The International Center for Tropical Agriculture (CIAT, its Spanish acronym) is one of 15 food and environmental research organizations known as the Future Harvest centers. The centers, located around the world, conduct research in partnership with farmers, scientists, and policymakers to help alleviate poverty and increase food security while protecting the natural resource base. The Future Harvest centers are principally funded through the 58 countries, private foundations, and regional and international organizations that make up the Consultative Group on International Agricultural Research (CGIAR).

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Achieving
Widespread Impact through
Agricultural Research

Edited by:

Douglas Pachico and
Sam Fujisaka

Economics and Impact Series 3

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International Center for Tropical Agriculture

CIAT Economics and Impact Series

This publication is part of a series of reports that aims to disseminate—among decision makers, scientists, and development experts—the economics research results of CIAT and partners. This research covers a broad spectrum of issues related to tropical agriculture and natural resource management, and places special emphasis on evaluating their impact.

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Local descriptors in Spanish:
1. Yuca. 2. Frijol. 3. Investigación participativa. 4. Impacto de la investigación.

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1. *Manihot esculenta*. 2. *Phaseolus vulgaris*. 3. Research. 4. Watershed management. 5. Soil management. 6. Natural resources. 7. Resource management. 8. Rural development. 9. Pest control. 10. Integrated control. 11. Technological changes. 12. Innovation adoption. 13. Decision making. 14. Planning. 15. Case studies. 16. Philippines. 17. Latin America. 18. Caribbean. 19. Africa.

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Contents

Introduction

*Douglas Pachico** and *Sam Fujisaka***

In recent years, individual centers of the Consultative Group on International Agricultural Research (CGIAR) and other research and development (R&D) institutions, especially those concerned with natural resource management (NRM), have given a lot of attention to the issue of scaling up and out. A workshop carried out at the International Center for Research in Agroforestry (ICRAF) in 1999 focused on innovations emerging from agroforestry research. Two other workshops organized by the World Bank in 1999 and the International Institute for Rural Renovation (IIRR) in the Philippines in 2000 drew on case studies to identify key principles involved in spreading technical and social innovations to rural areas.

Profiting from the outcomes of these and other consultations, the International Center for Tropical Agriculture (CIAT, the Spanish acronym) decided to make scaling up the theme of its 2002 Annual Review. Why the interest in this issue? Donors and civil society are increasingly imposing pressures on R&D that investments must achieve lasting impacts on the lives of the rural poor. It is recognized that many relevant technologies and approaches are not achieving their full potential impact because of low levels of adoption. This has led to more emphasis on the effectiveness of research to produce adoptable technological options. Thus, donors (amongst others) are not only calling for increased impact—they are putting conditions on the quality of that impact regarding sustainability and equity. Delivering solutions on a large scale, however, is obviously not an easy task.

What role must CIAT play? A quick survey of CIAT projects shows that researchers understand the need to scale up, and the issues involved, whether they use the term "scaling up" or not. However, many challenges remain to be met. Scaling up will imply more changes in the way we work.

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This book presents research by CIAT scientists and various partner institutions that was presented at CIAT's 2002 Annual Review. The first chapter builds on several internal CIAT seminars, and served as input into the Review. The 16 chapters in four sections address the key issue of achieving impact: In benefiting more people over greater areas and in institutionalizing useful approaches within CIAT, other CGIAR Centers, and partner organizations.

Underlying the book has been a growing awareness among donors, researchers, and development workers of the need for agricultural research to achieve and demonstrate greater impacts. In the 1980s, CGIAR researchers were enjoined to conduct "basic" and "strategic" research and to leave "applied" research to the national agricultural research systems (NARS). Times have changed; and the pendulum has swung back. Many of the NARS have faced financial crises to the point that some have all but disappeared. At the same time, CGIAR researchers are being asked to show the impacts of their work. The response has included the forging of new alliances between R&D agencies, between the public and private sectors, between governmental organizations and nongovernmental organizations, and among the above and farmers and farm communities. Approaches have become integrated—as in Integrated Natural Resource Management—in the recognition of multiple stakeholders with differing, often conflicting, goals and objectives operating at different spatial and temporal scales. Research not only has returned its attention to achieving development impacts, but also has embraced generally the objectives of maintaining and better managing public, environmental goods. The tool kit available today for R&D includes participatory research and technology development, gender analysis, geographic information systems and modeling, the Internet, and different sorts of "learning alliances".

The book has four sections:

- An Overview of Issues
- Scaling Out for Impact: Germplasm Technologies
- Scaling Out for Impact: Natural Resource Management
- Institutional Innovations for Scaling Out

Each section is briefly introduced in terms of the topics included and their importance, the "fit" of the section within the book, and of each chapter within the section. A critical review of each chapter follows in order to stimulate further thought and discussion (and to anticipate readers' shouts and murmurs). The reviews are meant to be provocative on arguable points, but not critical (that went on in the Annual Review). Some summarizing has been given in order to set up the comments for thought, but these sections are in no way abstracts of the chapters. Authors were provided with an early draft of the comments and their responses ranged from irritation to total agreement, independently of whether or not comments seemed "critical".

The process of scaling out is one that is still in development and this book is aimed at getting some response on the subject. The feedback already received from authors on their pioneer work has been most helpful in sorting out concepts, providing evidence through case studies, and speculating towards the future.

PART ONE

An Overview of Issues

Editorial Comments

The first section sets the conceptual and definitional stage for the chapters that follow.

The four chapters in this section deal with definitions and issues regarding scale, scaling up, impact assessment and participatory research, impacts of geographic information systems (GIS) research, and spatial dimensions to scaling issues. Overall, these contributions address different combinations of "impact" and "scale". The first chapter, by Menter et al., is a discussion of concepts, definitions, and assertions as to what is necessary to achieve widespread impact. A chapter by Lilja et al. puts some of the concepts regarding participatory research to test via presentation of case examples. White provides a case example of analysis of GIS researchers' own evaluations of the impacts of their work at the International Center for Tropical Agriculture (CIAT, the Spanish acronym). The fourth chapter, by Cook and Fujisaka, is a conceptual piece that clarifies how easier-to-use GIS tools combined with (magnitudes) more spatial data has enabled development of more complex models that better manage the concept of scale.

Besides being fun for those fond of pushing prepositions into new poses, **Chapter 1**, by **Menter et al.**, provides definitions useful for thinking about what is meant by "achieving impact through research". Included in the chapter are discussions of scale and scaling up. "Scaling up" is both horizontal and vertical; the former referring to adoption and the latter to institutionalization. "Horizontal scaling up", moreover, is also known as "scaling out". Thus:

- Horizontal scaling up = scaling out = adoption, and
- Vertical scaling up = institutionalization = decision making at higher levels.

Obviously there must be more to the story; and there is. The authors describe how agricultural research today seeks better, lasting, and equitable benefits for more people over more area through innovations including, but going beyond, seed technologies. Many, if not most, innovations are more knowledge and management intensive than new seed (especially those emanating from integrated natural resource management [INRM] research); and scaling up often faces barriers that have nothing to do with limitations of the innovation itself. The chapter indicates that the keys are that:

- Scaling up requires adapting knowledge and innovations to end-users, be they farmers or institutions, and to variable conditions.
- Adaptation and application of innovations to different contexts requires understanding the knowledge and principles underlying the innovation.
- Such understanding is achievable through capacity building.

The chapter also touches upon learning approaches, linkage building, policy dialogue, and, finally, funding. In terms of funding, "...donors need to be lobbied to obtain long-term flexible funding, which allows for a learning process to take place".

What can be inferred from the chapter is certainly correct:

- Scaling up *requires* adaptation of innovations *requires* understanding of underlying principles *requires* capacity building *requires* substantially greater investment.

This last appeal is the rub, however. A good part of the very interest in scaling up derives from the need to show donors real impact: And, again, impact beyond the plot or key site level to impacts on more people over wider areas, and on institutions and policies that enable the process. Are researchers now in the predicament of having to say to donors, "We want to show you the wide impacts of the research you funded, but in order to do so, would you please give us more money over the long term and let us spend it in a flexible fashion, and we will get back to you"?

Chapter 2, by **Lilja et al.**, is concerned with scaling up and out of the impacts of user participation on agricultural research. Four examples are provided. In terms of "vertical scaling up" (see Menter et al. in the previous chapter), the examples describe the institutionalization of decentralized participatory plant breeding and/or crop management research at the International Center for Agricultural Research in the Dry Areas (ICARDA), among all of the West Africa Rice Development Association's (WARDA's) 17 national partners, by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and partners in Malawi, and by the International Potato Center (CIP, the Spanish acronym) and partners in Indonesia.

The chapter is equally or more concerned, however, with estimating the impacts of farmer participation on the bottom line (i.e., with the impacts of horizontal scaling up/scaling out/adoption). Claims are made that:

- A move from conventional to participatory breeding of barley (*Hordeum vulgare* L.) in Syria has potential to increase benefits by 90%-260%; while operational costs are increased by 56%, total breeding budget is increased by 2% due to reallocation of funding to different types of breeding operations.
- Participatory barley breeding reduced the research lag by 3 years (from initiation of breeding to release and initial adoption) from 10 to 7 years.
- Breeder ignorance was overcome via participatory varietal selection of rice (*Oryza sativa* L.) in West Africa.
- Mother-Baby (MB) trials combined with informal social networks in Malawi led to widespread dissemination of knowledge of new legume-based soil fertility management technologies.
- Participation in improved farmer-designed farmer field schools (FFS) using an integrated crop management approach in Indonesia led to 44% higher sweet potato (*Ipomoea batatas* [L.] Lam.) net returns per hectare.

Interesting questions and issues arise from these cases, in some of which the authors provide the fine print regarding the above impacts. The barley benefits to farmers are based on farmer *ex- ante* estimates of the area they will plant, on what they are willing to pay for the new seed, and what they expect in terms of yield increases; and on the critical assumption of functioning extension and seed systems. It will be important to follow the story to see if the *ex-post* analysis confirms the *ex-ante* expectations. If so, the story will be an important one for the Consultative Group on International Agricultural Research and its partners.

The authors also observed that the MB trials plus social networks led to dissemination of knowledge about, but not to adoption of, new technologies. Why, and under what circumstances, additional knowledge is not accompanied by adoption is an issue requiring further research. It is commonly recognized that not only is new knowledge needed, but that it must also reach the intended beneficiaries. Less is known about cases in which the knowledge arrives, but is shelved.

Adherents of participatory approaches have often portrayed “conventional” breeders and agronomists as ignorant of the “real” needs and criteria of farmers. But is this portrayal or caricature? User participation can certainly improve targeting by breeders wanting to provide appropriate, beneficial materials. Such breeders would welcome the additional information. On the other hand, a different type of capacity building is called for if breeder ignorance is widespread. Fortunately, a few anecdotal cases have probably exaggerated this possibility.

Finally, FFS participation is intensive and thereby expensive. Both costs and benefits need to be examined in all cases.

Chapter 3, by **White**, is based on the author's elicitation and analysis of evaluations by GIS researchers at CIAT of their own respective work. He provides a useful framework to identify the needs for broad-based research that may be used to prioritize research activities and improve their focus and breadth.

White selected and weighted six criteria and numerous sub-criteria for researchers to evaluate their work. The six major criteria were poverty alleviation, environmental preservation, economic growth, geographic extent of impact, level of participation, and research costs. The author interviewed researchers (with the help of an electronic spreadsheet) about 31 Land Use Program projects, and analyzed the resulting data using descriptive statistics and correlation analysis. The chapter provides ample discussion of the evaluation criteria and their respective weighting, the potential pitfalls of eliciting and using subjective data, the results obtained, questions of analytical rigor, and the potential of the method's use for evaluating INRM research results. Readers needing to evaluate the impacts of any multiple-objective research should find the method, analysis, and discussions important and timely.

A striking feature of the method of eliciting subjective data from scientists is quite simply that it is little different from similar eliciting of farmer views and evaluations used in farmer participatory research and technology development. This latter research approach, as in the case example, has long been concerned with the issues of correct weighting, of not double counting, of problems related to informants' desires to tell interviewers what they want to hear (i.e., what the informants think that the interviewers want), and biases related to simple desires to underestimate or overestimate for various reasons.

The general method of using a selected set of multiple criteria to examine impacts of integrated research approaches is now becoming more commonplace. Each author or set of researchers differs, however, and as might be expected, in the choice and weighting of criteria. Some (even in this volume) might have included institutionalization of results and methods as key criteria. Others might have combined the poverty alleviation and economic growth criteria, not because they are the same, but because the researchers interviewed might likely and incorrectly assume that progress in the latter means advances in the former.

Finally, White offers the method used to evaluate impacts of GIS research as a way to assess the impacts of INRM research. Possibly yes, possibly no. On the one hand, it may be that evaluating GIS impacts is trickier than evaluating INRM research impacts. GIS is generally thought of as a tool employed by researchers. It may contribute to development goals (see Beaulieu et al., this volume); but ultimate impacts usually stem from a much wider set of research and development activities. Despite comparing their work against their peers, it appears likely that the GIS researchers interviewed were responding as to *potential* impacts, which could become realized *if, and only if*, a chain of other activities reached fruition. On the other hand, talking to a set of GIS researchers (or farmers from a single community, for that matter) may be easier and far less complex than eliciting responses from a whole range of stakeholders dealt with in (the more complex versions) INRM research.

Chapter 4, by **Cook and Fujisaka**, deals with the concepts and importance of scale and of the spatial dimension to scaling up and out. Scaling up or out involves multiple interactions among pairs of individuals. These interactions occur in physical space and, as such, can be assessed in terms of the effects on the interactions of size, location, distance, direction, and the configuration of multiple individuals. The chapter discusses three types of models used to analyze spatial characteristics of multiple interacting nodes: network analysis, analysis of cellular automata, and multi-agent system. GIS and its advances in size and quality of data sets has enabled improved modeling of complex social behavior in which spatial dimensions are clearly relevant.

The chapter is a largely conceptual foray into incorporating the spatial dimension into understanding scaling up and out. Probably most useful is the set of queries provided to assess the significance of the spatial dimension (starting with “Does size matter?”). Once significance is established, however, the problem of importance or relevance remains: Do we not already know that people farther away (distance) will be less likely to reap development benefits or that trying to encourage outdoor orchid growing in the Sahara (location!) is probably hopeless.

Such doubts aside, however, social and biological scientists do need methods to explicitly define spatial attributes and to incorporate them into analysis of scaling up and out. As stated in the chapter, “The advantage of developing explicit models is that predictions of interactions can be tested against observation and used to reveal obstacles to beneficial diffusion”.

CHAPTER 1

Scaling Up

*Harriet Menter**, *Susan Kaaria***, *Nancy Johnson****, and
*Jacqueline Ashby*ψ

Introduction

There has been a recent surge of interest in the subject of "scaling up" in development and natural resource management (NRM) and, to some extent, agricultural research. The literature is similar in focus to the large body of literature that already exists on diffusion or dissemination of innovations, especially with regard to agricultural innovations. However, there are some important differences (see, for example, Rogers [1995] and Ruttan [1996] for a history of diffusion research). There are also similarities with the literature on industrial scaling up.

This opening chapter provides an overview of basic issues addressed in the scaling up literature; it does not attempt to summarize the existing literature on dissemination. Within agricultural and NRM research, this area of debate reflects a concern to increase the impact, and thus the value, of research. Scale is understood to mean magnitude, and more is generally better than less (see Swallow et al. [2001] for a discussion of scale as magnitude and as hierarchy in the context of watershed management). In this sense, scaling up and the debates surrounding it do not constitute a social science issue as such. Rather, scaling up is a management issue. It is about how to manage projects to ensure that positive impact is maximized. In research in social and biophysical science, scale is generally understood in the terms of a hierarchy of levels of analysis. Research results relating to hierarchical scale can be very useful in the management of a process of scaling up, but the meaning of scale in the two contexts is different.

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The term "scaling up" and various related terms are widely used, and the literature on the subject is relatively extensive, yet our experience suggests to us that the terms do not have definitions that are clearly understood or universally accepted. As a result, it is often difficult to carry on a meaningful discussion about the underlying concepts. The purpose of this chapter is to summarize the central concepts and issues related to scaling up. We are interested in interventions/innovations that are the outcomes of agricultural research, such as new technologies, ways of managing resources (e.g., land and water), seed systems, agricultural enterprises, and collective organization (e.g., cooperatives, farmer research groups, and water-user associations). Research outcomes also include methodologies. The chapter also proposes working definitions that are both consistent with the literature, and useful for the International Center for Tropical Agriculture (CIAT, the Spanish acronym). The goal is to stimulate reflection and discussion within the center about how more attention to scaling up can enhance the ultimate impact of research. The chapter builds on several internal seminars, and served as input into the 2002 Annual Review.

The definitions and objectives discussed in the chapter are consistent with those developed by participants at the Consultative Group on International Agricultural Research (CGIAR)-nongovernmental organization (NGO) committee at the conference in the Philippines (April 2000, Silang, the Philippines), which defined the objective of scaling up thus:

> "Scaling up leads to more quality benefits to more people over a wider geographic area more quickly, more equitably, and more lastingly."

This definition is somewhat problematic because (a) it really defines the objective of scaling up, and (b) it uses the comparative yet does not state with what it is comparing. Nonetheless, this implies increasing the impact of an innovation or intervention to its logical or appropriate level, which in turn implies reaching larger numbers of people (Gonsalves, 2001b; p. 6). Scaling up according to this definition reflects both a concern for the extent of the impact, and for the quality of the impact in terms of sustainability and equity. Thus, scale refers not only to the benefits brought about through the intervention, numbers of people, and geographical area, but also refers to time scale and justice scale.

The chapter begins with a discussion on the reasons for the recent interest in this topic, followed by some general definitions of scaling up from recent meetings and literature. We briefly examine the relationship of scaling up with the longstanding body of work on dissemination and technology transfer, and the relationship between scaling up and issues of scale. We then look at some of the points and processes involved in scaling up, and suggest a structure for considering scaling up within CIAT's projects.

Background—Recent Debates and Changes in Thinking about Agricultural and NRM Research

Quality of impact

The issue of scaling up has been the center of much recent debate within research and development (R&D) institutions, especially those concerned with NRM. Workshops carried out include those at the International Center for Research in Agroforestry (ICRAF) 1999, the World Bank 1999, the International Institute for Rural Renovation (IIRR) in the Philippines in 2000, and most recently at the Natural Resources Institute (NRI) in the UK in 2001. There is also a multitude of publications on the matter (see, for example, Unwin, 1995; IIRR, 2000; Unwin et al., 2000; Gündel et al., 2001; Harrington et al., 2001).

This interest has arisen in the context of several important developments in thinking about R&D. First, donors and civil society are increasingly pressuring that money spent in R&D must bring about lasting impact on the lives of the rural poor. Second, the recognition that many relevant technologies and approaches are not achieving their full potential impact because of low levels of adoption has led to more emphasis on the effectiveness of research to produce adoptable technological options.[1] Thus donors (amongst others) are not only calling for increased impact, they are putting conditions on the quality of that impact in terms of sustainability and equity. This leads to the objective of scaling up expressed in the IIRR workshop definition, and is one of the considerations that separates the scaling up literature from its dissemination predecessor.

New ways of involving end-users

Another change also has been important. In the past, agricultural R&D institutions traditionally adopted a technology-focused approach (Biggs, 1990). This implies a system in which scientists in institutions develop and test the technologies, such as germplasm, which they consider relevant to farmers, and once this process is complete, disseminate them, often through national agricultural extension services. Farmers were often involved in this process; however, their participation was usually not systematic nor were they in a position to make decisions over research priorities or activities. In this type of system, increasing impact implies disseminating material, and making sure it reaches as many people as possible. A significant amount of research was done on technology adoption/diffusion with the goal of improving the extension/dissemination process (see, for example, Rogers, 1995; Ruttan, 1996).

1. Skeptics may suggest that researchers are simply looking for ways to increase adoption of innovations that nobody actually wants. However, the literature on going to scale suggests that with many innovations there are barriers to going to scale that may not reflect a fault in the innovation itself.

Agricultural research organized under this model has been extremely successful in some cases; however, several limitations have come to light. In cases where there is a high diversity of environmental conditions, and users' preferences are poorly defined (as is generally the case with poorer smallholders), the technologies developed may not be useful or desirable to large numbers of the rural poor. This, in turn, leads to lower levels of adoption, which implies limited impact. Key restrictions of adoption include the small farmers' inability to be flexible with land, labor, and capital inputs. Often one or all are in short supply, so the technology cannot be adopted. Moreover, small-scale farmers need to protect household welfare; hence they are very cautious about changing established practices. Marketing challenges of products also limit adoption. For innovations to be adopted, these constraints must be addressed. The heterogeneous characteristics of small farms and families make vertical scaling up (see page 16) especially challenging, and perhaps impossible without adaptation or fine-tuning. These challenges have led to the development of new ways of working with end-users in order to both develop and scale up innovations, some of which are outlined below.

Systems' approaches

Confronted with the complexity of the problems facing farmers, an integrated approach often needs to be taken that works with different components of the system, including social, economic, biophysical, and policy dimensions. The farming systems' research initiatives of the 1970s and 1980s, which introduced social science inputs, and more recent participatory and gendered approaches, seek to address both the complexity and equity challenges (see Collinson, 2000). This change was also accompanied by a shift in focus from global or regional scales towards expanding efforts into local and intra-household perspectives.

Partly as a consequence of the development of research methods and perspectives, the types of innovations that centers are producing are evolving from relatively easy-to-use technologies (e.g., seeds) to more knowledge- and management-intensive innovations, such as guidelines for soil management or integrated pest management (IPM), or methods for organizing adaptive research or watershed management. Integrated natural resource management and integrated soil fertility management are examples of this (see Amede et al., 2003). An integrated approach also implies involving other actors, and including end-users in the research process in order to address multiple dimensions of a problem.

Part of the interest in going to scale—as opposed to disseminating technologies—has arisen in the context of these changes, which have led to more complex research outcomes and new ways of working with end-users. Scaling up of these more knowledge- and management-intensive innovations has created new challenges, some of which are not addressed adequately in the dissemination literature. The knowledge of breeders is effectively "packaged" into the seed, so in order to transfer this knowledge it may be necessary only to make sure that the farmer has access to the seed, and some basic technical knowledge. To pass on the knowledge a scientist has about how to evaluate different varieties (in the case that the seed is not appropriate to the farmer as is), or about other topics, such as soil nutrient flow and management, is far more complex (Simon Cook, personal communication, 2002). Thus, going to scale is similar to extension/dissemination in the sense that they both aim to get more benefits to more people more quickly, but presents different challenges.

Interest in going to scale with these types of innovations also has to do with how integrated systems research is conducted. In order to integrate research on many aspects of a problem, work often must focus on a single or very small number of physical sites. Large impact may be observed in a site, but it is difficult to identify causality given the high and often sustained level of intervention of researchers and others. Observed results are often due to both the research process and the technologies, so to some extent both must be replicated to achieve similar impact elsewhere. How to do this is the essence of the scaling up challenge. This problem is faced not only by research projects working in field sites, but also by NGOs who work in a limited number of communities yet hope to achieve impact in many.

Basics of Going to Scale

A note on definitions: Scale

Scale is a key element in natural and social science. Scale is generally understood in terms of hierarchy, and different disciplines generally have different criteria for defining and measuring scale. Research results are often dependent on the scale at which the analysis was done. Two important concepts concerning scale are the ecological fallacy (what works at one scale will work at another), and the composition fallacy (what is good for one person is good for everyone). An example of the ecological fallacy might be to extrapolate subplot-level soil erosion data to the watershed level, given that most soil moves only a short distance, may have its movement interrupted by a variety of biological or physical structures in the landscape, and may take a very long time to reach streams or other areas where it could potentially cause harm (Swallow et al., 2001). An example of the composition fallacy would be to assume that if one village increases its income by growing a new crop, all villages in the region could do the same. Unless there is a large market for the product, the result of expanding production would likely be a fall in prices and reduced rather than increased income. Multi-scale, multi-disciplinary analysis will play a key role in supporting the process of scaling up the use and impact of technologies.

More definitions—Scaling up

Part of the confusion with terminology comes from the fact that scaling up is often used as a catchall general term to refer to a combination of different processes, which themselves have a variety of different definitions. One of the earlier papers in this body of work defined four different types of scaling up for NGOs: Quantitative, functional, political, and organizational (Unwin, 1995). These are described in Table 1.

Table 1. Typology of scaling up.

Unwin's terms[a]	Description	Alternative terms
Quantitative scaling up	"Growth" or "expansion" in their basic meaning; increase the number of people involved through replications of activities, interventions, and experiences	Dissemination, replication Scaling out or horizontal scaling up[b]
Functional scaling up	Projects and programs expand the types of activities (e.g., from agricultural intervention to health, credit, training, etc.)	Vertical scaling up[b]
Political scaling up	Projects/programs move beyond service delivery, and towards change in structural/institutional changes	Vertical scaling up[b] Institutionalization
Organizational scaling up	Organizations improve their efficiency and effectiveness to allow for growth and sustainability of interventions, achieved through increased financial resources, staff training, networking, etc.	Vertical scaling up[b] Institutional development

a. Terms from Unwin (1995).
b. Term adopted in Gündel et al., 2001.
SOURCE: Adapted from Gündel et al., 2001.

However, for the purpose of this chapter, we have decided to use the terms, horizontal scaling up and vertical scaling up, proposed by the participants in the Going to Scale Workshop (IIRR, 2000). These are defined in Figure 1.

An example of ***horizontal scaling up*** (often referred to as scaling out) could be the adoption in different communities of a tool for managing soil nutrient content. ***Vertical scaling up*** may mean moving from individual to collective decision making, or it may involve moving from simple organizations based on face-to-face interaction to complex, hierarchical organizations. An example of this is if the same integrated soil nutrient management tool goes from being used by individual farmers to being used in a coordinated way by a group of farmers in the same community, or by an association of farmer groups in many communities. Such vertical scaling up might allow farmers to deal with soil management problems above the plot level.

Vertical scaling up includes ***institutionalization*** (often referred to as "mainstreaming", especially in the participatory literature). This implies

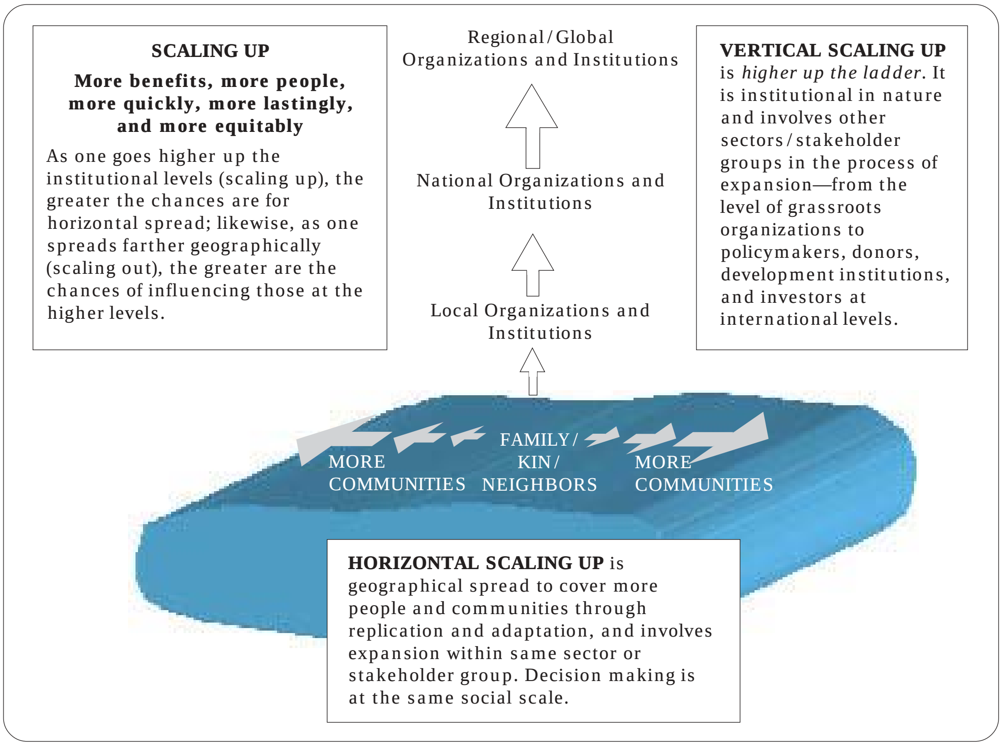

Figure 1. Definitions of scaling up (adapted from IIRR, 2000, p. 17).

getting institutions to accept and internalize the underlying principles of an innovation so that these will remain as guiding principles of practice even after the initial innovative project or program has come to an end. There is a growing body of work on the institutionalization of participatory approaches (see Blackburn and Holland, 1997; Bainbridge et al., 2000). For example, where the community has adopted a participatory integrated soil management process, the principles underlying this would be applied in other areas. So the same community may use the organizational and participatory approaches to work in areas such as water management, education, or health, or they may use the more holistic approach to combat a certain pest by incorporating organic solutions into their pest management strategies.

Horizontal scaling up

Horizontal scaling up of the more complex research outcomes referred to above differs in many respects from the process of disseminating a new variety. Because these complex research outcomes involve the end-users, and work with several different components of a complex system, immediate research outcomes will be less applicable for others. Horizontal scaling up therefore implies adapting knowledge and innovations to the conditions of different end-users, which requires understanding the principles underlying an innovation. For this to be done successfully, those doing the scaling out, whether extension agents or farmers, will need more training and support networks in order to work with communities to adapt innovations to their needs.[2]

In addition to technologies, methodologies can also be end products of research. The farmer participatory research (FPR) methodologies, such as Committees for Local Agricultural Research (CIALs, the Spanish acronym), participatory plant breeding modules, or farmer field schools (FFSs), are also research outputs that can be horizontally and in some cases vertically scaled up. A CIAL is a model for involving specified actors in a structured process with set objectives. Horizontal scaling up almost certainly will involve adaptations and unexpected impacts; however, the general process is well defined. Replicating CIALs according to the methodology, but allowing and even encouraging adaptation, is an example of scaling out. A similar argument could be made for methodologies for organizing watershed management associations, or implementing FFSs. Thus, replication of these methodologies is complicated because to horizontally scale up these innovations it will be necessary to adapt them to the conditions and demands of other communities. Again, this implies building capacity and transferring understanding about the underlying principles rather than just the methodologies themselves. These factors are discussed in more detail below.

Vertical scaling up

Vertical scaling up refers to expanding an innovation beyond the original participants and objectives. In the first instance, we can take the example given above of the adoption of an integrated soil nutrient management tool on a larger scale. The tool was designed to facilitate innovation at the plot level, but the basic information and principles (diagnosis, experimentation) may also be useful for addressing higher-level problems, such as community-level soil and water management. Scaling up the tool would involve recognizing its usefulness for other problems, and bringing additional actors into the innovation process so that it is broadened and strengthened via the coordination of their research/experimentation/adaptation activities. This almost certainly implies an increase in the geographical scale of the unit in which the technology is adapted and applied; however, the key variable is that decisions are being made at a higher level.

The sustainability condition within scaling up implies leaving people with the adaptive capacity to deal with problems as they arise. This

2. Farmers have always adapted agricultural innovations. However, recent thinking reflects recognition of the necessity and utility of this adaptation, and a commitment to support it.

process is inherent in adaptive management, which is increasingly understood as a promising way to innovate in whole ecosystems where, for example, major dysfunctions are occurring, the exact cause-effect relationships are difficult to ascertain, and interventions have to be made on a trial-and-error basis. The capacity to adapt is understood as a central characteristic of sustainability, also defined as the capacity to withstand or bounce back after major shocks occur in complex systems. One factor that contributes to adaptive capacity in a complex ecosystem is the extent to which the human beings impacting it are able to learn from experience and innovate. The development of this adaptive capacity involves a range of activities, including training, building networks, creating functional organizational structures, and gaining institutional support.

Institutionalization

Where the principles underlying an innovation and the adaptive capacity mentioned above become an internal part of an institution in a sustainable way, we can refer to this process as institutionalization. This implies not only a change in the way people work, but also a change in the written and unwritten rules of the institution, and a change in the way people within that institution think. This is the subject of much debate within participatory literature. While a lot of work has been done within management studies on processes of institutional change, there remains a long way to go on increasing the understanding of these processes within public institutions (Chell, 1987; Collins, 1998; Jones et al., 2000).

Often, these processes of institutional change are a necessary precondition for successfully going to scale on an innovation. As mentioned above, many innovations now involve a multi-disciplinary approach that incorporates a variety of stakeholders into the research process. Many institutions are structured in a way that does not easily allow for the creation of multidisciplinary teams or direct interaction with end-users. These are some of the obstacles to scaling up.

Elements of effective scaling up

This section will briefly highlight some strategies for scaling up as discussed during the four international workshops, based on participants' experiences (IIRR, 2000; Franzel et al., 2001; Gonsalves, 2001a; Gündel et al., 2001). We summarize the key strategies discussed under six key themes:

(1) Incorporating scaling up considerations into project planning,
(2) Building capacity,
(3) Information and learning,
(4) Building linkages,
(5) Engaging in policy dialogue, and
(6) Sustaining the process (funding).

Incorporating scaling up considerations into project planning. A key strategy that emerged in all the workshops is that to increase the impact of research, scaling up must be considered from the beginning of the research and planning process. This implies:

- Building scaling up strategies into the technology development process and including them in project proposals can ensure that these considerations are given full attention throughout the life of the project. The likelihood of scaling up can be increased if key opportunities and challenges are identified at an early stage, thereby allowing key channels for scaling up research activities and development outcomes to be identified. In this way, it forms an integral part of the technology/methodology development process, and much work can be done during the research process to lay the groundwork for going to scale. This is one of the key recommendations found in the industry literature on scaling up.
- Involving stakeholders as decision makers from the beginning of the innovation process. This is crucial in identifying real priorities, and in developing appropriate solutions to problems. Therefore research outputs (technologies, processes, methods) are shaped at an early stage of the project in collaboration with stakeholders and users, and can subsequently be adapted throughout the project. Additionally, participatory research can enhance the capacity of farmers and communities to become agents of change, and to respond to new problems arising in the future.
- Identify strategies to package/sell your outputs.
- Better use of extrapolation methods—linking different methods (geographic information systems [GIS]/FPR/economic modeling). In expanding the impacts of research outputs, it will be critical to use different methods. For example, linking FPR results to GIS information may offer a strategy to identify regions where the results can be scaled up—such as areas with comparable geographical, cultural, and socioeconomic characteristics.

Capacity building. In order for complex innovations, such as a soil nutrient management tool, to be adapted and applied in a variety of different contexts, those involved need to have a good understanding of the knowledge and principles underlying the innovation. This implies rigorous capacity building of staff in local institutions, and building the adaptive capacity mentioned above within local institutions and local communities. This process often occurs implicitly in the participatory research process, but needs to be made explicit in scaling up.

Capacity building is an important strategy, especially in the implementation and exit stage, to internalize new ideas within communities and institutions. This involves building the capacity of farmers and scientific personnel and the institutional systems to sustain and replicate the process.

Building and strengthening the capacity of communities to innovate may often be just as, or even more important than, the technologies themselves. It is critical for stakeholders to understand that the underlying principles behind a technology can help communities cope with changing environments, and in addressing arising problems. Finally, strengthening local capacities empowers farmers and local communities, and helps create broad-based support and effective local implementation of scaling up activities.

In addition to building the capacity of communities, it is important to develop a critical mass of R&D personnel with skills and experience in modalities for conducting agricultural and NRM research. This can include skills in consulting and collaborating with stakeholders, skills in working across disciplines, and an understanding of scaling up strategies, amongst others.

Information and learning. In order to ensure informed, effective, and appropriate decision making by a wide range of stakeholders in the scaling-up process, it is important to invest in a process of documenting, drawing lessons and experiences, and also undertaking corrective measures throughout the project cycle. Learning and corrective loops should be central to scaling up processes, in deciding what should be scaled up and how this might be achieved, and in providing validated evidence to influence policymakers. This involves several aspects:

- Participatory monitoring and evaluation (PM&E), which involves identifying indicators of change and building a process to monitor and evaluate change, and to measure impact and process of scaling up/out. PM&E ensures that learning and corrective loops are built into the innovation process.
- Effective impact assessment will also be necessary in order to learn from, and gain credibility on, the effectiveness and extent of impact of innovations, and to provide validated evidence to influence decision makers at different levels. Furthermore, impact assessment will help to identify factors that are important for adoption that may contribute to the success of innovation. However, if innovation occurs as the result of the interaction of the results of many simultaneous and independent (or perhaps only loosely coordinated) research initiatives, the traditional concepts of diffusion, adoption, and impact (especially attribution of impact to a specific research investment) may not be appropriate.

Building linkages. Developing partnerships and strategic alliances with other stakeholders (private sector, NGOs, governmental organizations [GOs], communities) is one of the essential strategies for successfully scaling up innovation. This will increase pathways through which the innovation can be scaled up, and thus leverage scarce resources to achieve greater impacts. These linkages have to be robust, ideally with direct participation of the other stakeholders in the research process in order to ensure local ownership, and to ensure that the necessary adaptive capacity is developed. This can involve several strategies, such as developing partnerships and strategic alliances, and linking with other stakeholders (private sector, NGOs, GOs, communities). This includes expanding and strengthening links amongst institutions and organizations with complementary agendas, expertise, resources, and “reach”, as leverage resources. Inter-institutional collaboration and coordination is not only important, it is crucial, and a prerequisite for maximizing impact.

Engaging in policy dialogue. It is necessary to engage in dialogue with policymakers not only to gather support for innovations and projects, but also to create the right institutional environment for innovations to be scaled up. For example, it may be necessary to convince managers of the need to work with end-users, but it may also be necessary to encourage the changes within the institutional structure necessary to overcome the institutional barriers mentioned above.

Engaging in policy dialogue on pro-poor development agendas is critical in achieving impacts. The NRI workshop emphasized the importance of placing research in the context of local, regional, and national development agendas because this helps identify key entry points and the major priorities. The participants felt that policymakers should be consulted at an early stage of the research project so as to shape the overall project design, and additionally through regular reviews of the project or at other development discussions.

Sustaining the process (funding). For the process to be sustainable requires reliable funding. Thus, donors need to be lobbied to obtain long-term flexible funding, which allows for a learning process to take place. Appropriate mechanisms also need to be developed to sustain capacity for expansion and replication. This involves paying special attention to mechanisms for self-financing, input/output markets, capacity building, and local and regional networking.

Conclusions: Implications for CIAT

A quick survey of CIAT projects will show that most already include many of the strategic elements mentioned above. Researchers have a general understanding of the need to scale up, and the issues involved, whether or not they term this as scaling up. However, to fulfill the equity and sustainability conditions of scaling up, many challenges remain to be met. Scaling up will imply more changes in the way we work.

The elements mentioned above are similar to those listed in Gündel and Hancock (2001), which have been put into Table 2, and may help incorporate scaling up considerations into project planning.

Table 2. Elements of effective scaling up.

Project phase	Activity relevant to scaling up	Strategic elements towards successful scaling up
Pre-project	Situation analysis	Engaging in policy dialogue on pro-poor development agendas Identifying community, institutional, and environmental enabling and constraining factors Appraising institutional capacity of agencies involved
	Identifying target groups	Identifying appropriate research objectives and outputs within development processes to ensure widespread uptake
	Setting objectives and outputs Developing monitoring and evaluation system	Identifying indicators and planning, monitoring, and evaluation methods to measure impact and process
	Collaboration	Building networks and partnerships to increase local ownership and pathways
	Funding mechanisms	Developing appropriate funding mechanisms to sustain capacity for expansion and replication
Implementation	Capacity-building and institutionalizing	Building capacity and institutional systems to sustain and replicate
	Partnership forging	Demand, supply, and support actors identified
	Networking	Other resource organizations contribute with products and by building technical capacity
	Raising of awareness	Multi-media dissemination of findings
	Policy dialogue	Aggregate and assess findings from individual projects and derive policy-relevant information
	Monitoring and evaluation and support studies	Central to scaling up processes in providing evidence to influence policymakers, in deciding what should be scaled up, and how this might be achieved
Post-project	Exit strategy dissemination	Concerted action required on a regional level should involve the target group as disseminators
	Impact assessment	Built upon monitoring and evaluation Representatives of target group part of assessment team Technological and livelihoods assessment required

SOURCE: Adapted from Gündel et al. (2001).

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CHAPTER 2

Scaling Up and Out the Impact of Agricultural Research with Farmer Participatory Research[1]

*Nina Lilja**, *Jacqueline Ashby***, and *Nancy Johnson****

Introduction

We can no longer claim that participatory research is a marginalized activity, because a sizeable amount of both budget resources and human capacity is invested in it. According to a survey in 2000, the Consultative Group on International Agricultural Research (CGIAR) reported 144 projects that involved participatory research, with a total budget of US$65 million (PRGA, 2000).

Despite many claims about the impact of participatory research, only a few published studies exist in the literature. The anecdotal evidence of the impact of participatory research needs to be verified, especially if we are interested in its mainstreaming. For the approach to be institutionalized, decision makers need to have good evidence, that is, what works, what does not, and with what impacts, and how participatory research and gender analysis (PRGA) may or may not contribute to scaling out and up.

This chapter uses examples from empirical impact studies that the CGIAR Systemwide Program on Participatory Research and Gender Analysis (SWP-PRGA) Program and the Impact Assessment Unit of the International Center for Tropical Agriculture (CIAT) have conducted in collaboration with many partners to illustrate how and when user participation has potential for contributing to the processes of scaling up and out the impact of agricultural and natural resource management

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1. This chapter draws from several impact studies funded by the SWP-PRGA that the authors have co-authored or collaborated upon with the following people: Elske Van Der Fliert, Sieglinde Snapp, Olaf Erenstein, Aden Aw-Hassan, Hisham Salaheih, Salvatore Ceccarelli, and Stefania Grando.

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(NRM) research. Scaling out in this context implies the geographical spread of PRGA methods through replication and adaptation, and scaling up is taken to mean the adoption of PRGA methods at a higher organizational level (Menter et al., this volume). The scaling up and out of methodological innovation is integrally linked to perceived benefits of the method over conventional methods of agricultural technology development.

The chapter is divided into three sections. The first provides the context for the empirical examples by outlining what implications participatory research has for scaling out and up the impact of agricultural and NRM research. Next, some empirical examples are drawn from two plant-breeding projects and two NRM research projects. The concluding part summarizes some key lessons emerging from empirical results.

Conceptual Framework

Many definitions are available of the types of PRGA, but a basic distinction is always made between functional and empowering approaches. Many of these typologies define PRGA in terms of the nature of the communication, interaction, and decision-making process between scientists and end users (Biggs, 1989; Lilja and Ashby, 1999).

The impacts of PRGA are influenced by the nature of this interaction, but also at which stage of the innovation this interaction takes place.[2] Why does the nature of the interaction and the decision-making process matter? It is assumed that the type of participatory research approach (functional or empowering) and the stages when it was applied, influence the process of innovation, and lead to some intermediary process impacts. For example, the research objectives of projects are consistent with the needs of clients because they are involved in the project planning. This allows the feedback of information back to research, and social and human capital formation impacts, such as that the participating clients are empowered to carry out some of their own experiments, and seek and find solutions on their own.

From this process, which is shaped by the participatory approach used and stage of research when applied, some benefits will accrue from research outcomes (adoption) or technology impacts. The adoption impact will influence the welfare outcome of the project in terms of who benefits, or how benefits are distributed among the end-users of the technology.

The process and technology impacts can contribute to both scaling out and scaling up of impact. Feedback to research can help in the process of scaling up the research methodology, because it can change priorities and

2. Technology innovation is a process in which the problems are identified, solutions are found and tested, and as a result, the target group adopts a technology or other type of innovation.

practices within research and development (R&D) institutions, and hence influence the technology design and process or scaling out. The research process, which builds local capacity to experiment and adapt (human and social capital impacts), individually and/or collectively, is a benefit in itself, but can also help the scaling out process of technology adaptation. If collective action is important, then social capital impacts are very relevant to scaling out technology.

Technology impacts are particularly relevant to scaling out. Obviously, having a better technology makes it more likely that people will adopt it, in greater numbers, and at a faster rate. Targeting the technology towards specific beneficiary groups increases the probability that it will be adopted, and generates impact among users.

Examples of Scaling Out and Up

Scaling out the impact of barley breeding

The International Center for Agricultural Research in the Dry Areas (ICARDA) has used decentralized-participatory barley (*Hordeum vulgare* L.) breeding in Syria since 1996.[3] The barley breeding program has evolved from centralized to decentralized breeding, and then to decentralized participatory breeding. The latter began when the initial 208 barley lines were planted on farmers' fields in nine villages throughout Syria in 1997. The participatory barley breeding at ICARDA can be described as currently operating at a "sustainable rate". That is to say, that it is not in its transition stage, but that the participatory research has been institutionalized in the breeding program. Participatory breeding methods are now used in ICARDA's work in Syria, Tunisia, Morocco, Yemen, Eritrea, Egypt, and Jordan.

According to ICARDA's current breeding approach, each year a large sample of barley lines are planted on a farmer's field in several locations, and they are called farmer initial trials (FIT). These barley lines are a random sample representing the initial stages of the breeding process, that is, lines that are normally planted at the research station. The lines represent different types of germplasm—2- and 6-row, modern and landraces, uniform lines and segregating populations, black and white seed color. The materials, which farmers select in the FIT, are then planted in the second year in fields of several host farmers at each location. These are called farmer advance trials (FAT). Material selected from the FAT enters the farmer elite trials (FET) in the third year. Each year, a new FIT is also initiated that sets off the advanced and elite trials in the subsequent years. The breeders' role is to make the initial crosses and

3. The results of the participatory plant breeding (PPB) at ICARDA have been widely published, see for example Ceccarelli et al., 2000. A complete impact study of the ICARDA PPB is forthcoming in 2003 (for preliminary results, see Lilja and Aw-Hassan, 2002).

increases on station, provide genetic material for the trials, and keep records about the agronomic characteristics of the lines. The farmers' role is to manage the trials, select, and record their selections. Breeders and farmers together discuss and decide what materials go to different trials.

Long, variable, and uncertain lags occur between commencing a research activity and generating useful knowledge (technology) and seeing it adopted, and hence yielding eventual research benefits. The ICARDA barley breeding case shows that the structure of participatory plant breeding (PPB) itself has the potential to reduce the R&D lag, and so corresponds to an early flow of research benefits, and ultimately higher returns to research investment.

Figure 1 shows the structure of PPB as compared to conventional breeding at ICARDA. It illustrates how the R&D lag differs between conventional and participatory approaches. The first 2 years of the research structure are the same, the crosses are made, and initial increases are made on-station. Then ICARDA's participatory barley breeding takes the lines to farmer selection in year 3, whereas on-farm testing in conventional breeding takes place 3 years later, in year 6. This means that decentralized participatory research has potentially a 3-year reduction research lag.

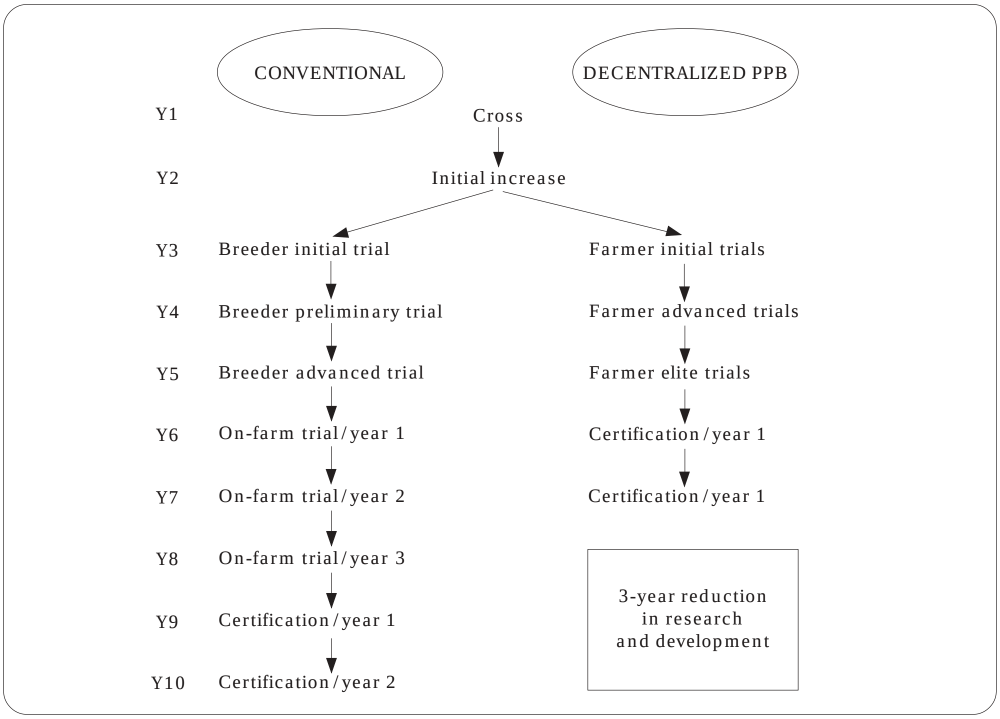

Figure 1. Structure of the past and current barley participatory plant breeding (PPB) program of the International Center for Agricultural Research in the Dry Areas (ICARDA).

The conventional breeding research lag is 8 years at the minimum. After 8 years, 2 more years of large-scale testing follow before a variety can be released. If single plant selections are made, then the pedigree method adds at least 3 more years because materials are not bulked until year 5.

One of the most robust findings of the economic theory of innovation diffusion is that the technology adoption follows an s-shaped curve (Mansfield, 1979). When the technology first becomes available, usually a small group of farmers will adopt immediately, or after short experimentation. These are known as “early adopters”. As time passes, a much larger group of farmers will adopt, and they can be called “mainstream adopters”. Lastly, a few farmers are always very slow to take advantage of new and emerging technologies, and often wait until the technologies are “mature”.

The ICARDA case provides some evidence about how participatory breeding may increase returns to research by shifting the diffusion curve through adoption occurring earlier in time, as well as at a higher rate, and increasing the maximum area under cultivation in the new variety or in the numbers of farmers adopting. The speed of barley adoption developed under the conventional breeding program has been 3% per year, and the adoption ceiling for modern barley varieties developed through the conventional breeding program has been 25% of the barley area (Aw-Hassan et al., 2004).[4] A 2001 survey of 86 farmers, who took part in ICARDA’s participatory barley evaluation research, assessed the adoption potential of the new barley lines the farmers had seen in the ICARDA PPB trials (Lilja and Aw-Hassan, 2002). The participating farmers expect a 26% yield increase of the new barley over their local variety; this is quite high over the breeders’ moderate estimate of a 10% yield advantage. The participating farmers estimate that they will plant 69% of their total barley area in the new barley lines, after their own initial 2-year experimenting period. This 69% represents the adoption ceiling, and it is 44% higher than the 25% ceiling rate of the varieties developed by the conventional breeding program. The participating farmers were also willing to pay a 24% premium on the new barley seed over the locally available seed.

The results of the economic surplus model show that the discounted, research-induced benefits to Syrian agriculture from conventional barley breeding are US$21.9 million. The model results also show that the benefits in reduction in research lag and 10% yield increase, due to participatory research, increases total benefits by 90%. The higher adoption ceiling for the participatory breeding as compared to

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4. A 5-year seed tracer study, done by ICARDA since 1994, which followed released varieties over time, was an important basis for modeling the adoption profiles for different breeding approaches, that is, the speed of adoption and the adoption ceiling, or the maximum amount of area planted in the new cultivar. The study tracked the adopting pattern of the seed that was distributed to 52 farmers in 1994 in five provinces of Syria, and the seeds were traced yearly until 1999.

conventional breeding increases the benefits a further 50%, and if we also allow for faster adoption speed, the benefits are increased by 260% compared to conventional breeding. These are *ex ante* estimations of the potential benefit of PPB, and realizing these benefits partially depends on the functioning extension and seed systems—since without them, autonomous diffusion may be slow, and the benefit forgone is then simply a cost.

The ICARDA 2002 barley breeding budget of US$1.5 million devotes 47% to personnel costs, 30% to overhead, and 23% to operational costs. Analysis showed that the shift from conventional to participatory research increased the operating costs by 56% (US$122,154). Further calculation shows that the move from conventional to participatory breeding only increases the total breeding budget by 2%.

Scaling up the impact of rice breeding

By 1996, the West Africa Rice Development Association (WARDA) had made significant and breakthrough advances in plant breeding by developing interspecific hybrid rice (NERICA, New Rice for Africa) by crossing Asian varieties (*Oryza sativa* L.) with traditional African rice (*Oryza glaberrima* Steud.). The same year, the WARDA upland breeder and production economist attended a seminal meeting of the SWP-PRGA at CIAT. The WARDA researchers then developed a 3-year participatory varietal selection (PVS) and breeding approach, which it implemented in its 17-member, national agricultural research systems (NARS) programs. In the first year, a centralized village plot is identified with local farmers, where a rice garden is established with about 60 upland or lowland rice varieties. Men and women farmers are invited to visit the plot as frequently as possible, but formal plant evaluations are held at three stages during the season. In the second year, each farmer receives the varieties s/he selected in the first year, and thus a new diversity of varieties enters the locality. During the second year, observers visit the field to record performance indicators and farmer appreciation of the varieties. At the end of the season, and in anticipation of the third and final year, the farmers' willingness to pay for seed varieties is elicited in order to derive an estimate of technology demand.

WARDA has been successful in scaling up participatory rice breeding in West Africa. By 2000, WARDA's national partners were conducting upland, lowland, and irrigated PVS trials in some 100 sites in 17 West African countries, and had involved more than 4000 farmers in the evaluation of improved rice varieties (Figure 2).

Input from farmers led to stated changes in the breeding program, and added value to scientists' work in terms of improving the understanding about farmers' preferences. This has led to real changes in breeding goals in 50% of the 17 West African national programs. In 25% of the cases, the breeders and social scientists from national programs said that they had not changed the breeding goals, but that the farmer input confirmed that their breeding goals were already consistent with farmers' needs (Lilja and Erenstein, 2002).

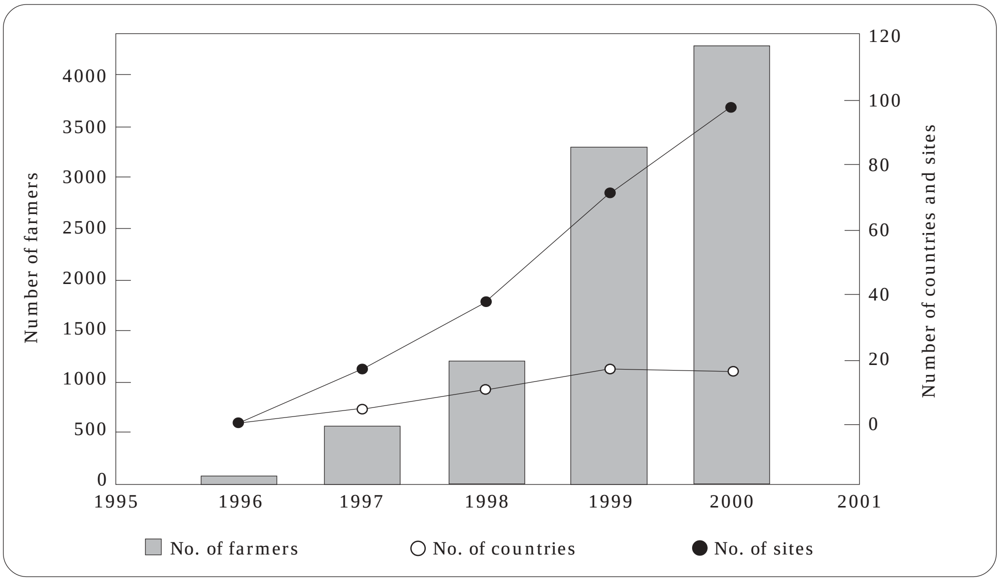

Figure 2. West African farmer participation in rice improvement research sponsored by the West Africa Rice Development Association (WARDA), 1996-2000. (Data from WARDA)

The 17 West African NARS all followed the same research design in their model. According to their common model, gender analysis (GA) was a required part of the research. All programs received training in GA, and half of all the farmer participants were purposely selected among the women. Sixty-nine percent of the breeders and social scientists said that doing GA and involving women participants had made a difference in terms of what they had learned, and its subsequent implications and changes to the rice breeding objectives. They cited several examples; one was that, in the past, breeders had selected out rice varieties with "spikes" or awns because they were not a preferred plant architecture type. Guarding against birds is women's responsibility, and given that their labor is limited, they prefer the longer awns. Having learned this, breeders now are including the long awn plant types to their breeding program.

Some of the success factors for the rapid and large-scale institutionalization of participatory research in West Africa can be drawn from WARDA's experience. First, WARDA is a "unique" CGIAR center because it is an association of member states, and has a governing body of Council of Ministers, hence it benefits from constant and open dialogue with policymakers. Second, there is also an established pre-existing network of regional professionals, national program scientists, who are used to working together, and are often convened at WARDA for various planning and training exercises. This tightly knit group of professionals is used to working together, which further fosters and promotes peer acceptance of new approaches, and allows rapid movement to large scale in research efforts. The benefits of social networks for innovation diffusion are well-established phenomena in the sociology literature. Third, since 1997, all national program partners have received training (one breeder and one social scientist each) in PRGA methods at WARDA during the annual Participatory Rice Improvement and Gender Analysis (PRIGA) training, reporting, and planning week. In addition to advantages from continuous training in methods in building researchers' human capital, regular meetings reinforced group cohesion, which in turn fosters both peer acceptance of, and peer pressure for, innovations. Fourth, WARDA had a new exciting and superior technology (NERICA) to offer to the national programs and farmers. Farmers were engaged at a rather late stage of the research process—the adaptive stage. The breeders selected their best-bet varieties for testing with farmers and, in this case, their selections were highly correlated with farmers' preferences. Fifth, upland rice farmers in West Africa were faced with declining yields and lack of suitable planting materials, so there was an acute need for new cultivars in West Africa that undoubtedly contributed to increased acceptance of the NERICA. Sixth, national varietal certification and release boards in most West African countries were deemed inefficient and participatory research was seen as a method to bypass the inefficient system and go directly to the farmers. Seventh, WARDA gives each country a small grant each year (US$3000), which allows national programs to work off station and conduct PVS trials with farmers.

Scaling out soil fertility research

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Mother-Baby (MB) trial model is a methodology designed to improve the flow of information between farmers and researchers about technology performance and appropriateness under farmer conditions (Snapp, 1999). The methodology was initially developed and implemented to test legume-based soil fertility management technologies in Malawi in 1997. The mother trial is researcher-designed, and conforms to scientific requirements for publishable data and analysis. A baby trial consists of a single replicate of one or more technologies from the mother trial. A single farmer manages each baby trial on his or her own land. The MB trial design has gained significant popularity among researchers in recent years in several CGIAR centers, and hence it is important to consider its potential contribution to scaling out impact.

Because no formal dissemination program has been based on the results of the MB trials in Malawi, the spontaneous local adoption and diffusion in the communities where the trials took place is discussed here in order to consider the implications of the MB methodology to the scaling out of impact. Although lack of a diffusion program that addresses constraints, such as credit and seed availability, may limit observed adoption, spontaneous local adoption is usually a good indicator of the adoption potential of a technology. No spontaneous local adoption would suggest low probability of success even with a well-designed extension program.

In order to assess spontaneous adoption, a few weeks prior to the planting season, respondents were asked what they were planning to plant (Johnson et al., 2000). The survey of baby-trial farmers showed that only two out of 40 cases surveyed planned to adopt one of the legume best-bet technologies tested in the MB trials—maize (*Zea mays* L.)/pigeon pea (*Cajanus cajan* [L.] Millsp.) intercrop. However, evidence shows that farmers are testing the technologies, and shows a high level of partial adoption in terms of incorporating crop residue that was part of the technology package tested at the MB trials. The survey results also show that the MB methodology is associated with widespread dissemination of knowledge of the technologies through informal social networks. Although adoption of technologies tested remains limited, knowledge of the technologies is much more widespread. As expected, it is significantly higher in the project villages (varying from 45% to 96%) than in the controls; however, it is high in control villages as well (ranging from 36% to 70%).

Many people reported visiting the baby trials rather than the mother trials, which suggests that this methodology may be more effective than a traditional test or demonstration plot in disseminating information about new technologies.

ICRISAT's initial experience with MB design is a case where scientists' best-bet technologies had very low farmer acceptability because farmers' opinions did not coincide with researchers about which technology was most preferred, based on farmer-defined criteria. Farmers preferred a technology that was lower yielding, but that was perceived to be less risky. The MB approach was successful in quickly "discarding" the technologies that were not acceptable to farmers. In order to appreciate this result, one needs to consider the costs avoided as a "benefit" from discarding technologies that have a low probability of succeeding. These costs would include the further development and dissemination of these best-bet technologies through the R&D channels.

Scaling up integrated sweet potato management

During 1995-97, the International Potato Center (CIP, the Spanish acronym), in collaboration with public and private sector groups, implemented a project to develop a protocol (curricula) for a sweet potato (*Ipomoea batatas* [L.] Lam.) farmer field school (FFS) in Indonesia. The project used participatory approaches at all stages of the research process: Needs assessment and project design, R&D of technologies and practices, design of farmer learning protocols applying the FFS approach, pilot-scale implementation of the sweet potato FFS, and monitoring and evaluation. The CIP project highlights the benefits of involving end-users in the research process at a very early stage of the research. The project changed its focus from integrated pest management (IPM) to integrated crop management (ICM) as a result of user input gained from individual and group interviews and detailed production data. The change involved broadening the scope of the field school curriculum from pest management alone to include varietal selection, seed and plant health, nutrient management, and economics and marketing.

To scale up (institutionalize) the sweet potato FFS model that was developed, and allow for large-scale farmer learning and implementation, staff from the national IPM Program's local NGOs underwent FFS facilitators' training. A survey of ICM-FFS participants in 2001 showed that the number of beneficiaries has increased because technologies are more relevant to farmers' priorities. As compared to the conventional IPM-FFS, farmers who attended the ICM-FFS liked the aspects of FFS curricula that were added because of the input from farmer researchers. The expansion from IPM to ICM increased the number of people that the technology reaches by increasing the range of problems for which the technology is relevant.

The farmers who attended the improved FFS benefited; in the analysis of the impact of the implementation of six sweet potato ICM FFSs, participation in ICM was associated with 44% higher net returns per hectare from sweet potato production. The results also show that the farmer-researchers who developed the FFS curricula benefited significantly from their participation in the research project; they formed strong bonds with researchers and with the other farmers, and continued to maintain them after the project ended. Their roles in their communities also changed, relative to other farmers and to officials such as extension agents. The farmer-researchers are sharing the benefits of their increased knowledge and skills with the rest of the community. However, it would be incorrect to interpret this as an increased human capital impact of participatory research alone, because it appears also to be a consequence of existing modes of social interaction (Johnson et al., 2000).

Conclusions

The empirical examples presented here lend support to some specific conclusions about the role of participatory research in scaling out and up the impact of agricultural research. The degree of confidence a researcher has on the best-bet technology options available to farmers should influence the decision about the stage of farmer involvement. Both WARDA and ICRISAT involved farmers at a very late stage in the innovation process, and offered "finished" or best-bet technologies, with different results. In WARDA's case, NERICAs, which were developed through the conventional breeding approach, were quickly tested and found to have high farmer acceptance. This is also an example of how "conventional" research and participatory research compliment each other, and how participatory approaches can add significant value to conventional research processes. High farmer acceptance, combined with the acute need for new varieties, was one of the contributing factors to scaling up the participatory rice varietal selection methodology in West Africa. In contrast, ICRISAT quickly learned through MB trials that their best-bet technologies had low farmer acceptance, which benefited research in terms of costs avoided from developing technologies that had low farmer acceptance.

In contrast, both CIP and ICARDA involved farmers very early in the research process. When research and extension are farmer-led, or when participatory research has a specific empowerment or farmer capacity-building element, the process of participating and engaging in research can have a significant impact on farmers' human and social capital, hence creating the basis for sustainable local innovation through enhancing learning capability and knowledge generation in rural communities.

Finally, the importance of social networks in the agricultural innovation process is evident, both in terms of formal networks, as in the case of WARDA, or informal, as in the case of ICRISAT. In West Africa, this wide professional network allows rapid information creation and dissemination. The members of this social network communicate with ease, which in turn promotes social support as well as social pressure to change.

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CHAPTER 3

Estimating Impacts of Geographic Information Systems Research: Using Rubbery Scales and Fuzzy Criteria

*Douglas White**

> *"When you think you know something about a subject, try to put a number on it. If you can, then maybe you know something about the subject. If you cannot then perhaps you should admit to yourself that your knowledge is of a meager and unsatisfactory kind."*
>
> Lord Kelvin, 1893

Introduction

Impact assessments of international agricultural research have documented past efforts and guided its future direction. Numerous *ex post* impact assessment studies authenticated early Consultative Group on International Agricultural Research (CGIAR) successes of increased staple grain productivity. For years, such assessments have influenced decisions with regard to the allocation of financial resources. In general, crop research that produced greater economic benefits received larger investments.

