Assessing the Impact of Integrated Natural Resource Management: CIAT Challenges and Experiences

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1 Introduction: INRM and Impact Assessment

With its world-renowned contribution of increasing agricultural productivity, current and future expectations of the Consultative Group on International Agricultural Research (CGIAR) remain high. Yet while advances of the Green Revolution have led to enough food being produced to feed the world, problems of poverty and natural resource degradation persist (CGIAR 1995). In response, the CGIAR has expanded its mandate to address these pressing issues by introducing Integrated Natural Resources Management (INRM) research in its agenda. As such, "INRM research and development activities within the CGIAR provide the basis for the development of sustainable agricultural landscapes within which the products of the genetic improvement programs can gain maximum impact for the benefit of the poor" (INRM, 1999).

The introduction of the INRM concept challenges scientists of the CGIAR. Increased complexity of research and development (R&D) interventions[2] as well as more stringent and rapid reporting of results by the donor community lead to a need to monitor and evaluate social, economic, environmental and biophysical change. The current situation poses special challenges for socioeconomic and impact assessment (IA) research, particularly as this change has increased the demand for a more holistic IA[3] approach beyond traditional economic surplus analysis.

Difficulties of assessing the impact of INRN research stem from its own definition, as there is not a universally accepted one. Proponents (from the Bildeberg Consensus) generally

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[1] The authors wish to emphasize CIAT-wide effort in advancing the theme of NRM Impact Assessment and they acknowledge the input from Jacqueline Ashby, Nathalie Beaulieu, Alejandro Imbach, Douglas Pachico, Bruno Barbier, Jaime Jaramillo, Olaf Westerman, Sue Allan, Dean Holland, Tamsyn Murray, Manuel Winograd and Sam Fujisaka. However, the authors remain responsible for any errors and omissions.

[2] R&D focus has changed from classical agronomy to ecological sciences, from analytical research to systems dynamics, from top-down to participatory approaches, and from factor-oriented management to INRM.

[3] Guijt (1998) defines the term "Impact" as "the effects of an intervention on its physical surroundings, the people involved, and/or the organizational context. This refers to short term outputs of products, medium term results, and longer term consequences or outcomes."

perceive the term to represent a responsible and broad-based management of the land, water, forest and biological resources base (including genes) needed to sustain agricultural productivity and avert degradation of potential productivity (INRM, 1999). Izac (1998) emphasizes that INRM is not a straightforward concept as it embraces social, economic, environmental and biophysical components. INRM changes (at different spatial and temporal scales) and is assessed in terms of multiple objectives (e.g. poverty alleviation, resilience, natural resource conservation, economic growth, human and social development) that reflect the needs and expectations of different stakeholders (Izac and Sanchez, 1998). Therefore, INRM research requires a wider geographic scope (manageable plot and farm level analyses expand to more unwieldy scales of community, watershed and even larger areas), which brings numerous complicating ecological, social, cultural, institutional, economic and political factors. Furthermore results are rarely visible in a short time frame such as the agricultural cycle, and it is still not clear how far the scientists should work across the research-development continuum in order to increase the probability of achieving impact.

The second difficulty on INRM research IA arises from its requisite inclusion of multiple stakeholders. The CGIAR Centers have two sets of clients to whom they are ultimately held accountable: beneficiaries of research and the donor community. Research beneficiaries include rural dwellers, NARs, NGOs and other partner institutions, each with their own perspectives and interests. In order for INRM research to affect change in terms of sustainable natural resource use and poverty alleviation, ultimately local people must alter their livelihood strategies[4]. How this is most "efficiently" accomplished often runs counter to the constraints placed by the external donors. Furthermore, not only should results be effective in a research site but they need to be replicable and scaled up (or out) to other locations. Scoones (1997), analyzing the feasibility of scaling up success stories, concludes that the major lesson is that no blueprint can be provided. Change occurs as a result of an unpredictable combination of contingent circumstances, which are historically specific and relate to a range of imprecise political, economic, social and personal factors.

[4] A term employed by the Sustainable Rural Livelihood approach of IDS/DFID (Scoones, 1998). According to the author, three broad clusters of livelihood strategies are identified. These are: agricultural intensification/extensification, livelihood diversification and migration.

However, efforts to scale up and generalize are anathema to a countervailing group of development practitioners, (many within the donor community) who espouse the importance of local experience, understanding and decision-making. This group emphasizes that rural dwellers are more than mere recipients of INRM research, but are the true clients who express their demands accordingly. These processes of local awareness and prioritization are the actions that drive development (Guijt and Shah, 1998). INRM practitioners need to be ready to accept a low priority ranking by locals for their activities, perhaps only initially, as other needs such as education and health care could be deemed more important.

A third issue concerns tradeoffs amongst the multiple stakeholders. With the reach of INRM expanding beyond the farm or household level, the possibility and gravity of conflict increases. Many of the problems related with INRM - pest, water and soil management - move beyond the farm level because of their biophysical characteristics and multiple actor decision-making process. Management affects the natural resources that are common to a group of people who live locally, and to an external population who are affected, albeit sometimes indirectly. Understanding and properly addressing both private and public incentives are the key difference between previous CGIAR efforts and those of INRM. As a result, optimal decisions require an analysis of tradeoffs, as well as a careful negotiation and collective action amongst them (e.g. individual farmers, households, communities, and policymakers).

In this paper we present advances and travails of CIAT scientists as they develop and implement an IA Framework for three INRM sites in Latin America (Hillsides, Savannas and Forest Margins). In Section 2, the importance and growing interest of IA for INRM research as a planning, learning and accountability tool is presented. Section 3 is a brief historical perspective of the relationship between development thought and IA methodologies. Section 4 contains an analysis of the major challenges of developing and implementing an appropriate methodology that satisfies the needs of multiple stakeholders. This is followed in Section 5 with a proposed Conceptual and Analytical Framework for INRM research IA, along with first insights about CIAT efforts on implementing an IA process in its INRM sites. Section 6 finishes with some conclusions and recommendations.

2 Importance and Growing Interest in INRM Impact Assessment

When a variety of complex social, economic, biophysical and institutional innovations are being developed, IA needs to be a key part of the INRM research process. As stressed by Pachico et al. (1998), IA should not initiate as a retrospective exercise after a research program has produced an innovation that has entered into use. IA needs to be a crucial part of research planning and it cannot be tacked on at the end of an intervention, rather it must be built into the design and implementation from the beginning. As such, a Monitoring[5] and Evaluation[6] (M&E) process is required for proper IA.

This implies a connection between project planning, monitoring and IA phases. Indicators of achievement, success and results are established during the planning phase but they are used, validated and enriched throughout the implementation and ex-post phases (Quintero Uribe, 1997). Furthermore, a continuous M&E process should permit a better understanding of the performance of innovations under different human, social, natural and economic/financial endowments, and under different historical, political, macroeconomic and cultural contexts. However, as stated by Guijt (1998) despite the obvious advantages of M&E, few organizations carry out systematic M&E of their activities, making overall IA a difficult task.

