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Assessing research impact on poverty: the importance of farmers' perspectives

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Abstract

In this paper we provide evidence to show that farmers' perspectives on poverty processes and outcomes are critical in the early stages of evaluating impact of agricultural research on poverty. We summarize lessons learned from farmer impact assessment workshops held in five African locations, covering three agro-ecological zones and five different agroforestry and livestock technologies arising from collaborative national–international agricultural research. Poverty alleviation is a process that needs to be understood before impact can be measured. Workshops such as those we describe can help researchers to identify farmers' different ways of managing and using a technology and likely effects, unanticipated impacts, major impacts to pursue in more quantitative studies, the primary links between agricultural technology and poverty, and key conditioning factors affecting adoption and impact that can be used to stratify samples in more formal analyses. Farmer workshops inform other qualitative and quantitative impact assessment methods. We discuss the linkage of farmer-derived information with GIS-based approaches that allow more complete specification of recommendation domains and broader-scale measurement of impact. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: Impact; Poverty; Agricultural technology; Agricultural research

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1. Introduction

Investors in international agricultural research have the right to ask for comprehensive impact assessments demonstrating the returns to their investment. What donors and research managers attempting to prioritize research want to see, however, goes beyond merely estimating realized or potential economic benefits compared with the costs of the research investment. They want to be convinced that the research is leading to impact on people — that is, to technologies, strategies, and policies that are improving poor people's wellbeing in a way that is sustainable and enhances the environment.

The typical approach to measuring impact of agricultural research on poverty, the environment and on productivity has been to ask experts for appropriate impact assessment indicators in each of these categories, and many workshops have been held within the international donor, non-governmental organization (NGO) and international agricultural research center (IARC) communities to compile lists of such indicators (Henninger, 1998 provides a comprehensive review of such indicators). The planning for impact assessment rarely involves the participation of farmers.

In this paper we examine a key initial step in evaluating social, environmental and economic impact of agricultural research products that features farmers. We summarize lessons learned from farmer-participatory workshops in five locations aimed at evaluating the impact of technologies arising from collaborative national–international agricultural research. These workshops were held in three agro-ecological zones and four African countries, and covered five different agroforestry and livestock technologies (improved cowpea for food and animal feed, improved fallows, fodder trees, live fences, and biomass transfer systems). These technologies are summarized in Table 1.

Although dealing with different technologies, all the workshops took the same approach with similar objectives, which were as follows:

1. To obtain community and farmer views on the types (economic, social, and ecological), levels (plot, farm, community), and magnitudes of impact that they perceive or expect to be important, and how they measure or would measure them.
2. To elicit community and farmer experiences or expectations of constraints to achieving these impacts.
3. To develop a general strategy for monitoring impact that could be implemented at additional research sites.

Assessing the impact of agricultural innovations (e.g. technologies, strategies, policies, or institutional innovations) is complicated by the lack of experimental design in this field (i.e. for ethical and logistical reasons, researchers do not control which farmers or communities will take up a technology for a period of time and which will not). Thus the manner in which agricultural innovations are diffused, tested, adopted, and used are shaped by a complex set of social, economic, and environmental factors. Such factors and impacts are also felt at many different scales

Table 1
Description, management, workshop location, recommendation domain and use of technologies assessed in workshops

