



The CGIAR at 31: An Independent Meta-Evaluation of the Consultative Group on International Agricultural Research

**Thematic Working Paper
Natural Resources Management Research in CGIAR:
A Meta-Evaluation**

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Abbreviations and Acronyms

AIDS	Acquired immune deficiency syndrome	INIBAP	International Network for the Improvement of Banana and Plantain (CGIAR)
ARI	Advanced research institution		
ASB	Alternatives to Slash and Burn (a CGIAR System-wide program)	INRM	Integrated natural resource management
CDMT	Change Design and Management Team (CGIAR)	IPCC	Intergovernmental Panel on Climate Change
CGIAR	Consultative Group on International Agricultural Research	IPG	International public good
CIAT	Centro Internacional de Agricultura Tropical (CGIAR)	IPGRI	International Plant Genetic Resources Institute (CGIAR)
CIFOR	Center for International Forestry Research (CGIAR)	IPR	Intellectual property right
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo (CGIAR)	IRRI	International Rice Research Institute (CGIAR)
CIP	Centro Internacional de la Papa (CGIAR)	ISNAR	International Service for National Agricultural Research (CGIAR)
DFID	Department for International Development (U.K.)	IWMI	International Water Management Institute (CGIAR)
FAO	Food and Agriculture Organization of the United Nations	MAS	Marker-assisted selection
FY	Fiscal year	MTP	Medium Term Plan (CGIAR)
GPG	Global public good	NARS	National agricultural research systems
GPPPs	Global public policies and programs	NARES	National agricultural research and extension systems
IBRD	International Bank for Reconstruction and Development	NGO	Nongovernmental organization
ICARDA	International Center for Agricultural Research in the Dry Areas (CGIAR)	NRM	Natural resource management
ICLARM	International Center for Living Aquatic Resources Management (CGIAR)	OECD	Organization for Economic Cooperation and Development
ICRAF	International Center for Research in Agroforestry (CGIAR)	OED	Operations Evaluation Department (World Bank)
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics (CGIAR)	SINGER	System-wide Information Network for Genetic Resources (CGIAR)
IDA	International Development Association	SPIA	TAC Standing Panel on Impact Assessment (CGIAR)
IFPRI	International Food Policy Research Institute (CGIAR)	SRO	Subregional organization
IITA	International Institute of Tropical Agriculture (CGIAR)	SWIM	System-wide Initiative on Water Management (CGIAR)
ILCA	International Livestock Center for Africa (CGIAR)	TAC	Technical Advisory Council (CGIAR)
ILRAD	International Laboratory for Research on Animal Diseases (CGIAR)	TDR	Special Programme for Research and Training in Tropical Diseases
ILRI	International Livestock Research Institute (CGIAR)	TSR	Third System Review (CGIAR)
		USAID	United States Agency for International Development
		WARDA	West Africa Rice Development Association (CGIAR)
		WTO	World Trade Organization

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Preface

This is one of five thematic working papers by independent scholars prepared as part of the meta-evaluation of the Consultative Group on International Agricultural Research (CGIAR) conducted by the Operations Evaluation Department (OED) of the World Bank. The report, entitled *The CGIAR at 31: An Independent Meta-Evaluation of the Consultative Group on International Agricultural Research*, is available on OED's external Web site:

<http://www.worldbank.org/oed/gppp/>. The thematic working papers are: C. B. Barrett, "Natural Resources Management Research in the CGIAR: A Meta-Evaluation," C. K. Eicher and M. Rukuni, "The CGIAR in Africa: Past, Present, and Future," A.B. Gardner, "Global Public Goods from the CGIAR: An Impact Assessment," W. Lesser, "Reviews of Biotechnology, Genetic Resource and Intellectual Property Rights Programs," and D. J. Spielman, "International Agricultural Research and the Role of the Private Sector."

The report on the CGIAR is part of an independent review by the OED of the World Bank's involvement in global programs. The first phase has been published: *The World Bank's Approach to Global Programs: An Independent Evaluation, Phase I Report* (OED, Washington, D.C., 2002). The second phase, due in FY 2004, involves case studies of 26 programs, of which the CGIAR is one. The inclusion of the CGIAR evaluation in the OED review of the Bank's global programs was requested by the Development Grant Facility (DGF) and Bank Management in June 2001, and endorsed by OED's global program advisory committee.

While the focus of the meta-evaluation is on the Bank and the strategic role it has played and ideally will continue to play in the future in ensuring the CGIAR's development effectiveness, the thematic and country working papers and the country background papers focus on the different components of CGIAR activities that determine impact, including country perspectives. In addition to informing a broader understanding of the policy and technical context of CGIAR implementation, the papers provide a tool for assessing the performance and impact of the whole CGIAR partnership; this, in turn, provides a critical context for gauging the impact and value added of the Bank's participation in the program, the primary objective of the CGIAR meta-evaluation.

All five thematic working papers are based on extensive reviews of CGIAR's own evaluations as well as other related scholarly literature and discussions with relevant stakeholders. Four of the five thematic working papers were extensively peer-reviewed by knowledgeable external experts. A list of working and background papers and peer reviewers for the working papers is provided in Annex 4 on page 155.

In addition, four country case studies on Brazil, India, Colombia, and Kenya provide developing country perspectives on the CGIAR. Two of the four — a study on India, written by Dr. J.C. Katyal and Dr. Mruthyunjaya, and a study on Brazil, by Jamil Macedo, Marcio C.M. Porto, Elisio Contini, and Antonio F.D. Avila — are issued as country working papers. The other two — C. Ndiritu, "CGIAR-NARS Partnership: The Case of Kenya" and L. Romano, "Colombia Country Paper for the CGIAR Meta-Evaluation"— are available on request.

The CGIAR was the first program providing global public goods to receive grants from the Bank's net income. Although the program has an impressive tradition of self-assessments, System-level evaluations have been few and far between. An exception, the Third System Review (TSR), was carried out in 1998, 17 years after the previous System-level review. OED determined that a meta-evaluation would most effectively assess CGIAR performance and inform OED's overall review of the Bank's involvement in global programs. In brief, the objectives of the meta-evaluation were three-fold:

- Evaluate implementation of recommendations in the 1998 TSR review
- Identify issues confronting the CGIAR from a forward-looking perspective
- Draw lessons for overall Bank strategy on global public policies and programs

The meta-evaluation report is in three volumes. *The Overview Report (Volume 1)* addresses strategic questions regarding the organization, financing, and management of the CGIAR as these have affected research choices, science quality, and the Bank's relationship to the CGIAR. *The Technical Report (Volume 2)* explores the nature, scope, and quality of the System's scientific work, assesses the scope and results of the reviews, and analyzes the governance, finance, and management in the CGIAR. *The Annexes (Volume 3)* provide supporting materials and are available on request.

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Summary

1. Over the past decade or so, natural resources management (NRM) has come to occupy an increasingly prominent position within the research portfolio of the Consultative Group on International Agricultural Research (CGIAR). This brief paper offers a meta-evaluation of the work of the CGIAR and its Centers and System-wide programs as regards the impact of the CGIAR's NRM research portfolio. This report is prepared as an input into a broader meta-evaluation of the CGIAR by the World Bank's Operations Evaluation Division (OED), as part of OED's evaluation of global public policies and programs (GPPP), under the overall direction of Dr. Uma Lele. The CGIAR is the single largest recipient of World Bank Development Grant Facility resources (around \$50 million annually, equivalent to roughly 40 percent of the budget for global programs) and thus is of particular interest in OED's review of GPPP. Given the heightened profile of NRM research within the CGIAR and the global public goods (GPGs) nature of many NRM issues, the topic has been identified for focused treatment.

2. This study does not aspire to offer an in-depth assessment of CGIAR performance, nor to provide detailed recommendations. Rather, the terms of reference (Annex 1) direct that, based on previous analyses, reviews and evaluations of the CGIAR, its Centers, and selected System-wide Programs (SPs)¹, as well as on interviews with a few individual experts, this report draw broad lessons relevant to the World Bank's future involvement in the CGIAR and GPPP more broadly and to make recommendations as to specific areas on which a larger, independent evaluation should focus. More specifically, this report is to assess, at a System level, the quality, and coverage of the CGIAR's NRM research and implications for its structure, financing mechanisms, and scientific strategy.

3. Perhaps the most serious challenge to this undertaking arises because NRM research has become a significant, explicit component of the CGIAR research portfolio only over the past decade or so. Furthermore, as is discussed below, ex post impact evaluation of NRM research remains largely underdeveloped. So this meta-evaluation needs to be understood as a tentative assessment of the current state of play of NRM research within the CGIAR. Moreover, it necessarily has to delve into primary evaluation in some places, rather than meta-evaluation, because the primary source material from which a proper meta-evaluation could be undertaken either does not exist or is too thin to be relied on exclusively.

4. With those crucial caveats in mind, several preliminary conclusions emerge clearly from the existing body of reviews and evaluations:

5. First, NRM research is indisputably central to sustainable productivity increases in agriculture and to improvements to rural livelihoods worldwide. The CGIAR is correct to emphasize NRM and germplasm research as the twin pillars on which to base its program to

1. The term "Systemwide Programs" is used broadly here to represent inter-Center initiatives, including what are formally labeled system-wide programs, global initiatives and ecoregional initiatives. The distinctions between the different identifiers are unclear to at least this informed outsider. Moreover, documents within the CGIAR vary as to how they identify some programs (e.g., documents identify the Alternatives to Slash and Burn program variously as a Systemwide Program and as a Global Initiative). Since this report offers a meta-evaluation of the overall System, readers will hopefully forgive this blurring of the lines between differently classified initiatives.

enhance agricultural productivity. CGIAR NRM research has the potential to generate significant GPGs in the form of new knowledge, especially concerning core processes, analytical and measurement methods, and meta-data sets offering global coverage.

6. Second, the CGIAR's NRM research has made key intellectual contributions in several areas important to achieving the goals of improving rural livelihoods, food security, and agricultural productivity, notably related to problems of water management, tropical deforestation, characterization of agro-ecosystems, and sustainable NRM in marginal lands. These important past accomplishments notwithstanding, the CGIAR presently falls short of realizing its considerable potential to generate significant GPGs, due primarily to System-level issues of focus and framework. Satisfactory resolution of these issues (discussed in detail in Section 4) would do much to push the CGIAR to the frontier of its potential.

7. Third, and related to the preceding point, CGIAR NRM research programs sometimes appear to venture beyond the System's core competencies without providing a compelling case as to why the research is strategically important. The CGIAR, perhaps through the new Science Council, needs to identify explicitly its core competencies and related areas of comparative advantage vis-à-vis other prospective GPG providers, and then to establish clear boundaries on the work that Centers and SPs undertake, even when leveraging core resources with additional, restricted donor resources. The early 1990s' expansion of the System added scope without commensurate growth in real funding, thereby increasing the pressure to leverage resources and leading to drift in the research program. This threatens the traditional excellence of CGIAR science, NRM research included.

8. Fourth, the CGIAR has made significant, productive investments in training individual national agricultural research and extension system (NARES) scientists and, in a few cases, in helping develop NARES institutional capacity and regional networks and subregional organizations (SROs) related to NRM.² Such capacity building seems to have declined in recent years, however, although the need remains acute. Given funding and personnel challenges facing many NARES, perhaps especially in the social science disciplines and in Africa, NRM-related capacity building poses a serious challenge that demands System-wide attention.

9. Fifth, perhaps predictably, the resources-oriented Centers are generally doing more and better work in integrated NRM than are the more established, commodity-oriented Centers, with the ecoregional Centers falling somewhere in between. Although a few System-wide Programs (SPs) are making significant advances toward addressing global problems such as tropical deforestation, the SPs on the whole have objectives that far outreach their resources or authority, thereby limiting their effectiveness.

2. The careful reader will note the inclusion of the "E" for extension in NARES. This inclusion is not meant to imply a broadening of the mandate of the CGIAR well beyond the research domain. Tradition and informal consensus have historically explicitly excluded extension from the CGIAR's mandate on national partnerships. Rather, the inclusion of the "E" is meant to reflect both that there have nonetheless been some successful IARC partnerships with national extension services that could prove instructive (notably by WARDA and IITA in west Africa) and that the model of research-extension interaction is evolving, perhaps especially in NRM, where the development and dissemination cycle for best practices increasingly requires close interaction between both functions (Barrett, Place and Aboud 2002, chapter 21).

10. Finally, and most importantly, NRM research has appropriately attracted considerable, increasing interest and resources over the past decade, although these have perhaps been insufficiently tightly focused on those topics and functions in which the CGIAR can make tangible, high-return contributions to GPGs: in contributing to sustainable agricultural productivity increases and to improving the livelihoods and reducing the vulnerability of the rural poor. The CGIAR's NRM research can be justified by the System's impressive, well-established agricultural impacts, but only so long as the NRM research portfolio stays true to the System's core agricultural productivity agenda. Otherwise, impact assessment of the NRM portfolio becomes a reasonable demand of donors bearing a fiduciary responsibility for wise use of their resources.

11. The remainder of this meta-evaluation is organized as follows. Section 1 considers what sort of NRM research mandate might be given to a newly created multilateral network of international agricultural research centers (IARCs) as a means for thinking through what are (and are not) GPGs with respect to NRM, on which of these would one expect a network of IARCs to provide the most cost-effective research, and what does this imply for the organization of NRM research within the network. Section 2 then reviews what NRM research the CGIAR has been and is currently doing and how well, and compares this portfolio to the design implications of Section 1. Section 3 then reviews the impact of NRM research within the CGIAR. There is effectively no quantitative impact assessment evidence on NRM research within the CGIAR — indeed, more broadly — so it is difficult to state definitively whether or not NRM research has been effective within the CGIAR. One must be careful, however, not to rush to the judgment that the absence of clear, quantitative evidence of a strong ex post impact demonstrates the absence of an impact, not least of which because the primary obstacle is not institutional commitment to program evaluation but the lack of an established set of methods for ex post impact assessment of NRM research. Section 4 draws out the implications of the preceding evidence, examines some of the relevant, new recommendations for change design and management within the CGIAR and offers some suggestions for subsequent, independent evaluation of NRM research within the CGIAR.

1. Overview: Natural Resources Management Research and Global Public Goods

1.1 In recent years, increasing awareness of and concern over transnational problems has increasingly focused donor and policymaker attention on multinational institutions' role in the provision of GPGs. It is therefore useful to begin this meta-evaluation of the multinational CGIAR with a simple thought experiment. If one were to design a *de novo* system of international agricultural research centers (IARCs) founded on the principle that GPG provision is necessary to justify their existence, what sort of NRM research portfolio would one choose? The answer to such an exercise depends fundamentally on the identification of the GPGs created directly or indirectly by NRM research, the organizational forms under which NRM research effectively generates GPGs, and the comparative advantage of alternative suppliers of such NRM-related GPGs.

1.2 We begin therefore by asking what are GPGs to which NRM research can reasonably contribute? To begin, it is important to remind ourselves of the basic definition of a public good. Following the classic formalization by Samuelson, pure public goods are nonrival and nonexcludable. Anyone can enjoy a public good if s/he is in the relevant vicinity (nonexcludability) and the participation of one person in no way degrades the availability or quality for others (nonrivalry). A consequence of public goods is that all subjects in the relevant vicinity enjoy the same access, although they may not all choose to use the public good to the same extent nor will they necessarily identically value the common quantity supplied. It must also be borne in mind that some public goods must be produced or provided (e.g., knowledge, common defense) while others must be conserved or protected (e.g., clean air or the existence of species or historical or natural landmarks).

1.3 GPGs comprise only a subset of the universe of public goods. The "global" modifier defines the relevant vicinity over which the conditions of nonexcludability and nonrivalness are expected to hold. The distinction between "global" and "international" is important in so far as it reflects the geographic range over which the public good in question proves relevant. The "global" distinction signals that cross-border effects are insufficient. Rather, the justification for dubbing a public good "global" derives from its relevance across multiple international boundaries and continents. Truly universal applicability (as in the case of global warming, for example) is sufficient but not necessary to meet the global public goods standard. The appropriate "global" standard is somewhat weaker: relevance to large, multi-national sections of the globe (as in the case of tropical deforestation or coral reef conservation).

1.4 The primary justification for this more restrictive definition in space arises from the fundamental design principle of subsidiarity. This principle 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. Local public goods, such as the provision of street lighting, are best provided at the local jurisdictional level, national public goods, such as the defense of sovereign territory, are best provided by nation states, and limited international public goods, such as pollution control on a river that serves as the boundary between two countries, are best handled by subregional

institutions.³ The root economic justification for any multilateral agency with greater than regional scope is the existence of identifiable global public goods.

1.5 What sorts of GPGs are produced by NRM research and might therefore reasonably fall within the research portfolio of our notional IARC network? The only significant, direct GPG that an international research system can produce with respect to NRM is knowledge.⁴ It must be kept in mind, however, that knowledge only becomes a public good once it has been made publicly available. Methods or theories developed and data gathered and analyzed are nonrival by their nature, but until they are released into the public domain, they fail to meet the nonexcludability standard of a public good, especially a global public good. Hence the importance of published research, especially publication in widely indexed and circulated journals and books, and of accessible, well-documented data made readily available to the international community of researchers. Recent advances in telecommunications and information technologies facilitate more rapid and widespread dissemination of research findings, potentially obviating the traditional centrality of scholarly books and journals as media through which findings can be made available to the global scientific and policy communities, as well as to interested individual firms, communities, and persons. The quality-control function of journals' and presses' peer review continues to make those channels of public dissemination more attractive and useful than alternative means that offer no quality-control assurance. But for data in particular, advances in information technology and telecommunications make public release and accessibility far faster, cheaper, and easier.

1.6 The GPG knowledge derived from NRM research falls broadly into four domains: (i) theories of natural resource systems' interrelationship with human activity, especially within agricultural systems, of ecological recovery and adaptation, call this "process research", in recognition of the fact that most such work revolves around identifying, characterizing and modeling processes; (ii) methods of ecological monitoring, of environmental impact assessment and of policy analysis related to NRM, call this "methodological innovations"; (iii) empirical evidence as to what works, when, where and why, especially of generalizable interventions, policies, practices or technologies, call this "policy research"; and (iv) data, whether raw observations or meta-data describing underlying raw data sets, that can be used by analysts other than those who originally collected the data to replicate important empirical results and to undertake original empirical research, perhaps especially synthesis work to derive general patterns and causal mechanisms of global importance.

1.7 Knowledge also has instrumental (indirect) value through its capacity to change behaviors and thereby well-being. Knowledge that improves the management of even purely private goods can therefore be a GPG. Some natural resources are in particular, common contexts primarily private goods. For example, where property rights in land are clearly defined, secure and transferable, soils and forests represent a largely private natural resource, the value of which is capitalized in the value of the land, implicitly through crop and

3. As used in this report, the term "subregional" refers to international areas at smaller than continent scale.

4. In other areas of research, notably germplasm improvement, knowledge can be embodied in prototype technologies that can be reproduced, disseminated, and ultimately employed without an understanding of exactly how or why it works. NRM fundamentally differs in that regard. What are often mislabeled NRM "technologies" are more aptly described as knowledge-based "practices."

livestock productivity or explicitly in land markets. Management of private resources is not, at least directly, a public good, much less a GPG. While research into better management techniques for largely private natural resources is nonetheless a public good, the private sector can and often does effectively supply this type of knowledge, either bundled with goods it sells (e.g., extension services provided by seed and machinery suppliers) or as a stand-alone information product (e.g., subscription-based newsletters). So a publicly funded multilateral organization needs to be careful not to compete unnecessarily with viable private providers of relevant NRM research related to essentially private resources. In the case of NRM research, the knowledge generated can contribute indirectly in a potentially substantive way to two further classes of GPG. First, in so far as the whole world benefits from poverty reduction and food security, for both humanitarian and self-interested reasons, and NRM contributes to increased agricultural productivity and improved livelihoods for vulnerable populations, NRM research can have a significant, albeit indirect, GPG impact. Most traditional *ex post* impact assessment work within the CGIAR has aimed at establishing these sorts of welfare impacts attributable to knowledge generated by the CGIAR through its research. Second, NRM research can improve *in situ* conservation of renewable natural resources (e.g., water, forests, fish and wildlife, soils) which people around the world value for multiple instrumental reasons associated with current and future use, option and bequest value as well as for intrinsic (aesthetic, spiritual) reasons associated with existence value. Impact assessment methods to establish the effectiveness of NRM research in achieving these goals remain underdeveloped at this point.

1.8 NRM research aimed at producing the sorts of knowledge that satisfy the GPG criteria can be organized under one of three broad sorts of models: fully internalized research, collaborative research with other institutions, or facilitation of research networks outside the System. The CGIAR tradition in germplasm research has been predominantly of the former sort (fully internalized research), with some supplementation through collaborative research with advanced research institutions (ARIs) and NARES and only modest experience with the facilitative model. The CGIAR has no such tradition in NRM research, which raises the question of how best to organize NRM research, quite apart from the question of what NRM research topics satisfy the GPG criterion that justifies the CGIAR's existence.

1.9 Perhaps the most important consideration in the organization of NRM research is the importance of connectivity in two different dimensions. First, given our present, relatively underdeveloped understanding of coupled human and natural systems, there seems to be extraordinary site-specificity to many core NRM research questions. This necessitates detailed, longitudinal study of specific benchmark sites, with replication at similar locations elsewhere so as to establish generalizable findings. Because NRM research is so site specific at present, there must be local-to-global connectivity in the research design.⁵ This was a design principle of the ecoregional approach (TAC Secretariat 2000). Hierarchical connectivity implies interdependence across scales. The global research system cannot

5. As NRM research advances, however, scientists are gradually uncovering global patterns, permitting more direct, general exploration. In his comments on the first draft of this paper, Ted Henzell helpfully pointed out that plant breeding and plant pathology went through similar transitions wherein knowledge was completely site-specific for a long time before a few major breakthroughs helped to establish truly global relationships and methods.

function well without reasonable capacity at national and sub-regional scales, and vice versa. This interdependence provides a first-order justification for investment in capacity building at national and sub-regional levels. Without it, global research programs inevitably get drawn excessively downstream, diluting their efficacy in GPG production.

1.10 The second sense in which connectivity looms large relates to the scientific disciplines. The natural (atmospheric, biological, chemical, hydrological, and geophysical) and social sciences are linked inextricably in coupled human and natural systems. So NRM research must be organized in an interdisciplinary fashion in order to understand and improve the management of natural resource flows in space and time. This implies a critical mass of scientists and thus a minimum efficient scale of research in order to be effective. As Eicher and Rukuni (2002) emphasize in their meta-evaluation of CGIAR research in Africa, this likely implies a need to concentrate on those NARES that have such critical mass and on SROs to facilitate the flow of relevant research from such NARES, the IARCs, and the ARIs to weaker, smaller NARES.

1.11 Given the range of NRM-related GPGs identified above, and the research organization principles necessary to effective provision of those GPGs, what is the role for the CGIAR? There are many prospective and actual providers of global public goods, so it is essential to consider carefully where a network of IARCs might possess competitive advantage due to technical skills, complementary interests and activities, location, or some other crucial attribute. Although there is no rationing device for public goods, as in market-based allocations of private goods, public goods can be privately provided and often are, although it is more common to see the private provision of local public goods than of GPGs. The public sector in individual countries may likewise provide GPGs. A network of IARCs must therefore consider its place vis-à-vis both the private sector and subnational, national and regional (international) public institutions. Of most immediate relevance to the CGIAR are two classes of institutions. The first is the suite of advanced research institutes (ARIs) comprised of private and public laboratories, research institutes and universities, currently in the high and middle income countries but prospectively even in low income nations. The second are the NARESs of the low and middle income countries and SROs that link NARES among neighboring countries.

1.12 By virtue of the high quality of scientific staff across the various disciplines concerned and of supporting research infrastructure, the ARIs almost surely hold comparative advantage in most areas of basic theory and methods as well as in applied areas closely related to problems with which they deal directly in their home countries (e.g., evaluation of the impacts and potential mechanisms for mitigating nonpoint source pollution due to agricultural chemicals). Collectively, the ARIs have an indisputable mission of global public goods production and their research programs have historically generated high social rates of return. Relative to the ARIs, the comparative advantage of a global network of IARCs based largely in tropical countries lies in their superior access to study sites and local partners — an issue of particular importance in NRM research due to the extraordinary site-specificity of many core research questions — and their focus on NRM issues related to sustainable improvements in agricultural productivity and in rural livelihoods. With a few pockets that mark the exception to the rule, the ARIs' NRM research programs are more general and more focused on basic theory and methods. This complementarity offers

considerable opportunity for fruitful collaboration, although this potential has been underexploited to date.

1.13 Public goods at national and subnational scale are plainly the responsibility of the NARES, hence the existence of these institutions. The significant and increasing technical capability of NARES in middle-income countries such as Brazil and Malaysia and in large, low-income countries such as China and India nonetheless raises questions as to the role of a multilateral network. Especially in large countries whose own agro-ecologies are similar in many ways to those of others with less domestic NARES capacity, it is an open question as to whether bilateral spillovers or multilateral IARC-to-NARES transfer is more cost-effective. The larger, better managed NARESs are clearly capable of producing GPG themselves and, in some cases, are doing so already. It must be said, nonetheless, that social sciences capacity is limited in even the best NARES and thus even those institutions have limited capacity for interdisciplinary NRM research. The comparative advantage of the CGIAR in GPG provision vis-à-vis the larger, more skilled NARESs typically lies in superior information as to research priorities elsewhere, suggesting an important brokerage role in helping identify new research from these stronger institutions that are relevant in places where NARESs are weaker.

1.14 Institutional weakness in many low-income countries, however, also suggests the need for higher-level presence in those areas in order to ensure necessary provision of public goods, but with a careful eye toward building and maintaining NARES and SRO capacity and, especially, to avoiding crowding out NARES and SRO emergence and growth. Capacity building involves both the degree and non-degree training of individual scientists and distinct efforts at institutional development, including regularization of priority-setting exercises, research management, infrastructure development and maintenance, etc. NARESs are fundamentally the responsibility of national governments, whose fiscal (and often political) crises of the past generation have badly weakened NARESs in much of the low-income world. Yet, a network of IARCs can help maintain institutional capacity during downturns and help build capacity when government is supportive, provided it pays attention to the nature of its relationships with the NARESs.

1.15 At subregional level, the principle of subsidiarity implies the advisability of devolving NRM research programs to SROs and other regional and subregional agencies. Improved information and communications technologies facilitate greater sharing of information across and within national and regional organizations, reducing the need for internalization of them within a global system. As in the private sector, networks can cost-effectively replace encompassing organizations in the public domain as well. The primary challenge here is the weakness of the constituent NARESs in some regions, especially sub-Saharan Africa (Eicher and Rukuni 2002). This suggests an important role for the CGIAR in convening and bringing to independent maturation SROs as a complement to its role in helping build and maintain NRM research capacity in the NARESs. In both the national and regional cases, this implies a gradual shift of responsibilities and resources from the multilateral bodies to subregional and national institutions.

1.16 The issue of where to locate responsibility for NRM research is not just about comparative advantage resulting from scientific capacity and the cost of doing research at

different classes of institutions. There is also the central issue of how research priorities are set. The research community, within the CGIAR and far more broadly, has become appropriately sensitized to the need for participatory identification of problems to be addressed by research, participatory *ex ante* evaluation of candidate technologies or policies aimed at addressed identified problems, and participatory *ex post* evaluation of impact. The essence of the movement toward participatory research is devolution of authority, underscoring the intrinsic as well as instrumental importance of bottom-up approaches to GPG provision. This only reinforces the importance of close IARC collaboration with NARES and SROs. Participation is only one key element in the priority setting challenge. The other relates to *ex ante* impact assessment, establishing what research areas are likely to deliver the biggest bang for the buck. As this report discusses extensively in section 3, impact assessment, whether *ex ante* or *ex post*, is especially difficult with respect to NRM for a variety of reasons. The appropriate metrics one uses to establish expected returns to research and thus to set priorities depend fundamentally on the interests of the responsible authorities. One therefore needs to pay attention to the priorities and motives of those making strategic and tactical research decisions, since these factors shape the direction research programs take and the degree to which they address global or parochial needs and interests.

1.17 The implication of the preceding discussion is that the complex issues underpinning NRM cut across multiple levels of research globally. It is essential to establish and maintain structures that foster collegial sharing of data, findings, and materials, often through collaborative research, but at a minimum through regular, structured interactions among ARIs, Centers, System-wide Programs, NAREs, and SROs. This can both boost productivity and cut costs significantly (Anderson 1998).

1.18 Finally, were this hypothetical, multilateral agricultural research system to take responsibility for those NRM-related GPGs in which it held comparative advantage, how ought it to finance and organize this research internally? Following the Tinbergen Principle, a separate structure for each distinct NRM-related GPG might seem ideal at first. One needs to consider, however, the apparent existence of economies of scope due to savings that can be achieved from using fixed costs (e.g., in infrastructure) and spare capacity (e.g., in skilled scientists) for multiple GPGs and economies of size that might exist, although these are likely least in field-based, adaptive science such as that underpinning much NRM research (Byerlee and Traxler 2001). As a consequence, it is often desirable that one Center tackle multiple GPGs, especially given the minimum scale considerations raised by necessary disciplinary interconnectivity. This was an implicit rationale for the CGIAR's rapid expansion of NRM research in the early 1990s, as the synergies attained from co-located germplasm and NRM research were plainly recognized (TAC 2001).

1.19 The funding of such Centers raises the ubiquitous problem inherent to public goods provision (Kanbur et al. 1999). Common pool financing of the core can induce free-rider problems and underfunding of important global public goods, including NRM research. This is perhaps especially true with respect to research that is inherently longer term, basic science. NRM research is inherently long-term, since one is looking to establish multivariate patterns in complex systems that sometimes emerge only slowly. But NRM research also tends to be relatively site-specific and applied. As a consequence, there is a natural tendency toward restricted funding in response to the immediate objectives of particular donors. Donor-specific

funding and project design, however, privileges the concerns of those with greater ability and willingness to pay for research, thereby potentially co-opting whatever common pool funding exists and potentially undermining broad participation in key priority-setting and evaluation processes. In principle, all stakeholders need to participate in setting research priorities, in formulating and implementing resource allocations, and in evaluating the impact of existing and prospective activities if research is to be cost-effectively targeted toward the provision of GPGs. But the political economy of such processes is often difficult and can lead to donor frustration and withdrawal. The CGIAR appears to have evolved governance structures that have proved far more effective in balancing these considerations than has been the norm among multilateral bodies more generally. Yet serious issues remain nonetheless.

2. Past and Present Natural Resources Management Research Within the CGIAR

System-wide Objectives and Strategy

2.1 NRM has been a concern of the CGIAR since its inception. Four of the older Centers (e.g., CIAT, ICARDA, ICRISAT, and IITA) were established with clear agro-ecological mandates and for years invested heavily in NRM issues, often under the mantle of farming systems research. In the wake of the Brundtland Report, the prominence of linkages between agriculture, the environment, and poverty grew sharply and the CGIAR responded quickly and tangibly. Over the past 10 to 15 years, the System has created or adopted four Centers (ICLARM, ICRAF, CIFOR, and IWMI) and at least five System-wide Programs (ASB, CAPRI, INRM, SPIPM, SWIM) whose primary mandate is to address NRM issues. The older, commodity-oriented Centers and the other System-wide Programs likewise address NRM issues, albeit typically as issues subsidiary to their core productivity enhancement mandates.⁶

2.2 One immediate, striking feature of the preceding description is the heterogeneous manner in which Centers have been organized. Opinions differ as to whether this reflected conscious design strategies, donor preferences, or mere historical accident. But it is nonetheless striking that the CGIAR attempts to coordinate research across Centers that are variously organized for a global mandate on a particular commodity (e.g., CIMMYT, CIP, ILRI, IRRI, WARDA) or resource (e.g., CIFOR, ICLARM, ICRAF), others that are organized around a particular agro-ecology (e.g., CIAT, ICARDA, ICRISAT, IITA), and still others organized around a particular research function or theme (e.g., IFPRI, IPGRI, ISNAR, IWMI). It is by no means clear that this design corresponds with the blank sheet organization one would choose following the principles enumerated in the preceding section, whether for NRM or the broader portfolio of System research.

6. One well-informed commentator on the first draft of this report confirmed that much of what the commodity Centers report as NRM research in the CGIAR project database indeed looks like old-fashioned agronomy with a few cosmetic changes. This is consistent with others' casual observations and comments and my own field observations, both about the content of programs labeled as NRM research and about staffing patterns, where scientists with skills no longer needed are rarely retired to make way for replacements with new, different skills in NRM research.

2.3 The proportion of CGIAR total resources spent on environmental protection rose from 14 to 17 percent between 1993 and 1997 (Anderson and Dalrymple 1999, p.12), while that spent on protecting (both *in situ* and, especially, *ex situ*) biodiversity almost doubled, from 6 to 11 percent. Plainly, the environment and NRM have become more important to the CGIAR in recent years.

2.4 Since pushing more heavily into NRM a decade or so ago, the CGIAR has been experimenting with different approaches to NRM research, using different, evolving terms and modalities — e.g., “sustainability research,” “ecoregional approach,” “integrated natural resources management” (INRM) — as it has thought through a coherent NRM research strategy. There is now essentially universal recognition throughout the CGIAR of the need for NRM research to address not only current poverty and food insecurity but, at least as importantly, to prevent future poverty and food insecurity by protecting the natural resource base on which future productivity improvements depend. Yet, as a recent TAC report notes, “In the past, research on natural resources has been too often conducted in a disjointed, fragmented fashion” (TAC 2001, p.4) and “[n]otably absent ... is a coherent System-wide strategy for INRM priority setting and for operationalizing a more effective set of strategic INRM activities within the CGIAR” (TAC 2001, p. 1). In hindsight, it appears clear that the CGIAR joined the early-1990s “sustainable development” bandwagon without having systematically thought through the issues raised in section 1 and is now recognizing that the resulting NRM research portfolio did not necessarily match either the core competencies or the strategic objectives of the CGIAR, nor did it necessarily fill gaps left by the rest of the scientific community with related research interests. Significant attention is being paid to these issues currently, resulting in discernible and largely appropriate adjustments to priorities and the expected scope and organization of CGIAR work in NRM research.

2.5 Consistent with the discussion of the preceding section, the TAC is appropriately concerned that the CGIAR NRM research portfolio “focuses on management of natural resources for the purpose of achieving the goals of the CGIAR related to poverty reduction and sustainable food security through improved sustainable food production” (TAC 2001, p.2). Put differently, the TAC, in its 2000 Vision and Strategy documents, recognized that within the range of NRM issues, the CGIAR must be vigilant in concentrating its energies and resources on just a subset of NRM-related GPGs that relate directly to the System’s core goals and in which it holds comparative advantage. This evolved perspective is stimulating greater emphasis on collaboration and cooperation with complementary organizations, including the private sector, ARIs, NARESS and SROs. The TAC now espouses the following six principles for determining NRM research priorities (drawn from TAC 2001, pp. 2-3):

- The CGIAR should concentrate on NRM research that contributes to productivity enhancement and sustainability of natural resources for production of crop, livestock, forest, and fish outputs that have impacts on poverty reduction and food security, giving appropriate consideration to inter-generational equity of benefits.
- The Centers should use an integrated NRM focus in their planning to define problems in NRM that require research.
- International integrated NRM research should be process oriented to ensure maximum contribution to the production of international public goods.
- The CGIAR should give greater attention to research to resolve water issues.

- Focusing NRM research around common reference locations or benchmark sites is essential in incorporating the many dimensions of integrated NRM.
- Priorities for specific NRM research themes should be determined by the CGIAR Centers in the context of the sustainability issues affecting productivity increases, regional priorities, and comparative advantages of the CGIAR.

2.6 In keeping with these general priorities, the current thematic priorities within NRM research within the CGIAR can be roughly summarized as (i) management of terrestrial resources (soils, flora, fauna) to enhance sustainable agricultural productivity, including management of intensive peri-urban systems, (ii) integrated water management for both quality and quantity as an input to agriculture and as a habitat for living aquatic resources, (iii) management of forests for enhancing rural livelihoods and providing sustainable sources of fuelwood and nontimber forest products, (iv) incentives and policies for improved NRM management (TAC 2001). These foci, like the six general principles above, are readily apparent in the stated aims of the Centers and System-wide Programs reviewed explicitly in this meta-evaluation (details on which appear in Appendix 2) and clearly play to the comparative advantage of the CGIAR, complementing its core competencies in agricultural technology development. The TAC is also emphasizing the importance of and opportunities surrounding interdisciplinary approaches to NRM research and the historical imbalance between the (overemphasized) natural sciences and the (underemphasized) social sciences, as well as the need to better exploit collaborative opportunities with potential research partners outside the CGIAR. These changes seem appropriate given the composition and performance of the CGIAR's recent System-wide NRM research portfolio, the subjects of the next two subsections.

System-wide NRM Research Portfolio: Coverage and Quality

2.7 The System-wide NRM research portfolio encompasses a wide array of topics and methods across the Centers and System-wide Programs (SPs). Appendix 2 provides details on most such efforts within the Centers, as well as in some selected, NRM-related SPs (ASB, CAPRI, INRM, SLP, SPIPM and SWIM). Most of the other SPs also conduct some NRM research, but the emphasis is less squarely on NRM. Much of this is reported on under the host Center details in Appendix 2. In this section, we just review the major components of that portfolio.

2.8 Knowledge is the primary GPG produced by CGIAR NRM research — indeed, knowledge is arguably the only GPG such work can produce given the necessary site specificity of applied technology and management work in NRM. As section 1 emphasized, the GPG character of knowledge production depends fundamentally on public availability and quality. CGIAR scientists have collectively earned an enviable reputation for frequent, high quality, peer-reviewed publications that ensure both accessibility and quality. In the past few years, many Centers have moved aggressively to develop and expand their Web sites so as to make available working papers, data and other background materials that contribute substantively to the global stock of knowledge. These are positive steps. The knowledge produced by CGIAR NRM research can be crudely categorized into four distinct groups: process research; methodological innovations; NRM-related policy research; and global data.