One of the strategies used by the CGIAR to develop INRM research products is the implementation of pilot R&D projects in selected reference sites. To increase potential development impact, the leading Centers in INRM research develop and plan research strategies with partners. As a result, the Centers conducts not only conventionally defined research activities but are also involved with "action-research" activities that support development initiatives led by or in collaboration with partners. Yet the allocation of CGIAR resources to Ecoregional programs in general and INRM research specifically, is being questioned (TAC, 1991). INRM research is considered to be too site specific and multi-sectoral for a modest

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[5] According to Guijt (1998) "Monitoring" refers to *"the systematic and continuous process of assessing the progress and changes caused by the implementation of an activity over a certain period of time, usually using pre-determined indicators or recurrent questions."*

[6] Guijt (1998) defines "Evaluation" as a *"a process of identifying the broader positive and negative outcomes of an activity or process to reach a conclusion about its overall value and whether objectives have been met."* Often such conclusions relate to longer-term objectives, such as effectiveness, equity of impact, sustainability and cost-effectiveness. In contrast with monitoring, which establishes with a certain frequency what the outputs (desired or not) are of an activity, an evaluation process will try to assess how these outputs contribute in the longer term to the intended objectives. Therefore evaluation is usually less frequent than monitoring activities and is undertaken sometime after an activity starts to allow for changes to occur and assessment to be possible.

international research program to generate significant and demonstrable impacts. Skepticism within the international agricultural research donor community can in part, be explained by the lack of rigorous assessments of the economic, poverty and environmental impacts of the research (Scherr, 2000).

In order to validate the contribution of research outputs to development impact, the assessment of INRM research is an important research component in these sites. Continued financial support requires confirmation that innovations produce sufficient improvement in production, poverty and environmental outcomes that can be applicable beyond the specific reference sites. Yet application of research results does not imply a top-down approach. Learning processes for use in other areas is a major objective of the reference-site strategy. Moreover, an understanding of the contexts that contribute to the success of the innovation must also be achieved to help in the identification of "recommendation domains" for the innovations.

3 Evolving CGIAR Agenda and Impact Assessment Methodologies

Both international agricultural research and methodologies used to assess its impact have long reflected contemporary rural development thought. Since the 1980s, the CGIAR has been concerned with measuring the impact of its research (Anderson et al., 1998) and has produced a vast amount of studies concentrated on assessing the adoption of agricultural production technologies. Reviews of these types of studies can be found in Dalrymple (1986a, 1986b), Seré (1986), Timothy et al. (1988), Echeverría et al. (1989), Pachico (1992), Byerlee and Moya (1992), Evenson (1992), Stifel (1992), and Collinson and Tollens (1994).

Economic impact of agricultural research and returns to investment continue to be synthesized and extended (Alston et al. 1995). The new robust quantitative methodologies employ economic surplus methods, which estimate the net present value of benefits, internal rates of return and cost-benefit ratios. Also, a broad literature has arisen to assess total factor productivity through aggregate production and cost functions, production density functions and input-output market interfaces. Microeconomic assessments include input savings and consumer preferences (Bantilan, 1998). As the CGIAR included in its agenda post harvest research, studies on the impact of new post harvest and processing technologies have been conducted (i.e. Mullen, 1985; Mullen et al., 1991; Scobie et al., 1991; Best et al., 1994; Gottret and Henry, 1994; Gottret et al., 1997; and Ospina, et al., 1998). Most of these studies also use consumer surplus models

that were extended to consider the size and distribution of benefits in the context of multiple factors and multiple-product markets.

While techniques for evaluating the impact of adopting improved germplasm, new cropping and post harvest technologies are well known and utilized, IA methodologies became a critical issue for INRM in the mid 1980s. As a result of larger scope issues of INRM, much remains to be done to enable IA to evaluate the final effect of more complex R&D projects in addition to economic criteria.

As expressed by Izac (1998) there are two fundamental differences between IA for crop improvement research and for INRM research. First, natural resources generate a number of ecosystem services, and they do so differently at various spatial scales (farming system, watershed/village/ landscape, region and global). Second, as a consequence of the first, the diversity of stakeholders in NRM is much wider than in crop improvement research, whereby different categories of stakeholders are associated with the different spatial scales.

Furthermore, these more complex R&D challenges mark an era of disappearing controlled experiments, making it more difficult to attribute the success or failure to any one intervention. Guijt (1998) states that establishing cause-effect linkages is more complex than just tracking changes, and is not as simple as comparing 'before' and 'after' situations, as many other influences will have occurred and affected the situation simultaneously. Also, the other option to compare 'with intervention' and 'without intervention' situations, in the hope of establishing clear causal links may not be the most appropriate because the following reasons:

- Obtaining data for the 'without' situation may be time-consuming and costly
- Households who are not being benefited by an intervention are unlikely to be willing to monitor their situation or have it monitor
- It may be too difficult (if not impossible) to control for other factors that may influence the outcome of an intervention.

4 INRM Impact Assessment Methodological Challenges

Following the above discussion on the evolution of IA methodologies accordingly with the evolution of the CGIAR agenda, there is no commonly accepted protocol for assessing the impact of INRM on sustainable rural livelihoods. Persistent issues include the following:

- finding feasible spatial and temporal scale boundaries
- integrating and negotiating stakeholder development objectives
- stakeholder participation in the IA process
- defining and empirically assessing sustainable rural livelihoods
- linking research outputs to development impact and attributing outcomes to it
- developing output, outcome and development impact indicators.

In this section these methodological challenges are discussed and some approaches to deal with these challenges proposed.

4.1 Finding Feasible Spatial and Temporal Scale Boundaries

According to Pachico et al. (1998) the measurement of impact across scales is a central issue in the IA of INRM research. For example, the impact of erosion on the natural resource base varies from the plot to the slope face, the watershed and river basin. Scherr (2000) states that for the case of hillsides, many of key environmental impacts expected must be evaluated at the landscape scale. However, landscape-scale impacts of INRM can only result if significant number of farmers adopt the innovations, and depend upon the spatial pattern of adoption.

With respect to temporal scales, Scherr (2000) argues that longer time periods are required to assess sustainability and the degree and significance of environmental impacts, but these longer periods increase the likelihood of major socioeconomic or biophysical shifts taking place that confound the impacts of innovations. Therefore, IA for INRM must be designed to consider long-term change. Scherr (2000) proposes the use of different instruments such as time series of remotely senses variables, panel data sets, historical reconstruction of plot or community level trends with local people, and participatory historical mapping. Yet, the issue of protracted results may not be entirely compelling stand-alone argument that creates challenges for INRM. Agricultural crop improvement research programs took a minimum of a decade from the outset of a program to the delivery of the first outputs, and in may cases it took even longer. Thus INRM research may not require a significantly longer time horizon to produce results

(Pachico et al., 1998). Rather, a new climate of more stringent reporting within timeframes is more likely culpable.

4.2 Integrating and Negotiating Stakeholders Development Objectives

As discussed in Section 3, the diversity of stakeholders in INRM is much wider than in crop improvement research, and each one has a different emphasis in their objectives and expectations. The merging of stakeholders with different interests and backgrounds (farmers and rural inhabitants, community organizations, local governmental and non-governmental institutions, national and international Centers, donors, politicians etc.) can often lead to communication difficulties and differences in opinion and perceptions. So plagued are IA efforts of INRM. Box 1 presents some insights of preliminary work done in the CIAT Hillside reference sites in Central America.

While CGIAR Centers share most of these different stakeholder development objectives and goals, the main objective of the Centers work in their reference sites is not the development of the reference site per se. Rather development should be the result of interventions and justify extrapolations of the research innovations. In other words, the ultimate goal is not the achievement of site-specific tangible outcomes, but the development of social, economic, biophysical and institutional innovations that can be extrapolated beyond the reference site, as required by its mandate of developing international public goods. As such, processes are more important or as important as the final development outcome.