Technology	Description and management	Workshop location and recommendation domain for technology	Typical farmer use
Dual-purpose cowpea with improved drought and pest resistance, higher grain and fodder yields than traditional varieties	Intercropped with sorghum or millet, rows of cowpea are transposed with rows of cereal the following season	Kano, northern Nigeria Recommendation domain: Dry Savannah zones (semi-arid and arid) of west and central SSA and parts of east and southern SSA	People eat the high protein cowpea as a fresh vegetable while maturing and when mature, the dry beans can be stored and are eaten in many forms. The rest of the plant is used for livestock feed. It fixes atmospheric nitrogen, thus is also used as for soil fertility replenishment
Improved fallow agroforestry systems with *Sesbania sesban* and *Tephrosia vogelii*	Used in rotation with maize. Farmers raise seedlings (sesbania) or plant directly (tephrosia). Trees may be planted into maize crop after first weeding. Fallows last 2 or more years	Eastern Province, Zambia Recommendation domain: Moderately populated areas of southern Africa with unimodal rainfall, without severe phosphorus deficiencies	The fallow trees are cut and the leaves incorporated into the soil, providing nutrients to the soil, suppressing weeds, and improving soil structure
Calliandra calothyrsus, a fodder tree	Calliandra is a fast growing, atmospheric nitrogen-fixing tree. Seedlings are planted along contour lines and boundaries at a spacing of 2.5–5 feet, and cut to a height of 3 feet, with cutting intervals of 1–3 months	Embu, central province, Kenya Recommendation domain: For higher grade dairy cows already receiving an adequate basal diet	Leaves are fed to dairy cattle mixed with other fodders as a supplement, alone as a substitute for purchased feed concentrates, or mixed with dairy meal. Calliandra fixes atmospheric nitrogen, thus enhancing soil fertility, and its use on field contours reduces soil erosion

(Table continued on next page)

Table 1 (*continued*)

Technology	Description and management	Workshop location and recommendation domain for technology	Typical farmer use
Live fences	Farmers are planting fences of *Zizyphus mauritiana, Acacia nilotica* and other species around their off-season gardens to replace fences made of scarce wood and crop residues	Konodimini, Cercle de Ségou, central Mali Recommendation domain: Suitable throughout the Sahel and also in southern Africa, where off-season gardens need to be protected from free-ranging livestock	Fences provide protection against free ranging livestock. They also provide valuable byproducts, including fruit, resins, dyes, and firewood
Biomass transfer system with *Tithonia diversifolia* (a shrub)	Green leaves from tithonia is incorporated into the soil at planting of maize, bean, kales, french beans, tomatoes. It is sometimes used in conjunction with DAP, TSP, phosphate rock or compost and is sometimes applied a second time later in the season as a top dressing	Siaya district, western Kenya Recommendation domain: mainly for higher value crops grown on small plots; primarily in humid zones.	Tithonia leaves are incorporated into the soil as a green manure for soil nutrient replenishment. It does not fix atmospheric nitrogen, but is an excellent source of N, P, and K
Improved fallows with the following trees/shrubs: *Tephrosia, Crotalaria*	Practiced mainly as a one-season fallow with maize or maize/beans. Trees are planted into an existing crop stand during the long rainy season after first weeding and tree lies dormant until the crop has matured	Siaya district, western Kenya Recommendation domain: bi-modal rainfall zones with medium to high population density	Trees are allowed to grow during the short rainy season, then cut and the leaves incorporated or laid onto the soil. This provides nutrients to the soil, helps suppress weeds and loosen soils, improving soil structure

(plot, farm, community, watershed, region) and over varying time horizons. One of the challenges in any comprehensive assessment of the impact of agricultural research is thus to figure out how to link analyses of impact at different spatial and temporal scales. Then there is the attribution problem. How can changes in peoples' welfare be attributed to a specific new technology, for example? This is rarely easy or straightforward. Changes in poverty indicators such as income, expenditure, nutrition and health may arise from changes in the external environment that have nothing to do with the new technology. Qualitative (e.g. in-depth case studies) and quantitative techniques (e.g. econometric analysis) can help to distinguish impacts of single interventions, but because they are data intensive, they require clear guidance on promising relationships in order to be accomplished with a reasonable budget. For example, prior knowledge on probable impacts could greatly shape conceptual modelling, impact indicators, analytical methods, and sampling design. Thus one of the goals of the farmer impact workshops was to ascertain how useful the information gained from such an approach would be for an impact assessment strategy.