The CGIAR has produced a wealth of new publicly available knowledge on NRM, especially in process and policy research, somewhat less in the areas of methodological innovations and global data. In several areas, such as research on tropical deforestation, the CGIAR is clearly a leader within the global scientific community and on topics of immediate, obvious relevance to its core mandate to increase sustainable agricultural productivity and to improve rural livelihoods.

2.9 The inextricability of biophysical and socioeconomic processes in natural systems generally makes it necessary to organize multidisciplinary teams to tackle broad NRM research projects. The best of the CGIAR's NRM research has originated from precisely such multidisciplinary teams of skilled scientists. The general shortage of social scientists within the CGIAR appears to be a limiting factor, more obviously so in some areas than others. Partly because social science perspectives are often not fully incorporated from the outset in problem identification and technology development and dissemination, improved NRM methods and technologies developed by CGIAR researchers often suffer low rates of adoption or adaptation by smallholder farmers, thereby limiting the efficacy of these investments (Barrett, Place and Aboud 2002). A strong correlate of effective targeting of GPGs and high-quality science in the NRM research portfolio thus seems to be the degree to which Centers or System-wide Programs have effectively built multidisciplinary teams of strong scientists with clear research objectives.

2.10 From a System perspective, it is perhaps most useful to consider the CGIAR's broad thematic areas of NRM research in turn, incorporating observations specific to relevant Centers and System-wide Programs under these broader groupings. Richer information and detailed citations specific to Centers and System-wide Programs can be found in Appendix 2.

Management of Terrestrial Resources to Enhance Sustainable Agricultural Productivity

2.11 The CGIAR has long been interested in establishing the environmental impacts of its agricultural productivity research. Largely in response to emerging concerns as to the environmental consequences of decreased agrobiodiversity, increased chemical applications, and water use associated with the Green Revolution in Asia, the CGIAR became a leader in environmental impact assessment in support of its productivity enhancement research. Among other key findings, this work established that productivity improvements had conserved as much as 230-340 million hectares, 1960-95, of land in fragile (forest, desert, and coastal) margins (Nelson and Maredia 1999, Evenson et al. 2000, SPIA 2001, p. 4), but had also indeed contributed to soil and water degradation due to salinization and waterlogging of improperly irrigated lands and nonpoint source water pollution by agricultural chemicals, at least in the cases of rice and wheat (Maredia and Pingali 2001). The SPIA also concluded that no further effort is justified to quantify more precisely the aggregate extent of unintended negative or positive changes in natural resources associated with CGIAR productivity enhancement research. This old line of environmental/sustainability research to establish and quantify the natural resource spillover effects of productivity enhancement research has justifiably declined sharply within the CGIAR in recent years.

2.12 More recently, there has emerged a second generation view of NRM as an inextricable component of agricultural systems, wherein conserving or enhancing the quality and availability of renewable natural resources such as soils, water, forests, and other natural vegetative cover, and wildlife could contribute, directly or indirectly, to improved agricultural productivity, poverty reduction and food security. The essence of this vision of agricultural development is perhaps best captured in Gordon Conway's *The Doubly Green Revolution*, although the basic principles existed and were practiced without fanfare within the CGIAR from its inception. People just didn't think of nor refer to farming systems work as "integrated NRM" (INRM), although there is considerable overlap between these traditions. The INRM paradigm involves not just the integration of different disciplinary efforts to combine technical, social, and institutional factors into agricultural research, it also places considerable emphasis on hierarchical connectivity, the inherent connectedness of research from plot through farm, watershed, landscape, national and subregional to regional and global levels. This integration across disciplines and scales is one of the hallmarks of good NRM research and it has been articulated as well within the CGIAR as anywhere.

2.13 This second-generation approach to NRM has prompted a somewhat different approach to environmental impact assessment (EIA). The focus of first-generation EIA was on identifying ex ante or, more commonly, ex post externalities associated with new technologies due to the divergence of private benefits and costs from social benefits and costs. Second-generation EIA emphasizes more the modeling of ex ante impacts over multiple human and environmental objectives in an integrated system that internalizes within it the feedback effects between the natural and human processes. This more systematic and dynamic view of the relationship between natural and human systems, typically over a broader geographic scale of watersheds, catchments, or ecoregions and with more of an eye toward possible feedback effects, aims at capturing both tradeoffs and synergies involved in NRM. Put differently the focus has shifted from classical cost-benefit analysis to determination of the sustainability and intergenerational as well as intragenerational distributional effects of alternative institutions or technologies and from ex post to ex ante impact assessment.

2.14 The 1996, TAC-led study on "Priorities for Soil and Water Aspects of Natural Resources Management Research in the CGIAR" marked a significant revision of CGIAR research with respect to terrestrial resources, ushering in this second-generation view. In particular, the TAC advanced a vision of INRM research, subsequently enshrined in the INRM System-wide Program, and explicitly looked at broad-based management of land and biological resources, including genetic material, to meet productivity, poverty, and sustainability goals. The emphasis was placed squarely on productivity-enhancing and resources-conserving research, for example on soils degradation processes, improved nutrient cycling, landscape-level process modeling, the relationship between above-ground biodiversity and agricultural productivity, etc. In some sense, the new INRM mantra marks a return to the earliest NRM research within the older Centers with an agro-ecological mandate (CIAT, ICARDA, ICRISAT, and IITA). This work historically focused heavily on managing soils and water in rainfed agriculture.

2.15 The disciplinary emphases in this line of NRM research has traditionally been on soil biology, chemistry and physics, as well as plant pathology and agro-ecology. The work has branched out, however, especially as participatory research methods have moved into the

mainstream, drawing more social scientists into the multidisciplinary research teams advancing the terrestrial resources research programs within the CGIAR. This effort laid out the key principles, but it failed to define the priorities that should be set for the System, much less for particular Centers, on the basis of those principles. As a consequence, the principles are so widely invoked as to lose much of their intellectual power.⁷

2.16 The 1998 Third System Review appropriately endorsed the INRM approach, emphasizing that linking productivity research to environmentally sound management of natural resources is fundamental to the work of the CGIAR. The Center Directors Committee (CDC) concurred that INRM must be an approach that permeates the entire System, much like integrated gene management, and that research must focus increasingly on scaling up from plot- and farm-level to community, watershed, national, regional and global scales. The TAC echoed these core recommendations, not least of which in the 2000 “CGIAR Vision and Strategy” paper. So the more holistic, multidisciplinary approach to management of terrestrial resources for improved agricultural productivity now pervades the whole System, making it exceedingly difficult to separate NRM research from commodity research (Pachico et al. 1998).⁸ This INRM vision has been recent, however, and many Centers have not had INRM programs in place long enough to have been reviewed. Many of those that were reviewed were nascent and so the quality and impact of the programs could not yet be well established. Several recurring themes emerge in Center and System-wide Program reviews with respect to terrestrial natural resources management, however.

2.17 First, the Centers and System-wide Programs are doing much excellent work in addressing the NRM issues at the heart of sustainable productivity improvements. The inherent site- and commodity-specificity of this type of applied and adaptive NRM research leads to a vast portfolio of efforts in subjects such as conservation tillage, improved fallows, green manure cover crops, functional biodiversity and biological control, residue management, and soil conservation structures. Much of this work is proving highly effective, as in the case of the soil microbiological research carried out under ICRAF’s improved fallows and biomass transfer in maize-based systems in sub-Saharan Africa — the Tropical Soil Biology and Fertility (TSBF), now being absorbed by CIAT — as well as work by ICRISAT, IRRI, and CIMMYT in promoting conservation tillage methods developed in recent decades by partners in Latin America.

2.18 Second, a concern regarding much of this work is that the site and commodity-specificity limits the reach of the public good component of the knowledge generated, raising fundamental questions as to how heavily the CGIAR ought to be investing in this work, as opposed to drawing on its national- and regional-level partners through closer research collaborations. The impacts on food availability, poverty and conservation of resources of

7. One astute commentator on the first draft of this paper remarked that the adjective ‘integrated’ is “applied far too freely in the NRM community, starting with integrated NRM but extending to integrated water management, soil management, land management, pest management, crop management, crop-livestock system management, etc.”

8. Indeed, this poses a serious challenge to impact assessment that tries to isolate NRM research, as discussed in section 3.

global importance (e.g., tropical forests, biodiversity) are clearly GPGs, but it is difficult to measure such impacts, moreover they have yet to be established (see next section).

2.19 Third, another concern that emerges from the observation of such a diffuse body of applied and adaptive INRM research revolves around focus. Many Centers' reviews have recommended focusing the NRM research programs. There is some drift into tangential topics (e.g., ILRI's work on modeling livestock and wildlife on the east African savanna) and in some areas one gets the impression of a collective research program that is "a mile wide and an inch deep" (e.g., ICRDA, ICRISAT). In other Centers, EPMP concerns suggest that NRM still seems an afterthought (e.g., IRRI, WARDA). These shortcomings are reflected in the mediocre academic publication records of the NRM researchers in many — although by no means all — of the Centers. Limited publications are often rationalized as the result of following System-wide recommendations to shift toward longer-term field and impact studies, to invest more in collaborative research and training of national-level partners, and to undertake more multidisciplinary research, all of which makes it harder to publish in traditional disciplinary outlets. The question nonetheless remains as to whether this perhaps also partly reflects excessively diffuse research that limits the depth of the scientific contributions made. The CGIAR's new emphasis on helping small farmers cope with global climate change seems a strong example of the sort of globally relevant, focused, scientifically important work in which the CGIAR can make significant, unique contributions (CGIAR 2000). More of the INRM research agenda needs to push in this general direction.

2.20 Fourth, the CGIAR has done some pioneering work in process research that is clearly contributing knowledge that is a GPG. ICRAF, CIP, IFPRI, and ILRI have been actively pushing the frontiers of process modeling of complex agro-ecosystems, especially in capturing the interaction of naturally occurring biophysical processes (nutrient cycling, soil erosion, biomass regeneration) and those managed by farmers. The CGIAR has been at the forefront of developing adaptive, collaborative management methods for agricultural and NRM research. Centers such as CIAT and IITA have contributed substantively to the rapid rise to prominence of participatory research methods and gender analysis in agriculture. This work has been motivated by the CGIAR's increasing focus on improving rural livelihoods as well as on increasing agricultural productivity.

2.21 Fifth, with a few notable exceptions, partnerships with either national or regional research bodies or the ARIs have been limited. CIMMYT identifies one of its key roles as facilitator and catalyst for SROs, of which the Soil Fertility Network in southern Africa is its foremost activity in NRM. IITA has developed extensive, fruitful relationships with NARES throughout west and central Africa, especially in its long-term benchmark research sites, where long-term presence both requires and benefits more from substantive local engagement. CIAT likewise has a good record of collaboration with NARES, especially in Latin America. WARDA has developed noteworthy collaborative relationships in West Africa, including with extension services. The International Board for Soil Research and Management (IBSRAM) recently absorbed within IWMI, has built a strong network for research on sloping lands management in Southeast Asia. Several Centers have excellent INRM research projects in which they have heavily leveraged ARI resources to address Center objectives. Examples include much of the best process research within the CGIAR, including CIP's work with Montana State University in modeling tradeoffs between pasture-

potato systems productivity, human health, and soils sustainability in the Andes, and IITA's work with Texas A&M University in developing useful Spatial Characterization Tools. Unfortunately, such examples are more the exception than the rule.

2.22 Sixth, the CGIAR has yet to systematically promote, much less establish, integrated meta-data sources that offer global coverage of agro-ecological conditions. Very recent work by IFPRI in collaboration with the World Resources Institute (Wood et al. 2001) is a major contribution. But the vast stock of data being collected by CGIAR Centers and System-wide Programs represent a serious missed opportunity to contribute to the global stock of relevant knowledge if they are not organized and made readily available to the broader scientific community. This is especially true with respect to the many long-term benchmark sites now being monitored reasonably continuously over periods of years, if not decades.

2.23 The general conclusion with respect to NRM research on the management of terrestrial resources is that the CGIAR has generated much very useful, important knowledge with regard to processes that are clearly GPGs, as well as a voluminous amount of more locally important INRM research. This thematic area is clearly the one most closely tied to the CGIAR's core competency in development of improved genetic resources.

Management of Forests and Agroforestry

2.24 Given its size and newness, this area has perhaps been the most productive within the CGIAR's NRM research portfolio, although focus on GPG production related to agriculture remains an issue. The two lead Centers, CIFOR and ICRAF, and the primary System-wide Program, ASB, have all received highly laudatory external reviews. Given the global importance of tropical deforestation problems and the previous dearth of high quality research linking agricultural technology development, sustainable intensification, and tropical forests, this area of work seems a wise investment by the CGIAR. Nonetheless, there are tendencies, perhaps most evident at CIFOR, for NRM research to drift from NRM research squarely focused on improving agricultural productivity and rural livelihoods in the low- and middle-income countries toward topics of more interest to environmental interest groups in the high-income countries.

2.25 CIFOR has done pioneering scientific research on the interrelationship between forest and human systems, offering a perhaps uniquely global and holistic institutional vision and doing an effective job of connecting solid, site-specific research back to global issues, thereby creating significant GPGs. CIFOR's work on the relationship between agricultural technologies and deforestation have established the intellectual frontier in this area (Angelsen and Kaimowitz 2001) and its work in developing biodiversity assessment tools and on sustainable exploitation of forest resources and forest recovery after fire have generated high quality publications and filled real voids in the global scientific community. According to the EPFR, CIFOR has worked closely with key national-level institutions, especially in China, Indonesia, and the Philippines. There has been much good, participatory work on institutional modalities for tropical forest conservation and the contributions to institutional capacity building appear substantial.

2.26 ICRAF has evolved rapidly from an institution focused narrowly on agroforestry into a leading Center for integrated nutrient management research. In part through its ongoing collaboration with ARIs, ICRAF is at the forefront within the international scientific community in problem-oriented integrated NRM based on systems methods. ICRAF scientists have amassed an excellent publications record, contributing significantly to the process research literature on agro-ecosystem dynamics, nutrient replenishment, and management using trees, and productivity improvements through improved nutrient management using biomass transfer, green manure, improved fallows and rotations, etc. As the convening Center for the African Highlands Initiative, ICRAF has played a significant role in facilitating information exchange and coordinated research among NARES and in helping build up subregional research networks, such as the Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA). There is a difficult balance to be struck between crowding-in NARES research through these convening activities and crowding-out NARES research through intense local presence, but ICRAF seems to have mostly struck an effective balance thus far.

2.27 The System-wide Program on Alternatives to Slash-and-Burn (ASB) has been applauded in its most recent external review for innovative field research, strong science, and for going furthest within the CGIAR toward implementing effectively a holistic, ecoregional approach founded on in-depth local research linked methodologically across long-term benchmark sites around the world to permit effective scaling up to global level. The intellectual value of this work has derived from the synthesis afforded by careful methodological coordination across sites on different continents, and close working relationships with ARIs and NARES, as reflected in Angelsen and Kaimowitz (2001) and the ASB chapters in Lee and Barrett (2000). ASB has also contributed significantly to methodological research into indicators of above-ground biodiversity and carbon stocks and into spatially explicit land use modeling, as well as to policy research on quantifying tradeoffs among agronomic, conservation and socioeconomic objectives and on the opportunities potentially afforded by conservation credits for small farmers in the tropics.

2.28 The principle area of CGIAR NRM forest and agroforestry research that is less obviously of strategic importance from a GPG perspective relates to climate change mitigation. There has been considerable work in recent years on carbon sequestration and climate change mitigation by CIFOR and, to a lesser extent, ICRAF, much of this within the context of ASB. While some of this work has been at the forefront of scientific efforts to develop good estimates of carbon stocks — for example, some of the ASB work has been used as an input into recent IPCC guidelines — it is not entirely clear whether the CGIAR's work on climate change mitigation, regardless of its high quality, fills a significant void in the broader scientific community. ARIs are doing closely related work of comparable or higher quality, as are other multilateral efforts and even some middle-income country NAREs (Watson et al. 2000, Scholes and Noble 2001). Although the GPG nature of climate change mitigation research is obvious, the case has not yet been compellingly made as to why this is an area of comparative advantage for the CGIAR, given prospective partners' ongoing work on these issues. It would appear that some of the Centers and System-wide Programs may be getting lured away from their appropriate foci by the availability of specific project funding from donors.

Integrated Water Management

2.29 Water management is globally important to the CGIAR's core missions both as an input to agriculture and as a habitat for living aquatic resources. Indeed, there is arguably no more pressing natural resources management issue facing agriculture nor the world as a whole than how best to manage water quality and scarcity in the future given steadily increasing demand and finite supply. IIMI (the predecessor to IWMI)'s long history of leading work in irrigation management contributed substantially to global knowledge production in that particular area of water management. IWMI has also been a leader in advancing the holistic approach of whole catchment/basin analysis in water management, has produced key, global scale strategic analyses of water resources and the most authoritative data reference on world water (the World Water and Climate Atlas), has been a primary innovator in the development of methodologies for the measurement of water productivity, and has done high quality research on organizational design for irrigation systems.

2.30 ICLARM has developed key global databases on fish and reef systems that are an important GPG and its tilapia programs have brought sharp productivity gains in inland aquatic systems. There has similarly been considerable, important process research done within the Centers on simulation modeling of hydrological processes, including contaminant transport in soils and water related to nonpoint source pollution from agricultural chemical use, and key policy research done at several Centers, notably IFPRI, on water pricing and regulation. Much of this work has been very policy-oriented and targeted to specific problems in particular countries. The empirical results and the analytical methods developed and applied to these problems have nevertheless revealed fundamental points largely overlooked in the more abstract ARI work on water management. ICARDA, ICRISAT, and IFPRI have likewise made significant contributions in the areas of water harvesting and supplemental irrigation.

2.31 These very real successes notwithstanding, the TAC (2001, p. 6) worries that “[f]or too long, research on water issues has been disjointed, based on traditional disciplinary sciences without crossing boundaries, focused on short-term issues, and lacking coordination and cooperation among potential partners. Surface waters were treated separately from ground waters; water quality, independently from water quantity and each sector of users (e.g., agriculture) was ignorant of all the others. This approach to research often led, not surprisingly, to inadequate policies that were not well suited to solve problems addressed.” Research on integrated water management appears to have underperformed its potential within the CGIAR, largely for organizational reasons related to insufficient multidisciplinary, especially weak incorporation of social science research, inadequate incorporation of water productivity research into crop productivity research, degraded international hydrological data collection infrastructure, and perhaps excessive concentration of CGIAR water research capacity in a single Center. Given the massive amount of research on water management done within ARIs and the better NAREs, there also exist crucial questions as to the CGIAR's niche in integrated water management research. The need for CGIAR activity in this area is nonetheless indisputable; the question is rather one of focus and framework.

2.32 The issue of focus largely concerns CGIAR's place within broader global research programs on water. International water management — both freshwater and maritime — is widely and appropriately recognized as an international public good, but commonly more on

regional than global scale (Swedish Foreign Ministry 2001). International rivers groups, regional fisheries commissions, and NARES play an important role and the Centers have not always been especially effective in partnering with these organizations on integrated water management research. On the other end of the spectrum, there exist a variety of other global fora for water management, including the Global Water Partnership, FAO, and the Hague Water Forum, plus there is extensive research on global water issues in the ARIs and OECD-government NARESs. Through careful strategic management of its own research portfolio in this area, the CGIAR ought to be able to leverage others' work effectively to address core CGIAR concerns related to water without funding duplicative work. One example arises from IWMI's movement into irrigation-related health issues, which run significant risk of drifting into water-borne disease research, as reflected by the Center's search for funding for research in Africa on controlling schistosomiasis through water management. The WHO, UNICEF, any number of epidemiology groups at ARIs, and others would seem better positioned to lead such research, which raises the question of what is an appropriate allocation of CGIAR resources to what is clearly an important, relevant topic, if one a bit off center for the CGIAR. Similarly, the TAC previously raised questions about ICLARM's movement into Egypt, particularly whether funding opportunities were suddenly driving the research program. Research on living aquatic resources management (LARM) remains relatively underdeveloped in its exploitation of the tools of modern biophysical and social sciences, not just within the CGIAR, but globally. Since aquaculture is the fastest growing major food production sector worldwide, there clearly exist significant research opportunities here and the CGIAR is perhaps well positioned to make major contributions in these arenas. Nonetheless, fisheries and integrated coastal zone management are relatively new topics to the CGIAR, so that there are outstanding questions surrounding the System's capacity to focus on the key questions effectively and quickly. In these various, interrelated dimensions, water management thus exemplifies the challenge the CGIAR faces in multiple domains in finding its niche in the provision of clear NRM-related GPGs.

2.33 Framework questions abound with respect to the CGIAR's integrated water management research. Each of the key Centers (ICLARM, IWMI) is relatively small and has gone through significant institutional transitions during the past decade. Indeed, considering scale and transition-related transactions costs, the scientific output of ICLARM and IWMI has been quite impressive. ICLARM suffered internal governance problems in the early-to-mid 1990s, deals with lingering questions as to its managerial and scientific organizational structure, and has recently moved headquarters from the Philippines to Malaysia. Its external review panel questions whether it has sufficient quality scientific staff to fulfill its research objectives fully. IWMI changed names, mission, strategic orientation, and programmatic focus and staffing in the past decade. It is aggressively adding research staff and moving toward more precise, quantifiable, impact-oriented research goals, in direct response to what had previously been a somewhat disjointed, albeit productive research program.

2.34 One of the major framework questions surrounding water management research within the CGIAR surrounds the future of the System-wide Initiative on Water Management (SWIM). The objectives of SWIM and IWMI, SWIM's convening Center, are essentially indistinguishable. As a consequence, SWIM lacks the focus of most of the CGIAR's other System-wide Programs and SWIM has become largely a vehicle for IWMI to obtain additional funding to extend its partnerships with other Centers. Moreover, most of these partnerships are

bilateral, limiting effective System-wide collaboration on issues germane to multiple Centers. For these reasons, SWIM's external review panel questioned whether SWIM really functions effectively as a System-wide Program and recommended that TAC consider phasing it out. The TAC rejected this suggestion, but the core design questions clearly remain.

Incentives and Policies for Improved NRM Management

2.35 Natural resources management is inherently an investment problem of how best to time the exploitation of natural capital stock, and how and when to invest in its replenishment, all subject to considerable uncertainty. As with all investment choices, government policies, community-level institutions, international agreements and trading systems (e.g., for carbon), and other issues of incentives and policies exert considerable influence over both natural resources use by small farmers and the ability of the CGIAR to have an impact through its NRM or other research programs. For this reason, all of the Centers and System-wide Programs have rightly adopted policy research objectives in recent years, although the System as a whole has concentrated its policy research capacity in IFPRI and ISNAR.

2.36 The hub of much policy research within the CGIAR remains IFPRI (TAC 1996), which convenes the System-wide Program on Collective Action and Property Rights (CAPRI), one of the primary System-wide Programs related to NRM policy and institutions. IFPRI is extraordinarily effective at making its work broadly available to the research and policymaking communities through formal scientific publications, a rich Web site, copious briefing papers, and effective, short summaries of research findings. Its Vision 2020 program has focused attention worldwide on key issues in agriculture and natural resources management. The practical importance of such consciousness raising should not be underestimated (TAC Secretariat 1996). Beyond mere heightening of awareness of sustainable agricultural development issues and the policy questions at their core, IFPRI has been actively engaged in well-respected research on a range of related subjects. Its Environment and Production Technology Division (EPTD) has successfully established itself at the forefront of global research on the linkages between agriculture, poverty, and natural resources and environmental issues. IFPRI helped to explode the longstanding myth that poverty or population growth inexorably lead to environmental degradation, especially in rural communities of the tropics. CGIAR research, complemented by that of ARI scholars, demonstrates clearly the striking heterogeneity in environmental management by the rural poor. Local conditions related to resource tenure, risk exposure and management capacity, market incentives, nonfarm opportunities, etc., have been found to heavily condition NRM in rural areas, underscoring the importance of policy research as a central component of NRM research (Vosti and Reardon 1997, Scherr 2000). It has made important contributions in bioeconomic modeling, on the environmental consequences of alternative water management policies, and on the sustainable development of less-favored lands. IFPRI was cautioned in its third external review (TAC Secretariat 1998) that it needed to improve the integration of its research and outreach activities and to reach beyond the traditional academic goals of individual scientists. Its research program has nonetheless been consistently praised for its quality and relevance.

2.37 IFPRI is, of course, not the only Center doing significant, relevant policy research on NRM topics. CIAT has been at the forefront of developing participatory approaches to agricultural technology development and NRM. CIP, in collaboration with Montana State

University and Wageningen University and Research Centre, has done pioneering process modeling work to quantify the tradeoffs between agricultural, environmental, and human health and income objectives. One could continue with other Centers such as CIMMYT and ICRISAT, as well, each of which has contributed good NRM-related policy research. For example, ICRAF has been usefully pushing exploration of why much of the agricultural technology already developed by CGIAR and NARES scientists goes un- or under-exploited by small farmers, and what can be done to keep the scientists from getting too far out ahead of the clientele they are meant to serve. Research on overcoming the barriers to adoption and adaptation of new agricultural technologies and NRM practices promises high returns where it can help identify barriers amenable to research or feasible policy changes (Barrett, Place and Aboud 2002). Work on facilitating adoption and successful implementation of new technologies can significantly increase the impact of the broader CGIAR research portfolio on poverty, food security, and conservation of globally important natural resources.

2.38 All the CGIAR Centers belong to CAPRI, which therefore provides an outstanding information-sharing platform within the System. Property rights in resources are indisputably central to NRM and CAPRI affiliates and projects have made significant scholarly contributions. CAPRI studies have aimed at generating useful policy research that can help governments and communities strengthen property rights in ways that are institutionally sustainable, equitable, and foster prudent stewardship of scarce natural resources on which future generations will likewise depend. This work includes identification of when indigenous tenurial institutions can and do work and when more formalized, western-style rights in land and water are necessary and appropriate.

2.39 The core question surrounding CAPRI is its distinctiveness. Does it reflect CGIAR comparative advantage and does it duplicate equivalent research elsewhere? There is little evidence to date that CAPRI is mobilizing non-CGIAR partners' research efforts to focus on CGIAR objectives, thereby leveraging System resources. Nor is the CAPRI work sufficiently distinct in nature from parallel, closely related work being done independently in a large number of ARIs to make it clear that CGIAR investments in this area create additional knowledge of global relevance beyond that which others are already producing.⁹ If this work were more tightly focused on the link between property rights and technology generation, adoption and adaptation, thereby harnessing this body of social science research to strengthen the CGIAR's core competencies and improve their impact, the distinctive contribution of the CGIAR's investment might be more apparent. But as it stands, the quality of much of the CAPRI research seems to mask more fundamental questions as to the appropriateness of CGIAR investment in this sphere in which other institutions are making most of the path breaking discoveries.

9. Work by Elinor Ostrom and her colleagues at Indiana University, by Jean-Philippe Platteau and his colleagues at the Facultés Universitaires Notre-Dame de la Paix in Namur, Belgium, and by Dan Bromley and his colleagues at the University of Wisconsin-Madison, to pick just three examples, have done basic research in this area which is frequently invoked by CAPRI researchers but have also long been pursuing applied work in collaboration with local and IARC partners. It is not clear what additional work CAPRI has mobilized.

System-wide Training and Institutional Capacity Building and Maintenance

2.40 Research that develops new technologies and policy instruments can only generate sustainable impacts ultimately if a cadre of well-trained scientists and resource managers exists to bring these instruments and technologies to bear appropriately on pressing local problems. Training is therefore a key objective in the CGIAR's research program, as is institutional capacity building with national- and subregional-level partners. This is especially true with respect to the training of NARES scientists and research managers in keeping with the earlier stated emphasis on helping to fortify and maintain national system capacity for adaptive and applied research following the principle of subsidiarity. Furthermore, the hierarchical connectivity of NRM research creates interdependencies in research between the global Centers and local and subregional partners, making capacity building perhaps more important to NRM research than to germplasm improvement, especially since NARES and SRO capacity is generally less in NRM relative to areas such as crop breeding, even in the stronger NARES (e.g., Brazil, China, India). Within the CGIAR, training and capacity building is accomplished both through formal supervision of scientists in degree-oriented research programs, short courses, in-service training courses, informal training, on-the-job training in collaborative research, and strengthening of skills in research management and administration.

2.41 Center training programs appear to have become more individualized, focusing increasingly on higher end, specialized skills for graduates and mid-career scientists (Dixon 1999). This raises basic questions as to the extent to which this training becomes capitalized in increasingly mobile specialist scientists and the degree to which it generates public goods, much less GPGs. Although training of individual scientists is widespread and ubiquitously identified as an objective with global spillover effects, institutional capacity building and training within host nation NARESSs and associated SROs is not always articulated as an objective and is commonly not evaluated explicitly. No exact numbers are available, but simple estimates based on noncomparable data provided by Centers (Dixon 1999) suggests several thousand NARES scientists worldwide participate annually in CGIAR training courses, making the CGIAR equivalent in size as a training institution to a small-to-medium size university in the North, although the training is typically of short duration. Dixon (1999) concludes that an impact study of CGIAR training activities is badly needed. There was some review of institutional capacity building in 1996 (TAC 1996), but the last complete review of CGIAR training and capacity building seems to date to 1984.

2.42 In spite of the public-good nature of training and capacity building and the System's significant, longstanding efforts in this function, CGIAR funding for training was nonetheless in decline until the past few years, when it increased in response to NARESSs' and SROs' expressed high prioritization of staff training within the CGIAR System. Over the past decade, there has been increased devolution of training to stronger NARES and more emphasis on inter-Center collaboration in training, as with the IARC-NARS Training Group for Sub-Saharan Africa or the Southeast Asian Network for Agroforestry Education, a network of universities throughout five nations in southeast Asia. These innovations appear to have generated cost savings and provide greater assurance of the relevance of the training to local needs.

2.43 Furthermore, training programs can also be effective, if subtle and informal, channels through which the Centers can assess the continued relevance of their research programs to

the evolving needs of NARESSs and SROs. Given the indirect input most NARESSs and SROs have into the research priority-setting process at the Centers, such informal channels have significant value in ensuring the relevance of research programs.

2.44 A serious question exists, however, as to the System's comparative advantage in formal training of scientists. While the Centers have the facilities and scientists to provide excellent, individualized research training through learning-by-doing, they are not practiced at nor staffed for the in depth classroom or laboratory instruction that necessarily precedes hands-on training. As a consequence, the quality of the CGIAR training experience depends heavily on the quality of trainee's prior studies at university. Where universities have been in long term decline, as in Africa, this has likely led to some weakening of the quality of the CGIAR training experience, while in places where universities have been growing and improving rapidly, as in some parts of Asia and Latin America, the value of individual scientist training to both host Centers and trainees has likely been increasing over time. This underscores the importance of CGIAR relationships with not only elite universities in the North (the ARIs), but also with the tertiary education sector in the developing world. This is another reflection of the issue of hierarchical connectivity raised earlier: The global System's performance depends in part on national and sub-regional system performance.

2.45 There has been only sporadic System-level thought given to these broader strategic issues of training and capacity building functions within the CGIAR. The Centers basically each devise their own programs and approaches with little coordination. ISNAR identifies institutional capacity building as its primary mission. But ISNAR has been significantly restructured and its funding cut in recent years. A recent overview of ISNAR's program reviews reports scant documentable outcomes from the Center's past investments in training (Tollens 2001). Among the CGIAR Centers, ISNAR faces perhaps the most difficult external environment for fulfilling its mission. Most of its key NARES clients have been gripped by long-term fiscal crisis, now compounded by personnel management challenges related to HIV/AIDS in Africa, that have severely undercut ISNAR's partners' ability to undertake serious capacity building activities with the Center. ISNAR's reviewers pushed it to move more firmly toward the research-end of its service spectrum and there is plainly potential there for making substantive contributions, e.g., in helping NARES and other CGIAR Centers develop and implement effective ex post impact assessment methods for NRM research (see next section). To date, however, there is little solid evidence of widespread institutional capacity building at national or regional scale by the CGIAR, whether through ISNAR or on an ad hoc basis by other Centers or System-wide Programs.

2.46 A serious concern one does not find in the published reviews of Centers or System-wide Programs but that one nonetheless hears in conversations with scientists at NARESSs and ARIs with respect to the CGIAR's capacity-building role revolves around the nature of research collaborations between NARESSs and Centers. There are several examples of excellent, balanced working arrangements between NARES and, especially but not exclusively, locally based Centers. For example, Ndiritu (2002) describes the very fruitful relationships between Kenya's KARI and both ICRAF and ILRI, the two Nairobi-based Centers. There are also, however, too many cases in which NARESSs are tasked to handle local logistical and data collection/entry tasks while Center scientists "do the science." Such arrangements are readily rationalized by the very real pressures to generate results and

measurable impact in short order to satisfy donors, which creates incentives for such hierarchical relationships given most Centers' absolute advantage in the more technical scientific functions and the institutional and financial problems plaguing many NARESs today. For example, few NARESs have any significant social science capacity for NRM research; of course, such hierarchical arrangements merely perpetuate the problem. Similarly, many of the stronger project-level collaborations between Centers and NARESs turn out to be largely relations between individual scientists that do not take root at deeper, institutional levels. Research managers need to do more to forge institutional bonds around strong individual relationships between scientists whose assignments are commonly of short duration. In summary, the CGIAR needs to give further careful thought to its role in institutional capacity building and the degree to which it is prepared to trade off measurable research productivity on specific projects in the short-term for increased scientific capacity at partner institutions at national and regional level.

3. Impact of CGIAR NRM Research

3.1 Over the years, the CGIAR and its Centers and System-wide Programs have developed an extraordinarily detailed, extensive system of external reviews, a core objective of which has evolved to the search for evidence of research impact attributable to the reviewed Center or Program on the aggregate objectives of agricultural productivity, poverty reduction, and environmental sustainability. The transparency, regularity, thoroughness and independence of the CGIAR's system of reviews, as well as the responsiveness of the CGIAR to reviewers' criticisms, should be applauded and mimicked in other research organizations. It brings great credit on the System's research managers and scientists, although it clearly represents a significant draw on their scarce time and resources. Anderson and Dalrymple's (1999) thorough review of the CGIAR similarly praises the System's flexibility in response to regular external evaluations.

3.2 In recent years, the System has tried to move toward more systematic, quantitative indicators to provide clear, comparable impact measures of the relative efficiency and effectiveness of alternative research programs within and between organizations. Toward this end, at the 1995 Mid-Term Meetings, the CGIAR endorsed the creation of an independent Impact Assessment and Evaluation Group and has been grappling seriously ever since with tricky questions of how best to measure impact in precise, reliable, quantifiable terms that lend themselves to comparison across research themes and Centers. Gardner (2002) reviews impact assessment within the CGIAR and concludes that the evidence overwhelmingly points to very high social rates of return on investment in the CGIAR's historical area of emphasis, cereals varietal improvement, but scant evidence on other types of research. All the evidence reviewed for this meta-evaluation confirms this basic conclusion.

3.3 This of course raises a conundrum. Given strong evidence of past high returns to research on agricultural productivity improvements, which has included work that would today be classified as NRM (e.g., work on improved soil and water management and on integrated nutrient management, including the use of chemical fertilizers to complement organic matter inputs), does this suffice as evidence that the CGIAR's current or prospective

NRM research likewise is or can be expected to generate similarly high rates of return? One's answer to this question depends fundamentally on how tightly the CGIAR's NRM research portfolio maintains its fidelity to the System's core mandate for agricultural productivity improvements. So long as NRM research is aimed at supporting agricultural productivity increases — with some corroboration that this indeed contributes to poverty reduction and environmental conservation goals through improved per capita food availability, lower real food prices, increased intensification and reduced nonpoint source pollution — then the donor community should and likely will be prepared to accept the System's aggregate returns estimates as encompassing all parts of its research portfolio. But where the NRM research portfolio begins to depart from the CGIAR's core productivity work, the need to assess the impact of the CGIAR's NRM research becomes more acute in order to justify its present, generous funding. Put simply, the CGIAR's NRM research can be justified by the System's impressive, well-established agricultural impacts only so long as the NRM research portfolio stays true to the System's agricultural productivity agenda. Otherwise, impact assessment of the NRM portfolio becomes a reasonable demand of donors bearing a fiduciary responsibility for wise use of their resources.

3.4 There is moreover a widespread perception — yet no hard evidence available in the literature reviewed for this meta-evaluation — that apparent declines in the returns to CGIAR agricultural research, as manifest in declining yields growth, are associated with insufficient attention paid to related NRM issues. The argument is that both NRM and germplasm research are inextricably linked components of the broader project of increasing agricultural productivity, but that the System's historical emphasis on varietal improvement has moved too far ahead of its NRM work, thereby leading to rapidly diminishing marginal returns. The argument has a certain logic, to be sure, but lacks solid empirical evidence thus far.

3.5 Impact assessment is far more complicated than simply establishing whether research goals have been met and whether the resulting science is of high quality. The complications arise not only because of the lags involved between scientific discovery and the manifestation of the value to society of those discoveries, but also because of problems of attribution when so many different entities contribute to the scientific, market, institutional and regulatory environment in which human behavior ultimately takes places. In all countries and research domains, impact assessment is understandably demanded by those who must account for the efficacy of invested funds. Yet no truly satisfactory analytical methods have yet been developed to establish precisely the aggregate socioeconomic or biophysical impact of research. The CGIAR has been at the forefront of methodological innovations in impact assessment over the past decade, so the limited evidence available on impact reflects inherent methodological challenges, not lack of interest or antiquated methods.