The distinction between natural resource management (NRM) and integrated natural resource management (INRM) can be subtle (for more on the evolution of these approaches see Douthwaite et al., 2003; Fujisaka and White, 2003). This chapter does not distinguish between the two terms; INRM is used to describe both these relatively new CGIAR objectives. In addition to increasing agricultural productivity, research objectives added the broader development objectives of (1) alleviating poverty, (2) preserving the environment, (3) spurring economic growth, and (4) facilitating organizational/institutional change. While these objectives were sometimes embedded within earlier research efforts, they have become more explicitly important following the vanguard of modern ecological and social science.

But identifying and measuring the impacts of such an extensive INRM research agenda remains difficult. For example, geographic information systems (GIS) research includes upstream products of knowledge, information, and training that modify decisions and policies, which in turn lead to final impacts. Two major issues confound efforts to assess the impact of GIS research: (1) clearly identifying the multiple cause-and-effect

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relationships, and (2) determining appropriate precision of measurement instruments. This chapter's objective is to provide a rapid, comprehensive, and generalized method to evaluate the impact of GIS research. Three objectives of INRM—poverty alleviation, environmental preservation, and economic growth—are used as summary development goals (Reardon and Vosti, 1995). Research outputs affect change with respect to one, two, or all three of these objectives. Two additional measures consider the process by which research influences the development goals: (1) the level of participation and (2) the spatial scale at which research and impacts take place. Impacts are evaluated in a systematic and transparent manner using qualitative criteria. Research outputs of the Land Use Project of the International Center for Tropical Agriculture (CIAT, the Spanish acronym) serve as the case study.

Impact Assessment of INRM Research

Impact assessments are used to improve decision making and resource allocation. They provide an account of past investments, and identify promising and effective investments. Multiple cause-and-effect relationships of INRM research, however, bewilder attempts to assess impact. INRM research is complex in both its approaches and results. Since multiple objectives reflect the needs and expectations of different stakeholders (Izac and Sánchez, 1998), interventions range from relatively tangible germplasm and land management to subtle development processes of increased knowledge and capacity. Functions of organizations, policy, and institutions comprise this latter and larger research domain (Leeuw, 2000).

Demonstrating links between such research outputs and development impacts is difficult. Complications are particularly acute with upstream research products of information and training. A long chain of events is often required where many people adapt and improve a scientific innovation before adoption and impact occurs. In other words, adoption processes are not linear (Douthwaite et al., 2003; Ekboir, 2003; Kuby, 2003). Adopters and researchers work, learn, and affect change together. Furthermore, other concurrent development processes, such as changing government policies and market prices, confound identification and measurement. Hence, causality of research impact upon development process is often tenuous and hard to assess.

Methods

This chapter employs three unconventional methods to comprehensively estimate the impact of INRM research projects. One, multiple evaluation criteria correspond to the numerous objectives and subobjectives of INRM. Two, scientists subjectively assess the impact of their own projects. Three, elicited responses are qualitative measures analyzed using descriptive statistics and correlations between the multiple objectives.

The multiple objectives inherent to INRM research require appropriate recognition and measurement of different impacts. Six summary criteria are used to estimate the impacts of research projects, similar to those used by Campbell et al. (2001) and by Kristjanson and Thornton (2002) of the International Livestock Research Institute (ILRI). Three criteria relate to the development goals of poverty alleviation, environmental preservation, and economic growth; two scalar criteria, level of participation and geographic scale of research impact, take account of INRM processes; one summary criterion estimates the cost of the research (Figure 1). Together, these criteria answer the basic questions of what, when, where, how, who, and how much.

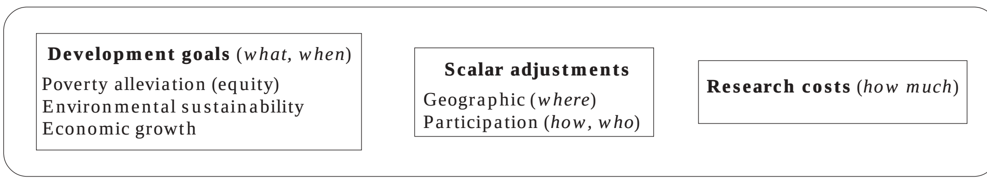

Figure 1. Impact assessment of integrated natural resource management research and questions addressed.

The three development goals form the first half of the summary impact criteria. They encapsulate the key objectives of INRM research—the *what* question. As they appear, however, the three criteria are difficult to understand, and require additional criteria in order to minimize individualistic interpretations. Two of the goals, environmental preservation and poverty alleviation, use a pair subcriteria in order to evaluate the relative importance of the problem and the ability of the research project to affect change. These subcriteria have a temporal aspect to them—the *when* question. Severity refers to the current state of the problem, whereas vulnerability considers future seriousness of the problem being addressed by research. The vulnerability component attempts to address perceptions of fragility or lack or resilience to exogenous shocks. The third goal, economic growth, employs more traditional economic measures. Since the poverty alleviation goal captures aspects of severity and vulnerability, the economic growth criterion is relatively straightforward. A research project is evaluated according to the size of production difference, and what the change represents within overall household income. More sophisticated economic models could be used in order to estimate more accurately the economic benefits, but again they are time consuming and expensive to implement.

Two scalar criteria address the process aspects of INRM research impacts. The first scalar estimates the geographic coverage impact—the *where* question. Given that development processes occur at different organizational levels, INRM research includes higher scales of analysis above the field, plot, and farm. Research may have a tendency to focus on a specific region and have pervasive effects, or it may be wider in scope and influence a lower percentage. To capture this possibility, estimates are made regarding the percentage of people or land area affected at four different scales—community, nation, continent, and globe. In the case of economic impacts, the geographic scalar estimates the rate of adoption per given area at different area scales.

The second scalar refers to the level of participation—the *how* and *who* questions. Research that includes other scientists and development workers is deemed to have higher "buy-in", so impacts have a higher probability of occurring and lasting longer. Beneficiaries of research take on more active roles by determining and implementing the research and development agenda. Such a participatory approach is seen to be more sustainable, following the adage of "teaching a person to fish." As a result, INRM approaches empower many people ranging from farmers and extension agents to policymakers and fellow scientists. Besides improving the potential of individuals, these efforts also build social capital that encourages development processes.

To capture the human and social capital impacts, research outputs are evaluated according to a scale of participation. The scale functions on a cumulative basis. Research that produces scientific journal publications alone has the lowest score. Adding technical reports/Web site/CD-ROM raises the score to the next level. The previous outputs, along with training and the establishment of a user/discussion network, receive a higher score. A demonstrated policy change, at any spatial scale, from community to globe, is the highest level. This scale estimates the level of policymaker empowerment at scales ranging from the farmer, who is a private policymaker/manager, to administrators who may influence policy over much larger spatial areas.

The final criterion addresses research costs—the *how much* question. Research costs are a function of the number of scientists involved, the percentage of time they dedicate to the project, and the number of years the project requires. This estimate also serves as an estimate of the project size.

A case study of intermediate INRM impact: GIS research

Geographic information systems, along with associated spatial analysis, are an example of INRM research that does not lead to direct impacts. Nevertheless, the research does have influence; the challenge is to derive valid estimates of impacts. Scientists of the Land Use Project evaluated their research projects (n = 31) according to the above criteria. The list of research projects is given below. Qualitative measures systematically recorded their subjective assessments. Measures were intentionally imprecise to avoid pseudo-precision. Four categories were employed with scores ranging from 0 to 3; intermediate values were also used (e.g., 2.5). Higher values represent positive, desired traits. Table 1 presents a summary of the criteria, subcriteria, and qualitative scoring scales.

Table 1. Impact assessment criteria of integrated natural resource management research and qualitative scales.

Goal/process criteria	Subcriteria	Qualitative scale descriptors
Economic impact	Production change, percentage of household income	0 = none 1 = low 2 = medium 3 = high
Environmental impact	Severity, vulnerability	0 = negative 1 = neutral 2 = good 3 = excellent
Poverty alleviation impact (equity)	Severity, vulnerability	0 = none 1 = low 2 = medium 3 = high
Geographic coverage (population affected)	Community, national, continental, global	0 = 0%-24% 1 = 25%-49% 2 = 50%-74% 3 = 75%-100%
Participation (level of decentralization)	Scientists, development workers	0 = only scientific journal publications 1 = plus technical reports/Web site/ CD-ROM 2 = plus training/networks 3 = plus policy change
Research cost	No. of scientists, percentage of time, time period (years)	0 = none 1 = low 2 = medium 3 = high

Research projects of the CIAT Land Use Project

Accessibility and spatial interaction analysis
Basic needs index for Central America
Cassava resilience on hillsides
Climate database
Consortium of Spatial Information
Decision support system (DSS) for agricultural projects and land use
DSS of Andean infrastructure
Ecoregional research network
FloraMap
Food insecurity mapping (Ecuador)
Food security and poverty mapping
Genotype selection in participatory bean experiment
High spatial resolution imagery
Landslide prediction
Land use change (Nicaragua)
Land use planning training (Ecuador)
Local and scientist views of NRM
Maize and climate change
MarkSim
Measure/model forest biodiversity
Participatory 3-D mapping
Remote sensing for planning
Role of local knowledge in NRM
Rural sustainability indicators
Socio-spatial decisions of forages
Soil macrofauna at catchment scale
Spatial interactions of dairy markets
Targeted wild relatives conservation
Tropical precision agriculture
Whitefly and climate change
Wild beans and climate change

All subcriteria except those of geographic scale are equally weighted. Since a central objective of the CGIAR is to produce international public goods, research that affects change at larger geographic scales receives greater weight. Amongst the four categories (community, national, continental, and global), the two lower scales use a multiplier of 0.2, while the two higher scales use a multiplier of 0.3, thereby summing to one.

Scientists scored their research projects within an electronic spreadsheet. Estimates were not made in isolation; scientists compared their evaluation scores with those of other projects. Cells of the spreadsheet acquired darker hues as scores increased in order to facilitate rapid visual recognition of the score and comparison with other project assessments. The survey instrument was administered with the author present to clarify questions.

Systematic inquiry of the development goal, processes, and costs enables the examination of various hypotheses:

H_o: Survey results of GIS research projects are homogenous.
Scientists will be unwilling to distinguish the potential impacts of their research outputs.

H_o: Perceived impacts of GIS research are equal with respect to three development goals.
Research projects are multi-objective; investments demonstrate a balance amongst the goals.

H_o: Research at higher spatial scales is inversely related to decentralized research approaches.
Participatory approaches typically occur at local levels. GIS research and analysis at higher scales, as with policymakers, is rarely collaborative.

H_o: Higher cost research is more decentralized.
Participatory research processes require more time to coordinate efforts and have expensive travel costs.

H_o: Research to alleviate poverty spurs economic growth.

H_o: Poverty alleviation research focuses on site-specific regions.
The issues of poverty are highly contextual requiring in-depth analysis of geographic regions.

Results

Analysis of the qualitative data provides numerous insights into how GIS scientists view the influence of their research. The qualitative data enabled rapid and systematic examination of general interrelationships between development goals, processes, and costs. Quantitative summary statistics (e.g., mean, standard deviation, and correlation coefficients) were used to analyze the elicited scores. In comparison to quantitative analyses, the potential of qualitative analyses to make detailed inferences has many limitations. The qualitative measures employed do not use a common metric; therefore, results amongst the different measured criteria are not directly comparable.

Scientists estimated modest impacts of their research on average (Figure 2). GIS research was seen to have similar qualitative effects (~1.6) on economic growth and environmental preservation. Since the two qualitative scales differ, these translate into medium-low impact on economic growth, and between neutral and good impact on the environment. Research toward the equity goal had stronger perceived impact (1.9). This result reflects the poverty alleviation strategy and tactics of the GIS project.

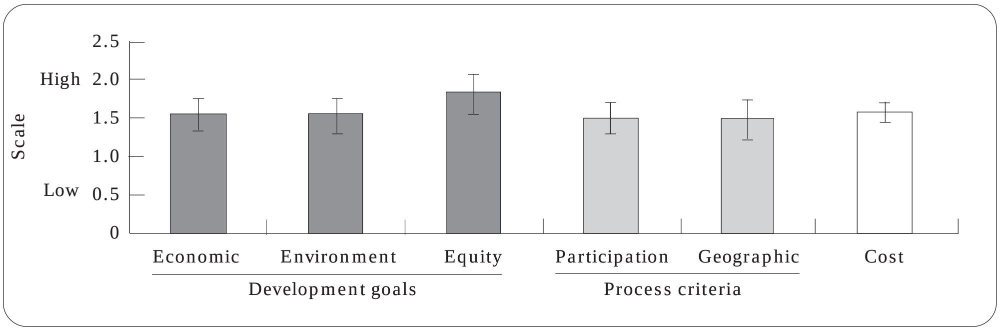

Figure 2. *Ex-ante* impact assessment estimates of Land Use Project (mean, standard deviation).

The standard deviations about the mean of the elicited responses were similar, about 0.46 for the economic, environment, and participation criteria. These somewhat large standard deviations imply that researchers were able to distinguish different levels of impact of the projects and rate them accordingly. The process criteria of INRM also received medium-low ratings along with the cost index. Again, all comparisons between the indices must be made with care; elicitation of responses was accomplished by evaluating a research project per criteria. No assessments regarding the relative importance of the criteria were conducted. These summary results are more a demonstration of the behavior of the indices than a comparison between the distinct criteria.

Correlation coefficients examine general tendencies of the qualitative data and produce logically consistent results (Table 2). The correlation coefficients compare the entire group of projects with respect to the development goals, processes, and costs. Some results were anticipated; others were not. An example of an expected result is that research addressing economic growth is highly correlated (0.62) with poverty alleviation (equity). The criteria appear to have much thematic overlap. Also, impacts of the development goals are highly correlated with research costs, ranging from 0.40 with economic development to 0.67 of environmental preservation. Surprisingly, however, more participatory approaches are only slightly positively correlated with research costs, 0.25. At the risk of pseudo-precise results, correlations greater than 0.37 are statistically significant at $\alpha = 0.05$.

Table 2. Correlation coefficients of impacts of geographic information systems research.

	Environment	Equity	Participation	Geographic	Cost
Economic	-0.11	0.62*	-0.06	0.27	0.40*
Environment		-0.08	0.36	0.20	0.67*
Equity			-0.22	-0.23	0.59*
Participation				-0.30	0.25
Geographic					0.42*

* statistically significant ($r > 0$, $\alpha = 0.05$).

The levels of research participation are positively and negatively correlated with the different development goals. Participatory methods are positively correlated with the environmental research, but negatively correlated with themes of economic growth and equity. This result may be due to the management requirements of natural resources by local people, whereby participatory approaches are more effective. A negative correlation between increased participation and larger geographic scales (–0.30) appears to support this result. Also, research at the community level reveals a tendency of employing a more participatory approach (correlation coefficient = 0.38).

Of the six criteria examined, geographic scale contains the most subcriteria. A more detailed analysis of responses reveals that scientists perceive that their research has more pervasive impact at smaller scales (Figure 3). Average assessments of impact, equally weighted, range from medium (1.9) at the community level to just above low (1.1) for global. The

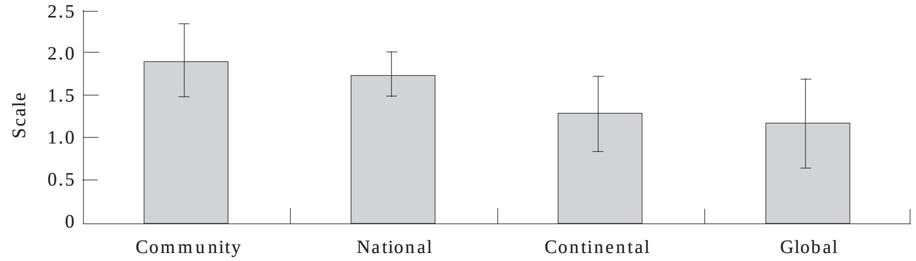

Figure 3. Perceived impacts of research per geographic scale (mean, standard deviation).

variation about the mean also changes according to scale. From national to global scales, standard deviation becomes larger as scale increases. The standard deviation of GIS research impacts at the community level was relatively high.

Correlation coefficients of the geographic subcriteria are both negative and positive (Table 3). Community level research is negatively correlated with all higher scales, ranging from –0.13 at the national level to –0.59 at the continental level. This implies that research that has greater perceived impact for specific communities is not easily generalized. Research impacts at higher scales are positively correlated. This could mean that, once beyond the community level, research impacts are generally applicable and scales have less distinction and fewer implications. The high positive correlation between global and continental research supports such an inference.

Table 3. Correlation coefficients of impacts of geographic information systems research at geographic scales.

	National	Continental	Global
Community	-0.13	-0.59*	-0.36
National		0.45*	0.29
Continental			0.70*

* statistically significant ($r > 0$, $\alpha = 0.05$).

Returning to the hypotheses posed in the previous section, many of them were founded. Scientists were willing and able to distinguish the potential impact of their research outputs. Variability in responses was reflected by the standard deviations about the means. Scientists also assessed different levels of impact to the three development goals. The overall mean of the three goals by project was 1.6, with a standard deviation of 0.4. This is the average of the means, which is not equal to the mean of the averages (1.7) as depicted in Figure 2.

Participatory GIS research is more costly. Time required to coordinate research with others is likely to be longer than a scientific publication strategy. Travel costs are also likely to increase when more people are involved. With respect to specific development goals, some analysis outcomes are expected. Results fail to reject the hypothesis that GIS research impacting economic growth also alleviates poverty. The two impacts of research projects are highly correlated (0.62). In contrast, GIS research that addresses poverty alleviation does not necessarily occur at a community scale. Projects demonstrate a nearly negligible positive correlation (0.07).

Research benefits of GIS (i.e., impacts) tend to increase as costs increase (Figures 4 and 5). Both cost and benefit estimates demonstrate sufficient dispersion, supporting the inference that scientists could distinguish their work using qualitative measures. Vertical groupings of results are an artifact of the categorical nature of the cost estimates and equal weighting of the subcriteria. Scientists tended to respond using integers and in-between half values (e.g., 2.5). This could signify that insufficient detail was provided with the subcriteria and associated scales, thereby causing scientists to respond with broad estimates.

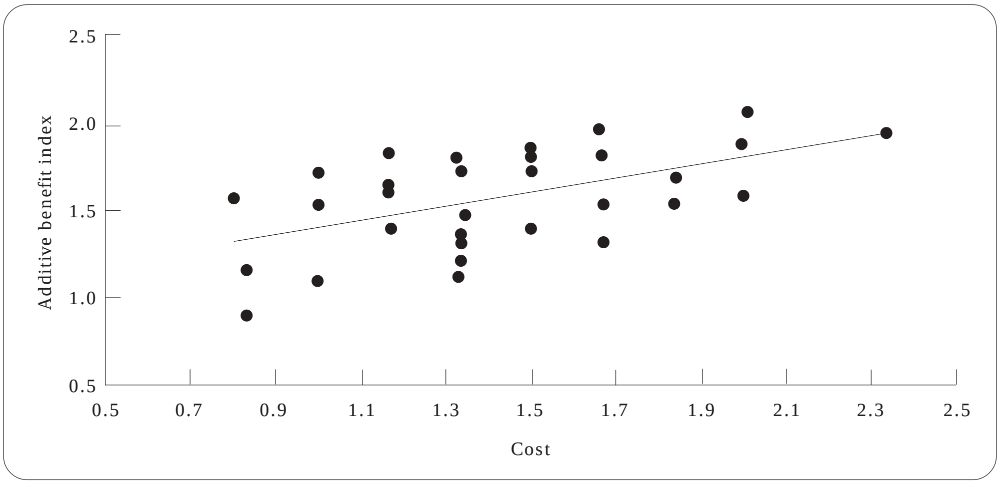

Figure 4. Benefits (additive scales) versus costs of geographic information systems projects.

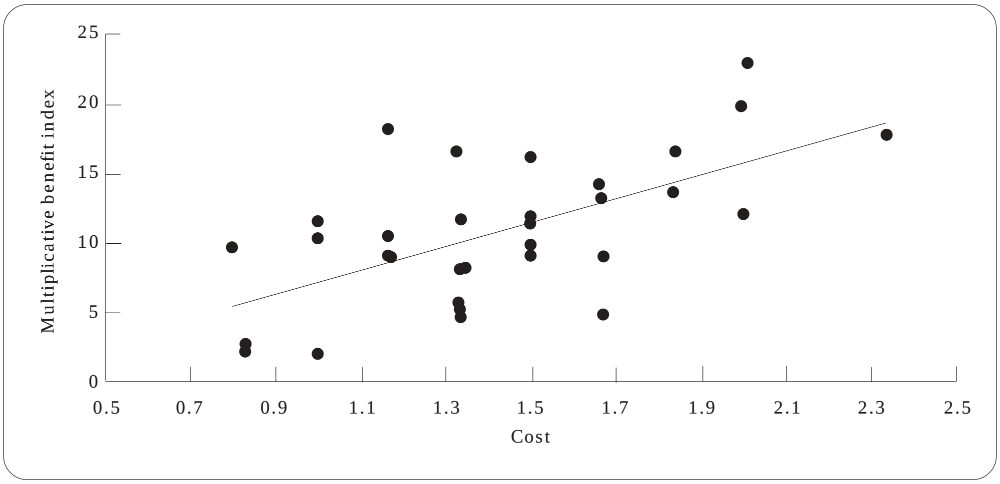

Figure 5. Benefits (multiplicative scales) versus costs of geographic information systems projects.

Summary analyses using two different associations amongst the criteria reveal different results. Figure 4 is based upon a simple additive association where total score is the sum of the five criteria. All the criteria are weighted equally. In Figure 5, the three development goal impacts were scaled by the level of participation and geographic coverage. The process criteria were used as multipliers. As a result, the summary scores of many of the projects change, as can be seen by the different estimate positions within the vertical groupings.

Discussion

The use of unconventional methods to estimate the impact of INRM research projects raises more questions than it answers, especially with regard to (1) goals and their definitions, (2) multiple interpretations and measurement, and (3) their relation and analysis.

One, the comprehensive nature of INRM research requires that impact assessment include multiple evaluation criteria that correspond to numerous objectives and subobjectives. But achieving accurate measures against criteria is another matter. Given the complexity of research projects and their impact context, the use of precise measures would be invalid. The goals of INRM research are subjective concepts that are not only ill defined, but also distortable by emotion or personal bias. Despite estimation challenges, many scientific disciplines attempt to objectively measure subjective phenomena. Psychologists, for example, estimate intelligence and personality traits (Dalkey and Rourke, 1971). Such characteristics are imprecisely defined, and thus open to interpretation. Similarly, economists use survey instruments to measure subjective characteristics, for instance consumer preferences. Although these types of estimates are not considered to be highly exact, they provide a basis with which to analyze difficult-to-define subject matter. The initial broad tendencies can be identified, contrasted, and further explored.

Two, eliciting expert opinion is one manner with which to estimate research impacts. Personal biases and preferences, however, can affect responses. Overstating research impact is a tempting strategic behavior to satisfy desires of professional advancement or personal ego. Although personal subjective judgments remain within an evaluation, the transparent peer-review evaluation process minimizes such potential behavior by providing a checks-and-balances system.

Many concepts are ill defined because of multiple themes embedded within them. Poverty, for example, is a well-known concept, but difficult to fully characterize. Besides a World Bank definition of income being less than US$1 per day, other aspects of the condition require recognition, such as empowerment, opportunity, and nourishment. Thus, the use of subcriteria that represent aspects of the larger concept facilitates more general understandings and reduces personal interpretations.

Three, qualitative measures limit the ability to conduct rigorous quantitative analysis. Partly as a result of unclear goal and criteria definitions, this study relies upon direct comparison between projects in order to estimate impacts. Since the categorical evaluation scales do not always provide consistent interval measures (Scheibe et al., 1975), the associated numerical values need to be analyzed with caution. For example, the concepts and criteria of the poverty alleviation and economic growth development goals appear to overlap. This may lead to problems of double counting, which in turn may skew summary results away from the environmental preservation goal. Similarly, the process criteria of GIS research, participation and geographic scale, could benefit from further refinement. Their relationship to the development goals, whether additive or multiplicative, also requires discussion.

The weights of the indices are subjectively determined. Analysis results directly depend upon the weights, since they determine the relative importance of the criteria. The ILRI study, for example, established their relative values via expert opinion. Yet other views of diverse INRM stakeholders are also important to consider (Kelley et al., 1995). Future research could contrast the preferences and priorities of stakeholder groups with analytical hierarchy process (Saaty, 1995) or Delphi (Turrof, 1970) methods.

To describe research to development processes, causal pathways are often used to explicitly document the intermediate links between the final impacts of research outputs (Gottret and White, 2001; Douthwaite et al., 2003). Pathways help establish a plausibility of impact by explaining the context and identifying conditions or concurrent interventions that are required in order for impacts to occur. Three points along the path are distinguished: (1) outputs, immediate products of a project after using the given inputs, (2) outcomes, consequences of the outputs, and (3) impacts, the broader and longer-term goals. Scientist responsibility and control over specific activities declines as one moves along the pathway from a research output to a development impact (Smutylo, 2001). Causal pathways, however, are difficult to compare since no summary measure are developed. The participation criteria used in this chapter attempt to estimate the strength and magnitude of the pathway links. Indicators of participation could include more detailed assessment of processes such as those of Biggs (1989) and Lilja and Ashby (1999).

Questions of analytical rigor

Quantitative economic impact assessments of Green Revolution crop improvement research established a high standard for broader INRM impact assessment approaches to meet. A single monetary value describing research benefits has indisputable appeal when making decisions. Such an estimate is easy to comprehend and compare with other research efforts.

Impact assessments come in many forms and differ in analytical rigor. On one side of a continuum representing different levels of rigor are quantitative impact assessments (Figure 6). Systematic and mathematically sophisticated methods provide objective estimates of research impacts. Most of these concern economic impacts (Pardey et al., 1991; Alston et al., 1995; 2000). Econometric models are often used to estimate not only the overall magnitude of benefits, but also how these benefits are distributed, such as toward the poor (Binswanger, 1980; Ravillion, 2001). Use of a common metric, a monetary measure such as US dollars, facilitates comparison amongst different studies.

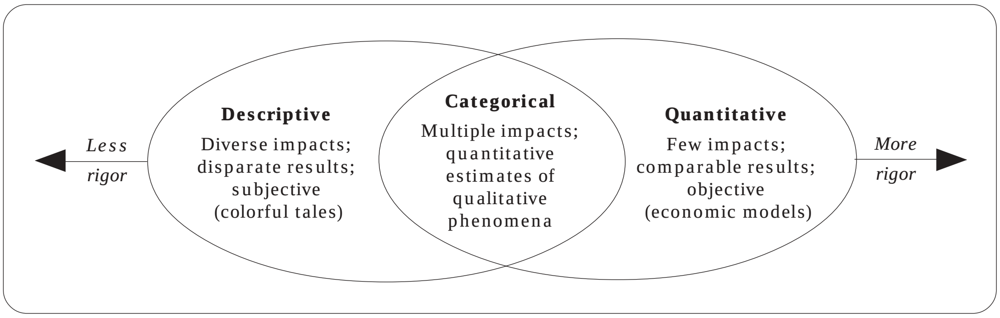

Figure 6. An impact assessment method's continuum, representing different levels of analytical rigor.

On the other side of the continuum are descriptive impact assessments. Despite their rather informal and subjective methods, they are often persuasive. Anecdotes of research success include tales of improved farm earnings, increased farmer participation in research processes, or sustainable management of resources. Such human-interest stories can be effective in conveying to listeners and readers that impact has been achieved. The relevance and potential impact of individual successes can, in theory, be scaled out to larger populations and geographic areas by posing plausible arguments regarding others who face similar conditions and challenges.

These two extremes of impact assessment, quantitative and descriptive, tend to measure different types of impact. Rigorous studies typically focus on research outputs that address only one or two of the development goals. Such studies usually concern private or on-farm economic benefits or the public economic benefits of research for a specific commodity (e.g., rice [*Oryza sativa* L.], maize [*Zea mays* L.]) over a larger geographic region. In contrast, descriptive studies are used to explain the benefits of multi-objective INRM-type research, especially improvements in development processes that are difficult to measure. Since many actors and scales are involved, these benefits are often public in addition to private in nature. Rarely are these studies conducted over large geographic areas, but focus on groups of farmers or specific communities (Schioler, 1998; 2002).

Between these extremes appear qualitative impact assessment approaches. These studies often employ both non-economic quantitative and qualitative measures to estimate diverse impacts of research (see Horton et al., 1993). Indicators and indices summarize before and after conditions to estimate impacts. Participatory monitoring and evaluation fits into this realm (Guijt, 1998). While this scoring approach can address a broad research and development agenda, it tends to be site specific. Increased local participation highlights local concerns, and thereby reduces the ability to compare results with other impact assessments (Gottret and White, 2001).

Conclusion

The methodological approach used in this chapter appears to both conflict and concur with those of the recent literature. In many cases, evaluators should seek to "establish plausible links" between research investments and development impacts rather than to "prove causation" or "measure impacts" of research on summary development goals (EIARD, 2003).

No matter how well intended or well developed evaluative activities are, they can and probably will have unintended and undesired side effects, thereby jeopardizing effectiveness and performance. One way around such an uncomfortable result is to perceive evaluation as providing a learning function that facilitates knowledge building in the collaborative development contexts. More then ever before, larger numbers of different stakeholders are involved in evaluation and impact assessments (Leeuw, 2000; Horton and Mackay, 2003).

Raising questions is perhaps one of the latent objectives of this chapter. Despite analyzing concepts with fuzzy generalized criteria and rubbery scales, discussion of how to measure the impacts of research projects spurs further analysis of how to upstream research outputs more effectively.

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CHAPTER 4

Spatial Dimension of Scaling Up and Out

*Simon E. Cook** and *Sam Fujisaka***

Introduction: The Concept of Space and Scale

The conceptualization of space has preoccupied philosophers and scientists since Aristotle's *Physics* (Couclelis, 1998), which expressed concepts to help understand inert entities that exist in space, and human interactions with them. A succession of ideas has enlarged this understanding, from the positivist *absolute space* of Newton to constructivist positions proposed by Werlen (1993).

Scale is a concept used to manage information about the real world and to summarize observations about complex phenomena that vary within space, time, or other dimensions. The ordering of phenomena according to scale enables human beings to store, recall, and analyze information about features that would otherwise be impossible to evaluate. The concept is essential to researchers of agricultural development processes because scale organizes our understanding of complex socioeconomic and biophysical processes that interact in space (valley, region, continent), time (daily, annual), and institutions (household, community, nation). Scale is especially useful where variation is essentially "lumpy".

Scale is perceived differently by the respective disciplines that attempt to deal with it (Marceau, 1999). Social or economic systems and biophysical systems tend to be referenced internally. That is, social networks are described without reference to biophysical characteristics, and biophysical with weak reference to socioeconomic. Since both overlap in space and time, the distinction between social and biophysical systems is to some extent arbitrary. Such systems can be modeled explicitly in space by expressing interactions formally in a way that can be observed.

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Most studies that use geographic information systems (GIS) to represent specific scale-dependent entities do so to represent biophysical processes. The concept of scale in space and time has been a major preoccupation with biophysical sciences for some time because of the obvious connotations scale has on process, on research domains, and on the validity of extrapolation and interpolation. Scale is essential to understand fundamental biophysical phenomena that are too big, too small, too fast, or too slow to be observed directly. Notwithstanding the search for scale invariance, predominantly in the natural and information sciences (e.g., see Burrough, 1981; Barabasi and Albert, 1999; Gisiger, 2001), processes are generally assumed to be scale dependent and to operate within predominant *domains*. Moving up or down scale from the domain at which the concept was developed introduces additional uncertainties because of phenomena referred to as ecological or atomistic fallacies.

Gimblett (2002) points out that biophysical studies of scale dependence tend to neglect the human dimensions of such systems, specifically through the use of social science data and modern intelligent simulation techniques. Increasing attention has been directed in recent years to spatial and temporal dimensions of social interactions. Giddens (1984) sees space as both a medium of social relations and a material product that influences interactions. Raedeke and Rikoon (1997) identify time and space as fundamental categories of human experience.

Social scientists use scaling concepts to describe variations of purely human phenomena such as institutions and policy (Gibson et al., 2000). Indeed, the concepts of scaling up and scaling out, as described in companion chapters to this, are applied equally to institutional dimensions and the biophysical environment in which they exist. Institutions, however, exist in real space and are inevitably influenced to some degree by variation in spatial dimensions. It is essential to describe spatial characteristics where spatial variation is significant to the processes being examined.

Variation in the spatial dimensions of scale should be described if such variation significantly influences the validity of representation; that is, if representation of the location, size, or spatial proximity between entities helps identify the process. However, broadening the concept of scaling to include spatial dimensions increases the complexity of analysis, and few would willingly embark on this process if it cannot be shown to be necessary. Therefore, our first objective is to clarify when the spatial dimension is significant to scaling up and scaling out in the socioeconomic sense (as is used predominantly by other chapters in this book).

Acknowledging that variation within real space may be significant, the second objective of the chapter is to identify the various modeling approaches that can be used to describe spatial variation.

When Is the Spatial Dimension Significant to Scaling Up and Out?

Basic concepts

Scaling out means extending scope by repeating a process at one scale to other individuals of about the same scale. This process is influenced by the variation among individuals.

Scaling up occurs when the dimension of a process is increased, for example, when a social interaction process increases from village to municipality; or a hydrologic process from first- to third-order catchments. For reasons discussed below, changing the dimensions of a process from that at which it has been observed almost always introduces new sources of uncertainty.

Scaling up tries to represent a process of interaction among individuals that becomes bigger or more distant. The process can be social, such as cooperation between two people within a community, or economic, such as trade between two countries. It can be biophysical, for example gas exchange between trees and the atmosphere, or water flow between an irrigation plot and a river. The essential feature is that exchange or flow occurs between two or more individuals. The objective of the study is to understand the nature of the interaction. Having understood the interaction process better, the objective of intervention is to improve the overall result.

Modeling the scaling process

Since a major purpose of this chapter is to examine the effects of space on processes of scaling out (dissemination), we need to define the concept of interactions as they occur in physical space. We do this by describing a basic model of interaction between two individuals that accounts for spatial characteristics such as size, location, distance, or direction.

Intuitively, these spatial characteristics seem important to the scaling processes. Few would doubt that interaction between neighbors is more likely than between individuals in different continents, or that groups of similar size interact more easily, or that germplasm is more likely to flow between sites with similar environments. But the question is whether the effects can be described in a form that can be analyzed. To do this, the scaling process is rephrased in a more analyzable form by considering it as a quantifiable process of attraction between pairs of individuals. Space influences two broad types of characteristics significant to the interaction process. First, the strength of attraction is determined by the suitability of individuals for interaction to occur, for which information about their location and size is useful. Second, the interaction may be influenced by resistance or loss of signal that might result from distance, friction of the surface over which interaction is attempted, or interruption from intervening processes. We illustrate below a selection of spatial modeling processes that attempt to quantify these effects.

Assessing the significance of the spatial dimension

Failure to acknowledge the influence of spatial processes reduces the accuracy of statements that can be made about the process of interaction. The question is, "How significant is the variation, and how can it be predicted?" The significance of the spatial dimension to the scaling process can be assessed from the following questions:

Does the process of interaction change significantly if:

(1) It is larger or smaller, that is, if the process applies to more or fewer individuals?
(2) Individuals are in particular locations?
(3) It occurs over different distances?
(4) It occurs in different directions?
(5) If individuals are formed in different configurations?

Question 1: Does size matter? More individuals are involved as processes are scaled up or scaled out (i.e., extended to reach individuals further away). Larger processes encounter more cumulative variation among individuals simply because individuals differ, and according to the standard tenets of probability theory (albeit that individual variation is not distributed randomly). Processes that are highly adapted to a particular group of individuals become less and less suitable as individuals become more dissimilar over space. Conversely, processes that are described for large-scale phenomena encounter a reverse problem when applied to subpopulations. Aggregate solutions that exist for a whole population become increasingly at variance with individuals as the process is scaled down.

Scientists tend to adopt a pragmatic approach to scale by predefining the object of study—for example, *global* climate change, a study of *catchment* process, or development of *community* preferences. Experienced practitioners make reasonable assumptions about the limitations of scaling up or down from the definition. Few hydrologists would contemplate applying models developed from measurements at field plot level to large regions, even fewer would attempt to predict field conditions from global-scale models: Social scientists have developed methods of analysis that are specific to individuals, families, communities, persons affiliated via different kinship systems, and to aggregates of people tied together through political units such as municipalities, states, or countries.

Methods of numerical spatial analysis to describe the deviations of individuals from purely random patterns include measures of spatial autocorrelation, clustering, or geographically weighted regressions (see Cliff and Ord, 1981; Diggle, 2003).

Question 2: Is location significant? Information about the non-random spatial variation of individuals can be used to assess the likely degree of interaction between them. A site that has a suitable condition increases the likelihood of adoption during scaling up or out. For example, a crop that is bred at a dryland research station is more likely to succeed in other dryland sites than in humid ones, even if such areas are closer. A technological innovation to ease cultivation that is suited for men is unlikely to be successful in locations where most farmers are women.

In these cases, information about location is used to carry knowledge about site conditions that determine whether interaction takes place. Classifying sites quantitatively according to similarity improves definition. An example is the exchange process provided by the assessment of site suitability for germplasm transfer in models such as FloraMap (Jones and Gladkov, 1999). FloraMap is premised on the assumption that climate at a site strongly influences the regional distribution of germplasm.

Question 3: Is process influenced by distance? In addition to the effect of increasing variance that occurs as populations expand (documented well by geostatistical theory [see Isaaks and Srivanasta, 1989]), distance will decrease the strength of interactions among individuals. As distance increases, the chances that an intervening process will occur that influences individuals in a different way also increases. Sociologists have for some time referred to path length between two individuals as a key factor in determining networking (Newman et al., 2002).

The effect of distance formed the basis of classic spatially sensitive theories of geo-economic development from von Thunen and Christaller in the last century. Recent additions to economic theory include Vickerman et al. (1999). Inadequate infrastructure hinders people's access of people to markets, services, and one another, leading to the so-called "spatial poverty trap" (Ravallion, 1997). Because accessibility and its inverse, isolation, are considered significant factors in development (Deichmann, 2001), tools have been developed to model explicitly these factors over space (e.g., Farrow and Nelson, 2001). In this model, accessibility is defined by the shortest travel cost distance, accounting for the cumulative distance over which exchange occurs and the friction of the surface. Factors not explicitly modeled by Farrow and Nelson (2001) include the cost of transport (roughly equivalent to surface friction) and the opportunity costs to individuals.

Question 4: Is direction significant? This question concerns spatial anisotropy of *process*, that is, variation that is introduced solely by a change in direction of process, such as dispersion across- or down-stream.

This is in addition to effects that are caused by variation of site characteristics such as landscape obstacles.

Anisotropy can be represented quantitatively using geostatistical models of anisotropic spatial dependence (see Isaaks and Srivastava, 1989). The vector-dependent processes have been modeled successfully to reveal spread along transport networks (Deichman, 2001) and spread of diseases over two-dimensional grids using a process of Eulerization (Colville and Briggs, 2000).

Question 5: Is the configuration of multiple individuals significant? The sections above describe how size, location, distance, or direction influences a single process of interaction between two individuals or nodes. In reality, of course, interactions are not restricted to two individuals or one process, but occur simultaneously among many nodes with multiple processes. Therefore we now move on to outline some concepts that are used to analyze the more complex spatial characteristics of *multiple* interacting nodes. We describe three approaches to illustrate the development of analytical models: Network analysis, analysis of cellular automata (CA), and the multi-agent system (MAS).

Network analysis has a long history in the social and economic sciences to describe interactions among multiple individuals through descriptors such as connectivity, accessibility, or path length analysis. This use is almost exclusively aspatial, that is, analysis is concerned primarily with network topology rather than the spatial characteristics that influence the state of individuals or the interactions among them.

Recent additions to the social science literature provide examples of explicit modeling of social networks. Newman et al. (2002) describe network activity quantitatively within different groups of social actors and test the model by comparing predicted with actual measures of network function. Burt (2002) evaluates network function within a commercial organization and identifies clear relationships between an individual's position within a network and his/her apparent activity. Several other examples exist of models that attempt to quantify social or economic behavior, while assuming biophysical variation to be insignificant.

In the late 1980s and early 1990s, spatial scientists realized that complex socioeconomic processes of land use change could not be predicted exactly by rigid mathematical models, regardless of how elaborate they might be. In parallel, the expansion of insights into ecological processes revealed that existing models based on simple deterministic functions could not describe behaviors such as complexity, self-organization, chaos, and multi-scale functionality (Heylighen, 1999). Janowski and Richard (1994) note the shortcomings of trying to oversimplify social processes in space: "Current GIS analysis is based on simple spatial geometric processing operations such as overlay comparison, proximity measures, and buffering. It does not provide optimization, iterative equation solving, and simulation capabilities necessary in planning”.

Anthropologists and archeologists have more recently examined fractal patterns of human settlements, linking the emergence of higher fractal dimensions (a measure of how quickly self-similarity patterns scale up) to higher efficiency and, possibly, eventually to social collapse (e.g., the prehistoric lowland Maya). Analysis of both systems efficiency and eventual collapse is based on spatial analysis of the simultaneous scaling out and “scaling in” (a sort of urban intensification) of such self-organizing complex systems (Ravilious, 2004).

Out of such thinking arose a new breed of models that treated complex socioeconomic systems as self-organizing, partially predictable systems, but for which models became tools with which to visualize complex dynamics rather than the basis on which to make definitive statements.

A different model emerged, based on the concepts of CA developed by von Neuman over 60 years ago, in which complex dynamic behavior is described as the result of relatively simple transition “rules”, which govern the rate and direction of change amongst individual “cells”. While Wu and Marceau (2002) observe that the concepts of self-organization, emergence, and order date back to even earlier ideas of ecologists such as Clements (1916), the realization of such theories has been strengthened considerably through the ability to model such hypotheses in GIS.

The basic principle includes concepts of site suitability and access. As explained by Engelen et al. (1997), however, CA models also include a neighborhood function, to account for intrinsically spatial features such as agglomeration, dispersion, or other pattern-creating processes. Cells are allowed to take a number of states (*z*), and are expected to allocate themselves into whichever state seems most probable, according to the general expressions:

$$P(z) = v(S_z A_z N_z)$$

Where $P(z)$ is the potential for transition into state z; S signifies suitability of the cell for state z; A accessibility to acquire state z; and N the neighborhood effect on z. Parameter v is simply a stochastic disturbance term, which can be adjusted to accommodate random effects. Cells are shown to change to the state that acquires the highest transition potential (P_z).

Rules in CA models can be quantitative or qualitative, and deterministic or stochastic. Some CA models attempt to condense complex behavior into two or three rules. The number of rules can be increased to represent the richness of dynamic processes that are believed to operate within a region.

While CA theory has successfully demonstrated a few patterns of behavior, some modelers regard the technique as inadequate to describe complex human systems because of its dependence on rigid spatial structure and synchronicity between processes. In response, increasing attention is being directed towards methods of agent-based modeling (ABM), which can represent dynamic patterns of individual behavior within complex biophysical and social systems. Whereas behavior in CA models is generalized, processes in ABMs are object oriented and can perform asynchronously to one another. This distinctly "bottom-up" approach of individual models has the advantage of recognizing individual complexity (Judson, 1994). As perceived by Wu and Marceau (2002), complex systems are so because they are not completely reducible to components. The challenge remains to determine rigorous theories of behavior that are also comprehensive enough to be realistic. Many examples exist of the use of ABMs in ecological and land use studies that purport to represent dynamic processes of diffusion and change (Parker et al., 2002).

Discussion

This chapter reviews methods that enable social and biological scientists to represent processes of interactions between individuals with explicit definition of spatial attributes such as size, distance, and direction. Through these methods it is possible to show how space influences the diffusion processes as they involve more individuals (scaling out) or individuals at higher levels of organization (scaling up). The advantage of developing explicit models is that predictions of interactions can be tested against observation and used to reveal obstacles to beneficial diffusion.

The steady improvement in the ease of use of GIS, coupled with the availability of better coverage of spatial data, has enabled scientists to analyze social behavior within a biophysical setting more realistically, and to create models to reflect their understanding of complex processes. Indeed, the understanding that a priori oversimplification can actually obstruct accurate modeling of complex processes stimulated the development of ABMs. The question is, "What is the gain of more complex models, and in what circumstances are such models essential for reasonable representation of complex processes of human interaction?"

The third major feature of relevance to scaling up and out is the dramatic increase in availability of spatial data, against which such complex models can be tested. These data describe both the "*y*"s (population, income, adoption, etc.) and "*x*"s (environmental attributes that modify the influences). Whilst data are more available for remotely sensed biophysical attributes, this also influences the resolution of insight for social phenomena (Geores, 2000).

Conclusions

Processes of scaling up or scaling down involve a change in multiple interactions between pairs of individuals. The change due to scaling up or out occurs through extension or diffusion to actors that are more distant or closer, or as repetition within new pairs of actors. The spatial dimension is significant to these processes when the likelihood of interactions is influenced by spatial attributes of size, location, distance, and direction. This influence is exerted in a number of ways—through the size-related variation of actors, their location-determined suitability for interaction, and the distance- or direction- determined cost of interaction.

The effects of space on scaling processes can be modeled in GIS in a number of ways. The effect of changes in size and location on likely interactions is modeled through its known effect on variation of individuals; for example, a community-scale institute will prove incapable of handling the uncertainty of national-scale problems; germplasm spreads more easily to locations with similar characteristics. Distance and direction effects are more effectively modeled as repetitive transfers over a variable surface. More complex processes of self-organization of individuals can also be represented through rule-based or agent-based models that use these spatial attributes to modify individual transactions within the overall system.

These techniques exist to describe spatial effects on scaling processes, but they require significant effort and data to achieve a useful accuracy. So, are the benefits adequate? The first major advantage of formally modeling spatial influence on scaling processes is that the processes can be understood more completely through visualization of effects over “real” areas, as represented by maps. Patterns and associations with cultural or biophysical variables may become evident only after the process is represented spatially. A second advantage is that spatial analysis of processes of diffusion can identify and quantify constraints to scaling processes that may not be evident before the information is assembled within a spatial context. Spatial epidemiology provides the most obvious example where vectors have been identified only *after* spatial representation, but many other examples exist in social science or economic literature where diffusion processes could be explained most easily in relation to spatial features such as roads or geographic clusters. Finally, through spatial modeling it is becoming increasing possible to predict complex diffusion processes realistically to identify the likely influence of changes in policy, markets, or biophysical change. Through rule-based and agent-based models it is possible to represent increasingly complex social and biophysical effects on individual-to-interactions as they scale up and out within an uncertain world.

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PART TWO

Scaling Out for Impact: Germplasm Technologies

Editorial Comments

The three chapters in this section deal with the scaling out of germplasm technologies, in this case of forages in Asia, rice (*Oryza sativa* L.) in Latin America and the Caribbean (LAC), and cassava (*Manihot esculenta* Crantz) in Colombia. The offerings, however, go well beyond the simple spread of new crop germplasm to institutional change in research and development, and the effects of policy on the impacts of germplasm.

Roothaert and Kaaria document a wide range of factors that contributed to exponential forage adoption in a second phase of a project in Asia. Partnership with local government, farmer cross-visits and key farmer extension workers were a part of the story. According to the chapter by Sanint, rice research and development in LAC is now in the hands of the private sector, representing important institutional change and adaptation to decreasing public sector funding of germplasm research. Gottret and Ospina offer another important story of a change to public and private sector involvement in cassava research and development. They also recount how the ups and downs faced over time by the Colombian cassava industry were largely policy rather than technology related.

Chapter 5, by **Roothaert and Kaaria**, discusses terms and definitions, the history of the Forages for Smallholders Project (FSP), and scaling out (i.e., again, "horizontal scaling up" or adoption) of forage technologies over two phases of the project. In essence:

- Phase I provided well-suited technical (forage) options, good printed technical materials, well-trained local facilitators, and a planting material multiplication system adopted by farmers.
- Phase II resulted in an "*exponential increase of numbers of farmers*" associated with the above and with the addition of farmer cross-visits, facilitation of distribution of seed and planting materials, and key farmer extension workers.

The number of farmers growing forages increased from less than 100 in 1996 to about 1200 in mid-2002. This is certainly an impressive case of adoption or "horizontal scaling up" and one that lends credence to the authors' authority in discussing strategies for going to scale. Among others, the authors discuss the importance of champion farmers, farmer cross-visits, working with local government, and market demand.

The authors state that the introduction of planted forages reduced time spent by women and children in grazing animals and cutting forages, and led to increases in herd sizes. Quantitative data (available in other publications) were not included, leaving it unclear as to the extent of planted forage use on adopters' farms and implicit rather than explicit that impacts included increases in well-being through income and/or security benefits.

Attribution is also open to some speculation. That farmers and researchers had figured out ways to make planting materials available in Phase I (an impressive feat) meant that a typically major barrier to the success of forage projects had already been solved. To what extent was the exponential growth in adoption due to successes developed in Phase I, as opposed to Phase I achievements plus the additional activities conducted in Phase II? Although most likely *not* the case, it would be ironic, but illuminating, if the foundations established during Phase I, when scaling out was not really an objective, led to adoption; while and if at the same time Phase II, with its emphasis on scaling out, had relatively little to do with the observed substantial adoption. These comments are *not* meant in any way to be critical of the chapter, but rather, to flag the need for all integrated natural resource management (INRM) projects to carefully consider the issue of attribution.

The authors also describe how the FSP worked with local government and the presence of livestock distribution programs. It would be interesting and important to know to what degree the observed adoption was influenced by peoples' expectations vis-à-vis the forces of local partisan politics (a major force in rural Filipino life) and/or the livestock distribution programs.

Chapter 6, by **Sanint**, discusses rice production and rice research in LAC, and the establishment and functioning of the Fund for Latin America and Caribbean Irrigated Rice (FLAR). Rice production in LAC increased from 8 million tons in 1960 to about 23 million tons in 2000. Research led to gains in efficiency and productivity that, in turn, helped to decrease hunger in the region. The Consultative Group on International Agricultural Research (CGIAR), in this case the International Center for Tropical Agriculture (CIAT, the Spanish acronym), decreased investments in germplasm research in the mid-1990s. In response, CIAT worked with the private sector to establish FLAR, which as the chapter describes, "…provides a mechanism for collective action in which countries join forces and share the cost for rice research and development" and a means to scale out research findings.

The chapter tangentially touches on impacts and benefits. Sanint correctly points out that "…some of the new practices put much strain on the cultivated areas and on the environment, and that the challenge to reduce the damages is a paramount task still at hand". The chapter asserts that, "Yet progress…has been beneficial to the natural resource base. Higher efficiency has helped preserve huge new areas that would have been disturbed in the absence of higher yields, and would have led to higher damage, higher costs, and more expensive food at lower levels of supplies". Although the chapter acknowledges that rice is a preferred pioneer crop in the forest margins throughout the region, it also asserts, "flooded rice production gradually replaced upland rice areas".

An examination of Food and Agriculture Organization (FAO) statistics suggests some alternative hypotheses for further study. Paddy area increased from 4.5 million hectares in 1961 to a mean high of 7.8 million hectares for the 15-year period, 1975 to 1989; and then fell to a mean of 5.9 million hectares for the last 7 years, 1996-2002 (FAOSTAT, 2002). These data show increased production (mean of 21.1 million tons for the 7-year period) on *less* flooded rice area, suggesting technological change supporting or pushing concentration on more favorable rice paddy lands, and likely into the hands of fewer producers.

The FAO statistics also show that *arable* land in LAC increased steadily and continually from 619 million hectares in 1961 to 784 million hectares in 2001, a 27% increase. Despite productivity gains in irrigated rice in LAC, CIAT's work in the forest margins indicates that rice remains the pioneer crop of choice in the forest margins. Most of the increase in area of arable lands most likely represents forest conversion by the poor who have not benefited from research of the type provided first by the CGIAR and now by FLAR. Although increased efficiency and productivity certainly led to lower rice prices and benefits to consumers, especially the urban poor, claims regarding benefits to poor farmers and to the environment need further investigation.

Sanint, in a further conversation, offered that decreasing and low market prices for rice combined with successes with paddy rice have led to substantial decreases in rice as a forest margins crop—either as pioneer or subsequent crop. Our best-bet conclusion is that the effects of improved paddy production (and lowered prices paid to producers) differ among regions and countries (and provide an opportunity for needed follow-up research).

Without acknowledging doing so, **Gottret and Ospina** actually tell two interesting and important stories in **Chapter 7**.

The first story is about scaling up *and scaling down* cassava production, mostly in response to economic conditions. What can be condensed from the chapter is that:

- Farmers lost ground in the 1980s after protectionist policies and available credit led to overproduction and falling process for fresh tubers.

- Small-scale farmers gained with the introduction of new varieties plus dried chip technologies combined with demand for livestock feed supplements in a protected market in the 1980-90s.
- Cassava lost ground when the Colombian economy was liberalized in the early 1990s and imported grain was more competitive than dried cassava chips.
- Prices increased and cassava became more competitive after the Colombian peso was devalued and the national poultry industry grew in the late 1990s.
- Maize (*Zea mays* L.) and cassava remain as important feed sources: Maize imports since the 1980s increased from 200,000 to 2 million tons per year; and both area planted to cassava and fresh cassava tuber prices are currently increasing.

The story is interesting in that, although gains were achieved through the introduction of new varieties and the cassava chip technology, the major forces buffeting the small-scale producer were policy related. Although the research and development efforts targeted small-scale poorer farmers, moreover, the chapter does not provide data on who (i.e., small- or larger-scale farmers) benefited during the good times.

The second story relates how, as in the rice case discussed by Luis Sanint (this volume), leadership in cassava research has changed hands from the international centers (CIAT) to a combination of public and private sector involvement. The Latin American and Caribbean Consortium to Support Cassava Research and Development (CLAYUCA, the Spanish acronym) was formed after CIAT redirected investments to include more work on natural resource management and less on germplasm development.

One of CLAYUCA's founding principles is: "Competitiveness: The cassava crop faces tremendous challenges to establish and strengthen new markets. These new market opportunities demand that crop production and processing systems be competitive". Relating the two "stories" brings to the fore the question as to how the consortium will be able to help to positively regulate the largely policy-related boom and bust cycles. The research and development work cited as of importance for the Consortium include processing technology, planting and harvesting mechanization, and new organizational models. Based on the first story, the Consortium might be well advised to analyze the policy mechanisms that have affected the sector in the past and to work with national policymakers to help to buffer (albeit *not* via protectionist policies) some of the meaner effects.

Ongoing monitoring and evaluation to determine if benefits are reaching the targeted poor also appears to be required.

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CHAPTER 5

Issues and Strategies for Going to Scale: A Case Study of the Forages for Smallholders Project in the Philippines

*Ralph Roothaert** and *Susan Kaaria***

Introduction

Challenges of scaling up

Scaling up the impacts of agricultural research outputs has become the center of much recent debate within natural resource management (NRM) research. This interest has arisen in the context of growing concern that NRM research has not demonstrated its ability to benefit large numbers of poor people across wide areas within sensible time frames. Harrington et al. (2001) argue that it is opportune for NRM research to demonstrate its ability and meet the challenge of improving human well-being. However, other issues also are pushing the scaling up agenda. For instance, civil society and donors are increasingly pressuring that money spent in research and development (R&D) brings about lasting impact on the lives of the rural poor. The recognition that many relevant technologies and approaches are not achieving their full impact because of low levels of adoption has led to greater emphasis on the effectiveness of research to produce adoptable technological options. Therefore, reduced financial support to agricultural R&D, and increased pressure from donors, policymakers, and civil society, has compelled researchers and development workers to expand impact and "scale up" the development process.

An indication of this concern is the number of international consultations that have taken place over this period. At least four international events have dealt with scaling up over the last few years: The International Centre for Research in Agroforestry (ICRAF) Workshop, 1999, focused primarily on scaling up agroforestry innovations within an R&D

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framework (e.g., Cooper and Denning, 2000). The nongovernmental organization (NGO) committee of the Consultative Group on International Agricultural Research (CGIAR) initiated two workshops, in 1999 and 2000, which focused on using case studies and participants' experiences to derive common principles and improve the overall understanding of the scaling up process (IIRR, 2000). More recently, the Natural Resources Institute (NRI) sponsored a workshop, which focused more directly on developing a framework for scaling up NRM research (Gündel and Hancock, 2001). Menter et al. (this volume) provide a clear and comprehensive review of the central concepts and issues related to scaling up, consistent with the objectives agreed upon by participants at the CGIAR-NGO committee at the workshops:

> "Scaling up leads to more quality benefits to more people over a wider geographic area more quickly, more equitably, and more lastingly."

Overview

The objective of this chapter is to review an approach for scaling up improved forage systems, and to identify successful elements in reaching more people over a wider geographic area. The chapter first provides a brief review of some of the key definitions and terms in the scaling up literature. An overview and background of Phase I and II of the Forages for Smallholders Project (FSP) follows. The final section presents a study conducted to evaluate strategies for increasing the number of farmers adopting improved forage technologies. The study had two stages: (1) informal interviews using a case study approach in one of the FSP focus countries, the Philippines; and (2) a review of existing reports from project inception in 1995. A synthesis of results is presented, with lessons learnt and recommendations for scaling out highlighted, and new areas of research identified.

A glossary of terms and definitions

Menter et al. (this volume) argue that the confusion with terminology comes from the fact that scaling up is often used as a catchall, general term. However, as a strategy to develop a consistent definition of terms, they propose to follow the definitions and terms proposed by the participants in the Going to Scale Workshop (IIRR, 2000) which are: (1) Horizontal scaling up/Scaling out, and (2) Vertical scaling up.

Horizontal scaling up/Scaling out is geographical spread to cover more people and communities through replication and adaptation, and involves expansion within the same sector or stakeholder group. Decision making is at the same social scale.

Vertical scaling up is moving higher up the ladder. It is institutional in nature and involves other sectors/stakeholder groups in the process of expansion—from the level of grass-roots organizations to policymakers, donors, development institutions, and investors at international levels.

Vertical scaling up includes ***institutionalization*** (often referred to as "mainstreaming", especially in the participatory literature). This implies getting institutions to accept and internalize the underlying principles of an innovation so that these will remain as guiding principles of practice even after the initial innovative project or program has come to an end. There is a growing body of work on the institutionalization of participatory approaches (Blackburn and Holland, 1997; Bainbridge et al., 2000).

History and Background of the Forages for Smallholders Project

Geography, government administration, and environmental characteristics

This chapter is based on the R&D processes in Mindanao, the second largest island of the Philippines. The project started at two focus sites, Malitbog municipality, and the rural area of Cagayan de Oro City. Malitbog has a much smaller population than Cagayan de Oro City (Table 1). While Malitbog is classified as rural, only 18% of the population of Cagayan de Oro lives in the rural areas, which comprise 80% of the land. In both places there is a pronounced dry season from December to April.

Table 1. Site description of Malitbog and Cagayan de Oro, the Philippines.

	Malitbog	Cagayan de Oro
Status	Municipality	City
Province	Bukidnon	Misamis Oriental
Population (1995)	16,000	428,000
Area (km^2)	580	412
Soils	Clay, sulfaquent, loam, pH 5.8-6.5	Clay, sulfaquent, loam, pH 5.8-6.5
Slopes	90% of the area more than 8% slope	70% of the area more than 8% slope
Average annual rainfall (mm)	1720	1620
Forest	58% of the area	NA

Malitbog municipality is headed by a mayor and is relatively autonomous in agricultural development activities. The Municipal Agricultural Officer (MAO) is responsible for all agriculture-related development, and is assisted by several Agricultural Technicians (AT). Cagayan de Oro City, capital of Misamis Oriental province, is also headed by a mayor. The City Veterinary Office (CVO) provides livestock-related services in Cagayan de Oro. The MAO in Malitbog and the CVO in Cagayan de Oro managed the two FSP focus sites. Teams of government

AT assisted them at both sites. The city and the municipality are divided into several *barangays*, each of which consists of several *sitios*, the smallest administrative level.

Initial development of improved forage systems

From 1995 to 1999, Phase I of the FSP operated in five countries, funded by the Australian Agency for International Development (AusAid). The objectives were to develop forage technologies with smallholder farmers in the upland areas of Southeast Asia, using improved forage germplasm from various research institutions. Although several decades of research had been invested in improving forage species, this had not resulted in significant adoption by smallholder upland farmers in Southeast Asia (CIAT, 1994; Stür et al., 2002). The lack of farmer involvement in the research process was identified as the main reason for this low adoption. The FSP developed participatory methods for problem diagnosis, experimentation with new forage varieties, and monitoring and evaluation. In the 5 years of FSP Phase I, more than 500 species and varieties were evaluated in research sites on-station, and farmers evaluated more than 100 species on-farm (Stür et al., 2000). During this phase, more than 1750 farmers at 19 focus sites in the Philippines, Indonesia, Lao PDR, Malaysia, and Vietnam adopted about 40 species and varieties (Tuhulele et al., 2000). Choices and experimentation of forage types varied per location. For example, at the two focus sites in the Philippines, farmers selected 18 different species for use in five different systems in 1999 (Table 2). They are still being cultivated and expanded in 2002.

New focus on scaling out

Scaling out had not been an objective of FSP Phase I, and the numbers of farmers developing and adopting new forage systems were far beyond the aim of the project. From 2000 to 2002, Phase II of the FSP was funded by the Asian Development Bank (ADB) in six countries in S.E. Asia. The focus of Phase II was on further scaling out the research outputs from Phase I. This was divided into several different outputs:

(1) Provide opportunities for each new community to develop new forage systems, using “building blocks” developed during Phase I.
(2) Promote participatory research: Ensure that participatory processes were used for scaling out.
(3) Developing a strategy for promoting local forage multiplication systems was essential for scaling out, because planting materials of improved forages were often difficult for farmers to obtain.
(4) Capacity building: Ensuring that enough facilitators were trained, to implement the exponentially expanding project in new communities and provinces.
(5) Develop a network: This would primarily provide the chance to exchange experiences among countries dealing with the same research issues.

Table 2. Forage species and systems used by farmers at focus sites in Cagayan de Oro and Malitbog, Mindanao, the Philippines, 1999.

Forages	Systems[a]				
	C&C Pl	Co He	Gr Pl	Orn	Bd Lf
Grass species					
Andropogon gayanus Kunth	x				
Brachiaria brizantha (Hochst. Ex Rich.) Stapf	x[b]	x			
Brachiaria decumbens Stapf	x		x		
Brachiaria humidicola (Rendle) Schweik.			x		
Panicum maximum Jacq.	x	x			
Paspalum atratum Swallen	x	x			
Pennisetum purpureum Schumach. and hybrids	x	x			
Setaria sphacelata var. *splendida*	x	x			
Legume species					
Arachis pintoi Krapov. & W.C. Greg.			x	x	
Calliandra calothyrsus Meissner		x			x
Centrosema macrocarpum Benth.	x		x		
Centrosema pubescens Benth.	x		x		
Desmanthus virgatus (L.) Willd.		x			
Desmodium cinerea Wight & Arn.		x			
Flemingia macrophylla (Willd.) Merr.		x			
Gliricidia sepium (Jacq.) Walp.		x			x
Leucaena leucocephala (Lam.) De Wit		x			x
Stylosanthes guianensis (Aublet) Sw.	x				

a. C&C Pl = cut and carry plot; Co He = contour hedgerow; Gr Pl = grazed pasture; Orn = ornamental; Bd Lf = boundary planting and live fence.
b. Not in Cagayan de Oro.

Participatory Processes and Scaling Out of the Forages for Smallholders Project

Increasing use of participatory methods

The FSP is an example of how a research project started in a conventional way, with little farmer participation before 1995, with on-farm experiments being largely contractual. Lilja and Ashby (1999) described how participation usually increases when farmers become more independent in the decision-making process. The authors classified different stages, naming them contractual, consultative, collaborative, collegial, and farmer experimentation, with advancing levels of decision making by farmers. The contractual stage actually started during the Forage Seed Project in 1992. The objectives were to evaluate the agronomic, climatic, and adaphic adaptability of sources of improved forage germplasm in nurseries in different environments of Southeast Asia. These forage nurseries were often established on station, but sometimes also on farmland rented from farmers.

In 1995, the FSP entered consultative participation with a group of 14 farmers in Pangalungan, Cagayan de Oro City. The farmers expressed their interest in new forage varieties to overcome shortages of feed during the dry season. An experiment field was allocated nearby at the Cagayan Capital College (CCC). In January 1996, about 18 species were planted on this land in 5 m x 5 m plots, and farmers of Pangalungan evaluated the species (e.g., growth rate, drought resistance, and skin irritancy), facilitated by technicians. Farmers decided which species they wanted to test and plant on their own farms. More farmers in Pangalungan became interested and, within a few months, 30 farmers had collected and planted forages on their farms. Formal research started with these farmers, where farmers and project staff were equal partners in decision making; FSP was now engaged in collaborative farmer research. Research became more complicated, because forages were no longer solely grown in plots, but also on contour lines along steep slopes, on farm boundaries as living fences, or integrated in crops and fruit trees. Within a year, more and more farmers started to test forages on their farms, and it became more difficult to structurally facilitate research on all farms. Project field staff would still give advice on which forages would best suit someone's need, and how best to evaluate them. At the start of Phase II, the number of farmers that had been given planting materials had grown to such an extent that it was no longer possible for field workers to facilitate the research processes of every farmer. The collaborative phase thus went through a collegial phase, and the result was truly independent farmer experimentation with improved forages in many cases.