Below, we summarize the workshop approach taken and the lessons learned. We discuss how the information derived from this approach is important to the selection of key poverty variables, the formulation of objectively verifiable poverty impact indicators, and more broadly to an impact assessment strategy. Finally, we make some suggestions as to how to link information derived from this "bottom-up" approach with broader-scale approaches to impact assessment and technology targeting that make use of geographic information systems (GIS), in order to assess the impact of technology on poverty at different spatial scales.

2. The workshop approach

In all the workshops, farmers with direct experience and neighbours who were familiar with the technology in question were selected to participate. Such a purposeful selection is essential in this early stage of impact assessment where a premium is placed on evaluation of experiences with the intervention (Okike et al., 2000, Franzel et al., 2001). To accommodate varying perspectives, the workshops also sought to include men and women, as well as farmers from different ethnic groups. In most of the workshops, farmers were brought to a central venue such as a training, research or community center. Such venues have the advantage of being able to accommodate a large number of participants. They may also have facilities for providing a meal, and are generally easy to reach. This is not always feasible, however, and some of the workshops were held under a tree in the village. In Zambia, Mali and Kenya, members of several different communities attended the workshops, and researchers provided transport to assist farmers. In Mali, the workshop was preceded by a brief field visit, which was especially useful for farmers visiting from other communities.

After a plenary session for introductions and explanation of workshop objectives and approach, most of the workshops randomly divided the large group (ranging from 28–55 farmers) into smaller working groups with a facilitator and translator assigned to each group. The facilitators were national agricultural research system (NARS) and IARC researchers, technicians, or extension staff who were familiar with the technology, and were briefed about the interview techniques to be used beforehand. Translation of terms for the technology in question and concepts such as "impact" and "benefits" were also discussed by workshop leaders, facilitators and translators in advance of the exercise. The workshop leaders moved around to the different groups to observe discussions, answer any questions, and in some cases to ensure comparability of results across groups. In some locations, it was possible to have women and men together; in others, for cultural reasons this was inappropriate and separate male and female sessions were held.

In several of the workshops, time was allocated at the beginning of the workshop for a farmer presentation about the technology in question in order that all participants would have at least a minimal understanding of the system and technology that was to be the focus of the session. A question and answer session followed that was found to be extremely helpful, regardless of how many times farmers had been exposed to the technology.

In the working groups, facilitators and translators were encouraged to ask open-ended questions to the extent possible, since the main objective was to elicit the farmers' views on impact and not the researchers'. The facilitators were requested to ask participants what benefits and problems they saw from the technology at the plot level (such as less soil erosion or higher yields), farm or household level (such as improved nutrition, more leisure time), and the community or village level (such as communal grazing area increased). Group leaders were also encouraged to elicit information as to different kinds of impact, including the ecological (such as better soil structure), economic (more cash income, for example), and social (such as reduced conflicts). The objective of encouraging wide-ranging discussions rather than the typical interview approach was stressed.

Working groups were asked the following:

(a) To identify types of impacts at the field, farm (household), and village levels.
(b) For each type of impact, to identify ways of measuring them.
(c) For each impact, to identify factors that would tend to increase or lessen the impact.

In some of the workshops, the working groups were also asked:

(d) For each impact, to indicate whether the participants expected it to be large, moderate, or low.
(e) For each impact, to indicate whether they expected it to occur immediately (the same season), in the short-run (over the next few seasons), or in the long-run (after several years).

Questions such as "Does this technology increase soil fertility?" were avoided and instead when farmers mentioned soil improvements, they were asked to explain what was meant and how they measured it.

3. Results from the workshops

In this section we discuss results and implications from the farmer workshops. We begin with an analysis of the workshop as a tool and follow this with thematic sections that address different aspects of impact assessment: (1) how technologies are used and managed by farmers, (2) the effects and impacts of new technologies, (3) conditioning factors affecting impacts, and (4) attribution links between agricultural technology and poverty.