3.6 For these reasons, the 1999 System Review (Strong et al. 1999) expressed concern that impact assessment not become so fundamental a method of defining research success within the CGIAR that it stifles creative, risk-taking research that necessarily carries a nontrivial probability of failure, which may take decades to show its full results, and which may yield significant benefits that ultimately defy quantification. When, clear, quantifiable indicators become too prominent a measure of efficacy, they naturally induce the scientists being evaluated to work to the indicators rather than the more amorphous concepts (e.g., poverty, sustainability) that are the true objective. In particular, there is a threat that Centers

will begin to focus on short-term applied research instead of long-term fundamental work, and that they will eschew their roles in helping build NARES and regional network capacity in low-income regions with weak systems *ex ante*.

3.7 Ex post impact assessment is even more challenging with respect to NRM research than with respect to agricultural research more broadly. NRM research impacts are supposed to be “increased productivity in association with enhanced ecosystem resilience and human well-being.” (INRM 2001, p.2). But as hard as it is to measure agricultural productivity accurately in the aggregate, how does one quantify “enhanced ecosystem resilience” and how does one weight these disparate objectives?

3.8 Perhaps most fundamentally, the problem is that the concept of sustainability is the operative basis for impact assessment of NRM research. But the CGIAR has never defined sustainability objectives in a fashion amenable to routine monitoring and evaluation — in part because there is no consensus on an appropriate, operationalizable definition of “sustainability” in the literature. Although there exists widespread acceptance that sustainability implies multidimensional metrics of performance, spanning the biophysical and socioeconomic domains (Herdt and Lynam 1992, Henzell et al. 2000, pp. 28-31), no widely accepted list of indicators and associated measurement and valuation techniques yet exist. The total social factor productivity approach that has become increasingly popular in recent years as a summary measure suffers serious conceptual flaws, as do all existing, rival methods (Byerlee and Murgai 2001). Even were there an accepted metric for establishing sustainability, there remain a host of technical difficulties in measuring basic variables related to, for example, soil loss or quality under alternative NRM and cropping systems scenarios and in coming up with comparable nonmarket valuations of all the biophysical variables of interest (Crosson and Anderson 1993). Then too, considerable intra-zone variation in biophysical characteristics can make generalization from a small set of intensively monitored locations extremely imprecise. The holistic nature of NRM research necessitates long-term tracking of a range of variables, which renders *ex post* impact assessment relatively expensive and slow. Finally, the usual problems of attribution of impacts to a particular vein of research performed by a particular Center or System-wide Program are perhaps magnified in the case of NRM research by the integrated nature of the problem. Where a new cultivar may be plainly the product of a particular laboratory, attribution is far murkier in cases such as an adaptation of traditional crop rotation and soil conservation methods that arises from participatory research among local communities, NARES and a CGIAR Center. In short, it is extraordinarily difficult to come up with unambiguous measures of impact, hence the dearth of clear evaluations of NRM research impact within the CGIAR.

3.9 Even if one could readily measure the impacts of NRM research, given the relatively recent launch of most of the CGIAR’s NRM research and the excessively diffuse nature of some of the early research in this area in the early-to-mid 1990s, it seems unreasonable to expect to see significant aggregate level evidence of any impact just yet. The absence of clear, quantitative evidence of impact to date does not imply the absence of current, much less likely future impact; it merely means we simply do not know yet. As the CGIAR moves forward, donors will understandably want to see clear evidence of impact established using credible methods. This is a significant challenge that the CGIAR is struggling to address methodologically.

3.10 The upshot is a dearth of ex post impact assessment of CGIAR NRM research. On the one hand, this is troubling since stakeholders justifiably want to know the efficacy of investments in this area and the opportunity cost of funds spent or not spent on NRM research. In the absence of good impact measures, the CGIAR must accept or reject NRM research largely on the basis of *a priori* beliefs and assessments as to the quality of the science, which is perhaps too academic an evaluation criterion in the case of the CGIAR. On the other hand, given the manifest importance of NRM to agriculture in low- and middle-income countries, this lacuna also signals a significant opportunity for the CGIAR System to exert leadership in the provision of a global public good through development and dissemination of robust, cost-effective ex post impact assessment methods for NRM research. Based on the available evidence, it seems reasonable to conclude that NRM research oriented toward the CGIAR's core agricultural productivity enhancement mission is covered adequately by impact assessments on the returns to CGIAR agricultural research. Until such time as defensible methods of NRM research impact assessment are developed, the allocation of resources between NRM and other, complementary areas of agricultural productivity research and within NRM must proceed on the basis of System scientists' evidence as to what appear the primary limiting factors in a given class of agro-ecosystems. This will focus NRM research in those ecoregions where NRM seems to restrict the impact one can reasonably expect to achieve solely through germplasm improvements. The limited available evidence (Barrett, Aboud and Place 2002, TAC Secretariat 2000 *Review of System-wide Programmes with an Ecoregional Approach*) and much expert opinion points to marginal lands, especially rainfed agriculture in sub-Saharan Africa and South Asia (Fan and Hazell 2000, Eicher and Rukuni 2002).

3.11 The above caveats notwithstanding, the Centers and System-wide Programs largely accept that donors will continue to demand ex post impact assessments as a vehicle to establish the cost-effectiveness of resources invested in the CGIAR. Most (although not all) Centers have been making significant efforts to devise effective impact assessment methods, although the most recent external review panels for ICLARM, ILRI and IWMI criticized those particular Centers for insufficient effort to attempt impact assessment. In the case of NRM research, there is a clear need for innovation with respect to scaling up within benchmark sites and for extrapolation from them using new remote sensing and spatially-explicit computer modeling methods (Henzell et al. 2000). Such advances are necessary if the Centers are to make the local-to-global bridge necessary to generate significant GPG returns from in depth NRM research in specific sites. To this point, however, scaling up impact assessments is notoriously difficult, imprecise, and expensive. Nelson (2000) goes so far as to suggest that "one might conclude that time and cost of obtaining *useful* estimates of sustainable impacts is too high, particularly when it seems entirely reasonable to assume sustainability a priori. Rejecting this position, the challenge is to structure a systematic research program, addressing the problem of *scaling up*, by successive approximation" (emphasis in original). As yet, such methods remain beyond the current state of the art in impact assessment (TAC 2000).

3.12 There is a significant amount of largely anecdotal evidence of impact at small scale from CGIAR NRM research. For example, tens of thousands of farmers in east and southern Africa have adopted improved nutrient management methods developed and extended by ICRAF and its partners, resulting in sharply increased average yields in these maize-based

systems. There is the very real prospect for significant aggregate impact if such patterns can be effectively scaled up. Policy research by ICRAF, IFPRI, and IWMI has helped bring about changes in pricing, tending, or regulatory policies that impeded environmentally sustainable growth in agricultural productivity. Although it is difficult to prove this because of the inherently unobservable counterfactual, policymakers, and others widely acknowledge the impact some CGIAR research programs are having on policy formulation and implementation in certain low- and middle-income countries.

4. The Future of Natural Resources Management Research Within the CGIAR

Implications for the CGIAR

4.1 This meta-evaluation began by considering what constitutes GPGs in NRM research and what this ought to imply for a multilateral network of international agricultural research centers. It then went on to identify how the current portfolio of NRM research undertaken by the CGIAR through its Centers and System-wide Programs compares to this notional design before going on to synthesize the findings of previous evaluations and consider issues of impact assessment. It is important to keep in mind that although NRM research has taken place within the CGIAR for many years in some form or another, the current, concerted effort in this domain is really no more than a decade old. The CGIAR has made important strides during this period and proved highly responsive to changing international demands placed on both the whole System and on specific Centers through a thorough external review process and extensive stakeholder participation in priority setting and resource allocation processes at System level. This responsiveness, which has typified the CGIAR throughout its history (Anderson and Dalrymple 1999), is perhaps best reflected by the introduction or adoption of several new Centers and System-wide Programs over the past decade. Centers and System-wide Programs have made important contributions to the scholarly literature on NRM, including major innovations in methods and process research, especially for modeling complex agro-ecological systems, and contributed key empirical findings from particular agro-ecosystems (e.g., tropical forest margins) that are likely generalizable to other areas of the world. The CGIAR's NRM research has helped usher in a more integrated vision of the dynamic relationship between human, agricultural, and environmental systems at all levels, from plot to global. These accomplishments contribute indisputably to the provision of important knowledge-based GPGs that related directly to CGIAR objectives in the areas of improved agricultural productivity and food security, environmental sustainability, and poverty alleviation and prevention, even if quantifiable measures of impact in these domains do not exist.

4.2 While the CGIAR's NRM research merits the many plaudits it has received in extensive external evaluations, there are, nonetheless, legitimate concerns about the CGIAR's NRM research portfolio. Some of these concerns appear in various Center or System-wide Program reviews. Others become apparent more at System level than at Center or Program level. These concerns can be usefully broken up into two sets of issues: focus and framework.

Issue: Focus

4.3 The issue of focus derives from two fundamental points. First, the CGIAR's core competencies do not lie in environmental and natural resource issues, but in agricultural issues, so the CGIAR should not be expected nor tasked to make fundamental scientific contributions in NRM not directly supportive of agriculture. Put differently, NRM research, like germplasm research, is indispensable to the CGIAR's agricultural research program, but it must not proceed independent of that focus. The issue is not whether NRM research plays second fiddle to work on varietal improvement. There are places where improved NRM likely would have a greater impact on agricultural productivity over various time horizons than would germplasm research, and vice versa.¹⁰ Rather, the System needs to walk on these two legs, without one drifting too far from the other. There is some evidence of drift into potentially valuable NRM research that is nonetheless tangential to the CGIAR's core mission, perhaps because donor funding available to skilled scientists sometimes diverts the research agenda in Centers suffering budgetary stress. This is occurring at multiple levels as manifest by EPMR concerns about focus in multiple Centers (e.g., CIFOR, CIP, ICARDA, ICRISAT, and others). The CGIAR needs to define and enforce clear priorities at both System-wide Program and Center levels in the very near future. Center leadership needs to provide similar direction at the level of specific research programs within Centers.

4.4 Second, the justification for a system of international agricultural research centers lies in the CGIAR's role as a producer of GPGs. This poses a challenge for much NRM research because of the inherent site specificity of most empirical and applied or adaptive research at present. Several external reviews indicate some apprehension and misunderstanding within Centers as to how the local-global research link needs to be made. This is perhaps most clearly captured in the 1998 report of the CIFOR review panel:

“The Panel found that some CIFOR researchers are frustrated with the IPG [International Public Goods] criterion because they view it as being associated with shallowness of research at the specific site level. The Panel wishes to point out that this is (or should be) a false assumption. The IPG nature of CIFOR's work should not make it incompatible with in-depth research on particular sites. In fact, significant generalizations based upon a profound understanding of the nature of crucial variables at multiple sites is what CIFOR projects should, and in most cases do, seek to achieve. A misunderstanding of this basic concept will, axiomatically, lead to research that is neither cost-effective nor IPG related. The need for cost-effectiveness of CIFOR research must not deter in-depth research. When expensive senior staff cannot engage in time-consuming field activities, they should recruit and supervise students in the field and develop mutually beneficial links with other appropriate,

10. It is perhaps instructive that recent research using WARDA data (Sherlund et al. forthcoming) finds that when one accounts for natural resource conditions in estimating the technical efficiency of rice farmers in Côte d'Ivoire, the median farmer appears to operate on or quite near the production possibilities frontier, achieving maximal output given inputs. By contrast, if one fails to control for environmental production conditions appropriately, technical inefficiency estimates rise sharply, suggesting significant foregone output. Management of latent variability in natural resource conditions matters fundamentally to agricultural productivity.

lower cost and locality focused partners who can carry out the in-depth field work in the overall IPG context of the research” (TAC Secretariat, 1998).

4.5 Although perhaps not articulated quite so plainly in other reviews, although one does find variants on this theme in several EPMP reports, it is apparent the CGIAR leadership faces a significant internal communications challenge to explain the GPG criterion plainly and to impress upon System scientists that this does not preclude in depth research in specific, carefully chosen sites. Much of the CGIAR’s NRM work remains highly site-specific, with scant evidence of zone-to-zone spillovers or even success in scaling up results from a well-studied site to the broader zone in which that site resides (Henzell et al. 1999).

4.6 The core research foci that satisfy these two core points seem to be process and methodological research and the compilation and distribution of meta-data. The CGIAR is generally doing well in the first and second of these, contributing very important, fundamental research on systems modeling, appropriate sustainability indicators, methods of establishing and quantifying tradeoffs between biophysical and socioeconomic objectives, nutrient cycling and soil microbiological processes, and impact assessment and evaluation methods. The GPG value-added from the knowledge produced could nonetheless be enhanced in many Centers and SPs by an increased commitment to peer-reviewed publication and to ensuring the accessibility of scientists’ research through journals, books, and working papers readily available on Web sites. Some Centers have outstanding publications records (e.g., CIMMYT, ICRAF, IFPRI), but many important CGIAR NRM research findings are insufficiently broadly or quickly distributed to have full impact. A good, System-wide searchable electronic library would be a useful step toward making CGIAR research more readily available and could probably help the System achieve some economies of scale in information delivery.

4.7 Meta-data sets offering truly global coverage, such as the recent IFPRI-WRI agro-ecosystems mapping (Wood et al. 2001) and IWMI’s World Water and Climate Atlas, offer not only opportunities to improve the targeting of research and technology development, but also crucial baseline information on which to found ongoing agro-ecological monitoring activities necessary to identify the dynamics of threats and to conduct reliable ex post impact assessment at a scale beyond that of strategically selected benchmark sites. When well documented and readily accessible to prospective collaborators worldwide, such data sets can generate important knowledge spillovers globally. There seems, however, to be significant underproduction of such meta-data sets, even though this was an explicit objective of the CGIAR’s eco-regional initiative. Like too many publicly funded ARIs, some Centers and System-wide Programs seem to treat data as proprietary. Even NARESS and ARI partners can have difficulty accessing relevant data necessary to do their own analyses as part of a broader, collaborative program of work. This may partly reflect insufficient recognition being given the GPG value of producing and disseminating high quality, well-documented data. When only publications resulting from such data count in personnel management, scientists and Centers face strong disincentives to the timely, public release of data they collect. This must change. Tracking data acquisition and resulting research based on such meta-data might be one way of documenting the impact of data assembly and dissemination, and thereby rewarding it. There are good examples within the CGIAR, such as the System-

wide Information Network for Genetic Resources (SINGER), that might offer useful insights as to how to remedy this deficiency in meta-data-set production and dissemination.

4.8 The other major area on which the CGIAR needs to rethink its efforts is institutional capacity building at national and subregional level. Although there is considerable individual-level training taking place, there is scant evidence of systematic capacity building or maintenance at the institutional level within NARES that can be directly linked to CGIAR NRM research. ISNAR has thus far proved unable to fulfill this daunting but crucial mission. Especially if the CGIAR is to put greater emphasis on strategic partnerships (see section below), institutional capacity development — not just individual professional development for the best NARES scientists — seems essential. A draft Professional Development Partnership Program is presently under review. However, the draft concept note suggests this program would be heavily focused on developing individual scientists, in part to “enlarge the network of ‘friends of the CGIAR’” and in part to “widen and deepen the pool of NARS candidates who may be considered for scientist and management positions in the Centers.” More thought needs to be given the CGIAR’s role in developing local-level capacity for NRM research and the implications for the design of training systems and the pursuit and use of project-specific donor funding. This is especially a challenge in low-income countries with weak NAREs. Some nascent efforts at building SROs among NAREs and other stakeholders to achieve critical mass across countries facing similar challenges show much promise, as with CIMMYT’s Soil Fertility Network in southern Africa. The CGIAR should perhaps be evaluating such efforts and their design more formally with an eye to exploring the returns to reinforcing such investments.

Issue: Framework

4.9 The second class of concerns revolves around the framework in which NRM research is conducted within the CGIAR. A range of organizational and financial issues exist, most of which have been addressed recently through the Change Design and Management Team’s recent work (CDMT 2001) and the ensuing discussions within the CGIAR (CGIAR 2001).

4.10 The CGIAR needs to consider carefully its role within the international scientific community in the production of NRM-related GPGs. The CGIAR has special skills and a unique mandate, but these do not endow it with comparative advantage in all areas of NRM research. In some areas, it is best suited to be the direct producer of NRM research. This is most likely true with respect to INRM closely tied in with germplasm improvement to improve production practices and in areas where ARI and NARES research has historically been deficient, as on questions of tropical deforestation. Yet although the organization of varietal improvement research has historically and effectively been largely internalized within Centers with global commodity mandates, it is by no means clear that this model is as well-suited to NRM research. One indicator is that the Centers widely evaluated as doing the best work in NRM have either had ecoregional mandates (e.g., CIAT, ICRISAT in the past) or have an explicit NRM emphasis that enables them to attain the scale and scope needed to make significant advances (CIFOR, ICRAF).

4.11 Given the importance of both hierarchical and disciplinary connectivity to NRM research, there is a strong argument for a greater share of CGIAR NRM research to be

organized following the collaborative or facilitative models than has been the case to date. The new Challenge Programs are clearly oriented toward the collaborative model (see the next several paragraphs). Yet given the site-specificity of much NRM research and the lack of critical mass to do good NRM work in many NARES, more attention needs to be given the facilitative model, in which the CGIAR serves more as a broker between NARES and ARIs and among NARES. At present, there are few if any effective regional suppliers of NRM research. The CGIAR can and should help fill this breach. Instead, there is a great deal of site-specific work taking place that could arguably be tackled as capably, but more appropriately, by local partners in NARES, SROs and the private (for profit and not for profit) sector. Where scientific capacity is lacking at the more local level to perform necessary, site-specific research, the CGIAR needs to structure individual training and institutional capacity building with an eye toward an exit strategy, wherein local work is handed off to partners.

4.12 The collaborative model also offers significant opportunities for the CGIAR to overcome its capacity limitations in the social sciences and to raise the quality of the science — especially as manifest in scientific publications — in the half or so of the Centers that lag in this area within the NRM research arena. The CGIAR can leverage its resources better by partnering with ARIs and leading NARES doing related work in which they have independent interest. There exist good examples of such partnerships on an ad hoc basis. What have been lacking to date are strategic collaborative and facilitative partnerships with more secure, longer-term funding with which to pursue more innovative, longer-term strategic research. Even inter-Center strategic cooperation has been scant, with generally successful System-wide Programs such as ASB the exception rather than the rule.

4.13 This has been the thrust of the new system of Global Challenge Programs, which are intended to facilitate increased Center collaboration with a wider range of partners (CDMT 2001). The design, wherein problems of global importance are to be pursued through a network of in-depth, long-term, local applications, in principle lends itself well to NRM research. Whether it will succeed is by no means clear. In particular, if the Challenge Programs (CPs) prove to be mainly “old wine in new bottles” — a possibility that emerges as one notes that several current inter-Center programs are on the short list being considered for pilot CPs — it will likely fail to reconstitute CGIAR research, on NRM or any other topic, in a productive, substantive way. This is frankly the sense one gets from the very brief abstracts of pilot challenge program proposals prepared on, for example, “water and agriculture.” Of even greater concern, one gets the sense that pilot Challenge Programs are being designed and advanced without systematic prior identification of the CGIAR’s areas of comparative advantage and how best to organize research on themes deemed priorities through such an explicit process, free of proposals on the table. Many of the pilot Challenge Program proposals seem to suggest further expansion of the scope of CGIAR research with the explicit ambition of capturing additional donor resources through networking at the thematic margins of agriculture. This seems unwise at a time when the System is still reeling from the rapid expansion of its mandate a decade ago and when there seems to remain spare capacity for approaching the System’s possibilities frontier through improved connectivity within the CGIAR and between the Centers, NARES, SROs, and the ARIs within agriculture. The Challenge Programs run a serious risk of fostering further drift into tangential topics (e.g., the pilot proposals on climate change and HIV/AIDS). These cautions notwithstanding, if Challenge Programs prove a new way of allocating research dollars,

advancing the need for improved disciplinary and hierarchical connectivity coupled with improved quality monitoring and capacity building at NARES and SRO levels, then they have real potential to lever CGIAR resources better to produce (or facilitate the production of) significant GPGs at the heart of the CGIAR's mandate.

4.14 The efficacy of the Challenge Programs will largely depend on the performance of the new Science Council. The role, composition, and resources of the Science Council need clarification. The latest organizational design charts do not show any direct supervisory role for the Science Council over either the Centers or the System-wide Programs. It makes sense to engage an internationally prestigious group of scientists to identify what are the strategically important research questions to which CGIAR Centers and scientists are poised to make significant contributions to global knowledge that should ultimately impact on poverty, food security, and sustainable improvements in agricultural productivity. The group must likewise be prepared and empowered to identify what the CGIAR should not do. The CGIAR has been repeatedly and justifiably criticized over the years for lacking an architecture that enables it to make politically difficult but scientifically essential choices. It would be wise to invest the Science Council with the authority and responsibility for maintaining the System's focus.

4.15 This leads to a significant design challenge. In order to effectively exert research and science oversight, the Science Council must have substantive input into resource allocation decisions as well. This would seem to suggest the need to identify specific areas of scientific expertise the Council would need to encompass through its membership. However, as soon as resource allocation decisions become a prominent feature of the Council's mandate, Council composition related to attributes such as region and gender becomes more of an issue. There are inevitable tensions between balancing out representative interests across stakeholder groups and the collective interest in the best possible scientists, regardless of their representativeness. The relationship between scientific review and resource allocation therefore needs further thought and clarification. In the end, donors will only value the Science Council's independent advice and commit the necessary resources if the scientific credibility of the group is beyond question and its procedures adhere to high standards of transparency.

4.16 The CDMT (2001) recommends that one-half of CGIAR research be moved to Challenge Programs by 2006 but that these Programs be responsible for raising the funds they need. This raises the classic public finance tension between unrestricted, common pool funding and restricted, project funding from specific donors (see section 1). The target of one-half seems to overshoot the desirable expansion in the System's collaborative research. Most importantly, this appears to reinforce the current problems associated with donor-driven research foci. The rise of restricted CGIAR funding has been contemporaneous with the growth in the CGIAR's NRM research portfolio, but also appears correlated with diffusion in the research agenda. The Executive and Science Council's capacity to maintain appropriate focus in the Challenge Programs may become an issue if core CGIAR funding does not underpin these major research initiatives.

4.17 The number and organization of Centers is another active issue on which the CDMT (2001) has spoken. In NRM research, just as in agricultural research more broadly, there exists a nontrivial critical mass of skilled scientists and research infrastructure one needs to undertake world-class research. This increases in NRM research due to its inherent multidisciplinaryity.

Henzell et al. (1999) recommend that “frequently observed imbalances between biophysical and social science research must be redressed” as must capacity development in the NARES, where “social science capacity in NRM is one of the weakest disciplines.” In particular, that review notes that increased social science research has the unique potential to shed light on what might be done about the apparently large backlog of under- and unused CGIAR research results in NRM and needs to be expanded in almost all Centers undertaking significant NRM research. Critical mass is also increasing in the range of donors supporting the work and each requiring independent reporting. The fixed costs of high-quality science for GPG production must not be underestimated. These fixed costs argue for concentrating restricted project funding in multifunctional Centers where the average fixed cost becomes relatively low, and probably also for moving toward clusters of the sort mooted by the CDMT.

4.18 A decision to reduce the number of Centers through consolidation or closure — which seems advisable given that System resources are spread excessively thinly today — should probably include serious consideration of the option to decentralize social science and water research, two of the less effective threads within the CGIAR in the NRM domain. To date, the System has concentrated most of its social science research capacity in IFPRI and ISNAR and most of its water research capacity in IWMI. One might legitimately ask whether this remains (or ever was) the optimal organizational design. Most other Centers presently lack critical mass in either of these areas and several EPMRs suggest this lack of capacity limits the efficacy of the broader NRM research portfolio in the Centers. System-wide Programs have thus far proved ineffective in remedying this problem, not least of which because they are generally overly reliant on short-term project funding and have insufficient autonomy and core resources to embark on significant collaborative research ventures within the System.

4.19 At least in the NRM domain, it appears worth exploring in closer detail whether the System-wide Programs have sufficient focus (a weakness of SWIM), successfully avoid duplication of ARI research (an apparent weakness of CAPRI), and should be separated as a System-wide Program rather than mainstreamed within all the Centers (an issue with INRM). The independence of the programs in terms of priority-setting and resource allocation also needs to be reviewed. Although System-wide Programs appear to play a central coordinating role among Centers and between the CGIAR and external collaborators and stakeholders, they are universally hosted by a Center, have relatively meager budgets and support staffs, and therefore appear to have little if any authority or flexibility to deviate from the prevailing wishes of the host Centers. Henzell et al. (1999) recommend the discontinuation of System-wide Programs where they cannot be more tightly focused; that advice seems sound. Are System-wide Programs to continue with the emergence of Challenge Programs? Might/ought they be placed directly under the control of the new Science Council as a manifestation of the Programs’ roles in addressing System-wide scientific priorities?

4.20 Finally, the CDMT has made a number of reasonably conservative suggestions regarding the provision of Center support services. The reviews do not really speak to the System-wide question of centralization of certain functions, including impact assessment, much external communications, legal, financial and management backstopping services. There is clearly some duplication of efforts across Centers and these functions are plainly a drain on staff time and resources at Center level, so at first blush there seems merit in the CDMT suggestion. But this would require more detailed scrutiny than can be undertaken in

this meta-evaluation in order to ensure that the sustainable operating costs savings would be sufficient to justify the transaction and transition costs of the changes. Similarly, it would seem prudent to explore greater outsourcing of support services at Center level. Many such functions continue to be organic to the institutions, but in many host countries, rapid recent changes in private services availability, quality and cost may make it worthwhile to look into a switch to increased outsourcing.

Recommendations for Subsequent, Independent Evaluation

4.21 Given the relatively short period of time since NRM research became a significant, explicit activity of the CGIAR, previous evaluations of Centers and System-wide Programs, as well as of the CGIAR more broadly, have necessarily been limited in coverage and quality as they relate to NRM. This final subsection identifies a number of topics that seem to merit more careful independent evaluation than this meta-evaluation can possibly provide.

4.22 In order to identify areas in need of more careful, independent evaluation, it is necessary to begin with a quick review of key, recent System-wide reviews. In the domain of NRM research, these include the Third External System Review of the CGIAR (the “Strong report,” TSR), the First Review of System-wide Programmes with an Ecoregional Approach (the “Henzell report,” TAC Secretariat 2000), the World Bank OED evaluation of the CGIAR (Anderson and Dalrymple 1999), and the individual Center EPMRs, which do not receive further attention here because they are reviewed in Annex 2 and discussed throughout the text.

4.23 Taking these in chronological order, TSR has had a profound effect on the System, for both good and ill. One favorable effect is that it underscored the importance of mainstreaming NRM research within the CGIAR. Many of TSR’s key NRM-related recommendations have been subsequently implemented. Most notably, the CGIAR has embraced TSR recommendation 5, adopting the INRM approach and organizing the INRM Task Force (TAC Secretariat 2002). Furthermore, recommendation 1, relating to the CGIAR’s mission statement, has been largely enacted, incorporating “the environmentally sound management of natural resources” as a central part of the System’s mission (TAC Secretariat 2002). The primary problem with TSR is that it devoted insufficient attention to the serious problem of mission creep that pervades the System (see below “Issue: Focus”). Indeed, one might reasonably argue that by broadening the System’s mission statement, TSR contributed to that problem. The proliferation of Centers in the early 1990s without corresponding growth in real financial or human resources has caused financial stress to guide too many research management decisions. This leads to funding-driven drift into topics outside the CGIAR’s areas of comparative advantage and into activities that seem to produce little in the way of GPGs. The problem appears more acute within NRM research — where Centers are dabbling in issues such as climate change mitigation and epidemiology — than in the System’s more conventional agricultural science programs. This endangers the CGIAR’s essential NRM research portfolio, which TSR did so much to emphasize, in so far as insufficient focus dilutes the overall efficacy of CGIAR NRM research in fulfilling its core mission.

4.24 Anderson and Dalrymple (1999) provide an excellent, detailed evaluation of the overall performance of the CGIAR and its responsiveness to changing concerns and emerging evidence as to its efficacy and to shifting challenges facing agriculture in the low-

and middle-income countries. Anderson and Dalrymple award the CGIAR high marks for its alignment with Bank goals and programs, implementation and accomplishments, and their evaluation backs up these conclusions with considerable evidence. Their evaluation was intended to provide a broad gauge view of the efficacy of the Bank's support for the whole CGIAR, of which NRM research comprises just a modest portion, especially in historical context. There is consequently relatively little attention given to NRM research issues in isolation from the rest of the System's agricultural research activities. This merely underscores a theme of the current meta-evaluation, that the value of NRM research within the CGIAR as a GPG likely to have considerable impact lies in its complementarity with the System's other agricultural research endeavors. Anderson and Dalrymple necessarily focused on the CGIAR's relationship to the World Bank, emphasizing the need to increase interactions at the technical level. They stopped short of extending this recommendation to the broader scientific community, which seems nonetheless the implication of their assessment, and one consistent with the conclusions of this report.

4.25 The Henzell report provided an especially insightful review of the role of NRM within the broader CGIAR research portfolio, including an articulate defense of the continuing validity of the ecoregional approach for the CGIAR and its partners. This report lays out the principles that ought to underpin the ecoregional organization of much of the CGIAR's work under a mainstreamed INRM approach. It squarely identified the System's principal shortcomings at that point in time, for example, insufficient social science research capacity, the need to focus on GPGs, the need for "sunset" reviews, and poorly defined governance of System-wide Programs that suggests locating most NRM research authority at Center level instead. Although the Henzell report laid out principles clearly, it stopped short of drawing out priorities for the CGIAR and the TAC has to date largely failed to take that next step. This leads directly to the first topic on which further, independent evaluation seems necessary.

4.26 With this brief appraisal of highlights from recent System-wide evaluations in mind, what are the key outstanding issues on which a subsequent independent evaluation ought to focus? There seem to be five key topics needing significantly more in depth treatment than can possibly be undertaken in the present meta-evaluation.

Identify Areas of CGIAR Comparative Advantage in NRM Research

4.27 If the CGIAR is to focus NRM research effectively in support of its core competencies in agricultural research and in a manner that generates significant GPGs that other research bodies cannot produce as efficiently or effectively, it needs to know the research domains in which it holds comparative advantage. The first step in this process will require establishing a clear set of criteria according to which comparative advantage is measured. The quality of the science involved, the geographic and temporal scope of the relevant scientific questions, the quality and composition of available research staff, the existence of complementary research initiatives, and past, less-than-fully-depreciated investment in costly and productive fixed resources (e.g., laboratories, benchmark site) are among the criteria that ought to be considered in identifying those niches in which the System holds comparative advantage. At present, the NRM research terminology within the System is loose and encompasses a wide array of activities, some of which appear distant from the CGIAR's core competencies and some of which may conflict with the capabilities

and needs of prospective collaborators. This necessarily means looking not just at what the Centers and System-wide Programs are doing, but also at what NARES, ARIs and other prospective partners or competitors are doing. An evaluation that identified areas of comparative advantage could also help rationalize the Challenge Programs of strategic collaboration with research entities outside the CGIAR. For example, an evaluation may well find that the CGIAR's justified interest in issues of climate change mitigation, water borne diseases, or collective action and property rights might be best approached through highly leveraged strategic collaborations outside the System due to a lack of comparative advantage in such research within the System.

Explore Funding Mechanisms to Ensure Centers Retain Focus on Comparative Advantage

4.28 There is widespread perception that occasional drift in Centers' and System-wide Programs' research programs outside the CGIAR's core competencies or mandate almost invariably boils down to money. Generous donor funding available to tackle pet projects can help relieve the very real, sometimes onerous budgetary pressures research managers face. Moreover, complete reliance on core funding may diminish Center responsiveness to stakeholder concerns. Demand-driven research has the virtue of providing an indirect indicator of past and projected impact. Nonetheless, it is not always clear whether donor project funding really functions as "demand-driven" research in the positive sense of the phrase. The casual sense one gets from discussions with donors and CGIAR scientists is that this reflects donor perception of Centers' holding absolute (but not necessarily comparative) advantage in a research area due to location and past portfolio of research. The rationale (if any exists) as to why Centers and System-wide Programs are being drawn off on tangents within the NRM research domain needs to be more carefully explored in the context of establishing the System's areas of comparative advantage.

Evaluate CGIAR Performance in Building Institutional Capacity at National Level

4.29 As previously mentioned, a review of the impact of CGIAR training programs is presently underway. The subtle but important distinction between individual training and institutional capacity building must not, however, be overlooked. Training is merely a part of the latter activity. Collaborative research, shared facilities or services, etc. also matter, as do prospective points of implicit or explicit competition between NARES and Centers, for example in the hiring of skilled local scientists or in the competition for project research funding. The issues are also somewhat different in places with weak NARESs and in nations with strong NARESs. One popular belief is that CGIAR impact is relatively low in places with strong NARESs. Does this reveal poor mechanisms for effective collaboration or an appropriate avoidance of duplication of work with capable institutions with similar charters? This question deserves deeper exploration, not least of which as an indicator as to how best to arrange the Challenge Programs to succeed in improving CGIAR partnering with national-level institutions.

Revisit the Role and Method of External Reviews

4.30 Although the CGIAR has a far more thorough and effective system of external reviews than is typical of the ARIs or nongovernmental organizations, and although it has undertaken quite recent revisions to its review process, the review system nonetheless perhaps ongoing scrutiny. It is expensive and time consuming for Centers and System-wide Programs with scarce human and financial resources, costing up to half a million dollars per review, once one accounts for staff time (Strong et al. 1999). Moreover, because they demand significant periods (commonly three weeks) at Centers, review teams tend not to be able to draw on leading, active research scientists fully knowledgeable of current and prospective advances in the relevant sciences. Too often, review panels are CGIAR ‘insiders’ evaluating and writing for other ‘insiders’. Partly as a consequence, the EPMR reports are too often vague and imprecise with respect to outcomes, impacts, and the quality of the science under review. The very recent introduction of shorter, cheaper CCERs may prove an effective remedy, but this remains to be seen. Much will depend on the composition and guidance given the external review teams. Will the CCER design increase the participation of scientists familiar with current research frontiers? Will it improve the flow of constructive criticism to Centers and assist in priority setting? Perhaps especially, will they help Centers and the System more generally maintain a tighter focus on their core competencies and areas of comparative advantage? This remains to be seen.

Establish the Appropriate Scope of Impact Assessment

4.31 Donors appropriately want to see evidence that the resources invested in CGIAR research generate at least adequate social returns through the production of GPGs. Quite aside from the methodological issues surrounding how one generates such evidence defensibly, there is a more basic question of the level at which such evidence is required. There seems to be a growing sense within the System that all research programs have to demonstrate impact. Yet, given their interdependence, the problems of attribution and measurement are magnified as the scope of research required for documenting impact is defined more narrowly. The importance of measuring the impact of the CGIAR as a whole is just as incontestable, given the range of other good uses on which scarce donor funds could be spent, as is the silliness of demanding impact assessment of individual scientists’ research records.

4.32 At present, however, there is no clear definition of where one draws the line within this rather wide window: At what point does it become essential to come up with and implement credible impact assessment methodologies? This issue is especially germane to NRM research within the CGIAR today. The dearth of evidence on the impact of NRM research legitimately calls this line of work into question so long as it is sufficiently distinct from the rest of the System’s agricultural research portfolio. If the CGIAR mainstreams INRM research and guards against drift into NRM topics at the thematic margins of its mission, this will provide solid justification for the inclusion of NRM research within the envelope of work to which assessment of the returns to agricultural research applies. The allocation of resources between different components of an integrated portfolio then ought to be left to Center-level research managers, following the principle of subsidiarity. In so far as the CGIAR permits or (perhaps inadvertently) encourages further broadening, so that its NRM research portfolio becomes reasonably distinct from the rest, donors will eventually

and appropriately demand clear evidence as to the returns to these investments, which could prove a challenging task indeed. At present, the CGIAR needs to guard against Icarian tendencies, lest its significant, laudable accomplishments to date in NRM research and the natural lure of new funding and scholarly and policymaker attention become for the System like Icarus' wings and the sun, respectively, and it wanders dangerously off course.

Annex 1. Sources Consulted

Much of what has been reported in this meta-evaluation reflects the cumulative impressions left by extensive desk study of a massive set of documents, many of which are not individually cited in the main body of the text, not least of which to minimize the clutter in an already dense report. The following listing identifies the full range of documents reviewed, as well as experts consulted and Web sites visited. (The reader should keep in mind that materials inevitably change on Web sites. All Web-derived information cited here was current in October-November 2001; some but not all of it was rechecked in January 2002.)

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Annex 2. Terms of Reference

OED Evaluation of Global Public Policies and Programs

Meta-Evaluation of the Consultative Group on International Agricultural Research (CGIAR): Terms of Reference for Christopher Barrett

Background

As part of the OED evaluation of Global Public Policies and Programs (GPPP) being carried out under the leadership of Ms. Uma Lele, OED will conduct a meta-evaluation of the Consultative Group on International Agricultural Research (CGIAR) staffed by an independent team of five people in the United States, with additional input from Africa, Brazil, China and India. (see attached Terms of Reference).

This meta-evaluation largely will rely on prior reviews of the CGIAR and on interviews. Its main purpose is to draw broad lessons of experience relevant to the Bank's future involvement in global public programs and policies; to track implementation of the recommendations of OED's 1998 *Process Review of the World Bank Grants Program*; and to make recommendations for any specific areas on which a larger, independent evaluation should focus.

Responsibilities

Prepare a paper evaluating the work of the CGIAR and its Centers from the standpoint of the impact of natural resources management research.