While there can be a strong and useful complementarity between local and external perspectives, incorporating local views into scientific discussions may require profound flexibility on both sides. Small holder farmers and researchers not only describe the world with different words, but also may hold incompatible views of how the world functions. At the extreme, van Dusseldorp and Box (1993) contrast a fatalistic view held by some farmers with the "voluntaristic" view of research, where the world can and should be manipulated with direct intervention. Research conducted within either of these two worldviews is unlikely to be seen as legitimate from the opposing perspective.

Box 1. Concealing Different Development Objectives in Central American Hillsides

In July 2000, workshops and interviews were held with a range of different INRM stakeholders (community members and organization leaders, as well as personnel from local institutions) in hillside reference sites of Nicaragua and Honduras. The objectives were to identify and conceal their development visions and objectives, and assess their interest in participating in an IA process.

Inhabitants of poor rural communities typically have a clearer, more tangible and short-run development vision and objectives, and lower expectations than those of external agents such as national or international cooperation and support institutions[1]. Rural people express their desire to have a community where people have enough to eat, as well as a more diversified diet, and where they are able to buy clothes and shoes for the family (especially the children). They also aim to have access to basic infrastructure, appropriate education and health services. However as a result of land degradation, water scarcity, recent natural disasters and promotional campaigns by external institutions, there is a growing consciousness about natural resource preservation. Rural dwellers prioritized improving in land productivity and water availability. These interests are expressed by the desire to have a community with more trees, especially around the watershed, and to employ farming practices that at least help maintain soil fertility.

Often caught in the middle between donors and recipients, local support institutions (governmental and non-governmental) share the final development vision and goals of rural inhabitants of developing sustainable rural livelihoods with site-specific tangible results. Furthermore capacity building through the developing and/or strengthening of community organizations are central efforts to empower communities

On the other hand, the initial appraisal to determine the interest of these institutions in participating in IA, showed that locals are not as much interested in the learning process and its systematization as CGIAR Centers do. However, they do have interest in showing that tangible results were obtained towards the desired development state, and furthermore, that their intervention has contributed to that change. In general, they are more interested in the action (implementation) part and the tangible results of this action than in the evaluation, reflection and learning process. Furthermore, it seems that most of their interest was based on donor-led demands.

Moreover, differences in communication among scientists, farmers, policymakers and other stakeholders can sabotage dialogue and learning among these groups. This albeit less extreme (and hence less visible) issue can nevertheless affect the ability to synthesize the distinct IA perspectives. Holland (1998) shows how research terminology can come to dominate discussions with other stakeholders, making communication meaningless[7]. Such communication difficulties may be symptoms of fundamental differences in the ways that scientists and other stakeholders learn. Improving communication may not improve the situation without a willingness also to be more flexible about styles of researching and learning. These communication breaches will pose special challenges to measuring the impact of INRM where people from many disciplines and backgrounds must be involved. Insights by van Dusseldorp and Box (1993) do not bode well, "in experience with interdisciplinary research in the Philippines and the Dominican Republic, we found it more difficult to bridge the gap between individual disciplines than between researchers and cultivators"

Participatory Monitoring and Evaluation (PM&E) approaches have been proposed and implemented in order to develop partnerships of multiple stakeholders for efficient, effective, and socially inclusive monitoring (Guijt, 1998; Abbot and Guijt, 1998). One of the expected benefits to PM&E has been that monitoring efficiency can be improved by harnessing multiple perspectives. However, Abbot and Guijt (1998) argue that this benefit cannot be assumed as it requires considerable investment and commitment, in terms of time and resources, as well as careful design, to bring different world views and languages together. Cooperative integration will not happen through good intentions alone. Insights of an experience in trying to start a multi-institutional approach to IA in the Peruvian Amazon (a forest-margins reference site) are presented in Box 2.

4.3 Stakeholder Participation in the Impact Assessment Process

The identified benefits of PM&E are numerous. First, since the application of INRM research produces a broad range of impacts in communities, including many of a social nature,

[7] For example, the term "significant" passed from Philippines researchers to extension agents and then to farmers served as an unchangeable "trump-card". Use of the word "significant" would supposedly convince people about natural phenomena and eventually became employed by a farmer to explain results in his field to mystified visiting farmers.

these changes can be difficult for outsiders to observe (e.g. changes in the access to forest resources, changes in conflict between communities over water access). Externally defined IA studies may risk serious problems caused by omitted variables and the subsequent misinterpretation of findings (Scherr, 2000) Hence, PM&E can improve the accuracy and relevance of the collected data and information and their analysis. Second, the participation in self-evaluations can be a powerful contribution to local institution building. Guijt (1998) emphasizes that PM&E enhances local capacity to record and analyze change, and improve community-based initiatives, thus empowering rural communities. Third, PM&E is more cost-effective and as such can make a more rational use of limited human and financial resources (Guijt, 1998).

Box 2. Elusive Consensus and Hidden Agenda in the Peruvian Amazon

In April 1999, over twenty institutions in Pucallpa, Peru attended a two-day *Indicator Framework and Impact Assessment* workshop. The event had the dual objectives of establishing a structure to measure the impact of research and development efforts and to improve institutional coordination. These institutions consisted of NGOs, international and national from diverse sectors of agricultural research/extension, health, natural resources management and the university.

Small groups of participants constructed research to development causal pathways by first identifying t the goals of sustainable development. A series of intermediate steps, representing the activities required to achieve the goal, connected the institutional outputs with development. While some of the paths were relatively easy to construct, those of institutional cooperation and policy were the most challenging.

Even though there was consensus after the meeting to continue the process of IA, the working groups organized to refine indicators and identify people to collect data met only for a few times. Troubles of finding convenient times to meet for overworked contributors and differing incentives of the institutions contributed to group disintegration. With decision making power being concentrated in the capital, incentives to obfuscate and even embellish reports exist in the highly politicized environment.

Many issues lie at the heart of a participatory IA process. According to Guijt (1998) in a serious participatory process, people affected by any intervention should be involved in the definition of the monitoring goals, the design of the system, the selection of indicators, data collection and analysis, and in the end should use the analyzed data and results. However, with respect to stakeholder participation on IA, a fundamental question to be asked is why anyone should bother assessing change, and for whom will the information and the process of collecting information, bring benefits.

Abbot and Guijt (1998) state that most project-initiated M&E processes make the rather tenuous assumption that the monitoring process has value for local people. It can be argued that farmers and rural inhabitants know what has changed and improved (or not) towards the achievement of a sustainable livelihood and overall quality of life. Therefore, they do not need to collect and analyze data to prove that this has (or has not) been the case, nor they are accountable for external intervention outcomes. Besides participatory M&E approaches can be costly for local people considering the opportunity costs involved in taking away a significant amount of time which could otherwise be spent in income-earning activities.

Therefore, data collection on a voluntary, unremunerated basis (as often happens in participatory processes) is unlikely to be sustained unless the information has some direct relevance or value for community members, community organizations, as well as local and national institutions. As such, there is a need to identified different interest groups (both locally and externally) as well as their assessment needs and interests. Parallel IA processes can be conducted with the different groups and then integrated.

Furthermore, before taking the decision to start a PM&E process it is important to have a basic understanding of the limitations of what is possible in order to avoid poor quality work and disillusionment. Guijt (1998) argues that efforts to involve multiple stakeholders on IA faced the difficulties caused by the limited understanding of what M&E actually involves, as well as limited local expertise and financial resources. Therefore is important to consider the implications of bringing together multiple stakeholder groups in a participatory process. Each group has different needs, priorities, capacities, power to speak, norms for trustworthiness of information, and expectations of being involved. While working mainly with partners may generate potential biases, at the same time, participation in self-evaluations can be a powerful contribution to local institution capacity building" (Scherr, 2000).

