PART FOUR

Lessons Learned

this part touches on the most significant lesson outcomes of the Cases as summarized by authors, or as noted by the editors.

International public goods (IPG)

The mandate for INRM work within the CGIAR is for the creation of scientific understanding, of technologies and for providing services that can be used as IPG to preserve and favourably impact both the environment and its natural resource base, while improving human well-being. These IPG have applicability, with modest adaptation, across national boundaries, usually with maximum utility within ecoregions. International public goods appropriate for use in INRM management programmes of the Centres' development partners are important outcomes in every Case. Many of the Cases illustrate direct impact on the incomes and lives of those farmers and communities (test sites or "benchmarks") where the research is being conducted. These are termed "intermediate beneficiaries" in logframe parlance. The full impact of IPG, however, is in their use in broadly-based "scaling" programmes run by partner development institutions and groups. The universal IPG presence and magnitude are surprising, given much conventional wisdom on NRM research, holds that natural resources work is location-and situation-specific. These outcomes are testimony given to the way in which process-based outcomes have been sought and on up-front attention to scaling. Case authors were not asked to identify IPG in the requested presentation outline, and in most Cases they have been treated matter-of-factly in the write-ups. The IPGs appear as several types:

Coordination and facilitation services

In every Case the Centres are acting in a coordinating or facilitating role for a range of institutions within a region that face similar NRM problems. It should be stressed that all the documented projects are working towards problem solution at the research end of the development spectrum. Such coordination can only be done by institutions that have both the resources and the scientific capacity to make significant contribution. They must be active partners participating fully, and have the respect of those groups in the region that provide input, support and expertise. That capacity and respect comes only from long experience and contribution within the regions.

Ecosystem process science

Scientific models (quantified understanding of the behaviour and relationships of NR factors , species and populations across gradients of time and space in response to management options) are being upgraded, adapted and calibrated to local and regional environments (Campbell *et al.* 2001). A process model for minimum tree diameters at the time of cutting to maintain economic forest populations of the various high value species is shown in Case 4. This model can be broadly applied within an ecozone once it is calibrated, and across gradients with additional calibration, to serve as a guide for longer-term forest management policy. As in most instances of ecosystem processes, the partners do not develop the models from scratch. They have adapted well-known process science to local high-value timber species within their forest environments. The process approach can be further extended to determining the resultant biodiversity and maintenance of species that contribute to forest multipurpose use, and the well-being of rural communities and forest dwellers that depend on them.

The refined and recalibrated models developed by the Management of Soil Erosion Consortium (MSEC) as described in Case 1 are additional types. The new, user-friendly "Predict and Localize Erosion and Runoff" (PLER) model, based on well-known and widely-used runoff parameters, predicts soil loss across gradients with sufficient accuracy to delineate between major management alternatives such as cropping pattern and tillage intensity. It can thus be used as a first approximation of the environmental impact of landscape-level changes on cropping intensity. The model requires calibration at reasonably large regional scales. The ability to predict the effect of cropping pattern and tillage options on sediment loss and, equally importantly, on downstream reservoir sedimentation is extremely useful in the selection of alternative technologies. It is also important in the selection of incentive or regulatory policies to achieve desired natural resource services or ends (e.g., reservoir sediment loading and eventual lifespan). The model is most useful in larger river basins where sediment loading in downstream areas has a high economic cost, and the calibration and use of the model to provide quantitative estimates of management alternatives can be economically justified. Eventual adoption of alternatives by farmers is ultimately a matter of labour availability, access to the needed technologies, and the economic incentives for their making the desired change. The ability to quantify outcomes is highly useful to policy planners who can provide the needed incentives.

Soil and biomass carbon determinations and models are becoming precise and highly useful in the selection of cropping systems, plant and animal residue management and tillage options. The Alternatives to Slash and Burn (ASB) project, while not shown here, has generated excellent data on carbon management across several continents (Ericksen 1999). Aspects of this type of work on carbon studies are seen in several of the Cases. Carbon preservation, sequestration and stocks are becoming critical to the maintenance of productivity of soils in dry areas in particular, and to fertility management of soils across the semi-arid and humid tropics of Africa. The scientific methods, models and location of individual benchmark sites on gradients of carbon change are highly important to the understanding of soil productivity and of its degradation. The Tropical Soil Biology and Fertility Programme (TSBF) has been working and publishing in this area for over a decade, and its experience is very evident in the ASB and in several of the Cases of Part III. This area of science yields major IPG, and their adaptation to local environments. It is a perfect example of the IPG nature of much NRM work. It is necessary to point out, however, that this type of process work must lead to results that are useful in determining the type and levels of appropriate technologies and management that farmers and communities can reasonably be expected to use. Many ecosystem processes can be expensive to understand and quantify, and may lead to non-applicable results.

Ecosystem frameworks

A third major type of IPG is seen in the ecosystem frameworks that evolve through broad stakeholder collaboration. These frameworks serve as a guide for selecting and moving technologies across environmental and sociopolitical gradients. The framework shown in Case 5 (Figure 1) of the M&M project is a prime example. By serving as a reference point for discussion among stakeholders, it gives guidance on the adaptation of technologies, or for the creation of new ones, to accomplish similar goals in different regions with similar ecologies. The Decision Making Tools from Case 2 are an example of process information which leads users to a holistic view of their ecosystem, then narrowing to focus on specific problems within their ecosystem context.