During FSP Phase I, two international scientists, who were not based in the province, mostly facilitated the participatory research. More sustainable facilitation capacity that was locally based was badly needed. Field staff needed to be trained in forage agronomy and participatory research approaches. The first training course for technicians was conducted in the Philippines in 1998. It formed the basis for many more courses for new field staff when the project expanded during Phase II. The course also resulted in a training manual, which is still used by the project and by national agricultural research systems (NARS) (Stür and Horne, 1998).

Regular contact was made among farmers and researchers, and technologies were fine-tuned to farmers' needs. The initial nurseries and regional evaluation plots served not only to test forages, but also as sources of planting materials, which farmers would collect after the evaluation exercises. Between 1996 and 1998, cross-visits were organized; farmers who had been involved in a participatory diagnosis in new villages were invited to see farmers' experimentation in Pangalungan, and the evaluation site at CCC.

Unlike the conventional Training and Visit programs of the World Bank, FSP used very few extension publications in the early stages, nor did it have regular farmer training sessions. Although dissemination was not an objective of the research in FSP Phase I, at the end many more farmers had adopted forages than had been foreseen (126 in Cagayan de Oro, and 160 in Malitbog in 1999).

A new research and dissemination strategy

During FSP Phase I, the unexpected scaling out seemed promising, and for Phase II, scaling out became one of the major research issues. In order to better guide the processes and understand the dynamics, a strategic R&D diagram was constructed (Figure 1).

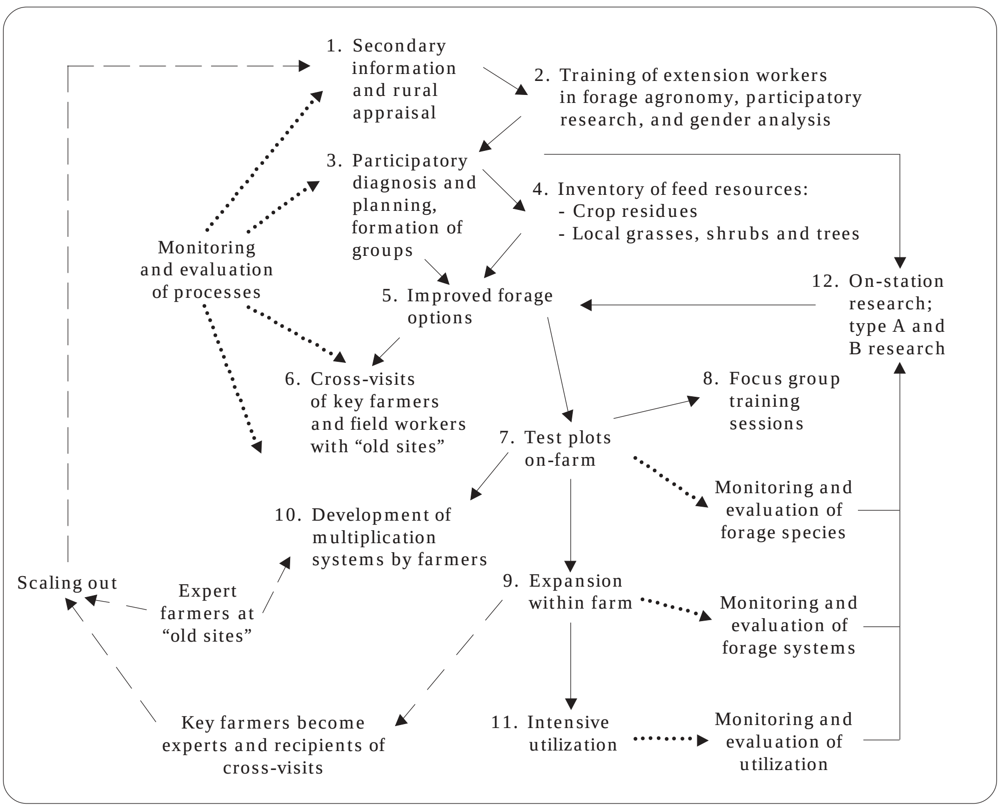

Figure 1. Research and development processes in the Forages for Smallholders Project.

There was a natural sequence of research activities (stages 1 to 11). The first step for either starting research at a focus site, or scaling out to a new site, was to gather secondary information, and to carry out a rapid rural appraisal with a wide range of stakeholders. If a need for forage R&D was perceived, extension workers of the Local Government Units (LGU) were trained in forage agronomy, participatory research, and gender analysis. During these courses, the more active and motivated extension workers, who can effectively lead work in the project, were identified (step

2). The selected extension workers were assisted in their first participatory diagnosis and planning exercises with their communities (step 3). Community inventory of existing feed resources greatly assisted the identification of suitable improved possible forage systems, which were offered to farmers (steps 4 and 5). If focus sites with experienced farmers existed elsewhere, cross-visits were facilitated for farmers to visit them at the old sites, even if it sometimes involved domestic flights (step 6). New farmers would normally follow a pattern of expansion within their own farms; they started with small plots of new forage species and varieties, often only a few square meters per species. They would evaluate the new forages using a variety of criteria, ranging from agronomic performance to ease of harvesting. Expansion occurred in an opportunistic way, when planting conditions were favorable. At this stage, enough forage material would be available to compare palatability for animals among forages, and evaluate grazing persistence. After about 1 year, farmers would start to perceive effects on animal productivity, soil fertility, or erosion control (steps 7 to 11). The dotted arrows indicate the different levels of monitoring and evaluation, which provided feedback to stakeholders, and assisted in identifying strategic research issues (step 12).

The key elements for scaling out in this strategic diagram were the participation of new key farmers and field workers in cross-visits to old sites (step 6 and dashed arrows); expert farmers at the old sites would show and explain their work, teach practical management skills, and provide planting materials to the visitors (link with step 10). It was important that the new key farmers were carefully chosen by the community and field staff, because they would represent that community and be responsible for extending all that was learned in the cross-visit to the other farmer group members. The selection criteria for new key farmers were: Outstanding record in terms of adopting agricultural innovations, good communication skills, readiness to share, and good reputation in the group or community. Many early key farmers not only served their own community, but also developed into forage experts who would start to receive new farmers cross-visiting (dashed arrow from step 9).

Scaling out in numbers

There was an exponential increase in the number of farmers growing forages at project sites in Indonesia (Figure 2A), the Philippines (Figure 2B), and Vietnam (Figure 2C). A slow phase of about 3 to 4 years was needed to allow a few innovative farmers to experiment. Once the innovations provided tangible benefits, more farmers adopted the forage technologies. The data used in the figures consist of the number of farmers in the previous year plus the new farmers in the current. This record system is easy to implement by everyone involved. However, what it does not take into account is the number of farmers who stop growing forages each year. Although this could be a flaw in the system, in practice it is of minor importance. Farmers dropping out are estimated at no more than 5%

on the average in the Philippines, Indonesia, Vietnam, and Thailand. Trying to obtain exact numbers of farmers dropping out each year for each site is difficult for several reasons. Farmers who have stopped are often shy to admit it, feel a sense of failure, or are plainly unwilling to talk or collaborate with data collection. All of these create a negative incentive for fieldworkers to pursue collecting this type of information. Figure 3 shows that in Malitbog the drop out of farmers was significant; in 1 year the net increase was close to zero. The magnitude of the problem made it easy to record. The drop out of farmers was caused by false expectations. During the previous 2 years, farmers had been promised by a different government project that they would receive livestock on loan if they established an area of forage. When the project failed to deliver the animals, it frustrated the farmers, who then stopped their forage activities.

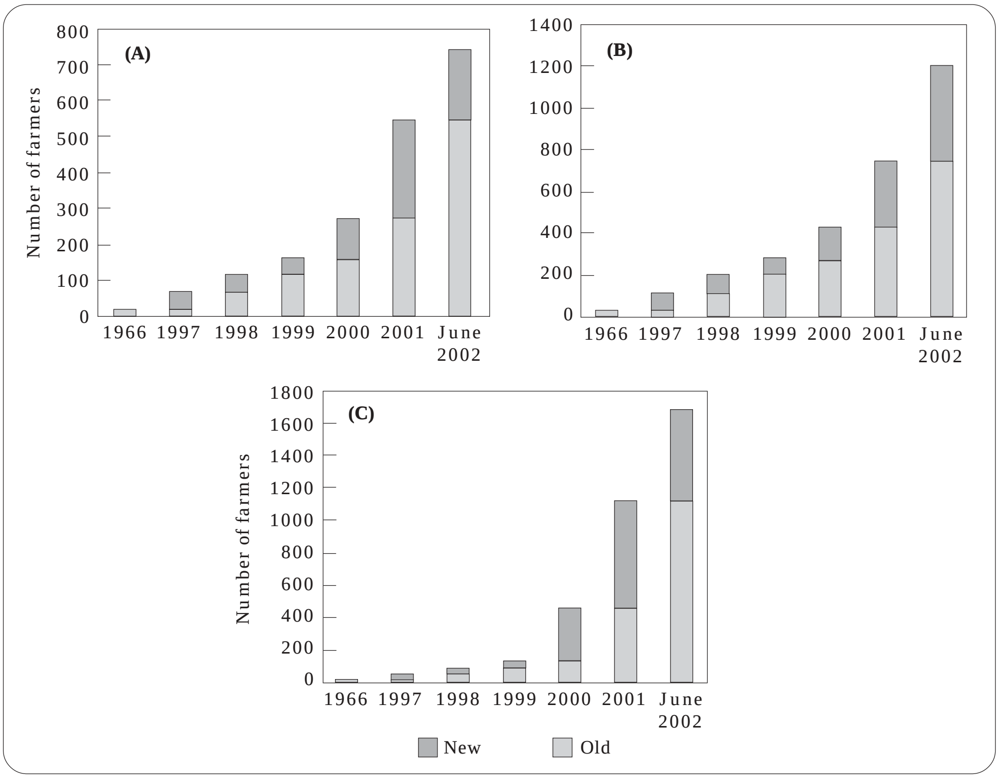

Figure 2. Exponential increase in the number of farmers growing forages at project sites in (A) Indonesia (E. Kalimantan), (B) the Philippines (Mindanao), and (C) Vietnam (T. Quang and Daklak).

Scaling out does not happen everywhere at the same exponential rate; in Vietnam more than twice as many farmers were reached as in the Philippines. Many local factors can influence the process. In Vietnam, the field workers found working for the FSP particularly attractive because they were drawn by its participatory approaches, which in government projects is still uncommon. Vietnamese fieldworkers reported that they enjoyed the work, because it was different from their conventional extension work, and they received appreciation from farmers. The culture of not sitting down before the work is finished pushed them to even working with farmers at weekends. Another unique situation of Vietnam is the feeding of forages to ponded fish. Large quantities need to be fed each day since the fish cannot feed themselves. Fish production has increased over recent years because prices have been very good, resulting in a high demand for cultivated forages.

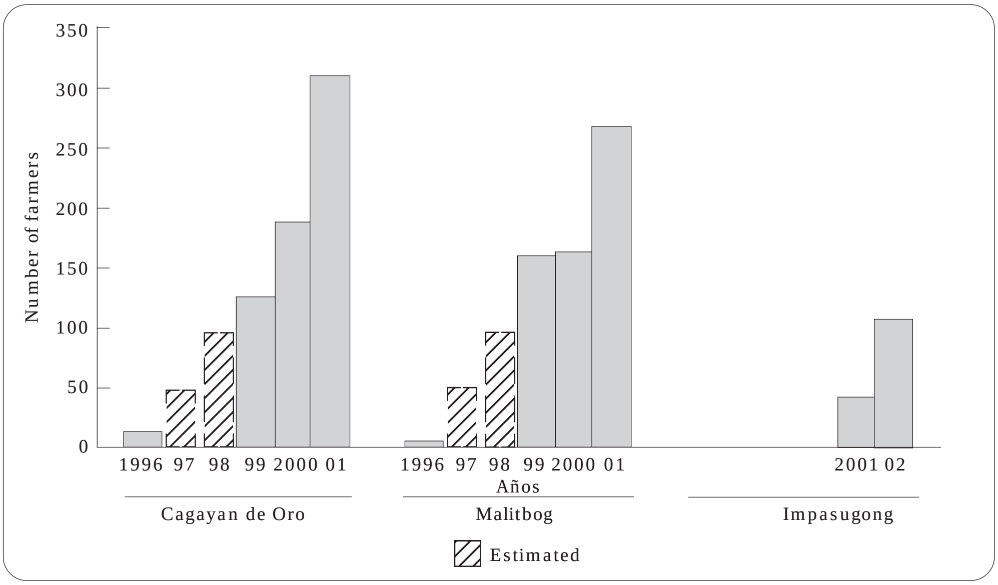

Figure 3. Number of farmers planting forages in the Philippines, 1996-2001. Impasugong site was established in 2000.

Scaling out in the political and institutional environment

The FSP in the Philippines started with focus sites in, among other places, Cagayan de Oro and Malitbog. Successes with experimentation and adoption of forages occurred at grass-roots level, and some scaling out occurred spontaneously, as described in the previous section. When Phase 2 moved beyond this spontaneous scaling out, it became more exposed to local politics. In the Philippines, governance is decentralized, and much power lies in the hands of the municipal mayors, especially when it concerns development of the municipality. Agricultural development is only one of the issues among others, such as development of infrastructure, education, health services, and power and water supplies. When the objective of FSP became to scale out to as many farmers in the municipality as possible, it created new implications for the use of resources. Where, in the first phase, the involvement of one fieldworker employed by the Municipal Agricultural Office was sufficient, in Phase 2 the involvement of all eight fieldworkers of the municipality was needed. The budget that the

FSP availed to the municipality increased almost fivefold—money that was used mainly to finance cross-visits and training courses for fieldworkers. The budget was at the disposal of the MAO. Obviously such a development needs the blessing of the mayor. We learned that misunderstandings are easily created, and interaction of senior project staff with mayors is essential. In addition, the FSP has been more successful in municipalities with a strong agricultural development policy.

In Cagayan de Oro, the livestock dispersal schemes are a clear example of a local policy that reinforces the scaling out of improved forage systems. The Department of Agriculture of Region 10[1] has invested in agricultural development by dispersing improved dairy cattle and buffaloes to farmers. The program, which started in 1995, has greatly contributed to the increased interest of farmers in improved forages. In fact, it was a requirement for beneficiaries of the dispersal program to have at least 600 m^2 planted with forage crops before they could receive an animal. The dispersal programs are revolving; one or two female offspring per received animal, depending on the program, need to be forwarded to a new beneficiary. The programs still exist and are popular among farmers.

Although these dispersal programs seem to benefit farmers categorically, there are some tricky implications. For instance, politicians at various levels initiate some of the programs with a clear earmark to win voters in an upcoming election. Mayors, who are elected by the public in the Philippines, sometimes do not cooperate with programs initiated by a rival. On a more general note, dispersal programs can paralyze farmers' initiatives to breed their own productive livestock. Such has already happened in East Kalimantan Province in Indonesia, where farmers sell fattening cattle, including all female animals, and wait for the government to supply new young stock through loan schemes. East Kalimantan has a severe shortage of beef, and the dispersal programs do not have the capacity to distribute enough fattening stock to farmers. The solution here would be to encourage farmers not to sell female breeding stock for slaughter. Smallholder farmers in east Africa have demonstrated that they can successfully breed their own stock; there are no indications that farmers in the Philippines or Indonesia would not be able to do the same.

Mindanao Case Study

Informal interviews were held in the Philippines, from 6 to 9 August 2002. The first 3 days were spent in Cagayan de Oro City, Malitbog Municipality, and Impasugong Municipality. A multidisciplinary team, including a social scientist, soil scientist/agronomist, and animal scientist, selected and interviewed individual farmers and farmer groups, who had participated in the project for at least 2 years. Although most farmers understood English, the agricultural officer of the LGU translated the questions and answers in

1. "Region" is an administrative level, comprising several provinces.

the local language, Cebuano. Question guidelines were developed before the interviews, and they were slightly adjusted for individual farmers and for groups (Appendix 1). During the fourth day, project site managers of the municipalities and city were interviewed about the history of the project at their site, and each one was asked to rank the importance and effectiveness of scaling-out methods.

There were two layers of stratification of the interviewed farmers. First, it was expected that farmers at the focus sites, Malitbog and Cagayan de Oro, would have more profound knowledge and experience in issues of scale, because these sites had been involved with forage projects since 1992. Impasugong was a relatively new site, established in 2000. The second layer of stratification was the selection of individual farmers to be interviewed. At each site, the aim was to have respondents representing poor- and average-income households, male and female respondents, and respondents with animals, obtained through dispersal programs or through own acquisition.

Results of Mindanao Case Study

Information flows

Questions 4, 5, and 7 (Appendix 1) were aimed at assessing the effects of different methods and activities on information flows to farmers. Activities that were mentioned by individual farmers and groups were farmer cross-visits, field visits to institutes, and training by fieldworkers. Additional activities mentioned by site managers were participatory diagnosis and planning exercises, and training courses for fieldworkers. Farmers and site managers ranked the activities and explained their ranking order. The results are segregated by responses from site managers and farmers (Table 3). Some clear observations are:

- Farmers did not mention participatory diagnosis and planning at all as information flows. For site managers, these activities were of average relevance for this purpose.
- Site managers ranked technician training courses relatively low.
- Farmers and site managers ranked cross-visits high.
- Site managers considered field visits to research stations and field days organized by managers more important than did farmers; whereas farmers ranked farmer training sessions and fieldworker visits much higher than did managers.

Group issues

In Cagayan de Oro, all respondents were organized in cooperative groups that met once a month. The site manager or fieldworkers were often invited to talk about forage technologies and animal husbandry. A specialized government official facilitated the formation of groups in Cagayan de Oro.

Table 3. Site managers' and farmers' ranking of importance and effectiveness of activities as methods for scaling out, and the reasons for ranking, Mindanao, the Philippines.

Activity	Ranking[a]		Reasons given by	
	Site managers	Farmers	Site managers	Farmers
Technician training on participatory research and agronomy	√ √	-	Focus sites: • Basic principles New site: • Knowledge on technologies and skills	Not applicable
Participatory diagnosis and planning	√ √ √	-	Focus sites: • Listening to farmers' problems and ideas • Boosts farmers' morale • Start of a lasting partnership and thrust New site: • Provides direction and clarifies expectations	Not ranked
Field visits and field days[b]	√ √ √ √	√ √ √	Focus sites: • Convinces farmers of the technology • Creates awareness on multiple uses and importance of forages • Provides recognition to farmers New site: • Not mentioned	• Exposure • Access to planting material
Farmer training and seminars and visits by technicians	√ √	√ √ √ √ √[c]	Focus sites: ***Technicians' visits*** • Direct contact of the farmer • To establish a good relationship • To understand farmers problems and needs • Farmers feel important New site: ***Farmer training*** • Enhances interest of farmer • Orientation of project	• Learning on management and agronomy of forages, animal husbandry, manure application • On-farm experimentation on soil erosion
Cross-visits (farmer to farmer)	√ √ √ √	√ √ √ √	Focus and new sites: • Effective in convincing other farmers • Occasion for sharing of experiences, supplementary information and knowledge • Opportunity for farmer interaction	• Knowledge on new species, forage management, soil and water conservation, animal husbandry, animal nutrition, legumes, ration formulation, milking animals, artificial insemination, coconut planting densities, fruit trees in contours • Protecting forage as a crop • Access to planting material

a. Ranking: √√√√√ = highest, √ = lowest.
b. Visits to Malaybalay Stock Farm, Delmonte, Kaluluwayan, and Los Baños.
c. Training sessions happen at a later stage of the cycle; feedback is received and used to focus training topic. Technician was present when question was asked.

In Malitbog, a women's group was started to be able to qualify for dispersal of improved goats and help each other to grow the required amount of forages. The group has been successfully operating for 6 years, and members decide who among the 30 members receive offspring. Rules on planting forages are still enforced within the group. In Impasugong, all respondents were members of a group and met once a week, except one group, which had disintegrated shortly after launching. There appeared to be strong leadership, either a farmer or fieldworker. Forage technologies are discussed, livestock dispersals are planned, and cross-visits are planned. Group objectives and activities seemed to be similar at focus sites and the new site. Differences were the size of the groups; those at focus sites had 25 to 60 members, while those at the new site had 14 to 17 members. Groups seemed to grow naturally, contributing to scaling out within the community.

The role of project facilitators in providing information on forage innovations is still strong. In a few cases, the group chairperson has been on enough cross-visits and field trips to take over the responsibility of providing information. One case revealed evidence that several group members were empowered to share information. As one farmer expressed it: "In the beginning, Nick (farmer chairman) talked and explained in the meetings, but now there are more people talking and exchanging information."

Gender and equity

During the four interviews, data were collected about male and female membership of the groups—one women's group and three mixed groups. The mixed groups had an overrepresentation of men, on the average 73%. However, overall, the groups contained 48% women. Women groups seem to be necessary to balance the number of women involved in social functions. Decision making in forage- or livestock-related activities is shared between husband and wife. Plowing is normally done by men, and sometimes women delegate the cutting and carrying of forage to men. These observations were not different at old and new sites.

The sample group was too small to arrive at any conclusions of how the wealth of farmers relates to functioning in the project. Poor and rich farmers belonged to groups or did not, and they participated in various training and dissemination activities. No clear observation could be made either on whether beneficiaries of livestock dispersal programs engaged in different activities or had superior knowledge, skills, or social status. Other studies, such as the monitoring and evaluation surveys, would be able to illuminate these issues.

Monitoring and evaluation

Participatory monitoring and evaluation (PM&E) has been in place in the project since 1995. In Phase 1, it consisted of farmers ranking forages by criteria that they considered important, such as leaf production, drought resistance, competitiveness with weeds, and ease of harvesting. In the second phase, a broader context of monitoring and evaluation (M&E) was applied. Forage crops were evaluated not only for their growth potential, but also for their use as feeds and other multipurpose benefits. The project went further by trying to evaluate participatory processes. Workshops were held in each country to discuss the concepts of M&E, impact assessment, indicators and methods, and to develop M&E workplans. At most sites, the workplans consisted of a combination of PM&E with community-defined indicators, and conventional donor M&E. The major challenge has been to discuss the concepts of M&E questions, indicators, and methods with the fieldworkers and communities. Composing a dictionary of PM&E terminology was a helpful tool. Simultaneous translation in the local language and English was essential during the whole workshop. Roothaert (2001) described examples of farmer-defined M&E questions.

Discussion

Impacts of the project

The main objective of the FSP Phase 2 has been twofold: (1) to further develop forage technologies with farmers with the aim of improving livelihoods, and (2) to scale out the process to new communities. The first objective resulted in increased farmer experience in cultivating the preferred species and accessions, and expanding their cultivation to a larger area within the farm. Farmers were also able to better qualify and quantify benefits from forages on household income, soil management, labor savings, and community aspects, as described by Bosma et al. (2003) in a study that was carried out in Malitbog and Cagayan de Oro in June 2002. The introduction of new forages reduced the time dedicated by women and children to tasks such as herding and cutting forages. While time was saved for animal husbandry tasks per animal, farmers increased their herd size and thus spent more time on livestock keeping. Other farmers used saved time to extend crop activities. The participatory approach of FSP changed the attitude of fieldworkers, and increased the number of farmers interested in training, workshops, and cross-project visits. This extended the impact of FSP to farmers' knowledge of soil conservation, crop rotation, and intercropping. Farmers also began to use participatory tools to facilitate decision making in their other activities.

Sparks in a flammable environment

There are certain prerequisites for scaling out to happen, be it spontaneous or structured, which have also been called "sparks" (IIRR, 2000). Some of the biggest sparks in the FSP-Philippines have been beyond doubt the presence of champion farmers, who had tested, modified, and evaluated forage technologies with great success. They cultivated more forages than did average farmers, often had more different species and used them in more ways, and experienced larger benefits than average. These farmers also felt the desire to share their knowledge and experience with other farmers, and as a result obtained a higher social status. The FSP has encouraged these farmers to be socially engaged by making them the host for farmer cross-visits and using them as farmer trainers for new farmers. Both farmers and site managers in our case study evaluated cross-visits as highly effective (Table 3) for providing first-hand information that often complemented the official information from fieldworkers, for showing innovations, for providing planting materials, and for finally convincing new farmers. Sparks do not ignite anything without a conducive environment. The environment in this case has been the structure of project implementation, based on a sound policy for collaboration with LGU. Part of the environment was also the production of forage seed and planting materials by experienced farmers, and the facilitation by the project to distribute them. Training of government fieldworkers has fueled the environment even more. Other sparks have included the availability of training materials and technical publications.

Working with partners

Although numerous NGOs are active in the southern Philippines, the project opted for having its primary facilitation through the LGU because the structure was already in place. Also, LGU are considered more sustainable, because they are there to stay, as opposed to NGOs, which are generally more involved on a short-term basis. The weakness that often exists in LGU, the lack of funds to implement field activities, was compensated by modest project budgets in the form of research contracts. We have seen, however, that LGU have been able to acquire alternative funds from government and other sources to fund project activities that they prioritized, such as farmer cross-visits, farmer training courses, and field days to research stations.

At the beginning of every year, site managers developed annual workplans for each FSP site, based on their site priorities (Roothaert et al., 2001). These workplans would include the activities to be conducted for each project output, the time of year they would take place, and an expectation of results. Small research contracts with site managers were based on different outputs of these workplans. The workplans have been helpful to keep everyone in the team focused, yet allowing enough space for flexible ad hoc activities. The importance of workplans is illustrated by an example of the Sustainable Agriculture and Natural Resource Management (SANREM) Collaborative Research Support Project (CRSP) in Lantapan, the Philippines. Buenavista and Consuelo del Castillo (1997) reported that their project went astray after confusion arose between the various institutional stakeholders and LGU about the latter's role in the partnership. The co-development of the Lantapan Natural Resource Management Plan rescued the project just in time. In FSP, workplans have also been a guide in the reporting of the project's progress on a regular basis.

Sustainability of scaling up

Lovell et al. (2002) compared several integrated natural resource management projects that had various levels of success in scaling up. Among the various conclusions, they state that a scaling objective needs to be in place right from the start, and that it needs to be agreed upon by all stakeholders. Another important conclusion was that community-based projects (such as NGOs) need to link up with larger structured programs (such as national policy); in other words, bottom up needs to link with top down. The FSP has benefited from the fact that the community-based projects (groups at focus sites) and the government (LGU) have been working closely together from the start. The basis for an effective link seems to be in place; however, it needs further institutionalization to higher political levels for scaling out to accelerate even more.

The sustainability of the scaling process depends on various factors:

- A genuine need for the innovation is felt at other places.
- Innovations do not require a high start capital or high labor input in the starting phase.
- Something "sparks" the scaling out process, e.g., champion farmers, market demand, or a "critical mass" of farmers.
- Fuelling the sparks: A facilitating structure is in place, planting materials are available, technical information is available in printed material in appropriate language and level of understanding.
- Communities and individuals in those other places have the resources to test new innovations.
- The facilitating structure meets the complexity of the innovation; the more complex, the more skills, thus capacity building is needed. The innovations that often diffuse without facilitation are simple, cheap, adaptable, handy, and elegant (IIRR, 2000).

Work on scaling out improved forages in Southeast Asia scores high on some and low on other factors of the above list. For example:

- A genuine need for the innovation is felt in many places, and if appropriate participatory diagnostic tools are used, those places can easily be identified.
- Forages do not require a high starting capital; most planting materials are vegetatively propagated and given out or sold at low prices by farmers at focus sites. One farmer can start small and expand later with her own planting materials. The poorest in a community might not have

ruminant livestock, which decreases the potential benefits of the innovation.

- The sparks are very obviously there: Many farmers champion improved forage systems.
- The facilitating structures are in place where FSP operates, and are expected to remain beyond project duration.

On the last points, the project scores lower: The complexities of the forage innovations are high. A wide range of forage crops is offered with different growth habits, requiring different types of planting, management, harvesting, and feeding. Most benefits are long term, because forages have to be cultivated and passed through an animal for a certain period before increases in animal production can be observed. Similarly, benefits on soil management through forages are only observed after prolonged use. Some concerns are the equity issues in the communities, and the need for a relatively high level of skills required in the facilitating structure. Capacity building needs to be continuous and targeted. These are important messages for any project or government wishing to uplift the smallholder animal industry.

Availability of germplasm

If project funding were to stop, or if the project were to steer away from forage and scaling issues, there would be a benefit in having established local germplasm resource units on various islands of the Philippines. Currently, farmers produce most materials, and knowledge about species and varieties is accessible. There is a risk, however, that the ability to distinguish varieties will fade, resulting in farmers growing and comparing different accessions of species, thinking they are the same, or in communities growing the suboptimal accession in their environment. The preferences and uses of accessions have been well documented (Horne et al., 2000; Roothaert, 2000), but diversity of germplasm availability needs to be maintained at island level if we want to maintain comparative accession advantage. For example, there are eight accessions of *Pennisetum purpureum* K. Schum, two accessions of *Panicum maximum* Jacq., two accessions of *Setaria sphacelata* (Schumach.) Stapf & C.E. Hubb., three accessions of *Brachiaria brizantha* (Hochst. Ex A. Rich.) R.D. Webster, and five accessions of *Leucaena leucocephala* (Lam.) de Wit now widely cultivated in the FSP sites in Mindanao.

Conclusions

Research on complex innovations, such as growing improved feeds, animal nutrition, and monitoring productivity, need the involvement of researchers and users at every step of the design and implementation. The more these innovations are directed to support the livelihoods of the poor, the more participatory approaches gain in importance. The upland farmers in Southeast Asia are a very diverse group, and the forage systems they have adopted vary considerably, not only among sites, but also within villages. Scaling out to similar target farmers elsewhere would not reduce the complexity, hence participatory approaches in scaling out remain essential.

During Phase I of FSP, an environment ideal for scaling out was created at focus sites. The enabling environment consisted of well-suited technical options for a diversity of applications, good printed technical materials, a network of well-trained local facilitators, and a planting material multiplication system adopted by farmers. Some spontaneous scaling out began, but it was greatly enhanced by structural efforts, resulting in an exponential increase of numbers of farmers. Many activities have been instrumental, but cross-visits are notable. They have empowered communities and resulted in key farmers becoming extension workers. Sustainability of the scaling process is enhanced by larger numbers of key farmer extension workers.

The enabling environment is highly susceptible to the political scene. This is again truer for complex innovations than for easy and smooth ones. The political scene affects the facilitation required for scaling out exponentially. Institutionalization of approaches and objectives will remain an important issue during the entire scaling process.

More research is needed on group processes and empowerment as a result of these processes. Groups could play an even bigger role in future in identifying and providing key farmers who take on the responsibility of extension. Some farmers are already paid for their services, and this might become a saleable product of groups. Many groups already have a tight internal financial control system. Other areas of research that deserve further elaboration are the questions of whether involvement in the project is influenced by household wealth status, and how much involvement in the project is influenced by receiving livestock on loan. The monitoring and evaluation tools developed by the project can provide some answers.

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Appendix 1

A. Questions for individual farmers

1. General: Number of livestock, farm size
2. When did you get involved with FSP?
    a. How did you know about FSP?
    b. What kind of interaction did you have with other farmers? Are you organized in a group?
    c. What FSP activities have you been involved in since the start?
3. What forages do you grow?
    a. Forage varieties.
    b. Ranking of varieties.
    c. Reasons or benefits.
4. What have you learned from FSP?
    a. General.

   b. Through own experience.
   c. With whom have you shared this information?
   d. What have they done with it?
   e. What is their relationship with you?
5. Application of knowledge
   a. How would you test a new variety if it were brought to you?
6. Innovative roles of project
   a. Is there any difference between this project and other projects?
   b. What are the differences?
   c. Are you working differently now in the community?
7. Information flows
   a. Where did you get the information that was most useful to you?
   b. What have you learned from other farmers? (farmer-to-farmer contacts)
   c. Rank sources of information.
   d. What did you get out of those sources?
   e. On what occasion did you get the information?
8. Gender roles and responsibilities
   a. Who does what in the livestock and forage activities?
   b. Who is responsible for planting, management, feeding?
   c. Who makes decisions about which forages to test and expand, or selling animals?

B. Questions for groups

1. History of group
   a. How did it start?
   b. When?
   c. Why?
   d. Activities?
2. Meetings
   a. How often are there meetings?
   b. What do you discuss?
   c. Which forage issues?
3. Are there farmers more active in FSP?
   a. How?
   b. How are these persons selected?
   c. What are their roles and responsibilities?
   d. Are there other committees or subgroups within the group? (repeat b-d)
4. Information flows
   a. If you need information, where or how do you get it?
   b. Are there committees or individuals within the group responsible for this?
   c. If yes: How do they access information?
   d. If no: How did they get information if extension worker is not there?
5. What role do key farmers and committees have in information feedback to other farmers or the group?

CHAPTER 6

Sustaining Innovation in the Latin America and Caribbean Rice Sector

*Luis R. Sanint**

Introduction

The chapter is divided into four sections. It first presents a broad picture of technological and social developments over the twentieth century, stressing the effects of population increase. A quick review follows of major technological innovations that conferred on agriculture a protagonist role by avoiding hunger mainly through increased efficiency. The Fund for Latin America and the Caribbean Irrigated Rice (FLAR) is then presented. FLAR, created in 1995, is a new international model for the rice sector. Its role in sustaining and scaling out innovations is also explained. Finally, some conclusions are drawn.

Population Dynamics in the Twentieth Century

The twentieth century was characterized by rapid change in response to the enormous challenges that emerged from unprecedented increases in human population, which more than tripled to surpass the 6 billion mark by the year 2000. In the last 40 years, the population has doubled from 3 to 6 billion people. By the middle of the century, there were serious doubts that mankind could meet the exponential growth in population with food supplies that grew at linear rates. Books, such as "Famine 1975" (Paddock, 1968), "Too Many" (Borgstrom, 1969), or forecasts by the Club of Rome had a Malthusian flavor (Meadows et al., 1972). Yet technological advances took mankind from the horse to the airplane, from the telegraph to the cellular phone and to satellite communications, from the cash register to computers and beyond, from organic fertilizers and pesticides to powerful, specific chemicals that controlled insects, pathogens, and weeds. As a result of these and many other innovations, and the intertwined synergisms that resulted, agriculture performed at unexpected levels to slash the negative predictions and allow for abundant food supplies.

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The so-called century of the masses saw deep changes in the way societies organized and governed themselves. Amidst technological progress, there was war, poverty, and the exclusion of millions of people, mostly in the name of progress. Social Darwinism has overshadowed humanitarian approaches. The survival of the fittest was taken to extremes through market-oriented philosophies that minimized the value of the person in favor of economic ideologies. Big challenges still remain as to how to put the economy at the service of the people and not the other way around, and how to avoid hunger in a world of plenty. While there are enough provisions to feed everyone on the planet, nearly 800 million people go to bed with an empty stomach and hundreds of children die every day from malnutrition. Many other forms of organization (e.g., labor unions, farmer associations, and political parties) accompanied the rise of democracy in all corners of the world. Several nations achieved independence, and countries formed economic blocks. By the end of the century, capitalism turned the free market into a dogma, the norm, the infallible truth, the only alternative, especially in western countries.

In Latin America, political parties remain weak, and farmer associations lack the power to articulate their needs and defend their interests in an effective manner. Countries do not form cohesive blocks, and Mercado Común del Sur (MERCOSUR) and Comunidad Andina de Naciones (CAN) have lost power and effectiveness over recent years. However, rice producers have had relatively strong confederations and have been supporting research and development (R&D) very actively thorough strategic alliances within and outside their countries. The century brought awareness of the need to look for alliances: Labor unions, producer associations, political parties, economic blocks, corporate conglomerates, etc.

The governability of the growing masses is at the heart of most social and economic problems. Deeper questions also remain unanswered: How to conciliate the interests of the masses with those of powerful, small groups with huge lobbying capacity; and how to defend culture and the innermost traditions from the charge of superficial market-oriented dogmas. The attack on rural traditions and ancestral forms of life in the name of capitalism and progress represents an enormous challenge to rural communities everywhere.

Agricultural Performance and Innovations

Agriculture was a protagonist in the past century, not only for what it accomplished, but for the issues it avoided and the way in which it did so: Through efficiency and productivity, avoiding hunger. Granted that the intensive new practices put great strain on the cultivated areas and on the environment, and that the challenge to reduce the damages is a paramount task still at hand. Yet, progress “with its bark and its pits” has been beneficial to the natural resource base. Higher efficiency has helped preserve huge new areas that would have been disturbed in the absence of higher yields, and would have led to higher damage, higher costs, and more expensive food at lower levels of supplies.

At the heart of these events were the advances in the biological sciences, with new varieties that produce with higher and more stable yields, and new chemical inputs, as well as impressive inventions in mechanical engineering. Opportunely, these technological and scientific advances become mixed and combined with impressive efficiency to allow for rapid gains in agricultural productivity. Yield increases in the three main cereals (rice [*Oryza sativa* L.], maize [*Zea mays* L.], and wheat [*Triticum sativum* Lam.]) surpassed population growth rates (Table 1).

Table 1. Annual rates of growth (%) for cereals, worldwide, 1961-99[a].

	Rice	Wheat	Maize
Production	2.5	2.5	2.9
Yield	2.0	2.3	2.1
Area	0.5	0.2	0.8

a. The rate of growth of the world population in 1961-99 was 1.75% per year.
SOURCE: FAOSTAT, 2001.

Rice production stagnated in the first half of the century to boom after 1960 (Table 2). The creation of international centers, such as the International Rice Research Institute (IRRI), the International Maize and Wheat Improvement Center (CIMMYT, the Spanish acronym), the International Institute of Tropical Agriculture (IITA), and the International Center for Tropical Agriculture (CIAT, the Spanish acronym), fostered by visionaries like George Harrar and Forrester Hills (from the Rockefeller and Ford Foundations), was a pivotal event that helped catalyze a wealth of knowledge into concrete shared efforts with a specific commodity approach (Chandler, 1992).

Table 2. Rice in the world: Production, area, and yield, 1900-2000.

Year	Production	Area	Yield
1900	148	84	1.8
1950	151	94	1.6
2000	598	154	3.9

SOURCES: Efferson, 1958; FAOSTAT, 2002.

In Latin America, rice became one of the basic food staples due to expanded production, more notably during the first half of the century. Based on mechanization schemes and strong government support, rice became a preferred pioneer crop in the frontiers of the Brazilian Cerrados and the Colombian, Venezuelan, and Bolivian savannas, as well as in forest margins throughout the region. Annual per capita consumption of rice went from less than 9 kg in the 1920s to 20 kg by the 1940s (mainly because of a jump in production from 1.0 to 8.0 million tons of paddy rice), and currently is around 30 kg (Sanint and Gutiérrez, 2001). In absolute terms, however, the large increase occurred in the past four decades, when paddy rice production tripled, from 8.0 million tons in 1960 to about 24.0 million tons by the end of the century.

Fund for Latin America and the Caribbean Irrigated Rice (FLAR): Sustaining Innovation in the Rice Sector

Central to these accomplishments in technological innovations and impact, several institutional developments can be highlighted:

- The progressive involvement of the private sector in rice research and extension, through formal associations that consolidated strategic alliances with public institutions, both national and international.
- A linkage by the region through CIAT to the world's premier source of rice germplasm (IRRI).
- The development of a strong, regionally relevant, rice improvement program in the 1970s and 1980s through a productive partnership of CIAT, the Federación Nacional de Arroceros de Colombia (FEDEARROZ), and the Colombian Institute of Agriculture and Livestock (ICA).
- The close cooperation between CIAT's regional rice program, national programs, and producers in major rice producing countries of Latin America and the Caribbean (LAC).

While the upstream linkage to IRRI was a valuable component of this three-part improvement model, high-quality downstream activities at the country level, frequently involving cooperation between public programs of research and extension with private producer organizations, were key to locally relevant adaptive efforts. Through research, extension, and training, the new knowledge was capitalized to accelerate and expand the spread of improved germplasm, complementary cultural practices, and related institutional and policy developments. Even though the investment commitments made by the private and public sectors throughout the past 3 decades were of major proportions, attractive (even unprecedented) returns have been gained.

When CIAT signaled a change in strategies, by the late 1980s, and decided to give higher emphasis to natural resource management research at a time of decreasing funds, it was clear that support for rice research would diminish. By the end of 1993, the announcement of a sharp decline in support from CIAT's core resources to its rice program caused alarm mainly because of the high dependence that the region had developed on that international center as a model to sustain innovations, particularly in germplasm research.

Fostered by CIAT, the initiative to create a self-relying research effort based on financial contributions from the private sector was well received among several producer associations in the region (Colombia, Venezuela, Brazil, and Uruguay). Several of these associations had already voiced support for a mechanism such as the one proposed by CIAT since the center announced its shift from irrigated to upland rice research in 1990. Conversations to create the producer-based mechanism began in 1994, when CIAT hired two consultants for the task: One to assemble it in terms of rules, regulations, and terms of agreement among founding members, and the other to contribute in the process of identifying a research agenda that would be agreeable to all parties involved. In January 1995, CIAT's Director General, along with representatives from six organizations, took the torch of innovation and signed the Heads of Agreement for FLAR. The six others involved were:

(1) FEDEARROZ (Colombia),
(2) Instituto Rio Grande de Arroz (IRGA), Rio Grande do Sul, Brazil,
(3) Asociación de Productores de Semilla Certificada de los Llanos Occidentales (APROSCELLO), Venezuela,
(4) Fondo Nacional de Investigaciones Agropecuarias (FONAIAP), Venezuela,
(5) Instituto Nacional de Investigacíon Agraria (INIA), Uruguay, and
(6) Instituto Interamericano de Cooperación para la Agricultura (IICA), Chile.

By 2002, thirteen countries had contributed resources to FLAR and, by the end of this same year, 10 were still actively involved. They represent 56% of total and 62% of irrigated rice production in LAC.

FLAR's vision statement reflects its essence: "An inclusive model, headed by the private sector, to ensure stable resources for sustaining innovations that enhance the quality of life in the rice sector of Latin America". Its main mission is to meet the needs of its partners to achieve the stated vision. The FLAR partners govern the fund through administrative and technical committees, where all of them are represented with right to voice and vote, and equal powers.

FLAR was created to:

- Avoid duplications of efforts,
- Maintain efficient use of the resources available for research,
- Achieve effectiveness through clear mandates, high quality staff, and active involvement from partners,
- Rely on the relative strengths from each partner to take advantage of specialization for specific tasks, and
- Maintain an international scope.

Total financial contributions during 1995-2002 reached US$3.8 million. In the 10 countries, alliances include producer organizations in 80% of the cases, millers in 60%, seed producers in 30%, and the public sector in 50% (Table 3).

Table 3. Strategic alliances within the Fund for Latin America and the Caribbean Irrigated Rice (FLAR) members, by sector of activity.

Partner[a]	Producer	Miller	Seed	Public
Bolivia (CONARROZ)	x	x		x
Brazil (IRGA)	x			
Colombia (FEDEARROZ)	x			
Costa Rica (SENUMISA)		x	x	
Cuba (IIA)				x
Guatemala (ARROZGUA)	x	x		
Nicaragua (ANAR)	x	x		
Panama (FEDAGPA)	x			x
Uruguay (INIA)	x	x	x	x
Venezuela (FUNDARROZ)	x	x	x	x
Colombia (CIAT)				x

a. CONARROZ = Consejo Nacional Arrocero; IRGA = Instituto Rio Grande de Arroz; FEDEARROZ = Federación Nacional de Arroceros de Colombia; SENUMISA = Semillas de Nuevo Milenio S.A.; IIA = Instituto de Investigaciones Agrícolas; ARROZGUA = Asociación Guatemalteca del Arroz; ANAR = Asociación Nacional de Arroceros; FEDAGPA = Federación de Productores de Arroz de Panamá; INIA = Instituto Nacional de Investigacíon Agraria; FUNDARROZ = Fundación Nacional de Arroz; CIAT = Centro Internacional de Agricultura Tropical.

The main research objectives were defined from its inception:

- Maintain access to the elite rice material of the world and store it in a germplasm bank;
- Characterize all the material for yield, for its tolerance and resistance to the major constraints in the region (blast, *hoja blanca* virus and its vector *sogata* [*Tagosodes orizicola*], secondary diseases, cold, iron toxicity, straighthead), and for quality aspects, cooking, and milling;
- Select progenitors and make crosses to produce varieties with superior traits and yield performance;
- Facilitate improvements in integrated crop management; and
- Perform postharvest studies to improve milling efficiency and offer better products to the markets.

FLAR provides a mechanism for collective action in which countries join forces and share the cost for rice R&D. The founders of FLAR were among the strongest countries in terms of organization, production, and R&D infrastructure. Joining efforts is essential for most countries in LAC, because few have adequate resources and personnel to support the required effort in rice R&D. However, several of the countries that can benefit most from FLAR have not developed the means for securing finances to maintain their participation in FLAR. Examples are Ecuador, Peru, and the Dominican Republic. This most immediate problem has been an objective since the creation of FLAR and is reflected in its vision statement. The subsequent step will be to assist the grower associations in strengthening their R&D agendas. Finally, most of the associations require assistance in strengthening the technical expertise within the national association or affiliated organizations.

FLAR is the most suitable organization for addressing the needs of the rice producing countries of LAC, particularly the small, resource-deficient countries. External assistance to FLAR from the international donor community will enable the organization to provide the previously described assistance to its member-countries. In 2002, the Common Fund for Commodities (CFC) approved a grant of close to one million dollars to implement a crop management project over 3 years in Venezuela and southern Brazil. These activities will subsequently be sustained through membership fees. National associations can sustain their membership via revenues generated by a production check-off and other innovative means of finance, such as sale of germplasm and royalties.

An overview of recent accomplishments in breeding

Over the years, the breeding program has been refining its strategies as members become more involved, diversified, and sophisticated, and as FLAR governance becomes more capable of self-assessment, which is where true learning begins. Besides the original quest for higher yields, better cooking quality, and resistance to major diseases (blast and rhizoctonia), the program now includes tolerance to *sogata* and *hoja blanca* (in the tropics), as well as cold and straighthead (in the temperate region). Milling quality is also an important objective. FLAR selects elite lines every year and forms nurseries for the tropics and the temperate zone (Vivero de Observación del FLAR [VIOFLAR]) that are evaluated by members for their specific micro environments.

This year, FLAR has a set of 640 promising F_4 lines for the tropics that will be shipped to members in 2003. The best 100 lines, in terms of yield, out-yield the checks by over 10% and the elite 20 lines out-yield them by more than 20% (Table 4). For the temperate region, there is a set of F_2 lines that showed significant tolerance to cold.

The superior performance of the new lines obeys a redirection in the breeding strategy. For many years, and after the development of IR-8 at IRRI by Dr. Peter Jennings and his collaborators (Chandler, 1992), the main objective was to tame the new yield potential and make it more stable by adding new sources of tolerance to biotic and abiotic constraints. Three decades later, there were lines with good resistance to blast, *hoja blanca* virus, *sogata*, and other diseases, but the yield potential remained stagnant. The current strategy, led by the team of breeders at FLAR, coordinated by Dr. Jennings himself, recalls the emphasis on yields by bringing in objectives of plant type, vigor, stay green, tillering capacity, etc. Other changes included new fields at CIAT, higher rates and earlier applications of nitrogen, and triple crosses. The result was the set of lines already depicted that also carry very good cooking and milling quality characteristics. For the temperate region, the challenge is to blend the yield potential of the tropical lines with cold tolerance.

Table 4. Yield of elite lines of the Fund for Latin America and the Caribbean Irrigated Rice (FLAR), Palmira, Colombia, 2002.

Advanced lines	Yield (t/ha)
Total (640)[a]	6.9
100 highest yielding	9.0
20 highest yielding	9.9
Checks:	
FEDEARROZ 50	8.1
ORYZICA 1	8.2

a. Candidates for Vivero de Observación del FLAR (VIOFLAR) 2003.

Scaling out

Scaling out is understood in this chapter as the replication, dissemination, and adaptation (across space and time) of technologies or practices. To help research “deliver the goods” for many of the world’s poor over a large area and in a timely manner, Harrington et al. (2001) suggest a problem-solving approach that facilitates the scaling out of relevant agricultural practices. They propose seven ways to foster scaling out:

(1) Develop more attractive practices and technologies through participatory research;
(2) Balance supply-driven approaches with resource user demands;
(3) Use feedback to redefine the research agenda;
(4) Encourage support groups and networks for information sharing;
(5) Facilitate negotiation among stakeholders;
(6) Inform policy change and institutional development, and
(7) Make sensible use of information management tools, including models and geographic information systems (GIS).

The structure of FLAR reflects these seven requirements, because it is a participatory mechanism that uses demand-driven signals to define a research agenda that is the product of negotiations and dissemination of information among networks of collaborators. As FLAR enters into crop management activities, its research domain expands, and its capacity to scale out increases.

The CFC Project

The CFC functions under the frame of the United Nations. It favors projects that have a commodity approach. FLAR, under the aegis of CIAT, requested assistance for strengthening crop management and technology transfer for irrigated rice production. The project will be implemented in Venezuela (states of Portuguesa and Guárico) and Brazil (state of Rio Grande do Sul). There, national rice farmer organizations are already established and FLAR, in collaboration with its national counterparts, has conducted diagnostic studies to identify areas requiring improvements. Together, these two sites account for an annual production of nearly 6 million tons of paddy rice, which represents nearly 30% of all rice production in the region. In both locations, yields are relatively low, averaging only 4.4 t/ha in Venezuela and less than 5.5 t/ha in southern Brazil, both of which are far below the genetic potential of available varieties. The purpose of the project is to establish on-farm research and technology transfer programs that will introduce and extend to growers improved crop management practices, resulting in increased yields and more competitive production. Small-scale growers will be the primary beneficiaries of increased technical assistance provided by grower associations, because they have limited access to existing technologies and other forms of assistance.

The total cost of the project is US$1.5 million, and CFC will contribute US$975,000 in the form of a grant. Counterpart funds will be provided by IRGA in Brazil, Fundación Nacional de Arroz (FUNDARROZ) in Venezuela, and FLAR. The duration of the project is 3 years (March 2003 to February 2006).

The project goal is to increase productivity of irrigated rice in two strategically located countries, resulting in improved market competitiveness. The project objective is to strengthen the capacity of national grower associations to identify and transfer yield-enhancing crop management practices that narrow the yield gap in irrigated rice. The two countries included in the proposal are representative of tropical and temperate ecologies. The improved crop management practices and experience in organizing farmer-financed technology transfer programs will subsequently be extended to other FLAR-member countries within each ecological zone. Adoption of improved crop management practices will narrow the yield gap, increase on-farm incomes, and permit more sustainable production.

The project has several activities:

(1) Diagnosis and baseline data: It is critical to start with representative samples and units and to have a clear notion of the initial states-of-the-art, in order to identify adoption of the new practices and measure impact.

(2) Identification of entry points: These must be attractive and well focused. For example, applications of urea throughout Latin America are done in wet fields or even in flooded fields, seed densities are high, and seed quality is low, pesticide applications are heavily biased by sales promotions from input dealers, etc.

(3) With the initial information, trials are planned and on-farm trials are installed.

(4) Farmer groups and leaders are identified: One of the premises of the project is that extension works best when done from farmer to farmer. Technical extension personnel are also involved in the project activities, but they are usually reluctant to assimilate simple, new practices without doing extensive tests by themselves. Farmers are more pragmatic.

(5) Measure adoption and impact: Careful follow-up of adopters with thorough evaluation of management practices, costs, and implications for efficiency will be done to measure the impact of the project.

(6) Regional and national integration: The project serves as a platform to integrate other FLAR members as well as countries not affiliated to FLAR that are CFC members (such as Ecuador, Peru, and the Dominican Republic). At the country level, it aims at leaving in place fully active networks of collaborators.

FLAR and CIAT

FLAR represents a unique mechanism for its partners to tackle common objectives and reach farmers throughout the region. For CIAT, it offers a platform that facilitates the scaling out of innovations in a rather inexpensive and efficient manner. FLAR members represent over 50% of rice production in LAC. The emphasis on flooded rice environments targets over 80% of rice production in the region. Most of the remaining 20% is in the Brazilian Cerrados, where the Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) has a well-funded and well-staffed program for that system. How much CIAT should devote of its own resources to complement FLAR's efforts to sustain innovation in the flooded ecosystems of the region is a strategic issue for CIAT. Currently, the center puts a substantial emphasis on supplying technologies in non-FLAR domains and to non-FLAR members. From the perspective of FLAR, CIAT can play a major role in bringing non-FLAR members into FLAR, and in complementing FLAR efforts for flooded environments. This would give increased leverage to FLAR's current capacity as a prime vehicle for scaling out and sustaining innovation in the rice sector of LAC.

Conclusions

The twentieth century brought immense material progress to mankind. The Malthusian concerns that exponential population growth was going to outrun linear growth in food production were slashed by the impressive performance of agriculture. Governability of the rapidly expanding masses is at the heart of the emergent social and economic challenges. A deeper question also remains unanswered: How to conciliate the interests of these masses with those of powerful, small groups with huge lobbying capacity. The attack on rural traditions and ancestral forms of life in the name of capitalism, progress, and globalization represented an enormous challenge to rural communities everywhere by the end of the twentieth century. Producers' associations have been a powerful response to the issue of governability, and of innovation and diffusion of new technologies. A myriad of impressive technological advances and their respective synergisms allowed annual rates in productivity to surpass population growth. Progress, "with its bark and its pits", has been beneficial to the natural resource base as area harvested barely grew at the time that cereal production was quadrupled.

While, at the world level, rice production stagnated in the first half of the century, in LAC it grew relatively quickly, as rice became a preferred pioneer crop in the frontiers of the Brazilian Cerrados and the Colombian, Venezuelan, and Bolivian savannas, as well as in forest margins throughout the region. These early settlements took advantage of the new advances in mechanization. By the 1970s, the new semi-dwarf rice varieties arrived in farmers' fields and flooded rice production gradually replaced upland rice areas. The IRRI and CIAT centers became the prime sources of new germplasm and the hub for international efforts in the field of technology generation and innovations for the rice sector. By the 1990s, CIAT signaled its intention to diminish its support to the rice program. Rice producer associations from Colombia, Venezuela, Brazil, and Uruguay reacted to this situation and, together with CIAT, took the torch of innovation and created FLAR in 1995. By 2002, thirteen countries have contributed funds to this novel mechanism and the program is now growing from a primarily germplasm-based effort into crop management and postharvest activities as well. With the approval from CFC of a grant for US$975,000 for 3 years that represents an increase of 70% of the incomes from fees, FLAR's resource base is well consolidated and it emerges as a viable and stable international model to sustain innovations for the rice sector of Latin America.

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Chapter 7

Twenty Years of Cassava Innovation in Colombia: Scaling Up under Different Political, Economic, and Social Environments

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Introduction

Cassava (*Manihot esculenta* Crantz) is an important crop throughout the tropical world for small-scale farmers with access to marginal lands. Its high tolerance to seasonal low rainfall, high temperatures, and low to intermediate fertile soils makes it an essential source of food security and cash income in areas where few alternatives exist. This chapter analyzes 2 decades of a commodity-based innovation process that includes technological, social, and market innovations. The timely combination of this set of innovations was perhaps one of the key factors for the relative success of this process in making the cassava agri-food chain in Colombia more competitive as well as to contributing to poverty alleviation.

The analysis has been divided into three time periods:

(1) The 1980s, where an innovation process initiated by the public sector is analyzed. This period of the innovation process is called the Integrated Cassava Research and Development (ICRD) Period.
(2) The 1990s, where public support was limited to a minimum, and which has been called the Latent Period.
(3) 2000 to date, where a public-private partnership innovation process started as a response to a real demand of the private sector, and has been called the CLAYUCA Period. (CLAYUCA is the Spanish acronym for the Latin American and Caribbean Consortium to Support Cassava Research and Development.)

For each period, the political, economic, and social environment is described briefly, the problematic is defined, the proposed best-bet

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solutions are explained, and the roles of differentiated social actors are analyzed. This leads to determining the factors that have influenced the successes (and failures) of the intervention process in each period as well as its outcomes in terms of adoption, effect on prices and productivity, and, to the extent that is possible, its effect on income generation and its contribution to poverty alleviation.

The chapter concludes with some reflections on enabling innovation as well as on scaling out and up aimed at making a contribution to ongoing discussions on this topic.

The ICRD Period (1981-1993)

During the 1970s and 1980s, small-scale farmers of the North Coast of Colombia obtained 40% of their cropping income by marketing cassava (Janssen, 1986). The crop represented an important food source for the farmers and their families as well as an employment generator, creating about 7.3 million wage-days per year. Despite cassava's socioeconomic significance, the quick deterioration of cassava roots rendered its marketing difficult. Farmers across Latin America had limited marketing outlets for their cassava production, most of which was for on-farm consumption and sold on fresh markets. A marketing channel made up of several intermediaries ensured the supply of roots from the farm gate to the urban consumers. The short shelf life of harvested fresh roots made marketing cassava a risky business; losses were high, and fluctuations of daily price were large.

The political, economic, and social environment in the 1980s

During the 1980s, the Colombian government followed an import-substitution economic model. Production was highly protected by import taxes, making imports expensive. Thus, the market alternative identified for cassava in the early 1980s, as a feed ingredient, was dependent on this policy scheme that made cereal imports for the animal feed industry unattractive. During this period also an Integrated Rural Development Program (DRI, the Spanish acronym) was in place, with a strong public sector presence in rural areas and provided an integral support package to farmers including research, technical assistance, marketing, organization, and credit, among others. Moreover, this Colombian rural development initiative was completed with strong external donor support.

Additionally, organizational processes were already in place as a result of social struggles to secure access to land.

The challenge

In the early 1980s, the Colombian cassava market experienced particularly depressed prices, partly as a result of an intensification of cassava production. Taking advantage of improved access to land as a result of the Land Reform Program during the 1970s, and the credit program offered through the DRI Program, cassava farmers increased their production in the late 1970s (Janssen, 1986). By 1981, cassava production was extremely high and farmers were unable to find buyers; many farmers plowed their crops without harvesting.

With prices falling below production costs, problems of massive credit default appeared. Limited markets for cassava belied the DRI Program's basic premise that production increases would improve the income of small-scale farmers. After the 1981 debacle, farmers were afraid to increase cassava production. Small-farm development in the North Coast region clearly did not depend on production increases alone, but also on marketing. The DRI Program therefore began searching for alternative markets for cassava.

CIAT and the Cassava Program in the 1980s

During the 1980s, the International Center for Tropical Agriculture (CIAT, the Spanish acronym) had a commodity-based Cassava Program with a multidisciplinary research team. However, there was concern that, constrained by lack of markets, cassava farmers in Latin America were not adopting improved production technologies developed during the 1970s. The Center therefore studied alternative uses for cassava to identify markets with growth potential, the most promising of which was the use of dried cassava chips as an energy component in animal feed concentrates (Pachico et al., 1983). This industry was originally developed in Asia, where millions of tons of dried cassava chips had been produced for export mainly to European markets. After conducting economic studies, and based on an internal planning exercise, CIAT initiated an integrated approach to cassava research and development (R&D), leading to a change in approach from research only to R&D, and from research on primary production to research along the agri-food chain (Cock, 1985; Lynam and Janssen, 1988).

This new R&D approach was implemented through an ICRD methodology based on a planning process, both at the macro and micro levels, that led to a set of activities requiring a pilot phase (Best et al., 1991). In new words, this methodology aimed to facilitate a "learning selection" process (Douthwaite, 2002), leading to a commercial phase that helps scale out or promote a horizontal spread of the innovation.

The intervention: Best-bet solutions and participating social actors

For the DRI Program, also facing the challenge of finding alternative markets for cassava, CIAT was a natural partner. Thus, in 1981, an ICRD Project was started in the North Coast of Colombia that aimed to implement an integrated set of institutional, organizational, and technological best-bet solutions designed to link small-scale cassava farmers to expanding markets, stimulate their demand for improved production technology, and improve their income and welfare.

The first best-bet solution was the establishment of an agro-industry based on drying and chipping cassava roots by adapting the processing technology that was already available in Thailand, based on previous processing technology research in Asia. This required the construction and operation of small-scale processing enterprises, owned and managed by small farmer associations. The technology brought from Asia was tested, adjusted, and diffused with small-scale farmers' participation. This low-cost and appropriate technology consisted of chipping cassava roots, which were then spread on cement floors and sun dried. The North Coast region of Colombia was chosen to elaborate the project because of the importance of the cassava crop to the region. In the early 1980s, the region grew 35% of the country's total cassava production. Moreover, the region had a high proportion of small-scale farmers, with 80% of farms of 20 ha or less representing less than 10% of the total farmland (DANE, 1974). The North Coast region featured all the characteristics desirable to develop and implement the ICRD approach.

To implement the ICRD Project, each participating institution assumed an agreed set of responsibilities in accordance with its own mandates and capacity. However, although the project was coordinated by the DRI Program, CIAT's cassava R&D team became the "product champion", and was responsible for defining the research agenda, providing the set of best-bet solutions, and inducing the innovation process.

The pilot phase. This phase was implemented during the first 3 years (1981-83) of the project, and began with a group of 15 farmers, selected from the municipality of San Juan de Betulia, Department of Sucre. A technological prototype was developed, based on the technology brought from Thailand, and adjusted to Colombian conditions. Based on this, a pilot plant was built, the processing technology was evaluated and adapted, and an operational scheme was developed for local conditions. Seven tons of dried cassava chips were produced and during the first year distributed to several animal feed industries to obtain feedback on their potential interest in buying the product, and the price they were prepared to pay. As a result, one firm committed to buy the entire production of the next cassava season.

In 1982, the pilot plant became semi-commercial, with the farmers taking full responsibility for its management. The 1982-83 period provided reliable data on the plant's operation, and consolidated the market for the product. A technological and economic feasibility study was conducted, and its positive results prompted the DRI Program to create a line of promotional credit for establishing additional drying plants. The pilot plant expanded its capacity, and was used as a demonstration and training model for other farmer groups interested in building drying plants in their communities.

During this initial period of the project, small-scale cassava producers not only were the target group, but also participated actively as co-developers. The public sector had a strong role in planning, priority setting, funding, and on leading and controlling the project. The private sector acted as end-user of the product, provided feedback on the product quality requirements, and set up the price for the product that was pegged to the internal price of grains. Key success factors of this initial innovation process were:

(1) A pilot site that permitted an intensive involvement of farmers as co-developers, adaptors, and adopters;
(2) The pilot site was selected based on a felt need and interest, and by demand of farmers;
(3) The innovation process went through a pilot phase that gave enough time to test, learn, and adapt the set of best-bet solutions before a broader release; and
(4) Access to the technological innovation was free.

The scaling-out phase. To replicate the pilot plant to other sites in the North Coast of Colombia, an organizational prototype was developed to target small-scale farmers. For that purpose, the organization of cooperatives was proposed with an average of 25-30 members to build and operate small-scale processing enterprises owned and managed by them. At the same time, the development and validation of production technologies were intensified, and a methodology of farmer participation was incorporated into technology development. By 1989, small farmer cooperatives were managing 39 drying plants, and five plants were privately operated. As dried cassava chips production reached 5600 tons, the product had to be promoted among a larger number of buyers. The National Association of Cassava Producers and Processors (ANPPY, the Spanish acronym), an association of small-farmer cooperatives, was created and took responsibility for marketing the dried cassava chips. In 1989, the ICRD Project ended as a formal interinstitutional activity.

One hundred and thirty-eight processing plants for drying cassava were operating by 1993. Small farmer cooperatives managed 101 plants, while private individuals who had adopted the processing technology, but not the organizational model, built the remaining 37. The total drying capacity of all 138 plants was 179,715 m^2, of which private entrepreneurs installed 28% (Figure 1). The rapid growth in private investment occurred between 1990 and 1993, when the technology was completely adapted to local conditions, the market already established, and the economic feasibility of the investment proved. The private entrepreneurs therefore assumed a lower risk. In 1993, dried cassava production reached 35,000 tons, valued at US$6.2 million and requiring 90,000 tons of fresh roots. This volume represented 10% of total cassava roots marketed in the region. An estimated 36% of small-scale cassava farmers in the region were selling cassava roots to the dried cassava agro-industry, and 15% of all small-scale farmers were members of a cooperative.

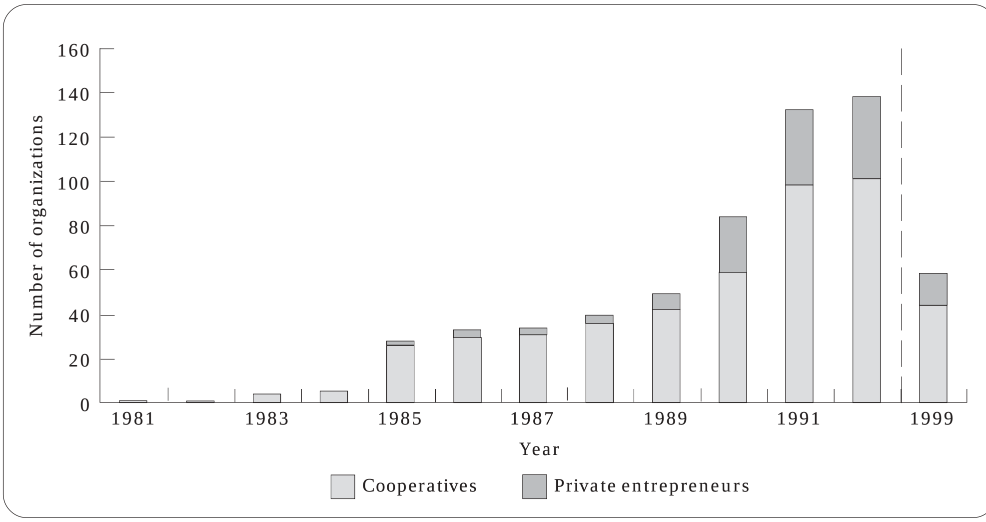

Figure 1. Emergence of the cassava-drying agro-industry in the North Coast of Colombia, 1981-1993. Data were obtained from the Integrated Cassava Research and Development [ICRD] Project monitoring and evaluation system.