However, de la Rive Box (1990) states *"...there has been renewed effort to devise ways to link IA to local people's capacities in ways that are less dependent on outsiders' insights and empathy, and more reliant on partnerships and negotiated procedures and conclusions, thus reflecting the biases and cultures of both parties."* Moreover, Guijt (1998) and Abbot and Guijt (1998) offer a wide range of proved methodologies for designing and implementing PM&E process for the assessment of sustainable agriculture initiatives.

4.4 Defining and Empirically Assessing Sustainable Rural Livelihoods

If INRM is a means to improve rural livelihoods and make them sustainable, then there is a need to more precisely define what we mean by "sustainable rural livelihoods". The World Commission on Environment and Development has defined "sustainable development" as "development or progress that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Izac, 1998). In operational terms, sustainable development requires the achievement of economic, social and environmental well being for current and future generations. Drawing from Chambers and Conway (1992), Scoones (1998) defines "sustainable rural livelihoods", as "the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base."

Thus sustainable rural livelihoods can be seen as a combination of at least three dimensions:

(1) the ***economic and financial,*** which includes employment and economic growth

(2) the ***natural resources,*** which relates to sustainability not only in terms of adaptation, vulnerability and resilience, but also the preservation of the natural resource base, and

(3) the ***human and social,*** which not only deals with individual and collective capabilities but also with the sustainability of the development processes

Nevertheless, as discussed in the previous section, the term " sustainable rural livelihoods" is broad and has different meanings for different stakeholders and requires a negotiation process to reach to a consensus about its meaning. However, even if rural communities and institutions share a common understanding and definition of sustainable rural livelihoods and a vision about the desired modified development state, it remains a

methodological challenge to assess these changes empirically. There is still a need to define better quantitative and qualitative indicators to changes in the development state of communities, and especially to reconcile institutional indicators with rural communities perceptions and indicators.

A broad-based and potentially useful approach of sustainable rural livelihoods is a framework that has a number of basic elements. According to this approach, the key question to be asked in any analysis (including impact) of sustainable rural livelihood is:

> *Given a particular context (of policy setting, politics, history, agroecology and socio-economic conditions), what combination of livelihood resources (different types of 'capital') result in the ability to follow what combination of livelihood strategies (agricultural intensification/ extensification, livelihood diversification and migration) with what outcomes? Of particular interest in this framework are the institutional processes (embedded in a matrix of formal and informal institutions and organizations) that mediate the ability to carry out such strategies and achieve (or not) such outcomes (Scoones, 1998).*

4.5 Linking Research Outputs to Development Impact

Sander (1998) proposes that to locate and assess the impact of research it is important to understand if and how people and organizations react to it, and whether they change their actions as a result of it. As such, recent work of the International Development Research Center (IDRC) sees these responses, called "reach", as an essential part of IA. Their proposed methodology traces the multiple, often non-linear chains of events linking the researchers and their findings with the other actors who are essential to change, and look for evidence of change along the way.

However, one of the major difficulties encounter in trying to assess the effect of INRM research on development impact has been the lack of a clear link between research outputs and development strategies that can lead to development impact. This is especially important in the case of research, where the chain of events from research products to their usage to development impact is not always as straightforward[8]. Hence, INRM research IA should start with a proper

[8] Goldsmith (1993) stresses the unspoken hypothesis that a causal connection runs through interventions to outputs, outcomes at the final user or client level impacts. While the connections are plausible, they are often treated as a "black box" that cannot be analyzed or explained in detail. He states that "no-one has yet found an easy way, for example, to find out the effect of policy advice to a country: the final impact may be great, but the causality is usually too subtle to measure exactly. The subtlety is particularly acute with agricultural research and technology diffusion, in which a long chain of events separates innovations made in the scientist's laboratory from their employment in the farmer's field."

planning stage that permits the articulation of steps between research and development strategies, with clear short and long run intermediate and final development objectives. Therefore, IA begins with a clear definition of the desired impact, where is it expected, for whom it is anticipated, and the pathway for getting there. Even though "outputs cannot be assessed fairly unless they are identified from the start" (Goldsmith, 1983), unexpected outcomes need to be also noted with intermittent revisions of the research strategy.

Therefore, the planning stage should provide more immediate to longer-term R&D objectives. To do so, it is important to identify three different levels of 'impacts':

- ***outputs***, defined as the immediate product of a project after using the given inputs
- ***outcomes***, which are the consequences of the outputs afterwards, and
- ***impacts*** that are the broader and longer term aims

For this purpose, Guijt (1998) proposes the mapping of hierarchical objective trees, as well as a participatory tool called "impact flow diagrams". An impact flow diagram is not more than a open-ended method that helps identify a wide range of impacts: positive and negative, expected and unexpected, and direct and indirect.

Once clear R&D strategies are developed and objectives mapped, a M&E process allows assessment of the progress towards the achievement of desired 'outcomes'. The performance assessment of these 'outcomes' yields further information about likely or potential 'impacts', and serves as a crucial feedback loop to adjust or refine the R&D strategies as needed. As stressed by Goldsmith (1993) an impact cannot be claimed by an intervention unless it can be explained logically and justified

As one moves along the pathway from an intervention to development impact, it also moves from the specific intervention with "performance or output indicators" that depend exclusively on the project, to "outcomes" that depend on the intervention and on its boundary partners[9] in its sphere of influence. However, final sustainable livelihood impacts go beyond the sphere of influence of an intervention and depend on a range of structural factors. These structural factors include the context conditions and trends (e.g. the policy setting, the cultural

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[9] "Boundary partners" are defined by Smutylo, 1998 as *"those individuals, groups, or organizations with whom the initiative interacts directly and on whom the initiative can anticipate some opportunities for influence. These actors are called boundary partners because even though the initiative works with them to effect change, it does not control them."*

and social differentiation and the agroecological conditions, among others), the livelihood resources and the institutional processes and organizational structures.

4.6 Developing Output, Outcome and Development Impact Indicators

Once project objective trees map the chain of events from project outputs to final development impacts, the next step is to develop indicators that permit to evaluate whether objectives are being achieved. Guijt (1998) argue that indicators are central to most M&E approaches and are simply an aid for communicating complex processes, events or trends to a wider audience. She defines them as *"a quantitative or qualitative characteristic of a process or activity about which changes are to be measured"*. However, indicators are only meaningful if they relate to needed information and if the users know how to interpret its meaning. Since indicators are only a proxy for a complex reality, they must be relevant and accurate enough, rather than perfect, and need to be selected carefully.

Guijt (1998) also considers that selecting indicators is probably the most difficult step in establishing a M&E process. The following difficulties are mentioned:

- each 'output', 'outcome' and 'impact' can be monitoring using a range of different indicators
- chosen indicators are likely to change over time as the external environment changes and as the project objectives are adjusted, and
- bringing different people together in a participatory process to select indicators reveals their different information needs and expectations of monitoring

Therefore important recommendations when developing and selecting indicators include the following:

- objectives and users of the M&E process should be clear
- project objectives, outputs, outcomes, and impacts should be well thought and mapped to make easier the process to develop indicators
- indicators must generate information that will be used, and falling in the trap of collecting a great deal of irrelevant information should be avoided
- indicators should be chosen by the people who are to do the data collection and analysis and the end-users of the information to be credible

- only indicators that are feasible to monitor, analyze and disseminate with the available resources should be chosen, and
- indicators should reflect the needs of quantitative and/or qualitative information

5 A Proposed Conceptual and Analytical Framework for INRM Impact Assessment

The conceptual framework for IA proposed by CIAT, is based upon the capitals within rural sustainable livelihood approach (Figure 1). This IA framework starts with an initial assessment or baseline study to describe the current development state, where the community has a given level of livelihood resources or capitals [10] (Scoones, 1998). Communities and individuals undergo different development processes in their desire to reach an improved modified development state. Different local development processes can be identified such as:

- *Local organization and coordination processes*, where individuals get organized for different activities that require collective action and make decisions that affect the community as a whole, either in a positive or negative manner.
- *Economic and productive processes,* in which individuals and households develop activities with food security and income-generation purposes. These processes include decision-making as to what to produce, how, with whom, where to sell, etc. Once decisions have been made, planned activities are implemented, leading to action and results. Then evaluation (informal or formal) of the means and results leads to a new planning-action-evaluation cycle.