Based on previous analyses, reviews and evaluations, as well as on interviews with select individuals, this paper shall:

- Include treatment of the CGIAR at the System level, as well as CIMMYT, IRRI, CIAT, IITA, ILRI, IFPRI, IPGRI and ISNAR. Any other Centers of particular relevance to this topic shall also be included. [NOTE: The TOR were subsequently amended to call for coverage of all the Centers.]
- Include: 1) a relatively compact analysis of what an international agricultural research network might/ought do with respect to global public goods related to natural resources management (a "blank sheet"); and 2) an enumeration of what the CGIAR has said it is doing/aims to do in this arena and how that compares with the "blank sheet" design.
- Assess previous evaluations' treatment of natural resources management research, including what the CGIAR is doing well, poorly, not at all, or unnecessarily, as well as any implications for the CGIAR's structure, its governance and financing mechanisms, and its scientific strategy.
- Analyze and assess the coverage, quality, and recommendations of previous evaluations.

- Consider the recent recommendations of the CGIAR Change Design and Management Team from the standpoint of previous evaluations.
- Identify issues confronting the CGIAR from a forward-looking perspective, and provide recommendations for areas of further study, including proposed methodologies.
- Include a full and detailed bibliography and list of persons consulted.

A first draft is due to OED no later than December 10, 2001.

Maintain on-going consultations with the OED meta-evaluation team and contribute as necessary to assist in the overall effort, including review of draft inputs into the main report.

Travel

Limited travel may be required in order to conduct interviews with CGIAR management and stakeholders. Expenses incurred will be covered by OED.

Confidentiality

Any findings or draft reports shall be kept strictly confidential without the express permission of OED.

Annex 3. Center and System-wide Program Notes

1. ASB — Alternatives to Slash and Burn

Main Web page: <http://www.asb.cgiar.org/home.htm>

Stated Aims

ASB was founded in 1994 as a System-wide Program of the Consultative Group on International Agricultural Research (CGIAR). It is convened by the Nairobi-based International Centre for Research in Agroforestry (ASB, 2001b).

The stated aim or mission of ASB is to identify and articulate combinations of policy, institutional and technological options that can raise productivity and income of rural households without increasing deforestation or undermining essential environmental services (ASB, 2001b). To put it slightly differently, the main aim is to identify which land use systems have the best chance of attaining multiple environmental, agronomic, socio-economic, and policy objectives and to quantify any tradeoffs among these objectives.

The principal goals of ASB are to:

- identify and test innovations that will help eradicate poverty while simultaneously curbing the environmental problems associated with deforestation
- provide fora for exchanging information, developing consensus and managing conflicts at the local, national, regional and global levels
- build capacity of the national ASB consortia to promote equitable and sustainable rural development

Activities

Through partner institutions, ASB has established a network of benchmark sites that span the humid tropics:

- South America — the Amazon of Brazil and Peru
- Africa — the Congo Basin forest of Cameroon
- Asia — the island of Sumatra in Indonesia, the northern mountains of Thailand, and the island of Mindanao in the Philippines

ASB's work has been thematically structured around several working groups:

- *Climate change*: to determine those land-use systems that sequester more carbon and reduce trace gas emissions and identify the trade-offs that exist between global environmental benefits and the local economic benefits to farmers (http://www.asb.cgiar.org/Climate_Change.shtm).

- *Biodiversity*: this portion of the site still under construction. However, there are published results for above-ground biodiversity work in all three geographical regions.
- *Sustainable land use mosaics*: agronomic sustainability, economic and social indicators — to develop a set of plot-level criteria and indicators to evaluate the sustainability of a range of land use systems which can follow forest conversion, including measurements of soil structure, nutrient balance, and crop protection and eventually extend this to hydrological, ecological and other environmental services at the landscape scale in its local, national, regional and global activities (<http://www.asb.cgiar.org/Sustainability.shtm>).
- *Poverty, policy, and deforestation*: global synthesis of implications for policy, institutional, and technological options — to identify the policy and institutional environment necessary for the successful adoption of alternative land uses that reduce poverty, improve natural resources management, and reduce deforestation (<http://www.asb.cgiar.org/povertypolicy.shtm>).

ASB is also engaged in capacity-building activities that are aimed at equalizing access to information (through application of information technology and ‘South-South’ exchange) and access to funding (especially links to new ‘environment’ money) and by investing funds and effort to build national partners’ capacities in INRM research and development (<http://www.asb.cgiar.org/Fundraising.shtm>).

One of the outputs of ASB researchers has been the development and testing of innovative indicators of

- above- and belowground biodiversity, carbon stocks and greenhouse gas emissions,
- agronomic sustainability,
- returns to labor and other determinants of adoptability by smallholders, and
- national policymakers’ concerns

so as to link global environmental benefits to sustainable land use alternatives (ASB, 2001a). ASB has been able to illustrate the trade-offs that exist between environmental parameters such as carbon sequestration (a means of reducing greenhouse gas emissions) and conservation of biodiversity on the one ‘hand, and agricultural productivity indices such as profitability on the other (TAC Secretariat, 2000).

Examples of specific outputs:

The Climate Change Working Group has developed improved carbon stock values for the IPCC guidelines used for estimating national greenhouse gas inventories that are required through the UNFCCC (ASB, 2001c).

The Biodiversity Working Group developed a new set of biodiversity assessment survey tools and techniques to predict biophysical response, and therefore biodiversity, to land use impact. This was used to derive best-bet land use strategies from a biodiversity perspective (Gillison, 1999).

The SLUM Working Group is currently developing spatially explicit models of interactions between farmers and landscape under an ASB program through the IITA in Cameroon (ASB, 2001d).

The Poverty, Policy and Deforestation Working Group has developed a matrix technique to link environmental, agronomic, policy, socio-economic, and institutional indicators that can be used to evaluate tradeoffs among and within major land use systems in the humid tropics (ASB, 2001e).

ASB scientists at ICRAF-Southeast Asia have released a series of lecture notes entitled, "Towards integrated natural resources management in forest margins of the humid tropics: local action and global concerns" (available at <http://www.icraf.cgiar.org/sea/Training/Materials/ASB-TM/ASB-ICRAFSEA-LN.htm> by Meine van Noordwijk, Sandy Williams and Bruno Verbist (editors)). The series, developed on the basis of past training and education activities and on the experiences of ASB, was developed for use in university and professional training at the graduate level.

Quality

The Alternatives to Slash and Burn Agriculture program has gone farthest in utilizing the holistic ecoregional approach to research (CGIAR, 1999). The external review (TAC Secretariat, 2000) concluded that ASB has carried out innovative field research, linking NRM with productivity concerns, and combining human and technical dimensions in a holistic way. The review also concluded that the programs had made excellent progress in developing partnerships with national agricultural research systems (TAC Secretariat, 2000).

The review panel noted that ASB had made a major contribution to research in natural resources conservation and management, and in linking such research to that on production systems. The ASB's global findings on trade-offs between environmental parameters such as carbon sequestration and biodiversity on the one hand, and agricultural productivity indices such as profitability on the other, are of great value for the global debate on sustainability issues. The Indonesian consortium has made considerable progress also in linking research on agroforestry production to policy on forest management. The work in West Africa has the same objective but has not progressed so far. However, CIFOR has carried out important research in its study of the causes of forest-cover change in the humid forest zone of Cameroon, which has strong policy implications (TAC Secretariat, 2000).

The ASB has carried out new natural resources conservation and management research, notably on biodiversity, carbon sequestration and greenhouse gas emissions, and new research on cropping and agroforestry systems. It has also produced publications on, process (project management within consortia) and the problem of extrapolation from benchmark sites (modelling the global representativeness of the 108 locations at which research has been conducted in the western Amazon, Indonesia, and Cameroon) (TAC Secretariat, 2000).

Impact

Of the System-wide Programs with an ecoregional approach, the external review (TAC Secretariat, 2000) concluded that the Alternatives to Slash and Burn Program had gone further than the others in relating its research sites to the whole area over which the problem occurs, and in scaling up to the global level its findings on the trade-offs between carbon sequestration and biodiversity on the one hand, and agricultural productivity on the other. They concluded that this was very helpful for the global debate on sustainability issues. ASB was one of two programs judged as having come closest to the ideal of exploring the full power of the holistic ecoregional approach to research, especially its human and policy dimension (TAC Secretariat, 2000).

In its summary recommendations, the TAC Secretariat (2000) stated that poverty and human aspects were not sufficiently covered in the ecoregional programs — wondering if perhaps this was because the programs reviewed gave more explicit consideration to natural resources than to poverty. As a result TAC suggested that ways for balancing these concerns should include stronger focus on poverty variables and on ‘Users’ role in the management of natural resources. It was unclear from the report whether this referred to ASB in particular. My impression of ASB is that it does fairly well in this area.

Resources Consulted

Documents

CGIAR. 1999. Summary of Proceedings and Decisions, CGIAR International Centers Week, 25-29 October 1999, Washington, D.C.

Gillison, A.N. 1999. Above-ground Biodiversity Assessment Working Group Summary Report 1996-99: Impact on Biodiversity of Different Land Uses. Alternatives to Slash and Burn Project: Phase II. October, 1999.

TAC Secretariat. 2000. Review of System-wide Programmes with an Ecoregional Approach. June 2000.

Web Sites

ASB. 2001a. Alternatives to Slash-and-Burn Programme: Innovations to Reduce Poverty and Conserve Tropical Forests: Home Page [Online]. Available by ASB <http://www.asb.cgiar.org/home.htm> (posted 14/Nov/01; verified 29/Nov/2001).

ASB. 2001b. ASB Global Partnership [Online]. Available by ASB <http://www.asb.cgiar.org/GlobalPartnership.shtm> (posted 2001; verified 29/Nov/2001).

ASB. 2001c. ASB Climate Change [Online]. Available by ASB http://www.asb.cgiar.org/Climate_Change.shtm (posted 2001; verified 29/Nov/2001).

ASB. 2001d. ASB Sustainability [Online]. Available by ASB <http://www.asb.cgiar.org/Sustainability.shtm> (posted 2001; verified 29/Nov/2001).

ASB. 2001e. ASB Poverty, Policy and Deforestation [Online]. Available by ASB <http://www.asb.cgiar.org/povertypolicy.shtm> (posted 2001; verified 29/Nov/2001).

ASB summary prepared by Douglas R. Brown, Cornell University

2. System-wide Program on Collective Action and Property Rights (CAPRI)

Main Web page: www.capri.cgiar.org/

Stated Aims

“Successful resolution of agricultural productivity and natural resources management dilemmas around the world requires understanding of institutional issues, specifically those concerning externalities, property rights, and community action. Many CGIAR Centers have been grappling with these issues, and in 1995 IFPRI received preliminary funding to coordinate these efforts through CAPRI. CAPRI aims to promote comparative research on the role played by property and collective action institutions in shaping the efficiency, sustainability and equity components of natural resource systems. All 16 CGIAR Centers participated in this program with IFPRI as the convening Center. Membership includes all researchers at Centers, national research institutes, NGOs, and universities who participate in component research projects” (About CAPRI at www.capri.cgiar.org/what.asp).

“The overarching goal of this Program is to contribute to policies and practices that alleviate rural poverty by analyzing and disseminating knowledge on the ways that collective action and property rights institutions influence the efficiency, equity, and sustainability of natural resource use. Within this framework, the program’s research agenda seeks to do the following:

Increase knowledge of the emergence and performance of voluntary, self-governing, and self-adapting community organizations; the emergence and performance of different property institutions in natural resources management; the pros and cons associated with different types of institutions in different resource and socio-economic conditions; and the similarities and differences associated with the effects of different property institutions across different resources and regions.

Identify concrete policy instruments that facilitate and encourage the formation, improved functioning, resilience, and spontaneous evolution of organizations of users and property institutions that assure optimal resource use; and promote partnerships between local organizations, states, civil society, and private entities to limit duplication of effort while supporting these goals.

Strengthen the capacity of national and CG research Centers, nongovernmental organizations, universities and local organizations to do research on the above collective action and property rights issues, and forge and strengthen linkages between them in order to capitalize on synergies created through collaborative effort” (goals and objectives of CAPRI at www.capri.cgiar.org/goals.asp).

Activities

“To facilitate comparative research, the Program sponsors research on collective action and property rights by CG Centers and thus national partners; develops broad conceptual

frameworks; sponsors workshops, training, and panels on priority research themes; directs face-to-face meetings of researchers and experts; edits books and a working paper series featuring members' research on collective action and property rights; coordinates an e-mail network for exchange of information; and supplies literature reviews, an annotated bibliography, and publications" (Goals and Objectives of CAPRI at www.capri.cgiar.org/goals.asp).

"Experience has shown that institutions of collective action and property rights play an important role in how people use natural resources, which in turn shapes the outcomes of production systems. This System-wide Program examines the formation and effectiveness of voluntary, community-level organizations and property institutions as they relate to natural resources management."

"The issues of collective action and property rights are of special concern to the Consultative Group on International Agricultural Research (CGIAR) because of their effect on technology adoption, natural resources management, and poverty alleviation. As natural resources management issues emerge in the forefront of concerns we face today, the development of viable strategies to ensure the future productivity of resources demands a more profound understanding of the motivating forces which contribute to their sustainability. To address these complex issues requires an interdisciplinary approach, with insights and methodologies from a range of social, as well as technical scientists. Through collaboration between CGIAR Centers, national research institutions, and NGOs, the System-wide Program is able to achieve the necessary complement of researchers to examine the environmental impact of institutional change."

"The Program stresses comparative research that yields international public goods. The conceptual framework deals explicitly with the effect of differences in the biophysical, socioeconomic, and policy environment. At the same time we recognize the value of comparisons that cut across countries, ecoregions, and resources. An understanding of the factors that facilitate effective local organizations and appropriate property regimes in one resource sector can be valuable for developing policies for another resource" (CAPRI at www.capri.cgiar.org/).

Priority Research Themes

The following themes will receive priority, based on their importance in natural resources management, policy focus, relevance to the CGIAR mandate, and their widespread applicability across resources and regions:

Technology adoption: The incentives and ability of people to adopt technologies developed by the CGIAR System and national agricultural research facilities (NARESs) are shaped by the types of property rights they hold — to access, use, manage, and alienate the resource. As the CGIAR moves from traditional production technologies that can be adopted by individual farms, to natural resources management techniques (e.g. watershed management, IPM) that require coordination, the strength of collective action becomes increasingly important.

Accommodating multiple uses and users of a resource: This theme explores the role of collective action and property rights in developing systems that allow women and men, farmers and herders, or other categories of users to share land, water, or forest resources, for a variety of purposes. Most analyses of the efficiency of natural resources management have failed to recognize that resources often have multiple uses and that there tend to be sub-groups of users who are characterized by their use patterns.

Structuring devolution: Privatization trends and growing fiscal constraints at the state level have led many governments to devolve responsibility for natural resources management to local bodies. Successful devolution, however, requires the establishment of effective organization at the local level. Research on this theme explores the feasibility and potential outcomes of expanding local authority over natural resources in an effort to advance potentially viable frameworks for structuring successful devolution.

Role of environmental risk: Past research conducted in the CGIAR and elsewhere has demonstrated the effects of risk on the behavior of individual farmers in the developing countries, e.g. as a constraint to adopting new techniques, and a reason to diversify production and income strategies. There is some evidence to suggest that there are equally strong relationships between risk, property rights, and collective action in natural resources management.

Feminization of agriculture and demographic change: Continuing trends of male migration to urban centers or non-agricultural employment have in many cases left women in charge of managing household agricultural production and local natural resources. Research under this theme examines how this and other demographic changes such as aging of the workforce are impacting the content, administration, and allocation of property rights. It further assesses how collective action responds to and is affected by various population dynamics with an intent to investigate pathways which will lead to more equitable and sustainable natural resource use.

Changing market relationships: Commercialization of agriculture in many developing countries has sparked a growing movement toward privatization of property rights. However, depending on how other markets evolve, such trends will have differential effects on the evolution of property institutions governing natural resources. Privatization of rangelands for maintaining commercial livestock, for instance, may not be an optimal solution if livestock owners cannot obtain insurance against drought (CAPRI at www.capri.cgiar.org/).

Research Grants

“In 1998, CAPRI launched a Research Grant component, constituting a major expansion in the services it provides to CGIAR researchers and their partners. By providing funding to support innovative empirical research on property rights and collective action issues, the new component addresses a growing demand among members of the CGIAR and their research partners to better understand the nature of institutions of property rights and collective action and how these institutions shape natural resources management and poverty alleviation.” CAPRI issued its first request for proposals in October 1998 to fund three projects in 1999. Grants of US\$125,000 each were provided to ILRI, ICARDA, and ICRAF (collaborative

project with ILRI). CAPRI invited a second round of proposals in October 1999. The three projects selected in this round were proposed by CIAT, CIMMYT, and ILRI. All awarded grants constitute matching grants of up to US\$125,000. Whereas only researchers based at CGIAR Centers may apply for the grants, the program requires partnership with national research institutions and strongly encourages collaboration with other CGIAR Centers. The main objectives that CAPRI pursues through these grants are to:

- Develop policy-relevant findings on how institutions of property rights and/or collective action can contribute to reducing poverty through sustainable natural resources management;
- Demonstrate the importance of property rights and collective action issues for the CGIAR's mandate;
- Mobilize attention and resources for property rights and collective action research within the CGIAR and among its partner institutions in developing countries;
- Develop and disseminate best practice methodologies and/or conceptual frameworks to study collective action and property rights (Research Grants at www.capri.cgiar.org/grants.asp).

Quality and Impact

I was unable to find CAPRI evaluations in CGIAR documents or on-line, therefore, I cannot give substantive information on the quality and impact of CAPRI's work on collective action and property rights. However, CAPRI's Web site on "Workshops and Other Activities" provides some information about work taking place under its research themes.

- *Property rights, collective action, and technology adoption*: The [Workshop on Property Rights, Collective Action and Technology Adaptation](#) was held November 22-25, 1997 at ICARDA headquarters. It drew together both current theory and recent empirical work on the relation between property rights and incentives to invest in new technologies, and the role of collective action in sustainable resource management practices. It highlighted recent work on this topic at CGIAR Centers and national research institutes. Seven CGIAR Centers and four regional or national institutes presented papers. A new edited book containing the complete proceedings is forthcoming. The Web site has links to 11 related papers.
- *Accommodating multiple uses and multiple users of a resource*: In June 1996, CAPRI sponsored a panel at the meetings of the International Association for the Study of Common Property meetings in Berkeley, California. This panel explored the nature of institutions which have the capacity to accommodate different and potentially competing categories of users of resources embodying different functions. The proceedings have been published as an [IFPRI EPTD Workshop Summary Paper](#) entitled, *Multiple Functions of Common Property Regimes*. On March 13-16, 2000, CAPRI held a Technical Workshop on Watershed Management Institutions hosted by CIAT, in order to foster more productive research on the institutions that affect watershed management. Twenty researchers from CGIAR Centers and other institutions attended the workshop. As a "technical workshop," the purpose of the forum was to explore tools and methodologies that can contribute to more effective

- research. Specifically, this workshop brought together biophysical and social scientists to jointly assess approaches that are derived from different disciplines in order to advance a more holistic appreciation of watershed issues. CAPRI has published Working Paper 8 summarizing the workshop. The Web site also has links to five papers that served as background for the workshop presentations and have been published as CAPRI working papers.
- *Structuring the devolution of natural resources management to local users: A policy workshop, Collective Action, Property Rights, and Devolution of Natural Resources Management*, was held June 21-25 1999 in the Philippines. It was co-sponsored by the Food and Agriculture Development Centre (ZEL) of German Foundation for International Development (DSE) and brought together CAPRI researchers, practitioners, and policymakers to develop strategies for effective devolution of natural resources. An executive summary of the workshop, further background, the full program, and the single chapters of the conference proceedings are available from the Web site. The conference proceedings have been published by DSE. The Web site has links to five related papers. In addition, a panel at the June 1998 meeting of the International Association for the Study of Common Property (IASCP) brought together findings from recent studies by SP-CAPRI members and provided a first step toward establishing identifying principles which cut across resources and regions. The Web site has links to four related papers that were presented.
 - *Environmental risk*: The international conference on Policy and Institutional Options for the Management of Rangelands in Dry Areas was held with the objective of contributing to the development of strategies for sustainable rangeland production and livelihoods of pastoral communities. Contributing institutions included CAPRI, ICARDA, and ILRI. The workshop convened policy makers and researchers to explore issues concerning property rights, collective action and the management of rangelands in dry areas in African and West Asian countries. The program included presentations of sponsored research output (which involved policymakers as discussants), a field trip, and working groups. The Web site listed 11 papers that were presented and are currently undergoing revision for publication as CAPRI Working Papers. Additionally, a joint ILRI/IFPRI/University of Göttingen project on “Property Rights, Risk, and Sustainable Livestock Development in Sub-Saharan Africa” is examining the link between random shocks imposed by the environment and the structure of property regimes and collective action forums. A link to International Symposium on “Property Rights, Risk, and Livestock Development,” is also available on the Web site.
 - *Feminization of agriculture*: From September 1995 to March 1996, IFPRI hosted an e-mail conference on Gender and Property Rights which explored issues surrounding the impact of various property regimes on the status and welfare of women in different regions of the world. The conference, cosponsored by the CGIAR Gender Program and USAID/G/WID, involved over 170 people in 27 countries. A synthesis paper, “*Gender, Property Rights and Natural Resources*,” is available as an IFPRI FCND Discussion Paper. This and all of the papers from the e-mail conference are published in the August 1997 issue of *World Development* (volume 25, number 8). A Web link is also available to a related paper, exploring implications of the shift from communal to individualized tenure on the distribution of land and schooling between

sons and daughters in matrilineal societies (Workshops and Other Activities at www.capri.cgiar.org/status.asp).

Resources Consulted

Web Sites

CAPRI. CAPRI's Main Web Page at www.capri.cgiar.org.

CAPRI. Goals and Objectives of CAPRI at www.capri.cgiar.org/goals.asp.

CAPRI. Priority Research Themes at www.capri.cgiar.org.

CAPRI. Research Grants at www.capri.cgiar.org/grants.asp.

CAPRI. Workshops and Other Activities at www.capri.cgiar.org/status.asp.

CAPRI summary prepared by Joy Learman, Cornell University.

3. CIAT — International Center for Tropical Agriculture

Main Web page: http://www.ciat.cgiar.org/inicio_in.htm

Stated aims

The stated aim or mission of CIAT is “to reduce hunger and poverty in the tropics through collaborative research that improves agricultural productivity and natural resources management.”

Activities

At CIAT there is a focus on reducing poverty and environmental degradation under the themes of:

- crop improvement,
- conservation, study and use of biological diversity,
- pest and disease management,
- soil quality and production systems, and
- land management.

The main outputs of the Center fall under three categories:

- improved seeds,
- methods, and
- information.

Research as it relates to natural resources management is organized largely on the basis of three target agro-ecosystems:

- hillsides,

- forest margins, and
- savannas.

CIAT also coordinates three System-wide Programs:

- Ecoregional Program for Tropical Latin America,
- Program on Participatory Research and Gender Analysis for Technology,
- Development and Institutional Innovation (PRGA), and
- Soil, Water, and Nutrient Management (SWNM) Program.

The PRGA (Participatory Research and Gender Analysis) program is convened by CIAT under the sponsorship of the CGIAR and cosponsored by CIMMYT, ICARDA, and IRRI. This program “develops and promotes methods and organizational approaches for gender-sensitive participatory research on plant breeding and on the management of crops and natural resources.”

One of the main project focuses is in the area of Participatory Research Approaches — one of the main objectives of this project is methods for participatory plant breeding and research on natural resources management.

Projects that include an NRM component encompass:

- IPM,
- reduction of soil degradation,
- sustainable systems for smallholders, and
- community management of hillside resources.

Quality

An external review of the CGIAR System Program on Participatory Research and Gender Analysis contained a short section on NRM (p 21). The authors found that the NRM component of the PRGA program was not yet well developed (in 2000) and needed to be focused. Work had been primarily through a small grants program. The review of System-wide Programs with an ecoregional approach (TAC Secretariat, 2000) found that there was considerable evidence in CIAT of strong links between NRM research and research on productivity enhancement, especially that on germplasm improvement.

Impact

Pachico et al (2000) point out that NRM research cannot easily be separated from commodity research — something that they do not see as problematic since most important NRM decisions are made in the context of agricultural production. For this reason they feel that a holistic approach to impact assessment is essential. They give several examples to illustrate the point, concluding that traditional crop research has important environmental implications that are difficult to establish *ex ante*. They also point out that recommendations based on narrow environmental protection considerations might be rejected by farmers in favour of a

second-best practice whereas a less-narrowly defined NRM practice may have had greater potential for adoption.

The CIAT overview pages specifically mention two outputs as having significant impact on NRM issues: CIAT contributed to finding natural enemies for the cassava mealybug and cassava green mite which were causing serious problems in sub-Saharan Africa; also, it contributed to reducing pesticide use on beans in Colombia through work on an IPM system for bean production; components of the system seem to be adopted fairly well.

Resources Consulted

Documents

Pachico, D., J. Ashby, A. Farrow, S. Fujisaka, N. Johnson and M. Winograd. 1998. Case Study and Empirical Evidence for Assessing Natural Resources Management Research: The Experience of CIAT. Paper presented at Workshop on Assessing the Impacts in Natural Resources Management Research, April 27-29, 1998, ICRAF House, Nairobi, Kenya.

Nelson, M. and M. Maredia. 1999. Environmental Impacts of the CGIAR: An Initial Assessment. Paper prepared for Reducing Poverty through Cutting Edge Science, International Centers Week 1999, October 25-29, 1999, Washington, D.C.

Pachico, D. 2000. Approaches and Challenges in Impact Assessment of Agricultural and Natural Resources Management Research. Paper prepared for the Impact Assessment Workshop organised by the Standing Panel on Impact Assessment (SPIA) of the Technical Advisory Committee (TAC) of the CGIAR, 3-5 May, 2000, FAO, Rome.

External review at: http://www.prgaprogram.org/prga/download/External_Review.pdf
TAC/Standing Panel on Impact Assessment — CIAT contribution to a May/2000 conference in Rome (<http://www.cgiar.org/tac/spia0500/ciat.pdf>) saved as “ciat.pdf.”

TAC Secretariat. 2000. Review of System-wide Programmes with an Ecoregional Approach. June 2000.

Web Sites

CIAT main Web page at http://www.ciat.cgiar.org/inicio_in.htm

Overview of CIAT work at http://www.ciat.cgiar.org/overview/bar_mission.htm

Information on project areas at http://www.ciat.cgiar.org/projects/bar_sn2.htm

The PRGA (Participatory Research and Gender Analysis) at <http://www.prgaprogram.org/>
PRGA and Natural Resources Management (under construction) at <http://www.prgaprogram.org/prga/natural.htm>

CIAT summary prepared by Douglas R. Brown, Cornell University.

4. CIFOR — Center for International Forestry Research

Main Web page: <http://www.cifor.cgiar.org/>

Stated Aims

CIFOR's stated aim or mission is "to contribute to the sustained well being of people in developing countries, particularly in the tropics, through collaborative strategic and applied research and related activities in forest systems and forestry, and by promoting the transfer of appropriate new technologies and the adoption of new methods of social organization, for national development" (CIFOR, 2001b).

CIFOR's principle objectives are:

- To improve the scientific basis for ensuring the balanced management of forests and forest lands.
- To develop policies and technologies for sustainable use and management of forest goods and services.
- To strengthen national capacities for research to support the development of policies and technologies for the optimal use of forests and forest lands.

CIFOR sees itself as unique due to (see

<http://www.cifor.cgiar.org/aboutus/Strategy/Different.htm>):

- Its global, holistic vision on forests and their changing relations to society.
- Its focus on international public goods, rather than locality specific or product specific research.
- Its commitment to working in collaborative partnerships and enhancing the capacity of national institutions and researchers.

Activities

CIFOR has six research programmes (<http://www.cifor.cgiar.org/research/>):

- Underlying Causes of Deforestation, Forest Degradation, and Changes in Human Welfare (UCD) — to improve understanding of the effects of economic crisis, structural adjustment, population and migration, the impact of technological change in agriculture, decentralization, and forest policies on forest condition and the livelihoods of people in forested areas.
- Sustainable Forest Management (SFM) — to develop, evaluate and disseminate harvesting and silvicultural management practices to sustain both the production of commodities and the environmental values yielded by natural tropical forests (including degraded forests and secondary forests which have re-grown on forested lands originally cleared for agriculture). Such improved resource management will, in turn, contribute to the alleviation of poverty, the conservation of biodiversity, and increased food security.
- Local People, Devolution and Adaptive Co-Management (ACM) — to achieve more sustainable and equitable management of forest resources and human well-being in a multi-stakeholder environment through the development and identification of a set of models, institutional arrangements, methods, tools and strategies to empower local

communities. It also aims to understand under what conditions such innovations can lead to real improvements in human well-being and forest quality.

- Plantation Forestry on Degraded or Low Potential Sites (PLT) — To facilitate greater transparency, fairer power balance and an increased role for the people whose livelihood depends on forests, resulting in a more sustainable and effective use of plantations and trees outside forests, and thus a greater contribution to well-being and maintenance of biological diversity.
- Biodiversity and Managed Forests (BIO) — to develop tools to assess/manage biodiversity and the analysis of important direct causes/mechanisms of forest biological diversity loss. Results will then be fed into the global dialogue on conservation and sustainable use of forest biological diversity in an attempt to influence the global agenda
(<http://www.cifor.cgiar.org/research/conservation/index.htm>).
- Forest Products and People (FPP) — to improve the welfare of communities where the subsistence value of forests and forest products to poor communities is recognised and protected; the commercial potential of forest products is exploited in a sustainable and equitable way, and the exploitation of forest resources leads to long-term improvements in living standards
(<http://www.cifor.cgiar.org/research/productsandpeople/>).

CIFOR also has a program on Fire Research (<http://www.cifor.cgiar.org/fire-project/index.htm>) and a large research forest (<http://www.cifor.cgiar.org/research/bulungan.htm>).

In the area policy debate about the impact on forests and forest health, CIFOR has contributed a number of significant publications including (see <http://www.cifor.cgiar.org/research/causes/>):

- An article on the causes of deforestation in the World Bank Research Observer,
- A chapter on policies for reducing deforestation in a World Bank anthology on agriculture and the environment,
- A multi-author book and several articles on the forest impact of technological change in agriculture.

Another key aspect of the work it is doing in the area of NRM is the development of criteria and indicators, which are objective, cost-effective and relevant, for assessing aspects of sustainable forest management in planted forests, with special concern to social and environmental impacts (<http://www.cifor.cgiar.org/research/plantation/>).

CIFOR has made a significant contribution to the discussion on biodiversity through a long list of publications in both the French and English scientific literature and in working papers that are available on line at (<http://www.cifor.cgiar.org/research/conservation/index.htm>).

Quality

The first external review of CIFOR came to the conclusion that CIFOR scientists are doing pioneering research and have produced many high quality publications (TAC Secretariat, 1998).

In response to recommendations about changes in management structure, CIFOR notes that the transactions costs which come with being part of the CGIAR and having thirty donors, many of whom have independent reporting requirements, are very high (TAC Secretariat, 1998).

CIFOR seemed to embody ecoregional principles more completely than that of many other CGIAR Centers. For example, CIFOR deals holistically with one of the world's most extensive natural resources, tropical forests, which are also a major source of environmental services, particularly water resources (TAC Secretariat, 2000).

Impact

Given that CIFOR has only been in operation since 1992 (only 5 years at the time of the review), only some of CIFOR's activities can be expected to have already had direct impacts on the well-being of people or on environmental protection (TAC Secretariat, 1998). However, CIFOR also needs to develop its impact assessment methodology, despite the long-term nature of CIFOR's research and impact pathways (TAC Secretariat, 1998). It seems apparent from Web documents that CIFOR has made considerable progress in all these areas since 1998.

Definition of Poverty

The external review (TAC Secretariat, 1998) noted that CIFOR uses an expanded definition of poverty — to include not only poverty alleviation, but also poverty prevention both for future generations and for those who are not presently poor. Many of CIFOR's activities relate implicitly and in some cases explicitly to the objective of increasing the well-being of currently poor people. Its work related to forest-based communities, tenure, employment creation, plantation management, NTFPs, etc. deal directly or indirectly with this theme. At the same time, CIFOR's research on sustainable forest management — protection and enhancement of the forest resource base on which currently *non*-poor populations also depend — is essential to avoid future impoverishment of existing non-poor or non-marginal populations. In a similar vein, research of CIFOR is focused on biodiversity conservation (environmental protection) and some global change issues related to avoiding conditions that will lead to poverty for future generations. CIFOR also sees opportunities for forests to contribute to alleviation of the negative impacts resulting from other sectors and activities, e.g., through forest sequestration of gases released by industrial activities. This broader interpretation of poverty issues provides a logical, and indeed necessary, link between CIFOR's mission and the goals of the CGIAR related to poverty alleviation plus natural resources and environmental protection and enhancement.

Discussion of IPGs

TAC Secretariat (1998) noted that IPGs are defined by the CGIAR as research that is important to at least several countries that would not be undertaken by any one country because the benefits to that country alone would not justify the costs (or because any one country does not have the incentive to undertake it). “The Panel found that some CIFOR researchers are frustrated with the IPG criterion because they view it as being associated with shallowness of research at the specific site level. The Panel wishes to point out that this is (or should be) a false assumption.

“The IPG nature of CIFOR’s work should not make it incompatible with in-depth research on particular sites. In fact, significant generalizations based upon a profound understanding of the nature of crucial variables at multiple sites is what CIFOR projects should, and in most cases do, seek to achieve. A misunderstanding of this basic concept will, axiomatically, lead to research that is neither cost-effective nor IPG related. The need for cost-effectiveness of CIFOR research must not deter in-depth research. When expensive senior staff cannot engage in time-consuming field activities, they should recruit and supervise students in the field and develop mutually beneficial links with other appropriate, lower cost and locality focused partners who can carry out the in-depth field work in the overall IPG context of the research” (TAC Secretariat, 1998).

“The implication of the above is that the IPG criterion is a necessary one, but not sufficient alone to justify inclusion of a project in the CIFOR portfolio. In addition, the research has to be designed in such a fashion that (a) a number of countries actually do benefit from the research because it relates to their priorities; (b) some linkage can be drawn in impact assessment between the research and poverty alleviation, food security, and environmental protection; and (c) site specific research as part of a broader programme is not shallow and superficial. CIFOR should be the most cost-effective producer of the research. These criteria are especially relevant to any Center that wants to be a “centre without walls” (TAC Secretariat, 1998).

“In this regard, the Panel is satisfied that CIFOR does consider the IPG criterion in planning its research but, beyond that, it should strive to maximize the realization of potential spillovers from its work in order to reduce further its costs per unit of impact” (TAC Secretariat, 1998).

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CIFOR summary prepared by Douglas R. Brown, Cornell University.

5. CIMMYT-International Maize and Wheat Improvement Center

Main Web Page: <http://www.cimmyt.org>

Stated Aims

“CIMMYT was established in 1966 with a mandate to promote and carry out, nationally and internationally, programmes to improve in all its aspects maize and wheat production...through research, the distribution of germplasm, training, scientific, and technical meetings, and information.” During the 1980s CIMMYT began devoting more attention to “the importance of increasing agricultural productivity for poverty alleviation, protecting natural resources, and collaboration with national research systems. CIMMYT’s current mission statement is to help alleviate poverty by increasing the profitability, productivity, and sustainability of maize and wheat farming systems” (Fourth External Review, p. 1).

Activities

- Provide a wide array of improved maize for favored and marginal environments
- Conduct strategic research on crop and natural resources management aimed at improving productivity while sustaining the natural resource base of maize-based cropping systems
- Generate knowledge and devise techniques that can increase research effectiveness
- Provide training in maize breeding and crop management research
- Consult with scientists upon request on the planning and execution of their research programs
- Maintain extensive collections of maize genetic resources for use by breeders worldwide and assist national programs with in situ monitoring of maize’s wild relatives, teosinte and tripsacum
(<http://www.org/research/maize/revisar/htm/mfsas.htm>)

The Center's main activities fall into the following programs:

- Maize Program
- Wheat Program
- Natural Resources
- Applied Biotechnology Center
- Economic Program

The Natural Resources Program seeks to increase agricultural production while reducing threats to the environment. It works with CIMMYT to provide “more food from less land, of better grain from fewer chemicals, of greater stability under less predictable growing conditions” for the world's growing population. The NRG's main topics of interest are conservation tillage, residue management, green manure cover crops, and degradation of soils

(<http://www.cimmyt.org/Research/nrg/map/about/BROCHURE97nrg/htm/BROCHURE97nrg/htm>).

The Natural Resources Program works to:

- Sustain yield increases on productive lands
 - Avoid the use of easily degraded land
 - Solve problems of resource degradation
 - Help achieve sustainable improvements in the productivity of maize and wheat
 - Facilitate integration of research within CIMMYT
 - Support other researchers and scientists through NRG skills in effective approaches to research on sustainable systems; spatially referenced databases and GIS; crop and soil modeling; participatory experimentation; human resource development
- (<http://www.cimmyt.org/Research/nrg/map/about/BROCHURE97nrg/htm/BROCHURE97nrg/htm>)

The Natural Resources Group's three main functions are:

- Synthesizing experience from research on sustainable systems.
 - Conducting strategic research on processes and prototypes for sustainable systems.
 - Backstopping CIMMYT scientists as they address productivity and sustainability issues. This includes NRG's focus on definitions of mega-environments, analysis of drought patterns to help establish breeding priorities, site similarity studies, crop distribution studies, soil taxonomy and provision of information on the relationship between agricultural land area and water availability.
- (<http://www.cimmyt.org/Research/nrg/map/about/BROCHURE97nrg/htm/BROCHURE97nrg/htm>)

The Natural Resources Group promotes the exchange of ideas and research findings through interdisciplinary collaboration within CIMMYT and collaboration with national researchers, farmers, and people from non-governmental organizations. SoilFertNet is an example of their

collaborative work. In SoilFertNet, CIMMYT links groups concerned with declining soil fertility in Malawi and Zimbabwe with similar groups in Kenya, Mozambique, and Zambia.