Reaching the poor: Cooperative emergence analysis

Based on an econometric model developed and estimated, Gottret and Raymond (2003) concluded that cooperatives emerged in communities with higher potential production surplus, and higher social and human capital. With respect to cassava supply conditions, cassava-drying plants tended to emerge in municipalities with cassava cropping land of higher potential, and with more productive farmers. Existing local demand for cassava also had a negative impact on the establishment of cassava-drying plants. Hence, these results indicate that dry cassava agro-industries did tend to emerge in communities with higher potential cassava production and lower fresh market demand.

Human capital played an important role in the emergence of cooperatives as captured by the average education of farmers in the community. Human capital influenced the capacity that the community had for becoming organized and for asking institutional support to build a processing enterprise. Although the number of public and community associations did not influence the cooperative emergence individually, their interaction and cooperation stimulated the creation of the drying plants. Through cooperation with local associations, research and public institutions reached the targeted population more effectively by taking advantage of the infrastructure already in place. Local associations served as intermediary for diffusion purposes of new technologies or for provision of complementary technical assistance and other types of services.

The project's target of reaching small-scale farmers was achieved because cooperatives emerged in communities where the average farm size was lower. However, the drying capacity built was neutral to farm size, and depended strictly on variables related to cassava production. Drying plants also emerged independently of land tenancy, indicating that the project reached equally those communities composed mostly of landowners and those mostly of landless peasants.

Short-term effect of the new alternative market for cassava

The development of the dried-cassava agro-industry in the Colombian North Coast created an alternative market for cassava roots. A price floor for cassava was established, and over the short term, farmers reacted by increasing their cassava area. As shown in Figure 2, prices for fresh roots rose between 1983 and 1990 at an annual rate of 3.5%. Also, the price paid for cassava roots by the cassava-drying industry started to provide a price floor, which provided a secure market for cassava farmers. If the price of fresh cassava roots fell under the price floor or the quality of the roots was not acceptable to the fresh market, farmers had the option of selling their product to a cassava-drying plant. By linking farmers to expanding markets, the cassava market situation was improved (see Box 1).

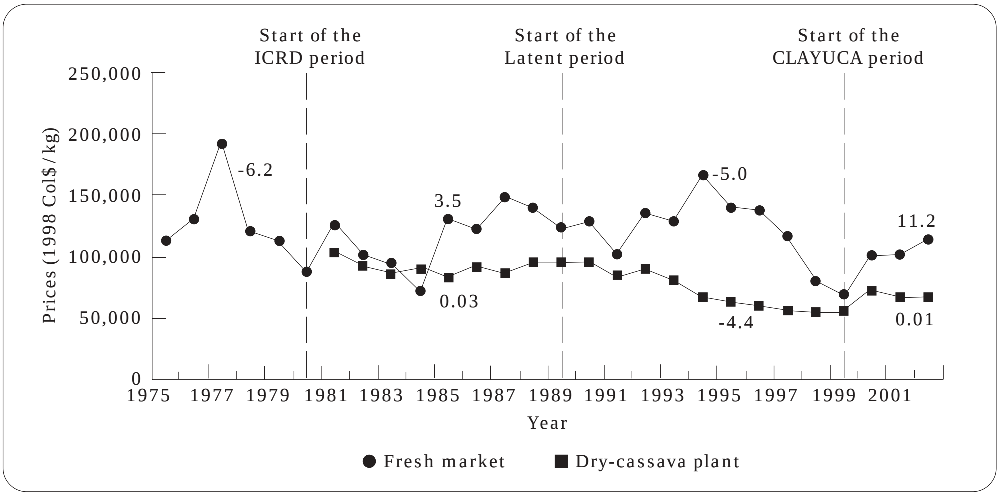

Figure 2. Trends in cassava prices in the North Coast of Colombia, 1975-2001. Prices are based on the 1990 Colombian peso. Data were obtained from the Integrated Cassava Research and Development (ICRD) project monitoring and evaluation system. Values in the field indicate price trends in percentages. (CLAYUCA = Latin American and Caribbean Consortium to Support Cassava Research and Development.)

Box 1

Comments by cassava farmers in San Juan de Betulia, Sucre, 1999

"I remember when I was child, some producers were left with their cassava...there were no markets for the product." And "... of course, it's the cooperative that has practically given life to cassava cropping in this region. Before, some years nobody would buy the cassava, there was no market, and the roots were completely lost. ...Now, we have different market alternatives, the fresh market, the drying plant, and the new starch plants that are being built. If the fresh market offers a better price, then farmers try to sell their roots to this market, but when things become complicated, farmers sell their crop to the drying plant".

Over the short term, this new market alternative created an incentive to increase the area planted to cassava. As shown in Figure 3, the area under cassava in the Colombian North Coast increased at an annual rate of 7% between 1983 and 1993. Results from a 1991 cassava-farmer survey show that about 43% of cassava farmers increased their area planted to cassava between 1983 and 1991. Of farmers who responded that their cassava area was increased, 50% said it was because the market for cassava had improved, 22% said that land availability had increased, 12% had substituted cassava for yam (*Dioscorea* sp.) because of the incidence of a serious yam disease, and 5% received credit for cassava cropping (see Box 2).

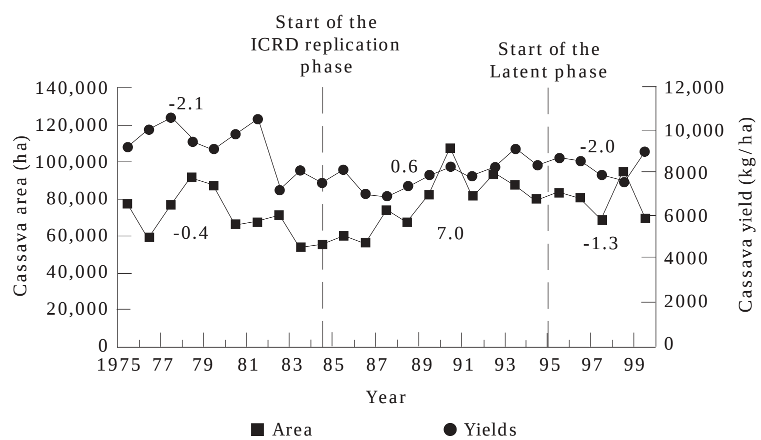

Figure 3. Trends in cassava area and yields in the North Coast of Colombia, 1975-1999. Data were obtained from the Colombian Ministry of Agriculture. Values in the field indicate trends in percentages. (ICRD = Integrated Cassava Research and Development.)

Box 2

Comment of a cassava farmer in Los Palmitos

"The construction of the drying plant was a major achievement of this community, and the changes in the standard of living are obvious. The association has improved the market for cassava. Before, farmers only planted a quarter or half a hectare with cassava, mainly for home consumption. Now, farmers plant 2 to 3 hectares of cassava because they have a secure market. The drying plant pays members and nonmembers in cash, therefore they increase their cassava cropping area, and this means a higher income."

(Alvaro Meza, cassava farmer and cooperative associate of Sabanas de Beltrán, Los Palmitos, Sucre, 1999)

Cooperative impact on adoption

Results from Gottret and Raymond (2003) showed that, in the long term, the new agro-industry fostered the adoption of improved production technology, such as new varieties to increase cassava yields. About 77% of cassava farmers in the region adopted the variety Venezolana, and 5% the variety MP-12. On the average, cassava farmers also planted 82% of their cassava area to modern varieties. Gottret and Raymond (2003) concluded that the existence of a drying plant in the community, but more importantly, the proximity of the farmer's field to the nearest drying plant, has a positive impact on the adoption of modern varieties. This result captures two possible effects of the drying plant on technology adoption. The first is related to the new market alternative and more stable fresh prices that, as discussed previously, gave farmers an incentive to increase their production by either increasing the area planted, or adopting new technology to increase yields. The other effect of the drying plant was to enhance technology diffusion in three ways. First, technological development programs found cassava-drying cooperatives to be natural partners for technology diffusion by allowing them to reach more farmers. Cassava farmer associations also fostered farmer-to-farmer networking, which was found in previous adoption studies to be a major source of technology diffusion (Henry et al., 1994). Further, a major constraint to adoption—availability of planting material—was partially overcome by the cooperatives that established seed multiplication plots.

The presence of technology development projects implemented by cassava research institutions in their municipality also influenced the adoption decision. The percentage of cassava area planted to modern varieties was therefore higher when at least one of these projects was active in the municipality.

Finally, the opportunity costs that farmers faced of working off-farm also had an impact on the adoption. The higher the agricultural wage in the municipality, the lower the importance of cassava cropping as an income-generation activity for the farmer and, consequently, farmers who grew cassava mainly for on-farm consumption had fewer incentives to increase cassava yields by adopting modern varieties.

This analysis allows us to conclude that the cassava-drying agro-industry influenced the adoption of modern varieties both directly and indirectly. It also provided a more secure market and a platform for diffusing technology and planting material. Adoption was also encouraged by the presence of technology research and development projects in the communities. Therefore, the presence of institutions, and the presence of and access to drying plants, each played an important role in the adoption of modern varieties.

Making a difference for the poor

In the early 1980s, the Colombian North Coast was characterized by poverty levels that were higher than the national ones: 76% of the population had unsatisfied basic needs compared with 64% at the national level, and 55% were living in absolute poverty compared with 36% at the national level (DANE, 1985). The small-scale farmers targeted by the ICRD Project were therefore among the poorest populations of the region, already poor by national standards. Can a project like the ICRD help alleviate poverty?

Results from Gottret and Raymond (2003) showed that the ICRD Project contributed to poverty reduction. It did so, not directly through the emergence of cassava-drying cooperatives, but through the provision of new production technology and its diffusion as captured by its adoption. The higher the percentage of cassava area planted to modern varieties in a municipality, the greater was the reduction in poverty.

An economic surplus model, applied to the ICRD Project by Gottret et al (1994), which shows the distribution of returns among the different groups of society, supports the above results. The study concluded that the direct benefits generated by the processing technology were US$1.6 million during the 1984-91 period (8.5% of total benefits). However, it was the indirect impact of the agro-industry on the adoption of improved cassava production technology that generated most of the economic surplus, estimated at US$18.6 million.

Beyond what these results can explain, the project had other direct impacts on poverty in the communities that built drying plants. It created employment, stabilized incomes, and the plants provided informal credit, with which farmers could buy durable goods or face health needs, and permitted the accumulation of capital goods such as cattle, which most farmers aim to own (see Box 3).

Box 3

Further comments by cassava farmers in San Juan de Betulia, Sucre, 1999

"There's been a big change since the drying plant was built. Before, labor was only used for cassava cropping (planting, weeding, and harvesting). Now things are different, and see the income that the crop generates for the community! A farmer eats from cassava if he harvests it, transports it to the drying plant, works in the drying plant, processes it, grinds it, sells it, or even owns the truck that takes it to the feed plant. This is a source of employment and income..."

"... a few years ago, in my house there was no television, no refrigerator, or stove. I didn't have money to buy shoes for my children or send them to school. Now, I don't have that much money, but if I need some, I can go to the drying plant manager and ask him to give me some in advance in exchange for cassava, and he will lend me the money."

Moreover, income generated from cassava cropping improved the well being of rural households (see Box 4).

Box 4

Comments of Don Carlos, cassava farmer and cooperative member of Segovia, Sampués, Sucre, 1999

"Before, our situation was critical. We only had one pair of pants each; we were all day workers. For example, we didn't eat three meals a day. If we had breakfast, we didn't have lunch. And now, I said that there was a change. If you walk around the village, you can see that almost all the houses are built of brick and cement. The village has a water supply and part of the village has a sewage system, and all of this we got with the little we earned. We don't live in adobe houses anymore, where you could see the beds from outside. The hammocks used to be made with jute, and now we have at least a more comfortable bed. Now we have money to send the children to school and to dress them, to buy shoes and socks, and we have enough to eat three meals too... and well... sometimes we even have enough to buy some beers..."

In conclusion, the ICRD Project directly and indirectly reduced poverty by creating an alternative income-generation activity through selling roots, creating employment, and reducing production costs through improved production technology. The organization of communities around a tangible activity that generates income and employment also fostered existing levels of social and human capital, and therefore further empowered the communities.

The Latent Period (1994-2000)

Four years after the ICRD Project officially ended, some institutional support for cassava continued in the region, but was terminated after 1993. During the 1990s, the Colombian government moved toward a neo-liberal economic system, opening the economy to international competition at the same time that developed countries maintained and even increased their subsidies to agricultural production, generating export surpluses. As a result, the Colombian government permitted massive imports of grains to attend the growing demand for raw materials for its feed industry, reaching levels of 1 million tons per year. Thus, the price of dry cassava chips that was pegged to the price of grains decreased at an annual rate of 5.5% between 1993 and 1999 (Figure 4). This situation made the cassava drying agro-industry noncompetitive. Prices of cassava roots paid by the agro-industry decreased at annual rates of 4.4%, and by the fresh market at 5.0%, between 1990 and 1999 (Figure 2). Producers responded by decreasing the area planted to cassava, and by not making any further investments to increase yields, Area planted to cassava decreased between 1993-2000 at an annual rate of 1.3%, and yields remained unchanged (Figure 3).

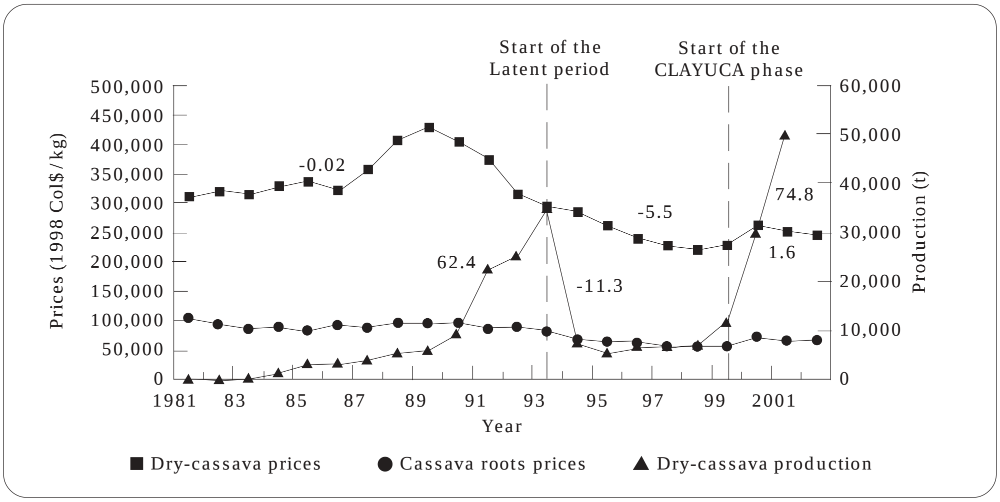

Figure 4. Trends in cassava prices and dried cassava production in the North Coast of Colombia, 1981-1999. Prices are based on the 1990 Colombian peso. (CLAYUCA is the Spanish acronym for the Latin American and Caribbean Consortium to Support Cassava Research and Development.)

During the same period, the collapse of institutional support eliminated the availability of credit at low interest rates for use as working capital. These two shocks, combined with the lack of accumulation of working capital by most associations, forced 28% of the cassava drying plants to stop processing between 1992 and 1993. Eight cassava associations also closed down because their members were displaced by political violence in their communities. Hence, dried cassava production dropped from 35,000 tons in 1993 to only 7,000 tons in 1994 (Figure 4).

Despite the drastic reduction in external support, some farmer groups and small entrepreneurs continued making innovations. Processing technology was kept simple, small-scale, and low investment, but simple innovations were made to reduce labor needs and decrease processing costs. The organizational innovation continued to shift from farmer cooperatives to small-scale, entrepreneur-owned agro-industries, reducing administrative costs. Also, a new market outlet was developed that targeted local poultry and pig producers with substantial reduction in transaction and transportation costs.

In 1999, even though cassava farmers had faced major shocks to the dry cassava agro-industry, 56 cassava-drying plants were still operating. Of these, 43 belong to small farmer cooperatives, although 15 rented their plant to individual entrepreneurs. Figure 5 also shows that dry cassava production increased again in the late 1990s as grain imports became more expensive because of the devaluation of the Colombian peso. These results show that the sustainability of the program is highly dependent on the macroeconomic environment, which directly affects the viability of the developed marketing alternative.

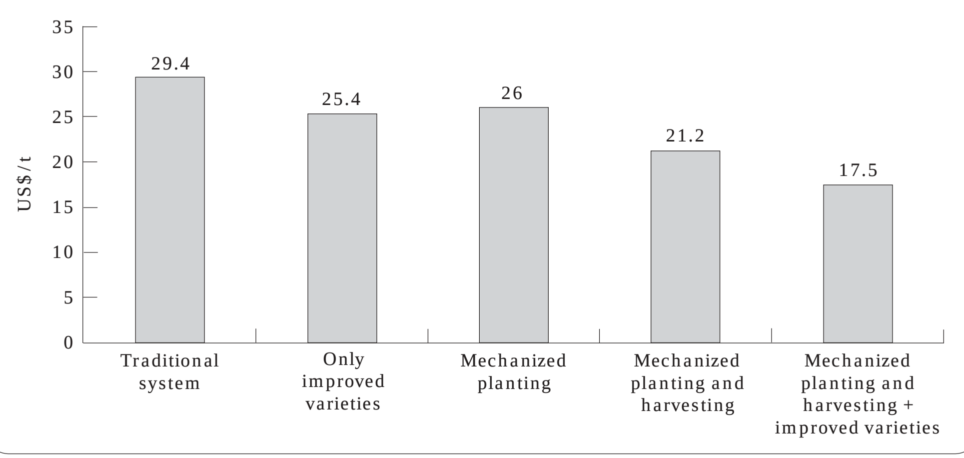

Figure 5. Cost reduction effect with different technology adoption scenarios, North Coast of Colombia, 2002 (taken from Pachico et al., 2001).

The CLAYUCA Period (2000 to date)

In the late 1990s and the beginning of the twenty first century, a new approach to cassava R&D was proposed by CIAT and collaborating institutions, in order to confront the urgent need to achieve a greater level of competitiveness in the cassava sector, without marginalizing the small-scale cassava producer from the process. This new approach, identified in this chapter as the "CLAYUCA model", has been based in the establishment of strategic alliances and partnerships between cassava farmer groups, and the private and public sectors. In 1999, CLAYUCA was formed as a regional planning and coordination mechanism for the cassava sector in the region.

Political and economic environment of Colombia from 2000 to date

During the period of establishment of CLAYUCA, some important changes had occurred in the economic environment of Colombia. With the help of massive amounts of subsidies in developed countries, prices of imported cereals were very favorable compared with prices of locally produced products. However, because of the devaluation of the Colombian currency, it became more expensive to import agricultural products, and policies to support local production of raw materials became a feasible strategy to reduce costs. The Colombian poultry industry is a good example to illustrate this situation. Despite the impressive growth rates that this sector has experienced during the last decade, with annual growth rates near 8% average, its dependency on imported cereals to be used as raw materials in the preparation of balanced feeds has increased dramatically, reaching levels of around 2 million tons per year in 2002. This increasing dependency was considered a threat for the sustainable development of the sector, and they decided to support the search for alternatives. One of the options considered was the cassava crop, a potential carbohydrate source that can be used competitively as a partial energetic substitute of cereals.

The interest of the private sector in the cassava crop was seconded by the public sector, which through the Ministry of Agriculture and Rural Development (MADR, the Spanish acronym) supported the formulation and implementation of strategic alliances with the private sector and with the participation of farmer groups. Thus, the public sector regained its importance with a new role as facilitator and co-founder of these alliances. Colombia became the original ground on which the CLAYUCA model started to form.

The public sector was seeking at the same time a more active participation in regional and bilateral trade agreements, fully convinced of the need to strengthen the competitiveness of the agricultural sector.

Cassava in Colombia from 2000 to date

At the start of the CLAYUCA period, with the renewed importance gained by the cassava crop as a multiple-uses carbohydrate source, the prices of the crop in both the fresh consumption and the industrial markets started to react positively. During the period 1999-2002, cassava prices in the fresh market in Colombia were growing at a rate of 11.2% per year, a significant increase after a decade of negative growth. Conversely, prices in the industrial market (dry cassava chips) were almost static, but were not decreasing.

The production of dry cassava chips during this period also presented a dramatic increase, with many small-scale agro-industries operating, located especially in the Atlantic Coast of Colombia, motivated by the growing demand and the increased prices. The volume of dry cassava chips produced in 2001 was estimated at 50,000 tons, an increase of 74.8% in comparison with previous years. Prices for dry cassava chips also presented a positive increase, growing at a rate of 1.6% during this period, after previous years presenting negative growth rates (Figure 4).

CIAT from 2000 to date

The changes that occurred in the macro environment and context in which CLAYUCA was formed also affected CIAT. During the late 1990s, the Center implemented a shift from its commodity-based programs to agro-ecosystem-based programs that were afterwards accompanied by an organizational restructuring from programs to a project portfolio, which in the case of the cassava crop affected the synergies and close relationships that CIAT had built with cassava-producing countries in the region. These changes meant a scattering around projects of the former multidisciplinary cassava research team as well as of their activities.

The model for cassava research used by CIAT and collaborating institutions in the region during the decades of the 1970s to 1990s was financed mainly with public sector funds. During the early 2000s, many public-sector institutions went through radical changes. Also, in the international donor community, competition for funding was stronger and among an increased number of players. Countries and institutions interested in cassava in the region felt the need to organize and form strategic alliances that could lead to the establishment of new models for financing and supporting cassava R&D activities. Catalyzing upon this felt need, CIAT proposed to cassava-producing countries in the region the formation of the CLAYUCA Consortium in April 1999.

Justification and rationale for the new model

The establishment of joint effort mechanisms between the public and the private sector to support cassava R&D activities is justified on the grounds that it allows countries to have more control of the research agendas and the benefits obtained. The investors gain control and assume responsibilities on the agenda, which becomes a regional agenda. The Consortium acts as a mechanism that facilitates access to technology according to user demands, common interests, and prioritized problems.

CIAT does not control the definition of the agenda, but has a new role as an active participant in its definition and implementation. The public and private sector also have new roles as co-funders and co-innovators in early stages of the innovation process.

The work of the Consortium goes beyond the traditional research domain and becomes a regional forum.

The CLAYUCA institutional model

The principles upon which the CLAYUCA institutional model has been established are:

- A regional, multi-country effort: The Consortium is working as a network that promotes integration of efforts among cassava producing countries in the region.
- Organized participation of public and private sector institutions, including universities, nongovernmental organizations, and farmer groups: Opposed to the traditional model of the public sector controlling research activities at country level, the CLAYUCA approach promotes active participation of the private sector, assuming leading and coordination roles.
- Common agenda based on prioritized problems: All participants in the Consortium are allowed to include their own needs and problems. Stakeholders own the agenda.
- Collaborative, participatory planning and implementation of the agenda in each country member: Planning of activities of the Consortium in each country is autonomous; everyone participates.
- Self-financed, autonomous operation: Each country and each member has to contribute for the financial operation of the Consortium.
- Competitiveness: The cassava crop faces tremendous challenges to establish and strengthen new markets. These new market opportunities demand that crop production and processing systems be competitive.

The cassava market situation from 2000 to date

New, increasing market opportunities for the cassava crop have appeared in 2000. The poultry sector, and in general the animal production and balanced feeds sectors, have been experiencing very high growth rates throughout the 1990s. Local production of cereals and other raw materials has been insufficient to meet this market expansion, thus creating an unsatisfied demand.

The import of cereals for use in animal balanced feed has increased constantly during the last decade. In 2001, an estimated 2 million tons of maize (*Zea mays* L.) were imported into Colombia, for use in the animal balanced feeds industry. Additionally, new market opportunities were developing and strengthening for the cassava crop, around new, higher value products, especially in the fresh market, starches, and other industrial uses. When the technological innovation (dry cassava chips) was first introduced in Colombia back in the 1980s, the volume of imported cereals in the country was around 200,000 tons per year. Two decades later, this volume has increased tenfold, yet the supply of the dry cassava sector has remained almost the same. To meet these new growing demands, technological as well as organizational and institutional changes were needed. A second generation of best-bet innovations has to be put in place.

Second best-bet technological prototype: Processing

Different from the technology introduced from Thailand during the 1980s, based on large cement floors and natural solar drying technology, the option that CLAYUCA is following in Latin America and the Caribbean is based on the development of an artificial drying system, a medium-scale processing capacity of around 50 to 70 tons of fresh cassava roots per day. This technology implies a higher level of complexity, allows getting a better nutritional quality of the final product (cassava dry chips or flour), and the yearly output is also higher—5500 to 8000 tons per year depending on whether the processing plants operate under two or three shifts schemes (16 or 24 hours per day). Another very important parameter for efficiency of the processing units is the availability of supply of cassava roots on an all-year-round basis.

The difference also occurs in the size of the investment. The relation of prices needed to build one processing plant based on artificial drying technology, and one based on solar natural drying, is of around 5 to 1. For example, to produce 40,000 of dry cassava chips, 128,000 m^2 of cement floor are needed, and the total investment would be about US$3.2 million. To produce the same volume, four drying plants based on artificial technology will be needed, and the total investment would be about US$600,000.

Second best-bet technological prototype: Mechanization

Important advances have been made during the last decade on the adaptation and validation of mechanized planting and harvesting systems for cassava. In the case of planting, prototypes that allow planting efficiencies of around 1 ha per hour with three workers are now available in the market. In traditional cassava production systems, with manual planting, a total of 12 workers are needed.

In the case of harvesting, one of the activities that demands more labor force in cassava production—the use of prototypes available for semi-mechanized harvesting of the roots—greatly improves the performance of the labor force. The use of the harvesters allows efficiencies of about 800 to 1000 kg harvested per day per person, whereas in the traditional system with manual harvesting the efficiencies obtained rarely exceed 400 kg harvested per person per day.

Second best-bet technological prototype: Germplasm

CIAT has been implementing some changes in its cassava scheme aimed at generating clones specifically adapted to agro-industrial uses and to the edapho-climatic conditions of the most important cassava growing regions of Colombia. As a result, new cultivars are available with higher yielding potential. Productivities of around 20 to 30 tons per hectare are an achievable target. These improved cassava varieties are obtained more easily by farmers through projects that CIAT is implementing with financial support from MADR, and active collaboration of public institutions and private industries.

Despite the strong emphasis in the development of industrial varieties suited for new uses and processes, the efforts at CIAT for developing varieties suited to the traditional fresh markets have been maintained.

The combination of the second generation of best-bet technological prototypes and innovations has the potential to facilitate the development of lower cost, more productive, and more competitive cassava systems that could generate additional employment and income opportunities for cassava farmers.

Studies made at CIAT and CLAYUCA (Pachico et al., 2001) to estimate the cost reduction effect of using different technology adoption scenarios indicate that the costs of the traditional cassava production systems can be lowered 13.6% by the introduction of improved varieties, 11.6% by introducing mechanized sowing, and 27.9% by introducing mechanized sowing and harvesting. The net effect of the three technologies combined, could give a total reduction in cassava production costs of 40.5% (Figure 5).

Second best-bet organizational innovation

Additional to the need for a second generation of best-bet technological innovations, the new development scenarios for the cassava crop demanded innovations in the roles and the organizational scheme for the different actors of the cassava agri-food chain.

These new scenarios are based on the promotion of joint ventures between public and private sector institutions and enterprises with the common objective of supporting cassava-based R&D activities. These partnerships do not occur overnight. A good solid initial thrust needs to be developed.

The private sector recognizes the importance of sharing responsibilities and risks in supporting and financing research activities, but at the same time, it clearly recognizes the benefits it will receive. It is also very important in securing the market.

The presence and active participation of the public sector is a very important component of these partnerships. It has a strong capillarity, and a wealth of knowledge and information about the appropriateness and adaptation of the technologies. It also plays an important role as supplier of risk funds and facilitator of the process.

Farmer groups participate as in-kind investors, contributing with their land and cassava production plots. The new partnerships allow them to gradually become co-owners of the agro-industrial enterprises. In some of the new joint venture enterprises that were being established in Colombia during 2002 (Figure 6), farmers groups were given the opportunity of acquiring shares of the agro-industrial enterprise using their lands as the main bargaining instrument. Through these arrangements, these lands will be used for the enterprise for a given number of years, and farmers will be given a proportion of the revenues. After some years, they will be given the chance to acquire the shares that belong to the public sector. The private sector, for example the poultry sector, was also participating with a percentage of the total investment.

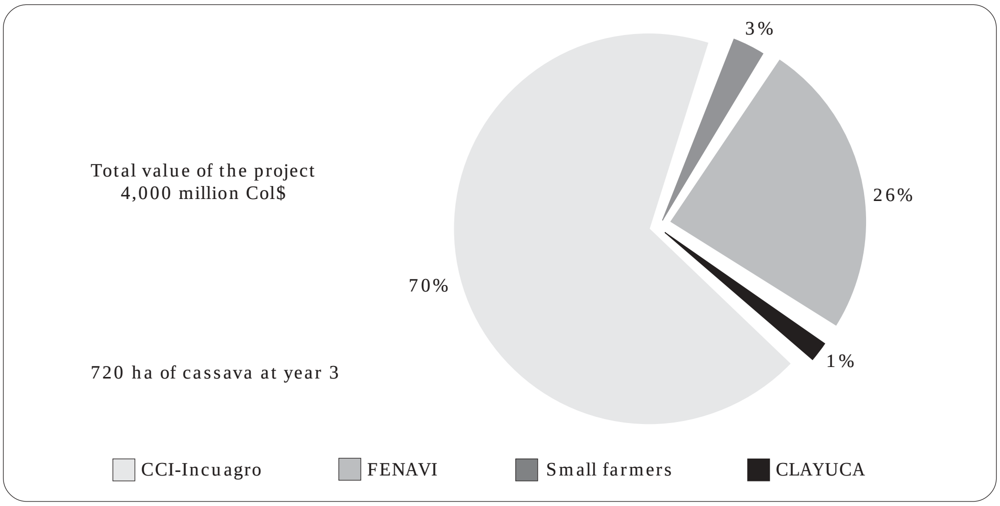

Figure 6. Second best-bet organizational innovation: An example of a joint venture organizational scheme. (From information from the Latin American and Caribbean Consortium to Support Cassava Research and Development [CLAYUCA, Revista Agricultural]; CCI = Corporación Colombia Internacional; FENAVI = Federación Nacional de Avicultores de Colombia.)

Social actors and their roles in the innovation process

The different actors also have had to learn and perform new roles in the development scenarios that have emerged for the cassava crop. The private sector now has a more active role in the definition of the priorities and the agendas. It provides financial support as co-investor, but also acts as co-innovator at early stages of the technology innovation process. One of the more important roles it performs is that of product champion, considering the strong lobbying capacity that it has to attract support from the public sector (see Box 5).

Box 5

Comments of Diego Miguel Sierra, Executive President, Colombian Poultry Growers Federation; President, Executive Committee, CLAYUCA, 2002

"We came to CIAT 5 years ago in search of its work in cassava and started the work with a seed multiplication agreement. One year later, CLAYUCA was created with the support of CIAT. The poultry production business depends highly on animal feed costs, and this year Colombia is importing 1.5 million tons of maize and 400 thousand tons of soybeans. With CIAT, CLAYUCA, and the Ministry of Agriculture, we started constructing two plants with funds from the private sector and cassava farmers. In early 2004, we expect to have dry cassava for the poultry sector. These are our immediate goals... to use tropical raw materials for the poultry sector as a competitive option, and this is becoming feasible thanks to the cooperation with CLAYUCA and CIAT."

The public sector is playing new roles in co-funding and facilitating the innovation process. The formulation and implementation of policies for the agricultural sector, for example the competitive agreements strategy, also helps consolidate public-private partnerships. During the period 1999 to 2002, in Colombia, the Ministry of Agriculture invested nearly US$1.5 million directly in cassava R&D activities. This support helped to consolidate the efforts of the private sector and the farmer groups, and to make it easier to generate the technological innovations that were required.

Farmer groups also perform new roles. Their participation is crucial as co-investors in the joint venture enterprises. They enter in the joint venture with their land, thus guaranteeing the supply of raw material for the new processing enterprises. They also work to strengthen their links with the other actors of the agri-food chain. They act as adapters and adopters of the technological innovations. Gradually, they may become owners and get full control of the processing units. They have direct participation in the Board of the processing enterprises.

For the donor community, the public-private partnerships are an attractive model to support and to mobilize resources. The fact that the model is based on competitiveness, has joint efforts from public and private sectors, and is regional, becomes very important. Also, the active participation of the farmer groups gives the donors a guarantee of addressing the more needed sectors. Finally, the participation of a Consultative Group Center facilitates the design, generation, validation, and transfer of improved, sustainable technologies.

Reflections on Enabling and Scaling Innovation

A key factor for enabling innovation effectively in the case presented has been the proper and timely combination of a set of market, organizational, and technological innovations. As has been shown in the analysis of 2 decades of cassava innovation, the political, economic, and social environment had a strong influence on enabling/disabling innovation processes as well as on the effectiveness of scaling out and up efforts. Thus, innovation-enabling strategies should be contextualized and flexible enough to be adjusted accordingly. A “champion” with a strongly felt need, genuine interest, trustworthiness, and enough lobbying capacity to mobilize resources is key for the effectiveness of the innovation process and its scaling out and up. Despite the downsizing of the public sector in most developing countries, its involvement, active participation, and commitment is key for effective scaling out and up of innovation processes. Through 2 decades of innovation in cassava, networking among farmer groups along the agri-food chain and with support organizations has been an important feature for its relative success even under different institutional models and economic, political, and social environments. Feedback and evaluation mechanisms are key for providing essential information for adjusting and refining innovation-enabling strategies, and for facilitating the establishment of a learning community.

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PART THREE

Scaling Out for Impact: Natural Resource Management

Editorial Comments

The third section turns to the scaling up and scaling out of natural resource management (NRM) research. In the cases presented, NRM includes work on integrated pest management (IPM), watershed management, and soil fertility management.

Two chapters, one by Ampofo et al. and another by Morales, deal with IPM; and both describe how impacts were achieved through researcher-farmer partnerships in which the former contributed needed science-based information and the latter provided local adaptation of technologies to the degree that the finally resulting, innovations were adoptable and widely adopted. The chapter by Beltrán et al. discusses how efforts to work at the watershed level were complicated by the need for innovations that worked at higher levels than on-farm, and by the presence of different stakeholders and their differing respective goals and objectives. Although (as the title promises) Ramisch identifies and discusses four obstacles to scaling up integrated soil fertility management, the chapter provides an experience-based conceptual discussion that should be of use to anyone concerned with achievement of impact via the types of agricultural research extant today.

Chapter 8, by **Ampofo et al.**, not only discusses widening adoption of IPM, but also relates an excellent case of combining researcher and farmer knowledge in the solving of bean foliage beetle (*Ootheca bennigseni*) problems.

Scientists worked with farmers on weekly soil and plant sampling. Farmers were able to study the pest's life cycle. Although they were well aware of the beetle as a defoliator, they had not understood that much of the problem resulted from larval damage to the plant root systems. Observations that adults diapaused from August to March dispelled the idea that the rains brought the pest. Participatory experimentation went on to identify needed management innovations. These included crop rotations to break the pest's life cycle, changing sowing dates to avoid peaks in pest emergence, and traditional control measures that varied by site and agroecology. One village used neem (*Azadirachta indica* A. Juss.) extract to control the beetle, while another at higher altitude used cowshed slurry, fermented cow urine, and other botanicals.

Apparently the IPM efforts worked: Between 1998 and 2002 the numbers of farmers involved in Tanzania, Kenya, and Malawi had grown substantially (Table 1 in the chapter).

The chapter then goes on to describe strategy elements to the scaling out: Training, community experimentation, field days, cross-site visits, farmer conferences, drama, printed materials, village information centers, training of trainers, activities in secondary schools, churches, and mosques, and work with local governments.

At this point, the project may want to examine some of the benefits and costs. Certainly the organization of FFSs and related activities is expensive. In terms of benefits, the reduction of beetle damage and the gains in bean production can be documented. Harder to document, but equally or more important, are the gains in human and social capital described in the chapter.

Chapter 9, by **Morales**, similarly and convincingly talks about the need for IPM and the partnering of researchers and farmers. In this case, tropical whitefly is a major crop problem, both as vector of viruses and as a direct crop pest. Farmers in Central America have been moving from cultivation of traditional crops such as maize (*Zea mays* L.), cassava (*Manihot esculenta* Crantz), potato (*Solanum tuberosum* L.), and bean (*Phaseolus vulgaris* L.) to production of higher value market crops. Unfortunately, this trend has occurred at a time when national agricultural research budgets in the region have suffered fatal cuts. Agrochemical companies stepped in, promoting “the indiscriminant use of highly toxic pesticides” that led to pesticide resistance and elimination of natural predators of whitefly. The chapter recounts how farmers and scientists worked together to successfully combat key pests. Researchers provided needed virus characterization that showed that aphids, and not whiteflies, were the key vector; while farmers modified and adapted the researchers’ initial physical barriers to make them more effective and less expensive.

The Tropical Whitefly Project of the Systemwide Program on Integrated Pest Management represents scaling out in that it works in 24 countries around the globe.

Chapter 10, by **Beltrán et al.**, discusses scaling in respect to the “Supermarket of Technology Options for Hillsides” (SOL, the Spanish acronym) and Committees for Local Agricultural Research (CIALs, the Spanish acronym). Scaling out is exemplified by the replication of CIALs—developed in Colombia—in Honduras and Nicaragua. Scaling up is described in terms of establishing SOLs and CIALs in other regions of Honduras and Nicaragua.

The conundrum that the authors implicitly address is more complex. The chapter correctly discusses how different stakeholders within watersheds can have different, often conflicting goals and objectives and how watershed problems cannot be solved (solely) on-farm. Researchers need to help broker different sorts of collaborative agreements among stakeholders. The chapter describes the work of the International Center for Tropical Agriculture (CIAT, the Spanish acronym) with different partners and stakeholders, efforts at capacity building, participation at field sites of different projects, and the involvement of different actors at different project stages.

What remains unclear, however, is: (a) the degree to which CIAT's Communities and Watersheds project (and its CIALs and SOLs) has successfully helped to broker workable agreements among different hostile stakeholders, and (b) the degree to which stakeholders within given watersheds are now working at scales beyond that of the farm, i.e., at the catchment or watershed levels. As progress is made, it would be helpful for the project to document such agreements and collaboration at larger scales. The project would also then be in the position to start to measure the impacts of work in terms of decreases in poverty and increases or maintenance of environmental goods and services.

Ramisch's Chapter 11 is a thought-provoking epistemological treatise, and one based on substantial experience with farmers in Africa.

As a quick preview of the four obstacles and their solutions:

- There may be "clashing expectations" among researchers and different sets of farmers regarding the desirability of scaling up. User interest in scaling up and out, however, depends on the degree to which technologies are client-driven.
- Knowledge- and concept-based innovations, such as integrated soil fertility management, are much more difficult to scale up and out than, say, germplasm. As part of the solution, "…facilitating the spread of knowledge requires clarity about which knowledge is needed in a given context".
- Many successes of integrated management approaches stem from local experimentation, innovation, and serendipity, all difficult to scale up and out. Lower precision technologies that allow for farmer adaptation and innovation are required.
- Complexity increases with the inclusion of multiple scales of action. Effective monitoring and evaluation is needed to be able to track what is happening and why, and to make informed changes.

Although the chapter title refers to obstacles, the authors provide evidence of success in scaling up and out in terms of spontaneous, farmer-led formation of FFSs in western Kenya and eastern Uganda, and in terms of relatively free adoption of certain green manures and improved fallow innovations. Farmer ownership of the learning process and mature farmer-researcher relationships are identified as key to such successes.

Two issues not emphasized by the chapter are perhaps of further interest: Farmers as interested in the final product rather than in the learning process, and farmers as systems ecologists.

Ramisch cites a farmer as saying, “Now that we know that green manures work, we have finished with experimentation… We would like to promote this now so that others can also know the goodness of green manures”. This outlook is not uncommon. Although researchers working on participatory technology development want to help farmers in improving their capabilities in experimentation, learning, and innovation, farmers often are quite satisfied once they obtain “the answer”. Peruvian Amazon farmers wanted and selected new rice (*Oryza sativa* L.) materials via their own experimentation, but were loathe to apply the methods and processes learned to other crops and problems. One (or another) of the barriers faced by farmers in FFSs in eastern Uganda and western Kenya may be the choice and use of the words “school” and “experiment” in local languages: We found that in many cases, “school” was associated with rote learning; while words used for “experiment” were closer in meaning to “demonstration” (Fujisaka et al., 2000).

On the other hand, where Ramisch discusses the difficulties of scaling up complex, systems ecology problems, one is tempted to ask to what degree are farmers themselves systems ecologists in the sense that they generally do not start from a world broken down into disciplinary components for separate analysis and evaluation.

The clarity of the discussions regarding the barriers goes a long way to breaking them down.

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Chapter 8

Scaling Out Integrated Pest Management with Bean Growers: Some Experiences from Eastern and Southern Africa

*James K.O. Ampofo**, *Hendry Mziray**, *Ursula Hollenweger**, *Elianeny M. Minja**, *Said M. Massomo**, and *Edward Ulicky***

Introduction

Integrated pest management (IPM) is a sound approach for dealing with pest problems. It contributes to the reduction of pest damage, lowers costs of plant protection, and reduces or avoids undesirable side effects caused by pesticides, while preserving the production environment from contamination. However, IPM strategies tend to be tailored to local conditions, and technologically sound and effective IPM strategies are not easily transferred across different production systems. This is often because site-specific agro-ecological and socioeconomic conditions often determine what is best at one place (Van Huis, 1997). To improve upon this, several concepts on farmer involvement in technology generation and diffusion have been proposed and tried. The generation of IPM technology is moving from the approach of research station trials, and subsequent transfer of results by the extension system, to one of different levels of farmer participation to ensure greater suitability of the technology to farmers' production circumstances and adoption. The approach also helps reach more farmers with relevant and new technologies more quickly.

In this chapter, we describe the approach and processes we used to develop and scale out IPM strategies for bean pests with smallholder farmers at selected sites in eastern and southern Africa. The approach was designed to capture inherent local knowledge and other resources to enhance IPM technologies, or adapt exotic technology to local production circumstances. The process helped move new knowledge and technology rapidly across environments. Our goal was to help institutionalize IPM at the community level through participatory processes that capture traditional knowledge and local initiatives.

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Methods

The approach was based on:

- Discovery-oriented initiatives, including community experimentation, to identify solutions to specific production problems; and
- Capacity enhancement initiatives: Training activities to enable communities to better manage resources (e.g., adapting available exogenous solutions to local problems).

In all cases, we used every available opportunity to supply relevant products to those that needed them in the target communities.

Participatory learning, technology development, and dissemination

The initial pilot technology development and dissemination process was generated with farming communities in Hai District, northern Tanzania, in collaboration with the District Extension Service of the Ministry of Local Government. The central problem was the "bean foliage beetle" (*Ootheca bennigseni*), a pest that was devastating bean (*Phaseolus vulgaris* L.) crops in the area. This was used as an entry point in the process of developing and scaling out IPM strategies with the local farming communities. Farmers were aware of the pest as a foliage feeder, but did not understand that the larvae damaged the rooting system causing the aboveground symptoms of stunting, yellowing, and premature senescence that farmers often observed. Our chosen approach was learning through participatory hands-on activities: We sampled the soil and plants weekly and studied the pest's life cycle (Figure 1) from adult emergence and foliage feeding through the oviposition in the soil, larval emergence and pupation, together with the effects of larval feeding activities, and back to the adults. We observed that adults diapaused from August until March. This process enabled communities to understand the seasonality of the pest and dispel myths such as: "The insect is brought in by the rain". It was also observed that the pest was restricted to beans and cowpeas (*Vigna unguiculata* [L.] Walp.), and could not develop on other crops within the local fields. The understanding of the pest's biology and ecology enabled farmers to make decisions on measures for control. Further experimentation identified opportunities for management, such as crop rotation to break the pest's life cycle, manipulation of sowing dates to avoid peaks of the pest's emergence, and identification of traditional concoctions for control.

Scaling out strategies

From the experience in Hai, we decided to scale out the IPM strategies to sites where the bean foliage beetle was recorded as a problem hindering bean productivity. The selected sites (Figure 2) were Lushoto district in northern Tanzania, Mbeya Rural in southern Tanzania, Misuku Hills in northern Malawi, Dedza district in central Malawi, and Kisii District in western Kenya. Scaling out strategies were developed for each site through Strengths, Weaknesses, Opportunities, and Threats (SWOT) analyses with all the local stakeholders. The strategies were varied, depending on local resources and opportunities as identified by the stakeholders. We always began with participatory planning activities at the district level, but encouraged each community to adapt the plans to suit their individual opportunities and other prevailing circumstances. At the end of each growing season, individual groups met at the community level to review achievements and failures, and develop strategies to move forward.

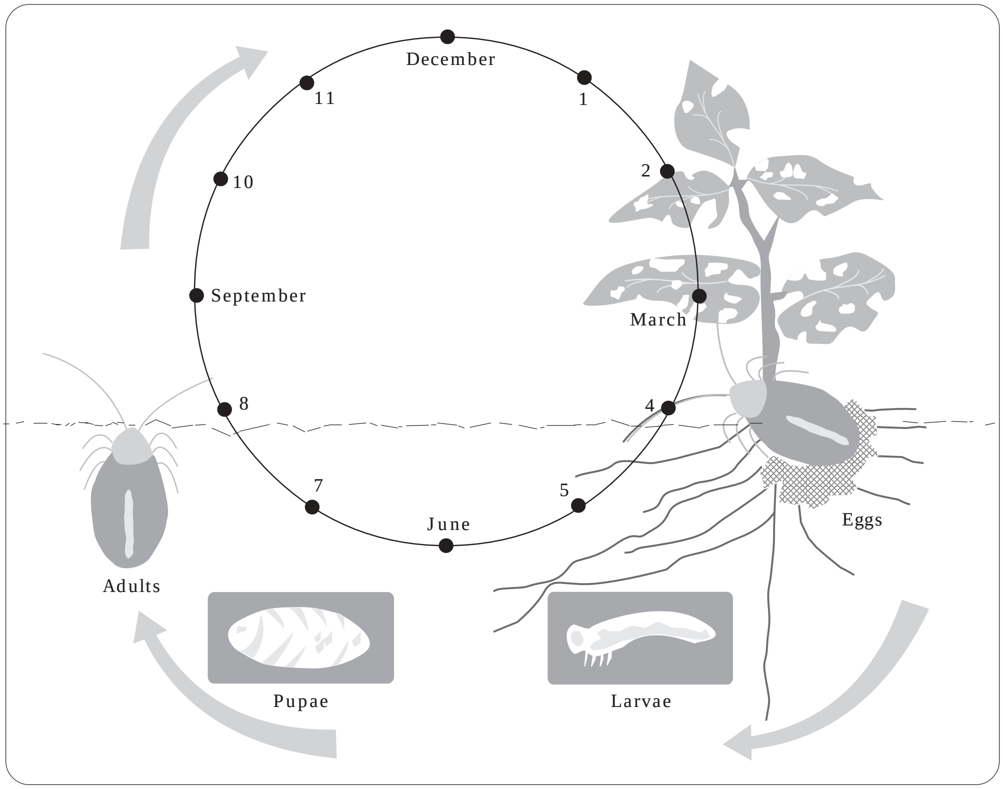

Figure 1. Life cycle of the bean foliage beetle (*Ootheca bennigseni*) in Tanzania.

The groups would also meet with other communities at the district level and share experiences and develop new plans. In this way, the farmers, extension officers, and policymakers received a broader picture of the progress that was being made. It was often interesting to observe how farmers captured their local constraints and opportunities in the planning and execution of activities. A key outcome was that the communities developed a capacity for problem analysis, identification of potential solutions, and opportunities to overcome them. This helped them tackle problems beyond our initial focus, and applied the process to other areas of their daily lives.

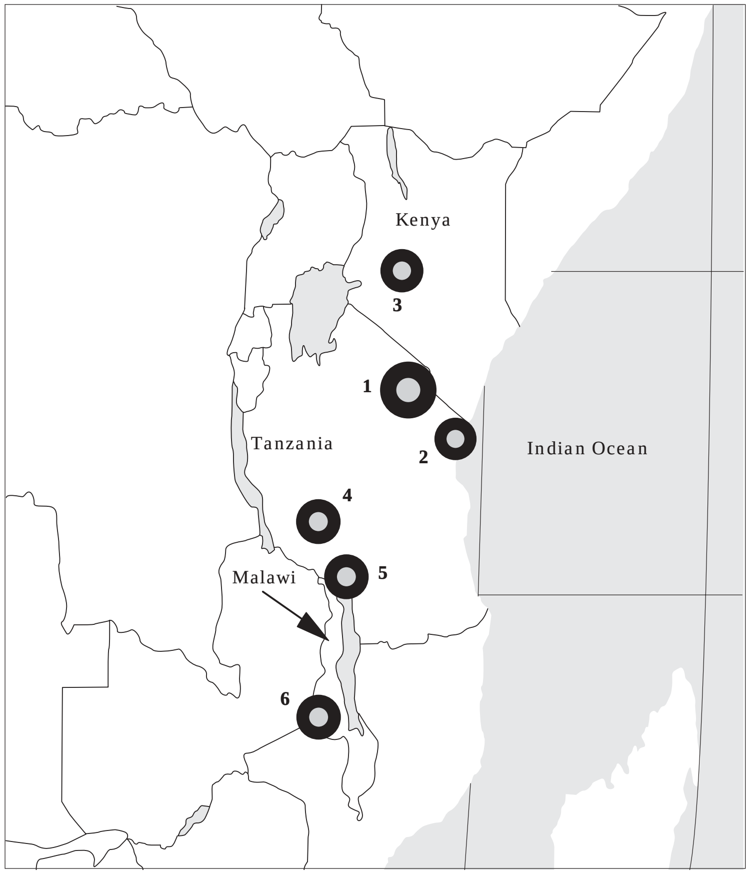

Figure 2. Selected sites for scaling out integrated pest management strategies: (1) Hai District, (2) Lusotho, and (4) Mbeya in Tanzania; (3) Kisii in Kenya; and (5) northern and (6) central Malawi.

A study through questionnaire surveys at field days in Sanya Juu, Hai District, indicated that different groups within the community preferred different dissemination pathways (Figure 3). More of the poorer farmers preferred less time-consuming dissemination processes, such as demonstrations, the mass media (radio), and extension visits, while more of the richer farmers opted for group training activities and seminars. We attribute these differences to the fact that richer farmers are better able to hire farm labor and therefore free themselves for other activities than are poorer farmers, who often hired themselves out to the richer ones.

Community experimentation, demonstrations, and field days. Community experimentation enabled farmers to test and adapt new technologies to suit their own production circumstances. For instance, farmers in Boma N'Gombe village (1020 m) in Hai District identified neem (*Azadirachta indica* A. Juss) extracts for bean foliage beetle control. In Sanya Juu, however, farmers observed that neem could not grow in their environment (1500 m), and therefore opted for a range of alternatives, such as cowshed slurry, fermented cow urine, and other botanicals for experimentation. The logic was that if neem, a plant product, could work, then some of their own traditional medicinal plants and other products could work also.

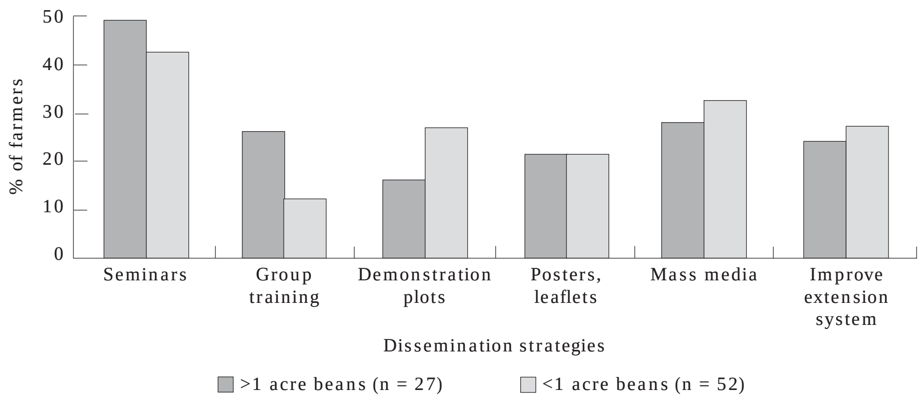

Figure 3. Dissemination pathways preferred by different groups of farmers in Sanya Juu, Hai District, Tanzania, categorized by farm size.

The experiments were installed at several points within the community for evaluation by the members, and as demonstrations for other community members. The experiments had labels describing each treatment. The results were usually obvious to passersby. The farmer research groups, in collaboration with research and extension partners, often held field days at opportune times to share the technology with the entire community. On such occasions, the participating farmers described the research problem, the objective of the experiment(s), the processes and products used, and the results achieved. They would often invite the community to walk through, assess, and discuss their observations. The researchers also often administered questionnaires to all attending the field day to obtain their views and comments for improvement of the entire process. Generally, visiting farmers learned more from the field days, and more easily identified with the explanations given by the participating farmers than by researchers. Several elements were used in the community experimentation process, including collective problem analyses, identification of potential solutions, and experimentation with them. These helped in the confidence building of the farmers, and led to incorporating local ideas and traditional control strategies in the experimentation.

Cross-site visits and farmer conferences. These were often held during the growing season. Farmers from one community or more, sometimes beyond national borders, organized themselves to visit and share experiences with another community (Box 1).

Box 1

Cross-site visits

Farmers from Sanya Juu in Hai District, Kilimanjaro Region, Tanzania, host others from Lushoto district, Tanga Region, Tanzania. Lushoto farmers are experimenting with botanicals for pest management and are also engaged in soil erosion control and integrated nutrient management (INM) studies. They shared these technologies with the Hai farmers and learned from the Hai farmers how to use fermented cow urine for pest control. At the end of their visit, the Hai farmers superimposed the INM strategies they learned on their integrated pest management practices. Farmers from all groups drew synergies from their different activities, and felt more confident about their research as others heard them and accepted their work. The researchers learned about which processes worked well and which ones did not. The process helped to move technologies and experiences across regions.

At such meetings, both hosts and visitors describe the technologies or processes they have used and the outcomes; the whole group discusses and often relates with what they are doing in their own communities. The host group conducts, shows, and describes its experiments and related activities to the visitors, who in turn share what they do. All parties share their experiences, and the groups discuss ways of adaptation of the new technologies under their different production circumstances, and in some cases how to blend them or superimpose one on another. The participants go home with a copy of the proceedings of the conference, and share the new knowledge with their communities.

For many farmers, the process of sharing their technologies and experiences in public, and the acceptance by the general conference, helped boost their confidence to an extent that they were encouraged to learn and share more when they went back home, and to develop farmer networks with a mechanism for information flow and exchange.

Drama. As the farmer research groups became established and gained confidence in their knowledge and the technologies they had generated, they began to assume ownership of the scaling out process, and were prepared to volunteer time and resources for it. They often identified pathways for scaling out that they found suitable to their individual communities. Cultural drama was one of the key pathways used by communities in northern Tanzania. In collaboration with the farmer research groups and local primary and secondary schools, we explored the potential role of drama and other cultural activities in the scaling out of technology among different communities. The messages were developed with the local communities: They composed songs and performed plays with them to create awareness about production problems and opportunities to overcome them (Figure 4). The audience identified with the songs and plays and remembered the messages. The process helped create awareness among the audience and many of them sought to participate in the community learning activities. In Hai District, northern Tanzania, the local administration supported this mode of technology dissemination, and paid for it to be aired over the local radio in order to reach a wider audience.

Figure 4. A group of farmers sharing extension messages through traditional drama and song.

Printed materials. The use of printed materials proved to be a highly useful resource. Researchers developed graphic extension messages based on the new technologies for wider dissemination across communities. They included posters, leaflets, booklets, etc. that were burned onto CD-ROMs and exchanged across the different sites, where they were translated into local languages and disseminated to the farming communities through the different partners. Researchers used the materials to train local extension agents and nongovernmental organization (NGO) field staff, who in turn used them to train farmers. Rural secondary schools also used the materials in teaching agricultural science to students. The availability of such extension materials helped the village extension officers in their delivery to farmers.

Village Information Centers (VICs). Participating farmers from Hai District, in their search for more information, began visiting the research station by the busload to ask for information on various topics. In response, we decided to take the information closer to them through VICs. These were designed as village libraries with agricultural information and contained various IPM as well as other general information that the community felt would benefit it. In some cases, the "library" was expanded to include other subjects, such as health (e.g., Human Immunodeficiency Virus [HIV] awareness), adult education, etc. The VICs were often housed by schools or the local administrative office, and in the absence of a village extension officer, the community appointed an individual who helped explain the contents to needy farmers. The schools also used the information to train students in agricultural science.

Training of trainers. Some farmers volunteered to train their colleagues about new technologies they had acquired, and a great deal of these informal training activities was carried out within the different communities. The researchers started a training program to inform and help develop tools and strategies to enable farmer-trainers and extension agents to perform better. The training activities were based on training needs of the specific communities, and included skill development in problem analysis, and identification of potential solutions and opportunities, but the training materials were shared across communities. Once communities were empowered in this way, several spontaneous community-initiated training activities emerged within many of the sites.

The role of rural secondary schools in the scaling out process. Rural secondary schools were an important dissemination medium. In some districts, about 5 to 10 villages shared a secondary school, and the student population represented all these villages. Teachers and their students participated in the community experiments, and the students took home what they learned and shared it with parents, relatives, and other members of the community. The schools often composed and performed drama activities about the local production problems and opportunities for their management. The teachers also helped in explaining written and other new information to the general community. Students from such schools often remained within the community as farmers (full or part time), and it is anticipated that the capacity they developed through the IPM development and scaling out processes will continue to benefit them and their communities.

Churches, mosques, and other places of worship. Announcements about the new technologies were made in various places of worship and at other gatherings, and helped inform and create awareness among the local communities about the IPM activities, technologies that were being disseminated, and where to get information.

Partnerships. The scaling out process was greatly enhanced through partnerships with NGOs and other groups such as World Vision (Tanzania), Adventist Development and Relief Agency International (ADRA-Tanzania), Concern Universal (Malawi), and the Ministries of Health and Education (Kenya). These partners developed activities to take the processes and technologies further out to their own areas of operation with their own resources. In Tanzania, ADRA helped to translate booklets from English into Kiswahili, and World Vision raised funds for their publication and dissemination. Concern Universal took the technologies and the processes used to their focus areas in Dedza district and other parts of central Malawi. In Kenya, the Ministries of Health and Education provided other publications on HIV awareness and adult education for the VICs. This helped increase and popularize the VICs in the target areas.

Policy effect on the rate of diffusion. The rate of diffusion was influenced by local government policy as well as local community behavior. In Tanzania, the extension service is a part of the Ministry of Local Government, and the involvement of the district administration helped in the mobilization of local resources for the scaling out process (Table 1). The district administration funded some of the costs of the process (e.g., field days and airtime for radio broadcasts). The communities also spontaneously initiated farmer-to-farmer dissemination activities. In Malawi, however, the Ministry of Agriculture has to test and approve technologies before dissemination activities are authorized. This places a check in the system to prevent rampant dissemination of unproven technologies, but it impedes a large-scale participatory technology development and scaling out processes. The rate of diffusion was therefore slower in Malawi than at the other target sites.

Table 1. The rate of spread of the dissemination process for integrated pest management at different locations.

Location	Farmers involved in:	
	1998	2002
Hai District, N. Tanzania	1 group	52 groups in 12 villages; > 800 farmers participating; > 2000 more aware
Lushoto District, N.E. Tanzania	0	~ 300 farmers participating; > 500 more aware
Mbeya Region, S. Tanzania	0	> 100 farmers participating; > 200 more aware
Kisii District, W. Kenya	0	> 700 farmers participating; > 1600 more aware
Central Malawi	0	14 farmers participating; ~ 100 more aware

Issues Contributing to Success

A key issue that enabled success was the mutual trust that was generated among the different partners in the process. Farmers observed that their ideas were valued, and that the agenda was set to focus on their needs and problems. This helped raise their self-confidence and enabled them to take charge of their actions, as well as ownership of the process. They became motivated to:

- Invest their own resources in the process, for example, meet transportation costs to visit other groups and attend conferences.
- Influence policy decisions, for example, farmers from Boma N'Gombe lobbied district administration to pass a byelaw forcing bean growers to adopt IPM strategies. Those that adopted IPM observed that their bean fields had reduced *Ootheca* emergence, but they were getting invasions from fields of non-adopters.

Another success factor was the (hands-on) learning-by-doing process; sampling and discovering diapausing *Ootheca* adults in the soil convinced farmers that the pest did not come with the rains. The knowledge sparked them with ideas for control, some of which were traditional. Finding success with traditional strategies was a confidence booster for the farmers.

Various dissemination pathways (e.g., posters and leaflets, seminars, cross-site visits and farmers' conferences, on-farm demonstrations, and community learning activities) were used to scale out the technologies. Each pathway had a different level of demand on local resources, researcher time, and costs, but these need to be assessed for benefit/cost efficiencies for better decision making and resource management. The communities often assessed their local resources and opportunities, and decided on the appropriate pathways for them.

In northern Tanzania, IPM appears to have permeated the different sectors of society, involving schools, religious institutions, policymakers, and various sectors of civil society, as observed in Gerung, Indonesia (Dilts, 2001). Different ethnic or social groups tend to identify with different technologies, for instance, traditional technologies of the Maasai and the Wameru in Hai District appeared to be based on animal products such as cow urine and cowshed slurry, while those of the Wasambaa in Lushoto district were more plant related. Recent social interchange and widespread technology diffusion may have diluted this, but it will be useful to understand the relationship between culture and traditional technology; this will help in rapid adoption and scaling out of technologies.

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Chapter 9

Integrating Integrated Pest Management and Sustainable Livelihoods in Central America

*Francisco J. Morales**

Introduction

The whitefly (*Bemisia tabaci*) is a major crop problem in the lowlands and mid-altitude valleys of Central America, both as a direct pest and as a vector of numerous plant viruses. The socioeconomic importance of these pest problems has been magnified by the introduction of high-value crops, such as tomato (*Lycopersicon esculentum* Mill.), cucurbits (Cucurbitaceae), and peppers (*Capsicum* spp.), in agricultural regions planted to traditional food crops, such as maize (*Zea mays* L.) and common bean (*Phaseolus vulgaris* L.). The new crops are highly susceptible to both the whitefly pest and the viruses it transmits, and the small-scale farmers who are trying to maximize their income from their limited land resources do not have technical assistance for the new horticultural crops. As a result, agro-chemical companies have been able to promote chemical control as the only crop protection alternative available. The intensive use and abuse of insecticides to control the whitefly problem has only aggravated crop losses due to the development of pesticide resistance in *B. tabaci* and the elimination of natural predators of the whitefly (e.g., spiders and beneficial insects). The Tropical Whitefly Project (TWFP) conducts collaborative research in Central America to implement integrated pest management (IPM) practices to control whitefly pests using environmentally friendly control measures. IPM is regarded as a sustainable approach to control pests in mixed cropping systems, and thus maximize the income of small-scale farmers.

This chapter presents partial results obtained during the development of the TWFP, which represents an advanced concept of "scaling out" considering that its research activities span 24 countries in the Americas, Africa, and Asia (IITA, 2000). The chapter also includes some personal observations regarding the contribution of this subproject to the

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Consultative Group on International Agricultural Research (CGIAR) goals of alleviating hunger and poverty in developing nations. The work conducted in Central America has been financed by the Danish International Development Agency (DANIDA), the United States Department of Agriculture (USDA) and, currently, by the United Kingdom's Department for International Development (DFID). The DFID Crop Protection Program considers IPM practices "an essential part of a holistic approach to crop improvement, which substantially contributes to poverty elimination, enhanced livelihood security, and reduced environmental degradation" (Sweetmore et al., 2000).

One of the central discussion points at the International Center for Tropical Agriculture (CIAT, the Spanish acronym) 2002 Annual Review was: How can we can bring about a lasting impact on the lives of the rural poor, knowing that even relevant technology may fail to accomplish this objective because of low levels of adoption. Indeed, one of the main obstacles to improving the livelihood of the rural poor has been the implementation of "top-down" approaches to research and development (R&D), which often fail to take into consideration the end-users. Also, it is desirable to follow a "systems approach", to include the socioeconomic and biophysical factors that affect small-scale farmers (Menter et al., this volume).