[10] *Natural capital* is defined as the stocks (soil, forests, water, air, genetic resources, etc.) and environmental services (hydrological cycle, pollution sinks, etc.) from which resource flows and useful services for livelihoods are derived.

Economic/financial capital is defined as the capital base (cash, credit/debt, savings, and other economic assets, including basic infrastructure and production equipment and technologies) which are essential for the pursuit of any livelihood strategy.

Human capital is defined as the skills, knowledge, ability to labor and good health and physical capability important for the successful pursuit of different livelihood strategies.

Social capital is defined as the social resources (networks, social relations, affiliations and associations) upon which people draw when pursuing different livelihood strategies requiring coordinated actions.

- *Local knowledge generation processes,* which provide communities with the "know-how" that differentiates them from other communities. These processes are based mainly on local knowledge development and diffusion from generation to generation.
- *Internal communication and information processes,* which permits the diffusion of knowledge, information and experiences within the community.
- *External relations and negotiation processes* that are used by communities to relate with the external environment and negotiate with external agents around different interests, needs and objectives.

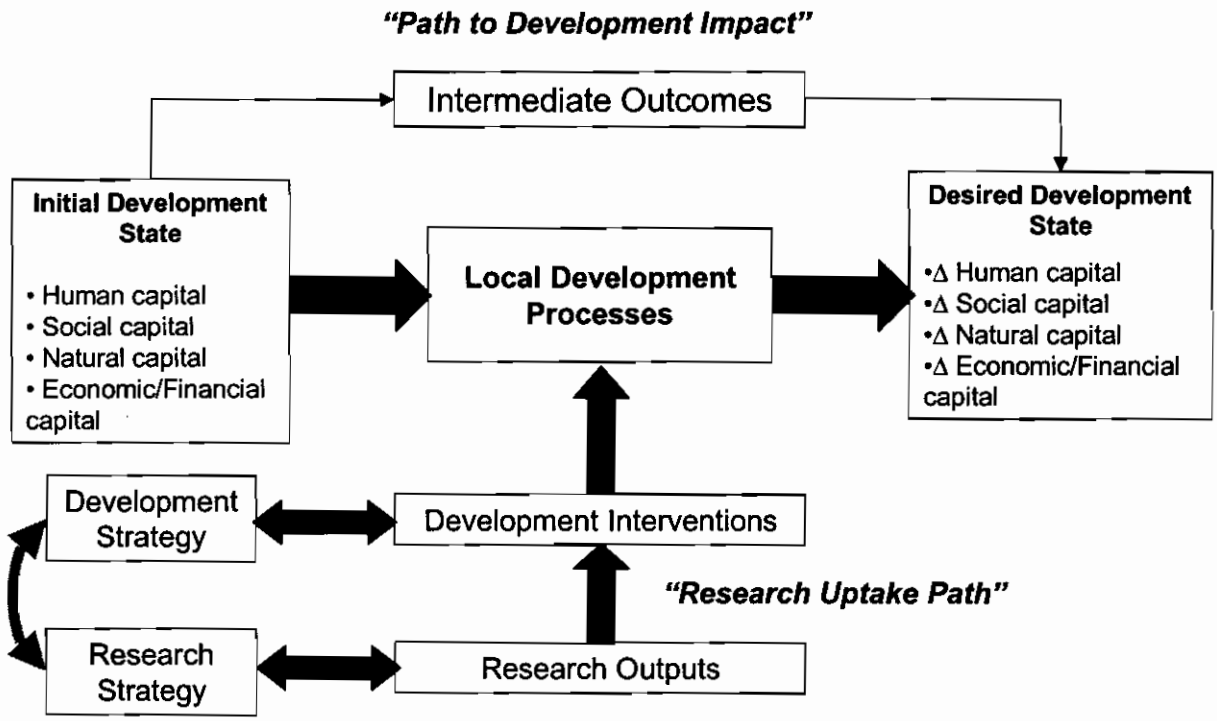

Figure1. Conceptual and analytical framework for IA of R&D interventions on sustainable rural livelihoods.

Development processes are aimed to enable communities reach a modified development state, moving it from an "initial" development state towards a "desired" one. However, there are several internal (within the community) and external hindering forces that limit the capacity of communities to move towards the improved desired development state. For example, communities where a number of institutions, local organizations and individuals work in isolation or independently may require promotion or strengthening of local organization and

coordination processes as an initial entry point. This intervention could facilitate collective action for NRM, contributing to move the community from its initial development process to a desired state, where the levels of social and natural capitals are improved.

Hence, interventions support different livelihood strategies. Agricultural R&D projects usually offer support for agricultural intensification and diversification strategies by providing technology and information, training, technical assistance and DSTs, among others. Land reform and/or land-use policies may affect agricultural extensification strategies. Rural microenterprise development projects provide business development services (i.e. market information and contacts, advising, technical assistance, training on management skills, etc.) and credit that could affect livelihood diversification strategies or even migration strategies.

On the other hand, institutional development programs could influence the ability of institutions and organizations to access livelihood resources and the portfolio of livelihood strategies by strengthening and/or facilitating community organization and their capacity for decision-making and action-development. Other intervention entry-points could be the strengthening of local capacities for innovation and diffusion or the empowerment of individuals and communities to improve their capacity to participate and negotiate with external agents.

The conceptual and analytical framework makes it possible then to develop an impact assessment framework that links research outputs to development interventions, through a "research uptake path". The impact assessment framework also makes it possible to link development interventions that affect local development processes through the "path-to-development impact", resulting in intermediate outcomes or milestones that show progress towards the achievement of final development impacts.

6 A Challenge to CIAT: Assessing INRM Impact Across Three Agro-Ecosystems

CIATs Natural Resource Management (NRM) projects work in different sites throughout Latin America, Asia and Africa. For the initial phase of INRM Impact Analysis, the Latin America sites in the Hillsides (Yorito, Honduras and San Dionisio, Nicaragua), Savannas (Puerto Lopez, Colombia) and the Forest Margins (Pucallpa, Peru) were selected. In these sites, the Center's NRM Division integrates the work of its six projects with themes of Overcoming Soil

Degradation, Community Management, Land Use Planning, Sustainable Systems for Smallholders, Agroenterprises Development, and Participatory Research, as well as with CIAT's germplasm research. Thus, CIAT integrates germplasm, technology and institutional innovations into pilot activities that are introduced, together with development partners to achieve the Center's mission of reducing poverty while preserving the natural resource base. These partners lead or play a major role in development planning and implementation, freeing CIAT researchers to focus their time in agreed-upon research activities. Center-employed coordinators play a crucial role in managing partner relationships.

