Strategic Assessments and Development Pathways for Agriculture in the Semi-Arid Tropics

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Assessing the Impact of NRM Research: Methodological Paucity, Recent Progress and Future Directions

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Introduction

Thirty years ago, the focus of the Consultative Group on International Agricultural Research (CGIAR) was almost exclusively on improving agricultural productivity and increasing input-use efficiency (reducing costs) for its mandate crops via genetic improvement. Yet, natural resource management (NRM) research can enhance crop productivity growth and sustainable use of natural resources (soils, water, forestry, etc.), and significantly contribute to poverty reduction and improving human welfare. These considerations have prompted the CGIAR to expand its research portfolio in the area of NRM (Figure 1).

Unlike crop improvement research, where there is large documented evidence of impacts, there is a dearth of evidence of NRM impacts. Along with the relative increase in research investments in this area, development investors and researchers are increasingly seeking evidences of impacts. Lack of documented evidence does not necessarily imply lack of NRM impacts. Methodological difficulties have hindered NRM impact assessment studies.

On 6–7 December 2002, ICRISAT convened an International Workshop at Patancheru, on 'Methods for Assessing the Impacts of Natural Resource Management Research'. Based on the papers presented and workshop deliberations, this Policy Brief summarizes special features of NRM, the strengths and weaknesses of alternative methods for assessing NRM impact, and highlights key issues that need to be considered in assessing the impact of NRM research.

Why NRM impact assessment is important

Impact assessment plays an important role in setting priorities, and provides useful feedback to improve the efficiency and effectiveness of research investments. Evaluating the impacts of NRM research is essential to understand its contributions to enhancing agricultural productivity, sustainability, reducing vulnerability, and ultimately alleviating poverty. Impact assessments could also help tailor CGIAR research investments in NRM towards areas that generate valuable international public goods. Donors and researchers alike are interested in evaluating the potential social benefits and environmental outcomes, resulting from adoption of new resource-conserving and/or productivity-enhancing NRM technologies.

The emergence of NRM as an important area of CGIAR research investment has made assessment of

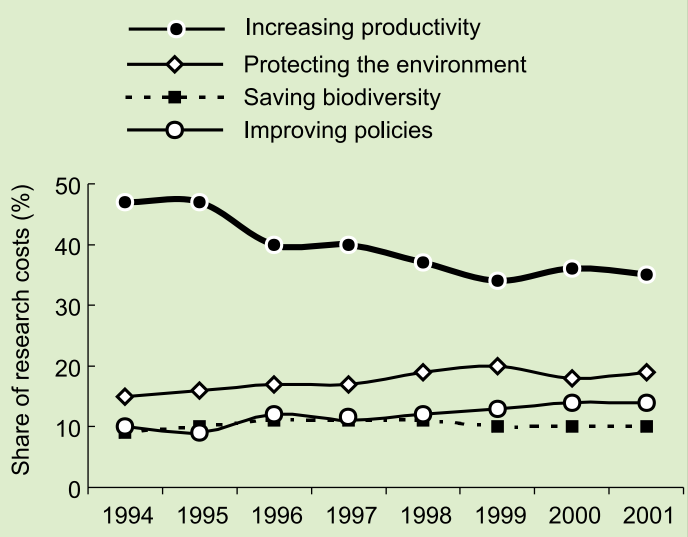

Figure 1. CGIAR research agenda investment by activity, 1994–2001.

Source: CGIAR Financial Reports 1994–2002 the impact of this research inevitable, both for setting priorities and for monitoring the efficiency and effectiveness of research investments (Kelley and Gregersen 2003; World Bank 2003).

As Figure 1 shows, NRM related research is a growing as well as changing part of the CGIAR research portfolio. Although overall financial contributions have been fairly stable during the last few years (1994–2001), growing at an average annual rate of 0.6 % in nominal terms and declining by 1.6 % in real terms, some significant patterns of investments have emerged (Kelley and Gregersen 2003; World Bank 2003).

CGIAR investments in 'Increasing Productivity' have fallen from 47% of the total in 1994 to 35% in 2001. At the same time, investments in 'Protecting the Environment' and 'Improving Policies' have risen from 15% to 19% and from 10% to 14%, respectively. This indicates that the recent investment trend favors NRM-environment related research. In order to justify a sustained investment in NRM, it is important to demonstrate impacts. As we show below, this is not an easy task.