CIMMYT has also participated in a Latin American Regional Consultation at CIAT in October 1997 to discuss with NGOs, IARCs, universities, and NARIS to discuss the future research challenges facing Latin American peasant agriculture. Among the topics discussed was the degradation of its resource base and sustainability issues.

Quality

The panel members of the Fourth External Programme and Management Review gave CIMMYT a very favorable rating. They stated that “the Centre conducts high-quality science and has an impressive record of achievements as well as impact on the daily livelihood of hundreds of millions of rural and urban poor. CIMMYT is well managed, has strong leadership, and is a flagship Center of the CGIAR System” (p. xxxii). They even went so far as to call CIMMYT “a jewel in the CGIAR crown. The panel suggests CIMMYT should move towards more formal priority-setting and “TAC strongly supports the Centre’s transition from a programme- to a project-based approach to management... The Committee particularly looks forward to seeing the synergies resulting through the projects from closer collaboration within CIMMYT in areas” including natural resources management research also wants to promote specialist training in that area (Draft Report of the Seventy-Fourth Meeting of the Technical Advisory Committee, p. 5).

Furthermore, the review stated that “the Natural Resources Group is small in number and of recent origin. Inevitably, questions arise as to whether it has critical mass. The recommendations of the Panel with respect to this Group are designed to encourage interaction within and outside CIMMYT with scientists of related disciplines, working on the unifying research theme of conservation tillage and related soil and crop management practices” (p. xxxiii). In particular, they recommended “that the Natural Resources Group make conservation tillage and related soil and crop management practices the primary research focus of the NRG, with the goal of quantifying the effects of conservation tillage on water and nutrient use efficiency, soil quality, and productivity of maize- and wheat-based systems” (pp. xv-xvi). CIMMYT did not oppose this recommendation and stated that these are already a central focus of the organization. The panel also recommended that “the Natural Resources Group establish a critical mass of scientific expertise in Frontier Project 7 (*Learning to More Effectively Confront Problems of Resource Degradation in Maize and Wheat Systems*) to improve research efficiency and the complementation of strategic and applied research on conservation tillage systems” (p. xvi). CIMMYT agreed to fortify maize and wheat program inputs in the Frontier Project 7. It also proposed to continue utilizing consultants and working collaboratively with other projects in accomplishing the work of the project.

“The [TAC] Committee [also noted] the Panel’s observation that CIMMYT serves many audiences (e.g., NARES, host country, the scientific community, financial partners and the CGIAR System)” and encouraged CIMMYT to “consider stronger NARS as full partners in the implementation of its activities, particularly in areas which NARS have a comparative advantage” (Fourth External Programme and Management Review of CIMMYT, p. 3).

An Interim External Review conducted in 1993 had recommended that CIMMYT give more attention to natural resource research and create a specific group to work in this area. Both of these recommendations have been fulfilled. Furthermore, “the establishment of the NRG, recent changes in IRS staffing, and CIMMYT’s new project structure demonstrate an increased commitment to interdisciplinary research on natural resource protection and the long-term sustainability of maize- and wheat-based cropping systems... Given the relatively small size, success of NRG programmes will depend on tightly focused objectives and outputs, strategic research capabilities in the regional projects, and strong linkages with, and increased commitment of, scientific resources from the Wheat, Maize, and Economics Programmes” (Fourth External Programme and Management Review, p. 30).

The Panel recommended the strengthen of CIMMYT’s work on natural resources management and “stressed the need to generate increased synergies between CIMMYT’s biotechnology, economics, and natural resources management research and its maize and wheat projects” (Mobilizing Science for Global Food Security, p. 44).

Impact

The Director General states the following as some of CIMMYT’s lasting impacts:

- Bred wheat and maize varieties
- Developed agronomic practices that have secured larger, more reliable harvests, raised incomes and helped sustain natural resources
- Developed research initiatives whose relevance and vitality reflect CIMMYT’s extensive field experience and links with advanced research institutes
- Strengthen scientific capacity in developing countries
- Contributions to scientific knowledge and human development by researchers (http://www.cimmyt.org/whatisimmyt/ar00_2001/message_dg.htm)

CIMMYT offers the following as its strongest impact:

- A 1990 study by CIMMYT economists with help from national systems found that maize seed sown on at least 13.2 million hectares in developing countries contains contributions from CIMMYT research. This includes more than 500 maize varieties and hybrids released since 1966, and use of the Program’s experimental varieties and hybrids is on the increase.
- According to CIMMYT economists, the Maize Program’s work adds an estimated 7 percent to the developing world’s maize harvest. The 15 million-ton increase is enough to supply the maize requirement for 270 million persons each year (<http://www.org/research/maize/revisar/htm/mfsas.htm>)

One of CIMMYT’s greatest accomplishments has been its work on germplasm x environment, which has put crop varieties in the hands of poor farmers. “CIMMYT-related wheat varieties cover almost 90 percent of the spring bread wheat area in the developing world — almost 53 million hectares — and account for a significant proportion of production in the North. These higher yielding varieties possess diverse pedigrees, multiple gene resistance to diseases and are tolerant to heat, drought and soil acidity.” The human impact

was summarized in Paul Raeburn's 1995 book, *The Last Harvest*: "the specific use of the dwarfing gene from Norin 10 has affected the food supply of one-quarter of the people of the world-one billion plus. And for over 100 million it has been the margin of survival. A single gene from a seemingly unimportant variety of wheat has saved 100 million lives." (http://www.cimmyt.org/whatisimmyt/ar00_2001/message_dg.htm, Quote from Garrison Wilkes, Dept. of Biology, University of Massachusetts)

Finally, "CIMMYT has made a tremendous impact on the production of wheat and maize throughout the developing world. More than 70 percent of the wheat area in developing countries, excluding China, is planted with CIMMYT-derived material, covering more than 50 million ha. Of the area planted to improve maize varieties in developing countries, 55 percent or more than 14 million ha of non-temperate maize is now sown to CIMMYT-related cultivars. In China, CIMMYT-related wheat varieties are grown on 10 million ha and CIMMYT-related maize varieties on 1 million ha. CIMMYT-related wheat and maize varieties are worth over US\$3 billion in extra grain production each year in the developing world."

"In the 1980's and early 1990's, CIMMYT economists and agronomists were leaders in developing a conceptual framework for conducting farming systems research and in the development of NARES capacity to conduct this type of research. Outputs have been of high quality: Natural resource constraints to sustained productivity in maize and wheat systems were identified using diagnostic survey methods, and the conditions that favor farmer adoption or rejection of technologies that preserve or enhance natural resources were documented. In recent years, CIMMYT has greatly reduced its efforts in farming systems research although the NRG plans to continue work on farmer participatory research approaches" (Fourth External Programme and Management Review, p. 30).

"Outputs from CIMMYT's programmes have had a positive impact on conservation of natural resources despite the lack of a formal natural resource research programme before September 1996. Much of this impact is the result of indirect effects of germplasm improvement. Increased genetic resistance of wheat and maize germplasm to diseases has contributed to reduced need for agrochemicals that are potentially damaging to the environment. Greater yield and yield stability of wheat and maize germplasm in combination with appropriate production practices have spared millions of hectares of non-agricultural land from cultivation, land that is either marginal or presently in forests, grasslands, and wetlands.

"CIMMYT's applied research on natural resources management includes a portfolio of ventures on conservation tillage, soil fertility, green manure cover crops and improved fallow systems, and crop rotation. About two-thirds of this total effort, including both CIMMYT's own research and its collaboration with NARES in regional projects, has focused on the development of conservation tillage, residue management, and related husbandry practice that reduce soil degradation and increase productivity. Resource-conserving minimum tillage (and now its work on zero tillage), residue management, and sowing methods have been identified for hillside maize" in various areas. "In fact, conservation tillage, residue management and related agronomic practices provide a unifying theme for much of CIMMYT's natural resource and sustainability research on wheat- and maize-based cropping systems. Moreover, conservation tillage systems can provide an entry point for addressing a range of other related natural resource constraints such as soil fertility and quality, water and

nutrient use efficiency, and greater cropping system diversity (Fourth External Programme and Management Review, p. 29).

CIMMYT's agronomic research on conservation tillage has documented consistent benefits in maize and wheat cropping systems in a wide range of agro-ecological zones and ecoregions. "The causes and effects that link system performance to soil properties and crop response have received less attention, as have the longer-term issues of soil quality and yield stability. At several of the regional projects and in the Rice-Wheat System-wide Programme, however, longer-term research experiments and farm monitoring studies have been established and initial results are expected in the next few years" (Fourth External Programme and Management Review, p. 29).

"Although NRG staff contribute to a wide range of MTP Projects, the Frontier Project 7, *Learning to More Effectively Confront Problems of Resource Degradation in Maize and Wheat Systems*, is the only project under direct supervision of the NRG." Outputs of the project include; "a framework for research on NRM, acceptable to a wide range of stakeholders, and featuring improved research methods; dissemination of productivity-enhancing, resource-conserving sustainable maize and wheat systems; and documentation of regional consequences of resource degradation and the effect of technical change on resource quality and system productivity" (Fourth External Programme and Management Review, p. 30).

In conclusion, the Panel recommended that "conservation tillage and related soil and crop management practices should be the primary research focus of the NRG, with the goal of quantifying the effects of conservation tillage on water and nutrient use efficiency, soil quality, and productivity of maize-and wheat-based systems." The Panel also encouraged CIMMYT to balance short-, medium-, and long-term goals; develop a more specific research agenda and detailed work plan and timeframe for accomplishing meaningful research outputs; make strategic decisions based on the balance among research, service and training activities; and allocate a larger portion of CIMMYT's operating research budget to natural resources management concerns (Fourth External Programme and Management Review, pp. 30-34).

Resources Consulted

Documents

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CGIAR. 1997. Report of the NGO Committee to the CGIAR, International Centers Week. Paper prepared for discussion during International Centers Week 1997, October 24-25, 2000, Washington, D.C.

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CIMMYT. About Natural Resources Group at

<http://www.cimmyt.org/Research/nrg/map/about/BROCHURE97nrg/htm/BROCHURE97nrg/htm>

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CIMMYT. A Message from the Director General at

http://www.cimmyt.org/whatisimmyt/ar00_2001/message_dg.htm

CIMMYT summary prepared by Joy Learman, Cornell University.

6. CIP — International Potato Centre

Main Web page: <http://www.cipotato.org/>

Stated Aims

The stated aim of the International Potato Center (known worldwide by its Spanish acronym, CIP) is to reduce poverty and achieve food security on a sustained basis in developing countries through scientific research and related activities on potato, sweet potato, other root and tuber crops, and on the improved management of natural resources in the Andes and other mountain areas (<http://www.cipotato.org/Org/mission.htm>).

The Center's research mandate includes:

- potato,
- sweet potato,
- other Andean root and tuber crops, and
- natural resources management.

The 1995 external review (TAC Secretariat, 1995) noted that CIP's three main goals, around which the research programs were designed, were:

- to increase agricultural productivity and efficiency in order to produce more products of better quality at lower costs, to raise farmers' income and increase consumers' welfare (efficiency);
- to protect the natural resource base (sustainability); and
- to improve the well-being of the poorest populations of the world more than the better-off populations (equity).

Activities

Research to fulfill this mandate involves ten projects and three global and regional partnerships (<http://www.cipotato.org/Projects/portfolio.htm>). The projects are:

- Integrated management of late blight

- Uptake and utilization systems for improved potato production technologies in specific agro-ecosystems
- True potato seed (TPS)
- Integrated pest management for root and tuber crops
- Sweet potato improvement and virus control
- Post-harvest quality, nutrition and market impact of root and tubers
- Biodiversity and genetic resources of root and tuber
- Integrated natural resources management in mountain agro-ecosystems (<http://www.cipotato.org/Projects/NRM.htm>) — this project aims to contribute to further more productive and sustainable natural resources management in selected mountain areas by enhancing the capability of local and national researchers and authorities to analyze their problems, search for windows of opportunities, and to ex-ante assess the tradeoffs of interventions. The research tools and methodologies, management practices, and policy recommendations for alleviating poverty and making mountain production systems more sustainable are tested and made accessible to NARS and other partners.
- Gene discovery, evaluation and mobilization for crop improvement.
- Global commodity analysis and impact assessment for potato and sweet potato.

The partnerships are:

- SIUPA (Strategic Initiative on Urban and Peri-Urban Agriculture)
- GILB (Global Initiative on Late Blight)
- CONDESAN (Consortium for the Sustainable Development of the Andean Region) <http://www.condesan.org/> — focuses on the three interlocking issues of sustainable natural resources management, increasing rural incomes, and social equity. The objective of the Consortium is to create regional capacity to conduct and expand our understanding about natural resources management, the development of environmentally sound production systems and policies that enhance life in Andes. Key aspects are the development of a watershed analysis methodology and irrigation systems analysis methods to estimate social and biophysical externalities associated with alternative land use patterns.

Quality

In the 1995 review (TAC Secretariat, 1995), the Review Panel could not reach a consensus on the nature and amount of natural resources management research in which CIP should become involved. Part of the reason for this is that the amount of changes and new operational models being considered in the CGIAR and in TAC are too numerous to be able to choose wisely between the options that might be available to CIP. The Panel decided this matter was beyond its ability to assess and judge with the time and information available. The Panel therefore considers it necessary for the Board to continue to examine the alternatives that CIP faces, and work out how CIP should approach natural resources management research and what kind of Center CIP should be in the future. It should be possible then to make changes in the operational mandate.

The TAC Secretariat (1995) notes that CIP has the potential to increase its effectiveness by focusing its resources increasingly on those roles where it has the greatest special advantage as an IARC: strategic and applied research, which most individual developing country NARS cannot afford to undertake. However, they also note that while CIP itself does foresee some movement in this direction in its germplasm based activities, it is more actively pursuing a strategic research role in natural resources management of the Andes region.

Impact

The 1995 external review (TAC Secretariat, 1995) noted that 1989 External Review found limited evidence of direct production impact at the farmer level. Subsequently, CIP undertook a set of nine technology impact case studies to illustrate how improved technology from CIP had benefited farmers. The analysis showed specific improvements in variety, seed production, and IPM, with internal rates of return of between 27 percent and 106 percent. The review (TAC Secretariat, 1995) also noted that CIP has been very effective in collaboration with many individual countries where CIP staff worked with the national potato and sweet potato teams, directly or through regional research networks, increasing their competence and confidence and generally improving their institutional strength. Meanwhile CIP has made great strides in improving its training courses by integrating them into each main program, and by introducing a wide variety of programmed learning procedures using computers and video equipment. However, the TAC Secretariat (1995) also recommended that CIP develop a strategy for continuously monitoring and evaluating the performance of its research outputs in terms of their impact — both positive and negative — on welfare, gender, and the environment.

There is also the challenge of how to allocate research funds so that their marginal impact per dollar spent in each project is equal — a principle that is complicated because of the existence of different kinds of projects (e.g. potato breeding versus natural resources management in the high Andes), and because resources to carry out the work are generally not fungible (some of the funding is from special earmarked projects) (TAC Secretariat, 1995). This appears to have limited the impact of CIP in the area of NRM research.

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CIP summary prepared by Doug Brown, Cornell University.

7. ICARDA — International Center for Agricultural Research in the Dry Areas

Main Web page: <http://www.icarda.cgiar.org/>

Stated Aims

The stated aim of ICARDA is to improve the welfare of people and alleviate poverty through research and training in dry areas of the developing world, by increasing the production, productivity, and nutritional quality of food, while preserving and enhancing the natural resource base. ICARDA's research mandate is such that it:

- serves the entire developing world for the improvement of
 - barley,
 - lentil, and
 - faba bean; and
- serves dry-area developing countries for the
 - on-farm management of water,
 - improvement of nutrition and productivity of small ruminants (sheep and goats), and
 - rehabilitation and management of rangelands.
- serves the Central and West Asia and North Africa (CWANA) region, with responsibility for
 - improvement of durum and bread wheats, chickpea, pasture and forage legumes and farming systems, and
 - protection and enhancement of the natural resource base of water, land, and biodiversity.

Activities

ICARDA's research philosophy is such that it seeks to improve and integrate the management of soil, water, nutrients, plants, and animals in ways that optimize sustainable agricultural production. Within the management of natural resources, emphasis on on-farm water-use efficiency is an important component. ICARDA has 19 multidisciplinary core projects that cut across the following five research themes:

- Germplasm Enhancement
- Production Systems Management — the overall objective is the development of appropriate arable systems, which make efficient and conservative use of natural resources and externally-derived inputs, for sustainable production of field crops
- Natural Resources Management — involves the following projects:
 - Water Resource Conservation and Management for Agricultural Production in Dry Areas
 - Land Management and Soil Conservation to Sustain the Agricultural Productive Capacity of Dry Areas

- Agrobiodiversity Collection and Conservation for Sustainable Production
- Agroecological Characterization for Agricultural Research, Crop Management and Development Planning
- Socioeconomic and Policy — of the three projects under this theme, one is specifically related to NRM: Socioeconomics of Natural Resources Management in Dry Areas.
- Institutional Strengthening — focuses entirely on the improvement and strengthening of national seed-production systems.

ICARDA co-ordinates several international and regional research networks, including those related to NRM issues:

- Dryland Resource Management Research Network — promotes and supports interaction between countries conducting case studies of dryland resource management under the auspices of the Dryland Resource Management Project.
- Enhancing Productivity and Sustainability of Crop Production in the Mediterranean Highlands — improvement of crop production in the highland areas of the Mediterranean region through the use of improved, disease resistant, and drought- and cold-tolerant varieties in appropriate crop sequences, through enhanced collaboration between countries of the Mediterranean region with large highland areas of similar ecological conditions.

Quality

The EPMP found that scientific integration across the different projects and disciplines within the Natural Resources Management Program still has to be achieved. The work is becoming increasingly system oriented and participatory, but remains mostly applied research. Only a small proportion of its individual research projects could be classified as strategic, and a few as holistic (TAC Secretariat, 2000).

While ICARDA has greatly increased its work in the area of NRM in the past five years, the Panel recommended that ICARDA, together with appropriate partners, articulate a vision, strategy, and an implementation plan for natural resources management research, drawing on CGIAR and other experiences and centered on Unified Research Sites most appropriate for its emerging poverty alleviation focus (TAC Secretariat, 2000).

TAC Secretariat (2000) notes that ICARDA is in the process of incorporating natural resources management aspects into its research programs and projects. Its goals in integrated natural resources management are to:

- promote greater efficiency, integration and sustainability of production;
- enhance resource quality and quantity; and
- display transparent contributions to poverty alleviation and better food security.

TAC Secretariat (2000) notes also that the focus of future strategic NRM research at ICARDA should include drawing generic lessons from its many applied research projects conducted with NARS in the past.

One of the concerns about ICARDA's work (TAC Secretariat, 2000) is that its resources are spread too thinly across all of the dry areas in the developing world. In addition to this, TAC endorses the Panel's recommendation that ICARDA determine, with its partners, the livelihood strategies of the poor in its region to clarify what research options are most likely to benefit them.

Impact

While ICARDA has achieved much, TAC (TAC Secretariat, 2000) is concerned about the limited impact of the cereal and legume programs that have been reported to date. There is no significant documentation of impact of NRM research. There is a fairly extensive discussion of Natural Resources Management Research paradigms in the TAC Secretariat (2000) report.

Resources Consulted

Documents

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Web Sites

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ICARDA summary prepared by Douglas R. Brown, Cornell University.

8. International Center for Living Aquatic Resources Management (ICLARM)

Main Web page: www.iclarm.cgiar.org

Stated Aims

The World Fish Center is a food and environment research organization that joins forces with farmers, scientists, and policy makers around the world to help the rural poor increase their income, preserve their environment, and improve their lives. ICLARM was organized to conduct, stimulate, and accelerate research on all aspects of fisheries and other living aquatic resources. It is committed to assist in the affordability of food for poor people in developing countries now and in the future. It aims for:

- less poverty
- a healthier, better nourished human family
- reduced pressure on fragile natural resources

- people-centered policies for sustainable development.

(ICLARM's Organizational Statement is at <http://www.iclarm.org/orgsta.htm>)

Its program of work is aimed at resolving critical, technical, and socioeconomic constraints to increased production, improved resource management, and equitable distribution of benefits in developing countries. The Center's work focuses on tropical developing countries in both inland aquatic (mainly ponds and rice floodwaters) and marine (coastal and coral reef) systems. Research is carried out on their dynamics, on investigating alternative management schemes, and on improving the productivity of key species. The work includes cooperative research with institutions in developing countries, and supporting activities in information and training (About Us at <http://www.iclarm.org/objgov.htm>).

Activities

Through research, partnership, capacity building, and policy support, ICLARM aims to improve the production, management, and conservation of aquatic resources such as fish. Its research priorities are to:

- improve productivity of fisheries and aquaculture systems
- protect the aquatic environment
- save aquatic biodiversity
- improve policies for the sustainable development of aquatic resources
- strengthen the capacity of national programs to support sustainable development

(ICLARM's Organizational Statement at <http://www.iclarm.org/orgsta.htm>).

ICLARM's research activities are broken down into the following five programs:

The Biodiversity and Genetic Resources Research Program (BGRRP) pursues research on conservation and sustainable use of biological and genetic diversity. ICLARM has 11 related projects.

The Coastal and Marine Resources Research Program (CMRRP) focuses on developing methods to increase the productivity of species associated with coral reefs. Its location at the Coastal Aquaculture Centre (CAC) in the Solomon Islands enables staff to undertake projects on the conservation and management of inshore marine resources. ICLARM has 16 related projects.

The Freshwater Resources Research Program (FRRP) seeks to improve small farm productivity through the introduction of multiuse waterbodies on farms in Bangladesh, a country with abundant rainfall and a great variety of waterbodies that can be used for aquaculture; Malawi, a semi-arid country in southern Africa dependent upon seasonal rainfall; and the Philippines, where the project seeks to combine aquaculture with forest buffer zone management in the highlands. ICLARM has 14 related projects.

The Policy Research and Impact Assessment Program (PRIAP) searches for innovations and new technologies to augment aquatic production and find better ways to manage the aquatic environment. PRIAP's research continues to support them by examining the policy environment to ensure wider adoption of these technologies to benefit the poorer people in developing countries. ICLARM has 11 related projects.

The Partnerships, Information and Training Program (PITP) assists ICLARM in research and related activities (training / workshops / conferences / information dissemination) carried out in partnership with national institutions and regional and international organizations. The role of this Program is to strengthen existing collaborations and to develop new partnerships with NARS, nongovernmental organizations, regional and international organizations, advanced scientific institutions and the private sector. The Program also has an important role in ensuring the success of ICLARM's mission through the dissemination of the results of its research and by raising public awareness of its mission and activities. Information dissemination is done through publications, library services and public awareness activities (Research and Services at <http://www.iclarm.org/resprg.htm>).

Quality

One way to determine whether or not a group is working effectively is by determining how well they are able to obtain additional funding. During the CGIAR Mid-term Meeting in Nairobi, Kenya May, 1995, six Centers requested an increased budget on the "basis of changes in science and changes or rebalancing in the priorities of development assistance agencies. TAC recommended an increase in funding for three Centers that showed a responsiveness to the priorities indicated in Lucerne" (an earlier Ministerial-Level Meeting). ICLARM was one of the groups recommended at this time for a notable financial increase for its fisheries work (CGIAR Mid-Term Meeting, Nairobi, p. 35).

ICLARM had its first External Program and Management Review in 1992. It resulted in ICLARM's admission into the CGIAR System. One of the 1992 recommendations stated that ICLARM should "reassess its stated goals and objectives to give more emphasis to research and to make them more consistent with those of CGIAR." However, it was also stated that "ICLARM's priorities on natural resources management are also in compliance with CGIAR priority areas identified, as is the ecoregional approach to research..." (Report of the Mid-Term Review, p. 10). Shortly after ICLARM joined CGIAR, it experienced an internal governance crisis, which it seems to have overcome. The mid-term review was designed to "monitor the implementation of the Panel's numerous program and management recommendations [of 1992], and more particularly the progress made in building the new programs, which were outlined in ICLARM's strategic plan, and in improving its organization and management" (CGIAR Mid-Term Meeting, Nairobi, p.50).

The Mid-term Review Panel acknowledged "the good progress made by ICLARM in implementing most of the recommendations of the 1992 review, particularly in the areas of human resources management; an integrated system for project and program planning, monitoring, and review; financial management; the emphasis on research in the statements of the Center's goals and objectives; changes in its Inland Aquatic Resource System, Coral Reef

Systems, and Coastal Resource Systems Programs; and, better formulated strategies for training and information. Some of the issues raised by the Panel included:

- Science capacity: ICLARM has a high level of scientific expertise among current Program Directors, but needs to further strengthen the scientific and management capacity below the Director level.
- Research strategy: ICLARM's position in CGIAR allows it to interface with and contribute to CGIAR terrestrial science expertise. It should broaden its participation in inter-Center program activities and capitalize on a range of possible strategic research partnerships with strong NARS and advanced science institutes.
- Funding priorities: CGIAR should give a higher priority to aquatic research, which contributes vitally to nutritious food production and food security in the developing world, and translate priority into stronger and less restrictive financial support to ICLARM (CGIAR Mid-Term Meeting, Nairobi, p. 50).

In discussing the Panel's report, the Ad hoc Evaluation Committee II endorsed the recommendations of the Panel, particularly those relating to "pursuing vigorously the strengthening of ICLARM's managerial and scientific organizational structure; calling on the CGIAR (and other sources) to increase its funding base and diversify the funding mode from project to program based, thus providing ICLARM with the necessary flexibility in managing resources; and pursuing the enhancement of the scientific capacity of the Center (CGIAR Mid-Term Meeting, Nairobi, pp. 50-51). The mid-term meetings in Nairobi and Jakarta both discussed whether or not ICLARM should accept the Egyptian government's offer for the use of a site and facilities for aquatic resources research in Abassa. During the discussion, the Oversight Committee raised caution that funding opportunities should not drive the CGIAR Research Agenda (CGIAR Mid-Term Meeting, Jakarta, p. 67).

The TAC commented on the mid-term review saying "the Committee is convinced that ICLARM is well positioned to make a major contribution to CGIAR goals and priorities and that the Centre merits the full support of the CGIAR. The pains associated with the Centre's transformation from a project-driven to a programme-based organization, as well, as the turbulence arising from the 1993 internal strife, have been largely overcome and the Centre's research programme is being successfully implemented" (Report of the Mid-Term Review, p. ix). The TAC also noted "with pleasure the progress ICLARM has made in its Inland Aquatic Resource Systems Programme (IARSP). The quantitative genetic breeding programme has been very successful in increasing growth rates of Tilapia up to 60 percent. Over the last two years ICLARM has integrated its former Coral Reed and Coastal Resource Systems Programmes into a single programme and impressive output has been achieved in the form of databases such as Fish-base, FiDAS and Reef base alongside a number of valuable and well-received publications." However, the TAC expressed concern with ICLARM's science capacity, stating that it is a small institute with a global mandate for research on aquatic resources. TAC urged ICLARM to enhance its capacity and expand strategic alliances with other research organizations to overcome that difficulty (Report of the Mid-Term Review, p. ix).

The Panel's recommendations mainly centered around administrative issues such as cash flow management; external reviews; acceptance of Egyptian facility and search for

Philippines headquarters; strengthening of scientific and management capacity within ICLARM programs to ensure a sustainable long term effort by the Center; turning increased competition for funding into an opportunity for strategic alliances; allocation of US\$1 M which TAC conditionally recommended previously; inadequate resources made priority by TAC and development assistance community. Suggestions were also made regarding several specific programs and how research could be improved and impacts could be monitored. The Panel also encouraged ICLARM “to proceed with participation in inter-centre program activities of broader system importance, such as the system-wide program on coastal resources, on policy research with respect to common property resources and on water management.” Though the panel is aware that this is difficult due to limited staff and resources (Report of the Mid-Term Review, pp. xii-xvii).

Impact

Regarding ICLARM’s capacity to deliver an effective research program, it was said that “on balance, ICLARM’s present and immediate future capacity is sound, though limited. ICLARM enjoys several important strengths and enters a time of large potential opportunity. ICLARM’s internal weaknesses seem within its control to overcome, given the present will to do so” (Report of the Mid-Term Review, p. 16). It was stated that “ICLARM has a unique global mandate in the CGIAR System for research on living aquatic resources management... It undertakes work ahead of the capacity of national research agencies or beyond their national mandates. The 1992 EPMRP report noted that ICLARM’s detail research work at the local level and across localities and countries (particularly in resource assessment and coastal area management) was complementary to that of regional fisheries commissions and international bodies such as FAO.”

In addition, many opportunities are presented to ICLARM by the global attention to living aquatic resource management uses; to emphasis on the environment and natural resources management, including biodiversity; and to the connections with food security in developing countries — along with the attendant knowledge needs of these domains.” Furthermore, “Headquarters and field site locations in various countries of the developing world ensure close contacts with the issues facing target beneficiaries and to research sites and national system partners. ICLARM has a large number of fruitful and relevant linkages with government organizations, non-governmental organizations, universities in the developing and developed world and other partner organizations” (Report of the Mid-Term Review, p. 17).

However, due to time limitations, the Panel did not have the opportunity to conduct an impact assessment. Information in this area is greatly needed, as the question of impact on natural resources management has only been indirectly addressed. It was stated at that time (1995) that ICLARM plans to conduct some detailed impact assessment work over the next two years. ICLARM did, however, point out that much of its natural resources management research is not amendable to the standard research impact assessment methods of agricultural research and that new ground must be broken in the impact studies to be done. Questions have also arisen regarding whether its mandate is too large for a small organization. Yet, the Center is afraid a change will prevent the use of its comparative advantages which are considered to be: multidisciplinary and international research approaches; research across spectrum from conservation to natural resources management and sustainable production

systems; and expertise in all the major aquatic resource systems exploited by small scale operators” (Report of the Mid-Term Review, p. 17).

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Documents

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ICLARM. About Us at <http://www.iclarm.org/objgov.htm>.
 ICLARM. ICLARM’s main Web page: www.iclarm.cgiar.org.
 ICLARM. ICLARM’s Organizational Statement at <http://www.iclarm.org/orgsta.htm>.
 ICLARM. Research and Services at <http://www.iclarm.org/resprg.htm>.

9. ICRAF — International Centre for Research in Agroforestry

Main Web page: <http://www.icraf.cgiar.org/>

Stated Aims

ICRAF’s stated aim is “to improve human welfare by alleviating poverty, improving food and nutritional security, and enhancing environmental resilience in the tropics” (<http://www.icraf.cgiar.org/about/about.htm>). ICRAF conducts strategic and applied research for more sustainable and productive land use along five themes (<http://www.icraf.cgiar.org/about/about.htm>):

- diversification and intensification of land use through domestication of agroforestry trees;
- soil fertility replenishment in nutrient-depleted lands with agroforestry and other nutrient inputs;
- socio-economic and policy research to allow policies that will benefit smallholder farmers;
- acceleration of impact on farm by ensuring that research results are used;
- capacity and institutional strengthening through training and the dissemination of information

Activities

ICRAF’s research and development activities are made up of three research programs (http://www.icraf.cgiar.org/res_dev/res_dev.htm):

- Natural Resource Strategies and Policies
- Domestication of Agroforestry Trees
- Ecosystem Rehabilitation

There are also two development programs:

- Advancing Innovation and Impact
- Training and Education

Programs 1 and 3 are most directly involved in NRM issues and include the following:

1: Natural Resource Strategies and Policies

Land use and agro-ecosystem dynamics — identify and assess natural resources management problems within major land-use systems

- Integrated assessment of natural resources management options — predict and assess the possibility for mitigation of key problems in natural resources management and poverty of agroforestry practices compared with alternative options
- Natural resource policy development — identify and analyse policy problems that are major obstacles to the spread of agroforestry systems and support the reform process
- Ecological, social and economic impact assessment — understanding of the agroforestry adoption process and of its different impacts

3: Ecosystem Rehabilitation

- Water-use management — quantify water balance of agroforestry systems in comparison with those of agriculture for assessing their productivity and impact on long-term sustainable utilization of water resources
- Nutrient replenishment and management — quantify the various processes by which trees contribute to efficient nutrient management
- Productivity and environmental benefits of complex agroforests — evaluation of complex agroforestry systems in respect of their roles for productivity at farm level, as well as environmental and biodiversity functions at landscape level

ICRAF also convenes the System-wide Programs:

- Alternatives to Slash-and-Burn or ASB (<http://www.asb.cgiar.org>)
- African Highlands Ecoregional Programme (http://www.icraf.cgiar.org/sys_wide/ahi.htm)

African Highlands Ecoregional Programme (AHI) is an ecoregional research program where various IARCs and NARS operating in the East and Central African region work together as a collaborative alliance to address NRM and productivity issues in the intensively cultivated highlands that exist in these intensely cultivated areas (ICRAF, 2000, <http://www.icraf.cgiar.org/BoT/BoTDoc2.htm>). The primary mission is to foster farmer innovation and collective action for design and dissemination of appropriate, integrated technologies and methods for improving NRM in the diverse and complex situation.

ICRAF's activities encompass six ecologically distinct regions:

- Subhumid highlands of East and Central Africa
- Subhumid plateau of Southern Africa
- Semi-arid lowlands of West Africa
- Humid tropics of Latin America
- Humid tropics of Southeast Asia
- Humid tropics of West Africa

In the first three ecoregions ICRAF is addressing the issue of serious land degradation, while in the second three in the humid tropics, ICRAF is looking for alternatives to slash-and-burn agriculture at the margins of the world's tropical moist forests, where major global environmental damage is being done (<http://www.icraf.cgiar.org/regional/regional.htm>). The Web site links to region-specific information on activities and highlights of outputs, but is dated only as recently as May 2000. It is evident, however, that all the regions address NRM issues as part of their program.

ICRAF-SEA (Southeast Asia) has done considerable work modelling agroforestry systems (<http://www.icraf.cgiar.org/sea/AgroModels/AgroModels.htm>); including one to model shifting cultivation at the forest margins in a 100-grid cell landscape (<http://www.icraf.cgiar.org/sea/AgroModels/FALLOW/Fallow.htm>). Models account for biophysical and management parameters as well as impact on the natural resource base.

Quality

The review panel (TAC Secretariat, 1998) commended ICRAF for its role within integrated NRM, and for the problem-oriented integrated NRM research-planning concept it is developing, based on systems methodologies. They commended ICRAF for giving attention to the testing of farmer participatory research methods to link research and extension. ICRAF has done well at publishing its results in all relevant media and the quality, quantity, and diversity of other outputs, such as policy research, systems development, and capacity strengthening, is excellent.

The panel (TAC Secretariat, 1998) felt that ICRAF researchers are successfully working to produce results that are of widespread interest across regions of the world, especially to those concerned with NRM and make a conscious effort to link their site-specific work to broader IPG types of synthesis and modelling work. ICRAF is evolving towards research and development activities related to the introduction of new institutional and policy approaches, watershed- and landscape-level systems studies and, more fundamentally, improved understanding of all the components along the research to development continuum (TAC Secretariat, 1998). ICRAF has recognized that much of the technology already on the shelves of research institutions is far ahead of practice and the ability, resources and motivation to adopt it in the fields. ICRAF is attempting to discover why this is so and doing research on how to overcome the barriers to adoption of new and improved systems. Oftentimes, the barriers prove to be quite amenable to research, and the constraints small and easy to solve through research and development support.

Part of this approach has been to seriously consider NRM issues at the farm scale. To a large extent ICRAF has shifted its approach by developing and implementing a natural resources management approach to agroforestry research. However, the review panel found that a longer term perspective and a broader view of agroforestry within a more holistic Integrated Natural Resources Management (INRM) framework than is now implied by ICRAF's strategic plan and program of activities is needed (TAC Secretariat, 1998). In other words, what ICRAF is doing in this area is good, but it needs to go further in this direction.

“ICRAF is moving towards development and adaptation of an integrated natural resources management paradigm, one that recognizes the temporal, spatial, institutional, and disciplinary linkages that are so important in the process of pursuing sustainable development. Implementation of the INRM approach requires a broadening of ICRAF's perspective on the potential benefits of agroforestry beyond the farmer's fields and home. Above all else, it requires establishment of effective partnerships that focus on a “participatory adaptive management” approach to resource utilization and conservation and the contributions that INRM can make to poverty alleviation, food and nutritional security and environmental enhancement (TAC Secretariat, 1998).”

Impact

The 2nd external review (TAC Secretariat, 1998) found that there is good evidence that ICRAF's programs are producing useful outputs with prospects for substantial impact in the future. ICRAF has also focused on activities in which it believes it has a comparative advantage and can produce international public goods. The review panel noted that much of the research was completed too recently for the outputs to have created large scale, direct impacts on farmers' welfare, on national policy change, and on changes related to natural resources management practices. However, the review panel notes that there are indications from several countries that changes in management practices are taking place that are in line with the results and recommendations flowing from ICRAF research.

ICRAF has also had impact at the policy level where there have been changes in some laws and regulations as a result of advice based on ICRAF advice (e.g. in Indonesia with respect to farmer management on the forest margins). ICRAF's advances in research methods are also being widely disseminated and used by various research groups (TAC Secretariat, 1998). They note that ICRAF has not had as much success at institutionalizing agroforestry in partner countries as it has had with its research and development activities at the farm and community levels — but this requires inputs from others beyond its control.