Initial efforts to develop a methodology to assess the impact of CIAT NRM projects across the three agro-ecological reference sites focused on developing and/or selecting indicators to be measured in order to collect baseline data to compare 'before' and 'after' situations. These indicators ranged in scale from plot level to farm, landscape-watershed, region and continent. However scientists found it difficult to agree upon definitions of scale beyond the farm level. While physical boundaries such watershed was helpful to associate biophysical measures, policy decision-making followed political boundaries such as municipalities. In the end, consensus was found to analyze data using human-defined scales.

Moreover, besides the difficulties on the process of negotiating and developing indicators among NRM projects and scientists, the major constrain to move the IA effort forward was that the pathways from research outputs to development impact were not mapped during the project planning phases. The principal reason for this situation was that the 'logical framework' tool used for planning purposes, although being useful for monitoring project performance and reporting, does not go beyond project 'outputs'. As such the planning process did not provide a chain of expected events from project outputs to intermediate outcomes and final development impacts. Therefore, the development of indicators was set aside temporarily in order to first develop what has been called "the paths-to-development impact", which are not more than the mapping of the sequence of expected research outputs, outcomes and impacts in order to link research outputs with development impact.

Figure 2 shows the path developed for CIAT's Community Management of Hillside Resources Project research outputs. One of the interventions of this project is an inter-institutional organizational model that provides a forum for coordinated planning, implementation and evaluation activities aimed to solve specific NRM problems. Hence, the

path developed for this organizational intervention is presented in shaded squares as the backbone of the path-to-development impact, as this is the platform where research outputs are to be used and adjusted.

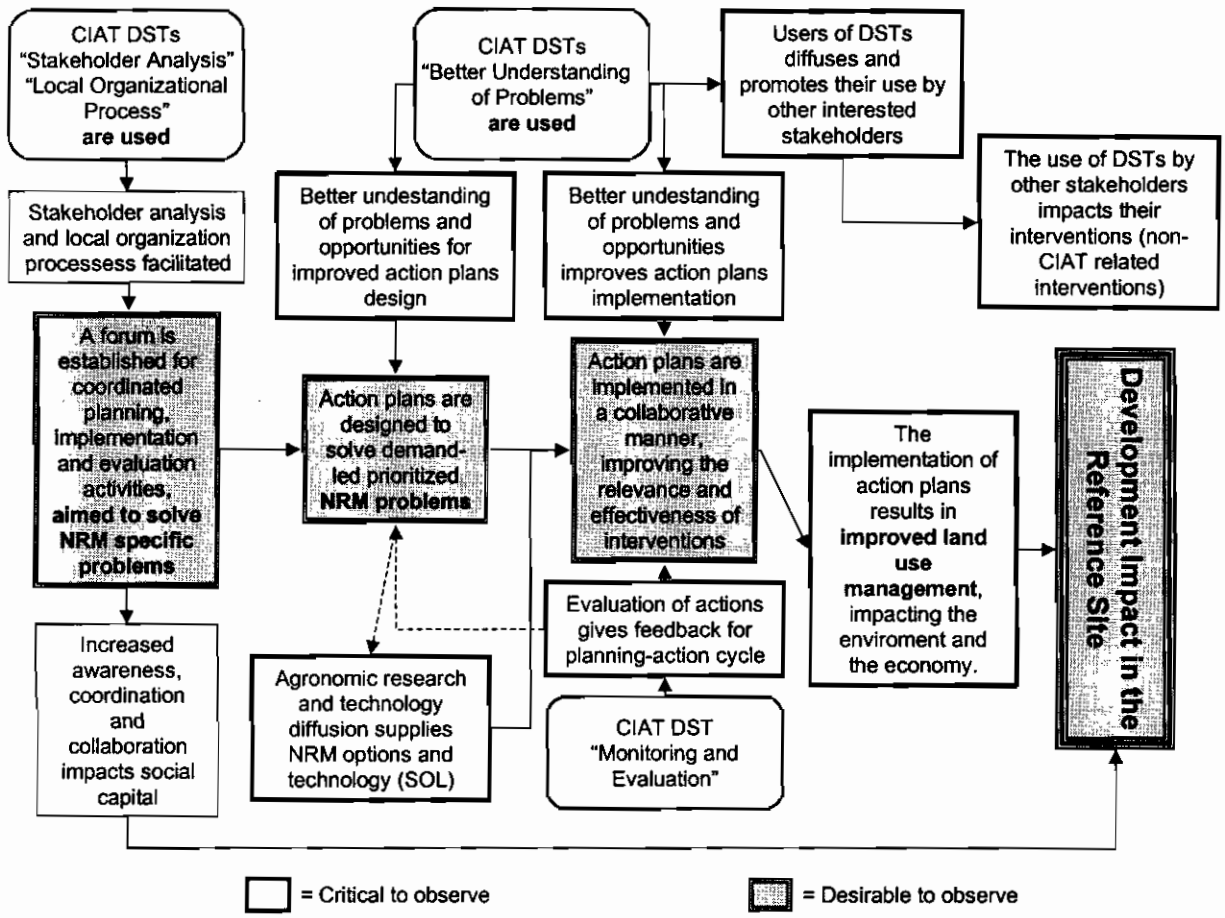

Figure 2. Paths to Development Impact of CIAT's Community Management of Hillside Resources Project research outputs: Inter-Institutional Consortium, Selected DSTs, and Agronomic Research.

DSTs for stakeholder analysis aim to improve the identification of relevant stakeholders to participate in the forum. Other DSTs developed by the project and other projects of the NRM Division (i.e. participatory land use planning, market opportunity identification and evaluation, bio-economic modeling, etc.) should improve the understanding of problems, opportunities and tradeoffs, improving the design and implementation of action plans to solve demand-led prioritized NRM problems.

At the same time, action plans provide demands for agronomic research, which then provide technological information and options for action plans implementation. DSTs for monitoring and evaluation should facilitate the evaluation of action plans implementation and give feedback for the planning-action cycle. All of the above should result in improved land-use management, impacting the environment and the economy, thereby, contributing to development impact.

Besides providing a clear understanding of a given intervention and its path from research to development impact, these pathways also permit a proper definition of R&D hypotheses and assumptions. In most of the situations the move from one milestone to the next requires that other external factors to the intervention also operate properly. Therefore, an intervention also needs to be proactive to increase the probability of achieving impact.

Another more specific example of a research-to-development impact path is presented in Figure 3 for the Rural Agroenterprise Development Project. Again, this path is based in an alternative institutional platform formed by a group of stakeholders involved in the development of rural agroenterprises. CIAT DSTs permits:

- a better understanding of the agroecological potential for sustainable production
- an improved awareness of market opportunities, and
- a better understanding of economic and sustainability trade-off to design a strategic plan for rural agroenterprise development, including a portfolio of products and incentives to promote sustainable production systems.

Based on a given portfolio of products, another DST for the design and execution of Integrated Agroenterprise Projects (IAPs) provides a better understanding of problems and opportunities for agroenterprise development, supporting the design of action plans for the development of the selected portfolio of products. Again the implementation of these action plans should improve the performance of existing and new established agroenterprises, therefore, contributing to development impact.

Besides providing a clear understanding of a given intervention and its path from research to development impact, these pathways also permit a proper definition of R&D hypotheses and assumptions. In most of the situations the move from one milestone to the next may require that other external factors to the intervention also operate properly. Therefore, an

intervention would also need to be proactive in ensuring that these assumptions are operational if development impact is to be achieved.