Perhaps the main challenge faced by the international centers located in Latin America is to evolve from the founding R&D goals of the 1960s, when traditional crops (e.g., maize, cassava [*Manihot esculenta* Crantz], potato [*Solanum tuberosum* L.], and bean) occupied most of the agricultural land. For the past 2 decades, most small-scale farmers have been trying to transform their marginal subsistence agriculture into more market-oriented mixed cropping systems. Examples are eggplant [*Solanum melongena* L.] and sorghum (*Sorghum bicolor* [L.] Moench) in Haiti; peppers and maize in El Salvador; or tomato, bean, and maize in Guatemala. Figure 1 shows that the area devoted to traditional food crops (i.e., maize, rice [*Oryza sativa* L.], bean, cassava, and potato) in Latin America has not significantly increased (FAO, 1970-2000), despite the fact that (1) the population of this region has more than doubled in the same period, and (2) the increases in productivity achieved do not compensate for the stagnant production trends.

To aggravate this situation, prices for traditional export commodities in Latin America, such as coffee (*Coffea* L.), cotton (*Gossypium hirsutum* L.), and banana (*Musa* spp. L.), have been steadily decreasing over time (Figure 2). In the absence of any significant industrial capacity, Latin America has developed a negative trade balance, only offset by an exponentially growing foreign debt that has been consistently associated with increasing levels of misery in Latin America and other developing nations (CEPAL, 2001).

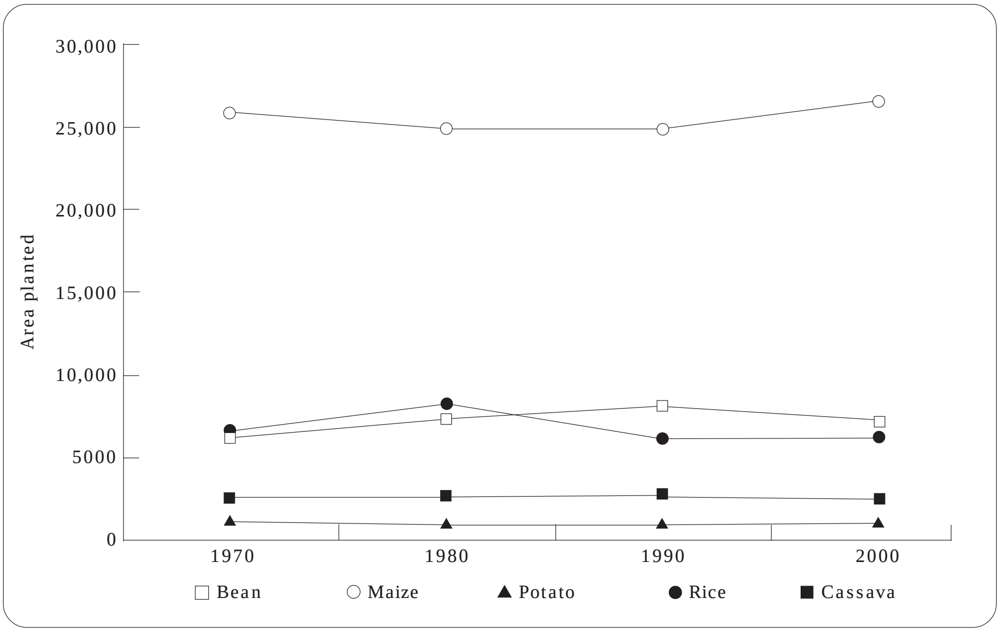

Figure 1. Area ('000 ha) planted to International Agricultural Research Center (IARC) commodities in Latin America.

Figure 2. International price (US$/t) of agricultural commodities, 1978-98.

Since the late 1970s, the main strategy adopted by most Latin and Central American countries to revert this trend has been the promotion of non-traditional export crops, for example, soybean (*Glycine max* [L.] Merr.) in South America, and horticultural crops in Mesoamerica (Thrupp, 1995). Although this effort was initially led by the agro-export sector, many small-scale farmers adopted some of these high-value crops to increase the profitability of their smallholdings. The agro-export companies soon noticed the comparative advantage that small-scale farmers had regarding the availability of family labor, and proceeded to subcontract the production of vegetables with them.

In order to better document this process, a case study (Morales et al., 2000) was conducted in two localities of the Department of Baja Verapaz, Guatemala: San Miguel Chicaj, a predominantly indigenous community with a 50% illiteracy rate, and San Jerónimo, a more progressive *mestizo* community with a 25% illiteracy rate. Figure 3 shows the predominant type of "subsistence" agriculture practiced in the community of San Miguel Chicaj, based on two main staples, maize and bean, and other crops that either enhance their food security (e.g., sorghum) or their income (e.g., peanut [*Arachis hypogaea* L.]). Additionally, this community was beginning to experiment with a high-value crop, tomato, albeit at a very low scale.

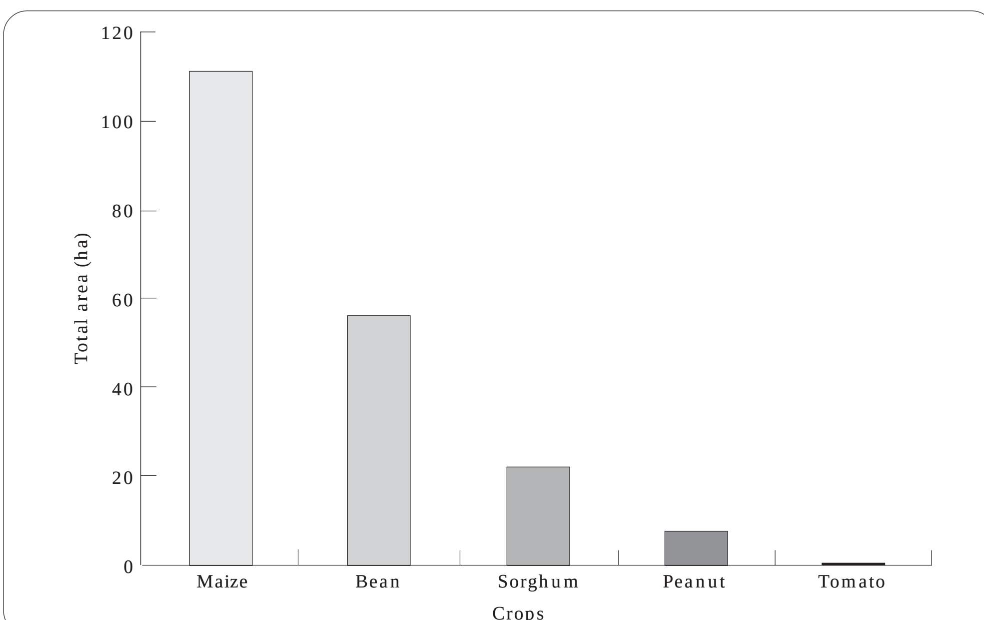

Figure 3. Total area (ha) of predominant crops surveyed in San Miguel Chicaj, Guatemala.

In San Jerónimo (Figure 4), we observe a more market-oriented approach, where high-value crops, namely tomato and cucumber (*Cucumis sativus* L. var. *sativus*), make up a significant proportion of their mixed cropping systems. However, the community does not neglect its food security based on maize and, to a lesser but still significant extent, bean. Chili (*Capsicum annuum* L.) and sweet corn (*Zea mays* L. subsp. *mays*) are also part of their cropping systems as cash crops.

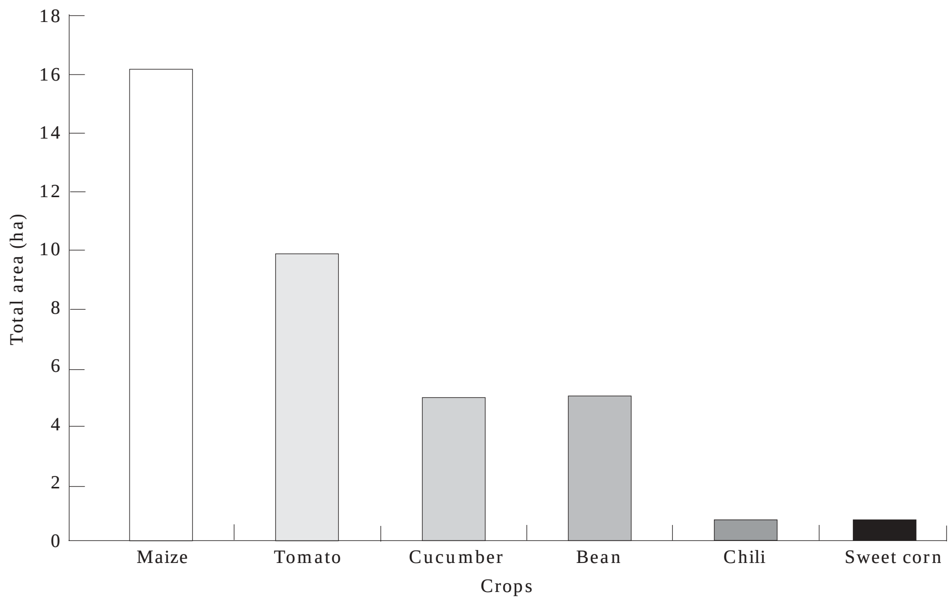

Figure 4. Total area (ha) of predominant crops surveyed in San Jerónimo, Guatemala.

Table 1 shows that even the very conservative strategy of mixed cropping systems adopted by farmers in San Miguel Chicaj places them above the poverty line, even assuming one cropping cycle per year. If they had planted the same area to maize and/or bean, their monthly income would not have exceeded $US70 per month.

Table 1. Revenues (US$) expected from mixed cropping system in two communities of Baja Verapaz, Guatemala.

Crop	San Miguel Chicaj		San Jerónimo	
	Area (ha)	Profit	Area (ha)	Profit
Maize	1.0	147	0.7	103
Bean	0.6	150	0.6	90
Sorghum	0.7	112	0	0
Peanut	0.4	134	0	0
Tomato	0.2	1486	0.5	3714
Cucumber	0	0	0.4	560
Total	2.9	2029	2.2	4467

Unfortunately, this new Green Revolution, in which the international centers did not participate, took place in the middle of the austerity measures imposed by the International Monetary Fund (IMF) in Latin America, which contributed to the financial collapse of most national programs and, consequently, to the ending of free technical assistance. Once small-scale farmers found themselves on their own, they had to resort to the only source of "technical assistance" available to them—the agro-chemical companies. The outcome has been:

(1) The indiscriminate abuse of highly toxic pesticides, often applied to crops on a daily basis until harvest time, and,
(2) The end of the contracts subscribed between exporters and small-scale farmers, because of the high amounts of pesticide residues detected in most of the agricultural produce destined for the US market.

Fortunately for growers who found a more profitable set of crops, and unfortunately for Latin American consumers, the internal market has absorbed this produce because of a significant increase in the consumption of horticultural crops in this region. The widespread abuse of insecticides had additional negative consequences. Whiteflies developed resistance to these chemicals, and soon tomato, pepper, and common bean crops were suffering severe damage from whitefly-transmitted viruses. Table 2 shows what happened to these susceptible crops in our current pilot site, the valley of Zapotitán, El Salvador, particularly during the dry semester of the year, when whitefly populations reach a peak. Basically, a drastic reduction occurred in the total area planted to common bean and horticultural crops, from 1350 ha in the early 1980s, to less than 78 ha in 1999 (Coto, 2000). Currently, up to 55% of the production costs for horticultural crops in Central America corresponds to crop protection. Consequently, one of the main objectives of the whitefly project has been to promote the rational use of pesticides.

Table 2. Dry season land use (ha), Zapotitán, El Salvador.

Crop	1989	1999
Maize	456	780
Bean	175	3
Tomato	153	3
Pepper	35	3
Cucumber	64	68

Methodology and Results

A series of meetings was held with selected farmers to explore the possibility of growing basic food and horticultural crops with minimum pesticide inputs during the dry season and take advantage of:

(1) Higher market prices for most agricultural commodities at the end of the dry season,

(2) The availability of irrigation water (point) in the valley of Zapotitán, and
(3) The availability of land during the 5-month dry period.

In the case of tomato, we introduced the concept of physical barriers, in the form of "micro-tunnels", which consist of fine whitefly-proof mesh over a homemade wire structure. Farmers in El Salvador made different modifications to the micro-tunnels—added pieces of plastic fertilizer bags to lower their cost, and made some tunnels bigger to protect plants longer than the 24 days usually recommended before the removal of the net.

A preliminary analysis of the results showed that:

(1) The unprotected tomato plants were destroyed;
(2) Those plants coming out of the tunnels covered during 24 days survived, but only produced 13 t/ha (60% of the national average); and
(3) The plants in the big tunnels that farmers designed showed excellent development and yields, over 60 t/ha (three times the national average with only two insecticide applications). Discounting the cost of the net and other production costs, the bigger tunnel would have yielded a profit in excess of US$10,000/ha.

Another simple IPM strategy was designed for a native food crop known as *loroco* (*Fernaldia pandurata*) (Apocynaceae) in El Salvador and Guatemala. This vine produces inflorescences that are consumed at the button stage in filled tortillas and even pizzas, and which have a high price in local and international markets (over $US10/lb). A hectare of *loroco* can produce up to US$15,000/year. More important, *loroco* is usually grown in backyards where women mostly tend it as a source of additional income. Unfortunately, *loroco* can also be severely damaged by whiteflies and viruses, which can devastate a *loroco* plantation within a year. However, a virus characterization study conducted at CIAT showed that two different viruses affect this crop in El Salvador, both of which are transmitted by aphids and not by whiteflies. Consequently, whiteflies are being managed as pests and not as virus vectors using biodegradable household soaps dissolved in water, which keep whitefly populations below the damage threshold. Aphid-borne viruses cannot be controlled with pesticides because they are transmitted within seconds. Fortunately, unlike the ground-level-flying whiteflies, aphids select their target plants by flying above crops. Thus, we decided to cover the *loroco* with locally available dry coconut palm leaves as camouflage against aphids. This practice reduced virus incidence and improved plant development, as compared to the uncovered control. Preliminary results show average yield increases of 40% compared to the uncovered controls. With these simple IPM measures, agrochemicals for virus vector control are no longer required in this food crop. We already have a request from the national program of El Salvador to replicate this simple experiment in other regions of the country.

In the case of common bean, we chose an advanced breeding line produced by the Pan American School in Honduras, using sources of virus resistance identified at CIAT. Local farmers had previously evaluated and selected this line as a potential new cultivar. The objective was to show farmers that it is possible to grow beans again in the dry season, with minimum pesticide applications; basically, one vs. up to 20 applications farmers used to apply before they gave up growing beans because of the high incidence of bean golden yellow mosaic virus.

Figure 5 shows the significant potential impact of improved germplasm on the alleviation of hunger and poverty when compared with the last CIAT-bred variety released in El Salvador over a decade ago and the local landrace. This occurred even though we experienced some seed quality problems because of the intense drought conditions and high virus pressure under which this experiment was conducted this year. This new bean line is expected to be rapidly adopted and grown in about one quarter of a million hectares in Central America within the next couple of years.

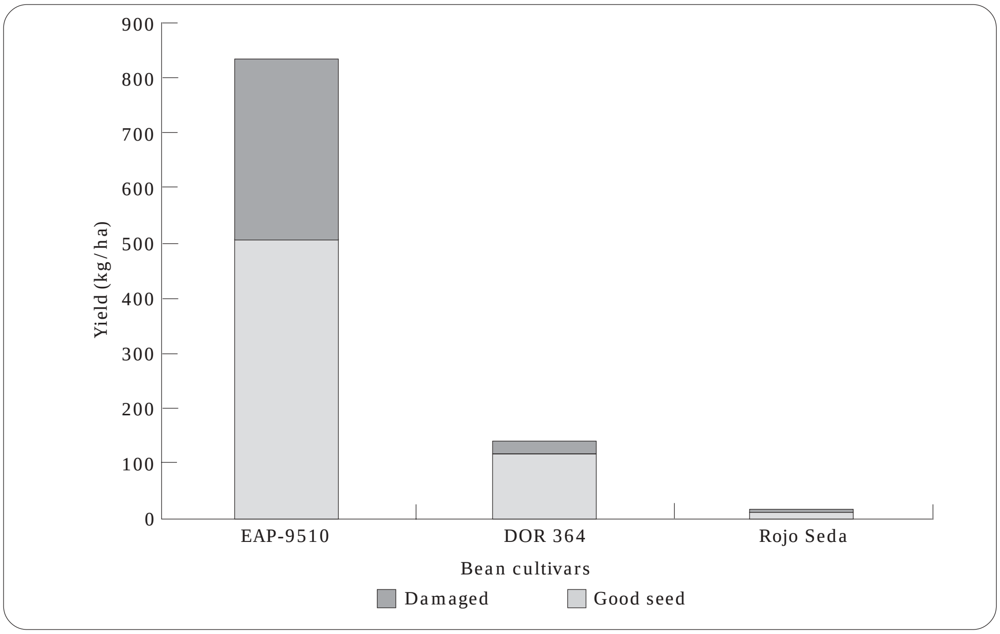

Figure 5. Yield (kg/ha) of three bean cultivars under bean golden yellow mosaic virus in Zapotitán, El Salvador.

Conclusions

These examples show that it is possible to respond to the multiple production problems that small-scale farmers are currently facing without technical assistance, to help them develop sustainable mixed cropping systems that satisfy both their needs to achieve food security and to increase the income derived from their smallholdings. To this end, we have to adopt an integrated "systems" approach, to which scientists from all programs, projects, or disciplines could contribute their expertise in order to improve the livelihoods of over 200 million poor people in Latin America.

Those international centers that still conduct research towards the improvement of major food crops should continue to do so, because this constitutes the basis of food security in developing countries. However, these centers should also reactivate their multi-disciplinary groups to solve production problems specific to the various cropping systems in the regions where these international centers operate, in a sustainable manner. These tasks can be more easily accomplished with the collaboration of national agricultural research programs or other similar organizations active in the R&D arena.

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CHAPTER 10

Scaling Out and Scaling Up—The Importance of Watershed Management Organizations

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Introduction

In this chapter, we examine experiences resulting from the involvement of local organizations, stakeholders, and institutions in the management of watersheds. These experiences focus on the lessons learned and on the principles derived from the reference sites of the Communities and Watersheds Project of the International Center for Tropical Agriculture (CIAT, the Spanish acronym) that allow the increase of scale, especially of organizational type.

In the area of natural resources, individual producers on their own farms cannot solve problems that involve other scales. Thus, to undertake watershed management, the focus should be more on the relationship of people with natural resources (CIAT-Hillsides Group, 2000).

Local organizations are widely recognized as the most important actors of watershed management and are key players in scaling out and scaling up processes, which lead to involving more beneficiaries, in wider geographical areas, and in a quicker, more equitable, and long-lasting manner (Gonsalves, 2001). Local organizations perform other functions, such as:

(1) They can be highly efficient in ensuring that rules are kept with regard to natural resource management (NRM).

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(2) The participation of stakeholders in selecting appropriate technologies at local level promotes their adoption and adaptation in a more efficient way than when external organizations alone are involved.
(3) Non-local entities become more efficient thanks to collaboration with local organizations because the latter reduce overall costs (Ashby et al., 2000).

Therefore, in watershed management, local organizations regulate the use of the resources, serve as a forum to air conflicts between different local interested parties, and act as a channel for the representation of stakeholders within and outside the intervention site when negotiating the use of resources. Local organizations can help promote technological innovation and adopt conservation practices—whether they demand individual or collective action—and can deploy a considerable quantity of resources, in cash or kind, needed for the sustainable management of watersheds.

The Context

In developing countries, watersheds present problems at different scales (farm, microwatershed, subwatershed, and watershed) and capitals (natural, social, human, economic, and financial). One of the most relevant aspects is the problem of organization for NRM (Figure 1).

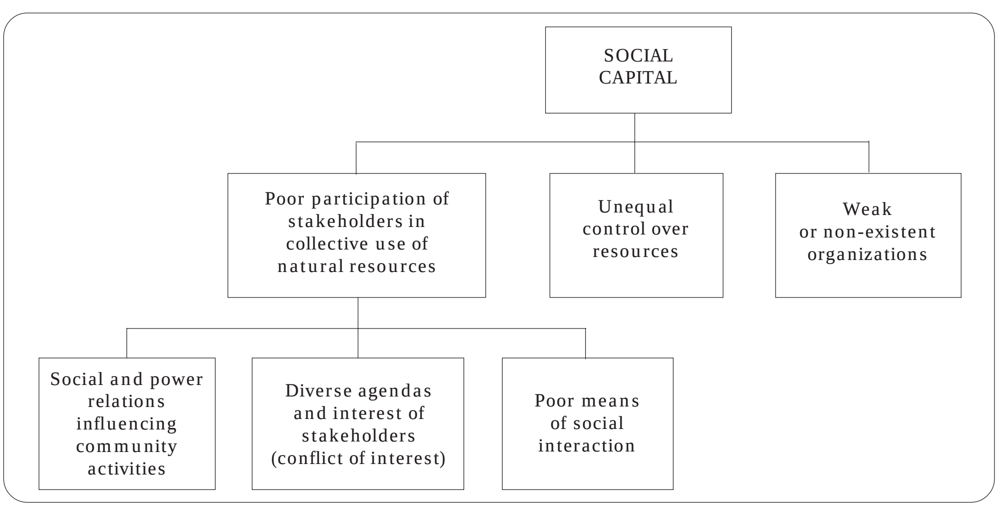

Figure 1. Social capital: Problems and their causes.

The main problems and their causes are identified in two components:

(1) Little participation of stakeholders in the collective use of natural resources at watershed level (social and power relations influence community activities, diverse agendas of stakeholders, and poor social interaction of the local organizations).

(2) The presence of weak and non-representative community organizations (poor coordination between local organizations, lack of methodologies that strengthen collective action, poor access to information, and little participation in technology design).

Because of the above situation, research and development (R&D) projects in agriculture and NRM have little impact in relation to dissemination to farmers, poverty reduction, sustainability of the development process, or on their impact on policy formulations. Thus, researchers and those involved in R&D face the challenge of maximizing impact and advancing the development process. In the present situation of reduced resources to support research and agricultural development, interest is growing in "enlarging the scale" (Gonsalves, 2001). Harrington et al. (2001) warn that if little attention is paid to increasing scale, or if research products in watershed management do not go beyond one scale, we will have failed by not benefiting many poor people in other areas. We "will have failed in our purpose of contributing to the alleviation of poverty, to improving food security, and to the protection of the environment".

The above implies that we need to work with local communities and institutions to produce viable alternatives and benefits for a greater number of people, in wider geographical areas, and in a more rapid, equitable, and enduring manner.

Approaching social organizations

In analyzing the role of local organizations in watershed management, we need to consider:

- Socio-cultural factors (land ownership, gender, ethnic groups, religion, local knowledge, and family structure) that influence NRM; and
- Biophysical factors (topography, climate, soil types, and geology), which are essential for understanding biophysical constraints and potential management options.

The dynamics of woodlands, soil fertility and erosion, water quality and quantity, and their relation with human health, poverty, and social capital, reveal the interconnection between environment and the socioeconomic factors, and allow for the prioritization of problems. Some of the options and opportunities for preventing the deterioration of natural resources and for their restoration are: (1) water resource management, (2) agricultural diversification and intensification, and suitable soil management, (3) sustainable use of forest resources, and (4) organizational processes (CIAT-Communities and Watersheds, 2002).

The analysis of resource use alternatives and the forms of social organization helps us understand the circumstances under which local organizations can be efficient administrators of watershed resources.

Scaling Out

Scaling out is the replication of sites or projects to other locations at the same scale, for example, from one site to other sites, or from one watershed to another. In this section, we present two examples of scaling out. The first case shows the replication of particular forms of organization developed in Colombia to similar locations in Central America. The importance of this case lies in the different time frame needed for scaling out when the lessons learned in the reference site are used for replication.

Participatory learning processes for community organization

To better understand the interactions in community-based watershed management, a review can be made of the work at reference-site level in Cauca (Colombia), San Dionisio (Nicaragua), and Yorito (Honduras) (Figure 2). These interactions have involved (1) technology design in production systems and NRM, (2) the development of decision-taking support systems, and (3) implementation of participative learning processes.

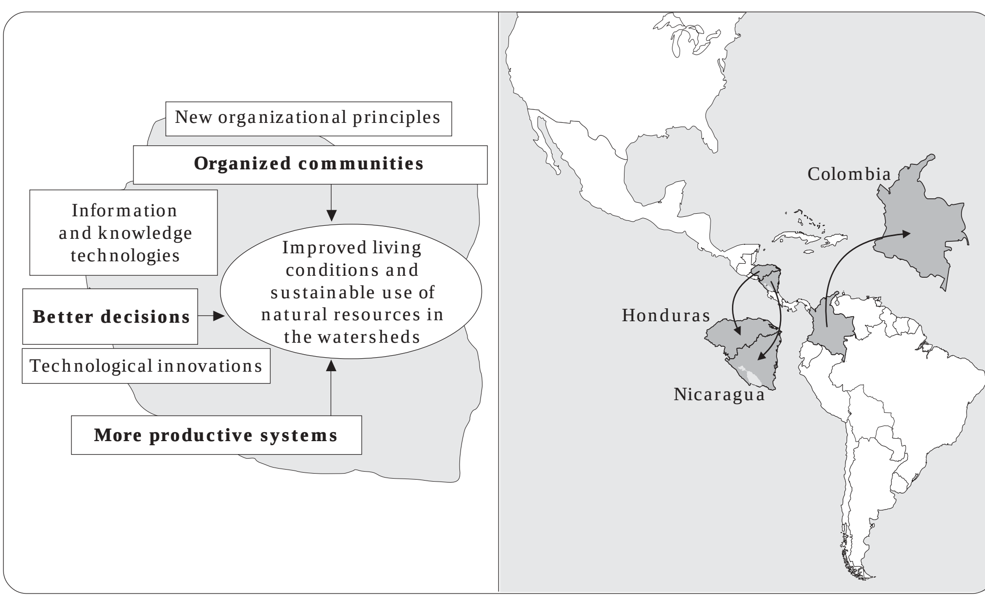

Figure 2. Reference sites in Cauca (Colombia), San Dionisio (Nicaragua), and Yorito (Honduras) and the watershed management strategy.

In the three sites, external actors initiated the watershed management process. In 1993, in the subwatershed of the Río Cabuyal, Cauca, Colombia, the Inter-institutional Consortium for Sustainable Agriculture in Hillsides (CIPASLA, the Spanish acronym) was formed, connecting institutions from the public sector, nongovernmental organizations

(NGOs), and farmers' associations. For CIPASLA to have an effective impact on the work area, the wide participation of the community was essential. To accomplish this, the committee of beneficiaries, the Association of Beneficiaries of the Subwatershed of the Cabuyal River (ASOBESURCA, the Spanish acronym), was constituted as speaker for the community. Within ASOBESURCA, user groups and stakeholders, such as the Communal Action Committees (JAC, the Spanish acronym), Committees for Local Agricultural Research (CIALs, the Spanish acronym), aqueduct officials, educators, and indigenous councils, should represent all the watershed population. This local leadership through the Federation of Beneficiaries of the Cabuyal Subwatershed (FEBESURCA, the Spanish acronym) allowed the mobilization of NRM actions.

Lessons learned in this organizational process for watershed management were later shared and applied in the Central America reference sites in the subwatershed of the Tascalapa River, Yorito, Honduras, and in the subwatershed of Calico River, San Dionisio, Nicaragua (Table 1). While the organizational process in Colombia went from 1993 to 1998 before showing effective actions, in Honduras and Nicaragua the process of social organization that began in 1998 showed positive results after 3 years. The lessons learned applied in the new organizational processes in Central America, along with the tools and methods to facilitate interactions between a broad range of stakeholders, were responsible for speeding up processes.

The second case of scaling out shows sites of the how Supermarket of Technology Options for Hillsides (SOL, the Spanish acronym) have become a scenario for multi-institutional research, and a demonstration site for technological innovations, as well as the importance of participatory processes in the adoption of successful technologies. The participation of local organizations and development institutions has been a key component for taking "best bets" to other sites in different locations.

Local Organizations and Technological Innovations: The Case of the Supermarket of Technology Options for Hillsides (SOL)

Involving local organizations and development institutions in the design of technological innovations for watershed management, and further planning for its implementation in the landscape, is now recognized as a key element in successful adoption and scaling out. One way to achieve this is the SOL strategy, which allows for the involvement of different actors at different levels. The SOL concept is based on (1) participation (design, planning, decision taking, follow up, and evaluation) integrating all stakeholders in the process, (2) multi-institutional alliances, and (3) a network of sites that covers a range from research to development practices (Orozco et al., 2002).

Table 1. Lessons learned and principles developed around organizational processes for watershed management.

Steps in the process	Lessons learned	Principles
Identification of social actors and partners	- Methodological tools needed to facilitate stakeholder identification. - Different actors, interests, and the relationships between them must be identified. - Municipal authorities should play a key role in development processes. - At the start, partners with common objectives should be sought to establish medium-term commitments and guarantee continuity of the process.	- Involve different stakeholder groups and provide for equal opportunity in the process (equity). - Establish collaboration with partners with similar interests and define commitments that generate synergism (coordination).
Facilitation of new organizational forms	- New organizational forms should be based on the community's demands and needs. - Organizational forms should not be imposed, but based on those already in existence.	- Free will to get organized, and local culture should be respected (equity).
Strengthening existing local organizations	- Strengthening is not short-term; time and resources need to be invested. - Training leaders strengthens local organizations. - Paternalism creates dependence.	- Effective leadership should be consolidated within the organization. - Space for reflection to take decisions should be guaranteed. - Paternalism and top-down assistance practices should be avoided.
Promotion of networks or associations of community groups	- Structures and decision-taking procedures of grass-roots organizations and their linkages need to be known. - Needs of each local organization must be identified in order to provide support. - Do not try to have all community organizations join the organizational processes from the start.	- Networks improve communication and exchange of experience between organizations. - Networks require their own space for analysis and discussion.
Inter-institutional coordination	- Common objectives and concrete activities are required to achieve coordination. - Coordination among technical people is an effective path for improving coordination at inter-institutional level. - Organizational processes must be linked to decentralization to increase sustainability and impact.	- Everyone should participate in planning, execution, and evaluation (participation). - Decisions should be consulted with all those involved (agreement). - Duplication must be avoided, and economic and human resource efficiency increased.
Generation of links at local, regional, and international levels	- When technological demands at local level cannot be met, links must be sought with other levels. - Links with other levels strengthen local organizations.	- Co-management of resources should be established to ensure sustainability. - Reporting to the community generates transparency.

Presenting the technological options to producers motivates them and strengthens their willingness to innovate or adapt the technologies (Figure 3). The SOL operates as a network of SOL sites, connecting not only institutions and farmers, but also different sites within a watershed so that all research undertaken in a landscape can be known and disseminated through the participation of those interested. The final impact is the sum of partners' interactions.

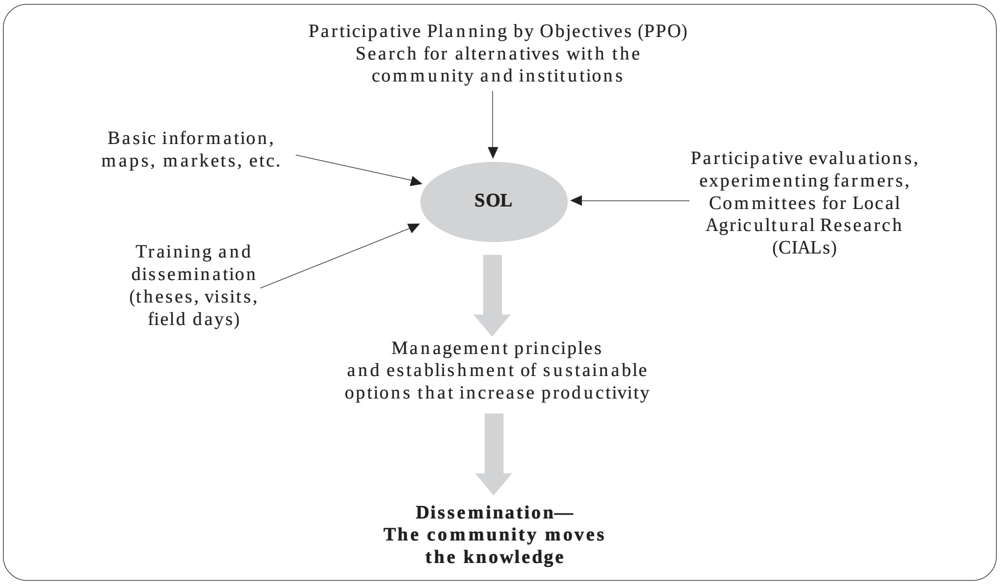

Figure 3. Components of the Supermarket of Technology Options for Hillsides (SOL, the Spanish acronym).

If capacities for innovation are to be strengthened, farmers need not only a greater diversity of technologies, but also different methods and tools that they can use for discovering and disseminating best practices in a gradual increase of scale (Gonsalves, 2001).

An important characteristic of the local organizations in the improvement of watershed management is that they can institutionalize the local capacity for innovation through collectively organized experimentation with new practices, and can provide a means for receiving and interchanging information on technological innovations. Among R&D approaches we can cite those of the CIALs and Campesino a Campesino.

The following cases show how CIAT projects in the reference sites have achieved integrated work with the participation of a variety of partners and local organizations. Several CIAT projects, such as Communities and Watersheds, Participatory Research in Agriculture (IPRA), Rural Agro-enterprises Development, Soil Water and Nutrient Management, Land Use in Latin America, and Conservation and Use of Tropical Genetic Resources, and their partners have joint R&D activities at the reference sites. Here, agricultural researchers, development institutions, and farmers come together along with local organizations to do strategic, applied, and adaptive research. Examples of the types of research carried out are multi-purpose forages, soil improvement, agricultural systems and crop rotation, live barriers, improved fallow, systems diversification and intensification, evaluation of soil erosion, and germplasm in different crops.

Three years after establishing the SOL sites in Central America, activities have been developed with the participation of different actors (farmers, local organizations, researchers, and development technicians) and at different levels—some in the phase of problem identification (Planning for Objectives Workshop and workshops for planning activities), others in workshops for presentation of results, and others in field evaluations. This participation has allowed for a balanced combination of demand-driven approaches with existing supply offers. Feedback from users helps redefine the research agenda, and encourages support groups and networks for information sharing.

In Cauca, Colombia, FEBESURCA is an example of the involvement of local organizations in the development of technological innovations. In 1993, FEBESURCA established CIALs to test technologies and adapt them to the local environment, combining local knowledge with successful technologies on thematic areas selected by the community. The development of small-scale dairies was also stimulated, and these in turn stimulated changes in land use. The introduction of commercial production linked the adoption of contour barriers, tree planting, and buffer zones just as local organizations had envisaged (Ashby et al., 2000).

In San Dionisio, Nicaragua, various local organizations such as the Campos Verdes Association, CIALs, Union of Organized San Dionisio Smallholders (UCOSD, the Spanish acronym), and the soil fertility interest group have begun to grow in scale (from plot to landscape). They are testing technologies in germplasm (bean [*Phaseolus vulgaris* L.], maize [*Zea mays* L.], rice [*Oryza sativa* L.], soybean [*Glycine max* [L.] Merr.], sweet potato [*Ipomoea batatas* [L.] Lam.], and sorghum [*Sorghum bicolor* [L.] Moench]), green manures, soil fertility improvement, and conservation of water sources (Figure 4). In Yorito, Honduras, the Network of Yorito and Sulaco Local Organizations (REDOLYS, the Spanish acronym) and the CIALs are evaluating technologies, such as germplasm, coming from the SOL.

From these experiences, we can observe how the initial approach of the SOL, seeking to incorporate only demand-driven research activities, has resulted in answers to the real needs of rural communities.

Additionally, support to local organizations focused on specific issues has facilitated the evaluation of concrete techniques developed at SOL sites, and their expansion to farmers' plots and farms within the same watershed.

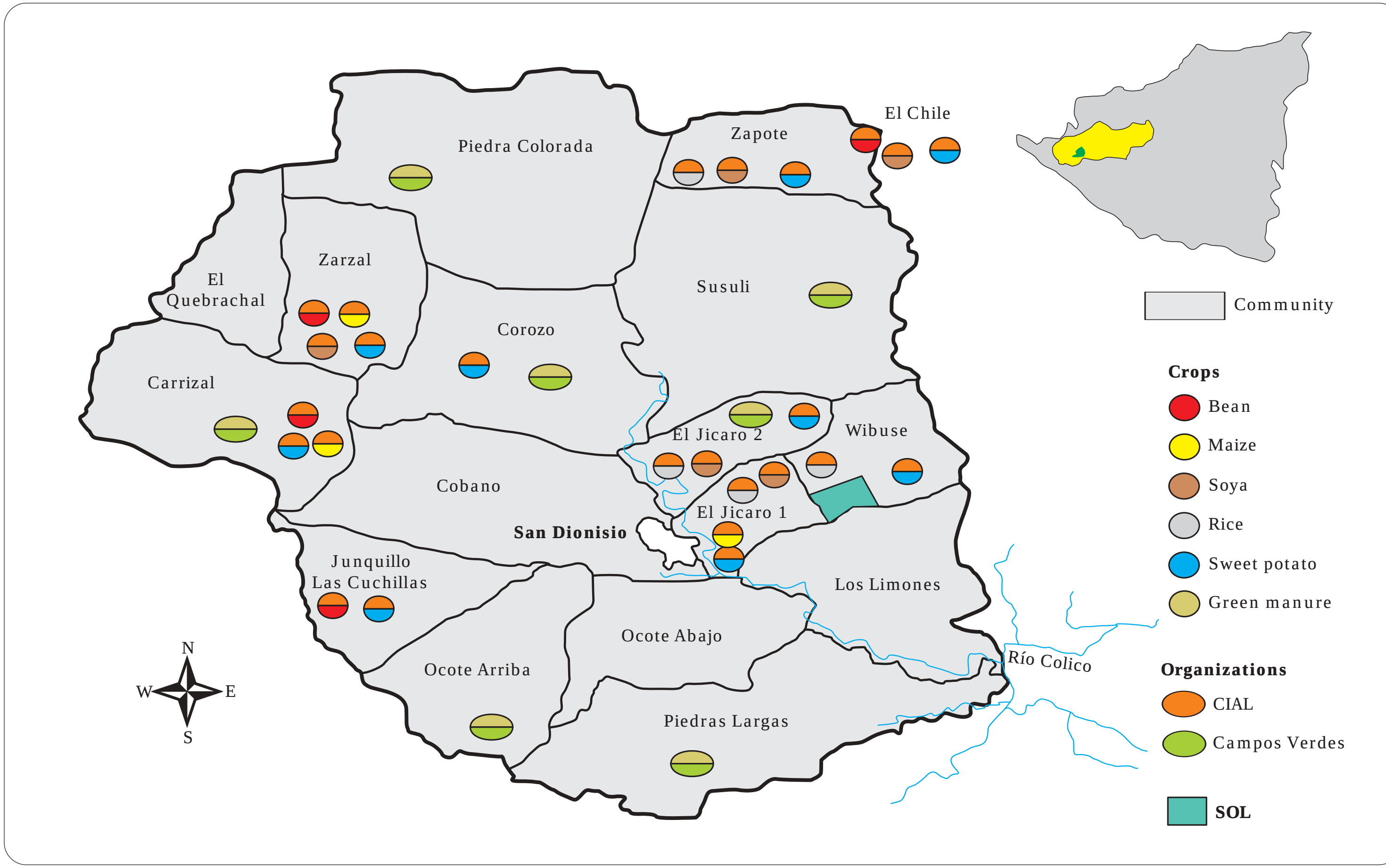

Figure 4. Technologies selected by local organizations from the Supermarket of Technology Options for Hillsides (SOL, the Spanish acronym) site for evaluation in other micro-watersheds of the subwatershed of the Calico River, San Dionisio, Nicaragua. (CIAL is the Spanish acronym for Committee for Local Agricultural Research.)

Scaling Up

Scaling up refers to the expansion in the area of coverage, for example from site to microwatershed, from microwatershed to watershed, from watershed to region, from local to national levels. This section describes the importance of the participation of local organizations in expanding technological innovations in the reference-site's area of influence.

Watershed management generally goes together with a combination of natural resource conservation efforts. Communities in these watersheds depend on these resources, therefore one of the main challenges is to establish and maintain management practices that reconcile economic needs with long-term soil, water, and forest conservation practices (Ashby, 2000).

Nowadays, a large array of technically sound practices exists (live barriers, green manure, agroforestry and agrosilvopastoral systems, and other soil improvement practices). Resource-poor farmers try to adopt these practices, sometimes with little success, because costs exceed local capacity (MARENA-POSAF, 2002). Vertical efforts to force the use of these practices, or to promote them through temporary subsidies, have not achieved a lasting adoption.

The following cases of scaling up show how reference sites have become scenarios for multi-institutional research and demonstration sites for technological innovations, as well as showing the importance of participatory processes in the adoption of successful technologies. The participation of local organizations and development institutions has been a key component for taking "best bets" to other sites in different locations.

From San Dionisio, Nicaragua, to several locations in different parts of the country

Scaling up involves a variety of actors. Therefore, it is not surprising that in various international workshops the importance of inter-institutional collaboration and collaboration between partners is emphasized. Many argue that agreements between partners are an essential element of a strategy for scaling out. It may be necessary to involve a wider range of organizations to reach a greater quantity of people in a horizontal scale—scaling out (Gonsalves, 2001).

The establishment of links between local and external organizations stimulates the development of actions at local, regional, national, or international scale. These links can be used to (a) establish agreements, (b) strengthen the local associations and organizations, and (c) link community organizations with others that support development. These links also include contacts for obtaining funds, interventions to overcome conflicts and obstacles in local communities, training in leadership of the community organizations, and channels to ensure the availability and flow of information between the different levels. Examples of these links are CIPASLA in Colombia, the Local Committee for Sustainable Development of the Tascalapa River Watershed (CLODEST, the Spanish acronym) in Honduras, and the Campos Verdes Association in Nicaragua.

Involving more actors, including policymakers, decision makers, and planners at different levels, favors complementarity and facilitates capitalizing on the strengths of each one in the execution of joint projects.

With CIAT's technological and methodological help, over the last 2 years visits by local organizations, government organizations, NGOs, universities, and donors have increased to the reference sites. Figure 5 represents the different stages of this strategy followed by interaction with partners:

(1) Approach partners with national or regional coverage, where institutional offers and demands are identified both at internal level, and at the level of the clients they serve.
(2) Visit the reference site with the aim of gaining technical and methodological experience.
(3) Identify products for partners that can be introduced, applied, or researched in other regions.
(4) Elaborate an institutional work plan that promotes learning alliances and scaling out processes.

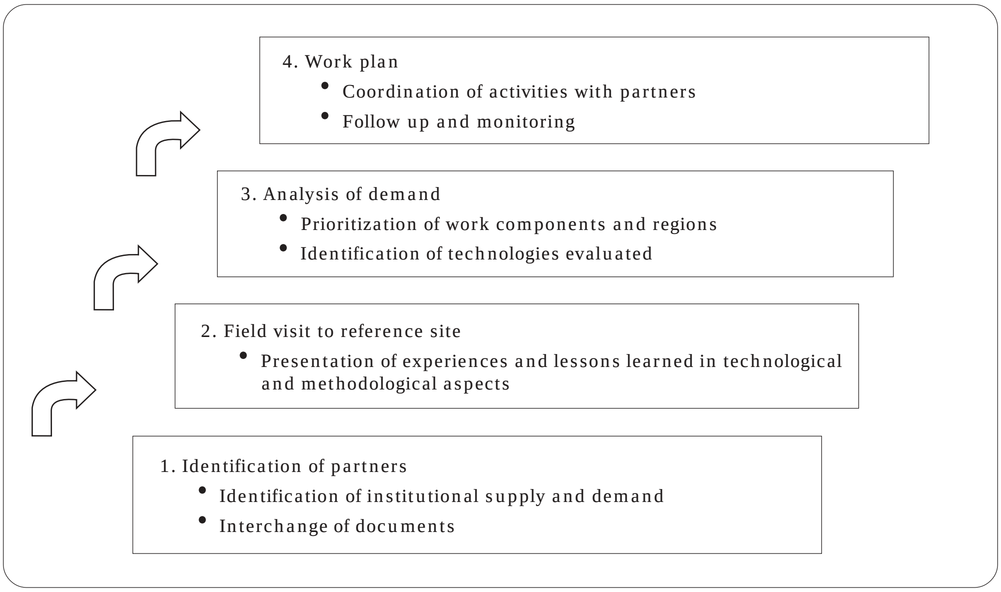

Figure 5. Steps in the strategy of interaction with partners.

The collaboration scheme includes, on CIAT's part, germplasm, methodologies, training, and teaching. With the steps outlined above we hope to enter into a process that allows the application of what is learned, monitoring and follow up of these experiences, mutual learning, and measuring the impact to evaluate and determine if work actually contributes to the improvement of people's quality of life.

In Nicaragua, during 2001-02, the following visits were made to the reference site:

- Groups of forage producers, CIALs, UCOSD;
- NGOs: Agricultural Development Fund (FONDEAGRO, the Spanish acronym) and Program for Sustainable Agriculture in Central American Hillsides (PASOLAC, the Spanish acronym);
- Ministry of Agriculture and Forestry (MAGFOR, the Spanish acronym), National Institute of Agricultural Technology (INTA, the Spanish acronym), Ministry of the Environment and Natural Resources (MARENA, the Spanish acronym), and Socio-environmental Forestry Program (POSAF, the Spanish acronym);
- Universities: National University for Agriculture (UNA, the Spanish acronym) and National Self-governing University of Nicaragua (UNAN, the Spanish acronym), Matagalpa;
- Donors: Norwegian Agency for Co-operation for Development (NORAD), United Nation's Children's Fund (UNICEF), Swedish International Development Agency (SIDA), and Swiss Development Cooperation (SDC); and
- International organizations: Rural Water and Soil (ATICA, the Spanish acronym, Bolivia), INTERCOOPERACIÓN, CIAT-Hillsides Agricultural Program (HAP, Haiti), and Development Alternative Inc. (DAI, Bolivia).

Table 2 presents a summary of the scaling out process initiated with different partners in Nicaragua during 2002. The main themes that partners identified are germplasm, silvopastoral systems, market options, SOL strategy, CIALs, watershed focus, collective action methodologies, and training.

Figure 6 shows the scaling up of technologies and methodologies developed by CIAT and partners from the San Dionisio reference site towards other regions of the country, such as the departments of Jinotega, Matagalpa, Boaco, Chontales, Managua, Estelí, Nueva Segovia, León, and Chinandega.

The combination of a strategy to involve partners and local organizations in the research process facilitates partners' understanding of the technologies being developed. It also allows them to see that the research process is demand driven, and that what is researched is useful for development processes.

Table 2. The scaling out process with different partners in Nicaragua, 2002.[a]

Partner	CIAT projects involved	Theme	Site
CARE International	Agro-enterprises	Market options	Matagalpa, Estelí
	C&W	Integrated watershed management, SOL	Subwatershed Río Pueblo Nuevo (Estelí)
	Forages	Germplasm, silvopastoral systems, training	City of Darío
FONDEAGRO	Forages	Forage grasses, legumes, and trees	Paiwas, Río Blanco, Ubu Norte
POSAF	C&W, Forages, Participatory Research in Agriculture (IPRA)	Establishment of SOL sites, training	Subwatersheds: Dipilto and Jicaro, Estelí, Molino Norte, Jiguina, Río Grande, Cuenca Sur, and S. Francisco Libre
NORAD	C&W	Non-protected areas of the Mesoamerican Biological Corridor	Central America
UNAN-Matagalpa	Forages	Germplasm and training (three theses)	Matagalpa
INTA	C&W, IPRA, Forages, Agro-enterprises	Watersheds focus, improvement of soils, Committees for Local Agricultural Research, forages, monitoring, and follow up	Matagalpa-Jinotega, Estelí-Madriz-NS, Léon-Chinandega, Boaco-Chontales, Masaya-Carazo
PRODEGA	Forages	Germplasm and training	Boaco-Chontales
UNICEF[b]	C&W	Training on Decision Support Tools for natural resource management	Juigalpa, Matagalpa, Estelí
ATICA	C&W	SOL, market options	Bolivia
HAP	C&W	SOL PES	Haiti

a. For acronyms, see page 287.

b. Training and “action plans”.

Institutional and local capacity development

To go up in scale, strengthening local capacity for innovation is as important as the technologies themselves (Gonsalves, 2001). In many cases, local organizations do not achieve their objectives because they cannot develop their potential for self-management (leadership, direction, execution, and planning). This is because of the lack of internal building capacities, especially for developing complex innovations, such as tools for soil management and dealing with markets, among others. To overcome these weaknesses, capacities for adaptation must be developed within the institutions and in local communities (Menter et al., this volume).

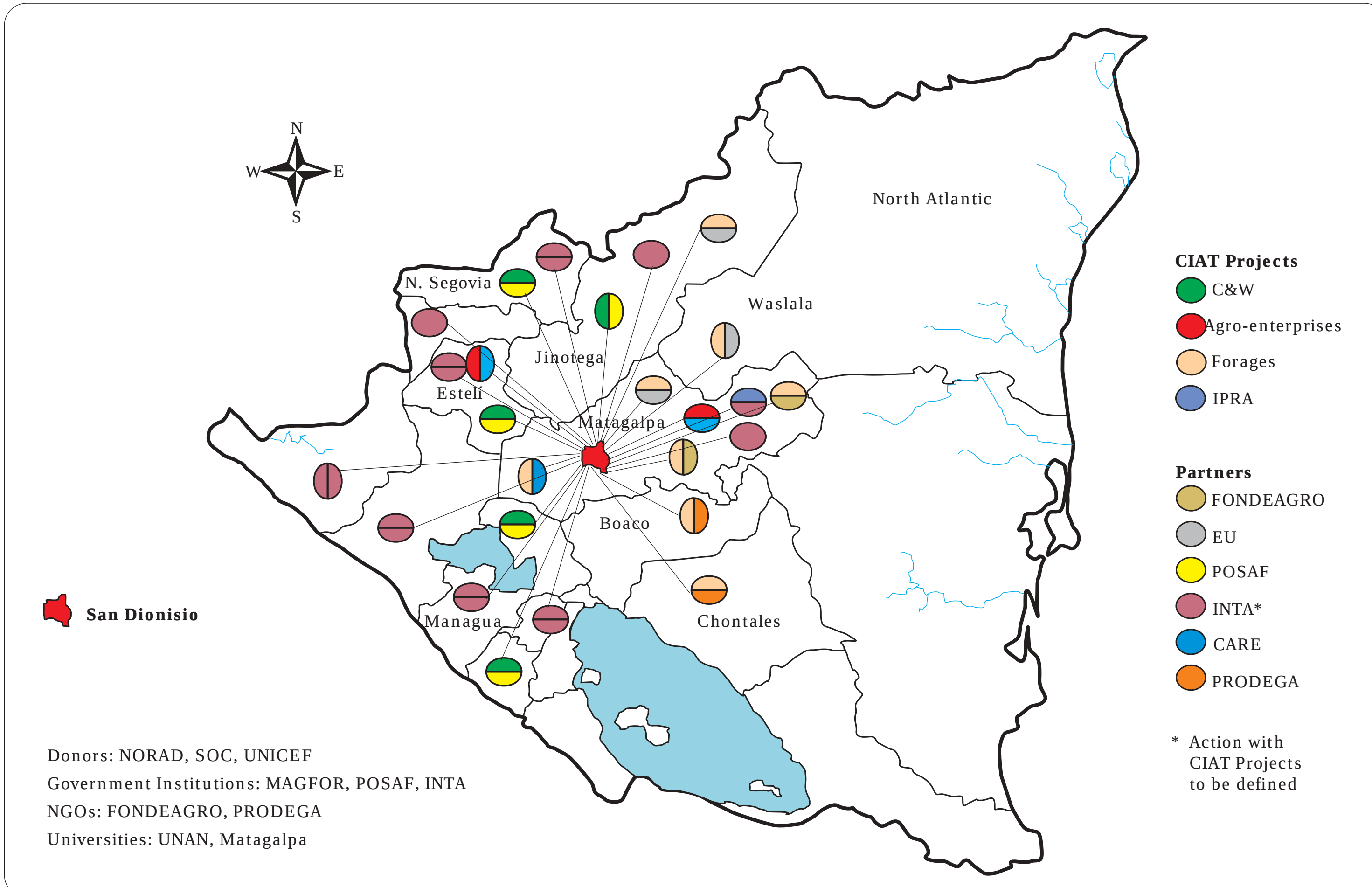

Figure 6. Scaling up from the reference site to other regions of the country. (For acronyms used, see page 287.)

Capacity is defined as the ability of individuals and organizations to perform their functions effectively, efficiently, and in a sustainable manner (UNDP, 1998). Capacity is also a set of attributes, capabilities, and resources of an organization that enables it to undertake its mission. Linked to the concept of capacity development is that of facilitation. This concept implies the provision of assistance and support to organizational processes by external and internal agents. Facilitation may involve stimulating, motivating, guiding, and providing technical or political support to the implementation of organizational processes.

Decision support tools for NRM—which integrate local knowledge through the participation of farmers and communities in their development—are examples of tools that can be incorporated into the organizational learning systems. In fact, these tools are being used in planning, decision making, and monitoring and evaluation at the local level.

Research results coming from joint efforts with local organizations and partner consortia at the reference sites have allowed the development of information, methods, technologies, and support tools for decision taking in NRM. More than 400 technical personnel of nearly 40 institutions in Honduras, Nicaragua, and Colombia have received training in the use of these research tools. Figure 7 presents the strategy followed by CIAT to build capacity and social capital at local level of both community organizations and institutions.

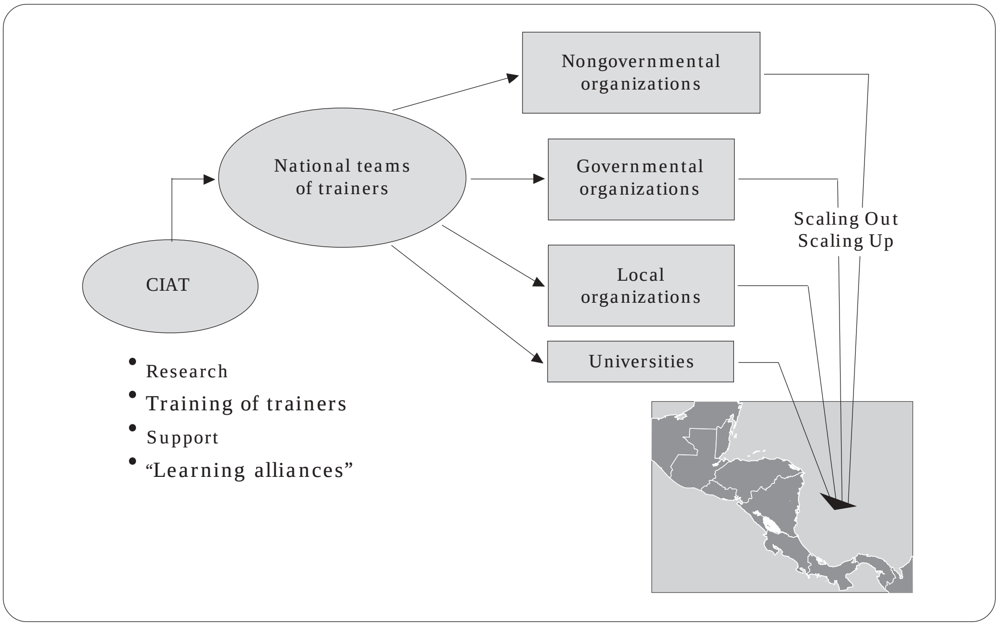

Figure 7. Strategy followed by the Communities and Watersheds Project of the International Center for Tropical Agriculture (CIAT, the Spanish acronym) for capacity building at local level.

Figure 8 shows the regions in Honduras and Nicaragua where the methodological instruments, such as Local Indicators of Soil Quality, Participative Mapping, Groups of Interest, Levels of Well-Being, and Market Options, were applied with local organizations and communities.

As a result of capacity building for watershed management at local organizational level in Nicaragua, the Campos Verdes Association—after fieldwork with the Participative Mapping and Local Indicators methodologies—identified critical microwatersheds (Quebrachal, Junquillo, Las Cuchillas, Piedras Largas, and Corozo) affected by problems in soils, forest, and water. This activity ended with the development of an environmental action plan at the subwatershed level. MARENA-Nicaragua and the Danish International Development Agency (DANIDA) approved a US$70,000 project for the improvement of soils and reforestation of water sources. As a result, 28 ha were reforested at water source sites, 30 ha rehabilitated with soil management strategies (barriers, irrigation channels, and dikes), and communities developed new attitudes regarding slash-and-burn practices. Another local organization, UCOSD, using the participatory Market Options Identification methodology, identified with communities five of the best commercial opportunities in the region—*quequisque* (*Xanthosoma sagittifolium*), *chiltoma* (*Capsicum annuum*), melon (*Cucumis melo* L.), black bean (*Lablab purpureus* [L.] Sweet), and *chilla* (sic. *Linum usitatissimun* L.).

Capacity building for local organizations and R&D partners is required to enhance the scaling out and scaling up processes. Training in the use of tools that have been developed with community participation has facilitated the adoption of new technologies by a wide range of organizations and farmers at different scales.

Implications for CIAT

Research carried out during the last few years at the three reference sites, located in subwatersheds of Colombia, Honduras, and Nicaragua, has allowed local and international researchers to learn together with local stakeholders about the dynamics of natural resources in the watershed, gradually integrating diverse local and technical views, and developing a platform for joint learning and action.

Three main conclusions can be drawn from the scaling out and up experiences. An important one from the work of several CIAT projects working in Latin America in the last 9 years is that the SOL is a research for development tool that fulfils the local demand for new agricultural technologies and NRM practices for increased food security and a healthy environment. The SOL, as a research tool, needs to be supported and strengthened, and at the same time it needs to be autonomous and self sustained. CIAT has a role to play in the process of leaving the operation of the SOL in the hands of local stakeholders. Currently, local organizations

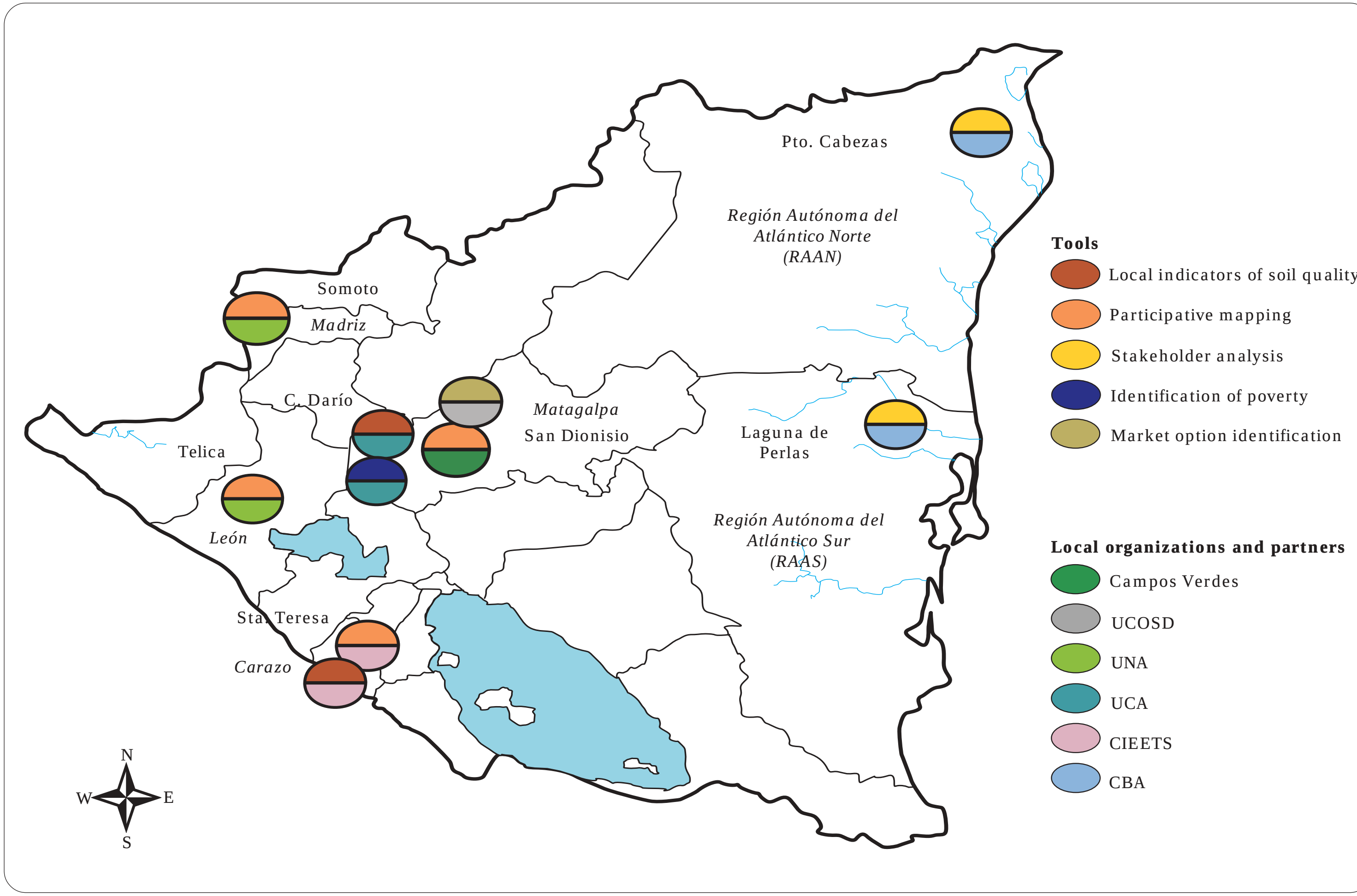

Figure 8. Natural resource management tools used by local organizations in Nicaragua. (For acronyms used, see page 287.)

have more to contribute to the research process, and CIAT can begin to reduce its participation, particularly in the maintenance of a research site. Local partners and organizations can provide research sites that keep the network functioning. The success of the SOL depends on the bonds that are created between local organizations, and these bonds should be made without the influence of external organizations such as CIAT.

Local organizations clearly carry out scaling up and scaling out also. The implication for R&D practice is that the processes of selection and support to these local organizations become critical. CIAT and its R&D partners need to work jointly to better judge and provide winner farmer organizations with the skills and capabilities for the accomplishment of their goals.

Finally, CIAT would benefit from a better understanding of NRM as a collective endeavor. This would imply strengthening collective action processes through the analysis of the social interaction of the farmers concerned around a particular common problem. This analysis has begun in San Dionisio-Nicaragua and Yorito-Honduras around the issue of decreasing soil fertility. However, much remains to be understood and designed to provide solid grounds for collective action.

Since scaling out is a process mainly conducted by partners, their participation becomes demanding in terms of CIAT's personnel. This implies the risk of diverging research resources to scaling out processes, and reducing research activities.

In terms of "going to scale", alliances will facilitate CIAT with scenarios in which the methodologies are implemented, adapted, and improved; where impact is measured, and where learning for the use of analysis and development tools are in the hands of development partners. This makes it clear, before traditional donors, that funds invested in research bear fruit.

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Chapter 11

Four Obstacles to Taking Integrated Soil Fertility Management Research to Higher Scales

*Joshua J. Ramisch**

Introduction

Much of the literature on issues of scale in natural resource management (NRM) addresses the nature of the relationships between information and data collected at different scales (Lovell et al., 2001). For example, both theoretical and methodological problems are inherent in extrapolating data from plot to landscape scale because of the increasing number of interactions between plots nested within wider spatial areas. Factors that must be treated as externalities at a lower scale become internalized by the system at higher scales, and the actions of decision makers become increasingly interconnected (Röling, 2002). There are also "emergent properties" of systems, such as resilience, that only become apparent or important above certain scale thresholds (van Noordwijk, 2000).

Beyond the purely theoretical or methodological issues of dealing with multiple scales, natural resource managers are often concerned with two other aspects of scale. The first is ensuring that technologies and innovations developed at a local scale can be scaled out (or reproduced at comparable sites). The second is ensuring that lessons learned at the farm or household level can be scaled up to inform policy and land-use decisions made at the landscape, national, or international levels.

Until recently[1], less explicit attention has been paid to these latter two aspects of scaling up and out, partly because they appear to be more managerial and not immediately obvious as topics of theoretical or researchable interest. Land-use management and geographic information

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1. For example, two workshops held in 2000: "Going to scale" workshop hosted by the International Institute for Rural Reconstruction (IIRR) and the UK Department for International Development (DFID), and the Consultative Group on International Agricultural Research (CGIAR) workshop "Integrated natural resource management in the CGIAR: Approaches and lessons".

systems (GIS) offer ways of characterizing landscapes and communities for the purposes of identifying comparable niches or opportunities for interventions based on local successes, but the processes and challenges of scaling knowledge out and up have largely been neglected.

This chapter takes integrated soil fertility management (ISFM) as an example of a knowledge-intensive system of technologies and innovations for managing natural resources. While researchers, farmers, and policymakers alike may express an interest in taking ISFM to "higher scales", the processes for achieving this scaling out or up are neither straightforward nor uncomplicated. It is argued here, using examples from the African experience of the Tropical Soils Biology and Fertility Program (TSBF) of the International Center for Tropical Agriculture (CIAT, the Spanish acronym), that taking ISFM to higher scales must contend with at least four potential obstacles. First, because ISFM addresses ecosystem properties and involves multiple stakeholders, transferring knowledge between scales must contend with and resolve the many potential clashes of expectations. Second, problems are inherent in the fact that the broader use of ISFM concepts requires a scaling up of knowledge itself, which is not the case with the spread of more simple technologies or goods. Third, the development of ISFM principles relies heavily on innovation and experimentation—indeed on creating opportunities and nurturing the good fortune of serendipity—to tailor generic management principles to diverse local conditions. Finally, there are obstacles related to managing the complexity of ISFM systems, from merely knowing what innovations have occurred and are worth reproducing to understanding and targeting interventions to different parts of the systems.