The list of specific achievements in the area of improved understanding and applications of natural resources management systems is considerable. The review panel was also impressed by the accomplishments and potential of the ASB and AHI System-wide ecoregional Programs coordinated by ICRAF (TAC Secretariat, 1998) — two programs with an especially strong NRM component. The panel noted that both AHI and ASB provide good examples of the facilitating role ICRAF can play in institutional strengthening of NARS, while at the same time conducting research and producing IPGs.

Resources Consulted

Documents

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Web Sites

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ICRAF summary prepared by Douglas R. Brown, Cornell University.

10. ICRISAT — International Crops Research Institute for the Semi-Arid Tropics

Main Web page: <http://www.icrisat.org/>

Stated Aims

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

As a result, ICRISAT's new mandate is to enhance the livelihoods of poor in semi-arid farming systems through integrated genetic and natural resources management strategies. More specifically, ICRISAT will:

- make major food crops more productive, nutritious, and affordable to the poor;
- diversify utilization options for staple food crops;
- develop tools and techniques to manage risk and more sustainably utilize the natural resource base of semi-arid tropics systems;
- develop options to diversify income generation; and
- strengthen delivery systems to key clients.

Partnership-based research for impact, gender sensitivity, capacity building, and enhanced knowledge and technology flows are integral to this mandate.

Activities

ICRISAT Research Programs are in three main areas:

- Genetic Resources and Enhancement Program (GREP): — the improvement of its mandate crops — sorghum, pearl millet, chickpea, pigeon pea, and groundnut.
- Natural Resources Management Program (NRMP) (<http://www.icrisat.org/text/research/NRMP/nrmphome.html>): consists of well focused research involving multi-disciplinary teams on major problems constraining the productivity through increased cooperation with NARS and other regional/national research and extension programs. There are four major themes in the NRM research program:
 - Raising Soil Fertility to Help SAT Farmers Grow their Way out of Poverty
 - Developing Community-scale Watersheds to Improve Rural Livelihoods
 - Farmer Participatory Approaches to Integrated Pest and Disease Management
 - Combating Desertification and Reducing Poverty in the Desert Margins of Sub-Saharan Africa
- Socioeconomics and Policy Program (SEPP) — the mission of SEPP is:
 - Diagnosis and resolution of technology design and delivery constraints
 - Evaluation of technology development priorities and prospects for the SAT
 - Identification of opportunities to increase research impacts.

The orientation of the NRMP is changing too — moving beyond a primary emphasis on plant/soil/water, plot, and farm-level production issues to include integrated pest management research. The NRMP focus will increasingly be broadened to natural resources management research on managing land, water, plant and animal resources at the broader scales of the community and the watershed landscape level (ICRISAT, 2002).

In order to strengthen ICRISAT's work in Africa, as emphasized by its recent External Review (EPMR), two of the three Program Directors are now based in Africa, including the Director of NRMP. The terms of reference of the Directors are to improve the focus and scientific quality of programs, develop program visions and strategies, make required changes in structure and functioning, develop and strengthen partnerships, and develop new initiatives and assure funding of on-going and future projects to ensure impact (ICRISAT, 2002).

Quality

Natural resources management (NRM) research has been one of the major programs at ICRISAT since its inception, with an overall goal of providing farmers with low cost sustainable technologies (TAC Secretariat, 1997). There has been a focus on the study of specific production systems that appear to be stable in various agroecosystems with an emphasis on generic and integrative research, the use of GIS and modeling as tools to generate research outputs of wide applicability, integrated resource management; and ultimately and enhanced analysis of on-site/off-site impacts of natural resources management and land use.

In the area of natural resources management research, TAC Secretariat (1997) notes as significant accomplishments the sound agroclimatic characterization work in West Africa, the demonstrated suitability of different rock phosphate sources available in the Sahel for direct application, crop and systems modeling, and the adoption of the modified broadbeds and furrows technology for management of Vertisols. However, they (TAC Secretariat, 1997) also note some deficiencies in the ICRISAT program on NRM research, in particular:

- lack of clear linkage between the modeling activities and the evolution of technologies for removal of production constraints;
- lack of a long-term strategy in development of crop models, their validation and broad applicability across different production systems;
- inadequate integration of soil physics, crop water use and hydrology; and
- domination of nutrient management studies by biological nitrogen fixation at the expense of fertilizer/manure studies.

TAC Secretariat (1997) noted that there is a need for the Center to be more decisive and resolute in making choices among the many attractive research themes identified in the current and previous medium-term plans, particularly in relation to the natural resources management component. They also noted a need for the need for a strategic realignment of ICRISAT by adopting a new paradigm based on the strategic partnership model, whereby strategic and global germplasm research would be concentrated in ICRISAT's Asian Center, while natural resources management research would be concentrated in Africa, where major bottlenecks exist, and research partnerships and networking would be enhanced via ecoregional approaches.

TAC Secretariat (1997) also noted that the current effort by ICRISAT towards integration of research on soil, water, and nutrient management with socioeconomic and biological factors of agricultural production — through its integrated systems projects — is a timely step towards INRM research. ICRISAT has gone even farther in its global project approach to identify specific production systems which will provide a sharper focus on the key problems associated with the productivity and sustainability of land use systems. The new projects are however still in their formative stages. The Panel, while commending ICRISAT for this initiative, observed that successful implementation of the strategy will be influenced by the accuracy with which the production systems can be defined.

Impact

Specific examples of achievements in NRM-related research from ICRISAT are in:

- agroclimatology, analysis of rainfall of the SAT has resulted in the development of a computer model relating probable length of rainy season to the date of onset of the rains in the West African SAT;
- in agronomy, cropping systems for optimum utilization of rainfall have been developed for different rainfall and soil regimes in the Indian SAT (TAC Secretariat, 1997).

During the period under review, ICRISAT made valuable contributions to NRM research, especially in the application of agroclimatic models for agro-ecological characterization of the SAT, and the use of the CERES model to estimate potential yields of mandated crops under different agro-ecological conditions. This work now facilitates better identification of the major natural resource constraints to production, and hence selection of research strategies to overcome such constraints on production (TAC Secretariat, 1997).

ICRISAT has had a long record of research achievements in the domain of socioeconomic aspects of NRM. These studies have however been largely confined to the Indian subcontinent. The Panel considers that research on socioeconomic aspects of NRM will have to be strengthened, especially in Africa, where such issues probably constitute the main barrier to adoption of improved technologies (TAC Secretariat, 1997).

Resources Consulted

Documents

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ICRISAT summary prepared by Douglas R. Brown, Cornell University.

11. IFPRI — International Food Policy Research Institute

Main Web page: <http://www.ifpri.org/>

Stated Aims

The stated aim or mission of IFPRI is “to identify and analyze policies for sustainably meeting the food needs of the developing world.” Research at IFPRI concentrates on economic growth and poverty alleviation in low-income countries, improvement of the well-being of poor people, and sound management of the natural resource base that supports agriculture (IFPRI, 2001b).

Activities

IFPRI conducts food policy research and disseminates it through four research and outreach divisions, a communications division, and the 2020 Vision initiative:

- Communications Division (CD) — the division’s Training and Capacity Strengthening Programme’s overall objective is to strengthen the capacity of

- developing-country counterparts to conduct food, agriculture, and natural resource policy analysis and to enhance the capacity of developing country institutions to provide training in policy analysis on a continuing basis.
- Environment and Production Technology Division (EPTD) — focuses on meeting food production needs in developing countries in ways that are beneficial to the poor and do not degrade the natural resource base. This division was created in 1992 following the 1990 external review to focus primarily focus on natural resources management and environmental issues (TAC Secretariat, 1998). It was to give highest priority to understanding incentive problems for natural resources management at the household and community levels. Some of the key outputs include work on the following:
 - Community survey methods for collecting participatory recall information as well as cross-sectional data for analysing the impact of property rights and other policy, institutional, and technological factors on natural resources management at the plot, household, and community levels, and for testing induced-innovation hypotheses.
 - Bio-economic modelling methods for analysing the economic and environmental consequences of alternative development pathways at the community level.
 - Methods for combining GIS data with economic models for ex post and ex ante evaluation of agricultural research.
 - Models of river basin systems for analysing the efficiency and environmental consequences of alternative water management policies.
 - Food Consumption and Nutrition Division (FCND) — research relating to improved economic access to food and improved ability to harness food for growth and nutrition.
 - Markets and Structural Studies Division (MSSD) — seeks to understand how countries can best develop markets, institutions and infrastructure in ways that contribute to agricultural growth, help alleviate poverty and ensure food security for all.
 - Trade and Macroeconomics Division (TMD) — analyzes the effects of national policies and the global economic environment on agricultural performance, food security, natural resource use, poverty, and equity in developing countries.
 - 2020 Vision Initiative — to identify solutions for meeting future world food needs while reducing poverty and protecting the environment.

IFPRI's research is conducted under 21 themes as well as two "hot topics" (<http://www.ifpri.org/themes/themes.htm>). The following 7 themes have NRM as an integral component:

- 2020 Vision for Food, Agriculture, and the Environment — to identify solutions for meeting future world food needs while reducing poverty and protecting the environment (<http://www.ifpri.org/2020/welcome.htm>). A key component of this program was the 2001 international conference "Sustainable Food Security for All" (Anderson et al, 2001) to promote dialogue on these issues. One section of the meetings addressed NRM issues.

- CGIAR System-wide Program on Collective Action and Property Rights (CAPRI) — (EPTD) — to promote comparative research on the role played by property rights and collective action institutions in shaping the efficiency, sustainability and equity components of natural resource systems
- (<http://www.ifpri.org/themes/capri.htm>). As such one of its major tasks is to identify concrete policy instruments that facilitate and encourage the formation, improved functioning, resilience and spontaneous evolution of organizations of users and property institutions that assure optimal resource use. Of its seven themes, the following relate specifically to NRM:
 - Adoption of Technologies for Natural Resources Management
 - Accommodating Multiple Uses and Users of a Resource
 - Role of Environmental Risk

It functions by providing grants to CGIAR projects that contribute to policies and practices that alleviate rural poverty by analyzing and disseminating knowledge on the role of institutions in natural resource use.
- Macroeconomic Policies, Rural Development, and Household Food Security — (TMD) — to investigate, at either the national or regional level, the interactions among agriculture, natural resources, and alternative policy regimes in specific countries, with a view to increasing understanding by policymakers of the effects of macroeconomic policy changes on agricultural performance, natural resource use, poverty, and overall income growth (<http://www.ifpri.org/themes/mp12.htm>).
- Priorities for Public Investment in Rural Areas — (EPTD) — employs methodologies that enable different types of rural investments to be ranked within the government's total rural investment portfolio in terms of their growth, poverty and environmental impacts — including interdependencies and cross-linkages (<http://www.ifpri.org/themes/grp03.htm>).
- Property Rights and Collective Action in Natural Resources Management — (EPTD) — to determine what types — and perhaps combinations — of property rights and collective action institutions are needed in different situations, in order to achieve the best patterns of development (<http://www.ifpri.org/themes/mp11.htm>).
- Sustainable Development of Less-Favored Lands — (EPTD) — to provide empirical evidence on (a) the productivity, poverty, environmental and food security consequences of targeting agricultural investments, including agricultural research to less-favored agricultural areas compared to more favored areas, and (b) the appropriate development strategies for different types of less-favored lands (<http://www.ifpri.org/themes/grp05.htm>). One particular component of this theme is of particular relevance for NRM — Strategies for Sustainable Intensifying Agriculture in Less-Favored Areas — which involves three major components:
 - cross-sectional and historical studies of community experiences in developing and managing their agriculture and natural resources.
 - bioeconomic models of watersheds and communities are constructed to simulate the consequences of alternative policy or technology changes.
 - typologies of less-favored lands are constructed and GIS databases generated to enable aggregation from the community-level studies to regional or national levels.

- Water Resource Allocation: Productivity and Environmental Impacts — (EPTD) — to understand how different ways of managing water affect food production, rural livelihoods, poverty, and the environment and to suggest fair and efficient mechanisms of allocating and using water (<http://www.ifpri.org/themes/mp10.htm>).

The other 14 research themes at IFPRI currently are:

- Agricultural Science & Technology Policy — (EPTD)
- Gender & Intra-household Aspects of Food Policy — (FCND)
- Global and Regional Trade — (TMD)
- IMPACT Special Project: Global Trends in Food Supply and Demand — (EPTD)
- Nonfarm Rural Development — (EPTD)
- Policies to Increase Income and Reduce Poverty Through Postharvest Activities and Agro-Food Based Rural Industrialization — (MSSD)
- Promoting Growth and Diversification Through Markets for High Value Crop and Animal Products — (MSSD)
- Public Policies for Rural Institutions, Markets, and Infrastructure Development — (MSSD)
- Rural Financial Policies for Food Security of the Poor — (FCND)
- Special Program on Impact Assessment (SPIA) — (EPTD)
- Strategies for Improving Availability of Micronutrients — (FCND)
- Successes in African Agriculture — (MSSD)
- Targeted Interventions to Reduce and Prevent Poverty — (FCND)
- Urban Challenges to Food and Nutrition Security — (FCND)

Two additional “hot topics” do not seem to have significant NRM components: Biotechnology and Genetic Resource Policy and Globalization, Trade and WTO.

Quality

The third external review (TAC Secretariat, 1998) stated that IFPRI’s current mission and priorities are on the whole consistent with CGIAR goals and priorities, and that the research issues on its agenda and its major research outputs are pertinent to poverty alleviation, food security and environmental sustainability in the developing countries. It noted that IFPRI’s research programs were found to be of high quality and relevance. They noted the high quality of science at IFPRI and the high regard peers generally have for the Institute’s work but at the same time noted that there is a need for IFPRI to amplify its skill mix by recruitment of persons with both research and policy experience.

This comment came about because of an observation that individual researchers seemed to be primarily focused on their academic goals while at the same time scientific quality is not the sole criterion by which IFPRI is to be judged. IFPRI was set up precisely because the CGIAR’s stakeholders expect more from it. They expect it to have an impact on the welfare of the poor people. They expect it to spread new ideas about policies to the governments of the world, to contribute to and stimulate policy debates within many developing countries, to participate in international debates concerning global policies, and a great deal more. They

suggested that one method would be to bring in a different mix of skills to IFPRI's research divisions and reduce the heavy academic presence by bringing in, for example, people with extensive exposure to the process of policy-making in developing countries. Another option is for IFPRI to hire more non-economists.

The review panel (TAC Secretariat, 1998) found that IFPRI's Outreach Programme lacked an integrating philosophy and that it needed to improve the integration of its research and outreach activities. Outreach should be the partial responsibility of every scientist, with senior scientists assuming a relatively larger role. It should also be proactive in nature. They noted that work ought to be done to nudge researchers towards outreach and the production of joint research publications with developing country collaborators. This is another reason why the skill mix of the Center needs to be balanced by inducting persons with significant policy experience in developing countries and from other relevant disciplines than economics.

The reviewers (TAC Secretariat, 1998) wondered if IFPRI multi-country analyses were essential in all cases and if by reducing the number of countries, eventually down to one, this would allow projects to be leaner and quicker, without necessarily compromising the international public goods character of the results obtained. They also found that while IFPRI gives substantial emphasis to food nutrition and consumption issues at the household level, perhaps insufficient attention has been given to the implications of alternative income generation activities for poverty alleviation strategies. This seems to have been corrected since the time of the review since there are now themes directly related to this subject.

The Environment and Production Technology Division (EPTD) with its primary focus on natural resources management and environmental issues got off to a bit of a slow start in 1992, having been formed from the old Production Division staff. Rather than focusing on a broad research program on the environment, it was decided that the division would examine the interface between agriculture and natural resources with the overriding goal of sustainable poverty alleviation (TAC Secretariat, 1998). Therefore its research has focused on policies to increase food production for poor people in an environmentally sustainable manner. The external review (TAC Secretariat, 1998) also noted the particular focus of this division arose because a considerable number of other major non-CGIAR research efforts were addressing environmental and natural resource issues in isolation from agriculture, whereas few were looking at the linkages between agriculture and environmental and natural resource issues (some exceptions were early work in watershed management).

Incidentally, the EPTD was the second largest in IFPRI both in terms of number of staff and level of funding in 1996 (TAC Secretariat, 1998).

As of the external review (TAC Secretariat, 1998), the EPTD had produced 15 books, 5 research reports, 191 journal articles, and 160 other published works and a large body of grey literature during the review period. In addition, numerous publications were in the pipeline. The review panel found that the outputs from the EPTD, both methodological and empirical findings, were relevant to partners, clients, and the research community at large and noted that EPTD researchers were on the forefront of research related to forest margins, fragile lands strategies, and land degradation issues. They also noted that IFPRI had not focused

resources on transnational issues in the areas of water resources and fisheries due to lack of funding for these specific areas — thought they are within its mandate.

Impact

The external review (TAC Secretariat, 1998) found that work of the research divisions, both in terms of empirical findings and methodological contributions is relevant to developing countries, other partners and the research community at large. They also noted that IFPRI's Vision 2020 and its outputs have not only given its work a high degree of visibility, but also contributed significantly to heightened awareness, worldwide, of global food policy and environmental issues. The dissemination of these outputs has resulted in several requests for IFPRI's advice and assistance from developing countries. The 2020 study has also helped integrate and highlight the different strands of research at IFPRI.

The review panel (TAC Secretariat, 1998) noted that a quantitative assessment of the impacts of policy research on goals such as poverty alleviation is difficult in the present state of our knowledge. It is necessary therefore to depend on intermediate indicators of IFPRI's impact. The Center's efforts to select and work on relevant policy issues of concern to developing countries, its wide dissemination of outputs, especially in a more accessible form to policy makers, its collaborative research partnerships in countries, and capacity-building efforts all qualify as adequate intermediate indicators. The Center is actively engaged in the task of policy research impact assessment. Islam and Garrett (1997) discuss issues related to impact assessment using an example from Pakistan. They discuss the unique challenges of assessing the impacts of policy research as compared to technology development and adoption.

One of the more immediate impacts of IFPRI's work comes through short-term training programs and conferences and longer-term partnerships with developing country institutions organized by the Outreach Division and designed to strengthen their capacity to conduct food, agriculture, and natural resource policy analysis. It also occurs through participation of individuals from developing countries in IFPRI research activities in ways integrated with their professional advancement; and through seminars, workshops, and conferences for experts and participants from both developed and developing countries (TAC Secretariat, 1998).

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IFPRI summary prepared by Douglas R. Brown, Cornell University.

12. IITA — International Institute of Tropical Agriculture

Main Web page: <http://www.iita.org/index.htm>

Stated Aims

The stated aim or mission of IITA is “to enhance the food security, income, and well-being of resource-poor people primarily in the humid and subhumid zones of sub-Saharan Africa by conducting research and related activities to increase agricultural production, improve food systems, and sustainably manage natural resources, in partnership with national and international stakeholders” (IITA, 2001b).

Activities

IITA’s principle objectives, according to TAC Secretariat (2001) are:

- develop and improve systems for the effective management and conservation of natural resources for sustaining agriculture;
- increase agricultural productivity and enhance commercialization leading to improved food security, higher incomes; and
- help strengthen national and regional research systems.

To do this IITA conducts research, germplasm conservation, training, and information exchange activities in partnership with regional bodies and national programs including universities, NGOs, and the private sector. The research agenda addresses crop improvement, plant health, and resource and crop management within a food systems framework and targeted at the identified needs of four major agro-ecological zones: the dry savannah, the moist savannah, the humid forests, and the midaltitude savannah. Research focuses on smallholder cropping and post-harvest systems and on the following food crops: cassava, cowpea, maize, plantain and banana, soybean, and yam.

Research facilities are strategically placed across the region and within the different agro-ecozones. Stations have different research focuses, depending on both agro-ecozone priorities and history. The Humid Forest Ecoregional Centre, located in Yaoundé, Cameroon, has a specific focus on resource and crop management.

In 2000 (IITA, 2001c, <http://www.iita.org/research/2000proj.htm>), most of the projects cut across the agro-ecological zones for which IITA’s work is targeted. They included:

- conservation and use of plant biodiversity
- improving
 - plantain- and banana-based systems
 - cowpea-cereals systems in the dry savannah
 - maize-grain legume systems in West and Central Africa
 - yam-based systems
- cassava-based systems
- biological control and functional biodiversity
- integrated management of
 - legume pests
 - maize pests
 - cassava pests
- protection and enhancement of vulnerable cropping systems where cropping systems incorporating fallow phases predominate — including the improvement of natural resources management
- improvement of high-intensity food and forage crop systems where continuous, intense annual cropping predominates— including the improvement of natural resources management and environmental services
- development of integrated annual and perennial cropping systems on degraded/deforested lands — including enhanced environmental services
- impact, policy and systems analysis
- system-wide program on integrated pest management
- ecoregional program for the humid and subhumid tropics of sub-Saharan Africa (EPHTA)

As can be seen from the above listing of project areas, apart from the crop-specific research, there are major programs in farming systems — “the real-life interactions between agriculture, livestock, the environment, and socio-economic conditions that enable farmers to successfully grow their crops and raise their animals, and the problems that prevent them from doing so.” (<http://www.iita.org/crop/farmsys.htm>). It is in this component that NRM issues are explicitly addressed.

As noted above, there are context-specific programs/projects related to three specific sets of circumstances:

- extensive fallow-based systems
- intensive continuous cultivation systems
- systems for degraded lands

Specific farming systems components include:

- crop rotation systems
- cover crops
- crop-livestock systems
- multistrata systems

IITA is also involved in a number of inter-Center partnerships:

- [Systemwide Program on Integrated Pest Management](#)
- [The Ecoregional Program for the Humid and Sub-humid Tropics of Sub-Saharan Africa \(EPHTA\)](#)
- [Systemwide Information Network for Genetic Resources \(SINGER\)](#)
- [Organizational Change Program](#)
- [Consortium for Spatial Information \(CSI\)](#)
- [International Crop Information System \(ICIS\)](#)

Of these six partnerships, IITA is the convening Center for two that are CGIAR System-wide Programs:

- the Ecoregional Programme for the Humid and Subhumid Tropics of Sub-Saharan Africa (EPHTA); and
- the System-wide Programme on Integrated Pest Management (SP-IPM).

IITA also collaborates with ICRAF on the Alternatives to Slash and Burn (ASB) System-wide Program.

The EPHTA program has two interrelated goals: reduction of rural poverty and reduction of resource degradation. It works in two agro-ecosystem zones:

- moist savannah
- humid forest

for a total of six benchmark sites, three in each zone.

A key component of the EPHTA approach is the characterization of the sites — including NRM-related factors.

Quality

In the area of crop and resource management, the external review (TAC Secretariat, 2001) noted that the bulk of IITA's research is on-farm and conducted in an integrated participatory manner with one of the primary goals being the sustainable management of the natural resource base — whether it be in the context of short-fallow or the more intensive continuous cropping systems. There is also an emphasis on retaining the environmental and socio-economic benefits of the forest canopy as part of the NRM system. Much of this work has been coordinated under the System-wide Program Alternatives to Slash and Burn (ASB).

With respect to the System-wide Program EPHTA that IITA convenes, NRM is a key component. While there is a wealth of data from the 5 benchmark areas, the external review (TAC Secretariat, 2001) found that much of it had yet to be analyzed extensively with respect to the driving forces behind intensification (such as market access and population). The EPHTA initiative has also had difficulty finding the funding to carry on its work. As a result it has been heavily subsidized by IITA (TAC Secretariat, 2001).

IITA has a draft strategy for the years 2001-2010, one component of which is designed to respond to the NRM issues raised by farmer groups, NGOs, NARS and the private sector. As such it appears to be a demand-driven research agenda based on farmers needs, market demand and the needs of its NARS partners (TAC Secretariat, 2001) — although the external review also noted that IITA needs to work on a methodology for prioritization of its research agenda.

Impact

The TAC Secretariat (2001), in its 5th program evaluation, notes that IITA has published less in the peer-reviewed literature in recent years. IITA responded by noting that there had been a shift towards long-term field and impact studies (both something inherent in maturing projects and also recommended by the previous EPMR) that naturally led to a reduced frequency of publications. They note that some scientists who are involved in special projects concerning implementation over several countries had not published in peer reviewed journals but that their impact had been in writing training manuals or monographs, or in giving training courses or bench training to national staff. This was evident from the Web site, as noted above.

An example of successful introduction of a new technology through collaborative research with farmer involvement is the use of leguminous cover crops in short fallow systems to control weeds and restore soil fertility in the derived savannah benchmark area in the Republic of Benin (<http://www.iita.org/research/high2000/eptha.htm>)

Some outputs of the EPHTA program (TAC Secretariat, 2001) that seems to hold considerable potential for taking NRM issues into account across the region are:

- genuine collaboration among institutions from several countries,
- rationalization of resources through 6 benchmark sites relevant to 14 countries, and
- considerable capacity building and technology dissemination through participator research in the partner countries.

The external review panel noted that IITA has tremendous opportunities to play a leadership role in helping to strengthen the partnerships among it and the NARS given that there is an increasing spirit of collaboration among them. This would contribute considerably toward the food security, poverty and natural resource conservation goals (TAC Secretariat, 2001). Given the significant erosion of NARS capacity to implement research and technology transfer in recent years and that IITA is dependent upon them to fulfil its role of improving NRM, alleviating poverty and improving food security at the local level, IITA faces a challenging task (TAC Secretariat, 2001).

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IITA summary prepared by Douglas R. Brown, Cornell University.

13. ILRI — International Livestock Research Institute

Main Web page: <http://www.cgiar.org/ilri/>

Stated Aims

The stated aim or mission of ILRI is to conduct “research in animal agriculture to reduce hunger, poverty and environmental degradation.” As such, it sees itself has having a global mandate to enhance the well-being of present and future generations in developing countries through research that improves sustainable livestock production (<http://www.cgiar.org/ilri/about/mandate.cfm>).

Objective of ILRI (TAC Secretariat, 1999):

To improve the productivity of smallholder livestock systems and protect the natural resources that support them.

Within this objective, ILRI defines its operational goals (TAC Secretariat, 1999) as:

- serve as a world center for animal production and health research
- find ways to control livestock diseases that limit production
- strengthen NARS in technical and policy research on sustainable livestock systems
- research and collaborate with others to improve contribution of livestock to sustainable animal production and equal income distribution
- contribute to scientific knowledge in understanding animal production
- natural resources management constraints and opportunities or research methods and techniques

Activities

Web site notes the importance of livestock as sources of:

- high quality food for humans,
- nutrients for soils, and
- income for households.

The specific research objectives are stated as:

- improve the nutrition, health and genetics of developing-country farm livestock,
- preserve the essential genetic diversity in a wealth of tropical livestock and forage species,
- promulgate policies that support enduring and equitable livestock livelihoods enhance livestock-based production and marketing systems essential to the poor,
- reduce the environmental footprint of smallholder livestock enterprises by augmenting their benefits and mitigating their costs to agro-ecosystem health, and
- strengthen the international livestock research portfolio through assessments of livestock research impacts on poverty and the environment.

ILRI program areas in 2000 (ILRI, 2001a) were:

- Systems Analysis and Impact Assessment
- Livestock Feeds and Nutrition
- Livestock Health
- Livestock Genetics and Genomics
- People, Livestock and the Environment
- Livestock Policy Analysis
- Strengthening Partnerships for Livestock Research
- System-wide Livestock Programme

Specific projects focus on:

- tropical dairying
- West African milk and meat enterprises that exploit transregional grazing

and marketing opportunities:

- crop-livestock farming in the tropical highlands
- rainfed crop-livestock farming in Southeast Asia

ILRI also coordinates the System-wide Livestock Program (SLP). The goal is to improve livestock feed resources and natural resources management in crop-livestock agriculture. This program provides grants to collaborative projects that address major constraints to feed production and related issues in NRM thereby bringing a livestock perspective to natural resources management research at the other Centers (ILRI, 1998b).

There is some published work related to Natural Resources Management available on the ILRI Web site. The 1998 annual report (ILRI, 1999) revolved around the theme of livestock and natural resources management. There appears to be some simulation modelling of smallholder livestock production systems in Kenya and in West Africa that is aimed at enhancing the sustainability of natural resource use. The external review (TAC Secretariat, 1999) conducted in 1999 noted that the Sustainable Production Systems Programme had three main research themes:

- improving productivity and economic opportunities for families
- improving food security
- reducing natural resource degradation

The one that seems to relate to NRM is in nutrient cycling, transfers and management in the crop-livestock system. ILRI collaborates with IFPRI on natural resources management as well as policy issues

Quality

The first external review (TAC Secretariat, 1999) found that:

- nearly one-third of projects found unsatisfactory — either due to quality or output
- nearly one-quarter were not considered well-focused
- virtual absence of sociological research
- good ex ante impact assessment but ex post assessment is weak and needs strengthening

With respect to NRM, the external review noted that ILRI produced:

- a two-volume set on sustainable nutrient cycling in mixed farming systems
- good work in quantifying stocks, flows and balances of nutrients between livestock and crops components of farming systems and the landscape
- geo-referenced databases of natural resource endowments for SSA that can help to develop tools and methods to address interactions between agricultural systems, natural resources and human welfare

It (TAC Secretariat, 1999) also noted that ILRI needs a thematic approach rather than a commodity one which should include (not only) nutrient dynamics and cycling, but bio-economic relationships at the nexus between these transfers, natural resources, and their joint management.

Impact

Impacts related to NRM noted on the Web site:

(<http://www.cgiar.org/ilri/factsht/p98d003.pdf>) — fodder banks

The external review (TAC Secretariat, 1999) noted that:

- direct farm-level impact is so far rather limited, and
- fodder bank technology in West Africa and vertisol management technology in Ethiopia were useful.

There also seems to be some useful output in the area of nutrient cycling and management which should be helpful for other institutions.

Resources Consulted

Documents

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ILRI summary prepared by Douglas R. Brown, Cornell University.****

14. INRM — Integrated Natural Resources Management

Main Web page: <http://www.inrm.cgiar.org/index.htm>

Stated Aims

The third system-wide review of the CGIAR (CGIAR, 1998) recommended the establishment of a global network for integrated natural resources management that would link productivity research with the environmentally sound management of natural resources. In so doing, national scientists in developing countries and their international counterparts would work together in preparing and implementing bottom-up, demand-driven projects to manage agricultural ecosystems in a sustainable manner. The result would be an explicit dual focus on productivity and natural resources management.

The intent of the TAC Secretariat (2001) is not that there should be an additional System-wide network established for INRM, but that it should remain a part of a sustainable production systems effort.

The home page of the INRM program defines INRM as “the responsible and broad-based management of the land, water, forest and biological resources base — including genes — needed to sustain agricultural productivity and avert degradation of potential productivity.”

Activities

The Bilderberg meeting on natural resources management research (CGIAR Secretariat, 1999) helped to clarify some of the evolving concepts. Several points needing particular emphasis emerged (TAC Secretariat, 2001):

- an integrated approach to NRM was needed;
- the social component was equally as important as the biophysical one, and that it should be strengthened;
- increasing emphasis should be placed on identifying and including stakeholder groups; and
- the problem focus must be clear and specific in INRM activities.

The 1999 System Review (TAC Secretariat, 2000) pointed to the emerging natural resources management methods as illustrating the paradigm shift in agricultural sciences:

- from classical agronomy to ecological sciences;
- from analytical research to systems dynamics;
- from top-down to participatory approaches; and
- from factor-oriented management to integrated natural resources management.

In discussing the place of INRM research in the CGIAR, the TAC Secretariat (2001) notes that the CGIAR is focused not only on NRM to help reduce existing poverty and food insecurity, but also on preventing future poverty and food insecurity by developing technologies that can help avoid future degradation of the natural resource base on which food, fibre, fuel and fodder production for the poor depends. While getting people out of existing poverty may have the most dramatic political visibility, preventing people from going into poverty because of declining food production due to environmental degradation is just as important from a humanitarian point of view.

While it is possible to argue that most aspects of INRM are inter-related and that, in a sense, all INRM issues and opportunities should be of concern to the CGIAR, it is also a reality that resources within the CGIAR are limited and that many more institutions of diverse nature and often with greater resources than the CGIAR are tackling many of the issues, relationships, and research opportunities that exist in INRM (TAC Secretariat, 2001). They therefore conclude that the CGIAR should focus on those INRM issues for which it has a comparative advantage, while at the same time being open to cooperation and collaboration with many other groups involved in researching INRM problems, which do not fall in the above category.

As a result, the priorities for NRM research should be determined based on the following six principles (TAC Secretariat, 2001):

1. The CGIAR should concentrate on NRM research that contributes to productivity enhancement and sustainability of natural resources for production of crop, livestock, forest and fish outputs that have impacts on poverty reduction and food security, giving appropriate consideration to inter-generational equity of benefits.
2. The CGIAR Centers should use an integrated NRM focus in their planning to define problems in NRM that require research.
3. International integrated NRM research should be process oriented to ensure maximum contribution to production of international public goods.
4. The CGIAR should give greater attention to research to resolve water issues.
5. Focusing NRM research around common reference locations or benchmark sites is essential in incorporating the many dimensions of integrated NRM.
6. Priorities for specific NRM research themes should be determined by the CGIAR Centers in the context of the sustainability issues affecting productivity increases, regional priorities and comparative advantages of the CGIAR.

Given these principles, candidate priority natural resource areas for CGIAR research is as follows (TAC Secretariat, 2001):

- management of land and terrain resources and related flora and fauna to enhance sustainable agricultural production;
- integrated water and watershed management;
- management of water as habitat for living aquatic resources for rural, coastal and floodplain (including estuarine) livelihood enhancement;
- management of forest environments for rural livelihood enhancement, including social forestry as well as through sale and personal consumption of forest outputs, including, but not limited to wild game, fruits, nuts, oils and other forest products;
- INRM associated with intensive peri-urban agriculture, livestock, and fuelwood production;
- incentive systems for securing improved NRM management.

Perhaps the most important outcome of the Penang meeting (Task Force on INRM, 2000) was greater elucidation of ways to assess the impact of INRM research in relation to the five forms of capital (natural, human, social, financial and physical). It was strongly agreed that impact assessment is an integral part of all INRM research, and is essential to provide the feedback necessary for sound, adaptive management of natural resources. The participants discussed the conceptual underpinnings of INRM as well as how it might be undertaken or expanded to help the CGIAR fulfill its mission of improving food security and reducing poverty without causing lasting damage to the environment. Several case studies from Asia, Africa and Latin America were presented at the meeting to illustrate how INRM research has successfully addressed real-life problems.

At Cali (CIAT, 2001) the question of how to organize to encourage and ensure knowledge sharing within a large and diverse group was a recurrent theme throughout the meeting. The issue was addressed in keynote presentation, small group session and plenary discussion. Communities of practice were adopted as a way to diffuse the best practices, cross-fertilize ideas, develop a common language, help people keep up to date and foster innovation in INRM. Five COPs were formed:

- Impact — monitoring and evaluation especially of indicators for success.
- Learning to work together — forging partnerships for stakeholder involvement in research; bridging scientific and local knowledge.
- Advocacy — spreading the message to top CGIAR decision-makers and members.
- Mainstreaming implementation promoting and facilitating the adoption of INRM principles and participatory approaches into existing programs.
- Learning from cases — documenting and sharing failures and successes to identify entry points for INRM.

The program is in the process of creating an inventory of important INRM research activities or projects being conducted within the CGIAR. The inventory is expected to be indicative not exhaustive. Currently, there are three projects listed on the INRM Web site (<http://www.inrm.cgiar.org/documents/project.htm>):

- Sustainable Land Use in The Andes
- Production and marketing of NTFP in West-Central Africa
- Partnerships for regional subsurface ecosystem management and groundwater assessment in arid and semiarid lands.

There is also a forum for discussion of INRM issues (<http://www.inrm.cgiar.org/documents/forum.htm>).

Quality

The Cali workshop suggested that “success” in INRM endeavours might be described in terms of the following (Task Force on INRM, 2001):

- Improvements in livelihoods, system resilience, system productivity, and environmental services that benefit many people over a large area.
- The improvements above attributable to the development and scaling out of a set of innovations (developed through INRM research) that address key problems.

Mechanisms in place for vertical and horizontal scaling up and scaling out.

- Local institutional innovations that empower communities to continue the process of experimentation with and adaptation of natural resources management strategies beyond the project life span.

The Sustainable Livelihoods Approach (SLA) developed by DFID was discussed at Cali as an approach that may complement INRM conceptual frameworks (Task Force on INRM, 2001). There was also discussion as to whether CG work, and INRM more specifically, is best conceptualised as a people-centered or NRM system-centered approach. Some participants felt strongly that “NRM without people is called evolution.” There are many issues that an SL approach takes into account that INRM many not (for example, the role of AIDS, conflict and other variables in shaping people’s lives and NRM). It was agreed that for the balance between a people-centered and system-centered approach will be different for different types of projects.

Impact

Nothing specific to INRM was found.

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INRM summary prepared by Douglas R. Brown, Cornell University.

15. International Plant Genetic Resources Institute-IPGRI

Main Web page: www.ipgri.cgiar.org

Stated Aims

IPGRI is an international research institute with a mandate to advance the conservation and use of genetic diversity for the well-being of present and future generations. IPGRI focuses on the conservation and use of genetic resources important to developing countries and has an explicit commitment to specific crops.

(<http://www.ipgri.cgiar.org/system/page.asp?theme=2>).

IPGRI believes that “through the collective, concerted action of farmers, forest dwellers, pastoralists, scientists, development workers and political leaders, the full potential of the Earth’s plant genetic diversity will be harnessed to eradicate poverty, achieve food security and protect the environment for the benefit of present and future generations”

(<http://www.ipgri.cgiar.org/system/page.asp?theme=2>).