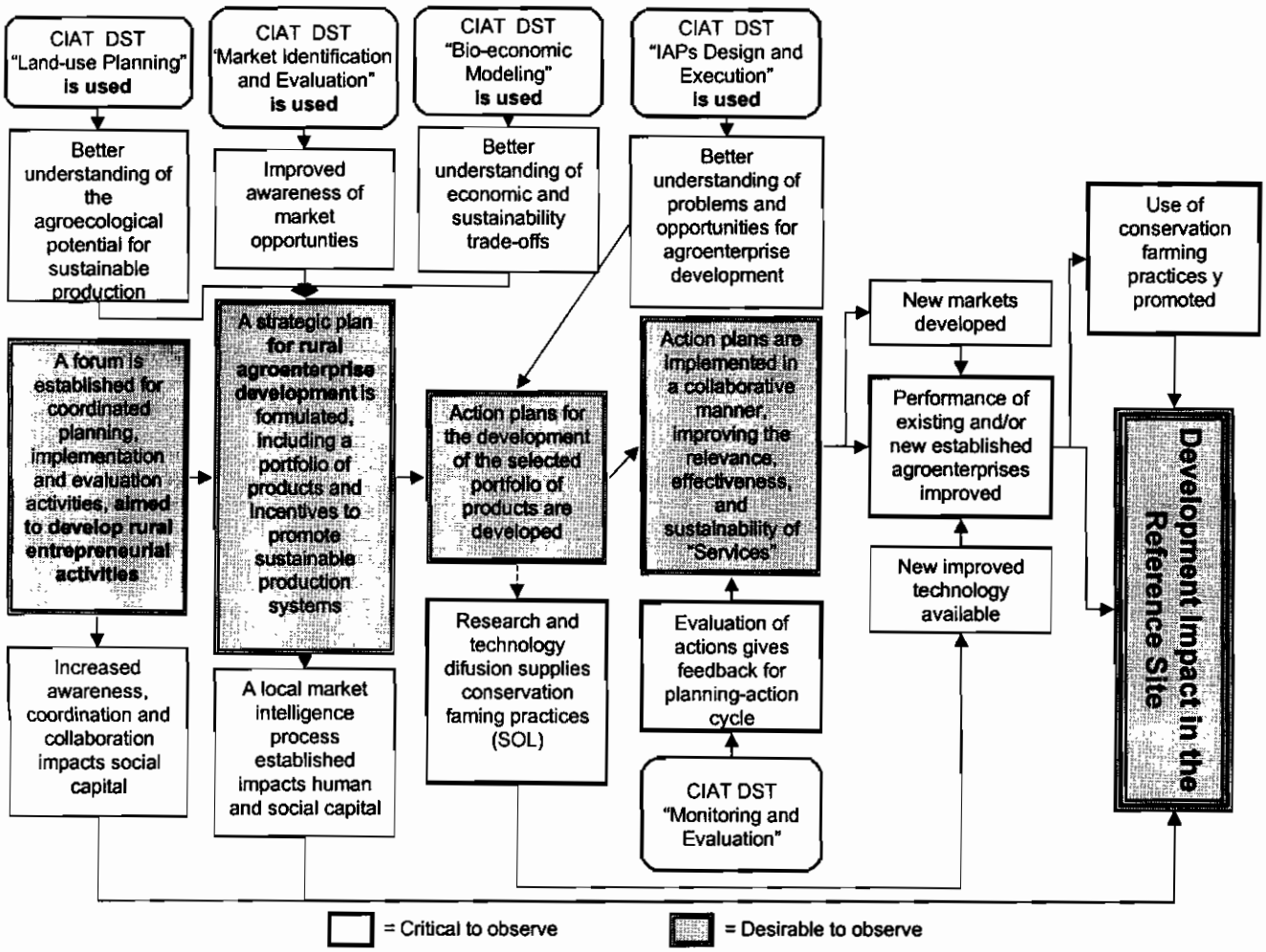

Figure 3. Paths to Development Impact of CIAT's Rural Agroenterprise Development Project research outputs: Rural Agroenterprise Support Services, Selected DSTs and Technology (Germplasm, Agronomic and Post harvest).

6.1 Intermediate Outcomes and Final Development Indicators

Once the "paths-to-development impact" are properly mapped, then indicators would be selected to assess the achievement of each milestone along the pathways as well as for development impact. However, if a participatory monitoring and evaluation process is to be achieved and impact assessment use, as a monitoring and evaluation tool, indicators need to be negotiated among the different stakeholders, especially development impact indicators. A first

list of proposed intermediate and development indicators, by type of capital is presented in Annex 1.

In order to validate these indicators with those of the main stakeholders and beneficiary communities, workshops with stakeholder institutions and community organizations need to be conducted. In these workshops an analysis would be made on the desired development state (the vision of the watershed and its communities). Based on this desired development state, actual conditions would be described and milestones to be reached in the next years would also be described. The results of this analysis with stakeholders should make it possible to validate and prioritize the intermediate and final development impact indicators.

6.2 Identification of Existing Secondary Data and Primary Data Collection

Once indicators are selected and prioritized, existing quantitative and qualitative data from previous studies conducted by both CIAT and other institutions, as well as from census data will be reviewed. A first assessment on the availability of studies that have already collected primary data in the reference sites, shows that there are a huge amount of collected information that is based mainly on surveys, and on semi-structured interviews, which can serve the baseline information needs. Available information from previous studies will be compared with the selected intermediate and final development indicators for monitoring and evaluation. Existing information will be organized in a database, and information gaps identified.

Depending on the type of data that needs to be collected, different methodologies can be used from surveys to semi-structured interviews and focus group discussions, among others. The baseline database will then be complemented with the primary data collected. First, a descriptive analysis of the baseline data will be conducted in order to describe the initial development state of the reference sites, and conduct a cross-site comparative analysis of existing conditions.

7 Conclusions and Recommendations

As INRM research has been introduced in the CGIAR agenda, the theme of assessing and demonstrating its impact has challenged scientists, especially socioeconomists. The complexity of INRM interventions, with multiple objectives, diverse stakeholders, and a wider geographic scope, requires a more holistic IA approach beyond analysis at the farm level and traditional economic surplus analysis. As such, a methodology that assesses changes not only in the

economy, but also in the environment, the organizational context, and the people that permits to evaluate the impact of INRM research on the achievement of sustainable rural livelihoods is needed.

Three characteristics that differentiates INRM from traditional crop improvement research poses methodological challenges for IA. First, its own definition is still not clear as it embraces social, economic, environmental and biophysical components. Hence, the concept changes at different spatial and temporal scales and is assessed in terms of multiple objectives. Second, INRM requires the inclusion of multiple stakeholders, each with its own needs, priorities, capacities, power to speak, norms for trustworthiness of information, and expectations of being involved. Third, the different interests and perspectives of multiple stakeholders may be in conflict, requiring rigorous tradeoff analysis and negotiations.

Since INRM develops complex economic, social, environmental and biophysical innovations, IA needs to be a key part of the R&D process. As such, a rigorous assessment of the changes brought becomes essential. However, this M&E process should start with a thoughtful planning process that should go beyond defining research products. Therefore, during the planning stage, impact strategies that maps expected intermediate outcomes and development impacts should be develop, along with their respective assumptions and hypothesis.

Moreover, beyond accepting the importance of IA as a planning and learning tool, it is essential to validate the contribution of research outputs to development impact. Continued financial support requires confirmation that innovations produce sufficient improvement in production, poverty and/or environmental outcomes to justify large-scale dissemination, to extrapolate research products beyond the reference sites, and produce important impacts at least at a regional level if not globally.