Special features and methodological difficulties

Credibility of the resulting R&D impacts depends on constructing plausible links between an impact 'generator' and the observed impact. This critically relies on identifying the source of the impact, and quantifying the derived impacts across time and space. The identification and description of the impact source being investigated is the foundation for establishing plausibility. To set up such links in NRM impact assessment is a highly difficult task.

Methodological difficulties for NRM impact assessment are rooted in several unique features of such technologies. Unlike germplasm technologies, the impact of the NRM technology occurs only indirectly through the economic and environmental goods and services that generate direct and indirect benefits to society. These benefits are often multi-faceted, including economic, environmental and social gains across different scales. Hence, these benefits are often externalized, and not entirely captured by the investors.

The management of externalities that frequently involves collective action in negotiation, decision-making, and conflict management among different stakeholders, complicates impact assessment of NRM projects. The challenges are also associated with interrelationships among natural resources, spatial and temporal dimension of impact, and valuation of the associated economic and environmental benefits and costs. The existence of different stakeholders at various spatial scales, which could have different needs and expectations from NRM research, complicates the assessment of costs and benefits. The temporal dimension of NRM impact also renders methodological difficulties as research interventions could have long-term impacts that are difficult to perceive or assess. Hence it may be hard to perceive its cost or the benefits of interventions to reverse the problem. Lack of clarity and the tendency to set multiple research goals and objectives also make it difficult to accurately assess NRM impacts. These complexities undermine the relevance of the existing tools and methods used for assessing germplasm technologies.

Adoption and adaptation of new NRM technologies lead to changes in patterns of resource use and management, which in turn generate diverse ecosystem services: production function, regulation function, habitat function, and information function (De Groot *et al*. 2002) to the resource user and to the society at large. The process of translating these changes into social benefits requires suitable performance indicators along each of the affected ecosystem services.

The type of ecological indicators to be used may differ by the type and scale of NRM interventions. There is no universal set of indicators that is equally applicable in all cases. However, a small set of well-chosen and well-defined indicators tends to be the most effective approach. Indicators must be practical and economical to develop, and should provide a reasonable approximation to the natural phenomenon being investigated and measured.

The primary candidates would include indicators for quality and quantity of soil, water, forests, and biodiversity. Soil quality can be assessed using indicators such as topsoil depth, organic matter, texture, soil respiration, etc., and comparing them with desired values (critical limits), at different time intervals. Water quality and availability can be assessed using hydrological indicators such as runoff, sediment loss, changes in groundwater tables, and water quality. Changes in cropping patterns and agro-biodiversity can be assessed using suitable agronomic indicators. It is important to develop the indicators through participatory and interdisciplinary methods in partnership with various stakeholders, especially the beneficiary farmers and communities.

Impact assessment will not be complete before valuation, in monetary terms, of the social benefits derived from changes in ecosystems services. Empirical monetary valuation of the goods and services generated through NRM investments is influenced by lack of markets, and the spatial diffusion of the derived benefits. When markets are missing and externalities prevail (offsite costs and benefits), monetary valuation of indicators of change depends on use of proxies or hypothetical markets. When markets exist, productivity changes, defensive expenditures and replacement costs could be used for valuation of changes. In the absence of markets, hedonic pricing and contingent valuation methods (CVM) could be useful. Hence, it is important to have a clear picture of the existence of markets for goods and services generated, and to know whether the benefits accrue to the individual user, the local or the global community at large. While the vast majority of applications of valuation techniques such as CVM are limited to the developed countries, such techniques are also equally applicable for cases in developing countries.

Methodological approaches

As NRM investments may not often generate goods and services directly ‘consumed’ by human beings and are often used as factors in production, it is important to establish a link to find out how such investments translate into welfare gains for the people. It is, however, difficult to specify a single quantitative approach for assessing economic and environmental outcomes. In the last few years, some methods have been developed to assess potential impacts associated with changes in patterns of natural resource use and management. The economic surplus approach is the most commonly used method for evaluating the impacts of agricultural research investments, particularly for technologies related to crop improvement. The approach relies on estimated changes in economic surplus (the sum of producer and consumer surplus) resulting from the associated supply shift. The major challenge is to make a plausible link between changes in NRM practices and the supply of economic goods and services. The presence of non-marketed externalities further complicates the approach, although in theory, the social marginal cost of production could be used to internalize the externalities. New methods (e.g., benefit transfer functions) are being developed to extend the economic surplus approach for assessment of non-marketed social gains from improved NRM.