Clashes of Expectations

Is there really an interest in scaling up?

At the most basic level, ISFM is about managing interactions between plot-level soil phenomena such as water, soil nutrients, and organic matter. When interventions, such as new cropping combinations of legumes and cereals or the complementary uses of organic and inorganic inputs, have proven themselves successful in a given context, it might seem natural to wish to see that success reproduced elsewhere.

And yet, consider for a moment the various stakeholders in a piece of successful research, even in a plot-level context. While the farmer, whose plot it is, may see the successful resolution of one of her NRM problems and now express a desire to conduct "more work on my other problems" using similar principles, the researcher involved in the experimentation might be enthusiastic about seeing this same experimentation process or intervention "used by more farmers". Thus the single moment of "success", however defined, produces two reactions facing in opposite directions: The land-users themselves seeing an opportunity for deepening their use of new knowledge (introversion), while outsiders are thinking of broadening the knowledge's use to include others (extroversion).

This suggests that, unless these obviously complementary outlooks are acknowledged and reconciled, there is the potential for much broader clashes of expectations about research and research outputs within the scaling up discussion. The project example cited in Box 1 shows how failure to explicitly discuss the different objectives of stakeholders in a project's Phase Two led to radically different impressions of what scaling up would mean.

Box 1

Negative comments about scaling up from a project feedback meeting

In early 2001, community discussions were held on the proposed next phases of an integrated soil fertility management (ISFM) project in western Kenya as the intensive, community-based experimentation phase was coming to an end. The new activities included leaving the original community to continue experimenting and adapting the technologies with minimal project oversight, and disseminating the research findings to other communities. However, clear differences of opinion regarding the merits of these new activities became evident, partly because project implementation had not explicitly involved all the participants in deciding the course and the justifications of the research. The following are extracts from the negative comments only made by various stakeholders, which were collected from the public (and private) discussions during and after the meeting.

Researchers (national and international)

- The only way we can carry out research these days is to persuade the donors that there will be an impact beyond just a single village, or a group of 30 or 40 farmers.
- Dissemination is not our job, it is extension's.
- If the technology is good, it will sell itself. All this [time and effort] here today is just a distraction.

Extension agents

- If the project is not even going to stay here, then it seems that all this attention to the "on-farm" research was just for the researchers' curiosity and nothing more.
- There is no enduring interest by the outsiders in this community. We [the national ministry personnel] were just used and are now being dropped.

Farmers

- [This particular] research [project] is just a passing cloud. It will go and something else will come to take its place.
- The researchers have learned what they needed to, and now they will forget us farmers and our problems.

These negative comments suggest that even the researchers felt that scaling up was not something for which they had a comparative advantage, to the point of cynically thinking that achieving and demonstrating impact only served a purpose of satisfying donors. The negative perceptions of the extension agents reflect the fact that they had not been involved in planning the second phase activities, obscuring any links between the initial stages and the scaling up. Finally, the farmers themselves were also ambivalent about a scaling-up phase, seeing the project as something transient and distant from their daily priorities, apparently responding to its own (mysterious) internal agendas.

Such an example highlights the need to generate realistic expectations collectively. Because NRM projects often begin with quite comprehensive benchmark surveys and community-based discussions, participants also tend to believe such energy levels will be sustained throughout the life of the project and beyond. While this is usually not the case, a fuller stakeholder involvement at strategic moments throughout the project cycle can both minimize the generation of false expectations, and ensure agreement on more realistic objectives.

Often, taking a given project's lessons to broader communities or policymakers is given relatively low priority at inception (see the researcher comments about "distraction" in Box 1). As the end of a project approaches, issues of scaling up or out then risk being blurred into plans for either renewal or the development of new projects, and may even fail to properly materialize if additional funds do not arrive (again, see the researcher comments about donors). While such thinking may appear pragmatic, it is more effective to view "scale" issues as inherent to all project processes and of interest to more than just the project "managers". Indeed, starting the discussion of scaling up and out activities **early** in the project cycle ensures that other participants, such as farmers and locally based institutions, can also recognize their own interests in seeing lessons applied more broadly.

Experience of the Tropical Soils Biology and Fertility Institute

As a small institute, focussed on soil biological processes, TSBF has developed most of its competence in small-scale, plot-level research. The emphasis on soil processes has also encouraged or facilitated a small-scale focus. A prevailing image from the earlier history of TSBF was that the institution itself had "no particular comparative advantage" in scaling up or out (Ramisch et al., 2002). As a result, all of its work has been done through partnerships, with national agricultural research and extension services (NARES) and various nongovernmental organizations (NGOs). Scaling up the general principles and understanding of soil functions has been achieved by linking multiple, local sites and experiments through the African Network of Soil Biology and Fertility (AFNET). Within sites, scaling out has been based on community-based experimentation and farmer-to-farmer dissemination strategies.

Having taken a conservative view of its own ability to widen the impact of its research, TSBF has therefore been surprised to observe examples of spontaneous scaling out activities. Farmer field school (FFS) groups to address ISFM topics have formed in both western Kenya and eastern Uganda purely on the initiative of farmers themselves (Delve and Ramisch, 2002). Certain green manure and improved fallow technologies, such as the use of *Canavalia ensiformis* (L.) DC and *Mucuna pruriens* (L.) DC, have also spread well on their own with relatively little input from TSBF or its partners (Figure 1). As will be discussed below, a common feedback from the community-based experimentation process is that more farmers want greater ownership of the learning process. Where this has been the case, more appropriate technologies have been developed and spread, and fewer clashes of expectations between farmers and researchers have emerged (Delve and Ramisch, 2002).

Scaling Up Knowledge

Although new varieties and cultural techniques are often a part of improved soil fertility management technologies, ISFM will not necessarily be promoted simply by spreading new germplasm, inputs, or agronomic advice. Its dissemination involves the spread of both intangible (knowledge-based) and tangible (resource-based) assets, which will be used in concert. However, since ISFM is essentially a set of management tools, its application is contingent on changing environmental conditions, and its expression may not even be apparent in a given context.

Different types of knowledge

The participatory technology design (PTD) methodology involves farmers directly in the problem-solving process needed to adapt nascent technologies into ones adapted to real-world conditions and constraints (Figure 2). As an iterative process, it is therefore both a knowledge-generation and knowledge-refining activity. Of course, the knowledge needed to conduct agricultural research can range from relatively simple concepts to highly complex understanding of systems. The more complicated the knowledge, the harder it is to present to others, and therefore the harder it is to transfer or to share.

For example, PTD relating to selecting or improving germplasm is at the simpler end of the continuum. It uses tangible, familiar materials (i.e., seeds, seedlings, or rootstock) and can exploit existing networks of local seed systems for sharing lessons and products. Adding an additional layer of knowledge, such as pest management, means that PTD on crop ecology becomes more complicated. For example, integrated pest management (IPM) research also addresses tangible, familiar entities (i.e., crops *in situ*, local pests), but typically demands continuous monitoring and evaluation by participants over full growing seasons to observe pest dynamics and the effects of interventions. More complicated

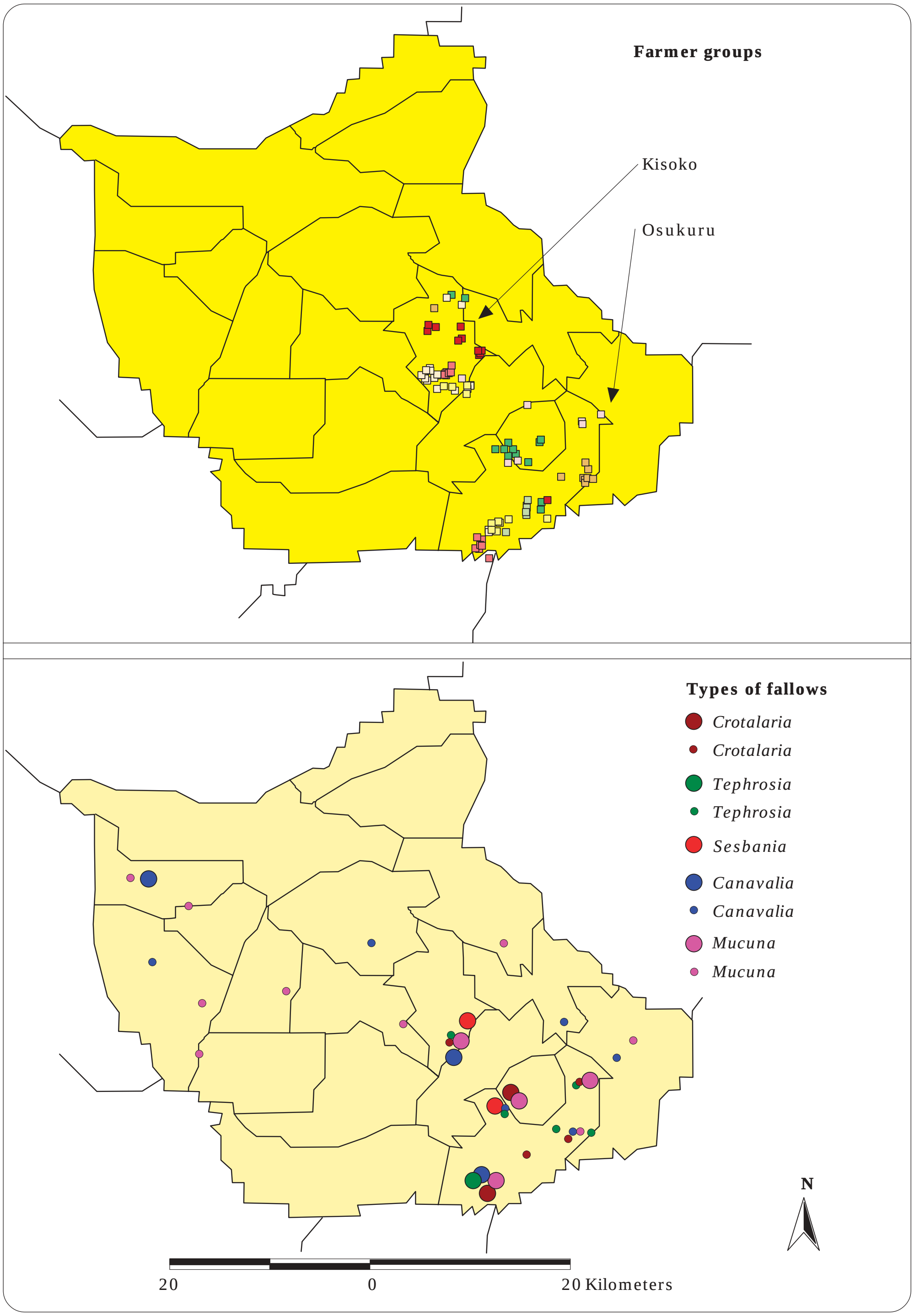

Figure 1. Spread of seeds for improved fallow species over five seasons (1999-2001) related to initial farmer groups in eastern Uganda.

still is PTD that addresses system ecology, such as ISFM, integrating choices about germplasm, and decisions about soil, pest, and water management. Such experimentation typically involves multiple seasons and reference to multiple sites to draw meaningful lessons. Indeed, the very process of learning about these system properties is stimulating the evolution of new ways of thinking, such as distributed cognition, based on the sheer interdependence of the processes involved (Röling, 2002).

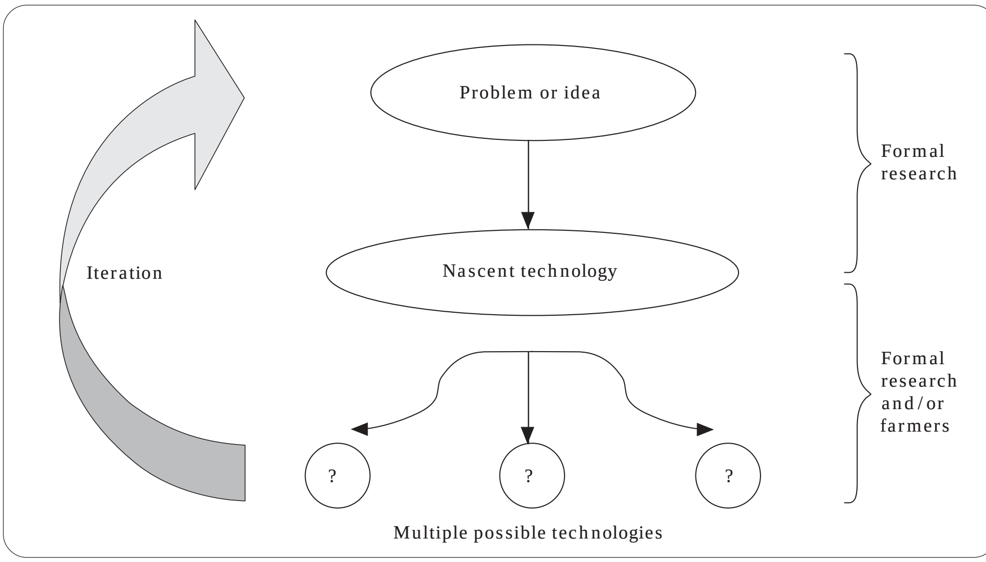

Figure 2. The participatory technology design process.

When addressing complicated, systems ecology problems, it is easy and tempting (and indeed often necessary) to extract individual components for analysis and evaluation. As such, ISFM is itself made up of several layers of knowledge and decision making: About technology decisions, about species, about relationships of those species to systems, and of ways of thinking or experimentation itself. While "solutions" to site-specific problems will be identified in the course of PTD, the principles of ISFM extend beyond them. The advantage of taking a systems ecology approach is that knowledge about more general principles uniting diverse, individual "solutions" will also be gained by referring to the knowledge generated under different sites and conditions. However, when it comes to sharing or scaling ISFM knowledge up and out, it is all too easy for more complex "general" principles to be overshadowed or forgotten once the "solutions" to local problems have been identified.

Knowing that knowledge is being used

The difficulty in tracking the spread of knowledge-based systems lies in having to observe the effects of knowledge indirectly. There are three potential problems here: Knowing that knowledge is being used, knowing where to look for the knowledge, and knowing who will be using it.

Knowledge is contingent. The first problem relates to the fact that most soil fertility management decisions are ad hoc and contingent. In the words of one farmer in Kenya, the use of soil inputs is "like medicine… you take it when you are sick and you stop when the sickness is gone." Tracking the use of concepts (such as decisions about crop rotation or input combination in responses to changing soil fertility status) is therefore not as straightforward as tracking the use of components, such as the presence or absence of a given input (i.e., manure or inorganic fertilizer use). For example, the cover crop *Mucuna* is frequently used by farmers as much for suppressing weeds (such as *Imperata cylindrical* [L.] Palisot) as for soil fertility improvement (see Houndékon et al., 1998). If planting *Mucuna* leads to a suppression of the *Imperata* within 2 or 3 years, it is therefore logical to see the use of *Mucuna* then also trailing off (Galiba et al., 1998).

The passing on of contingent knowledge can therefore become problematic. Certainly in informal farmer-to-farmer dissemination activities, TSBF has observed that the results of experimentation with technologies are typically distilled as "lessons" to be passed to others. The process that generated those lessons is usually not emphasized. As a farmer in Uganda put it, "now that we know that green manures work (*Mucuna* and *Canavalia*), we have finished with experimentation… we would like to promote this now so that others can also know the goodness of green manures".

Potential can be niche or universal. A second, related problem is that depending on whether a technology has universal or only niche potential, it is difficult to know whether a given level of adoption within an agro-ecosystem is high or low. African farmers' intercropping of cereals with legumes reflects a long history of trade-off decision making about meeting nutritional needs while using scarce soil resources (particularly soil phosphorus). The niches occupied by food legumes such as bean (*Phaseolus vulgaris* L.), cowpea (*Vigna unguiculata* [L.] Walp.), or soybean (*Glycine max* [L.] Merr.) are therefore important to both food security and soil fertility, even if they can rarely account for more than 5% to 10% of food production on a dry matter basis (Bremen and van Reuler, 2002).

The potential of non-food legumes must therefore be considered in a similar light. For example, improved fallows using leguminous cover crops are typically most attractive to households with abundant land, or that can meet their food security needs with alternate sources of (off-farm) income (Franzel, 1999). However, the trade-offs between these factors can be complicated, because the perception of soil fertility decline is itself linked to decreasing land availability. In extensive systems, where land is plentiful and existing fallows with natural regeneration of vegetation restore soil fertility, farmers have little incentive to invest labor in improved fallows. These are more likely to be attractive options where population density is higher, fallow periods are decreasing, and farmers perceive a soil fertility decline. However, in intensive systems where additional land is unavailable and cropping nearly continuous, access to off-farm income can serve as the stimulus to invest in soil fertility management. Thus, although non-food legumes have shown themselves beneficial to such farmers, it is unrealistic to expect their potential to be universal or widespread.

Even the way that adoption “potential” is presented can be misleading if the relevance of the technology is not known. It is relatively common, for example, to report baseline studies that show that a given percentage of farms in a community have soil conservation structures such as terraces. On its own, such a statistic is meaningless, since we have no way of knowing what proportion of the land is actually at risk of soil erosion and therefore warranting the massive investment that terraces incur. A more relevant index, although much harder to measure, would be assessing the declining rate of soil loss or sedimentation lower in the catchment as a function of increased awareness and use of soil conserving techniques. Developing similar indices for ISFM technologies would likely show that many of the actual interventions, from improved composting to legume rotations to cover crops, would qualify more as “niche” rather than “universal” options within the landscape.

Knowledge’s value depends on who is using it. The third problem, beyond knowing the conditions under which knowledge might be used and its potential agro-ecological boundaries, is that the same knowledge will be of different relevance to different people. For example, in many African settings, women often make the decisions about seed supply and variety selection for food crops, while decisions about land allocation are more often under men’s control. This means that when it comes to ISFM within a given farm, different members of the household manage different plots differently for different ends. Because of intra-household dynamics, such as access to land, labor, and external inputs, the rationality of ISFM decision making will be different depending on who controls which plots (Box 2). Each decision is rational within its own context, but reflects the fact that even within a single farm there are multiple management domains.

The implication, therefore, is that taking knowledge to higher scales holds many risks. The contingent (and often site- or niche-specific) nature of ISFM knowledge means that any communication or transfer may inadvertently “prune” or reduce the original knowledge down to only a few components, which may in turn prove irrelevant or inappropriate to many potential subsequent users. Much as many local plant breeders retain a diversity of genetic material as a precautionary principle, it is useful to keep a range of ISFM dissemination materials that reflect the full history of a technology’s development and use.

Box 2

Different integrated soil fertility management (ISFM) domains for kales grown on farms of western Kenya

Farm 1. Male-headed household, small area (1.5 acres), some market orientation

The husband uses his access to outside information and resources to justify a decision to grow kales (*Brassica oleracea* L.) for market on a less fertile part of the farm as part of an ISFM "experiment" that combines organic and inorganic resources.

His wife, however, with only indirect access to these off-farm resources is also growing kales, but purely for home consumption. She uses the land close to the home that she controls and directs the richest sweepings of chicken droppings from the compound to this plot.

Farm 2. Male-headed household, small area (1.1 acres), little market orientation

The wife grows kales for household consumption in small garden areas near to the main family home. These gardens are interspersed with other vegetables for home use, and some areas are shaded by banana (*Musa* spp. L.) groves. Many of the gardens benefit from the sweepings and kitchen wastes, but no other inputs.

The son is also growing kales for household consumption, but on plots at some distance from the home compound. This land is also being used to grow sweet potatoes (*Ipomoea batatas* [L.] Lam.) along with his mother, and does not receive any organic or inorganic inputs.

The husband has not prioritized kales within the farm and allocates no inputs to them. He was even willing to offer to researchers as a demonstration plot, the plot of land used by his son and wife for sweet potatoes and kales, until they later convinced him that they needed it.

Farm 3. Female-headed household, large area (3.2 acres), off-farm income

The widow invests some of the monthly income from her husband's pension and son's remittances in inorganic fertilizers and pesticides for a market garden of kale on a large plot. She is also using her connections with researchers to experiment with improved fallows and various organic and inorganic combinations.

Her younger son has a small plot of kale for market as well, but is not actively interacting with the researchers for new ideas. Also, since he does not have access to the household compost or manure resources, the only inputs are occasional doses of inorganics.

The hired (female) labourer maintains and harvests all of the widow's kale, and is able to retain a small share of the produce for her own use. She has not adopted any of the organic or inorganic practices on the kale she grows for home consumption on her own farm, saying she lacks the time and money required to use them properly.

Nurturing Serendipity

The PTD process relies heavily on the input of local knowledge into the generation and adaptation of prototype technologies to suit local conditions. To some researchers, this may mean little more than ensuring that farmers are winnowing out options that demand inappropriate inputs or are not suited to local tastes. However, many of the successes of integrated management approaches stem from the outcomes of local experimentation, innovation, and serendipity, which the Oxford English Dictionary defines as “the faculty of making happy and unexpected discoveries by accident”.

For example, the identification of *Tithonia diversifolia* (Hemsl.) A. Gray as an effective “scavenger” of soil nutrients was serendipitous, given *Tithonia*’s abundance as a hedgerow and wildly occurring species in many rural landscapes. So too was the later discovery that farmers in western Kenya were using *Tithonia* as an amendment to compost systems, rather than applying it directly as a mulch or top-dressing, as was initially promoted.

All innovations in agricultural systems rely to some degree or other on serendipity. However, it is harder to obtain serendipitous outcomes if the technology is already “over-designed”, with highly specified parameters and inputs. In such cases, the farmers’ potential input is reduced to the rather dis-empowering binary decision of whether to “accept” or “reject”.

Matching the precision of technologies to the precision of farming systems

When considering the “appropriateness” of a given technology, it is useful to think of its input requirements (natural, financial, labor, or managerial capital) in terms of its “precision” (Reece and Sumberg, 2003). A high-precision technology is one that yields favorable responses only when specific conditions are met, while a low-precision technology responds favourably over a wider range of conditions (Figure 3). While the best outcomes of a low-precision technology usually will not be as high as the best outcomes of a higher precision technology, the total benefits to users who do not muster the optimal resource combinations will be far greater for low- than for high-precision options.

In this context, it is worth analyzing whether many of the technologies in the so-called “ISFM basket of options” are not themselves over-precise. Work in Zimbabwe on manure management found that the initial scientific models made excessive demands on farmers’ managerial and resource-mobilization abilities (Box 3). The farmers’ management maximized the “quantity” of manure produced—maximizing the amounts of material included in the manure pile while also minimizing labor costs (such as digging pits, and covering or turning the piles). This management was well

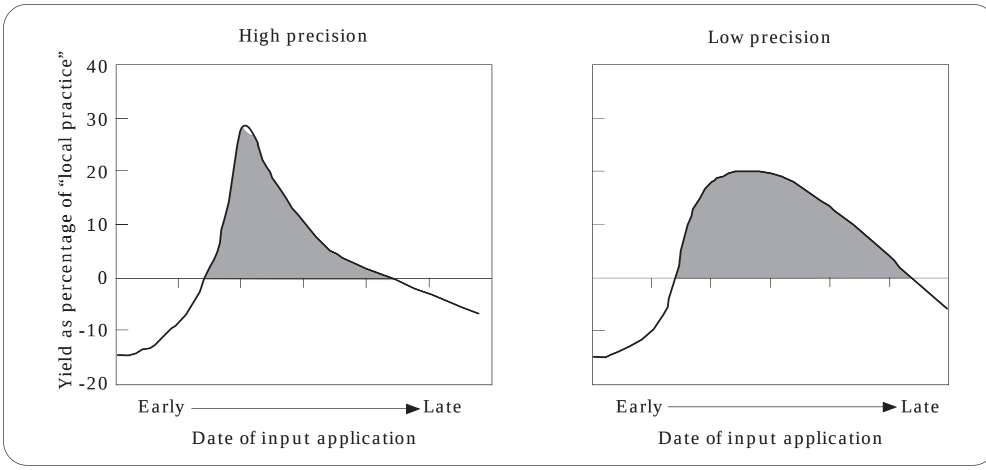

Figure 3. Comparing the "precision" and response of two different technologies.

suited to a low-precision system, where supplies of manure and other organic materials would be highly variable, and where opportunity costs of labor would be high. In contrast, researchers' management relied on much

Box 3

Integrating higher-precision scientist practice and lower-precision farmer practice in manure management in Zimbabwe

Farmer practice

- Managed for manure QUANTITY.
- Multiple materials were added to the manure regardless of quality (anthills, kraal sand, crop residues, sweepings).
- Local indicators of quality then determined how to use the resulting manure (broadcasting/banding, supplementation with top-dressing, used in gardens or field crops).

Scientist practice

- Managed for manure QUALITY.
- Selectively excluded low-quality (high C:N ratio) materials and covered pits to minimize N losses.
- Supplementation with inorganic inputs was inversely related to the quantity of high-quality manure produced.

Consultation between farmers and researchers showed that the many local criteria that farmers used to identify manure quality (which then guided manure use) could be matched with their earlier management practices. The addition of anthills and the feeding of supplements to animals, for example, corresponded with indicators that showed higher quality manure, which would be used in gardens or on field crops without top-dressing.

higher precision inputs, and was more concerned with generating high-"quality" manure (high nutrient content).

Engaging farmers and researchers in a participatory consultation process revealed the substantial differences in their priorities for manure management, and the different criteria they used to decide on its proper use. Combining the two sets of indicators for manure quality resulted in a set of testable recommendations for optimal uses that both farmers and researchers could then evaluate. This has since fed back into the research process as further management improvements. Farmers now make use of the resource quality criteria to manage and improve the manure while they are bulking it, and have broadened their repertoire of application techniques.

Formalizing the successes of participatory technology design

The participation process is not a recipe for success, but more of a checklist of issues that need to be considered when farmers and researchers collaborate. The experiences of TSBF in using increasingly participatory technology development processes have illustrated that certain concerns repeat themselves, and indeed must be addressed in a systematic manner.

The first is that serendipity has its limits. If the innovativeness of communities and individuals is to be nurtured, it is essential to foster the ability to recognize useful knowledge and patterns. This ability is self-reinforcing, but needs the support of farmers and researchers both collecting the right kinds of data and sharing that data amongst themselves.

A second issue that arises in PTD is that it is frequently driven by a relatively small core group of charismatic or dedicated individuals. Although such strongly motivated actors are essential to stimulating interest and mobilizing resources, the project or activity can ultimately be stifled if it remains centered on them for too long. One-on-one interactions cease to be effective after a critical mass of involvement is reached, and it becomes necessary to decentralize the decision making and leadership. The key challenge is to make a graceful transition from charisma-driven activities to institutionalizing bottom-up processes of leadership.

A final concern is that ISFM on its own rarely provides a compelling entry-point for research or development. While local communities eventually acknowledge soil fertility decline as a problem, it is not typically at the top of most lists of agricultural constraints until the soil has badly deteriorated. As a result, it is increasingly recognized that long-term soil fertility benefits can be better realized if they are generated by technologies that also provide more immediate impacts that farmers can readily appreciate, such as a readily marketable commodity.

To build confidence in the PTD process, it is important that the initial steps use relatively simpler technologies as entry points. The more that these are compatible with existing practices, beliefs, and needs, the more likely that farmers themselves will gain confidence in their ability to test hypotheses and learn from their experiments. Motivation and interest in the process are sustained if there are benefits that can be tested and observed in the short term, particularly ones that are economically profitable. Other useful benefits include technologies that have low initial start-up costs, reduce discomfort or save time and effort, or provide social prestige.

Managing Complexity

The fourth and final obstacle to taking ISFM to higher scales lies in the rapid increase in complexity inherent in moving to include multiple scales of action. On the one hand, this makes the task of monitoring and evaluating the spread of knowledge and practices, innovations, and adaptations difficult. On the other hand, it also increases the number and complexity of the actors involved. The targeting of future interventions therefore becomes complicated, with the increasing importance of gendered and other intra-group dynamics, and the political differences in resource control use and decision making.

Tracking innovations and adaptations

To paraphrase Marshall McLuhan's aphorism, in most cases of ISFM technology development, "the innovations are themselves the message". However, while farmers are adapting and modifying technologies, the beneficial outcomes of these innovations are "lost" if their findings are not fed back into the research and experimentation process of others, including formal research.

If cut-and-carry systems using *Tithonia*, for example, are being modified so that material is used in composting rather than for direct application on fields, the assumptions about material selection will also have changed. In the original cut-and-carry scenario, the "high"-quality material for direct application would be rapidly decomposing, low lignin, high nitrogen species such as *Tithonia*. In a composting scenario, material that breaks down rapidly might no longer be the optimal choice if the compost heap is built up over the course of 6 to 12 months or more, and new criteria will need to be developed based on the new assumptions.

A similar problem is arising in the use of legume cover crops, where users frequently mention "low palatability to animals" or "inedibility" (by people) as constraints to wider adoption. While it might be possible to find or produce varieties of *Mucuna* or *Canavalia* with greater food or fodder value, farmers who have seen the benefits of non-palatable legumes for soil fertility are more likely to be receptive to the introduction of other, dual-purpose species such as cowpea or soybean. Indeed, these farmers are the ones now demanding and experimenting with multiple-purpose species.

In both cases, the innovations have emerged from follow-up discussions held with farmers. It is important therefore to follow both the germplasm as it is spread to other households, and the knowledge being generated on its use. Ideally, farmers would themselves be keeping data as part of a participatory monitoring and evaluation network. This would also increase the perceived ownership of the technologies and ensure the collection of data relevant to local concerns. However, since outsiders are likely to be more interested in knowing how the knowledge and technologies are evolving, it seems only reasonable that a large part of the responsibility for tracking innovations should fall to them.

Targeting interventions

All of the preceding examples have demonstrated the complex, site- or actor-specific nature of many ISFM innovations. A given technology's potential will therefore vary greatly between different actors, and will not necessarily be appropriate to all socioeconomic, cultural, or agro-ecological conditions.

For example, the needs of marginalized groups, such as women farmers or the very poor, are different from those of more mainstream groups in kind and not just in degree. Technologies that are not directly developed by them, or targeted to address their needs explicitly, are not likely to meet those needs merely by coincidence. Appropriate and empowering strategies need to be followed, such as creating research groups for women only, or centered specifically around a given (marginalized) livelihood, such as households that sell much of their labor.

In general, community-based learning techniques have shown themselves particularly effective for ISFM research (Defoer et al., 2000). They accelerate the prioritization of local topics of interest, and situate ISFM within a much broader productive or livelihood context. The learning and research is therefore demand driven and problem oriented, and occurs in a setting that favours peer support and encouragement.

However, problems with community-based techniques remain numerous. Perhaps the most important is that most groups (either already existing or created specifically for the research tasks) tend to favor group stability over more dynamic aspects. This is fully understandable—groups exist in large part to share risks and enlarge individuals' capacities to access resources (Misiko, 2001). However, it is also true that when farmers' groups present themselves to others, much more emphasis is inevitably placed on the history, structure, constitution, and rules for inclusion or exclusion of participants than on experimentation per se, the actual generation of knowledge or presentation of accomplishments (Muruli et al., 1999). Table 1 shows that while many farmers ranked “access to new ideas” as the greatest benefit from their involvement in research groups, “experimentation” was not seen as a good in itself. Even though experimentation had been suggested as a benefit in the discussion preceding the ranking, it was clearly not given prominence. When asked to elaborate on their answers, most farmers defined “new ideas” as “technologies that work”, again highlighting the tendency to understand “solutions” as the product of the research rather than conceiving of research as a process.

Table 1. Ranking of selected benefits perceived to result from participating in farmer research groups in western Kenya (four communities, 85 respondents).

Perceived benefit	Frequency benefit was ranked (%)	
	Highest	Lowest
Access to new ideas	46	0
Links to outsiders	15	18
Access to new materials	11	6
Experimentation	6	21

The very principle of exclusive membership, defining an “in” versus an “out” group, also works against an interest in scaling out findings indiscriminately. It is therefore important to understand a group’s composition, history, and motivations before we can anticipate to whom and under what conditions learning will be disseminated (Misiko, 2001). The knowledge generated by the group can quickly become a valuable secret to be used for one’s own advantage, and not to be shared. In such cases, groups tend to reinforce existing power and gender relations, and participation in the research group is often motivated by potential access to outside resources that have little to do with interest in ISFM. If research or development projects arrive only rarely in a given community, it is hardly surprising that the initial volunteers are not always the best contacts (see the prominence given to “links to outsiders” as a benefit in Table 1).

Sharing Responsibility

Despite their complexity, these four obstacles to scaling ISFM up and out can be overcome provided that they are acknowledged, and partners take responsibility for overcoming them. This need not be a complicated process—consider that building shared expectations and assigning responsibilities are fundamental to most initial stakeholder meetings—but the barriers that partners themselves face in scaling ISFM out and up are still potentially great.

Formal sector

In the formal sector of government research or policymaking throughout the developing world, retrenchment and funding crises are the norm. Job insecurity is further coupled with a seemingly "fickle" climate of ever-changing donor priorities and obligations. As a result, "package solutions" are often still considered relatively attractive, because they are essentially self-contained or freestanding solutions that minimize the need for inputs or connections with other organizations or departments. Within agricultural ministries, the emphasis on food self-sufficiency and export priorities also are more likely to favor increased production objectives over more holistic strategies, such as ISFM. Finally, prevailing top-down information flows make it difficult for formal policy to receive or internalize bottom-up contributions, such as the views of farmers or field staff.

Professional insecurity, the competitive nature of inter-departmental or ministerial relations, and the enduring appeal of simple policy options over complicated ones will undoubtedly remain inherent to the formal sector. However, stakeholders in ISFM research should see the advantages of nurturing potentially sympathetic policymakers as advocates for ISFM strategies or components. At the same time, if the development of ISFM technologies is driven by the clients themselves, they will also be working to create and enlarge the livelihood opportunities those technologies will support.

Extension and nongovernmental organizations

Within state extension services, funding crises are even more acute, especially in sub-Saharan Africa where formal extension has been nearly paralyzed since the early 1990s. Thus, even with well-trained or self-aware staff, the lack of tools and resources severely limits extension's ability to feedback information between farmers and researchers. In many cases, extension agents are aware of farmers' attitudes and needs because of their presence at the grass roots, but there are not necessarily channels to internalize these, especially if extension is simultaneously obliged to carry out and promote official state policy. Problems also occur where extension agents have not received training in new methods or approaches, which may make them resistant or suspicious of "participatory" methods that might challenge their positions of local influence or power.

Community-based organizations (CBOs) and NGOs might offer viable alternatives to the formal organizations by virtue of their intensive and client-focused working styles. However, small-scale, NGO-led projects themselves often lack clearly defined pathways to scale their successes up or out, and usually can be expanded only by repeating the same slow, costly, in-depth techniques in successive communities. Certain types of technology—largely those that can be implemented individually—can spread laterally by farmer-to-farmer extension, but lateral spread that requires joint action is far less likely (Lovell et al., 2001).

Community participation should have the goal of building farmers' confidence with experimenting using new and existing knowledge, gradually increasing the levels of complexity that feel "manageable". Entirely "bottom-up" proposals for improvements limited to the possibilities already known to rural people are clearly not sufficient. The process must be open to the wider possibilities known to outsiders, and in a procedure for planning, implementing, and monitoring that allows outside agencies to verify that public funds have been spent properly (Farrington and Boyd, 1997).

Involving rural change agents in the research process, and making its outputs more accessible to them, could help insert ISFM more firmly into the fabric of community development strategies. This is particularly relevant where NGO and CBO agendas and budgets separate "environmental" from "agricultural" concerns, or put greater priority on the former than on the latter. From TSBF's experience, ISFM will rarely top any community's list of problems or priorities. However, addressing soil fertility issues is usually fundamental to solving many of the problems that do lead the list (food security, pest or water problems, low income, etc.). Because of its knowledge-intensive nature, ISFM presents an ideal starting place for community-development strategies that build local mechanisms to learn about learning (Maarleveld and Dangbégnon, 2002).

Conclusions

To see ISFM principles applied by a wide variety of actors at scales ranging from the farm level to the national or continental levels means addressing the problems of how to use knowledge gained at one scale to interpolate or extrapolate knowledge for decision making at another scale. To confront the four obstacles outlined in this paper, the experience of TSBF suggests the following resolutions.

Clashing expectations

The more client-driven the technology, the more likely the users will themselves have an interest in seeing the innovations scaled up and out. Farmer research groups typically share the researcher's desire to see successful outcomes replicated elsewhere (extroversion), as long as such scaling out is not at the expense of further and continuing problem solving (introversion) in the initial groups. It is never too early to introduce the ideas and the relationships that will be needed for future scaling up and out activities. Such discussions should be a part of initial stakeholder meetings, which already typically have the objective of establishing shared expectations and responsibilities.

Scaling up knowledge

ISFM will always be knowledge-intensive, and by its nature many of its management and decision-making processes will be highly interdependent. As such, facilitating the spread of knowledge requires clarity about which knowledge is needed in a given context. Identifying where this knowledge needs to be used, and by whom, facilitates the development of appropriate ways to enrich or supplement the existing knowledge and practices. The information needs of farmers require relatively detailed, practical, and accessible materials that are easily shared with others, while local officials or policymakers are more interested in syntheses and overviews of technologies, and the way that concepts fit together with other concerns.

Nurturing serendipity

In general, the greatest successes have come from matching the precision of technologies with that of the farming system. Lower precision technologies—for example, those using generalizable principles (such as resource quality) rather than emphasizing a particular species—are more amenable to further refinement by the users themselves. The innovation process inherent in PTD is iterative, such that the confidence inspired by mastering initial problems or technologies builds the innovators' ability and confidence to address greater complexity. Collectively developed successes are also more likely to endure longer than those that were the achievements, or "pet projects" of single, charismatic leaders or "model farmers".

Managing complexity

Finally, effective monitoring and evaluation is essential to successfully take ISFM to more users and higher scales. Without accurate record-keeping, and balanced appraisals of different innovations' results, recommendations for future steps risk being made purely on the basis of "faith" or ideological commitment to a given technology. Similarly, without knowing how soil knowledge fits within wider priorities, or an understanding of community dynamics (how different types of information are generated, disseminated, or kept secret locally), finding the appropriate channels for propagating new ISFM knowledge will tend to be a hit-or-miss affair.

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PART FOUR

Institutional Innovations for Scaling Out

Editorial Comments

The fourth and last section's five chapters examine institutional innovations that look forward towards new ways of scaling up and out.

Hesse discusses the new roles and responsibilities of libraries as they have adapted to the information technology age. Russell looks at the flip side of the coin in working out how modern information and communications technologies (ICTs) can contribute to rural, community-based innovations. Lundy examines "learning alliances" between researchers and development workers as a new, needed way to jointly maximize impacts of the "two camps". Beaulieu et al. discuss the potentials of working with local governments on their land use planning by offering geographic information systems (GIS) and map-making tools and associated analytical methods. Finally, Gurung and Menter examine the issue of mainstreaming gender-sensitive participatory approaches. In so doing, they provide a case study of the incorporation of both participatory research and gender analysis (GA) in the work of International Center for Tropical Agriculture (CIAT, the Spanish acronym) scientists and administration.

Has the Web made musty old libraries obsolete? Not at all according to **Hesse** in **Chapter 12**. This short, forward-looking essay updates and debunks some of the predictions that had librarians trembling with the advent of massive Web use. The predictions were:

- Most scientific literature will soon be available online.
- Most scientific literature will be retrievable via Web search engines.
- Bibliographic databases will become obsolete.

Despite decreasing budgets because decision makers have been more concerned about building information technology infrastructure, the roles of modern libraries have evolved and adapted to the times. The chapter contrasts traditional tasks and new responsibilities, points out that library use compared to Internet access is more affordable to users in developing countries, and describes the CIAT library's current global collaboration strategy.

Russell's Chapter 13 describes initial progress in a set of important, also forward-looking innovations: Hooking rural people up to modern ICTs, and working out ways to ensure that such "e" connections are successfully applied to rural development. The chapter describes the formation, organization, running, and functioning of a telecenter. The telecenter, operated by a nongovernmental organization (NGO), provides Internet access to interested individuals and groups, and operators who assist users as needed and help in turning information into community-based development initiatives.

Indeed, Russell succinctly points up the two crucial needs to "promote the creation of locally relevant content in forms that rural people can easily use" and to "foster a new local culture that encourages seeking, using, and sharing information". This latter meta issue is perhaps of relevance to all of CIAT's research and development (R&D) efforts. Necessary for the meeting of the two needs is the linking of specific local projects to the telecenter. CIAT is currently working with the telecenter and local groups in the establishment of community-based agro-enterprises.

The local information system being developed is comprised of a Web site and a network of local communications groups that identify and prioritize community information demands, seek and organize information, feed useful information into the Web site, characterize local channels of communication, develop information sharing strategies, and channel feedback from farmers to R&D organizations.

The chapter makes the very important point that, in terms of scaling out, CIAT's role will not be to extend access to ICTs, but to demonstrate how they can contribute to rural innovations.

Chapter 14, by **Lundy**, boils down to several assertions and to hopes that recently initiated projects will demonstrate the soundness of the sequence of assertions. This latter is comprised of:

- Donor agencies have come to "demand concrete development outcomes" at a time when financial assets of national agricultural research systems (NARS), and therefore development capabilities, are declining.
- Researchers "value...theory for its own sake, academic credentials, and complex research methods".
- Development workers "seek practical solutions to pressing problems, respect field experience and results, and favor simple effective methods".
- What is needed is successful collaboration between the "two camps", and that can be achieved via "learning alliances".

CIAT's Rural Agro-enterprise Development Project has begun testing the sequence of assertions (and especially the last one) by initiating collaborative work with CARE-Nicaragua and Catholic Relief Services in

East Africa. These collaborating NGOs can and do reach more communities over greater areas than can the Consultative Group on International Agricultural Research (CGIAR) centers with their typical "benchmark site" approach.

It is and will be unquestionably very important for the CGIAR Centers to determine if greater development impacts can be made through such alliances. In fact, over the last decade, the Centers have been repeatedly asked to work with NGOs explicitly in order to help scale up and out. The chapter suggests various elements thought to be necessary for such collaboration to be effective.

The chapter's drawing of spurious dichotomies, however, might not be helpful. The picture painted of the scientific nerd vs. the valiant development worker seems overdrawn. Scientists, especially those in the CGIAR over the past 25 years or so, to a great degree share the same goals as development workers. Science, however, is concerned with not only heading in the "right" direction, but also with *not* heading in a "wrong" one. One of my colorful agronomist colleagues screening germplasm in a small, NARS-less county in S.E. Asia continually threatens manslaughter charges against NGOs taking new materials to farmers if those materials fail after adoption and insufficient multi-season testing. Although the example is perhaps extreme, the lesson is not: In this case, both researchers and NGOs share the same development goals, but disagree as to how to achieve those goals. We continue in that country to search for ways to reconcile the two sides, to get materials out for testing by farmers as soon as possible, but with adequate controls over the process in order to avoid disasters.

The above quibble, however, does not take away from the important proposition of the work underlying this chapter: Alliances between research institutions and development NGOs may well be one of the ways for both sides to better achieve their (shared) development goals.

Chapter 15, by **Beaulieu et al.**, describes work by CIAT's Rural Planning Group of the Institute of Rural Innovation with local governments in Colombia. The latter are now required to develop land use plans; and the CIAT group has worked with a selected municipality to develop and test a set of innovative methods based on GIS.

Described are the introduction and use of GIS and mapping tools, and of "vision based planning". This latter is an exercise to clarify development objectives. Indeed, this "method aims at helping planners and stakeholders identify the questions that will guide the collection and analysis of information…" So far so good: Planners do need to know where they want to go. What is not overly clear in the chapter, however, is to what degree the GIS tool users are like the mythical economist who says, "Tell me what answer you want and I'll get the data (and analytical tool) to prove just that".

Time will be needed to determine if and to what degree:

- Land use planning by local governments helps to achieve their development goals;
- The GIS and mapping tools contribute to the success of such planning;
- The goals identified by the "vision-based planning" turn out to be equitable, feasible, and desirable; and
- Processes and variables left unanalyzed in the planning prove to be of importance to the success or failure of meeting development goals.

In sum, time will be needed to determine if information needs were correctly established and if information was then adequately analyzed in order to achieve development goals. Such analysis commonly calls for economic and market analysis, analysis of risks and constraints, and analysis of dynamic scenarios more and more affected by global forces. The authors are well aware, moreover, of the dangers of their important work with local governments falling prey to the whims of ever-changing politicians and political regimes.

Gurung and Menter (Chapter 16) first discuss the importance of mainstreaming gender-sensitive participatory approaches, and then recount results of a survey of CIAT scientists regarding their thoughts and experiences with participatory research (in areas ranging from plant breeding to natural resource management) and GA.

The chapter first explores at length reasons underlying the need for demand-driven research sensitive to more marginal groups, such as women and children, and the apparent reasons for a general lack of institutionalization of such approaches.

The second part of the chapter, the CIAT case study, seeks answers to two questions:

- What type of critical mass of participatory research and GA expertise exists in CIAT?
- What is the nature of "organizational adaptability" in terms of new approaches to innovation?

Discussion of the findings is extensive. A peek at the conclusions, however, reveals that (a) although CIAT has extensive experience in and commitment to participatory research by scientists and leadership, (b) GA is missing from most projects; (c) willing leadership has been necessary but not sufficient to bring about needed change; and (d) forums, rewards, and incentives are needed to "mainstream demand-driven approaches to innovation".

An alternative, optimistic interpretation of the authors' overall analysis is that GA is suffering from a time lag. As the CIAT study shows, and as would be repeated in most of the CGIAR centers and many of their partner

NARS, participatory research took some time and effort to gain its foothold in the CGIAR, but has since become largely mainstream and institutionalized. It can only be hoped that GA and meeting the needs of poor rural women will meet a similar, positive fate in the near future.

Finally, GA is at a point when it needs to pay its dues. Although no one can imaginably be somehow *against* GA, case examples often present near-trivial examples of how women's inputs resulted in the identification of the need for some different twist on available types of innovations. The question that needs attention is, "Can research that includes and responds seriously to GA show significant positive impacts on large numbers of poor women in given regions or agricultural systems?"

The CIAT case example, nonetheless, represents almost always needed, but most often missing, institutional self-examination and analysis. It can only be hoped that CIAT's management considers and acts appropriately on the issues raised.

Chapter 12

Rules and Tools Behind the Scene: The Library's Role in Knowledge Sharing

*Edith Hesse**

Introduction

Since the start of the massive use of the Web in the mid 1990s, the way we carry out our work in research and development has changed markedly. These changes have given rise to speculations about the future role of libraries. Some people predicted a diminishing role, claiming that most scientific literature soon would be available electronically via the Web, and that powerful search engines, such as Google or Altavista, would make obsolete the classifying and indexing work done by librarians and other information management (IM) professionals. However, most research librarians have taken quick advantage of the changes, and have embraced the Web as a platform to reach a broader audience with better and more efficient services. Moreover, librarians and other IM professionals are increasingly assuming new roles and responsibilities, and their skills in organizing large amounts of data for specific user groups are in high demand, thus making them attractive members on multi-disciplinary knowledge teams (Klugkist, 2001). This short chapter attempts to shed some light on the evolving role of libraries in the Information and Knowledge Era.

Libraries and the Web—Predictions and Realities

Predictions made about the possible diminishing roles of research libraries have not come true (Weston, 2002). Some of the predictions are reviewed below and contrasted with realities.

Predictions

Most scientific literature will soon be available online. Large publishing houses have moved quickly towards making their journals

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accessible via the Web. To date, about 20,000 scientific journals are accessible online, of an estimated total of 200,000 (Harnad, 2003). Online full-text access is usually provided for the most recent volumes and years, although a few publishers are making efforts to scan historic collections for online accessibility. Smaller publishing houses are catching up only slowly, particularly in developing countries. The International Network for the Availability of Scientific Publication (INASP; www.inasp.info/ajol/) has provided valuable help enabling access to currently 160 African journals (mainly table-of-contents and abstracts, and accompanying them with document delivery services). The Scientific Electronic Library Online (SciELO; www.scielo.org) also facilitates free full-text access to about 100 peer-reviewed Latin American scientific journals.

Many publishers provide initial free trial access to their journals, but soon advise the user to register and to pay for personal or institutional subscriptions. Developing country researchers and institutions usually cannot afford to pay, and are switching to free information sources that often are not peer reviewed, thus contributing to the bias against quality research. This tends to further increase the already existing “digital divide” between rich and poor, and north and south.

Several “open access” journals have become available over the past few years, and many adhere to strict peer review processes in the same way as commercial refereed journals. However, their number and coverage is still limited (Suber, 2003). (A listing of licensed and open access journals of interest to staff of the International Center for Tropical Agriculture [CIAT, the Spanish acronym] and collaborators is available in: www.ciat.cgiar.org/biblioteca/electronic_journals.htm)

Most scientific literature will be retrievable via Web search engines. Search engines, such as Google, Altavista, and others, have become powerful and can retrieve important and highly relevant results. However, only a small percentage of current scientific literature is actually available online, the amount varying greatly by subject area (Herring, 2001). Furthermore, users are usually overwhelmed with hundreds or even thousands of hits, and have difficulty filtering them either by range of years, subject category, language, geographic indicators, or other relevant criteria.

Bibliographic databases will become obsolete. Most bibliographic databases, whether commercial or free access, global or institutional, have been made available via the Web. They are used a great deal for complex and comprehensive literature searches, and often constitute the backbone for many other value-adding services. With over 2 million new scientific articles published every year (Harnad, 2003), well-structured databases and XML-indexed Web information is a must, especially since the number of scientific articles is estimated to double every 15 years, because of advancements in science, increasing specialization, and more recently the rapidly increasing number of doctorates in countries such as China and India (Meier, 2002). Knowledge workers are rediscovering standards, methodologies, and knowledge taxonomies (also called thesauri—see www.fao.org/agrovoc or ontologies—see www.fao.org/agris/aos/About.htm) developed and refined by librarians and other IM professionals over the past 30 years. Classifying and indexing done by librarians and other IM specialists is still an important task, although artificial intelligence applications can facilitate some of the work.

Based on what has been outlined above, the prediction that libraries will play diminishing roles has not come true. On the contrary, library knowledge and skills are in high demand, and librarians and IM specialists are important members of numerous multi-disciplinary knowledge teams (see also list below Evolving Roles of Libraries).

Realities

Over the past several years, many libraries have had to cope with decreasing budgets because decision makers have been more concerned with building and strengthening the information technology (IT) infrastructure. Furthermore, decision makers rarely use scientific literature themselves; rather they delegate literature search tasks to their assistants. These facts, combined with the uncertainties about the future role of libraries in light of the predictions above, have contributed to the weakening of many libraries.

Today, however, the crucial role of libraries in development and democratization processes is in little doubt. Particularly in developing countries, young researchers and students will not be able to afford home computers and pay for Internet access. Although the number of Internet cafes is increasing in urban areas, certain licensed materials will be available only via institutional computers. Most scientific journals available to non-profit institutions in developing countries at low or no cost will be controlled via Internet Protocol (IP) authentication. Each institution has been assigned a range of IP numbers by the respective national Internet domain agency. Publishers use these IP numbers to control and monitor access to their information resources. Librarians, together with their IT departments, will have to implement proper user authentication procedures and policies.

Publishers providing free or low-cost access to their electronic resources in developing countries are concerned that these special access privileges might be misused. They cannot afford to lose out on markets in private sector institutions in developing countries, nor in public and private institutions in countries in the north. Consequently, they see librarians as their natural allies in making sure that access privileges and copyright regulations are fully understood and respected accordingly.

Evolving Roles of Libraries and Information Management Professionals

Librarians are assuming new responsibilities, but still need to carry out their traditional tasks. For example, they will have to educate users about copyright regulations. Under the European Union Copyright Directives issued in April 2001 (European Union, 2001), each country had to implement new copyright regulations by December 2002 that differ from country to country. The US Digital Millennium Copyright Act (DMCA) was implemented in 1998, and its implications are still under debate because regulations now are considerably more restrictive than they were in times of paper-based documents (Lutzker, 2001). Librarians will also have to negotiate electronic usage licenses, and handle publishing permissions to populate their virtual library Web sites. The list below gives new and traditional librarian tasks.

Traditional tasks	***New responsibilities***
Selection	Copyright and fair use
Acquisition	License negotiations
Classifying and indexing	Publishing permissions
Serials management	Standards, methodologies, metadata
Preservation	Digital preservation
Bibliographic searches	User training (electronic resources)
Document delivery	Multi-disciplinary knowledge teams
User orientation	

As already pointed out, the standards, methodologies, and tools developed in libraries in the 1970s, when computers became widely used, are now becoming important tools for knowledge representation systems on the Web (Berners-Lee et al., 2001). Multi-lingual knowledge taxonomies, such as the AGRIS thesaurus and classification schemes, are regaining importance as metadata indexing tools.

Preserving electronic resources for future generations becomes an increasingly challenging task (Schaffner, 2001), particularly as people are noticing with concern the ephemeral nature of Web-based content. Policies and procedures on how best to handle the preservation tasks are currently being discussed at the institutional and national levels, and librarians are making important contributions to this debate.

Furthermore, librarians provide training on electronic information resources, participate in multi-disciplinary knowledge teams that establish Virtual Libraries and prepare other Web contents (e.g., e-learning materials), and are generally involved in a variety of knowledge-sharing and capacity-building initiatives (Rosenfeld and Morville, 1998).

CIAT Library Global Collaboration Strategy

CIAT's library is involved in numerous information-sharing initiatives at local, national, and international level (Figure 1), and provides advice and training to many Colombian IM professionals, to professors and researchers in collaborating academic and research institutions, and more recently to coordinators of telecenters and rural information systems.

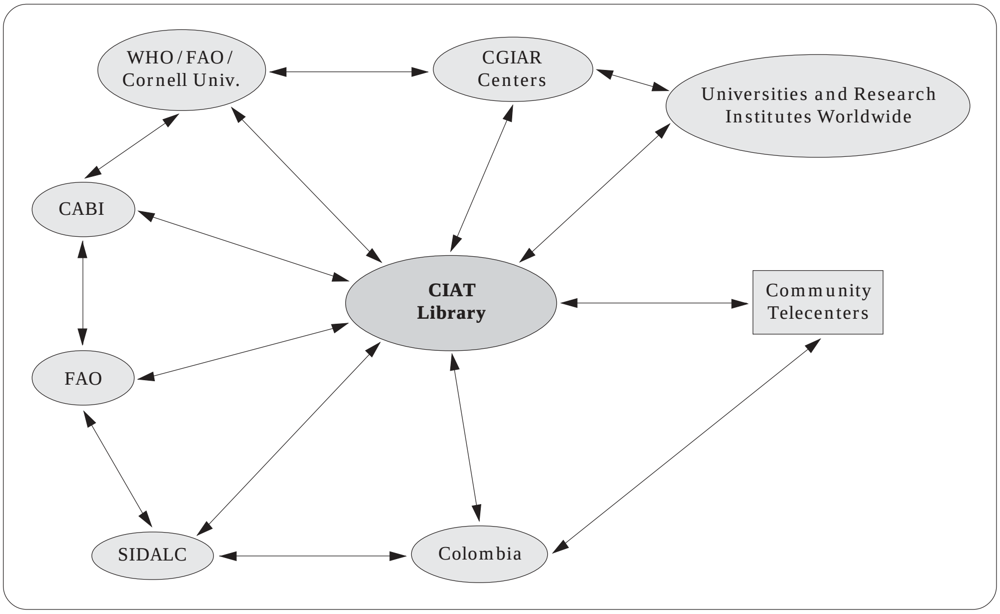

Figure 1. CIAT's library strategy for global collaboration (acronyms are given on page 287).

At national level, CIAT's library actively collaborates with the Agricultural Information System of the Cauca Valley (SISAV, the Spanish acronym), with a CIAT-led telecenter project in the Valle del Cauca (InforCauca), and with the Colombian Agricultural Information and Documentation Network (RIDAC, the Spanish acronym). At regional level, the library is an active participant in the Information and Documentation System of Latin America and the Caribbean (SIDALC, the Spanish acronym), submitting its in-house databases to the AGRI2002 bibliographic database on a regular basis. At international level, CIAT collaborates with the Food and Agriculture Organization (FAO), the World Health Organisation (WHO), Cornell University, and with major publishers to implement Access to Global Online Research in Agriculture (AGORA), an initiative to make scientific journals in the agricultural and environmental sector available free or at low cost to developing countries. Participation in the global AGRIS network and the Consultative Group on International Agricultural Research (CGIAR) InfoFinder (http://infofinder.cgiar.org/) ensures that CIAT research results are accessible to global audiences. The recently created CGIAR Library and Information Services Consortium (CGIAR-LISC) will result in broader access to scientific journals for all 16 CGIAR centers (Ramos et al., 2003). When fully implemented during 2003, CIAT researchers and library walk-in clients will gain access to 350 scientific journals, at practically the same subscription price the library has been paying for its 70 current subscriptions. In addition, CIAT continuously updates the CGIAR journal catalog, an important tool for library collaboration and document delivery services (see www.icrisat.org/text/partnerships/srls/srls.asp).

Conclusion

There is clear evidence that libraries will be playing progressively more important roles, because scholars heavily depend on scientific information resources usually only accessible via libraries. Increasingly, non-profit institutions in developing countries are granted access privileges for high-quality scientific literature at no cost or discounted prices. However, this access will be tightly controlled via IP authentication. Librarians will not only select and manage these important resources, but also be responsible for implementing proper user authorization processes and policies, as well as promoting these resources with staff and library walk-in users. Decision makers will have to take decisive steps to support their libraries, recognizing their crucial role in democratic development processes, and in bridging the digital divide between rich and poor, and north and south.

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CHAPTER 13

Is There an "E" in "Scaling Up"? Lessons from a Community Telecenter in Southwestern Colombia

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Introduction

Developments in electronic communications have created many new uses for the letter "e"—"e-commerce," "e-learning," "e-governance," and so forth. These terms point to some of the ways in which modern information and communications technologies (ICTs) are changing how millions of people work and live. Against that background, it makes sense for the International Center for Tropical Agriculture (CIAT, the Spanish acronym) to ask how ICTs—especially the Internet—might serve in our efforts to help the rural poor build sustainable livelihoods.

In dealing with that question, this chapter first considers the larger context of the "information society" and the "digital divide." Next, it describes the community telecenter as one means of enabling rural people to participate in the information society, focusing on the experience of a rural telecenter in Colombia's southwestern Cauca Department. Finally, the chapter offers some thoughts about how CIAT could scale up the use of ICTs for rural innovation.

The Information Society

That we now live and work in an information society has long since become a truism. The effects of the information revolution are, however, unequally distributed. While some people, those who can afford and wish to apply ICTs, are seeing radical changes in their lives and work, others, especially in developing countries, remain in a comparative information vacuum. The term "digital divide" is commonly used to describe this gap between information "haves" and "have-nots" (Morrow, 2002).

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In recent years, many organizations concerned about poor people being excluded from the information society have begun trying to make ICTs more widely available and beneficial to marginalized groups in society (Chapman and Slaymaker, 2002). Initially, these technologies tended to be seen as something of a panacea. Some people assumed that just extending Internet access to the poor would necessarily result in large economic and social benefits. But, increasingly, the information society is being examined from a more critical perspective (Gómez et al., 2001; Gómez and Casadiego, 2002). Experts now remind us that, while the information society offers huge promise, it also has some obvious pitfalls, which we must try to avoid.

What the information society promises is easier access to education, health care, technology, and many other services and goods (Agenda de Conectividad, 2003). It might also lead to more transparent governments and more equitable societies (APC, 2003). In addition, it offers new opportunities for community-based networking, and for increasing knowledge flows from large institutions to small communities and back again.

All of that sounds quite appealing, so what are the pitfalls? In the first place, the Internet remains available only to a privileged few; access is especially limited in rural areas. And unless steps are taken to close the so-called "digital divide," it is feared that the information society will merely create a new form of inequity that further distances the poor from the privileged. Another worry is that the Internet will become so dominated by corporate interests that it fails to serve development ends (CRIS, 2002). Then, there is the issue of intellectual property. Crop scientists at CIAT and elsewhere have already seen how this can complicate their work on plant genetic resources. It can frustrate knowledge flows as well.

In this setting, several global ICT initiatives of importance have emerged. Their overall purpose is to create a better policy and institutional environment for the many local, national, and regional ICT projects now under way (ITU, 2003). And they work toward this end in the usual ways—by forging global strategies, convening stakeholders, building partnerships, and so forth. Many such activities took place in preparation for the first part of the World Summit on the Information Society, held in December 2003 at Geneva, Switzerland.

CIAT should pay close attention to those deliberations—just as we did to the World Summit on Sustainable Development. As we follow the dialog on ICTs for development, I suggest that we pose two questions. First, what are some opportunities for bridging the digital divide by putting ICTs to work for rural people? And second, what specifically can CIAT do to seize those opportunities?

Putting Information and Communications Technologies to Work for Rural Communities

To some extent, these questions are addressed in CIAT's new strategic and medium-term plans. But even before or as those plans took shape, we were already moving forward with two ICT initiatives that extend benefits from the information society to rural communities. The first involved the development of a product-based CIAT Web site, and the second was a pilot project focusing on community telecenters.

The heart of the center's Web site consists of a series of options that offer access to the whole range of CIAT products—everything from plant genetic resources to tools and methods for research and development (R&D). The site also features a cluster of subsites corresponding to center projects. So far, 12 of these have been developed, and several more are in process, so shortly we should have subsites for all CIAT projects as well as for key regions in which the center works (specifically Africa, Asia, and Central America). These subsites provide further access to our products, and news and other information about ongoing research.

The number of visits to the site has grown exponentially since it was launched early in 2002. By May 2003, the site was getting about 125,000 visits per month, of which about one quarter were to the site's product catalog. Also, thousands of visitors each month are downloading PowerPoint presentations and Portable Document Format (PDF) files (accessed directly from search engines as well as from somewhere within the CIAT Web site) containing center publications and documents. Especially popular are the materials on agro-enterprise development. For example, in May 2003, PDF files for agro-enterprise documents were opened more than 140,000 times, although we cannot tell how many people actually downloaded the documents.

Our second effort to show how the information society can be extended to rural areas was the InforCauca Project, which supported three telecenters in southwestern Colombia. Among other functions, the telecenters offer public access to ICTs in poor communities. A central aim of InforCauca was to determine how ICTs could better enable organizations and individuals to work toward sustainable development.

With funding from the International Development Research Centre (IDRC) and the Rockefeller Foundation, the project was conducted jointly by CIAT and the Self-governing University Corporation of the West (CUAO, the Spanish acronym), together with various community organizations. InforCauca generated important impacts for the organizations and communities involved, and it was a rich learning experience that pointed the way toward further work with ICTs in Colombia and other countries.

But do those initiatives provide an answer to the question posed in the title of this chapter? Certainly, electronic publishing—especially CIAT's new Web site—appears to help disseminate the center's research products. Also, the telecenter project suggests how Internet access can be extended to rural areas and applied for rural development. So, perhaps it is just a matter of time before large numbers of rural people can easily access research-related information from CIAT and others via the Web.

Possibly so, but obviously disseminating products is one thing, while getting them adopted and used is another. As Menter et al. (this volume) point out, the real challenge is in scaling up rural innovations that involve complex and knowledge-intensive research products. Among other requirements, they tell us, this needs participatory approaches for working with end-users, as well as training and support networks that help rural communities adapt complex innovations to different conditions.

A Rural Community Telecenter in Colombia

Thus, in asking whether there is an "e" in scaling up, what we want to know is whether the combination of electronic publishing and telecenter development can help us meet that challenge in all its complexity. Or, to put it another way, can these interventions facilitate "learning alliances" and other strategies for scaling up rural innovations? To find answers, let us now consider the experience of one rural telecenter, located in the town of Tunía in central Cauca Department.

A distinguishing feature of this and other telecenters supported by InforCauca is that local development organizations host and support them. As suggested later, this is not the only telecenter model. But we think it is the best one for linking the use of ICTs to development, and for ensuring that the telecenters achieve both financial and social sustainability.

The telecenter at Tunía operates within a local nongovernmental organization (NGO), the Corporation for the Development of Tunía (CORPOTUNÍA, the Spanish acronym), which has 15 years of experience in conducting integrated development projects. Since the late 1990s, the organization has gained much experience in organizing farmers to create small rural agro-enterprises, using the territorial approach for agro-enterprise development devised by CIAT and various national partners in recent years. CORPOTUNÍA's leaders have a clear vision of how ICTs can facilitate that and other development initiatives, and they are competently managing the telecenter.

The telecenter at Tunía did not find such a good host overnight. It took about 18 months of experimenting with different kinds of arrangements, involving at one point an association of six organizations. The telecenter was also placed at other locations—a rural school and the local cultural center—before finally being moved to CORPOTUNÍA.

Despite its instability during that period, the telecenter at Tunía made important gains. The telecenter operators, who had never worked with computers before, became proficient with basic computer software through training and experience. They found out about information sources and applications available on the Web that might interest their community. And they learned the basics of Web publishing through a course and follow-up support from a consultant.