The CGIAR has been concerned with measuring the impact of its research since the 1980s. As such impact assessment methodologies were developed accordingly with its changing research agenda. Hence, IA methodologies became a critical issue for INRM in the mid 1980s. However, as a result of larger scope issues of INRM, much remains to be done to enable IA to evaluate the final effect of more complex R&D projects in addition to economic criteria.

More complex R&D interventions also make it more difficult to attribute the success or failure to any one intervention. Establishing cause-effect linkages is more complex than just tracking changes, and is not as simple as comparing 'before' and 'after' situations, as many other

influences will have occurred and affected the situation simultaneously. Moreover, the option of comparing 'with intervention' and 'without intervention' situations, in the hope of establishing clear causal links may not be the most appropriate. Among many other reasons, it may be too difficult (if not impossible) to control for other factors that may influence the outcome of an intervention to make the two sites comparable.

Given the above difficulties for developing an appropriate IA methodology for INRM research, there is no commonly accepted protocol for assessing the impact of INRM on sustainable rural livelihoods. Persistent issues include finding feasible spatial and temporal scale boundaries, integrating and negotiating stakeholder development objectives, stakeholder participation in the IA process, defining and empirically assessing sustainable rural livelihoods, linking research outputs to development impact, and developing appropriate and manageable indicators.

With respect to the first two issues, it can be argued that finding feasible spatial and temporal scales is not necessarily one of the most important issues, but rather the identification, negotiation and participation of multiple stakeholders. However, the inclusion of multiple stakeholders in the IA process requires a serious and thoughtful decision and consequently resources need to be allocated accordingly and a longer process expected. One way to deal with this issue could be to identify different interest groups (both locally and externally) as well as their assessment needs and interests, and as needed, parallel IA processes can be conducted with different interest groups and then integrated.

Furthermore, if a true participatory IA process is to be established, people affected by any intervention should be involved in the definition of the monitoring goals, the design of the system, the selection of indicators, data collection and analysis, and in the end should use the analyzed data and results. However, with respect to stakeholder participation on IA, a fundamental question to be asked is why anyone should bother assessing change, and for whom will the information and the process of collecting information, bring benefits.

The IA framework and methodology presented in this paper proposes that IA should start with thoughtful, well-defined and shared development vision and objectives. Based on these objectives, a development strategy needs to be design and research products defined accordingly, in a demand-led manner, if research-for-development products are to be produced. This planning process would then permit a proper mapping of research outputs, intermediate outcomes that

clearly shows how research outputs are articulated and used by the development strategy, and the final expected impacts of these R&D process. These maps are called "paths-to-development impact" and some examples are presented in this paper for two projects of CIAT's NRM Division.

Once paths-to-development impacts are mapped, the next issue is the selection of an appropriate and manageable set of indicators for the critical outputs, intermediate outcomes and development impacts. Indicators are central to most M&E approaches, however, selecting indicators is one of the most difficult steps in establishing a M&E process. Indicators are only meaningful if they relate to needed information and if the users know how to interpret its meaning. Since indicators are only a proxy for a complex reality, they must be relevant and accurate enough, rather than perfect, and need to be selected carefully.

The proposed IA methodology would permit tracking relevant types of changes over time. However, establishing cause-effect, or at least influence, linkages is more complex and is not as simple. Therefore, there is a need for further IA research to develop a model for assessing and validating these paths-to-development impact in order to evaluate the contribution, or at least the influence, of a given intervention to final development goals. This model could also be useful to conduct ex-ante impact analyses of different R&D interventions from organizational models to decision-support tools (DSTs) to technology and information as a criteria for INRM research priority-setting.

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Annex 1. List of Proposed Development Indicators

Economic and Poverty Indicators

Food Security

- Total and gendered available food in the household
- Seasonal available food in the household

Income

- Farm income ($/ha)
- Household income ($/HH, $/capita)
- Household income stability (Standard Deviation)
- Income sources (on/off farm, agricultural/non-agricultural)
- New products or processes introduced in the agricultural sector
- Participation on final consumer price (community gate price / final consumer price of most important selected commodities)
- Value added to primary production (selling price / primary product farm-gate price)
- Distribution of income sources

Equity

- Farm and household income comparisons by well-being group and by gender
- Distribution of economic surplus or value added.
- Land tenure situation (% farmers who own land, mean farm size)

Employment Generation

- Number of jobs (total, gendered and seasonal)
- % of active population employed (total, employees, self-employment, and gendered)

Environmental Indicators

Production System

Land use intensification

- Number of cropping cycles per year
- Fallow area as percentage of total area
- Fallow time as percentage of cropping cycle
- Fallow species diversity (native and enrichment with introduced species)
- Legume diversity
- Land with improved pasture

Land use diversification

- Number of species/crops per farm and /landscape
- Number/type of cropping systems within the farm
- Number of weeks per year that the soil is exposed to erosive effects (win and water)
- Number of perennial crops in the cropping systems
- Spatial distribution of crops
- Temporal distribution of crops
- New resource management practices introduced in the agricultural sector

Annex 1. (Cont.)

Land productivity

- Kg/ha/year for selected crops, livestock and forest products
- Total factor productivity
- Product / energy ratio (biophysical measure)

Forest

- Area of forest cover (ha/farm, ha/community, ha/municipality)
- Map of forest cover (spatial and temporal distribution)
- Secondary forest regeneration
- Species diversity in secondary forest (native successions and enrichment with introduced species)

Soils

Mass Balance

- ***Nutrient Balance (nutrient input/ nutrient output). Desired level is Nutrient Balance ≥ 1 at the farm and landscape level***

Land productivity

- ***Kg/ha/year for selected crops (already an indicator of production systems)***

Water balance

Area and spatial and temporal distribution of degraded land and pasture

Water

Water pollution

- Contamination points

Water quality

- Sedimentation,
- Turbidity
- Levels of nitrates and phosphates
- Conductivity

Water availability

- Volume of water by season
- Volume of water by levels of rain

Other indicators

- Agro-chemical use (kg/farm, # of applications)
- Burning of agricultural residues (Yes/No)
- Air pollution (Yes/No, CO, CO_2)

Annex 1. (Cont.)

Human/Social Indicators

Community Empowerment and Equity in Decision Making

- Projects designed and mobilize by the community and/or local and/or external institutions (# and description)

Participation in Local Policy Decision Making

- Existing channels and mechanism for participation in democratic governance
- Community access to political decision making
- Community capacity to influence political decisions that affect the community

Human Capital

Education and Experience

- Individual capacity (# years formal / non formal education, # years experience)

Individual Capacities

- Capacity to participation in key decisions that affect NRM and primary production and agroenterprises.
- Capacity to innovate in agriculture, agroenterprises and NRM.
- Knowledge of key cause-effect of NRM problems
- Knowledge of key cause-effect of agricultural production, processing and marketing relationships
- Capacity to manage agroenterprises, CIALs, community organizations, Consortia, and farm.

Access to opportunities

- % of children with access to primary education
- % of youth with access to secondary, technical and university education
- Technology
- Market
- Infrastructure
- Health
- Information

Social Capital

Structural Social Capital

- Organizational density
- Networks
- Support organizations
- Procedures and norms
- Precedents

Cognitive Social Capital

- Conflict resolution
- Collective action
- Solidarity
- Trust
- Reciprocity
- Cooperation

Annex 1. (Cont.)

Quality of Life Indicators

- Nutritional Levels
- Access to health services and medicines
- Access to consumption goods (clothes, shoes, etc.)
- Migration
- Local well-being indicators