Activities

IPGRI works to meet three major objectives:

- countries, particularly developing countries, can better assess and meet their own plant genetic resources needs
- international collaboration in the conservation and use of genetic resources is strengthened
- knowledge and technologies relevant to the improved conservation and use of plant genetic resources are developed and disseminated (see <http://www.ipgri.cgiar.org/system/page.asp?theme=2>)

IPGRI has chosen eight areas of work, which each address one or more of the institute’s three objectives, is essential to the fulfillment of its mandate, and reflects strong demand from its partners. All are areas in which IPGRI has a comparative advantage. The areas are as listed below. I have included brief descriptions for projects that have a NRM component or involve the dissemination of knowledge:

- [Strengthening national systems](#)
- [Working with networks](#)
- [Improving conservation strategies and technologies](#)

Advances in conservation science can increase the effectiveness of efforts to conserve and use genetic resources. IPGRI investigates and develops new options for overcoming the problems of *ex situ* conservation, seeks to improve *in situ* conservation (including on-farm crop management), and explores the combined use of *ex situ* and *in situ* approaches.

- [Increasing the use of plant genetic resources](#)
- [Managing and communicating information](#)

To promote the use of plant genetic resources, IPGRI helps national programs to analyze and document their own collections and gain access to information on other collections. In addition, the Institute provides information services and has extensive publishing and public awareness activities on:

- [Addressing socioeconomic and policy issues](#)
- [Conserving and using specific crops](#)

PGRI takes special responsibility for the conservation and use of certain important and potentially important crop species, especially when these are not included in the mandates of other international agricultural research institutes. A major focus of our work is on bananas

and plantains. In addition, coconut and cacao also receive attention at present. Neglected or underused species that are regionally or locally significant and that are threatened by genetic erosion also receive support, as do wild or semi-domesticated species, especially the wild relatives of major food crops.

The conservation of forests and the diversity they contain is one of the most urgent tasks facing humanity. IPGRI's work on forestry deals mainly with the *in situ* conservation of intraspecific diversity in those key species that are at the greatest risk of overexploitation. The institute also aims to improve *ex situ* conservation methods for forest genetic resources. (An International Institute at <http://www.ipgri.cgiar.org/system/page.asp?theme=2>)

IPGRI also has three programs. They are:

- The Plant Genetic Resources Programme, which supports the efforts of national, regional, and international systems to conserve and use plant genetic resources. This is IPGRI's largest program.
- The [International Network for the Improvement of Banana and Plantain \(INIBAP\)](#), which works to increase and sustain the productivity of bananas and plantains grown on smallholdings.
- The CGIAR Genetic Resources Support Programme, which provides advice and services to the CGIAR in the area of genetic resources policy, and enhances the System's work on genetic resources through the [CGIAR System-wide Genetic Resources Programme \(SGRP\)](#).

IPGRI's activities are implemented through 20 multidisciplinary projects that are regional or global in scope. More about these projects can be found at <http://www.ipgri.cgiar.org/system/page.asp?theme=2>.

IPGRI's Forest Genetic Resources Programme began in 1993 following IPGRI's decision, based on the recommendation of TAC and the CGIAR in 1991, to expand its mandate to include forest genetic resources. The specific goal of IPGRI's FGR Programme is to ensure the continuous availability of these resources for present and future use, through *in situ* and *ex situ* measures that allow species adaptation and evolution to changing environments. The FRG program is involved in 1) strengthening institutional frameworks and contributing to international collaboration and policy making, and 2) generating knowledge and developing appropriate methods and tools for conservation and use of forest genetic resources. IPGRI's FGR Programme generates knowledge and promotes the development of methodologies and tools to allow more effective and sustainable conservation and use measures in the following key areas: assessment of the extent and patterns of losses in forest diversity at the genetic, species, and ecosystem levels; design of *in situ* conservation programs; development of *ex situ* conservation options; identification of national priority ecosystem and species for research; locating and measuring genetic diversity (information on IPGRI's Forest Genetic Resources is found at <http://www.ipgri.cgiar.org/programmes/grst/FGR/home.htm>).

Quality

“The Panel has observed that the Institute is shifting more emphasis from ‘conservation for use’ to ‘conservation and use’ as illustrated by its leadership roles in networks or activities in bananas and plantain improvement (with INIBAP), coconut (with COGENT), and in cacao and other crop plants... During the past two years it has organized an activity, planned for nine countries, on local or *in situ* conservation of crops and crop relatives in farmers’ fields and home gardens.... The Panel was pleased to note that more than 100 expeditions were conducted during the period of this review and training activities for more than 830 scientists and technicians in genetic resources management were completed, thus contributing significantly to human resource capability for conservation” (Report of the Fourth External Programme and Management Review, p. xxx).

Although the Panel was pleased with IPGRI’s accomplishments and progress, it made recommendations concerning: strengthening the linkages between strategic program planning and the resulting operational aspects; cautioning IPGRI in assuming new leadership roles in networks with respect to resources required; strengthening collaborative linkages with CGIAR Centers; building capacity for management of technical genetic information and for training of genetic resources specialists; and continuing to provide strong leadership in the System-wide genetic resources effort (Report of the Fourth External Programme and Management Review, p. xxxi).

The Panel also noted that “the CGIAR, with its more recent emphasis on natural resources management for sustainable productivity and by the formation of SGRP, has acknowledged a broader scope in biological resource management. IPGRI maintains its own programs on plant genetic resources, but in response to this broader CGIAR scope, and as convener of the SGRP (System-wide Genetic Resources Programme), has extended its interests to those of other Centers, such as ILRI for domestic farm animals and ICLARM for aquatic genetic resources” (Report of the Fourth External Programme and Management Review, p. xxix).

“Dr. Qualset (the Panel Chair) explained that the PGR (Plant Genetic Resources) conservation framework was composed of: survey priorities, inventorying and monitoring, conservation strategy, conserved genetic resources (with a feedback to survey), and application. To operate such a framework required inputs from conservation biology, technology, agriculture and human resources development, as well as policy, information/documentation and finance. To enable the conservation framework to operate, IPGRI had a facilitation role which required collaborating with national agricultural research systems, international agricultural research systems, and specialized research organizations. It was pointed out that IPGRI should work on the methodology of inventorying and monitoring which will then lead to PGR conservation. With regards to SGRP, IPGRI needed help to deal with Centre Directors to see where to go in the future, including the question of fisheries and livestock genetic resources” (Draft Report of the Seventy-Second Meeting of the Technical Advisory Committee, p. 15). The TAC commentary also stated in response to the review that “as IPGRI is the only Centre in the CGIAR System which functions predominantly as a catalytic and facilitator institution, it would be useful to examine further the skills and competencies that are needed to operate most effectively in this way (Draft Report of the Seventy-Second Meeting of the Technical Advisory Committee, p. 19).

Impact

“TAC notes that the Panel did not address the issue of impact of IPGRI’s work. IPGRI is a young institution in its present form, and the impact of some of IPGRI’s work is likely to be difficult to access because of the service nature of its activities. However, IPGRI does engage in a number of activities whose impact should not be too difficult to assess, and TAC was informed in the discussion that impact assessment activities are underway at the Institute” (Draft Report of the Seventy-Second Meeting of the Technical Advisory Committee, p. 20). The document, however, does include assessment, achievement, and impact information on networks and thematic and regional activities. Nonetheless, I will not include the specific assessments here as they are formatted to look at IPGRI’s conservation of plant genetic resources and do not cover CGIAR’s broader definition of natural resources management.

IPGRI’s own Web site states that “IPGRI’s work has had considerable impact on the conservation and use of plant genetic resources worldwide. IPGRI has sponsored over 550 germplasm collecting missions in 136 countries. Many national genebanks have been established with the Institute’s assistance, and more than 2000 national scientists have been trained. Over 150 countries now participate in the 50 or so networks whose development has been supported by IPGRI. Through its research, IPGRI has contributed to a better understanding of genetic diversity and to major advances in conservation strategies and methods, especially in such areas as *in vitro* conservation and ultra-dry seed storage. This work has led to the production of guidelines on genebank technology and on genetic resources management. The Institute has also contributed to international and national policy-making, through its studies on issues such as intellectual property rights and access regimes” (IPGRI’s Impact at <http://www.ipgri.cgiar.org/system/page.asp?theme=2>).

Resources Consulted

Documents

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Web Sites

IPGRI. IPGRI’s main Web page at www.ipgri.cgiar.org

IPGRI. About IPGRI at <http://www.ipgri.cgiar.org/system/page.asp?theme=2>

IPGRI. IPGRI’s Impact at <http://www.ipgri.cgiar.org/system/page.asp?theme=2>

IPGRI. Programs and Projects at <http://www.ipgri.cgiar.org/system/page.asp?theme=2>

IPGRI. An International Institute at <http://www.ipgri.cgiar.org/system/page.asp?theme=2>

IPGRI. About IPGRI’s Forest Genetic Resources at

<http://www.ipgri.cgiar.org/programmes/grst/FGR/home.htm>

IPGRI summary prepared by Joy Learman, Cornell University.

16. IRRI — International Rice Research Institute

Main Web page: <http://www.irri.org>

Stated Aims

“Goal: Improved well-being of present and future generations of rice farmers and consumers, particularly those with low incomes. Objectives: To (a) generate and disseminate rice-related knowledge and technology of short-and long-term environmental, social and economic benefit; and (b) help enhance national rice research systems” (Fifth External Review, p. 18). IRRI is dedicated to helping farmers in developing countries produce more food on limited land using less water, less labor, and fewer chemical inputs, without harming the environment” (<http://www.irri.org/>)

“Role and Responsibility: IRRI’s role as part of an international scientific community is to contribute worldwide to the improvement of rice technology and maintenance of the natural resource base, and to the development of human resources in research and related activities” (Fifth External Review, p. 18). However, it seems that more needs to be done to fulfill its responsibilities in the area of natural resources management. IRRI’s strategic plan for 1994-1998, revised in 1993, did not even explicitly mention natural resources management as an objective (Fifth External Review, p. 19).

Activities

IRRI accomplishes its goals through: “Interdisciplinary research programs; anticipatory research initiatives exploring new scientific opportunities; the conservation and responsible use of natural resources; the sharing of germplasm, technologies, and knowledge; the participation of women in research and development; partnerships with farmers, farming communities, research institutions, and other organizations that share IRRI’s goals” (<http://www.irri.org/Aboutirri.htm>).

IRRI attempts to preserve “natural resources in the face of the growing intensification of rice-based systems due to increased population pressure.” It is also trying harder to understand the impact of intensive rice cultivation on natural resources and the impact of its work on global environmental issues such as global warming (<http://www.irri.org/Aboutirri.htm>). In the past, IRRI’s main focus was increasing food security. This is still a main focus, however, through its research it realizes that this can be done while preserving the environment. It is working to protect rice-growing regions which “cover about 11 percent of the Earth’s arable land...” (www.irri.org/AR2001/Forward.htm).

In relation to intellectual property rights (IPR) and the sharing of global public goods, IRRI would like to make materials and information more readily available to its stakeholders (www.irri.org/Aboutirri.htm).

Quality

The Fifth External Programme and Management Review stated that soil carbon and nitrogen dynamics in intensive rice systems deserve more attention in regards to IRRI's research agenda, as nitrogen supply has been associated with soil productivity rates. In a letter to Donald Winkelmann and Alexander von der Osten (Chairman of the Technical Advisory Committee and Executive Secretary of CGIAR, respectively), Robert Havener and Roelof Rabbinge stated that one of IRRI's main areas that needs further discussion and intensive attention is "strengthening research on natural resources management including water, as part of the development of sustainable rice agro-ecosystems." It also needs to affirm a more explicit system of "intellectual property and private sector linkage policies" (The Fifth External Programme and Management Review, p. 1 of letter).

However, the summary and recommendations section of the review stated that "Research on natural resources management is well integrated with productivity improvement research. Since the last EPMP, IRRI has mounted a sizable programme to understand the reasons for productivity decline in intensive rice systems observed on experiment stations. However, the Panel concluded that this work requires organizing in ways that allow the interdisciplinary potential to be realized in a strategic programme" (The Fifth External Programme and Management Review, p. xxx).

The Agronomy, Physiology, & Agroecology Division (APPA) of IRRI includes resource management as one of its research topics including "direct seeding involving tillage, and soil, water, and weed management." "During the period of 1993-1997, APPA scientists published 120 articles in refereed journals and 129 conference papers, book chapters, and other professional publications..." (The Fifth External Programme and Management Review, p. 58).

The Panel stated that "the advances in the biological sciences promise great increases in the ability of the rice crop to use the physical resources of the environment in generating yield and quality. The core NRM research on how the crop interacts with soils, water, and the atmosphere must therefore be maintained, and it is important to consider whether this resource base can be improved in terms of its ability to support the rice crop, or if it is fully sustainable." The Panel also suggests that IRRI collect statistics regarding the loss of high-quality irrigated land to rice cultivation as part of its Ecoregional studies. "The ability to deploy crop modeling in predicting the best use of land is important, as it allows all the interacting factors in the environment to be included in the assessment (The Fifth External Programme and Management Review, p. 80).

A CGIAR NGO Committee has visited IRRI along with other Future Harvest sites and will work to "define a natural resources management strategy aimed at poverty alleviation, food security, and sustainable agriculture in the developing world." The results will help in finding "the best operational natural resources management strategy to fulfill the CGIAR mission" (Mobilizing Science for Global Food Security, p. 48).

Impact

IRRI's research activities began in 1962 and are now estimated to have touched the lives of almost half the world's population (www.irri.org/Aboutirri.htm).

“IRRI developed the first semidwarf breeding lines for rice in the mid-1960s. The high yields and rapid farmer adoption of the new grain varieties triggered the Green Revolution. National agricultural programs worked in cooperation with IRRI to intensify rice production. The IRRI rices were soon followed by dozens, then hundreds, of semidwarfs developed by scientists in national programs.”

“Over the years, rice scientists have been able to incorporate ever-improving elements of resistance to major insects and diseases in successive modern varieties. This has not only helped to reduce farmers' dependence on harmful agrochemicals but also decreased costs and thus boosted incomes. Scientists have also bred varieties that mature faster and so save land area; that have improved grain quality and so allow farmers to obtain better prices; and that tolerate drought, submergence, and poor soils and so allow farmers to maintain yields even under difficult conditions” (www.irri.org/Aboutirri.htm). IRRI is currently working with CIMMYT to develop and promote zero tillage agriculture which can save as much as 30-50 percent of water per year, increase harvest, cause fewer weeds and reduce production costs. Future impacts may be dramatic.

Resources Consulted

Documents

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Web Sites

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IRRI. IRRI Annual Report 2000-2001 at www.irri.org/AR2001/Forward.htm

IRRI. New IRRI Publications at www.irri.org/pubcat2000/newtitles.htm

IRRI. Rice Science for a Better World: International Rice Research Institute at www.irri.org

IRRI summary prepared by Joy Learman, Cornell University.

17. ISNAR- International Service for National Agricultural Research

Main Web page: <http://www.isnar.cgiar.org>

Stated Aims

ISNAR's mission is to “support the institutional development of agricultural research in developing countries” (http://www.isnar.cgiar.org/about_isnar/index.htm). ISNAR seeks to contribute to the generation and use of knowledge that fosters sustainable and equitable agricultural development. It strives to foster innovation in agricultural research institutions in order to increase the contribution of research to agricultural development for the poor (http://www.isnar.cgiar.org/about_isnar/strategy.htm).

The Third External Programme and Management Review states that “its ultimate goal is to assist developing countries in improving the effectiveness and efficiency of their agricultural research systems through enhanced capacity in the areas of research policy, and organization and management” (p. 1).

Activities

“The International Service for National Agricultural Research (ISNAR) assists developing countries in bringing about lasting improvements in the performance of their national agricultural research systems and organizations. . . . ISNAR's services to national research are ultimately intended to benefit producers and consumers in developing countries and to safeguard the natural environment for future generations.” To maximize the impact of its work in developing countries, ISNAR focuses on three objectives:

- enhancing the capacity of agricultural research organizations to respond to their clients' needs and to emerging challenges
- expanding global knowledge on agricultural research policy, organization, and management
- improving developing countries' access to knowledge on agricultural research policy, organization, and management (http://www.isnar.cgiar.org/about_isnar/mandate.htm)

ISNAR's current emphasis on institutional innovation is broken down into six thematic work areas. The projects arise from ISNAR's analysis of global and developing-country research trends and of ISNAR's comparative advantage to deliver high-quality global public goods in the following areas (http://www.isnar.cgiar.org/about_isnar/mtp_2004/mtp04-2.htm#_Toc509049280):

- [Policies for institutional innovation for agricultural research](#)
- [Linking research organizations and stakeholders in a changing context](#)
- [Learning for institutional innovation](#)
- [Management of new technologies for agricultural research](#)
- [Building capacity to respond to cross-sector demands](#)
- Entrepreneurial partnerships to support agricultural research

ISNAR has found that agricultural research is increasingly asked to deal with nonagricultural concerns, such as natural resources management. Techniques must be found to satisfy both income demands and quality of life. ISNAR is also finding that rigid research boundaries between agriculture, forestry, fisheries, and other natural resources are breaking down. ISNAR's efforts in this area focus on environmental and health issues. Work most directly addressing NRM issues deals with the development of research models in which agricultural and environmental interests are treated with equal importance (http://www.isnar.cgiar.org/about_isnar/strategy.htm).

Discussions about these issues resulted in a new "road map" for ISNAR, entitled "*Institutions Matter: Let Knowledge Make the Difference*." "It reflects the recognition of the changed environment. It shifts the focus to developing a new understanding of how various sectors in civil society must interact to ensure that poor people are not left behind in agricultural development, and how the talents and energy of new sectors in society can be brought to bear for better food security and wiser use of natural resources." These changes have led ISNAR to decrease its number of projects from 18 in 2000 to 12 in 2001 and to 6 in 2002-2004. Without abandoning the activities and experiences of previous years, the new MTP consolidated and refocused the thematic areas in which ISNAR has traditionally been active. In 2001, 6 projects were discontinued due to (1) a refocusing on activities that enhance ISNAR's concern with institutions that are necessary for successful research on poverty, sustainable food security, and environmental protection, and (2) an immediate adjustment to reduced funding (http://www.isnar.cgiar.org/about_isnar/mtp_2004/index.htm).

ISNAR's new structure has not yet been reviewed as it is still quite new. The Third External Programme and Management Review focused on ISNAR's old structure, so I will mention it briefly here. In the 1990s, ISNAR's program structure included three major Programs: Research Policies and Systems Strategies (RPSS), Research Program Design and Management (RPDM), and Management of Organizations and Resources (MOR). Five major strategic directions and three themes were defined to guide the development and the execution of its programs and services in those years. The three major themes were: institutional sustainability, assessment of institutional performance and institutional implication of research in natural resources management.

ISNAR's Research Policy and System Development Program has three themes: Policy Development, Research System Development, and New Challenges. The priority setting and impact assessment sub-theme under Policy Development institutionalizes priority setting tools to include a natural resources management project on multi-purpose trees, one on livestock priority setting, and another on integrating biotechnology. In the area of system development's sub-theme "transnational cooperation," a project exists called West Africa G 4 (Research Management Network). In this project Niger coordinates the physical resources management. Under the new challenges theme's NRM sub-theme, there are 10 projects whose objectives are to assist NARS policymakers to clarify the NRM issues at a conceptual level, provide scientific measures of the importance of the problem or opportunity, and explain the consequences of alternative actions. ISNAR states that its new challenges' sub-theme on natural resources management is:

1. Closing the loop: NRM-oriented agricultural research policy formulation

2. Kenya: NRM-based research programming
3. Ecoregional initiatives
4. Planning NRM research

(Third External Programme and Management Review, p. 59). (Third External Programme and Management Review, pp. 15, 50-52, and 59).

Quality

“ISNAR’s one-liner ‘catchphrase’ is *‘Institutions Matter: Let Knowledge Make the Difference’* and this is very timely and appropriate. Strong and responsive institutions in agricultural research are the cornerstone of technology-induced agricultural development, and thus of poverty alleviation (about 70 percent of which worldwide is in rural areas), food security and the preservation of the resource base” (CGIAR Mid-Term Meeting, p. 42).

“In the panel’s view, ISNAR should develop a distinctive competence to lead (1) in the production, acquisition, and delivery of knowledge and information about the policy, institutional environment, and management of NARS, and (2) in the provision of services based on this knowledge to improve the policies and management of the organizations, partnerships, and linkages of NARS in the poorest countries” (Third External Programme and Management Review, p. xxiii). “First, ISNAR should move more towards the research-based end of the service spectrum, gradually leaving the less research-based part to competitors and other service providers. Underlying this recommendation is the recognition of the need to more fully exploit the comparative advantage of ISNAR as a provider of public goods that others cannot easily produce. Second, ISNAR should increasingly pay attention to the building and strengthening of institutional capabilities, both within and outside NARS, in countries and regions so that the functions/services being provided by it from a distance could be performed by appropriate organizations and groups in closer proximity to NARS” (Third External Programme and Management Review, p. xxiv).

The Third External Review declared that “during the period under review, ISNAR’s activities and outputs expanded substantially compared to the preceding period, and its contributions towards the mission of strengthening NARS have, on the whole, been positive” (p. xxiv). However, in view of the changing global environment, the review called for a strategic repositioning of the Center.” “TAC Chair Donald Winkelmann summarized TAC’s views on the assessment, stressing the need for ISNAR to adopt a more systematic approach to priority setting and TAC’s broad endorsement of the panel’s recommendations. Both TAC and ISNAR noted that one shortcoming of the review was the limited attention it gave to analysis of ISNAR’s collaboration with other CGIAR Centers and with FAO.” It was recommended that ISNAR should more clearly define its niche, better focus on capacity building, operate on the basis of a broad NARS concept, focus on weaker NARS and collaborate with stronger NARS as needed in regional efforts and within the context of a clearly articulated strategy” (CGIAR Mid-Term Meeting, p. 66). Minor recommendations mainly center on topics such as: improving research quality; targeting policy makers; developing strong allies; priority setting; attracting internationally recruited staff; and enhancing human resource strategies etc. (Third External Programme and Management Review, pp. xi-xiii).

Impact

“The assessment of ISNAR’s strategy cannot possibly ignore the rather difficult environment in which the institution carried out its work. In fact, the period under consideration was characterized by financial insecurity and budget reductions both at the international level and in its partner countries. At the same time this financial crisis was taking place, the needs and demands from NARS were significantly increased due to a changing global scenario that called for a much broader research agenda.... This unbalanced scenario in terms of available resources and demands certainly had a negative effect on the potential impact of ISNAR’s work” (Third External Programme and Management Review, p. 7).

Regarding ISNAR’s overall impact, the review stated that “ISNAR has made significant achievements, its work is of good quality, and NARS and stakeholders generally report favorably about what ISNAR is and does.” The report concludes: “ISNAR has an important role to play in strengthening the management of agricultural research internationally. ISNAR carries out this role with vigor, resulting in a high level of client satisfaction and significant impacts on NARS and their constituent organizations. ISNAR has earned a good reputation for itself in the process.” ISNAR is also credited with “major contributions in raising awareness about policy, planning, organization, and management issues and putting them on the agenda of research institutions, particularly national institutions.” ISNAR influences policy through its policy-related research, its advice to clients on policy matters, its information products of value to those involved with the analysis or making of policy, and by its training, workshops, and seminars in policy-related areas. Two-thirds of those asked said ISNAR had a positive impact in the area of formulating of agricultural research policy” (Third External Programme and Management Review, pp. 18-19). It is mainly through this policy-related research that the impacts of natural resources management are played out. NRM research has a policy dimension involving decision makers at various levels concerned with issues of (a) spatial equity, or who captures the gains and bears the cost of resource exploitation, (b) intertemporal equity — protecting the resource base for future food security, and (c) productivity or opportunity costs of investing in low-potential areas. NARS leaders struggle with these issues as much as the CGIAR itself. ISNAR’s guiding principles on these strategic issues are welcomed at a time of shrinking resources for NARS (Third External Programme and Management Review, p. 52).

“NARS and other stakeholders expressed satisfaction with ISNAR’s work and services, which had resulted in a considerable increase of ISNAR’s outputs and improvement in their quality over the last five years. Nevertheless, TAC supports the Review’s findings that some important directional changes are required to help ISNAR respond effectively to a rapidly changing external environment and to develop a more coherent research agenda. The Committee strongly endorsed the recommendation that ISNAR should develop a new strategic plan and considered that the Centre should carefully review its priority-setting process” (Draft Report of the Seventy-Second Meeting of the Technical Advisory Committee, p. iv).

The review stated that “ISNAR should also be praised for its timely publications on strategic issues such as biotechnology, natural resources management, and private-sector participation in agricultural research.” Goldsworthy in the Policy Program published eight external publications on NRM issues from 1993-1995. One clear NRM output is in policy

development. The resources for research sub-theme has two projects on information technology in the Indian Council for Agricultural Research and the Philippines Council for Agriculture, Forestry and Natural Resources Research and Development. This sub-theme addresses the slowdown in public agricultural research expenditures and access to knowledge. Projects in this area (especially the Indicator Series and the research financing projects) have led to several important publications containing useful data and quantitative analyses. (Third External Programme and Management Review, pp. 53 and 62).

Resources Consulted

Documents

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ISNAR. ISNAR's Main Home Page at <http://www.isnar.cgiar.org/>

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ISNAR summary prepared by Joy Learman, Cornell University.

18. International Water Management Institute (IWMI)

Main Web page: www.cgiar.org/iwmi/

Stated Aims

The International Water Management Institute is a non-profit scientific research organization specializing in water use in agriculture and integrated management of water and land resources. IWMI works with partners in the South to develop tools and methods to help these countries eradicate poverty and ensure food security through more effective management of their water and land resources.

Mission

Improving water and land resources management for food livelihoods and nature.

Objectives

- Identify the larger issues related to water management and food security that need to be understood and addressed by governments and policymakers.
- Develop, test and promote management practices and tools that can be used by governments and institutions to manage water and land resources more effectively, and address water scarcity issues.
- Clarify link between poverty and access to water; help governments and research community better understand water-related problems of poor people.
- Help developing countries build their research capacities to deal with water scarcity and related food security issues (Overview at www.cgiar.org/iwmi/about/intro.htm).

Activities

IWMI has research projects running in 21 countries in Asia and Africa. Work is coordinated through regional offices located in India, Pakistan, South Africa, Sri Lanka, and Thailand. The Institute has sub-regional offices in China, Nepal, Ghana, Kenya, Senegal, and Uzbekistan (Overview at www.cgiar.org/iwmi/about/intro.htm).

Research Themes

IWMI's research is organized around five themes, selected based on two criteria: 1) they address issues crucial to developing countries, and 2) they comprise areas where IWMI has the resources and expertise to make a significant contribution.

1. Integrated Water Resource Management for Agriculture: This theme brings together much of the core of the Institute's expertise, knowledge base and research outputs that have been produced over the past five years. Over the coming five years, this research will be deepened — concentrating on the areas of irrigation management, river basin analysis, and global-scale strategic analysis of water resources.

- IWMI is looking at irrigation management from the perspective of the competing uses of water in river basins, including agriculture, nature, local communities, cities, industry, etc.
- IWMI is adapting and applying modern information technologies and research tools for gaining new insights into irrigation performance at multiple scales (farm, irrigation system, and basin).
- IWMI is working to uncover key insights into the determinants irrigation performance and to provide tools and processes for improved water and irrigation management.
- WMI is joining with others to “rethink” the role of irrigation in food production, poverty reduction, and environmental security. This assessment will be a critical input

to the global debate on water-food security issues that is at present severely constrained by lack of science-based knowledge.

Objectives

- Develop and apply new research methodologies for assessing and improving irrigation water management performance in an integrated water resource management framework; and
- Identify key methodologies, processes, and actions that will contribute to poverty reduction and food and environmental security.

2. *Sustainable Smallholder Land and Water Management*: This theme involves identifying and evaluating water and land use innovations developed by poor communities and promoting their transfer to benefit people in other areas. Across Asia and Africa many villages and poor communities have developed novel approaches for handling scarce water and land resources. This research theme concentrates on identifying these promising innovations and evaluating them to understand why they work. Examples include treadle pumps, bucket and drip irrigation technologies, and water-harvesting initiatives.

The final step is to study how these practices can be adapted and transferred to help improve the livelihoods of the poor in other countries. The end result of this research is tools, concepts and ‘appropriate technologies’ that help poor people farm small landholdings more profitably and sustainably. Additional information was not available on the Web site.

3. *Sustainable Groundwater Management*: The goal of IWMI’s research in groundwater is to contribute to achieving sustainable use and management of groundwater in ways that promote food and livelihood security for the poor women and men in Asia and Africa.

- IWMI is assessing the extent of groundwater and groundwater irrigation.
- IWMI is understanding factors contributing to overdraft and contamination.
- IWMI is looking at groundwater quality and health.
- IWMI is interested in waterlogging and secondary salinization.
- IWMI is looking at techno-economics of conjunctive use of surface and groundwater, and of large-scale recharge programs.
- IWMI is assessing worldwide inventory of problems and successful approaches.
- IWMI is devising policies, technologies, and institutions for sustainable management.
- IWMI is investigating groundwater, poverty and gender linkages

Objectives

- To develop and disseminate a more accurate and refined understanding of the socio-ecological value of groundwater, and highlight the nature and scale of the consequences of its unsustainable use.
- To identify promising technologies and management approaches with potential to help achieve sustainable groundwater use. To research, evaluate and promote their potential to help achieve sustainable groundwater use.
- To aggressively promote solutions for sustainable groundwater use among strategic players in national and regional groundwater systems.

4. Water Resource Institutions and Policies: This research theme focuses on understanding how governments, communities, and entire societies change their habitual behavior in managing water resources when faced with water scarcity. To gain this insight requires a detailed study of laws and rule — making, policies, and institutional arrangements in developing countries — ranging from the community to the regional and national levels. The goal of this research is to produce knowledge-based guidelines and best practices in institutions and policies that allow countries to deal with specific types of water management problems. This research theme deals with institutional and policy implications of:

- Strategies for enhancing water productivity (at national, basin and local levels).
- Integrating poverty and gender concerns into national and sub-national water management regimes.
- Managing water scarcity and its consequences.
- Farmer-led/participatory irrigation management.

Objectives

- To understand the institutional arrangements and policy frameworks with the highest potential to improve the productivity of water in ways that promote livelihoods for poor men and women, and environmental sustainability. This will be achieved through a program of thorough systematic comparative research.
- To identify, test and evaluate research-based guidelines for water policy reform that lead to more effective management of water in river basins. The avenues explored will include organizational options and roles and support systems for the local management of irrigation.
- To test and validate the application of internationally established best practices so that they are effective in the regional and sub-regional contexts

5. Water, Health, and Environment: IWMI's research under this theme focuses on ways agricultural water use impacts human health and the environment. Its approach is based on agro-ecosystem management — where maintaining ecosystem sustainability means safeguarding its natural resources and the health of people who rely on it.

Objectives

- To put health and environmental issues on the water management agenda.
- To create tools to better address the health & environmental aspects of water in agriculture (Overview at <http://www.cgiar.org/iwmi/about/intro.htm>).

IWMI's Strategic Plan

IWMI's Strategy 2000-2005 is a road map that guides the Institute's research agenda. It identifies problems that need to be solved related to water, poverty, and rural development; chooses areas where IWMI is confident it can make a contribution — an impact that grows out of research findings — and explains how IWMI will organize itself to deliver on this commitment. From discussions with various shareholders, a series of facts and conclusions grew about how the Institute can best move forward. Examples are:

The Institute has expertise in certain areas that can be capitalized on. Two new research themes were formed to bring out specific areas of excellence that were “hidden” in general research activities. The themes are smallholder water and land innovations and sustainable groundwater questions.

More research “firepower” is needed to tackle a broader research agenda. A post doctoral program was started, and a first group of young professionals joined the Institute in January 2001. Through this program IWMI will increase its research ranks by up to 50 researchers, many from the South, over five years.

Research goals are quantifiable and impact-oriented. The Institute has a wealth of research that will be more aggressively disseminated and put into the hands of users. The new work plans that guide each of IWMI’s five research themes are as specific as possible about the type of outputs (in terms of types of tools and practical materials to be delivered) and impact (in terms of people affected). A series of strategic partnerships have been signed with national agencies, international NGOs with broad local links and research institutes with complementary expertise. The goal of these partnerships is to bring research results to users (Strategic Plan 2000-2005: From Research to Impact at www.cgiar.org/iwmi/about/strategy.htm).

Benchmark River Basins: IWMI’s Laboratories

A series of Benchmark River Basins complements the work of the Research Themes. These are IWMI’s ‘field laboratories’, where water management tools and concepts are tested in real-life situations and data is gathered on an ongoing basis. A further impact of this activity is the long-term partnerships that IWMI will forge with local universities, research institutes, national authorities and others in the countries where Benchmark Basins are located. Benchmark sites are being established in Sri Lanka, Pakistan, and Southern Africa in 2001. By 2005 there will be some 10-12 such Basins across Asia and Africa (Strategic Plan 2000-2005: From Research to Impact at www.cgiar.org/iwmi/about/strategy.htm).

Quality

In 1991, IIMI became a member of the CGIAR System. The first External Program and Management Review (EPMR, 1994) of the Institute recommended a shift to more strategic research in irrigation water management. The research program now includes consideration of water management and irrigation issues at a global scale with a central theme concerned with the emerging problem of regional water scarcity. Consistent with this theme, research attention has been focused through the notion that water management can only be sensibly considered within a river-basin context. This emphasizes that all water within a basin is interconnected and that use or reuse of water in one part of the basin can affect water users in other parts, especially those downstream. With this direction, IWMI has, over the last five years, established itself as a strong science-based organization concerned with the more effective management and productive use of water as a key resource to ensure the continued increase in world food production.

A TAC letter responding to the external evaluation stated: “IWMI has undergone a major transformation since the time of the last EPMR, not only in its name and mission statement but more importantly in its programmatic focus and strategic orientation. For a Center of its size, its research achievements are clearly impressive. The Report emphasized the high quality of science being done by IWMI and its partners and the increased recognition and acceptance by water management specialists internationally. TAC believes IWMI has indeed found a niche for itself in the global sphere of research on water management. . . . Looking to the future, we believe that issues related to the efficient and equitable distribution and management of water by multiple users in various sectors will loom even larger. IWMI has successfully demonstrated its ability to address some of these key global water issues and therefore, in our opinion, deserves the CGIAR community’s strongest support” (Report of the Second External Programme and Management Review, pp. iii-iv).

“TAC [also] agrees with the Panel’s assessment of the Centre’s need for setting clear priorities in order to focus its research efforts on the most critical issues within a global water management research framework. This is particularly relevant given the breadth of IWMI’s mission, the demands from the national programmes and the current financial resource constraints. . . . The current draft Strategic Plan does not provide sufficient guidance as pointed out by the Panel.” TAC also stated that “inter-Centre collaboration is essential in the case of IWMI, given the importance that water management has in the research programmes of many Centers of the CGIAR such as IRRI, IFPRI, ICARDA, ICLARM, ICRISAT, and CIFOR. It is imperative that strategic alliances are built between IWMI and other CGIAR Centres and that new incentives for collaboration are provided in view of the competition problems cited by the Panel . . . Furthermore, while TAC takes note of the strength and effectiveness of many of its diverse partnerships with national programmes, in some cases it appears that collaboration with national programmes may not be satisfactory, i.e., lacks sufficient ownership, and would therefore encourage the Centre to re-assess the way in which it relates to its NARS partners” (Report of the Second External Programme and Management Review, pp. v-vi).

The review Panel’s main recommendations related to research and water management, were as follows: add crop physiology expertise to the IWR program to facilitate incorporating or adapting components of complex plant growth models and to communicate better with other institutes that have this expertise; increase emphasis on the groundwater depletion problem; examine what further role PIM should have, if any, in IMT issues, particularly how much attention should be given to new and emerging problems often associated with IMT (such as equity in access to water, capacity of the private sector to manage water resources) and evaluation of turnover programs and policies that have failed; work on poverty, with special emphasis on its relationship with gender, be pursued in two directions; namely (i) investigating more precisely the relationship between poverty, gender and access to water and, (ii) incorporating more explicitly poverty and gender concerns in the design and conduct of research activities in programs other than PIM; and consider the implications of research results for the poor; careful attention be given to planning future PIM activities, based on a more formal, and more transparent, priority setting process; retain the research component dealing with irrigation-related health issues.

An effort will be made to obtain funding for research in Africa on controlling schistosomiasis through water management and on health impacts of small scale irrigation projects; increase its

capacity to develop a research effort on the effects of irrigation on downstream water resources by recruiting appropriate expertise in water quality and associated natural resources management; invest in researching the use of relevant information technology, remote sensing and modeling for use in irrigation and water management and recommends that this work should continue and, with respect to various modeling systems, that IWMI should continue to follow its current position of being a user, tester and adapter of existing models rather than being a primary developer; adopt more formal procedures for priority-setting and impact assessment (Report of the Second External Programme and Management Review, pp. xi-xvi).

Regarding the recommendation to increase IWMI's capacity to develop a research effort on the effects of irrigation on downstream water resources, IWMI stated that it agreed with the recommendation, but has found it difficult to raise sufficient funds to expand its work on environmental issues. However, IWMI agrees that more expertise on water quality and other environmental issues is needed to be able to be more successful in fund raising activities and in the building of a significant research effort on the effects of irrigation on downstream water resources.

The ad hoc committee concurred with the overall conclusions of the Review Panel and TAC that the review resulted in a positive overall assessment and commended IWMI for undergoing a successful transformation over the past six years to a broader, holistic, science-based and research-oriented approach to water management issues. The TAC noted IWMI's commendable effort in defining its mission, setting priorities, and implementing strategy, expressed satisfaction that IWMI is well positioned to exert strong leadership in developing science-based solutions to water management challenges, and encouraged its expanded collaboration with other CGIAR Centers to strengthen expertise in crop physiology.