Econometric methods could also be used to link measures of output, costs and profits directly to past research investments. The econometric approach uses regression methods to explain variations in agro-ecosystem services through changes in NRM patterns. To the extent that changes in biophysical and environmental indicators could be explicitly linked with or correlated to NRM interventions, impact assessment may use these values as proximate indicators of impact. These indicators could include changes in land productivity, total factor productivity, reductions in costs (e.g., reduced use of fertilizer), reduced risk and vulnerability to drought or flooding, improved net farm income, and changes in poverty levels (e.g., head count ratio). However, the need to justify NRM investments requires comparing aggregate benefits with research and extension costs. When properly estimated, this approach addresses the attribution problem. The limitations are related to data availability and measurement errors, and problems in internalizing externalities and inter-temporal effects.

Bio-economic models are used to incorporate changes in the biophysical conditions of natural resources within the economic behavioral models. Such models are useful to evaluate the potential effects of new technologies, policies and market incentives on human welfare as well as the quality of the resource base and the environment. Possibilities to address dynamic issues and linking changes in biophysical indicators with economic models are important advantages of this method. The integrated framework allows a consistent analysis of technology impacts within a given socioeconomic and policy setting. The approach can be used to account for externalities if the generation of externalities can be linked with NRM and economic factors. The flow of social benefits needs to be compared with the flow of research and extension costs to justify the investment. Integrated bio-economic models are cumbersome to develop and require estimation of several parameters. But the payoff in terms of insights gained and future use in policy analysis could be significant.

Future directions

Research and development (R&D) investments in NRM in agriculture should be able to document and demonstrate economic and environmental gains to society. It can be argued that the shortage of documented evidence of impact is mainly due to lack of suitable methods, and not due to lack of impacts from NRM interventions. Hence, CGIAR Centers need to increase their efforts to develop and disseminate cost-effective methods for impact assessment. Such methods are important public goods with a high potential for international spillover within and outside the CGIAR System.

NRM research also needs to establish plausible linkages between research products and desirable outcomes. Relatively simple and clearly defined attainable goals and objectives for NRM research will enhance the plausibility of impact assessment studies and improve attribution of observed changes to R&D investments and interventions. Along the clear goals and objectives, more holistic approaches are required to enhance the effectiveness and impact of NRM research. However, the continuing shift in the research approach and conceptual framework (e.g., NRM→INRM→IGNRM) further complicates the methodological difficulties and tends to further undermine assessment of NRM impacts.

As there is no impact without adoption of innovations by the resource users, an adoption study is a pre-condition to impact assessment. Information generated through adoption studies on how new NRM technologies have contributed to NRM at various levels (ranging from the plot, the farm to watersheds and beyond) will help inform impact assessment studies. In the presence of market imperfections and conflicting incentive structures, NRM technology adoption may be short-lived. Impact assessment of NRM should be on the basis of demand-driven adoption of new technologies by the resource users.

Impact assessment should be a continuous process involving resource users (farmers and communities) in participatory monitoring of impact indicators and evaluation of progress towards the desired outcomes. Generating baseline data and regular monitoring of key indicators of impact should be given high priority. Assessing impacts should not be restricted as merely a responsibility of socio-economists. As in the research process itself, an interdisciplinary team is needed for undertaking NRM impact assessments.

As it is often difficult to develop quantitative indicators for several important goods and services derived from NRM investments, it is important to complement quantitative approaches with qualitative data. Combining the two types of approaches can offer better insights and a thorough understanding of project impacts (Kerr *et al*. 2002). A semi-qualitative assessment of impacts based on the concept of sustainable livelihoods and changes in the capital assets of rural households may also improve insights. Future research should develop suitable methods for amalgamating the two approaches in NRM impact studies. Combined methods are also more likely to enhance inter-disciplinary research as well as make NRM impact assessment results more transparent and credible.

Further, it is important to identify the relative strengths within and outside the CGIAR System and establish strategic partnerships in testing and developing useful and simple indicators and assessment methods. The necessary capacity for NRM research and impact assessment within the NARS should also be developed.

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