Also, they began building a client base for the telecenter through personal contacts, promotion in local schools and events, and by organizing computer courses. As a result, the telecenter now has a steady stream of users, who reach it on foot, by bicycle, or by bus. For a modest fee of 1,500 pesos (about US 50 cents) per hour, they can do Web searches, send e-mails, and prepare documents, in addition to receiving basic orientation to these services.

A few characteristics of telecenter users are worth noting, determined through a baseline survey (Mosquera and Johnson, 2003). As one might expect, they tend to be young. The users surveyed ranged in age from 9 to 60, but had an average age of 26. This underscores the potential of telecenters for providing opportunities to rural youth. As one would expect also with "early adopters" of any innovation, telecenter users tend to be better educated than the general population. Almost half of users have at least finished secondary school. Most of them were visiting the telecenter in connection with their studies or work, or to maintain contact with family or friends living abroad. One user, for example, found out she could get a free e-mail address for her flower producers' association. Then, she realized it could be included in the agro-enterprise contact list on CIAT's Web site.

So, the Internet is starting to find a place in these users' lives and work. And it complements the other means by which they obtain or share information, such as radio and television.

Content and Culture

Evidently, however, the mass media in Cauca are not satisfying people's need for information in areas such as education and training, marketing of agricultural produce, production technology, and health. They mostly obtain this type of information from printed publications, such as leaflets and pamphlets, which are not very timely or widely available. Clearly, there is an important opportunity to provide people with development-related information via the Internet.

Nonetheless, just making information available on the Web and making ICTs more widely accessible in rural communities cannot guarantee that people will use these resources to make local agriculture more competitive, to protect fragile agro-ecosystems, and to work toward other important social aims. Rather, local organizations must deliberately and systematically incorporate the use of ICTs into community-based development initiatives.

For this purpose they need to achieve two key ends. First, they must promote the creation of locally relevant content in forms that rural people can easily use. Second, they must foster a new local culture that encourages seeking, using, and sharing information. What can CORPOTUNÍA and its telecenter do to help serve those purposes, beyond offering basic Internet and computer services? Apparently, quite a lot, and the answer lies in local projects, linked to the telecenter. Over the last year or so, CORPOTUNÍA has played a key role in developing or carrying out several projects that create local content or foster a new information culture.

With Colombia's Ministry of Communications, CORPOTUNÍA carried out one of these projects independently of InforCauca. Over the last few years, the Ministry has implemented a massive social telecommunications program called Compartel (www.compartel.gov.co). The program has set up 670 Internet access centers in small rural communities throughout the country; about 20 of these are located in Cauca. Each center has two computers with Internet access and is run as a small business, often within other businesses, such as pharmacies and hardware stores.

One shortcoming of the Compartel model is that it lacks an inherent mechanism for linking the use of ICTs to local development. In an initial effort to remedy this problem, Compartel carried out a 1-year program to provide training for selected organizations in every community where Compartel centers exist. In addition, proposals were invited from these organizations for local projects aimed at applying ICTs to development.

During the program's planning stage, its leaders visited the telecenter at Tunía and liked how it was being run. Taking advantage of this opportunity, CORPOTUNÍA offered to implement the Compartel training initiative in all of Cauca and Valle Departments. It could take on this task because it was the only organization available with practice in running a community telecenter. The training initiative gave CORPOTUNÍA extra resources and experience.

More importantly, however, it pointed the way to a more ambitious role for CORPOTUNÍA and its telecenter. To further explore that role, CORPOTUNÍA submitted a proposal for a research project to Colombia's Institute for the Development of Science and Technology (COLCIENCIAS, the Spanish acronym). Under way since March 2003, the 1-year project is comparing five different kinds of community organizations in central Cauca for their potential to identify and promote development applications of ICTs.

Meanwhile, CORPOTUNÍA has undertaken another ICT project financed by a Spanish foundation. Its purpose is to create a virtual network for students from secondary schools in Bolivia, Colombia, Morocco, and Spain. The project is part of a strategy to combat prejudice in Spain against immigrants from developing countries. CORPOTUNÍA is coordinating the project throughout Cauca and Valle Departments.

Community telecenters in the hands of local organizations evidently have much potential as focal points for ICT project development, and this can contribute importantly to the telecenters' financial and social sustainability.

Adding Value to Participatory Research

One project in which CIAT works closely with CORPOTUNÍA suggests even more concretely how local organizations operating community telecenters can help organize rural people to build local content and a new information culture. The purpose of the project is to devise an approach for creating local information systems that offer vital business support for rural agro-enterprises. The work is organized around seven priority market chains identified by a community-based, agro-enterprise development committee, which CIAT supports, and in which CORPOTUNÍA participates.

The information system has two main components. The first is a Web site that combines important knowledge from farmers' experience with relevant information available from a wide variety of organizations. The other consists of a network of local communications groups made up of representatives from various farmer associations. The groups' main tasks are to:

- Identify and prioritize the information demands of their communities in collaboration with community telecenters;
- Seek and organize information (from local and other sources) that meets those demands;
- Feed useful information from local experience and experimentation into the Web site;
- Characterize local channels of communications;
- Develop and implement communications strategies for sharing useful information widely through community radio, meetings, bulletin boards, and other means; and
- Channel feedback from farmers' experience to R&D organizations.

These groups are to some extent akin to Local Agricultural Research Committees (CIALs, the Spanish acronym) and to other types of stakeholder groups formed through participatory approaches. Much experience in Africa, Asia, and Latin America has shown that such groups can be relatively effective in adaptive research, agro-enterprise development, and rural planning (Fujisaka, 1999). If farmers can carry out such complex tasks with only modest support from formal R&D organizations, then surely they also can become effective communicators, with appropriate training that builds on strong local traditions of information exchange.

Local communication groups, linked to community telecenters, thus can help construct and share the knowledge farmers need to make their journey to sustainable livelihoods. And by doing so, they can add tremendous value to the participatory approaches that CIAT and other organizations have designed to help farmers reach that destination.

Moreover, local Web-based information systems, developed with the aid of local organizations, should provide farmer groups with electronic platforms for sharing their experience and insights with rural people at other locations. Such information sharing among farmer groups could contribute to scaling out participatory approaches through CIAT's learning alliances with international NGOs, such as CARE International and Catholic Relief Services (CRS).

Scaling Out the Use of Information and Communications Technologies for Rural Innovation

In the light of that experience, how should CIAT respond to new opportunities for putting ICTs to work on behalf of rural people?

First, I want to emphasize what we should not do. Obviously, it is not CIAT's job to extend ICTs on a massive scale to rural areas. We can leave that to government programs such as Compartel, to civil society organizations, and to private initiative, as reflected in the expansion of Internet cafes in small towns.

Occasionally, however, we probably will need to contract telecommunications experts to achieve connectivity for ICT projects in specific places. This will be necessary especially if we work in countries such as Honduras, Nicaragua, and Bolivia, where the infrastructure of telecommunications is less advanced than in Colombia. The main aim of this work will be, not so much to extend access to ICTs, but more to demonstrate how they can contribute to rural innovation.

A key requirement for demonstrating the potential of ICTs is having more content available in electronic form that is truly relevant to rural development professionals. CIAT can help do this, but we need to show more institutional commitment. Our product-based Web site is at least a step in the right direction.

We also need to explore the possibilities for sharing our tools, methods, and information more effectively through e-learning, or Web-based distance education, and through the development of dynamic multimedia products on CD-ROM. This requires new partnerships with universities and other organizations possessing expertise in those areas.

But even those steps will not be enough. Our experience with CORPOTUNÍA suggests that a lot of what people want to know is available locally in the filing cabinets of organizations, or in the heads of technicians and innovative farmers. With CORPOTUNÍA, and with communications groups in rural communities, we are learning how to put this information and knowledge to work. One of the main lessons we have learned so far is that community telecenters can serve as focal point for developing projects to achieve this end.

In addition to making the telecenter financially and socially sustainable, these projects are creating locally relevant Web content, and fostering a local information culture. I believe they also can lay the foundations for on-line networks of innovative rural people, who want to share their knowledge and experience with one other, and express their needs and demands to R&D institutions.

So, how can we take advantage of what we are learning with CORPOTUNÍA about the role of telecenters in developing projects that lead to information and knowledge sharing? I argue that we need to scale up this experience, following much the same steps that Menter et al. (this volume) outline in their chapter.

The first step is to begin incorporating what we are learning from the telecenters into CIAT projects. Actually, this is happening already. CIAT's Agro-enterprise Project, in particular, is closely involved in communications and information initiatives that have grown out of the InforCauca Project. Through InforCauca we have learned how to build the capacity of local organizations to use ICTs for development, and with them we are learning how they can extend that capacity to farmer groups. There is much scope for expanding this work to other countries.

As I pointed out earlier, the InforCauca Project has been a rich learning experience. And it gives high priority to monitoring and evaluation of impact, and to documenting the project's experience. This should give us a solid basis for continuing the learning process through other projects in other countries.

Obviously, partnerships with local NGOs have been critical to our work with InforCauca. But we have found also that local universities can play a vital role in providing NGOs such as CORPOTUNÍA with technical backstopping, training, and other support. In addition, we believe that if CIAT wants to develop further ICT projects we will need to develop strategic alliances with various international organizations with strong capabilities in this area.

Of course, we will need new donor funds as well. But it just so happens that the main donors funding ICT projects these days are the same ones funding CIAT's research on tropical agriculture—aid agencies, foundations, and so forth. Many of these organizations have established special programs on ICTs for development, and CIAT is trying to tap those sources of funds.

This means we have an excellent opportunity to develop projects that incorporate the use of ICTs into ongoing work on agro-enterprise development, integrated pest management, participatory research, rural planning, and the like. By doing so, we can give our traditional donors one more reason to support CIAT, and one more way to help rural people build sustainable livelihoods.

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CHAPTER 14

Learning Alliances with Development Partners: A Framework for Scaling Out Research Results

*Mark Lundy**

Introduction

How can research findings be translated into effective development outcomes that improve the livelihoods of the rural poor on a broad scale? Questions like this are often raised regarding international agricultural research, and the Consultative Group (CG) centers in particular, given their global mandates of food security, improved livelihoods, and sustainable resource management. In the case of the International Center for Tropical Agriculture (CIAT, the Spanish acronym), the internal debate about how best to move from research to development outcomes through "going to scale" or "scaling out" was the subject of the Annual Review in December 2002. This chapter forms part of that debate.

In the past, CG centers sought to disseminate their research through scholarly publications, seminars, and training sessions targeted towards national agricultural research systems (NARS). Many of these efforts used a traditional Transfer of Technology (ToT) approach in which it was assumed that technological advances generated by a CG center could be transferred through training or publications to NARS scientists who would, in turn, deliver these improved practices to the farmers. Although important advances were made—most notably the productivity gains of the Green Revolution—the ToT model has been widely criticized. As a result, the CG has identified, developed, and to varying degrees adopted a more nuanced approach using tools such as farmer participatory research (FPR) to better identify farmer needs and adapt technological solutions to myriad local conditions. However, FPR also faces limitations when the issue of scale is brought into play. To be effective, participatory approaches require a high level of interaction between researchers and farmers, and while millions of small-scale farmers exist throughout the developing world, the number of CG scientists engaged in FPR is limited. Thus, only a small

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fraction of the rural poor can be reached directly through these methods (Gonsalves, 2001).

While some centers invested in strengthening NARS' capacities to carry out participatory research, international policies of lean government and reduced public sector spending have reduced both the capacity and quality of NARS in large parts of the developing world. This is clearly the case in most of Latin America and parts of Africa, where some NARS have been abolished completely to be replaced by private sector technical assistance firms.

At the same time, international donor agencies that support agricultural research have begun to demand concrete development outcomes from the centers they support. These demands tend to focus on ex post impact evaluations and often seek to justify, using cost/benefit analysis, monies invested in agricultural research. Within a context of weakening NARS, persistent global problems, and limited staff, many CG centers have difficulties showing the quality and quantity of impacts that are increasingly requested of them. While few question the quality of the science, many ask about its appropriateness for the rural poor and whether the results are actually reaching these populations. How can research best serve them?

This chapter describes work by CIAT's Rural Agro-enterprise Development Project to forge a stronger link between research and development (R&D) outcomes through the promotion of Learning Alliances (LAs) with international development agencies. Such alliances seek to:

- Feed research outputs into existing or proposed development activities,
- Track use, adaptations, improvements, and adoption of methods and tools by users over time,
- Identify and document development outcomes influenced by CIAT's work more clearly, and
- Foster long-term, collaborative inter-organizational relationships that improve overall collaboration and effectiveness, both of development practitioners and researchers.

The chapter includes a review of key inputs that led to the idea of LAs, a section describing the concept in more detail, a comparison between LAs and Learning Selection processes, two brief case profiles, and conclusions and further research questions.

Inputs to the Process

The LA approach is the result of a mixture of journal articles and CIAT's institutional history driven by a long process of personal reflection about how to generate better development outcomes from a research perspective. This section seeks to provide the reader with an overview of that process in the hope that it will contribute to a greater understanding of the LA approach in practice.

A great deal has been written about the idea of scaling out or going to scale. For the purposes of this chapter, we can understand the process of scaling up as one that "leads to more quality benefits to more people over a wider geographic area more quickly, more equitably, and more lastingly" (Gonsalves, 2001). This process has important temporal, spatial, institutional, economic, technological, and equity components that should be viewed as complementary to one another. Hence the goal of scaling can be understood to be one of augmenting the reach of lasting, positive development outcomes across space, populations, and time. The question then becomes, how can a research organization best achieve this in an environment of weakening traditional partners, limited funding, and global mandates?

Denning (2001) proposes eight areas of intervention and investment to support processes of scaling up from the perspective of a CG center. These include linking to policymakers, higher education institutions, basic education institutions, seed supply systems, community organizations, product marketing systems, extension and development organizations, and research institutions. In sum, this is a more systemic focus where the research center seeks to effectively cover the continuum from basic science to downstream development outcomes. Of particular interest here is the importance given to working in partnerships with extension and development organizations. As Denning (2001) notes, "by directly engaging in the development process through strategic partnerships with development institutions, the impact of research will be realized more quickly and on a greater scale than with classical technology transfer approaches". The challenge here is for research organizations to re-think their role, organizational structure, values, and final goals in such a way that they can meaningfully engage with development agencies in confronting challenges at a global scale.

Achieving successful collaboration, however, is easier said than done. Although the potential for positive synergies is apparent, diverse institutional value and reward systems need to be negotiated. As Roper (2002) discusses, researchers and development practitioners differ in their perspectives on learning. While researchers value the development of theory for its own sake, academic credentials, and complex research methods, development workers seek practical solutions to pressing problems, respect field experience and results, and tend to favor simple, effective methods for their work. A successful collaboration between the two camps requires a common language that acknowledges these differences and, at the same time, identifies common ground or purpose, complementary skills, or strengths, and invests in the creation of personal and organizational trust among participants. Initial transactions costs and investments for these relationships are high. As a result, the selection of adequate, long-term partners is essential for positive results. However, once established, these relationships create new knowledge and improved practice. There is no end product as such; rather, there are processes, a series of products, and various configurations of relationships that are ongoing, fluid, and adaptable to the needs of the moment (Roper, 2002).

Finally, in a positive relationship established between researchers and development practitioners, results will include not only improved development outcomes, but also processes of institutional learning and change. Solomon and Chowdhury (2002) identify various factors that facilitate learning and contribute to effective partnerships. These include (1) an orientation towards learning and change, (2) adequate planning and resources, (3) positive collaborative experiences and relations of mutual respect, (4) a shared paradigm of evaluation for learning, and (5) clear links between learning and action. These factors also must be considered when collaboration with development partners is discussed.

This brief review suggests that effective processes of scaling out between research organizations and development agencies require clearly defined roles and responsibilities based on trust and mutual respect. These relationships can be long-term, flexible, and evolutionary in nature, and include an important learning component. Finally, given the transaction costs involved in their creation and the limited capacity of research organizations, it would seem that a few high-quality relationships would be preferable to many low-quality ones. Processes of scaling out achieved in this fashion would contribute to improved livelihoods for larger numbers of the rural poor.

How is CIAT as a CG center positioned to participate in the kind of scaling out process described above? What strengths or previous experience can CIAT bring to the table? Previous CIAT experience with training as a tool for scaling out provides another important input for the LA approach.

The Center ran a complete training program from its inception until the mid 1990s. This program included in-house training carried out at CIAT headquarters in Cali, Colombia, as well as in-country training carried out with NARS partners in various parts of the tropics. The major thrust of this program was to build scientific capacity of partner organizations through training in CIAT methods and tools. As such, this process can be considered a knowledge transfer. This paradigm suffered some changes during in-country training sessions where tools were adapted to local needs, but the focus remained on teaching NARS scientists how to replicate what CIAT knew how to do. Benefits from this program included wide geographic coverage, and strong personal and professional relationships with a generation of NARS scientists who have now become decision makers. Less attention was paid to how the scientists used what they learned and what were the results from their work.

The training program was abandoned in 1995, only to be resurrected the following year with a focus on capacity building for natural resource management (NRM) and the production of a series of guides for trainers. Over 400 participants from nongovernmental organizations (NGOs), universities, and NARS received instruction in the use of these training tools in Colombia and Central America from 1997 to 2000. While this marked a departure from an exclusive focus on NARS as engines for scaling out research results, limitations to the "training of trainers" approach were found. Lessons learned from this work include:

- Post training follow-up is needed to move from book knowledge to applied and locally relevant knowledge.
- Large organizations make better partners due to greater autonomy, and capacity to implement training results.
- CIAT research outputs, when translated into training materials, are widely accepted.
- There is no "one size fits all" ideal mix of training materials. Clients need a menu to choose from, depending on their needs at the time of training.
- It is important to move from a focus on training to one of capacity development, from short-term, one-off actions to long-term relations based on dialogue and collaboration.

Formal and informal consultations with development agencies, some of which had received training in the NRM guide series, complemented academic and institutional sources of information. During a series of meetings in Honduras, important complementarities between CIAT and international NGO staff, skill bases, funding, reach, and roles came into focus (Table 1).

Table 1. Complementarities between international non-governmental organizations (NGOs) and research organizations.

Areas	International NGOs	Research organization
Staff and skills	Large staff with skills focused on specific rural development processes. Strong field presence and capabilities. Informal in-house learning processes with limited flow across projects or countries. Diffusion dependent on personal knowledge and contacts.	Small, specialized staff with highly developed research skills. Limited field presence and capabilities. More formal and systematic in-house learning capacity focused on extracting basic principles for use by others. Diffusion through mainly academic channels.
Funding and reach	Medium to large development projects with coverage at the sub-national, regional, and international levels. Potential to reach hundreds of thousands of farmers.	Small, focused research projects limited to pilot sites in selected countries. Potential to reach hundreds of farmers.
Role	Implement development projects that seek improved rural livelihoods. Increasing shift towards the facilitation of local processes rather than direct project execution.	Implement research projects that increase knowledge about how to contribute to improved rural livelihoods, reductions in poverty, and sustainable resource management.

In addition, these agencies expressed interest in exploring a new way to work together with researchers that went beyond the traditional scope of training. Topics included research focused on their needs and those of their final beneficiaries, documentation and learning from experiences, the promotion of policy dialogue with municipal to national governments, and the development of joint R&D projects. From the point of view of development practitioners, an international research organization such as CIAT is well positioned to support such relationships not only through the provision of existing scientific findings, but also by facilitating processes of documentation and learning at various scales.

The need for increased, effective, and sustainable development outcomes, and a revision of limitations encountered in training and consultations with development agencies, provided the basis for the formulation of a new, partnership-centered approach between a research organization and development agencies. This approach strives to provide a framework to link R&D organizations, understand how knowledge flows between them, capture adaptations made to methods and tools, as they are adapted to diverse situations, and begin to bridge the gap between research agendas and development needs. The following section provides an overview of the idea of LAs.

Learning Alliances as a Vehicle for Scaling Out

In the context of this chapter, an LA can be understood as a process undertaken jointly by R&D agencies through which research outputs are shared, adapted, used, and innovated upon. This is done to strengthen local capacities, improve the research outputs, generate and document development outcomes, and identify future research needs and potential areas of collaboration.

The LA process begins with the identification of research outputs or development outcomes susceptible to scaling out by partners. It is followed by one or many adaptation and learning cycles, and is completed with the detection of new research demands, which feed back into the research process, and contribute to the generation of improved livelihood or policy outcomes. Figure 1 shows the LA process.

Several key issues need to be managed for an LA to be successful, as outlined below.

Clear objectives

Clear objectives based on the needs, capacities, and interests of the participating organizations and individuals must be defined. What does each organization bring to the alliance? What complementarities or gaps exist? What does each organization hope to achieve through this collaboration? Answers to these questions, and an overarching cooperative agreement are helpful first steps. In the real world, however, clarity on these issues is often only achieved through practice.

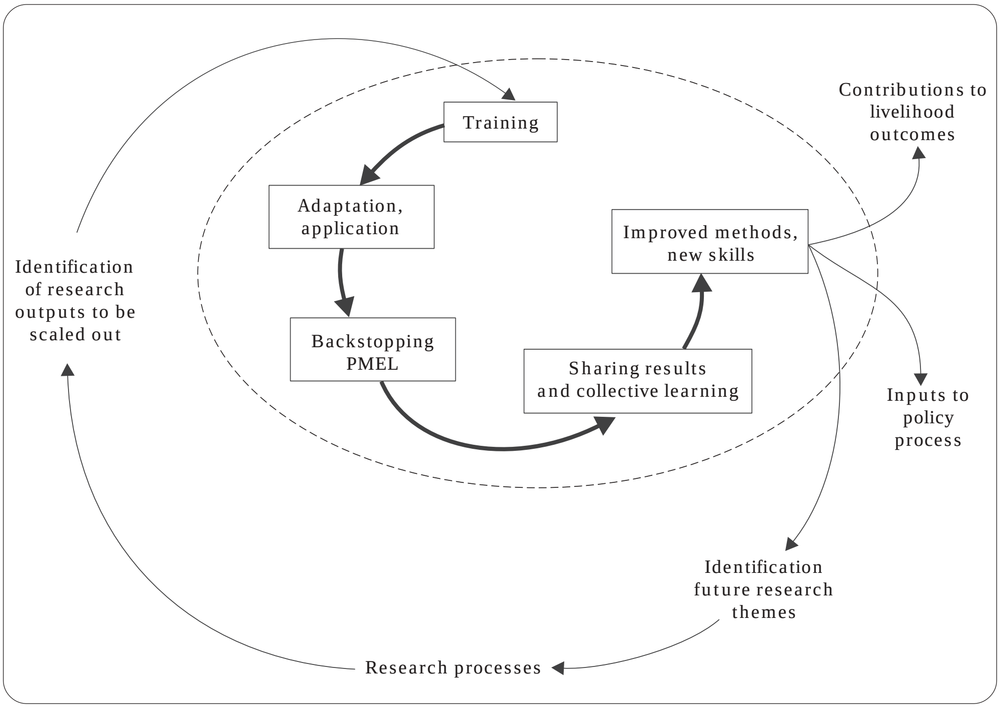

Figure 1. The Learning Alliance process (PMEL = participatory monitoring, evaluation, and learning).

Shared responsibilities and costs

An LA seeks to benefit both parties; therefore responsibilities and costs should be shared. This is imperative at the beginning of such relationships where funds for scaling out (from the research side) or training (from the development side) are often tied to project budgets that are difficult to modify in the short term. In the future, joint proposals for funding may present a good vehicle for supporting these activities.

Outputs as inputs

In the myriad contexts in which rural development occurs, there are no set answers. As such, LAs view research outputs as inputs to processes of rural innovation that are place and time specific. Methods and tools will change as users adapt them to their needs and realities. Understanding why adaptations occur, if they are positive or negative in terms of livelihood outcomes, and documenting and sharing lessons learned is the goal.

Differentiated learning mechanisms

Learning Alliances have diverse groups of participants ranging from rural women to extensionists to NGO managers to international scientists. Identification of each group's questions and its willingness to participate in diverse aspects of learning processes is key. Flexible but connected methods—ranging from participatory monitoring and evaluation to tried and true impact assessment—are also needed. A critical research issue is how different learning processes interface with one another, and how this interplay affects development outcomes.

Long-term relationships

Rural development is a process that stretches over many years. To effect meaningful change and to understand why that change occurred requires long-term, stable relationships capable of evolving to meet new challenges. These relationships should orient researchers' agendas towards key issues that contribute to positive change and, on the other hand, inform development practitioners of new or improved methods or tools that improve their practice. The transaction costs involved in establishing and maintaining LAs and their long-term nature indicate that quality should take precedence over quantity.

Based on these key issues, how should a research organization select adequate partners for LAs? A relatively simple way of going about this is to use a scoring tool such as a matrix based on key criteria identified by the research organization. Table 2 shows an example of such a tool adapted from Franzel et. al. (2001), and applied to rural agro-enterprise partners.

Table 2. Matrix for assessing the potential contribution of partner organizations in Learning Alliances (partners can be scored H-high, M-medium, or L-low on each criteria).

Selection criteria	Partner organization		
	1	2	3
Reach (areas and number of farmers)	H	H	L
Interest in rural agro-enterprise development	H	M	H
Use of participatory approaches	M	M	M
Availability of staff, resources, good management	H	H	M
Openness to change and new practice	M	H	H
Commitment to monitoring, evaluation, and learning	H	M	M
Accessibility (distance)	H	L	M
Shared objectives	H	M	M
Time and resources that CIAT spends on them	L	L	H
Potential value per unit effort	H: agreement on methods needed	M: Limited experience in agro-enterprise development	L: Small organization

Once LAs are operational, what use are they in terms of scaling out? Potential uses for LAs can be divided among direct results, contributions to development outcomes, and higher level results. Direct results are those from the learning process itself and include improved methods, tools, and approaches adapted to varying conditions, as well as increased knowledge about processes of institutional learning and change. Learning Alliances in the area of rural agro-enterprise development can also contribute to improved livelihood outcomes, and should be assessed in terms of increased competitiveness of rural economies and value chains, employment generation, and reductions in rural poverty. Finally, higher level results, which combine direct results with livelihood outcomes, can contribute more focused research agendas, and provide inputs for improved rural development policies.

Learning Alliances and Learning Selection

How do LAs relate to processes of innovation and change described by others? Are they complementary or contradictory? This section contrasts LAs to one model of technological innovation to see how they compare.

Douthwaite et al. (2002) present a conceptual model for explaining innovation in agricultural engineering called Learning Selection (LS). This approach posits four steps or stages through which a technology evolves on its way to being widely adoptable. These are: (1) bright idea, (2) best-bet, (3) plausible promise, and (4) wide adoptability. Throughout this process, the R&D team interacts with users in different fashions, often informally, to move a technology from development to expansion. In this process, much of the innovation needed to ready a technology for rapid expansion comes not from scientists and engineers, but from users themselves. During the innovation process, researchers assume a role of selectors whereby changes that increase the robustness of a given technology are “selected” and promoted, while others are discarded. A widely adopted technology, following this model, contains some of the researchers’ original ideas, but is composed mostly of user innovations that have been identified and selected throughout the process. This model of innovation is much more dynamic and realistic than the traditional ToT model when applied to hard technologies. How does the LA approach and its focus on knowledge-based or soft technologies fare when compared to the LS conceptual model?

Certain similarities exist between both models because they attempt to promote processes of adaptation and improvement between researchers and users. Key similarities include the need for a clearly defined output (or technology) to share with potential users, the importance of selecting motivated partners who face a real need for the technology in question, and a strenuous learning system that allows researchers to follow change in the technology and support positive innovation.

The LA approach complements the LS model in a variety of ways. First, there is an explicit focus not only on the robustness of the technology itself, but also on understanding the institutional learning and change process between researchers and development partners that leads to improved soft technologies. Second, results in areas indirectly related to the technology itself—development outcomes and higher-level outcomes, such as information for policy formulation or improved research agendas—are included in the scope of analysis. Finally, the LA approach advances the LS model in that it examines soft as well as hard technologies, thus providing inputs to assess the effectiveness of the LS model in the case of soft technologies.

Learning Alliances in Practice: Two Cases

The Rural Agro-enterprise Development Project of CIAT has developed a Territorial Approach to Rural Enterprise Development comprised of four interrelated components (Lundy et al., 2002):

(1) Formation of working groups on rural enterprise development within a territory;
(2) Identification of market opportunities;
(3) Analysis of product chains and the design of strategies to improve the competitivity of these chains, and
(4) Supply of sustainable rural business development services.

The Territorial Approach is the sum of these components and may be considered the technology being scaled out using the LA approach. This section will describe that process briefly as it applies in Nicaragua and east Africa.

In collaboration with CARE-Nicaragua, the Territorial Approach to Rural Enterprise Development is being applied in 10 municipalities in the Departments of Estelí and Matagalpa in Nicaragua. A working group on rural enterprise development has been formed in each department with the participation of a varying mix of local NGOs, farmer or community organizations, and for-profit technical assistance firms. These working groups have carried out a rapid diagnosis detailing the enterprise potential of their areas, existing enterprises, and support services, and identified market opportunities. During 2003, they will prioritize market opportunities and design strategies to increase their competitiveness in the selected product chains. The LA as originally negotiated will finish in July 2003 with the design of these competitivity strategies for 10 product chains.

Formal time for learning and reflection are built into the work plan after the first 6 months, and again at the end, while informal learning and documentation occur throughout the process. Of interest here is the variety of learning agendas ranging from those of community organizations to those of the international research center facilitating the work. An effort is being made to link these agendas in a coherent fashion so as to draw more complete conclusions about the process.

Based on work thus far, direct results achieved include improved methods for working group formation and market identification, augmented skills among participants, and the generation of locally adapted versions of CIAT tools. Early indications show that higher-level results may include changes in departmental development strategies, as well as links to other rural economic development activities funded by common donors in other parts of Nicaragua. A full evaluation of this process was carried out in the second semester of 2003 to more completely assess results.

A second example of an LA in practice is the collaboration between CIAT and the Catholic Relief Services (CRS) in east Africa. Based on the same technology—the territorial approach to rural enterprise development—an LA was established between CIAT and CRS for six countries of east Africa (Ethiopia, Madagascar, Kenya, Tanzania, Uganda, and Sudan). In this case, the LA process occurs at a regional scale, with CRS country offices being the direct participants. Within each country, the CRS office selects a pilot region where the technology will be implemented, and trains local partners in its use. This LA is slated to finish during 2004 with the design of strategies for improved competitivity for selected product chains.

Results achieved to date include changes made to the territorial approach to adapt it to African conditions (the technology was developed in Latin America), an increased use of participatory tools and techniques for market identification, as well as new skills learned by CRS staff in east Africa. Possible higher-level results include the reformulation of CRS enterprise development strategy for the region, and a proposal to replicate the process in additional countries in eastern Africa, southern Africa, and Latin America and the Caribbean.

What lessons can be drawn from these two experiences? First, a strong demand exists for an LA approach. Both CARE and CRS have repeatedly expressed their interest in a long-term, stable relationship through which research results could be scaled out and development outcomes improved. The philosophy of collaboration and learning appear to have struck a chord with these two development agencies. Second, a cost-sharing approach is feasible. In both Latin America and east Africa, costs for the LA are shared among the development agencies and CIAT. Third, the territorial approach to rural enterprise development is seen as a good way to improve development outcomes in the field or rural enterprise development.

Finally, the LA approach appears to be an effective vehicle for scaling out with limited resources. Prior to implementing the LA approach, CIAT was able to reach two municipalities directly in Central America and three sites in east Africa. As a result of this strategy, CIAT research findings are now being implemented and improved upon in six countries in east Africa and 10 new municipalities in Nicaragua, with no change in CIAT staffing. Additional possibilities for scaling out this process have also been identified. These can be grouped into "geographic spread" or "organizational spread" categories. In the geographic category, repetition of the LA approach is being discussed with additional partners in Africa and Latin America, and would open the possibility of inter-organizational sharing of results. In the organizational category, potential avenues of scaling out include collaboration with CRS Latin America in eight countries, and with CARE in four countries in Central America. A key challenge facing the LA approach at this juncture is how best to mix funding sources between development and research to take advantage of these opportunities.

Questions for Further Research

Experience to date suggests that the LA approach is an effective way for scaling out results and may serve as an appropriate vehicle for carrying out more systematic research on the process of scaling out itself. As the approach evolves, however, additional research needs to be conducted on the topics given below.

(1) When is it most appropriate to engage development partners during the research process? Some authors posit that stakeholders enter once researchers have defined their "best bet" (Douthwaite et al., 2002), while others cite the need for much earlier involvement of users in the process (Denning, 2001). What difference does earlier or later involvement in the research process make in terms of later scaling out of results?

(2) The use of a more nuanced model of scaling out where issues such as adaptation-, innovation-, and context-based best practice in a given time and space force us to look beyond simple, linear explanations of this process. How do institutional models and learning processes play a role in scaling out? Can they be promoted as a way to speed it up? Should they be treated as a research issue in their own right? Should CIAT and the CG pay more attention to this area when designing and assessing processes of scaling out?

(3) The use of an LA approach requires a willingness to negotiate research agendas between scientists and development practitioners. Is it feasible to expect research centers to shift from a tradition of researcher- or donor-led science to one of demand-led science where the research agenda is structured on concrete demands from development partners? What impact would such a shift have on

scientific quality, applicability, and final contribution to livelihood outcomes? How would this shift affect donor willingness to support research activities?

(4) Shifting from a paradigm of training to one where interaction with partners is characterized by joint learning requires specific skills, such as an ability to negotiate institutional agendas, a capacity to conduct research on process, not just product outputs, and the ability to relate discrete research findings to a larger context of development outcomes. Do research centers have the necessary skill base to effectively carry out LAs on a large scale? What skills would be needed to achieve this? Are donors willing to support additional staff with the skills necessary to make an LA approach work?

Conclusions

A more coordinated approach between R&D agencies offers the potential for positive synergies and improved outcomes to support the livelihoods of the rural poor. To achieve this in practice, however, negotiations on organizational and personal goals and structures are necessary. A clear mutual understanding needs to be developed to underpin collaborative efforts in the mid to long term. The structuring of this relationship and identification of key factors that facilitate it is, in itself, a research issue. The question facing the CG centers is one of remaining relevant not just scientifically, but as effective partners helping to resolve global issues such as poverty in a creative and sustainable fashion. This goal is too big for any one institution or even group of institutions. To achieve meaningful change, researchers and development practitioners need to join forces in effective alliances where skills and funds complement one another, rather than reinventing the wheel. The LA approach is an attempt to provide a framework for such collaboration.

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Chapter 15

Planning of Territorial Organizations as an Entry Point for Agricultural Research towards Rural Development and Innovation

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Introduction

This chapter argues that the planning processes undergone by local governments and community-based organizations are viable entry points for agricultural research into rural development and innovation processes. In this context, local, departmental, and national governments are partners, in addition to community-based organizations and institutions of the national agricultural research systems. The 2002 Annual Review of the International Center for Tropical Agriculture (CIAT, the Spanish acronym) focused on aspects of scaling up and out. In our case, scaling up refers to obtaining support from higher administrative levels to local initiatives through complementary activities or policy that could not be conducted at the local level. Scaling up can refer also to linking local planning efforts to the planning of higher administrative levels, although moving up in scale implies reducing the geographic scale of map representations when passing from local scale to national, continental, and global scales. Scaling out refers to the contribution of territorial-based organizations and governments in diffusing "technologies that work". Our arguments are supported partly by observations from our ongoing work within the agreement between CIAT, the Colombian Ministry of Agriculture, and the Colombian Corporation for Agricultural Research (CORPOICA, the Spanish acronym), and partly by observations from authors of other studies reported in the literature.

Planning means to anticipate the course of action needed to reach a desired situation. The process of planning is a systematized sequence of decisions and actions that includes the definition of the desired situation and the selection of means of reaching it (BID-EIAP-FGV, 1985). Planning

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is essentially an act of power and it bears an implicit idea of intent because we choose certain actions instead of leaving things to chance (PRONATTA-MADR, 1996) or letting others decide for us. Governments of all countries and administrative levels have to plan their activities and the spending of their resources, and in most countries this is done through an official and regulated process. The resulting plans express a series of programs, projects, and norms to be carried out during the mandate of the administration in question, and determine how the financial resources will be used, therefore constituting a highly important part of policy.

The discussions and needs identified during planning can greatly influence other forms of policy, such as legislation and specific decisions taken along the way. Planning is repeated after every change of leadership, but if done satisfactorily, it is a continuous management process including execution, monitoring, and evaluation. Governments can use planning to enable development processes led by other players, even when no funding is involved. This idealistic vision of planning is often shunted by clientelistic politics, corruption, and fraud, and "There is a growing skepticism and reappraisal of the ability of public administrators and politicians to manage and target public services" (Helmsing, 2002). This also discourages scientists from linking their work to governmental planning. Scientists are often reluctant to have their efforts used by politicians to increase the politicians' popularity or to promote certain projects that might be inequitable. Another reason for discouragement is that science is usually reductionist, whereas governmental planning is extremely vast, being multi sectoral, multi stakeholder, and multi level. The number of points to consider can be overwhelming, and it is sometimes difficult to break down problems and address them in parts. However, working independently of local and national policymakers limits the success of the processes that applied scientists are trying to encourage. Avoiding the political processes also limits all positive influence that could be had on democratic processes. If what is sought is to affect the way in which decisions are made, then involvement is in some way political. The political aspect should not be avoided, but the transparency of decision making should be increased (Vargas del Valle, 2002). Planning processes must also provide the necessary linkages for scientists to be able to participate in the whole, while concentrating on the part of the problem that corresponds to their area of competence.

Why Should Agricultural Research Scientists and Institutions be Interested in the Planning of Territorial Organizations?

For scientists and information providers, decision making by territorial or political institutions constitutes an opportunity to put results at the service of the development and management of natural resources. It provides an "entry point", a link in the chain between research and development (R&D), onto which scientists can “hook”. Hooking on to planning is much easier than contributing to solving problems as they arise, when the urgency seldom leaves sufficient time for decision makers to consider different options, look for relevant information, or to communicate questions to the scientific community. When considering the larger meaning of the word “planning”, which includes diagnosis, action planning, execution, monitoring, and evaluation, it becomes synonymous with management. Encompassing planning is a good way to strengthen the management component in integrated natural resource management (INRM), a need that Lefroy (2002) identified.

Agricultural research is conducted to help beneficiary groups to reach desired conditions, such as food security or sustainable livelihoods. In the case of CIAT, the main beneficiaries are rural communities, and small- and medium-scale producers, as well as the urban poor who can benefit from increased food production in rural areas. However, we have all faced situations where “external” factors, such as markets, prices, policy, transportation, infrastructure, conflicts of interest, and political good will, hindered the success of a given local initiative, or the successful adoption of a technology. In many cases, the impeding factor is the absence or lack of functionality of some necessary activity, mechanism, or infrastructure. For higher administrative levels, some of these impeding factors or needed contributions are not external, but form part of what is under their control.

On the other hand, planning is an opportunity for scientists to orient their research towards their possible contributions to their beneficiaries’ objectives. As we will see later, requests that come from a planning process can be different from ones obtained by consultations in which beneficiaries are asked what they need. Participating or responding to requests coming from a planning process can allow scientists to participate in endogenous innovation processes rather than impose technology. In addition, planning allows individuals and institutions to manage innovation processes because these encourage the consideration of a wider range of options than when solving urgent problems. Planning allows the analysis of problematic situations in a systematic way in order to understand the various causes and driving forces. This eventually leads to forming alliances with other players involved, thus changing the ways of organizing in order to reach the desired conditions. Planning also gives the opportunity to complement rather than duplicate the efforts of institutions with respect to R&D.

Planning can have a most important role in strengthening adaptive capacity. If done strategically, it allows players to calmly formulate questions, collect necessary information, explore different options with their consequences on the desired results and on the various stakeholders, and structure the relationships between the players for execution, monitoring, and evaluation. Because strategic planning includes the anticipation of future problems and the consideration of past ones, it can generate an organization of players and data to be effectively used in the solution of problems “along the way”. The monitoring and evaluation components of planning also provide an opportunity for collective learning, allowing players to learn from their successes and mistakes, and to adjust their actions according to the effects they cause.

Planning also offers an opportunity for leaders, influential groups, and the population to expand their mental image of their social and environmental systems. Through personal contact and discussions, they can become more aware of the needs and contributions of other players, and their mental picture of “us” can expand unconsciously. They are also obliged to think of the long-term implications of their actions, which may further expand their conception. These expansions may direct their decision making towards a more effective consideration of collective, diverse, and long-term needs. This phenomenon reduces power struggles because it enables the convergence of objectives. The resulting increase of trusts, combined with strengthened organization, contribute to increasing social capital. “Learning about each other and the issues at hand too, deliberating parties can create public value: From the value of mutual recognition to that of their empowered capacities to act, singly or together” (Forester, 1999).

Our interest in governmental planning is twofold. On the one hand it is an ongoing process routinely conducted in almost every country, and one that we scientists can piggyback to improve the relevance and impact of our work. On the other hand, it is a powerful mechanism for rural development and innovation, and thus a worthwhile subject of research in itself. Like many other mechanisms, planning is most often used well below its potential, and presents many opportunities for improvement that we will describe later. These constitute valuable research opportunities in a multidisciplinary field to which agricultural research can contribute.

Our experience

We initiated our work relative to governmental planning in Colombia in 1999, as the contribution of the Land Use Project to the agreement between CIAT, the Ministry of Agriculture, and CORPOICA. At that time, the country was experiencing a period of panic with regard to territorial planning. The national government required a new type of plan from municipalities, the Plan for Territorial Ordering (POT, the Spanish acronym) through law 388 of 1997 (http://www.dnp.gov.co/ArchivosWeb/Direccion_Desarrollo_Territorial/legislacion/ley_388_1997.pdf) and had fixed 1999 as a first deadline for their approval, later postponing this deadline to June 2000. Territorial planning has been, for municipalities, the first serious long-term planning effort. The POTs have a timespan of 9 years and cover three times the constitutional mandate of mayors. In this strategic planning effort, the municipal administrations have to set a series of norms, actions, programs, and projects at short-, medium-, and long-term, spatializing them over their legal territory. Previously, municipalities already were acquainted with planning through the Municipal Development Plans (Ley Orgánica del Plan de Desarrollo, Law 152 of 1994; http://www.dnp.gov.co), but these only consider the period of mandate of the administration, although they also respond to long-term objectives. The other novelty of POTs in regard to development plans is that maps are used to represent the spatial distribution of natural threats and risks, areas with specific restrictions or potentials for land use, areas with cultural, historical or environmental patrimony, as well as the present and desired distribution of infrastructure. Thus, POTs create a need for increased technical capacity and geographical information.

Our first entry point to planning was an offer of geographic information systems (GIS) technical capacity, geographical information, and the development of decision-support tools. The CIAT Land Use Project had digitized a significant amount of information over the municipality of Puerto López that we knew could be put to good use when made available to the municipal government for developing its POT. We therefore initiated a partnership with the municipal administration to assist in the POT, with the objective of adapting and developing methods and tools, which could then be applied elsewhere.

We participated in the adaptation and Spanish translation of the MapMaker software, developed by Map Maker Inc. in Scotland, which led to the version MapMaker popular (Dudley, 1999), which is freely distributed. We also elaborated a Spanish language guide for self-training in the software (Beaulieu et al., 2000a). However, as we collaborated with the municipal administration's staff and contractors, and as we discussed with professionals involved in POTs of other municipalities, we noticed the diagnosis stage often caused general frustration, which we humorously called the diagnosis syndrome. This frustration tends to occur when large quantities of data are acquired over a site, and yet diagnostic conclusions cannot be drawn. It is sometimes exacerbated by the use of GIS because important investments are made in digitizing, correcting, and organizing data. Indicators can be calculated from the data, but these are difficult to use in a diagnosis when the development objectives are not clear. Geographical information is of indisputable usefulness, but to be effectively used it has to be organized to answer the questions that occur during planning. These questions have to be guided by clear development goals.

We formalized a method for vision-based planning (Beaulieu et al., 2000b; 2002), which we call "visions-actions-requests across administrative levels". This method aims at helping planners and stakeholders identify the questions that will guide the collection and analysis of information, while helping improve the participatory component of planning and the articulation of players within and between administrative levels. In a series of meetings with focus groups, for each of the themes to be addressed, players define their vision of the desired future conditions, the actions that they can conduct to reach those conditions, and the actions or resources requested from other actors. Visions and the articulation of actions and requests from one level to the next are discussed in articulation workshops. The "vision" or desired future conditions help to define the questions relating to diagnosis or to monitoring and evaluation. The actions and requests identified in the exercises guide the formulation of action-planning questions. This method shares many elements with other vision-based planning methods (Green et al., 2000; Lightfoot and Okalebo, 2001), with the method used in Colombia's Agrovisión 2025 (Presidencia de la República de Colombia, 2001) and with other participatory methods that include visioning exercises, such as the soft systems methodology (Checkland and Scholes, 1990) and appreciative planning and action (APA) (Bhatia et al., 1993). Our method is distinguished by setting the desired future conditions before (and to guide) the diagnosis, and by strongly emphasizing the matching of actions and requests between players within and between administrative levels. It can be combined with other planning approaches, such as scenario planning (Schwartz, 1996) that involves the exploration of different possible futures, usually dependent on external factors.

The municipality, with our support, completed the Basic Plan for Territorial Ordering (PBOT, the Spanish acronym) of Puerto López in early 2000 (Alcaldía de Puerto López-CIAT, 2000). The GIS data (particularly soil maps) and satellite images were especially useful for determining areas with restrictions for land use (Rodríguez et al., 1999; Rubiano and Beaulieu, 1999; Vrieling, 2000; Vrieling et al., 2002) and areas vulnerable to natural disasters, such as floods. A variety of georeferenced information, photographs, and the documents of the plan were organized in a customized application of MapMaker Popular and widely distributed on CD-ROM. The plan received congratulations from Regional Autonomous Corporation for Orinoquia (CORPORINOQUIA, the Spanish acronym), the institution mandated to review and approve the environmental component of the POTs of its region. Following this success, there was much demand for training, and the Ministry of Agriculture encouraged us to transfer our know-how to other municipalities. In 2000 and 2001, we gave training and training materials to agriculture secretariats, so that they, in turn, could give training to municipalities. Eight 1-week courses were given, in different regions of Colombia, including concepts on the legal aspects of territorial planning, the visions-based planning methodology, and basic skills in MapMaker Popular; 185 professionals were trained. In 2002, four 1-week courses were given in Ecuador, funded by individual provinces, with the support of the Interamerican Institute of Cooperation for Agriculture (IICA, the Spanish acronym). Our capacity-building activities then expanded to include the Processing Georeferenced Information System (SPRING, the Portuguese acronym) image-processing software, developed by the

National Institute of Spatial Research (INPE, the Portuguese acronym) in Brazil.

In Colombia, following important decentralization processes, which have accelerated in the last 2 decades (Oliva et al., 1998), municipalities have increased resources and responsibilities regarding rural development. In 1998, the national government found that a fourth phase of the fund of Integrated Rural Development (DRI, the Spanish acronym) was unnecessary because municipalities receive sufficient funds from the government through obligatory transfers (Vargas del Valle, 2002). Now, municipalities are in charge of enabling rural technical assistance to small- and medium-scale producers through a public extension office, Municipal Unit of Agricultural Technical Assistance (UMATA, the Spanish acronym), or through contracting private agents. The funds allocated to rural infrastructure and activities bound to stimulate rural development are determined in the municipal development plan, which includes the Municipal Agriculture and Livestock Program (PAM, the Spanish acronym), itself including the plan for rural technical assistance. In the philosophy of Nueva Ruralidad (Echeverri Perrico and Pilar Ribero, 2002), municipalities are the interface between the rural population and the government.

In 2001 and 2002, we supported the municipality of Puerto López in developing its Plan de Desarrollo Municipal (Figure 1). In Colombia, each time a change in leadership occurs, every level is legally required to produce multi-sectoral development plans. Planning exercises are therefore repeated after each election, every 3 years in the case of municipalities and departments, and every 4 years in the case of the national presidency.

Figure 1. Participants in one of the participatory planning workshops conducted for the Plan de Desarrollo Municipal in the municipality of Puerto López, Colombia.

Because of their existence in various administrative levels, these offer the possibility to link actions between levels and to connect the various components of a given level. In Colombia, development plans are carried through at the municipal, departmental, and national levels. At present, territorial plans are only legally required for the municipal level, but the Organic Law of Territorial Ordering (http://www.dnp.gov.co), presently under discussion, will make them required at departmental level also. Independently of the legal obligation, various departments have elaborated their territorial plan.

In the follow-up of both plans, we tried to support specific projects or goals, especially those from small farmer communities. The report by Fajardo (2002) summarizes our work with communities, jointly conducted with the UMATA, which consists of helping five villages of the municipality with their planning, especially related to agricultural projects and commercialization. With the aim of using this experience to develop public goods that could be used elsewhere, we began developing other tools to be used by national government and municipal technical assistants. These tools (Box 1) complement others developed in CIAT and elsewhere, and include Crops and Fruits for Colombia (CUFRUCOL, the Spanish acronym) (Fajardo, 2001), CLIMCROP (León, 2000), GEOSOIL, and ARBOLES (Hoyos et al., 2001).

Box 1

Tools for use by national government and municipal technical assistants

Crops and Fruits for Colombia (CUFRUCOL, the Spanish acronym) is a database of crops and fruits of interest for Colombia that includes botanic and agronomic information, crop climate and soil requirements, and production costs. CLIMCROP is a geographic information systems (GIS) tool for mapping the degree of climatic limitation of a given crop, according to requirements given by CUFRUCOL or entered by the user. It also allows the elaboration of a more detailed report of limitations for a given location. It can be complemented by the use of FloraMap (Jones and Gladkov, 2002). GEOSOIL is a geo-referenced database for soil data, obtained from field measurements and observations, and from soil maps. It also produces basic estimations of soil quality, depending on the data available. ARBOLES is a database tool that allows applying rules of a decision tree to data entered by the user or from a soil map to make recommendations about the type of production system to be implemented. At present, the decision tree that has been programmed is for the Altillanura portion of the Colombian llanos, and contains rules relative to soil properties and slope. The rules can be edited to include other properties and can be adapted to other geographical areas. Areas recommended for a given production system can be mapped using GIS programs.

Parallel to tool development, we analyzed the costs of different strategies with farmers, and conducted a participatory evaluation of market options using methodology developed by the Agro-enterprise Project, all jointly with the UMATA. We also participated in initiating specific projects. For example, in the village of El Turpial, the main commercialized crop is cassava (*Manihot esculenta* Crantz), but sometimes farmers lose their crops because of a lack of market for fresh cassava. They also did not have the means of conserving this highly perishable crop. Technicians from the Latin American and Caribbean Consortium to Support Cassava Research and Development (CLAYUCA, the Spanish acronym) came to the village and showed farmers how to shred and dry their cassava using a machine lent by CIAT's Cassava Project, and put them in contact with an animal feed factory, which purchased the resulting dry cassava. The farmers then repeated this operation, with the support of the UMATA, who found an even more favorable buyer (see Figure 2). CIAT has been promoting this technology since the beginning of the 1980s (Gottret and Raymond, 2003), thus it is far from new, but responds to urgent farmer need. Although selling fresh rather than dried cassava is much more profitable, farmers can now sell off dried what remains unsold of their fresh produce. The community board has regained enthusiasm and increased its trust and will to work with the UMATA. Neighboring villages wanted to "do a project like in El Turpial".

Figure 2. The Director of the Municipal Unit of Agricultural Technical Assistance (UMATA, the Spanish acronym) of Puerto López, Nohemi Peñuela, provides payment to farmers of the village of El Turpial for their dried cassava, serving as an intermediary between them and an animal feed factory.

In participatory planning workshops with the two indigenous villages of the reserve of Humapo and La Victoria, residents wanted to recuperate the natural areas in their reserve, needed for hunting, fishing, and gathering materials to construct their roofs and produce their crafts. They also wanted to be more independent with regard to food supply. Ways to achieve this include diversifying crops and cultivating cassava on the altillanura part of the reserve, relieving pressure on the gallery forest. Cassava is traditionally cultivated on the riverbanks in a rotational *conuco* system, but an increase in population meant a greater demand for food requiring constant use of land that impedes crop rotation, and new forest areas are cleared for cassava cultivation. The Colombian Family Welfare Institute (ICBF, the Spanish acronym) has funded cassava projects on the altillanura, but since these ended, residents are looking for ways to be more self-reliant. The main obstacle to these agricultural projects is the purchase of inputs. Considered solutions to overcome this include micro-funding mechanisms and organic agriculture practices to reduce the need for inputs. Strategies to recuperate natural areas include preventive burning and reforestation. The communities have begun constructing a greenhouse to reproduce native tree species and fruits, with financial support from the Mayor's Office, for materials. At the end of 2002, the communities conducted a preventive burning trial, whose chosen location was helped by observing satellite images.

Under a special program by the Ministry of Agriculture and Rural Development (MADR, the Spanish acronym), CORPOICA obtained funding for a project with the Ministry on maize (*Zea mays* L.) for small-scale producers to promote the crop in the altillanura of the Colombian llanos. The UMATA of Puerto López is a partner in this project, and because of the participatory workshops run for municipal planning, knew that Puerto Guadalupe farmers wanted to implement such crops. They were therefore included in this project and in the co-funding of production activities during the first years of the project. Our contribution will be mostly in exploring options for the groups to continue productive activities in a self-reliant way, even after co-financing by the Ministry terminates, and to provide information for decision support.

Examples of Scaling Out and Up from Our Experience

Our activities being relatively recent, the scaling up and out of our results is only just beginning. Even if the examples we present seem trivial and local, they point to mechanisms that will continue to produce development impact and that can be used by any other group promoting rural innovation.

In terms of scaling out, the secretariats of agriculture that we have trained in the use of the participatory method and the MapMaker software have trained municipalities and other agents. Some of these trainees and their second generation trainees presented their results at a seminar organized at CIAT in November 2002. Both the use of the MapMaker software and the visions-actions-requests methodology are spreading out in an effective way. We have encountered people who use them, who have been trained by us or by others. Many trainees learned to use the vision-based planning method during a workshop in which they participated, and then they adapted the method to their taste. The planning secretariat of the department of Meta used it in 2003 to plan the territorial and development plans of its constituting municipalities. The agriculture secretariat of Valle del Cauca is using it to articulate the actions of various actors involved in food security. The department of San José del Guaviare has used it in the elaboration of its departmental territorial plan (Rodríguez Porras, 2002). Management committees also used elements for planning and capacity building in the La Macarena Special Management Area (AMEM, the Spanish acronym) (Vanegas Reyes, 2002).

Again in terms of scaling out, we can cite the municipality's role in repeating the cassava drying initiative of El Turpial in other villages, and the UMATA's distribution of germplasm for farmer trials. We need to mention that higher administrative levels are involved here in the scaling out, thus somehow involving a scaling up process.

Since we have been working mostly at the community and municipal levels, our examples of scaling up (in the sense of complementary actions at higher administrative levels) are mostly between these two levels. Because of the participatory planning workshops, the municipal administration and the UMATA have become increasingly aware of ways to support local initiatives. In addition to increasing investment in rural areas for services, such as electricity, water supply, and health, the municipality is supporting projects that village associations and boards propose. For example, following the success of the cassava drying operations in El Turpial, the municipality will be funding, in 2003, the purchase of two shredding machines and the construction of two drying floors with sliding roof, one for El Turpial and another for Puerto Alicia. The municipality is supporting the construction of greenhouses for reforestation in the indigenous reserve of Humapo and La Victoria, and shows strong interest in funding a cassava processing plant that could provide market opportunities for many small- and medium-scale producers. The UMATA has supported the formation of various farmer associations and the writing of various projects, submitted to the Ministry of Agriculture, for the co-financing of production projects. The UMATA also has run trials with farmer groups to try cassava varieties provided by CIAT.

Opportunities for Improving Planning

Planning rarely fulfills its potential, and is the object of justified criticism. However, problems related to planning do not imply that planning in itself is useless, but that we should improve the way it is being used. Instead of describing the problems related to planning, we will try to discuss the multiple opportunities to improve the process, and suggest ways to do so.

Clarify ends and define means

It seems almost typical that legislation, policy, or norms have effects that are totally opposite to what they were designed to do. All policy mechanisms are double-bladed knives, and if actors and stakeholders do not understand their objective well, the desired results will not be obtained. In the case of restrictive policy, players always seem to find ways around the restrictions, and in the case of incentives, abuses almost always occur. However, the behavior of those who fully understand the ends of a given policy is usually compliant, even when it is against their short-term and individual interests.

Unfortunately, the ends, desired outcomes, or desired future conditions are too often absent from planning or from the prescriptions coming from different forms of policy. “We have substantial technical knowledge about probing means and strategies to reach objectives, but we know much less about probing ends” (Forester, 1999). This probing of ends is what vision-based planning methodologies seek to attain (Green et al., 2000; Lightfoot et al., 2001). However, as Forester (1999) pointed out, the quest to learn about “what we should want” and about “value” can be manipulative. Planners and politicians can use these exercises as “dialogical boot camps” to help stakeholders really know what they want. Here again, learning and exploring common goals can be used aiming either at genuine deliberation or at manipulation. The end, sometimes hidden and sometimes openly exposed, is a determining factor. Because ends (or goals, or objectives) are often different among the actors and stakeholders, the result depends on who pulls strongest on the blanket through well-known power struggles. When goals are divergent, results are rarely fully satisfactory for any stakeholder. When actors and stakeholders can work out goals to which they can all identify, or more general ones where different objectives can co-exist, then these are reached with a disconcerting rapidity. It resembles a tug of war where both teams pull on the same side of the rope. And it is often much easier to find agreement on goals or desired future conditions than it is on the means of achieving them, because each actor can contribute differently to the objectives. Finding common goals does not mean homogenizing points of view. On the contrary, including different and contrasting viewpoints in the discussion of common goals ensures that the goals will be sufficiently general to avoid concentrating on only part of the problem, and considering only the contributions of certain actors. This helps avoid the trap of solving false problems (Mitroff, 1998). Indeed, when goals are general enough, different points of view often simply lead to different contributions to the goals.

Discussing a vision of a desired future also has a positive psychological effect on participants, compared with the discussion of problems (Bhatia et al., 1993; Kirway, 2001). Participants feel excited and motivated to do what they can to reach their dream, and the discovery that other influential actors share it makes them optimistic. On the other hand, focusing on problems (or causes of a dissatisfactory situation) tends to discourage people. In vision-based planning, problems become implicitly formulated within the proposed actions or requests, but in a more prospective way, with a better identification of who can solve them and how. However, developing a common vision of desired future conditions is different to coming up with a "vision statement", a technique often used in business management. The set of desired future conditions can be long, and should include all of the participants' input and all viewpoints.

As already mentioned, we often tend to focus more on the means than on the ends. Planning is also a means that can help us attain various objectives. It is important for planners, politicians, and all those who participate in planning to understand why it is being done. Is it only to fulfill a legal or administrative requirement? Planning can provide much more, including better organization, articulation, understanding, and trust between players, more effective management and decision making, better organization of information, a wider range of options, the possibility of choosing between different paths, and avoiding crisis situations by anticipating problems. However, we have to be guided by our desired future conditions, whatever they are, or else very different results can be obtained with the same means.

We work with the idealistic hypothesis that if players can deliberate and agree on desired future conditions, and can combine their means to reach them, then they will find the way to do so successfully, and will do so much more effectively than through social struggle. Naturally, this is not what happens in practice most of the time, but it is an approach that can be chosen. It is certainly more likely to happen than that humanity becomes overtaken by a spirit of generosity and goodness. Still, it must be borne in mind that not everyone has made that particular choice, and that, even if it were so, the world would remain an imperfect place.

Use planning in an effective management and learning approach

If planning is done to satisfy a legal requirement, but is not being used as a management or a learning tool, the exercise will be of doubtful usefulness and participants are likely to be frustrated about the time invested. Following up on planning has to be made simple, otherwise it can make management heavy and inflexible, or it can discourage players from taking part.

Independent of the type of management used, administrators and the civil society councils should actively practice monitoring and evaluation. The follow-up of planning between the actual planning exercises is a most important mechanism to remind the players of their objectives and engagements. Monitoring and evaluation includes verifying the effect of actions, allowing players to learn from successes and failures, and adjusting activities and norms included in the plan. It affords an opportunity for the organization that participated in the planning to continue to work with others in a regular fashion, and to develop operational linkages. It allows the collection of information that will be useful for the next plans.

Administrators and municipal councils should use the evaluation of previous plans as a basis for the diagnosis of any new plan. To simplify monitoring and evaluation and the continuity between plans, there should be clear objectives or desired future conditions determined in agreement during the participatory process. It is important not only to state what needs to be done (i.e., the mechanisms and actions), but also the effect we are trying to achieve on the environment and livelihoods of residents. As we have seen before, merely applying mechanisms as such does not ensure the success of the processes. Without clear objectives, administrators can be tempted to implement the mechanisms simply to comply with the plan, while missing the actual goals.

Planning and follow-up should work as much as possible with existing institutions, committees, councils, and other structures. When possible, for example in small municipalities, different councils grouping members of civil society can be integrated into one general council that have monthly meetings on various subjects, rather than having separate councils for emergencies, rural development, territorial planning, development planning, etc. meeting every 6 months or every year. The formation of new commissions or committees should always be related to existing ones to ensure more continuity and connection between the different activities.

Local learning groups, related but not necessarily dependent on governmental structures, can be created by community residents, and can be supported by local governments. These can include participatory research and experimenting groups, machinery rings, co-marketing groups, and community food cooperatives (Pretty, 1998). Lightfoot et al. (2001) give various reports of exploration of local learning processes in east Africa to help farmers and extension workers cope with the decentralization and privatization of agricultural extension services. Methodological suggestions, which include elements of vision-based planning, are also given. Participatory monitoring and evaluation is an important component of collective learning processes (Roothaert and Kaaria, this volume). Learning alliances can be created between groups and various institutions (Lundy, this volume), and stimulate complementary activities that could not be conducted only locally.

Improve participation and articulation of players through a systems approach

Mitroff (1998) states that the inefficiency of many institutions comes from the fact that they try to solve the wrong problems. This occurs when decision making only concentrates on part of the problem, considers only a limited range of options, and does not consider their consequences on all the interest groups. His approach for smart thinking therefore includes recommendations on how to think with a systems approach, to consider the various interest groups involved, to expand the limits of the problem, and the range of possible options. He insists strongly on the need to integrate different points of view to avoid falling into the trap of solving a false problem. He mentions that it is always better to count on the interest groups themselves, but when these are not available, that a variety of viewpoints can be generated or imagined. He presents techniques allowing enterprise decision makers to work with the help of psychological principles, allowing them to imagine the points of view of non-influential interest groups that could be against their decisions. Governmental and community planning, on the other hand, provide fantastic opportunities to combine different points of view without having to generate or imagine them. Thanks to the participatory requirements of most planning laws, and of the constitutions of democratic countries, planning processes have the excuse and the obligation of integrating the viewpoints of real-life players, *in vivo*. Actors and decision makers, however, need to develop listening, learning, and thinking skills to be able to take advantage of these exchanges.

"A systems approach involves placing as much emphasis on identifying and describing the connections between objects and events as describing the objects and events themselves" (Clayton and Radcliffe, 1996). A systems approach allows simplifying the understanding and description of complex hierarchical arrangements, where an exhaustive description would be overwhelming because another series of hierarchical organizations is found upon looking at any component in detail. A system is a set that is composed of a series of smaller sets or components (or subsystems), and which itself forms part of a larger set (or supersystem). Clearly, governmental hierarchies, the organization of most institutions, as well as social and biophysical processes can be described as systems. The most important defining characteristics of systems include emergence, hierarchical control, and communication (Clayton and Radcliffe, 1996). Emergence refers to the fact that each set has properties that cannot be explained solely by referring to the properties of its components. Hierarchical control refers to the imposition of functional relationships by each level on the dynamics of the level below, either promoting or constraining its actions. Communication refers to the transfer of information for regulation, and functions principally through feedback loops, which in turn affect hierarchical control. Systems must find an adequate degree of control to avoid excessive control limiting their ability to adapt to new conditions, and to avoid insufficient control, reducing their ability to determine outcomes. Planning therefore not only involves setting the control mechanisms, actions, and constraints to achieve the desired state of the system, but also involves strengthening communication, identifying and facilitating the necessary feedback loops, and enabling the necessary interactions between players within and between levels. Of course, it also includes defining the desired and acceptable states of the system and its subsystems.

Even when governments try to please all stakeholders, by offering programs, funding opportunities, and incentives within the limits of their resources, they will have limited impact if they do not enable interactions between the various players of the territory. Within the framework of decentralization, governments have a greater role in enabling than in providing (Helmsing, 2002). Consulting stakeholders separately, and then deciding to whom they should attribute resources, will not have the same effect as a fully interactive participatory process where players can discuss points, establish common goals, and enable the matching of contributions of some with the needs of others. Thinking systematically can improve the enabling role of governments, if they consider themselves as catalyzers of the interactions between players rather than the center point of “you request, I provide” relationships.

Pretty (1995) elaborated a typology of participation including seven types with increasing potential for rural development. The first type is manipulative participation, where participation is simply pretence. The others are passive participation, participation by consultation, bought participation, functional participation, interactive participation, and self-mobilization and self-reliance. In this latter case, “people participate by taking initiatives independently of external institutions to change systems. They develop contacts with external institutions for resources and technical advice they need, but retain control over how resources are used”. Although the exercises used for vision-based planning are mostly of interactive participation type, they should encourage capacity building for groups to continue to act even in the absence of facilitators. Also, self-reliance does not imply aiming at disconnection from external institutions and other players.