GIS data sets specific to regional agricultural and INRM development needs

All of the Cases include the structuring and assembling of such data sets in their activities. Data needs are determined by stakeholders and scientists as they seek to provide quantification of context within the five resource (asset) realms. Demographics, physical infrastructure, rainfall, topography and soil factors can be overlaid with the movement of races of plant pathogens or other variables that are of interest. Emphasis is placed on the factors that are thought to be most closely related to, and causes of, the priority problems. Technical assistance is nearly always brought in from advanced laboratories or commercial vendors to make the data system more efficient and user-responsive. In some cases the data required for the models, such as evapotranspiration data needed for determining water management, are of far higher quality than can be measured in field projects. Secondary analysis of relationships among variables can be of major assistance in the planning of priorities and the selection of entry points. In Case 6, Andean Livelihoods, the GIS model was advanced with the help of a commercial vendor. This resulted in graphic illustrations and virtual visual overflights of the mountain valleys, superimposing soil and crop fertility data, to demonstrate technological options and their predicted economic and environmental impacts to villagers. Thus, the model served as both a learning and extension tool. The building and application of such data sets requires an expertise not always available at the local level. They are too expensive for small user groups to afford, and efficiencies are only found at larger scales of adaptation and use. Their IPG nature is clear.

IPG summary

In Case 2, many of the scientific tools and processes described above have been packaged as "Decision Support Tools (DST)" and used as teaching devices. They appear to have broad applicability. As an example, "Stakeholder Analysis" presents a methodology for analysing stakeholder groups for the collective management of natural resources in a watershed. "Participatory Mapping" describes processes for participatory mapping, analysis and monitoring of natural resources in a watershed. In these Cases, they are "how to do it" tools, developed through stakeholder interaction. Others, such as the DSTs of Case 1, the soil erosion processes, are more technical. The "Toolkits" of Case 4, provide a combination of scientific relationships and stakeholder process understanding for use by forest managers, and national and local forest management policy makers.

In all instances, the process-level science and the management of data, as summarized by the "cornerstones" for INRM operations, provide contextual understanding, an understanding of key processes, and assistance to stakeholders in determining priorities. Many of these project outputs will be highly useful, and some essential to both *ex-ante* and *ex-post* impact assessment.

Focus within a holistic setting

Every Case illustrated an attempt by stakeholders to define the universe within which they are working. Each Case narrowed the options to a few that were thought to be key entry points and represented their priorities. Such early determination of focus is important to project effectiveness. There are numerous examples of projects where focus was not effectively accomplished. Some projects put too much time and effort into defining and describing "everything". Some projects focus too much on the "problems" and too little on the "solutions". Others become absorbed in social processes. Some make the mistake of assuming that one stakeholder group, either scientists or indigenous farmers, have all the required knowledge and discount other sources.

The end result of all agricultural development is to introduce specific change in plant or animal technologies and their management, in order to make them more productive, more efficient and more sustainable. The IPG dimensions of INRM science provide the frameworks, and the process understanding and quantification to guide the selection and adjustment of technologies to each local environment, reducing the huge cost of agricultural development through completely empirical approaches. They are only a means to an end. The prioritization of problems, the selection of entry points, and the availability of specific technologies are then crucial. Stakeholder group interaction has a high transaction and opportunity cost, and will remain functional only as long as technologies are flowing and effective change is occurring. The aim surely is to train stakeholders so that they become equipped to resolve many of their own problems and to take advantage of many new opportunities, with only minimal external institutional assistance, and that when external assistance is required they are in a position to be able to demand it.

The need for ongoing INRM learning

INRM process understanding and the scientific tools that support it are continually evolving. It appears that a community-of-interest activity will be needed for some time. What form this should take, its evolving functions and innovative ways to keep transaction costs low are open questions.

The short-term nature of funding is a limiting factor in some instances. Projects only have the groundwork laid for potential change once stakeholder partnerships, contextual frameworks and process understanding are in place. Several of the Cases indicate problems with frequent turnover of stakeholders, both among scientists, and particularly among upper level administrators whose tenure or assignment to any project is often limited. Each stakeholder group must have a core of participants, often at the community level, that continue for longer periods.

The institutional and knowledge infrastructure that are put in place in the early stages of INRM research can then be used to select, assess and implement technological alternatives and policies for their adoption and extension. Such “living infrastructure” persists only as long as it is needed, utilized, refreshed, supported and accomplishes the desired changes. Most of the Cases presented demonstrate an ongoing process for technological and policy change within their “living infrastructure”. It is important that such infrastructure be permanently embedded within national socio-political systems, particularly as technologies invariably need to change as their context within the physical, social, economic and political environment changes over time. In Central America the half life for technologies has been calculated as only six years!

References

Campbell, B., Sayer, J. A., Frost, P., Vermeulen, S., Ruiz Perez, M., Cunningham, A. and Prabhu, R. (2001). Assessing the performance of natural resource systems. *Conservation Ecology* 5(2):22. URL: http://www/consecol.org/vol5/iss2/art22.

Ericksen, P. (Ed) (1999). Alternatives to Slash-and-Burn Climate change working group final report, Phase II: Carbon sequestration and trace gas emissions in slash-and-burn and alternative land uses in the humid tropics. ASB Coordination Office, ICRAF, Nairobi, Kenya.