The TAC further suggested that the System-wide Initiative on Water Management be continued, with some redesign and focus, and that more emphasis be put on strategic alliances and partnerships to deliver research outputs. It also called for a strengthened policy focus at macro and System levels, and urged rethinking of strategic planning and product delivery modes in light of the regional and ecoregional focus, noting in particular that groundwater depletion is a serious problem affected by macroeconomic policy issues as well as use of small pumps for irrigation. ITAC noted that health issues were best dealt with through strategic alliances with UNICEF, WHO, and similar organizations. The Committee also praised IWMI for adopting the Panel's recommendations that the Center enhance expertise in crop physiology, address issues of groundwater depletion, water quality, and natural resources management, increase emphasis on poverty and gender issues, retain research dealing with irrigation-related human health issues, and adopt more formal procedures for priority-setting (Report of the Second External Programme and Management Review, pp. iii-iv).

Impact

In responding to the review, TAC noted "with some concern that IWMI has yet to undertake any systematic effort to measure the impact of its work. This seems somewhat surprising given the number and quality of IWMI's research achievements and given the current culture of the CGIAR with its strong emphasis on demonstrating the impact of successful research on the mission and goals of the Centres. IWMI appears to be lagging behind other Centres in this area.

Notwithstanding the difficulty in trying to measure the impact of improvements in the way in which a critical input like water is managed, TAC recommends that high priority be given to impact assessment by the Centre” (Report of the Second External Programme and Management Review, p. vii). TAC did, however, note several importance activities taken on by IWMI, which include its contribution to the recent World Water Forum; notable research achievements including the evaluation of the global water scarcity problem; the integrated, holistic approach to water management (river basin perspective); new methodologies of water accounting; and insights on the relationships between water management and poverty, gender and health (Report of the Second External Programme and Management Review, p. vi).

The Report of the Second External Programme and Management Review, gave the following as achievements/outputs and impact on specific research programs:

Irrigation and Water Resources Programme (IWR): The achievements by the IWR Program, or its outputs, consist primarily of a series of IWMI publications and papers published in national and international peer-reviewed journals. The IWR staff has an impressive record of research publications over the past three years. Many of the publications are the result of joint activities with other programs or cooperators. Development of a set of indicators that relates outputs of irrigated agriculture, i.e., crop production, to inputs of land and water has been another major achievement of the IWR Program. The IWMI indicators have been used for diagnosis, intervention analysis, and as a routine tool for monitoring performance at the project level and in national programs.

At the ICID Congress in September 1999, more than 100 participants from some 50 countries took part in a half-day workshop on “Performance Assessment of Irrigation Systems” led by the IWR Programme Research Leader. Furthermore, the water accounting publications over the last three years, such as Research Report 20, and the recent paper in the International Journal of Water Resources Development (Molden and Sakthivadivel, 1999) are of excellent quality and their general and rapid acceptance by irrigation professionals indicates that results are relevant. Research conducted by staff in this program was also instrumental in the development of the IWMI global water supply and demand paper that will be presented at the Second World Water Forum in The Hague in March 2000. The study, which involved about 45 countries and about 85 percent of the world’s population, identified those countries where water scarcity would become severe by the year 2025. And finally, extensive experience by the staff in widely varying climates and farming, an ongoing activity, has enabled IWMI staff to identify new and unique techniques used in one area that have potential application for small-scale farmers in other areas (Report of the Second External Programme and Management Review, pp. 11-14).

Policy, Institutions and Management Programme (PIM): PIM has had significant achievements in the area of organizational design for irrigation systems. The work with irrigation management transfer (IMT) has been important in providing an ongoing assessment of this institutional innovation as it was being implemented in various national settings. PIM staff have also made important contributions to the analysis of gender poverty issues related to water management. Finally, the work on world water supply and demand done using the PODIUM model has received considerable and high-level attention as it has

been a major contributor to the preparation of the World Water Vision of the World Water Commission.

The PODIUM model itself is beginning to be widely disseminated, thanks in particular to the sponsorship of ICID. However, there has not been a formal assessment of the impact of PIM's research outputs, nor are there current plans for a formal exercise in this domain. There are some informal indicators of impact that can be noted. First, with regard to the topic of IMT, as noted above, IWMI's research findings have become an important public good widely used by irrigation departments and policymakers for initial planning, implementation, and assessment of their own IMT activities. Second, the research and publications by PIM staff have helped stimulate independent IMT work by other researchers in both advanced institutions and NARS (Report of the Second External Programme and Management Review, pp. 18-20).

Health and Environment (H&E): By and large it is too soon to evaluate the impacts of the H&E program on the well-being and health of those its research is expected to benefit. Nonetheless there are some early achievements that warrant mention. These include: a) IWMI and its collaborators helped establish and design programs for community-based diagnosis and treatment of malaria in Sri Lanka, which led to the development of village treatment centers. This concept has been used as a model in a World Bank-supported malaria project and the WHO "Roll Back Malaria" program. b) IWMI's studies of comparative costs of different malaria control measures have strengthened the economic arguments in favor of managing water levels in streams through the periodic release of water from upstream water reservoirs as an important means of malaria control. Further contributions have provided guidance to Ministries of Health on the lowest cost combinations of preventive and curative methods of limiting the incidence of malaria. c) Studies in Sri Lanka and Pakistan in 1997 and 1998 showed that an exclusive focus on water efficiency in agriculture could actually reduce the availability of domestic water in irrigated areas. These studies indicated the need for further research into determining which options were most appropriate for supply of good quality water for domestic purposes in areas where irrigation water is only supplied seasonally (Report of the Second External Programme and Management Review, pp. 27-28).

Applied Information and Modeling Systems (AIMS): In reviewing this program, the Panel has borne in mind that this is a newly formed group and that it has a specific service role to the other programs. The researchers now making up the group have published widely and the published work includes reports on previous work in Turkey and the development work on energy balance derivations of evaporation coming from remotely sensed data. The forthcoming special edition of the *Journal of Hydrology*, with AIMS staff as guest editors, includes world class papers from IWMI researchers that compare various methods of estimating evaporation at different scales. A number of publications are the result of joint activities with other programs and co-operators (Report of the Second External Programme and Management Review, p. 33).

One of IWMI's Web pages, entitled "Putting Impact on the Research Agenda" states that "IWMI does research for one reason: to have a positive impact on the activities and perspectives of policy makers, water managers and poor rural communities in developing countries." The Institute's research strives for impact at three levels:

- ***The global impact of IWMI's research:*** IWMI's research is acknowledged by many as having brought new thinking to the international agricultural research community on how water is used, measured, and valued. Through involvement in global initiatives, the publication of our research in international journals and the participation of our scientists in international conferences, IWMI is changing the way people think about water.
- ***The individual impact of IWMI's various research projects:*** Each IWMI project proposal includes a plan for impact assessment. While some impacts may not be experienced for a decade or more, a series of benchmarks should be established to determine whether or not the anticipated results of research are being achieved and to gauge or reassess the likely impact. At the individual project level, each project leader is responsible for assuring appropriate impact assessment for his or her projects.
- ***Capacity-building and the transfer of practical knowledge and tools to various levels of users in developing countries:*** IWMI's capacity building and training effort targets several types of partners: IWMI visiting scientists and post doctoral scientists from developing countries, national research institutes, and policy makers in developing countries. A capacity building strategy is being put in place to deliver information and experience to these partners. (Putting Impact on the Research Agenda at www.cgiar.org/iwmi/about/impact.htm).

Other methods to increase impact of IWMI's work include: Policy Roundtables discussions for the highest possible level of target group (Ministers/Secretaries); Ph.D. Scholarship programs at IWMI; NARS partnership program to develop long-term relationships with excellent universities and research institutes in Asia and Africa under the theme 'IWMI's Excellence in Water Resources Management Education Program'; IWMI Postdoctoral Fellowship program; and Private Sector program offering private sector consulting firms and institutes the opportunity to send staff to IWMI for three to six month periods as Visiting Scientists (Putting Impact on the Research Agenda at www.cgiar.org/iwmi/about/impact.htm).

Another IWMI Web site provided the following information regarding prospects for future impacts/outputs of several of its programs:

Integrated Water Resource Management for Agriculture: Better investments in water resources schemes and better management of water resources will lead to sustainable increases in the productivity of water — and better livelihoods for poor people in rural areas. As a result of these smarter investments, over a 20-year time horizon, IWMI expects less environmental degradation and less poverty. IWMI will achieve impacts using a three-pronged approach:

- Significantly influence how investments in irrigation development, improvement, and management are made, by feeding results of relevant research into the global debate on water for food and environmental security.
- Develop and disseminate research tools to enhance the understanding of the most critical issues in the management of irrigation water.
- Provide tools, processes, and knowledge that allow water resources managers to adapt and respond to new and changing needs and expectations.

Sustainable Groundwater Management: The key outputs of IWMI's groundwater research will be a series of research products-publications, models, analytical tools and policy papers. A significant portion of time and resources will be devoted to distilling practical lessons from ongoing field research and engaging strategic players-that are active from the policy to the community levels-in discussing ways of putting sustainable groundwater management into action. This research should result in the creation of strategies for sustainable development and management of the resource.

Water Resource Institutions and Policies: The following targets will guide the research focus of the Water Institutions and Policies research theme. This research will:

- Significantly facilitate and influence the process and design of the Catchment Management Agency as it evolves in the Olifants river basin in South Africa.
- Significantly shape and influence the development of Pakistan's Irrigation Management reform program.
- Organize 25 Policy Dialogues over five years, and do necessary follow-up activities to ensure that the IWMI Policy Dialogue emerges as a significant platform for raising and discussing front-line water policy issues on an annual basis-in India, Pakistan, China, and South Africa.

The outputs of this theme will be applied to institutional and policy research products, such as guidelines and examples of best practices from other countries and river basins. These products will be targeted at national policy makers and at the international and national research communities. Close partnerships will be developed with some 25 institutions in 8-10 IWMI priority countries, to create a network of institutional and policy research groups that will share research results (Overview at www.cgiar.org/iwmi/about/intro.htm).

Resources Consulted

Documents

TAC Secretariat. 2000. Report of the Second External Programme and Management Review of the International Water Management Institute (IWMI). October 2000.

Web Sites

IWMI. IWMI's Main Web Page at www.cgiar.org/iwmi/.
 IWMI. Overview at www.cgiar.org/iwmi/about/intro.htm.
 IWMI. Putting Impact on the Research Agenda at www.cgiar.org/iwmi/about/impact.htm.
 IWMI. Strategic Plan 2000-2005: From Research to Impact at www.cgiar.org/iwmi/about/strategy.htm.

IWMI summary prepared by Joy Learman, Cornell University.

19. SLP — System-wide Livestock Programme

Main Web page: <http://www.cgiar.org/ilri/research/proj8.cfm>

Stated Aims

The stated aim of the program, which began in 1995, is to support development of technology and policy options for improved production and utilisation of feed resources in rainfed crop-livestock systems and natural resources management (ILRI, 2000). The principal objectives are (ILRI, 1998):

- Build and strengthen links with and between plant-oriented Centers, so as to develop a coherent, integrated approach to the development of livestock feeds, the management of natural resources and creation of a supportive policy environment.
- Influence CGIAR resources invested in Center programs, ecoregional initiatives, and other system-wide activities so as to increase the effectiveness with which livestock feed and natural resources management issues are addressed.

Activities

Priority areas identified for ecoregional crop-livestock research on feed resources and the management of natural resources are (ILRI, 1998):

- Improving the nutritive value of crop residues
- Improving the feed resources available for smallholder dairying
- Matching livestock nutritional requirements with local feed resources in different agro-ecological zones
- Nutrient cycling to sustain cropping systems
- Use of forage legumes in cropping systems
- Use of fodder shrubs for livestock feed
- Practices and policies to improve management of fragile lands.

As of 1998, there were six proposals being developed for Phase II (ILRI, 1998):

- Finding the balance among competing uses for crop residues in mixed farming systems of sub-Saharan Africa, West Asia-North Africa, South and East Asia, and Latin America and the Caribbean. This has four modules, whose lead Centers are IITA, ICRISAT, and ILRI (the latter Center is responsible for two modules).
- Crop-livestock farmers in the dry savannas of Western Africa working with scientists to improve the productivity and sustainability of their farming systems. Lead Center: ICRISAT.
- Raising livestock productivity in the mixed crop-livestock systems of South Asia. Lead Center: ICRISAT.
- Improving crop-livestock productivity through efficient nutrient management in the mixed farming systems of semi-arid West Africa. Lead Center: ILRI.
- The maize crop as food, fodder and fertilizer in intensifying crop-livestock systems in East and Southern Africa. Lead Center: CIMMYT.
- Use of geographical information systems to target the multiple uses of legume technologies for sustainable agriculture. Lead Center: CIAT.

The principal outputs of this (phase II) program are the following (ILRI, 2002):

- Improved supply, quality, and quantity of livestock feeds through use of forage legumes, fodder shrubs, and crop residues
- Strategies and technologies for integrated food/feed production systems developed
- Models for constraint analysis and delivery of technologies in smallholder crop-livestock systems developed

Quality

A recent external evaluation (TAC Secretariat, 2001) found that it was difficult to accurately assess benefits at this early juncture. They noted that the initial implementation of the SLP was marred by unfulfilled expectations of adequate funding, which reflected negatively on the SLP itself and on the role of ILRI as the convening Center. The appointment of a full-time SLP Coordinator coincided with the streamlining of the SLP objectives and, with the new funding that at last became available, the program was effectively launched with the first set of projects in 1998.

The review panel felt, however, that, overall, the benefits will probably well exceed the costs — although the situation varies greatly by project supported. Some are excellent examples of the inter-Center collaboration envisaged at the outset. It has also been successful in launching a credible set of projects, and in attracting a modest level of additional financial support. To quote the review panel: “the SLP has resulted in much expanded inter-Center cooperation, it has the potential to multiply several fold, the likelihood of impact on smallholder crop-livestock systems, with its attendant impact on poverty and human well-being, and has provided important feedback to Centers on the multidimensional nature of many of their products and outputs. Building on these lessons, the Panel is convinced that SLP is indeed worth the effort of all involved, and that an even better job can be done in the future, providing, of course, that investors really get behind the worthy thrust that it represents and support a program of sufficient size and substance to justify the coordination costs.”

Impact

The intended impact is (ILRI, 2002):

- sustainable increases in productivity of target production systems within the ecoregions, leading to increased food security and reduction of poverty; and
- better use of feed resources and reduced competition for nutrients (for livestock and crops) in smallholder systems will also contribute to improved natural resources management and reduced environmental degradation.

In its first three years (1995-98), the main achievements of SLP were (ILRI, 1998):

- Strengthened links of the plant-oriented Centers with each other and with ILRI
- Coordinated planning and implementation of crop-livestock research by three ecoregional consortia.

The TAC Secretariat (2001) notes that there is preliminary evidence that SLP projects are producing outputs that increase the knowledge base relative to smallholder crop-livestock systems, and that would otherwise be coming at a slower rate. This includes not only knowledge relative to the niche for the different products of the plant-oriented Centers, but also their interactions with other biophysical and economic components of systems as well as some of their environmental impacts. Impacts on labor, poverty, and other socio-economic parameters still await additional documentation and analysis, but the SLP would need to continue for several more years until more definitive data on these issues can be generated. The review panel (TAC Secretariat, 2001) is of the opinion that SLP grants have had a positive impact on catalyzing productive research on feeds and NRM as well as relevant policy work.

Resources Consulted

Documents

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TAC Secretariat. 2001. The System-Wide Livestock Programme Center- and TAC-Commissioned External Review, May-June 2001 [24 Sept. 2001] (draft).

Web Sites

ILRI. 2002. System-wide Livestock Programme [Online]. Available by ILRI <http://www.cgiar.org/ilri/research/proj8.cfm> (posted — undated; verified 22/Jan/2002).

SLP summary prepared by Doug Brown, Cornell University.

20. SPIPM — System-wide Program on Integrated Pest Management

Main Web page: <http://www.cgiar.org/spipm/>

Stated Aims

The stated aim of SPIPM (established in 1995 and coordinated by IITA) is to enhance the effectiveness of Integrated Pest Management research and training in the context of international efforts to alleviate poverty and improve food security (SPIPM, 2002).

Activities

It is expected that SPIPM will produce the following outputs:

- Joint planning, ownership and promotion of IPM processes/results, and public awareness and policy commitment to IPM are increased
- Ecologically sound and client-oriented methodologies approaches to understand/manage System-wide pest constraints are developed, tested, and promoted
- Effective models for IPM learning and adoption are developed, tested, and promoted

- Production constraints in System-wide cropping systems are analyzed and related opportunities for IPM identified

Quality

The first external program review was under way in 2001 (SIPM, 2001). The reviewers were generally pleased with SIPM efforts to date. Projects ranged from those with a focus on pure research and with a clear global emphasis (e.g., the whitefly project) to those focused more on adaptive research/implementation with a regional emphasis that could perhaps evolve into a global program (e.g., through pilot sites). The review panel's remarks included the following:

- advised on modeling to further promote understanding of the systems being studied and enhance replicability in technology transfer;
- cautioned against institute-specific perceptions/bias that could be associated with the location of the SP-IPM Secretariat at any particular CGIAR Center;
- advised on linking of IPM with policy makers, policy advisory bodies (especially those within the CG System, e.g., IPRI) as well as with private sectors and users of IPM products;
- urged the program to strengthen its focus on inter-disciplinary research, crop monitoring, wider collaboration in pest management to ensure that the demands of other groups are included in the programs agenda; and
- advised pilot sites on need to explore satellite areas/crops/problems for subsequent joint investigation with farmers; the evolving focus at pilot sites would, for example, include post-harvest storage/marketing issues and livestock health/tsetse fly issues as farmer's exploitation of fodder crops increases livestock production in the participating farming communities.

Impact

There does not appear to be any published material assessing the impact of the SIPM program. It has not been in existence long enough. The preliminary report of the first external evaluation did not discuss more than general impressions of the work. It may have more in it about impact when published. The Web site for SIPM has only some anecdotal information about the results of field trials.

Resources Consulted

Documents

TAC Secretariat. 2001. Report of the Fifth External Programme and Management Review of the International Institute of Tropical Agriculture (IITA). May, 2001.

Web Sites

SPIPM. 2002. Homepage of the System-wide Program on Integrated Pest Management (IPM) [Online]. Available by SPIPM <http://www.cgiar.org/spipm/> (posted 02/Jan/2002; verified 22/Jan/2002).

SPIPM. 2001. Report on the Annual Inter-Center Working Group Meeting, 8-14 March 2001, ICIPE, Nairobi, Kenya. [Online]. Available by SPIPM <http://www.cgiar.org/spipm/2coord/nairobi.htm> (posted 02/Jan/2002; verified 22/Jan/2002).

SPIPM summary prepared by Doug Brown, Cornell University.

21. System-wide Initiative on Water Management (SWIM)

Main Web page: www.cgiar.org/iwmi/pubs/SWIM/index.htm

Stated Aims

“SWIM, the System-wide Initiative on Water Management, is a collaborative program of research involving many different Future Harvest Centers. The purpose of SWIM is to bring a range of perspectives and expertise to bear on some of the key challenges of water management. Publications cover state-of-the-art and methodology papers that assisted the identification of priorities for SWIM and reports on the results of SWIM studies” (Publications: SWIM Papers at www.cgiar.org/iwmi/pubs/SWIM/index.htm).

The Report of the Second External Programme and Management Review of the International Water Management Institute (IWMI) states that SWIM activities began in 1996. It reported SWIM’s official objective as “to enhance the productivity of water in an environment of growing scarcity and competition.” This is very broad, and really not distinguishable from that of IWMI. However, this identification of objectives is deliberate. It puts SWIM at the heart of IWMI’s core agenda. But it also raises questions as to whether or not, as a System-wide initiative, it should be more focused (p. 37).

Activities

IWMI’s proposal for an Inter-Centre Initiative on Water Management (later to become SWIM) was introduced at the Sixty-Eighth Meeting of the Technical Advisory Committee. The proposal, which was “developed by an inter-Centre workshop, was structured in terms of three themes — inter-sector competition for water, productivity of water, and improved water use in a watershed perspective — that addressed a range of issues from sector to farm level. IIMI would convene the program and take the lead for a project on water accounting standards; three other Centres, IFPRI, ICARDA, and IRRI, would participate and take leadership, respectively, for projects on policies for efficient and environmentally sustainable water allocation, efficient use of water in agriculture, and improved water utilization in a watershed perspective.” IIMI was asked to revise the proposal because the “proposed projects have not been prioritized, so that there is a lack of focus. There is also a need for a much clearer identification of problems in water resource management, in terms of CGIAR

priorities, and for a definition of expected research outputs and benefits” (Report of the Sixty-Eighth Meeting of the Technical Advisory Committee, p. 23-25).

During the Sixty-Ninth Meeting of the Technical Advisory Committee, TAC endorsed IWMI’s revised proposal for an Inter-Centre Initiative on Water Management. It was said that “within a waterbasin, whole catchment perspective, the research would develop a standard approach to measuring and reporting on water productivity and apply it to two priority problems — productivity of water and competition for water. Its objective was to enhance the productive use of existing water supplies and manage more effectively water demands for sustainable development. Initiative partners include CIAT, CIMMYT, ICARDA, ICLARM, ICRAF, ICRISAT, IFPRI, ILRI, IRRI, WARDA, and NARS. Four basins were suggested for ICIWM activities: Indo-Gangetic-Bhamaputra, Nile, Niger and Mahaweli. ICIWM would be governed by an international steering committee and coordinated by IIMI.” At that time, TAC stated that “the proposed research would benefit from a diagnostic analysis of the constraints to effective water management, an assessment of what is already known about the problems to be studied, and a realistic appraisal of what improvements can be made in water management for sustainable development. TAC recognized that this is an area where the returns to research can be expected to be high; it therefore encourages IIMI to proceed with the initiative” (Draft Report of the Sixty-Ninth Meeting of the Technical Advisory Committee, pp. 16-17).

The following is a list of SWIM activities for 2000, including the names of project collaborators:

1. Water Saving Irrigation in Rice Production: IWMI, IRRI, ICIPE
 2. Increasing Water Productivity in Agriculture: IWMI, commodity Centers
 3. Water Allocation Among Sectors: IWMI, IFPRI
 4. Groundwater Depletion and Recharge: IWMI, Rice-Wheat consortium
 5. Modeling Flows in the Mekong Basin: IWMI, ICLARM
 6. Peri-Urban Agricultural Initiative: IWMI, CIP-proposed
- (Report of the Second External Programme and Management Review of the International Water Management Institute, p. 40).

In addition, a set of eight ‘state-of-the-art’ papers were commissioned, written, and published in a special SWIM series. Two more will eventually find their place in this series. These papers cover a gamut of topics, some squarely at the core of IWMI’s work, as for instance *Accounting for Water Use and Productivity*, while others deal with issues requiring inter-Center collaboration, e.g., *Producing More Rice with Less Water from Irrigated Systems*, done in collaboration with IRRI. The following are the above-mentioned SWIM publications:

- [Accounting for Water Use and Productivity](#)
David Molden, 1997
- [How to Manage Salinity in Irrigated Lands: A selective review with particular reference to Irrigation in developing countries](#)
Jacob Kijne, S.A. Prathapar, M.C.S. Wopereis, K.L. Sahrawat, 1998
- [Water-Resource and Land-Use Issues](#)
I. R. Calder, 1998

- [Improving Water Utilization from a Catchment Perspective](#)
Charles Batchelor, Jeremy Cain, Frank Farquharson, John Roberts, 1998
- [Producing More Rice with Less Water from Irrigated Systems](#)
L. C. Guerra, S. I. Bhuiyan, T.P. Tuong, R. Barker, 1998
- [Modeling Water Resources Management at the Basin Level: Review and Future Directions](#)
Daene C. McKinney, Ximing Cai, Mark W. Rosegrant, Claudia Ringler, and Christopher A. Scott, 1999
- [Water Harvesting and Supplemental Irrigation for Improved Water Use Efficiency in Dry Areas](#)
Theib Oweis, Ahmed Hachum, and Jacob Kijne, 1999
- [Multiple Uses of Water in Irrigated Areas: A Case Study from Sri Lanka](#)
Margaretha Bakker, Randolph Barker, Ruth Meinzen-Dick, and Flemming Konradsen, 1999 (Publications: SWIM Papers at www.cgiar.org/iwmi/pubs/SWIM/index.htm).

Quality

I was unable to find an evaluation of SWIM. However, as IWMI was designated by TAC as the convening Center for SWIM, I was able to find information on the initiative in the Report of the Second External Programme and Management Review of the International Water Management Institute (IWMI). SWIM was reviewed as a component of IWMI's research activities although SWIM activities are being conducted by CGIAR Centers other than IWMI, and most of IWMI's contributions are or could be incorporated in one or more of IWMI's global research programs. The main reason for a separate discussion of SWIM [in that report] is that it has received special attention by TAC and by the Group, including significant special financial support. It is also an important instrument used by IWMI to enhance its partnerships with other CGIAR Centers and these partnerships deserve to be reviewed (Report of the Second External Programme and Management Review of the International Water Management Institute, p. 37).

“SWIM has become IWMI's main tool for collaboration with other CGIAR Centres. That collaboration is mainly of a bilateral nature. Indeed, it must be stressed that the SWIM programme is not a joint response of several CGIAR Centres to a common challenge, which could have been the focus of a truly System-wide undertaking. This is reflected by the breadth of the official objective specified for SWIM (to enhance the productivity of water). Whereas such an objective is central to IWMI's mission, it is only peripheral to most sister Centres. In the case of ICARDA, for which water is very important and which devotes significant resources to water issues in dryland agriculture, only a small fraction of the corresponding activities are incorporated into SWIM. As a result, SWIM appears really as the tool of IWMI. Within that framework, the tool seems to have been used effectively to prepare the ground for future collaborations. But one must wonder whether it really qualifies as a System-wide initiative, with a clear objective shared by several partners, well-defined priorities and a well-articulated set of activities in pursuit of a common objective. This raises a major question for the CGIAR, since System-wide initiatives and programmes were invented to tackle important problems beyond the capacity and the mandate of a single

Centre” (Report of the Second External Programme and Management Review of the International Water Management Institute, pp. 37-38).

“In the case of SWIM, the Initiative started in 1995 with seed money allocated from the World Bank contribution to the CGIAR. At first, a Steering Committee of 16 members, with representatives from each of the 10 collaborating or interested Centres, was established. The transaction costs were, however, seen as very high by IWMI and, as governance structure, the Committee was perceived as unwieldy. As a result the Steering Committee was left dormant by IWMI and subsequently, *de facto*, disbanded. In a May 1999 “Report to Donors” (of SWIM), prepared by the SWIM Coordinator, a senior IWMI staff member, this position is clearly expressed: ‘In contrast with most other System-wide programmes, the objectives of both SWIM (increasing the productivity of water in an environment of growing scarcity and competition) and the convening Centre IWMI are essentially the same. IWMI sees the continuation and strengthening of collaborative links with other CGIAR Centres in water management as essential if the CGIAR goals of maintaining food security and eradicating poverty are to be achieved. In short, the catalytic role and coordination function of SWIM will now be assumed by IWMI.’ The Panel considers that the logic of such a position is perfectly defensible from the point of view of IWMI. One must however wonder what could then be the justification for special funding, in addition to the normal allocation to IWMI, under this perspective” (Report of the Second External Programme and Management Review of the International Water Management Institute, p. 37).

In conclusion, the Panel stated that “IWMI has coped well with the existing situation, characterized by intense competition among CGIAR Centres, making genuine collaboration the exception rather than the rule. But in operating SWIM on a bilateral basis and keeping the objective very broad, IWMI has placed itself in a vulnerable financial situation. Therefore, the Panel strongly suggests that TAC, IWMI, and the other CGIAR Centres that contribute to SWIM consider phasing it out as a System-wide initiative, and, instead, mainstream the activities into the regular programmes of the respective Centres, reinforced with ad hoc bilateral or multilateral partnerships arrangements; while the Panel urges donors to continue, indeed increase, their support to such activities. An alternative would be to initiate a set of multi-Centre activities focusing on a specific aspect of irrigated agriculture, as for example, along the lines of the proposed activity *Increasing Water Productivity in Agriculture* with IWMI working with other CGIAR commodity Centers” (Report of the Second External Programme and Management Review of the International Water Management Institute, p. 40).

In response to the Panel’s conclusion, TAC noted “the Panel’s ‘bold’ suggestion that IWMI consider phasing out the System-wide Initiative on Water Management (SWIM). While TAC appreciates the rationale provided by the Panel in coming to this conclusion, i.e., that SWIM activities be mainstreamed into the regular programmes of the respective Centres — since most are bilateral ventures anyway and do not necessarily foster multi-centre collaboration on specific water-related issues — the Committee also appreciates the practical dilemma the Centre faces in dealing with this issue. Recognizing the early and promising results to-date in terms of achievements in SWIM and cognizant of the Centre’s disagreement with the suggestion, TAC intends to revisit the rationale for System-wide programmes and develop ground rules for the management of such programmes before recommending action” (Report of the Second External Programme and Management Review, p. vi).

Finally, “the System-wide Initiative on Water Management (SWIM), while not a research programme in its own right, is important to IWMI as a means to enhance its partnerships with other CGIAR Centres. . . . The current review strongly suggests, however, that modifications to the SWIM arrangements are needed to enhance the original objective of encouraging CGIAR Centres to work together on shared issues” (Report of the Second External Programme and Management Review, p. xxx).

Impact

Very little information is available on SWIM’s impact. However, the papers published in the SWIM series are receiving good attention, as illustrated by the number of hits on the Web. They represent useful syntheses on specific topics and have been useful in the identification of research projects. In addition, a few research projects thus identified have subsequently been started under the SWIM umbrella and are linked directly to one of the four program areas. These activities involve collaborations directly with other CGIAR Centers or indirectly with other System-wide/ecoregional programs. The Panel’s review of these SWIM Research Reports indicates that they represent significant achievements, and build a solid foundation for future useful collaborative work (Report of the Second External Programme and Management Review of the International Water Management Institute, p. 37). Furthermore, SWIM paper 3, [Water-Resource and Land-Use Issues](#), challenges some of the conventional wisdom and beliefs regarding the impact of forest soils on water conservation and has had the largest number of downloads on the Web among all IWMI publications (Report of the Second External Programme and Management Review of the International Water Management Institute, Appendix III, p. 3).

Resources Consulted

Documents

TAC Secretariat. 1996. Draft Report of the Sixty-Ninth Meeting of the Technical Advisory Committee. July 1996.

TAC Secretariat. 2000. Report of the Second External Programme and Management Review of the International Water Management Institute (IWMI). October 2000.

TAC Secretariat. 1996. Report of the Sixty-Eighth Meeting of the Technical Advisory Committee. May 1996.

Web Sites

Publications: SWIM Papers at www.cgiar.org/iwmi/pubs/SWIM/index.htm.

SWIM summary prepared by Joy Learman, Cornell University.

22. WARDA — West African Rice Development Association

Main Web page: <http://www.warda.cgiar.org/>

Stated Aims

WARDA's stated aim is to strengthen sub-Saharan Africa's capability for technology generation, technology transfer and policy formulation, in order to increase the sustainable productivity of rice-based cropping systems while conserving the natural resource base and contributing to the food security of poor rural and urban households. As such the work of WARDA primarily benefits West African farmers — mostly small-scale producers — who cultivate rice, as well as the millions of African families who eat rice as a staple food.

Activities

WARDA's research program consists of three components:

Rainfed Rice — based at M'bé near Bouaké in Côte d'Ivoire: targets rainfed rice-based systems in the humid and sub-humid zones.

Irrigated Rice — based at Ndiaye in Senegal: focuses on irrigated and semi-arid rice systems (the most intensive and productive in West Africa, but which are threatened by salinization and alkalization).

Rice Policy and Development — reflects WARDA's commitment to support national policy analysts, and builds on WARDA's achievements by widening its focus, with the goal of accelerating on-farm impact. It places greater emphasis on transferring the most recent research results to public-sector research and development institutions, nongovernmental organizations (NGOs), and farmers' groups.

The building blocks of these programs are 14 fully interdisciplinary problem-solving projects.

Quality

The TAC commentary on the fourth external review panel's work (TAC Secretariat, 2000) notes that while the Center's mission statement had been refined to reflect food security, poverty alleviation, and natural resource conservation, the Panel's report appeared incomplete since it did not comprehensively discuss the Center's mission, strategy, and priorities. This gap clearly limits the usefulness of the Panel's work for this meta-evaluation. On the other hand, TAC concurred with the Panel that the quality and relevance of science practiced at the Center is commendable, as evidenced by refereed publications, methodologies, and activity products. Significant among the Center's products is the development of the interspecific rice hybrids between *Oryza sativa* and *O. glaberrima* (TAC Secretariat, 2000).

Natural resources management requires greater attention at WARDA because gains in rice production will be of short duration if the environment and natural resources are not taken

into account (TAC Secretariat, 2000). The Panel suggests that WARDA explores to what extent households, communities and governments in the Sahel and the region could improve the conditions for sustainable rice production. The issue of natural resource conservation merits particular attention, as it is of interest to both private and public sectors. WARDA should develop and publish an overall picture, and analyses of bottlenecks to sustainable development. More explicit attention to NRM issues in WARDA's mainstream programs also offers the research opportunity to address diversification issues, particularly on inland valleys, where NRM issues are important, at the same time households and communities utilize these inland valleys for an array of cropping and livestock activities.

WARDA's scientific achievements are well documented and span areas of crop improvement, crop and natural resources management, integrated pest management, social sciences and post-harvest technology. However, the panel recommended improved integration and treatment of NRM issues in its research (TAC Secretariat, 2000).

Impact

WARDA has developed a group of new varieties of rice. The rices, dubbed NERICAs (NEW RICE for AfriCA), are hybrids between a traditional type of African rice — which is well adapted to the region's soils and climate — and more productive Asian varieties. Large-scale testing has shown them to yield three to four times more than the varieties they are set to replace.

WARDA's main achievements are in two areas, namely the development of interspecific rice varieties and WARDA's effective partnerships. While the first emerges from WARDA's *raison d'être* and attests to the Center's rapid transformation into an international centre of excellence, the second is its modus operandi and an effective means of collaboration, particularly with its NARS partners (TAC Secretariat, 2000). In the area of NRM, WARDA has undertaken extensive studies in the key agro-ecologies to determine the incremental yield response to improved crop and natural resources management (TAC Secretariat, 2000). However, NRM requires greater attention at WARDA because gains in rice production will be of short duration if the environment and natural resources are not taken into account. This is mainly so because the physical, biological, economic, and social environment changes slowly but significantly, partly due to rice production itself and partly due to other causes. Sustainable development of rice production requires explicit attention to a range of aspects of the crops, cultivation practices, the people and the environment (TAC Secretariat, 2000).

TAC (TAC Secretariat, 2000) shares the view of the panel that WARDA should strengthen its capacity to monitor and assess impacts — apparently WARDA survey data exist that could be used to assess impact on food security, poverty reduction and natural resources management. With respect to specific achievements, the panel did not conduct sufficient in-depth analyses on all of them so as to adequately relate achievements (outputs) with impact (outcomes) (TAC Secretariat, 2000).

Resources Consulted

Documents

TAC Secretariat. 2000. Report of the Fourth External Programme and Management Review of the West Africa Rice Development Association (WARDA). April 2000.

Web Sites

WARDA. 2002. West African Rice Development Association: About WARDA [Online]. Available by WARDA <http://www.warda.cgiar.org/> (posted 16/Jan/2002; verified 18/Jan/2002).

WARDA summary prepared by Doug Brown, Cornell University.

Annex 4: List of Working and Background Papers, Authors, and Peer Reviewers

Working Papers

Barrett, Christopher B. 2002. *Natural Resources Management Research in the CGIAR: A Meta-Evaluation*.

Peer Reviewers: Jock Anderson, Derek Byerlee, Dana Dalrymple, Hans Gregersen, Ted Henzell, John Lynam, Vernon Ruttan, Meredith Soule, Joachim von Braun, Usha Barwale Zehr

Eicher, Carl K. and Mandivamba Rukuni 2002. *The CGIAR in Africa: Past, Present, and Future*.

Peer Reviewers: Malcolm Blackie, Dana Dalrymple, Bob Herdt, Alain de Janvry, Romano Kiome, John Lynam, Eric Tollens, Geoffrey Mrema, Wilfred Mwangi, Cyrus Ndiritu, Emmy Simmons, Moctar Touré

Gardner, Bruce 2002. *Global Public Goods from the CGIAR: Impact Assessment*.

Peer Reviewers: Jock Anderson, Dana Dalrymple, Osvaldo Feinstein, Paul William Glewwe, Hans Gregersen, George Norton, Scott Rozelle, Vernon Ruttan, Sara Scherr, Sudhir Wanmali

Lesser, William 2002. *Reviews of Biotechnology, Genetic Resource and Intellectual Property Rights Programs*.

Peer Reviewers: Ronnie Coffman, John Dodds, Robert Evenson, Brian Ford Lloyd, Anatole Krattiger, Steve Kresovich

Spielman, David 2002. *International Agricultural Research and the Role of the Private Sector*.

Macedo, Jamil, Marcio C. M. Porto, Elisio Contini, and Antonio F. D. Avila 2002. *Brazil Country Paper for the CGIAR Meta-Evaluation*.

Katyal, J.C. and Mruthyunjaya 2002. *CGIAR Effectiveness — A NARS Perspective from India*.

Background Papers (Available upon request)

Ndiritu, Cyrus 2002. *CGIAR-NARS Partnership: The Case of Kenya*.

Romano, Luis 2002. *Colombia Country Paper for the CGIAR Meta-Evaluation*.