Improve linkage of information to development

Information is an important input to planning. With the word “information” we include data, documentation, maps, information systems, and decision support tools that can be generated by diverse individuals or institutions. However, we all have seen or experienced situations in which information is accumulated without being used efficiently for planning or decision support. Sometimes, much energy is spent in digitizing, organizing, correcting, and updating information, and then when precise information is needed for a particular decision, we find that it has not been included in the database under development. Sometimes, we are in a situation where the need for the information that we are collecting has not clearly been defined.

On the other hand, it would be incorrect to say that all decisions are taken on the basis of external information. In many cases, decisions are correctly taken based on intuition and local knowledge, which are rooted in the experience of people, and on the information accumulated and interpreted in their minds over time. In many cases, especially where no conflicts of opinion occur, local knowledge and intuition are sufficient.

However, opportunities arise when additional information is necessary, for example, where opinions diverge or when there is uncertainty about what should be done. In these cases, diagnoses that are based on the players' perceptions need to be supported by trustworthy information from secondary sources, surveys, or measurements. Information can become extremely useful to expand the range of options being considered, and to explore their consequences. But in power struggles, less influential players, such as poor rural people, should have the same opportunities to access information as the more influential players. Democracy in data access suffers the same obstacles as democracy in any other sector, and participatory planning offers many opportunities for progress in this area.

While recognizing the importance of information for planning, we suggest starting the planning process based on local knowledge and intuition, rather than on information collection, and then supporting the planning process with information from secondary sources, surveys, field measurements and observation, and the results of scientific research. However, one source of information must be considered by all planners and participants at the start, and comprises all previous plans and any records of their monitoring and evaluation.

To prevent the blind accumulation of information, we must carefully define the questions that we want to answer. For this, we suggest the use of the visions-actions-requests methodology defined in the previous section. Two types of questions result from this analysis, those for monitoring and evaluation, and those for action-planning. The desired future conditions are used as a reference to formulate the monitoring and evaluation questions, which lead to the formulation of indicators. These questions include "How far are we from the desired conditions?" "Why is the present situation the way it is?" "How would the situation be if the present tendencies were maintained?" "What is being done about it, and how is that helping?" The actions and the requests lead to the definition of the action-planning questions of the type: "Which are the most appropriate actions for a given place?" "Which would be the best location for a given option?" And "what would happen if we chose such and such a strategy?" Local players can use geographic information in a learning and empowerment process, rather than have these players simply participate in a planning process that is managed by technical professionals (D'Aquino et al., 2002).

It is also important for scientists and information providers to receive feedback from users about the local questions and knowledge related to rural development, which are the conflicts of opinion, to define where more research or information gathering is needed. Planning can be a mechanism for this feedback, where needs in information and research are formulated in the requests, from individual levels of the social systems towards the national and international levels.

Information is useful to answer questions related to development, but it can help also to strengthen the relationships between institutions and players, because it can be shared at a minimal cost. As discussed previously, planning can help institutions understand the complementarities of their roles and contributions to development. Some of these institutions have the role of providing information. However, we need policies that facilitate rather than restrain the accessibility to information.

Conclusions

Governmental planning is a powerful mechanism that scientists can hook onto in order to increase their impact, through the scaling up and out mechanisms that are mentioned in this chapter, but also to orient their research towards the needs of their beneficiaries. However, planning in itself is a multidisciplinary research theme to which agricultural research can contribute. We became interested in planning as an entry point to geographic information and decision-support tools. We found that many opportunities to improve planning are available, and that they are necessary for planning to produce the desired links between science and development. In our work in Colombia, we have been promoting a simple planning method that aims at facilitating the four types of improvements mentioned in the text. Indeed, being vision-based, it helps clarify the ends sought through planning and planned actions. Results of the various workshops can easily be transformed into a list of goals, actions, and partnerships, which can be used in management and in monitoring and evaluation. The hierarchical structure of the workshops helps integrate points of view and stimulate interactions between players and administrative levels, through the matching of actions and requests. It can help identify questions for monitoring and evaluation and for action planning, which will guide the data acquisition and analysis, as well as the communication of information. It can be complemented with elements of other planning approaches.

Through our work in the Colombian llanos, especially in the municipality of Puerto López, we have seen modest, but extremely encouraging, examples of how governmental planning can help scaling up and out the results of agricultural research and the results of local innovations. We also have seen significant changes in attitude. For example, the UMATA of Puerto López went from being a "political" instrument to being a development mechanism that the municipality fully recognizes. We are bound to encounter more and more encouraging examples as we begin to support planning at higher administrative levels. We have seen that departmental secretariats of agriculture all over the country are genuinely motivated to develop their territorial plans and to help municipalities with their planning. The recently formed network on development planning benefits from the active participation of various members from the Ministry of Agriculture, departmental governments, municipalities, universities, and nongovernmental organizations.

Finally, we hope we have been able to convince readers to link their work, in one way or another, to the development processes supported by the various governmental planning mechanisms. In addition to this, it is important for all of us to realize that "real planning *is* research" (Eric Dudley, personal communication, 2003) in which we can test our hypotheses that the actions we envisage will take us to the desired outcomes.

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CHAPTER 16

Mainstreaming Gender-Sensitive Participatory Approaches: The CIAT Case Study

*Barun Gurung** and *Harriet Menter***

Background

Why this study?

As part of a larger initiative of the Systemwide Program on Participatory Research and Gender Analysis (PRGA) to mainstream gender-sensitive participatory approaches, three studies were conducted to assess the opportunities and constraints for mainstreaming. One study was conducted in the International Center for Tropical Agriculture (CIAT, the Spanish acronym), one in the International Potato Center (CIP, the Spanish acronym), and one in the International Center for Agricultural Research in the Dry Areas (ICARDA). The study reported on here consists of an analysis conducted in CIAT.

Additionally, this CIAT study attempts to address two important questions that arise from CIAT's central goal to address poverty alleviation through the development of innovative practices and methods, an objective highlighted by the Director General during the 2002 Annual Review. These, interrelated by separate questions, are:

(1) What would the innovation system or approach have to look like in order for CIAT to effectively address the needs of the rural poor, particularly women?
(2) What are the organizational implications of instituting such a process of innovation within CIAT?

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The problem statement

The Consultative Group on International Agricultural Research (CGIAR) Systemwide PRGA was launched in 1997 with two major objectives:

(1) To assess and develop methodologies and organizational innovations for gender-sensitive participatory research approaches.
(2) To systematize and mainstream what is being learned worldwide from the integration of gender-sensitive participatory research (PR&GA) with Plant Breeding (PB), and crop and natural resource management (NRM) research.

The mainstreaming objective specifically refers to efforts to establish client-oriented, gender-sensitive research approaches as credible research methods on the same footing as other scientific research. In designing its strategy for mainstreaming PR&GA approaches, the program developed a set of criteria that would guide the program's actions and enable tracking of progress (see Box 1).

Examining the achievements of the program[1] in the context of these mainstreaming criteria shows mixed results. On the one hand, analysis of surveys and impact case studies confirm that PR&GA approaches are effective for applied research. They enable new, more appropriate technologies to emerge or existing ones to be adapted to local conditions. They accelerate the uptake of relevant technologies. Effective partnerships between researchers and farmers are established. These results in themselves are good news. On the other hand, much of the effectiveness of PR&GA approaches to address client demands, particularly those of poor rural women, is critically constrained by an organizational structure predicated on a supply-driven, "pipeline" system of innovation.

The PRGA conducted several studies with the CGIAR centers. The results of these case studies highlight three interrelated problems that perpetuate the supply-driven, "pipeline" system, and hamper the mainstreaming of PR&GA approaches:

(1) Fragmented investment in, and application of, PR&GA approaches across the Consultative Group (CG) System[2] leads to the repeated testing of proven approaches under different names, and a slow learning curve in the use of PR&GA approaches. Thus, collectively, International Agricultural Research Centers (IARCs) do not evolve beyond a researcher-led type of participation.

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1. For a comprehensive account of the accomplishments of the PRGA, refer to the Synthesis Document, PRGA (2002). See also Farnworth and Jiggins (2003), Johnson et al. (2000), and Lilja and Erenstein (2002).
2. A total of US$26 million, devoted to PR&GA approaches, is spread among 144 projects over 16 Centers, which raises the question of whether the CGIAR is getting full value for its investment.

Box 1

Program on Participatory Research and Gender Analysis (PRGA) mainstreaming criteria

- Wide acceptance of gender-sensitive participatory research (PR&GA) approaches by donors, International Agricultural Research Center (IARC) management, and scientists as valid for achieving scientific research goals (e.g., soil analysis and gender analysis have equivalent legitimacy and validity as research tools).
- PR&GA approaches used scientifically in a discriminating fashion for improving research in the Consultative Group on International Agricultural Research (CGIAR) system—not for advocacy or the sake of appearances.
- PR&GA approaches assigned sufficient resources at the system level to enable IARCs to apply the approaches and methods when needed to solve priority research problems, to learn from one another's experience, and to conduct strategic research for developing new applications and cutting-edge methodologies.
- PR&GA approaches applied to increase gender-equitable stakeholder and client participation in relevant research processes and decisions so that feedback to research, research efficiency, and effectiveness is improved; technology appropriate to different stakeholders is developed; and adoption rates increase among the Consultative Group's priority client groups, such as poor rural women.
- PR&GA approaches used by IARCs to develop and promote collaborative research partnerships that incorporate gender-sensitive stakeholder and client participation, and contribute to empowering poor rural women to access new opportunities through technological innovation.
- PR&GA approaches used to encourage gender-equitable stakeholder and client representation in CGIAR external and internal reviews, impact assessment, and consultations for strategic planning.

(2) End-users, such as women, tend to be brought into the participatory research process at a relatively late stage to evaluate technologies that have already been developed and are ready for dissemination. The likelihood of these technologies matching farmers' priorities is small.

(3) New methods and practices resulting from farmers' feedback to projects are not being sustained beyond the life of the project because they are institutionalized in the research organizations implementing the projects. Rather, PR&GA approaches remain isolated from and often contradict the dominant paradigm of innovation.

A linear model of innovation. Hence, even though there is considerable adoption of gender-sensitive participatory approaches within the CG system, they are integrated into the research process only to a limited extent. This curtails how far their positive impacts can be scaled up.

An organizational structure predicated on a pipeline approach to innovation severely constrains the efficacy of gender-sensitive participatory approaches by limiting their use to a "functional" application. This limitation is largely due to an organizational structure that implicitly supports a hierarchical relationship between researcher and end-users of technologies. Such a model of innovation has been described as one in which "knowledge flows through a 'pipeline', which has basic activity at one end and knowledge embodied as useful products at the other" (Clark, 1994). Hence, when participatory approaches are employed in the context of an organizational structure predicated upon such a model of innovation, it does not change the fundamental nature of the relationship between researcher and end-user. As the broader arrows in Figure 1 demonstrate, information flows predominantly from researchers to extension agents and to farmers.

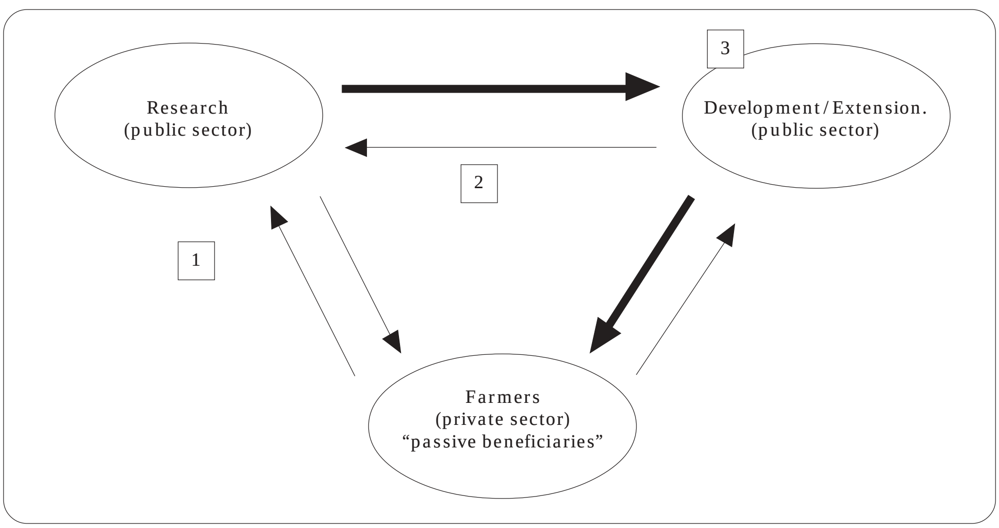

Figure 1. Participatory approaches and a "pipeline" model of innovation. The width of the arrows denotes the major flows of information (adapted from Gauchan et al., 2000).

Central to such a linear process of knowledge production and dissemination is the implicit hierarchy inherent to the system. The hierarchy embedded in an organization's approach to innovation is reflected and reinforced by a top-down structure and an organizational culture in which members conform to a hierarchical division of labor that is recreated by complementary mechanisms of rewards and incentives.

Limitations to the pipeline approach to innovation. The pipeline approach to innovation has proved effective, particularly in ensuring the success of the Green Revolution. Those CG Centers that were closely associated with its success have demonstrated that such an approach is effective under the following conditions:

- When there is a large, uniform demand for a particular technology;
- User preferences are well defined;
- Quality control is not a problem;
- Experiment results on station can be replicated on farm; and
- Enforcement is easy (e.g., use more fertilizer).

However, several challenges question the continued efficacy of such an approach to innovation. For one, the diverse environments in which research is conducted ensure a high number of end-users whose preferences are poorly defined. Moreover, under such conditions, enforcement of research requirements becomes a problem, as does quality control.

Other compelling factors would suggest that the process of innovation move away from a pipeline to a demand-driven, interactive model. For instance, the number of women living in absolute poverty globally rose by 50% in the last 2 decades (in contrast to 30% for men). This statistic becomes all the more alarming because poverty and gender are so intimately linked: It has been shown that an increase in women's income and education has a positive effect on nutrition, child survival, and birth rates. The potential for food security and higher incomes that could result from improving women farmers' access to resources, technology, and information is as great or greater than the gains expected from breeding "super plants". Yet global agricultural research and development (R&D) systems are failing to tackle poverty alleviation head on by responding to the demand of rural women for innovations that increase income under their control, relieve drudgery, and generate access to high-value products and new markets (Kaaria and Ashby, 2000).

Generated by global trends, pressure is increasing for change on innovation practices. Influences on organizations involved in agriculture and NRM research are coming from many sources, for example, globalization, international and local migration, changes in information technology, the World Trade Organization, and the advocacy of influential civil society groups, such as nongovernmental organizations (NGOs). All these influences have a bearing on the decision making of the many actors in technology innovation systems, particularly through funding decisions and the accountability demands that they generate (Gauchan et al., 2000; Biggs, 2002).

Moving from pipeline to demand-oriented models of innovation

Clearly, critical pressure is on those involved in agricultural R&D to address the needs of the rural poor in a more effective manner that takes into account the diversity and demands of the rural poor, particularly women.

Prompted by such a need, the World Bank has catalyzed a restructuring of the R&D systems of many national agricultural research systems (NARS) to reflect a demand-driven approach to innovation (e.g., Chile). However, what is being ignored in such structural transformation is that change is first required in the culture of the organizations. Hence, the end result is a “demand-driven” initiative in a “pipeline”-type setting. What is clearly needed for a transformation in innovation approaches is the prerequisite institutional change combined with transformation in the practice and culture of the research organization.

Although there is a general paucity of empirical research and experience of such transformations in public sector research organizations, there is a set of theoretical and structural principles for a demand-driven approach to innovation.

The first of these is that an “interactive” demand-driven approach to innovation is based on the notion that useful knowledge is generated by close collaboration and interactive links between researchers and end-users. This implies a continuous process of negotiation among stakeholders and researchers in order to find compromises between what the different stakeholders want, and what is technically feasible. Table 1 contrasts the “pipeline” with the “interactive” innovation approach.

In structural terms, change from a pipeline to an interactive mode of innovation will require several organizational changes in R&D systems, and several hypotheses exist about what these changes might be. For example, some organizational change literature emphasizes the need for new configurations of knowledge and skills (Rothwell, 1992; Gibbons et al., 1994; Pretty and Chambers, 1994), such as interdisciplinary teams with maximum sharing of information across disciplines. This is based on the notion that an organization’s capacity to innovate depends on its ability to respond to problems by assembling relevant people, by building trans-disciplinary teams, and by reconfiguring them into new teams as the questions evolve. The notion of a “team” is based on much more than a group coming together, but on how its members are managed so as to make their interaction meaningful. One way suggested for this is through the development of “metaperspectives” (Hursh et al., 1983; Brekelbaum, 1985).

Other authors (e.g., Gunderson et al., 1995) hypothesize that public sector R&D organizations need to develop policies and internal mechanisms that incorporate feedback from the innovative practices of its members. A different emphasis is that policy changes need to be accompanied by transformations in organizational culture (Gunderson et al., 1995; Leurs, 1996). A survey of the literature allows some hypotheses to be made about the key elements or “good practices” that are most likely to characterize an interactive approach to innovation, outlined in Box 2.

Table 1. Comparing two models of innovation (adapted from Ashby, 2002).

	Model of innovation	
	"Pipeline"	"Interactive"
Origins of approach	Extensively researched 1950-70	Extensively researched in the 1980s-1990s
	Widely used for public sector research and development	The basis of "thriving on Chaos" and the "customer first" management theory for dynamic markets in the private sector
	Private sector industry with large, established market dominance 1960-70 (e.g., General Motors)	
	Foundation for farming systems research and the training and visit system of agricultural extension	Foundation for growth of participatory research and appraisal methods
Main features	Predominantly experts' problems and ideas	Experts' and end-users' knowledge is combined to identify problems, prototype solutions and recommendations, and for dissemination. There is a high degree of adaptation.
	Experts>prototype solutions	
	Experts>recommendations	
	Transfer of finished technologies	
Effective when.....	large, uniform demand for the technology exists (e.g., irrigated rice).	the diversity of environments and end-users is high.
	users' preferences are well defined.	user preferences are poorly defined.
	quality control is not a problem.	quality control is a problem in research.
	experiment results on station can be replicated on farm.	
	enforcement is easy (e.g., use more fertilizer).	enforcement is a problem.
	transfer aims at mass dissemination.	products need to be adapted to be useful to diverse, segmented user groups.
Not effective when...	diversity of environment and users is high.	users are not involved early in technology design.
	user preferences are poorly defined.	monitoring and evaluation is too little too late so that learning is attenuated.
	quality control is a problem.	users do not have control over a significant proportion of the resources to be allocated to research.
	enforcement is a problem.	weak mechanisms for accountability of research providers to research users.
	transfer aims at segmented user groups.	

Box 2

Hypothesized best practices of an "interactive" model of innovation
(See also Douthwaite et al. [2001] for discussion on "best practices" in farming systems research and integrated natural resource management.)

- Engagement with priority client groups in planning, priority setting for research, and technology design.
- Devolution of adaptive research and development to farmers and other resource users in decentralized contexts.
- A culture of organizational learning that rewards institutions and professionals that are more accountable for the relevance and quality of their contributions to priority client groups (Kloppenburg, 1991; Pimbert and Pretty, 1995; Chambers, 1997; Posey, 1999; Groot and Maarleveld, 2000).
- Collaborative working environments where staff members are rewarded to work effectively in groups that are problem oriented and demand driven (Argyris and Schön, 1978; Senge, 1990; Garvin, 1993; Watkins and Marsick, 1993; Bessant and Caffyn, 1997).
- Participatory monitoring and evaluations that involve client groups in providing regular feedback, review, and adjustment of plans, and refinement of the environmental and social knowledge that frames their interventions (Rugh, 1986; Davies, 1995; Fowler et al., 1995; Bekalo, 1997; Estrella and Gaventa, 1997; Bandre, 1998; Guijt, 1998; Mosse et al., 1998).
- Critical reflection, particularly of the underlying assumptions, and a willingness to challenge and change them. This process of critical reflection focuses not only on operational procedures and rules, but also on more fundamental assumptions about gender, the dynamics of organizational change, the construction of knowledge related to people-environment interactions, the role of individual attitudes and behaviors on embracing and learning from error, and methodological issues (Habermas, 1987; Freire, 1993; Dilworth, 1996; Freire, 1998).

Participatory approaches and demand-driven innovation

Gender-sensitive participatory approaches are an integral component to a demand-driven approach to innovation. They are based on a process of discovery, through the formulation of questions and the search for information to address them, in which the end-users of the research are actively engaged. Such involvement means that instead of having research done on their behalf, the subjects take part in designing and implementing the research process, in interpreting the information generated by the research, and in deciding how to use the results.

The power of participatory research is realized when it is used in a process of innovation, which has the goal of producing change for the benefit of the participants. This process begins with the participatory diagnosis of problems or opportunities for innovation that enables the subjects to analyze and understand the problem or the need to be addressed, and continues through the process of participation in discovering, designing, testing, adapting, and adopting innovations.

Why do participatory research? Researchers have become interested in it for two main reasons. One is that it promises to make their research more effective and more efficient. Agricultural technologies developed using participatory methodologies have proven to take less time to develop (from conception to adaptation and adoption), and to have higher and faster adoption rates than those developed in the more favorable conditions and the isolation of research stations. Having been developed by the people who need them and expect to use them, innovations produced by participatory research are rapidly disseminated to other people with similar needs and opportunities, with whom the participants in the research want to share their results. This motivation is often referred to as “functional participation”.

The other allure of participatory research is that the process itself is a catalyst for change. It can strengthen the capacity of farmers to conduct more of their own research and to effect demand on the formal research system according to their needs and priorities. It also can create a sense of efficacy and self-worth, a respect for the value of combining expert knowledge and lay experience, skills for facilitating participation, and confidence that the power to catalyze innovation and change is within reach. This is often referred to as “empowering participation” (see Sanginga et al., 2002).

Methodology

The concept of an “organizational culture”. The methodology is informed by the view of an organization as “culture”. This moves away from the notion of an organization that is typically represented through an organigram. This popular organizational image with its linear, compartmentalizing, and dividing functions, and denoting a hierarchy that gives status and authority to those at the “top” over work and effort of those at the bottom, gives a semblance of rationality and logic and deters challenge. Drawing from the Weber (1967) model of a bureaucracy, this model is considered a rational way of organizing and controlling joint endeavors, and conforms closely to a “pipeline” approach to innovation.

Increasingly, the view of an organization as a complex set of relationships with its own “culture” is emerging in the organizational development literature (e.g., see Alvesson, 1993; Brown, 1995; Schultz, 1995), as well as in popular discourse. As an author on organizational culture (Handy, 1989) notes:

> "Organizations used to be perceived as gigantic pieces of engineering, with largely interchangeable human parts. We talked of their structures and their systems, of inputs and outputs, of control devices, and of managing them as if the whole was one large factory. Today, the language is not that of engineering but of politics, with talk of cultures and networks, of teams and coalitions, of influence or power rather than control, of leadership not management. It is as if we had suddenly woken up to the fact that organizations were made up of people, after all, not just 'hands' or roles' occupants."

This suggests a notion of an organization removed from traditional models based on the Weberian concept and replaced with more human, inclusive, and less punishing forms that facilitate both organizational and individual performance, and allow for learning and growth. Accordingly, organizational culture can be conceived in many different ways: As societal or national culture, as corporate culture, and as a homogenous or heterogeneous organizational culture (Wilson, 2001). Subcultures can be identified within the boundaries of an organization, and may be based on or across departments, or on occupations or other interest groups, for instance within the managerial group. The effect of gender on organizational culture is the topic of numerous studies of organizational researchers that have shown how organizational norms and values that are gendered affect organizational outcomes (e.g., Martin, 1992; Mills and Tancred, 1992; Itzin and Newman, 1995; Alvesson and Billing, 1997; Wilson, 2001). Similarities can also be seen across organizations (Turner and Hulme, 1997).

Some features of organizational culture include the use of symbols to convey meaning, the rites and rituals of organizational life, the use of specialized language within particular concerns, socialization and norms, the moral code transmitted by the organization, and attempts to manipulate culture (Wilson, 2001). Such a view of an organization is more consistent with a demand-driven approach to innovation.

An organizational framework: A tool for analysis and planning. The model of an organization employed in this study attempts to draw together structural elements that are usually represented in the traditional organigram, as well as the more "hidden" aspects of an organization that play a decisive function in terms of how its members, by those in leadership, and by other stakeholders develop and manage policies, decisions, incentives, and the values, attitudes, and image. This framework will be employed for two purposes:

(1) As a tool to analyze and assess opportunities and constraints for organizational development; and
(2) As a tool for developing action plans.

The proposed framework includes three dimensions of an organization:

(1) At the first level is the technical dimension. This is the most visible and tangible aspect of the organization and can be accessed through printed publications, policy statements, public relations manuals, and the like. The technical dimension is the public face of the organization, and this is what is usually represented in the organigram. It includes three elements: The policy or mandate, the tasks and responsibilities, and the human resources or expertise of an organization.

(2) Second is the political dimension of an organization. This is less tangible and is also referred to as the socio-political dimension. It represents those aspects of an organization that are more "hidden" from both public scrutiny and some internal members. The "hidden" nature of this dimension suggests that it is a more "fuzzy" and subjective arena in which decisions are made, policies are formulated, and individual members negotiate "spaces" in which to maneuver and innovate.

(3) Third is the cultural dimension, which is the non-tangible aspect of an organization. It represents those often unquestioned, but embedded, organizational elements that influence the norms and values underlying the running of the organization; the way work relations between staff and outsiders are organized; and the way members feel and think about their work environment and about other members. This dimension is comprised of three elements: Organizational culture, cooperation, and attitudes.

Taken together, the three dimensions and the nine elements are contained in a framework, where they cannot be viewed as separate and distinct aspects of an organization, but rather as an axis of meaning that runs across and down the elements (Box 3).

Research tools. An initial survey was conducted to assess the total number of projects in CIAT that were involved in using gender-sensitive participatory approaches. This was followed by a request to each project to give a brief description of the project and what type of participatory and gender analysis (GA) tools were being used. Next came a questionnaire survey, based on the nine elements of the organizational framework, which was sent to 30 people to elicit individual responses to the three dimensions of the organization (CIAT).

Interviews were also conducted with 27 individual members. They ranged from senior management to project leaders and scientists in CIAT. The semi-structured interviews were conducted with the aim of assessing the organizational culture of CIAT that included such factors as its history, its social relations, the values and attitudes of organizational members regarding gender-sensitive participatory approaches in particular, and the role of social sciences in the organization.

Box 3

Organizational framework
(Groverman and Gurung [2001], adapted from Tichy [1982])

	Mission/Mandate	**Structure**	**Human resources**
Technical dimension	I. Policies and actions	II. Tasks and responsibilities	III. Expertise
	The guiding policy and its putting into operation in action plans, strategies/ approaches, and monitoring and evaluation systems.	The way people are positioned and the way tasks and responsibilities are allocated through procedures, information, and coordinating systems.	The number of staff and the way requirements and conditions allow them to work, such as job description, appraisal, facilities, training, etc.
Political dimension	IV. Policy influence	V. Decision making	VI. Room for maneuver/ innovation
	The way and extent to which management and people from within and outside the organization influence its policy and running.	The patterns of formal and informal decision-making processes. The way diversity and conflicts are managed.	The space provided to staff (through rewards, career possibilities, variety in working styles), or created by staff to define their work.
Cultural dimension	VII. Organizational culture	VIII. Cooperation/ learning	IX. Attitude
	The symbols, rituals, and traditions. The norms and values underlying the running of the organization and staff behavior. The economic and social standards that exist.	The way the work relations between staff and with outsiders are organized, such as working in teams, networking. The norms and values underlying these arrangements.	The way staff members feel and think about their work, the work environment, and about employees. The extent to which staff stereotype other staff—the extent to which a staff member identifies with the dominant culture of the organization.

Finally, extensive secondary sources were employed to become familiar with the extensive literature on organizational development, models, and approaches to innovation, and CIAT's record of research.

The Case Study

Introduction

The analytical narrative is based on two major questions that link closely to the principles contained in the "best practices" of a demand-driven approach to innovation.

(1) What type of critical mass of PR&GA expertise exists within CIAT?
(2) What is the nature of "organizational adaptability" in terms of new approaches to innovation?

These questions have been addressed in the context of the following elements contained in the organizational framework: Expertise in PR&GA approaches, policy, organizational culture, attitudes, room to maneuver and innovate, and reward and incentives (Box 3).

What type of critical mass of PR&GA expertise exists in CIAT?

Engaging with end-users: A diversity of practices. This refers to the extent projects employ PR&GA; the quality and level of capacity for their differentiated use by those using such approaches; access to alliances and partnerships for new information by interested members; and organizational policy regarding such approaches (Figure 2).

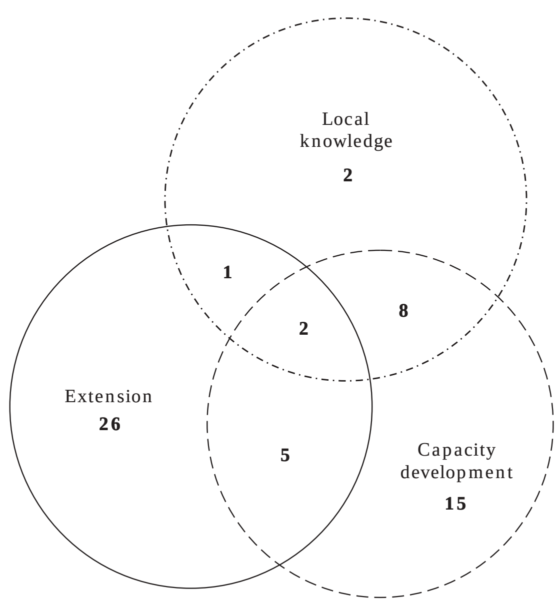

Figure 2. Venn diagram depicting the distribution of projects in the International Center for Tropical Agriculture (CIAT, the Spanish acronym).

Slightly more than 58 projects in CIAT are involved in the use of participatory approaches for R&D, excluding the systemwide PRGA. This number constitutes about 34% of the total number of projects within CIAT.

The experiences in participatory approaches range from their use in extension, for the effective dissemination of technologies, to developing the capacity of end-users (farmers) to better enable them to participate in the R&D process. Based upon their own descriptions of project activities, the projects and their participatory experiences can be classified into seven categories of participation:

(1) For extension,
(2) To elicit local knowledge,
(3) To develop capacity of end-users,
(4) For extension and capacity development,
(5) For extension, integrating local knowledge,
(6) For extension, capacity development, and integrating local knowledge, and
(7) For capacity development using local knowledge.

All these categories employ a number of approaches to engage with end-users. They include a wide range of approaches from the more conventional on-farm trials and evaluations to the more innovative approaches, such as participatory plant breeding (PPB), participatory varietal selections (PVS), farmer field schools (FFSs), Committees for Local Agricultural Research (CIALs, the Spanish acronym), and a variety of other methods that are designed to engage more meaningfully with end-users.

Participation for extension. By far the largest number of cases of projects using participatory approaches falls into this category. In sum, 34 projects claim to be using participatory approaches for activities that can generally be termed as “extension”. The term covers a wide range of activities: Technology transfer, on-farm trials, evaluations, FFS, PPB, and PVS.

Within the larger category of “extension”, projects can be further divided into several subcategories. For instance, 26 projects use participatory approaches for technology development, but are not necessarily involved in development of end-users’ capacity to participate in the R&D process as such. Technology development may occur through either formal or informal feedback mechanisms, such as on-farm trials, evaluations, and PVS, and be disseminated through either FFS or more conventional approaches.

The absence of capacity development of end-users to participate in the R&D process does not imply an absence of decision-making ability, however. For instance, the Populational Rice Breeding Program works on demand generated by farmers. In the Technology Transfer for Cassava

Disease Project, working in the North Coast of Colombia, farmers were instrumental in seeking support by identifying and presenting problems of root rot in cassava (*Manihot esculenta* Crantz) to the project. Additionally, in another case, farmers obtained additional funds to supplement funds already granted by the Ministry of Agriculture to seek support from the project on Integrated management of *moko* in plantain (*Musa* × *paradisiacal* L.). These are examples of end-users' active involvement in decision-making processes that influences the outcome and direction of the research.

Participation for integrating local knowledge. A smaller number of projects falls into this category. Only two research projects are working exclusively on integrating local knowledge with scientific practice. The Participatory Mapping Project, working collaboratively with a local NGO, seeks to compare "expert" and "local" knowledge to create a common spatial language to improve communication between communities and institutions. Two other projects—one on soils, which seeks to understand local knowledge of soils and soil management at the landscape level, and another on the mapping of resources and nutrient flows in the watershed—seek similarly to understand local knowledge for integration with scientific practice. The level of farmer participation in terms of decision making varies in these projects. In the former project, farmers are involved in the decision-making process in a meaningful way, but less so in the latter.

Participation for capacity development. The various projects are conducting a wide range of capacity development activities, including PPB, PVS, building research committees, local organizational capacity, manuals, tools, and networking.

Fifteen projects fall into this category. Developing the capacity of end-users is strongly emphasized in several ways. For instance, a farmer breeding workshop was conducted with the aim of exploring the feasibility and methods for complementing farmer-experts' knowledge and skills to enhance and conserve biodiversity. This was part of a larger initiative in PPB to enhance the capacity of women and small-scale farmers in Africa and Latin America. Another project on participatory development for low-cost, simplified rustic tissue culture for cassava works with farmers to conduct in-vitro seed multiplication and set up artisan tissue laboratories so that they can perform their own multiplication. Similarly, the Artisanal Seed Production Project works with NGOs in Honduras and Nicaragua to train local communities in seed production.

Also in this category, CIAT conducted a workshop for 25 participants to train them in rainfall measurement techniques, and improving the capacity of local communities to participate in a larger network.

Enhancing and developing local organizational capacity is another important area for capacity development. Using a combination of CIAL methodologies and variations that have sprung from its basic approach, the

Hillsides initiative works in several areas of Latin America to develop the organizational and research capacity of local people, particularly youth.

Perhaps the most significant work in the capacity development of end-users has been that of CIAT's Participatory Research in Agriculture (IPRA). The primary focus has been the development of CIALs, which have mushroomed throughout Latin America. Exploration is underway also to expand an adapted version of this methodology to Africa and Asia. In IPRA, five projects are involved presently in capacity development for research and developing networks for farmer groups. Research capacity development focuses on sustaining existing CIALs. It also includes enabling integrated pest management (IPM) programs to include farmers as partners in research and learning. In terms of establishing networking capabilities, it brings groups from Central America to Colombia to visit CIALs to identify and extract lessons so that these can be extrapolated and adapted to conditions in Central America.

Participation for extension and capacity development. Projects in this category are also involved in the capacity development of end-users. Five projects fall into this subcategory. The Populational Rice Breeding Program offers training to NARS breeders. Utilizing multi-purpose legume diversity to improve soil and feed quality, including application in a watershed in the Central American hillsides, the program provides training and workshops to farmers. The National Program of Technology Transfer (PRONATTA, the Spanish acronym) Project conducts training for dissemination. The FFS on soil productivity improvement in Uganda has built on the Integrated Soil Productivity Initiative through Research and Education (INSPIRE) initiative, which is based on farmer evaluation and adaptation of soil fertility technologies.

Participation for extension and integrating local knowledge. One project in this category is involved in utilizing local knowledge—the project on crop-livestock decision support to understand farmer decision making, developing scenarios with farmers for evaluating alternative options and implications of changing management practices at farm levels.

Participation for extension, capacity development, and integrating local knowledge. Two projects are involved in this category. The project working with indigenous people on cassava integrated women's preferences for cassava (starch content over yields) in the project design, while developing local organizational capacity through training to sustain activities beyond the life of the project. The Beyond Agricultural Productivity to Poverty Alleviation Project has attempted to integrate farmer experimentation, planning, and market identification in a development initiative.

Participation for capacity development using local knowledge. Eight projects fall into this category that attempt to develop the capacity of end-users by building on local knowledge and cognitive categories for decision making. In the initiative on rural agro-enterprises, in collaboration with beneficiaries, a number of tools and methods were developed. They focus on interest group formation, market opportunity identification, participatory planning to identify possibilities for value addition in the production-supply chain, and to facilitate multi-stakeholder decision making amongst farmers, NGOs, and governmental organizations. Finally, the initiative on agro-enterprise development also has adopted the CIAL methodology for postharvest technologies.

Tools and methods for the community-based management of genetic resources in hillsides landscapes also are being developed through working with farmers and a local NGO to use in a mapping project.

Expertise in PR&GA approaches

In order to sustain the diversity of experience for participatory approaches within CIAT, the quantity and quality of human resources available must be assessed. This includes an assessment of training opportunities, and the capacity development needs of those members already involved in the use of participatory approaches. In addition to human resources, it is also pertinent to assess the organizational policy regarding gender-sensitive participatory approaches. Have such approaches been integrated into the organization's policy, or do they evolve as practice among some projects only? Finally, it is important to the assessment to understand who in the organization is responsible for managing, developing, and disseminating information related to gender-sensitive participatory approaches. Are they confined to projects, or is there a larger organizational awareness supported by information flows among and between the various projects?

In terms of expertise, the review is mixed. Responding to a survey questionnaire distributed among 35 professional staff members of CIAT, most felt that they were not fully trained in the use of gender-sensitive participatory approaches. Many also expressed the opinion that there was insufficient capacity within their particular projects to deal effectively with the full range of participatory approaches (functional to empowering). The response of one member is typical:

> "There is a lack of true social science background and backstopping by those providing support in participatory research approaches".

Although many of the projects describe the involvement of women in some of their activities, there was little or no GA conducted in a systematic manner. As a result, the report only refers to participatory approaches.

Almost paradoxically, despite the numerous projects engaged in the use of participatory approaches, most respondents said that new staff selection in projects with a participatory component did not require them to possess or demonstrate experience in the use of such methods. In a few cases only, experience in participatory approaches was a precondition for selection into the project.

Response was also mixed on how new staff members to a project with a participatory component were familiarized into the use of such approaches. Most agreed that a new member of the project was "on his/her own" in terms of developing capacity to use participatory approaches. This usually involved learning from manuals, where available, or "learning by doing" in the field. But no formal training was given in most cases. Most staff members in the projects were not adequately trained or updated on new knowledge with regard to participatory approaches.

Most respondents felt there was an acute need for a "service" function to be provided by IPRA or PRGA. Some thought of these two programs interchangeably and made no attempt to understand their relative differences. Moreover, many felt rather strongly about the absence of support from IPRA and the PRGA, and a common refrain was "We need the assistance of specific projects dealing with the issue". From IPRA, the expectations were in the form of capacity development for gender-sensitive participatory approaches and timely dissemination of information regarding new developments in the field. However, there was little discussion about the structural adjustments that would be required for IPRA to provide more "services" and play a "supportive" role, while also functioning like any other project with research commitments and funding contingencies.

Policy for participatory research and gender analysis approaches: Are they needed?

No official organizational policy exists in CIAT for the use of gender-sensitive participatory approaches. Their use in CIAT can be attributed largely to a combination of events that include interest by some proponents from within and donor support from outside. However, the question of whether an official policy for the use of such approaches would contribute to overall efficacy and performance remains a divided issue among members who responded to the survey. Some argued that a high percentage of demand-driven activities already exists, although the exact nature of this process as it relates to the best practices outlined earlier is unclear. In another case, the project had to justify its use of participatory approaches against the donor's ambivalence for such.

Many argued that a policy for PR&GA approaches was irrelevant and may actually prove too constrictive, and provide an inflexible research environment. The statement of one respondent perhaps typifies the general consensus on the need for a policy on PR&GA approaches:

"There is no specific policy for participatory approaches", there is nevertheless "explicit agreement that participatory research approaches should be incorporated in every aspect of the program".

However, in the absence of a policy, the question that emerges and remains unanswered is: What are the processes by which accountability of research to end-users in ensured? Moreover, given the nature of the divergent assumptions of participatory approaches that exist among organizational members, this question has critical implications for the sustained introduction of demand-driven approaches to innovation.

Finally, in relation to the noted absence of the use of GA in the projects, clearly a more extensive study needs to be conducted to assess whether this absence is related to a lack of capacity amongst researchers and projects to conduct GA in a systematic manner, or whether the problem lies in gendered workplace practices, such as the inequitable representation between men and women in the organization and its hierarchy.

Organizational culture and attitudes: A diversity of assumptions about participatory research

Functional to empowering approaches to participation. The great number of projects using participatory approaches suggests an important organizational environment for the development of a demand-driven approach to innovation. However, this critical mass of experience must be assessed in the concept of two important concepts of participation, separate but interlinked, which are at the heart of a discussion on a demand-driven approach to innovation—functional/empowering.

Why use participatory approaches for research and development? Various responses were given to this question. A large majority felt that participatory approaches were highly effective in the transfer of technologies and an important conduit for understanding the needs of the end-users. Many of these responses came from those involved in research on commodities. In a similar vein, some acknowledged that farmers and other end-users could provide important information that could be utilized in R&D. Hence, the knowledge generated from the management of natural resources and crops, and the cognitive categories of decision-making processes, was viewed as an important resource that needed to be understood, elicited, and integrated with scientific practice (e.g., modeling, soils).

The general response of those in this category was that participatory approaches were an efficient means to involve end-users in the adoption of technologies. Moreover, to the extent that they were useful tools to achieve this end, such approaches should not be viewed as a "religion": The use of the term "religion" was alluding to some members in the organization who had become "messianic" proponents of participatory approaches.

In contrast are those members who, while recognizing the "functional" efficacy of participatory approaches to speedier adoptions by end-users, also recognized their use as a means to involve end-users in more "meaningful ways". More specifically, this involvement referred to enabling end-users to participate in the decisions, and hence catalyze change, both in the R&D activities and in their own capacity to organize and sustain change. These were achieved primarily through developing the capacity of farmers and other end-users in more upstream research (e.g., PPB in cassava), involvement of farmers in their own research (CIALs), and capacity development for local organizational capacity.

Reward and incentive for participation

This refers to the autonomy, allowance for innovation, and encouragement given to those who aim to learn and increase their capabilities within the boundaries of the work environment.

CIAT has a reward and incentive system that recognizes achievement by its staff in several categories. Of particular interest to the analysis is the Outstanding Research Publication Award (ORPA). The selection criteria for a publication are generally based on: Newness and originality of its content, scientific content, and the prestige of the publishing journal. However, no publication regarding participatory methods, impacts, or learning and change has ever appeared in this award category. Moreover, no publication with social science content has been awarded this recognition. In the years 1990-2001, the winners of this award have comprised publications from the biophysical sciences.

The chairman of the selection committee put forward several reasons for this. First, there were few publications with social science content. Second, most social science publications in CIAT have appeared as conference documents, and few have appeared in review journals. The implications of this are several. First, there is a need to question why social scientists publish so infrequently in review journals. And, if this is the case, why do social scientists not publish? Finally, is the poor publication record by social sciences indicative of the role they are expected to play within the larger CGIAR system?

Organizational Adaptability and CIAT

Organizational adaptability

This refers to how the organization responds to complex problems. The nature of the response is intimately linked to how R&D systems are organized and managed, whether there is emphasis on multi- or trans-disciplinary teams, and whether reward and incentive structures are consistent with innovative methods (e.g., demand-led PR&GA approaches).

Experimenting with models of innovation. Drawing upon two events in the historical record provides critical insight into the organizational potential that exists for a move to a demand-driven approach to innovation within CIAT. These events refer to how CIAT responded to the challenge of institutional change to become more consistent with recognition of the need to focus research beyond the discrete commodity to more complex environmental concerns. The compelling need for institutional transformation was as much a concern for the CGIAR system as it was for CIAT, coming as it did from considerable donor pressure.

Recognizing the limitations of the “pipeline” type approach to innovation, particularly when confronted with complex environmental (as opposed to commodity) concerns, considerable pressure was placed on the CGIAR system to make institutional transformations that were more consistent with the complex and larger problems confronting the rural poor. The donors sought to complement this new policy by (1) setting new research objectives for IARCs and (2) catalyzing structural change to the CG system as a whole. CIAT’s response to these thematic, structural changes and approaches to innovation, provides a useful context in which to assess organizational adaptability.

In a major study, Reece (1998) proposes that CIAT responded in two ways to the challenge for institutional transformation: (1) through formal authority, and (2) experiential learning.

Formal authority. This refers to the changes instituted by the then Director General of CIAT (and supported by the donors), which is encompassed in the 1991 Strategic Plan. Reece argues that, while the plan indicated that changes in methods of working were a precondition of meeting the environment-related concerns expressed by donors, the reforms that it outlined did not act directly upon the professional practice of the center’s staff, nor upon the style of innovation that this produced. Instead, they concentrated upon structural change at the level of the center. New programs with new objectives were added, while new goals were set for all four of the existing programs. Although these reforms were undertaken at the level of the overall center, they did result in some changes within its components (the programs).

Moreover, in terms of the extent to which such changes represented a move away from a pipeline approach to innovation is also ambiguous. First, the commodity programs responded to the reforms by revising their objectives and went on to develop an impressive range of research projects related to the management of renewal natural resources. This approach had both achievements and limitations: The focus remained on the crop, rather than the ecosystem within which the crop was grown. The objective was to manage the surroundings of the crop so that the germplasm developed could achieve its full potential by productivity-oriented research. Crop yield was still assumed to be the primary objective. A result of these assumptions was that research projects based upon them tended to be at the scale of the plot, rather than that of the landscape of even the individual farm.

Thus, the new emphasis on NRM did not result in a material change in the model of innovation. Rather, programs pursued new objectives in a manner consistent with their earlier approach to innovation. In particular, the exclusion of rural people from their systems of interest meant that these stakeholders had little or no scope to take part in negotiating the definitions of the research questions to be addressed, and hence the design of the innovations that resulted from this process.

This relative "isolation" from stakeholders was rooted in the CGIAR's conventional wisdom, which held that scientists could work most effectively when they were protected from "political" pressures, and free to get on with the job of developing valuable new technologies. Underlying this view was the assumption that "new technology is the key leading factor in the process of desired social change" (Anderson et al., 1991; p. 31).

Experiential learning. By contrast, the work of the Hillsides Program represented a different approach to the challenge of institutional transformation through a different approach to innovation. In terms of accomplishing organizational change within CIAT, the leadership of the program was aware that certain institutional prerequisites needed to be addressed. The team believed that organizational evolution would occur when scientists went through a process of learning and instituted such learning to processes of change in other projects within CIAT. This process of information sharing and collective learning are key elements of the demand-driven model of innovation.

The Hillsides Program's strategy for reforming CIAT depended upon the learning process that collaboration with the Inter Program Project (IPP) would provide for the scientists involved. The IPP strategy was to involve staff from different parts of CIAT in an effective "demand-driven" approach to innovation, and it was expected that it would catalyze widespread questioning of the assumptions linked to the pipeline approach to innovation. In turn, this learning process depended upon the quality of staff's interactions with the members of different groups, people whose viewpoint would call into question assumptions held by the scientists.

The Hillsides Program was strongly influenced, and to some extent frustrated, by CIAT's center-level characteristics and policies. The capacity of the program to modify its organizational environment was limited.

The most obvious contradiction concerned the applicability of the program's research to other contexts. As a member of the CGIAR, CIAT was mandated to produce technologies with a broad agro-ecological application. These were expected to take the form of generic knowledge that could be used by the national programs of member countries in their own, more location-specific, technology development activities. The Hillsides Program was instead conducting research in the context of application, building local-level institutions within a particular watershed. Hence, one criticism was that it was too location specific. This prompted the program leadership to justify its work in terms of the opportunities that it would offer for developing a "strategic understanding of how to intervene in a hillside agro-ecosystem (CIAT, 1993; section 1.3) so that it could be applied elsewhere. In effect, its justification had forced it to justify one important aspect of the demand-driven model of innovation in terms of the pipeline model.

Moreover, implementation of this approach was further hampered by organizational characteristics. The organizational policy that all programs should work in collaboration with external bodies proved inappropriate, even though partnerships is a key element of a demand-driven model of innovation. Why? Because it obliged the program to work in close collaboration with a range of partners, many of whom neither understood nor shared the objectives that the program had envisioned. As a result, the objectives of the program changed between conception and execution.

One critical aspect for the success of such an approach is that it is predicated on certain organizational characteristics (incentives to share ideas between disciplines, the manner in which specialists define their roles, the availability of facilitation skills to manage this kind of interaction effectively). However, CIAT as a whole did not satisfy this condition. Hence, this experience suggests that effective implementation of change in style of innovation practiced by an organization requires a wide range of changes at different levels of the organization. Change that is possible at a project level requires support at the highest level if it is to be sustained at the level of the organization.

Conclusion: Lessons for Moving Ahead

Several lessons emerge from this study; they have been outlined in a Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis.

Strengths

The introduction of a demand-driven process can be built upon several positive aspects.

Extensive experience and commitment by organizational members for PR. Many members within the organization for gender-sensitive participatory approaches are also extensively committed and experienced. These experiences range from function to empowering approaches to PR&GA approaches. Many of these members expressed keen interest in enhancing their capacities to develop expertise in PR&GA approaches as well as "support" from other projects or members with more experience or disciplinary training in their application CIAT.

Commitment by leadership. A key prerequisite condition for any organizational transformation is the support from key members in the leadership. The commitment from senior members in the management that include those in research and administration, as well as the Director General, provides a positive organizational environment for introducing the mainstreaming of demand-driven approaches to innovation.

Institutional context for change. Additionally, the establishment of the Institute for Rural Innovation is another positive development in that it provides a structural/institutional context upon which a demand-driven approach to innovation can be built.

Weaknesses

Absence of gender analysis. The notable absence of a GA component in the most projects raises two important questions: (1) does this result from a lack of capacity for GA; and/or (2) does this speak to the gender practices in the workplace, that is, the unequal numbers between men and women, particularly in the professional category? This is a topic that the Gender and Diversity Committee in CIAT needs to address in its forthcoming study and its proposed activities.

Leadership alone is not a sufficient condition for change. One major lesson that emerged from CIAT's experimentation with approaches to innovation is that formal authority, although an important element to change, is not a sufficient condition for change. Structural changes need to be complemented with changes in the "culture" of the organization. Cultural change is a slow process that requires continual efforts by change agents from within who can "champion" through personal commitment and skills in influencing behavioral changes amongst colleagues. Such agents of change themselves require organizational structures that reward their efforts and provide them with legitimate authority and decision-making roles.

Absence of a forum. Among the numerous strategies for affecting cultural change, one critical factor is perhaps the establishment of a "formal" process of exchange and debate, where differing views and strategies for reaching the poor can be shared. While it can be argued that such information flows already exist informally through "parking lot" or "dining room" exchanges, it nevertheless is important that a more "formal" process be initiated to legitimate the discussions and their content. Such a forum would go a long way in addressing some of the differing views and entrenched opinions of members that flow from the "divergent assumptions" regarding gender-sensitive participatory approaches.

Absence of rewards and incentives. The absence is notable of explicit criteria to reward those individuals or groups that are involved in the practice of innovative processes for learning and change in the existing award structure of CIAT. One important lesson that emerges from CIAT's experimentation with alternative approaches to innovation (the "experiential learning" of the Hillsides Program) was the absence of rewards and incentives for its members. Although "donor support" for individual projects involved in conducting innovative approaches may be considered a form of incentive, and an important one at that, it does not preclude the importance of organizational incentives. Internally generated incentives for a (disciplinary) diversity of innovative practices have critical implications for the culture of the organization.

Opportunities

The commitment from CIAT's leadership (Management, Board, Project Leaders/Managers and the Director General) for mainstreaming gender-sensitive participatory approaches to enable a demand-driven approach to innovation provides a potentially supportive organizational environment.

Moreover, the establishment of the Institute for Rural Innovation provides an institutional context for mainstreaming demand-driven approaches.

Threats

Finally, it needs to be emphasized that, although a generally supportive organizational environment exists for mainstreaming demand-driven approaches to innovation, a concrete plan of action needs to be developed to address the following threats. Diversity of "unquestioned" assumptions of the role and function regarding gender-sensitive participatory approaches, particularly as such assumptions are embedded in some aspects of the "organizational culture". These can be potentially disruptive to a cohesive organizational culture and could be further exacerbated in the absence of a forum for discussion. Strategies for organizational transformation need a combination of formal authority and experiential learning. Institutional transformation will need to be further complemented through prerequisite changes in other aspects of the organization, namely policy, reward and incentive, and team approaches. Finally, the absence of a more explicit policy structure/mechanism for generating accountability to end-users (poor farmers, and particularly women) needs to be addressed. Accountability to donors does not ensure that research practice will necessarily be client oriented.

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List of Acronyms and Abbreviations Used in Text

Acronyms

ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
ADRA	Adventist Development and Relief Agency International, Tanzania
AFNET	African Network of Soil Biology and Fertility
AGORA	Access to Global Online Research in Agriculture
AGRIS	International Information System for the Agricultural Sciences and Technology
AMEM	Area de Manejo Especial La Macarena, Colombia
ANAR	Asociación Nacional de Arroceros, Nicaragua
ANPPY	Asociación Nacional de Productores y Procesadores de Yuca, Colombia
APC	Association for Progressive Communications
APROSCELLO	Asociación de Productores de Semilla Certificada de los Llanos Occidentales, Venezuela
ARROZGUA	Asociación Guatemalteca del Arroz
ASOBESURCA	Asociación de Beneficiarios de la Subcuenca del Río Cabuyal, Cauca, Colombia
AT	Agricultural Technician
ATICA	Agua y Tierra Campesina, Bolivia
AusAID	Australian Agency for International Development
BID	Banco Interamericano de Desarrollo, USA
CABI	CAB International, UK
CAN	Comunidad Andina de Naciones
C&W	Communities and Watersheds Project, formerly Hillsides Project, of CIAT, Cali, Colombia
CASA	Center for the Advancement of Sustainable Agriculture, UK
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica
CBA	Corredor Biológico del Atlántico de Nicaragua
CCBD	Christian Commission for Development in Bangladesh

CCC	Cagayan Capital College, Mindanao, the Philippines
CCI	Corporación Colombia Internacional
CdO	Cagayan de Oro, the Philippines
CDS	Centre for Development Studies, UK
CENTA	Centro Nacional de Tecnificación Agrícola, El Salvador
CEPAL	Comisión Económica para América Latina y el Caribe
CFC	Common Fund for Commodities
CG	Consultative Group (shortened form of CGIAR)
CGIAR	Consultative Group on International Agricultural Research
CIAL	Comité de Investigación Agrícola Local
CIAT	Centro Internacional de Agricultura Tropical, Colombia
CIEETS	Centro Intereclesial de Estudios Teológicos y Sociales, Nicaragua
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico
CIP	Centro Internacional de la Papa, Peru
CIPASLA	Consorcio Interinstitucional para una Agricultura Sostenible en Laderas, Colombia
CLAYUCA	Consorcio Latinoamericano y del Caribe de Apoyo a la Investigación y Desarrollo de la Yuca, Colombia
CLODEST	Comité Local para el Desarrollo Sostenible de la Cuenca del Río Tascalapa, Honduras
COLCIENCIAS	Instituto Colombiano para el Desarrollo de la Ciencia y la Tecnología “Francisco José de Caldas”
CONARROZ	Consejo Nacional Arrocero, Bolivia
CONSAL	Congress of Southeast Asian Libraries
CORPOICA	Corporación Colombiana de Investigación Agropecuaria
CORPORINOQUIA	Corporación Autónoma Regional para la Orinoquia, Colombia
CORPOTUNÍA	Corporación para el desarrollo de Tunía, Colombia
CRIS	Communications Rights in the Information Society
CRS	Catholic Relief Services
CRSP	Collaborative Research Support Project of USAID
CUAO	Corporación Universitaria Autónoma de Occidente, Colombia
CUFRUCOL	Cultivos y Frutas para Colombia
CVO	City Veterinary Office, Cagayan de Oro, the Phillipines
DAI	Development Alternative Inc., Bolivia
DANE	Departamento Administrativo Nacional de Estadística, Colombia
DANIDA	Danish International Development Agency
DFID	Department for International Development, UK
DMCA	Digital Millennium Copyright Act, USA
DRI	Fondo de Desarrollo Rural Integrado, Colombia
ECA	Economic Commission for Africa
EIAP	Estudio de Impacto Ambiental Preliminar of IDB
EIARD	European Initiative for Agricultural Research for Development
EMBRAPA	Brazilian Enterprise for Agricultural Research

ENGREF	Ecole nationale du génie rural des eaux et des forêts, France
ENSA	Ecole nationale supérieure agronomique of INRA, France
EU	European Union
FAO	Food and Agriculture Organization of the United Nations, Italy
FEBESURCA	Federación de Beneficiarios de la Subcuenca de Cabuyal, Colombia
FEDAGPA	Federación de Productores de Arroz de Panamá
FEDEARROZ	Federación Nacional de Arroceros de Colombia
FENAVI	Federación Nacional de Avicultores de Colombia
FGV	Fundação Getulio Vargas, Brazil
FLAR	Fund for Latin America and the Caribbean Irrigated Rice
FONAIAP	Fondo Nacional de Investigaciones Agropecuarias, Venezuela
FONDEAGRO	Fondo de Desarrollo Agropecuario, Nicaragua
FSP	Forages for Smallholders Project of AusAID
FUNDARROZ	Fundación Nacional de Arroz, Venezuela
HAP	Hillsides Agricultural Program in Haiti
HIV	Human Immunodeficiency Virus
IAAE	International Association of Agricultural Economists
IARC	International Agricultural Research Center
ICA	Colombian Institute of Agriculture and Livestock
ICARDA	International Center for Agricultural Research in the Dry Areas, Syria
ICBF	Instituto Colombiano de Bienestar Familiar
ICIMOD	International Centre for Integrated Mountain Development, Nepal
ICM	Integrated Crop Management
ICRAF	International Centre for Research in Agroforestry, Kenya
ICRD	Integrated Cassava Research and Development
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics, India
IDB	Inter-American Development Bank, USA
IDRC	International Development Research Centre, Canada
IDS	Institute of Development Studies, UK
IFPRI	International Food Policy Research Institute, USA
IIA	Instituto de Investigaciones del Arroz, Cuba
IICA	Instituto Interamericano de Cooperación para la Agricultura, Chile
IIED	International Institute for Environment and Development, UK
IIRR	International Institute for Rural Reconstruction, the Philippines
IITA	International Institute of Tropical Agriculture, Nigeria
ILRI	International Livestock Research Institute, Nairobi, Kenya
IMF	International Monetary Fund
INASP	International Network for the Availability of Scientific Publication
INIA	Instituto Nacional de Investigacíon Agraria, Uruguay
INPE	Instituto Nacional de Pesquisas Espaciales, Brazil

INRA	Institut national de recherche agronomique, France
INSPIRE	Integrated Soil Productivity Initiative through Research and Education
INTA	Instituto Nacional de Tecnología Agropecuaria, Nicaragua
INTRAC	International NGO Training and Research Centre
IP	Internet Protocol
IPP	Inter Program Project, CIAT, Cali, Colombia
IPRA	Investigación Participativa en Agricultura / *Participatory Research in Agriculture* of CIAT, Cali, Colombia
IRGA	Instituto Rio Grande de Arroz, Brazil
IRRI	International Rice Research Institute, Philippines
ISG	International Support Group, The Netherlands
ISNAR	International Service for National Agricultural Research, the Netherlands
ITDG	Intermediate Technology Development Group, Zimbabwe
ITU	International Telecommunications Union
JAC	Junta de Acción Comunal, Colombia
KIT	Koninklijk Instituut voor de Tropen, the Netherlands
LA	Learning Alliances
LAC	Latin America and the Caribbean
LEISA	Low External Input Sustainable Agriculture Journal
LGU	Local Government Units
LISC	Library and Information Services Consortium
LS	Learning Selection conceptual model
MADR	Ministerio de Agricultura y Desarrollo Rural, Colombia
MAGFOR	Ministerio Agropecuario y Forestal, Nicaragua
MAO	Municipal Agricultural Officer
MARENA	Ministerio de Ambiente y Recursos Naturales, Nicaragua
MB	Mother-Baby trial model of ICRISAT
MERCOSUR	Mercado Común del Sur
NAAS	National Academy of Agricultural Sciences, UK
NARC	Nepal Agricultural Research Council
NCAP	National Council for Agricultural Economics and Policy research, UK
NERICA	New Rice for Africa
NISTADS	National Institute of Science, Technology and Development Studies, UK
NORAD	Norwegian Agency for Co-operation for Development
NRI	Natural Resources Institute, UK
ODI	Overseas Development Institute, UK
ORPA	Outstanding Research Publication Award, CIAT, Cali, Colombia
PABRA	Pan-Africa Bean Research Alliance, Tanzania
PAM	Programa Agropecuario Municipal, Colombia
PASOLAC	Programa de Agricultura Sostenible de Laderas en Centro América of IICA, Chile
PBOT	Plan Básico de Ordenamiento Territorial, Colombia

PCCMCA	Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios, Guatemala
PDF	Portable Document Format
PLA	Participatory Learning and Action Notes
POSAF	Programa Socioambiental Forestal, Nicaragua
POT	Plan de Ordenamiento Territorial, Colombia
PPO	Participative Planning by Objectives
PRGA	Systemwide Program on Participatory Research and Gender Analysis for Technology Development and Institutional Innovation of the CGIAR
PRODEGA	Proyecto de Desarrollo Rural Ganadero, Nicaragua
PRONATTA	Programa Nacional de Transferencia de Tecnología, Colombia
PWMTA	Participatory Watershed Training in Asia
RAAN	Región Autónoma del Atlántico Norte, Nicaragua
RAAS	Región Autónoma del Atlántico Sur, Nicaragua
REDOLYS	Red de Organizaciones Locales de Yorito y Sulaco, Honduras
RIDAC	Red de Información y Documentación Agropecuaria Colombiana
SANREM	Sustainable Agriculture and Natural Resource Management, a CRSP project
SARL	Sustainable Agriculture and Rural Livelihoods discussion papers of IIED
SciELO	Scientific Electronic Library Online
SDC	Swiss Development Cooperation
SENUMISA	Semillas de Nuevo Milenio S.A., Costa Rica
SIDA	Swedish International Development Agency
SIDALC	Sistema de Información y Documentación de América Latina y el Caribe
SISAV	Sistema de Información Agropecuaria del Valle del Cauca, Colombia
SOL	Supermercado de Opciones para Ladera of Communities and Watersheds Project, CIAT, Cali, Colombia
SPIA	Standing Panel on Impact Assessment, of TAC, CGIAR
SPRING	Sistema de Processamento do Informações Georeferenciadas
SPRU	Science and Technology Policy Research
SWOT	Strengths, Weaknesses, Opportunities, and Threats analysis
SWP	Systemwide Program of CGIAR
TAC	Technical Advisory Committee of the CGIAR
ToT	Transfer of Technology
TSBF	Tropical Soils Biology and Fertility Program of CIAT, Cali, Colombia
TWFP	Tropical Whitefly Project of Systemwide Project on Integrated Pest Management
UCA	Unión de Cooperativas Agropecuarias, Miraflor, Nicaragua
UCOSD	Unión de Campesinos Organizados de San Dionisio, Nicaragua
UMATA	Unidad Municipal de Asistencia Técnica Agropecuaria, Colombia

UNA	Universidad Nacional Agraria, Nicaragua
UNAN	Universidad Nacional Autónoma de Nicaragua
UNDP	United Nations Development Programme
UNEP	United Nations Environment Program, Geneva
UNICEF	United Nation’s Children’s Fund
UNRISD	United Nations Research Institute of Social Development
UPWARD	Users’ Perspectives with Agricultural Research and Development, Manila, the Philippines
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VICs	Village Information Centers, Tanzania
VIOFLAR	Vivero de Observación del FLAR
WARDA	West Africa Rice Development Association
WHO	World Health Organisation
WRI	World Resources Institute, Washington, USA
WSIS	World Summit on the Information Society
XML	Extensible Markup Language

Abbreviations

ABM	agent-based modeling
APA	appreciative planning and action
Bd Lf	boundary planting and live fence
CA	cellular automata
CBO	community-based organization
C&C Pl	cut and carry plot
Co He	contour hedgerow
DSS	decision support system
FAT	farmer advanced trials
FET	farmer elite trials
FFS	farmer field school
FIT	farmer initial trials
FPR	farmer participatory research
GA	gender analysis
GIS	geographic information systems
GO	governmental organization
Gr Pl	grazed pasture
ICM	integrated crop management
ICTs	information and communications technologies
IM	information management
INM	integrated nutrient management
INRM	integrated natural resource management
IPM	integrated pest management
ISFM	integrated soil fertility management
IT	information technology

M&E	monitoring and evaluation
MAS	multi-agent system
NARES	national agricultural research and extension services
NARS	national agricultural research systems
NGO	nongovernmental organization
NRM	natural resource management
OFCOR	on-farm (client-oriented) research
Orn	ornamental
PB	plant breeding
PLAR	participatory learning and action research
PM&E	participatory monitoring and evaluation
PMEL	participatory monitoring, evaluation, and learning
PPB	participatory plant breeding
PR	participative research
PR&GA	gender-sensitive participatory research
PTD	participatory technology design
PVS	participatory varietal selection
R&D	research and development

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