3.1. Lessons on workshop organization

Identification of impacts was most successful when small groups of between five and eight participants were formed. The first advantage of the working group approach was the ability to cover a wide range of issues (i.e. by assigning different issues to each working group). The second advantage was the increased opportunity for participants to contribute to the discussions. Another lesson learned was that it was important to take a sufficient amount of time at the beginning to give the groups very clear instructions as to their objectives and outputs, since in some cases it was difficult to monitor the discussions occurring simultaneously in several groups.

Identifying impact measures posed some problems for farmers who did not have substantial experience with the technology. However, another lesson learned from talking to the farmers was that even without direct experience with improved technologies (such as a particular new crop variety or tree species), useful information can be gained from participants who have been observing the use of the technology from a distance. Many of these "neighbours" were found to have already considered field-level impacts, and to a lesser extent, household impacts of these technologies. Moreover, for those participants who had not yet thought much about impact, there was a realization that it was a good idea for them to start thinking about it, even before adopting the new strategies.

3.2. How technologies are used and managed by farmers

An extremely important benefit of the workshop approach is the opportunity for researchers to learn how farmers are modifying the recommendations they originally received about how to use the technology. Finding out about the management of a technology is part of impact assessment, since most management modifications affect impact. For example, whether a farmer uses *calliandra calothyrsus*, a fodder tree, as a feed supplement or as a substitute for other feeds affects impact. In the former case, revenue from milk production increases. In the latter case, costs are reduced but gross revenue may not be affected. Similarly, certain species and management combinations produce secondary fuelwood benefits while others do not.

The workshops are also useful for farmers because they learn from each other about the different ways that the technology can be used and managed. For example, in Zambia, farmers devoted considerable time to discussing the advantages and disadvantages of intercropping trees for an improved fallow with maize during the first year of fallow establishment. In Embu, Kenya, farmers compared using *calliandra* as a feed supplement for their cows in order to increase milk production, with using it as a substitute for purchased dairy meal (Franzel et al., 1996). In Mali, farmers discussed the benefits of using different tree species, with different growth characteristics and byproducts (such as fruits and fuelwood), for establishing live fences.

3.3. Effects and impacts of new technologies

In all of the workshops, farmers were able to discuss with relative ease the kinds of benefits and problems they had seen or expected from the technologies (examples from each workshop are given in Table 2). But whereas farmers effectively stated the impacts they perceived, they were not necessarily adept at coming up with impact indicators that could accurately and objectively measure the impacts. For example, the benefits of several of the technologies regarding soil fertility were discussed, but farmers' perceptions in Zambia and Nigeria of more fertile soil being darker in colour is not a measurable indicator.

Perhaps the most critical lesson derived from the workshops was the value from fully understanding the process by which the impacts are felt. For example, the main plot level impact of improved fallows in Zambia and western Kenya is improved yields of the major food crop, maize. In western Kenya, farmers noted that the impact on maize was to increase the number of cobs per plant from one to two, an easy indicator to monitor. At the same time, researchers learned in the Zambia workshop that it might not be possible to scale up an increased yield indicator from the plot level to the household level (i.e. to assume that an increase in the yield of maize will lead to more maize available to the household). This is because, with higher maize yields, some farmers reported that they are substituting part of their land into other cash crops, and are producing the same amount of maize on less land.

Researchers usually felt they could identify most of the plot-level impacts of their new technologies before the workshops, primarily because they are usually directly or indirectly visible. But even at this level there were some surprises and lessons to be learned. For example, in western Kenya, researchers had not anticipated a plot level impact related to moles, burrowing unseen underground and reducing the positive impact of the technology. Unanticipated impacts were also uncovered at the community level. For example, in Mali, researchers knew that live fences would result in cost savings, particularly with respect to labour, and had a good understanding about the environmental benefits as well. What the researchers did not anticipate, however, was that the farmers like the fences because they lead to a reduction in conflicts within the community, especially between livestock owners and farmers with gardens. Again, it is difficult to derive a quantitative indicator for this impact, but it is an important impact to understand nonetheless.

Table 2
Summary of some household and community level farmer-perceived impacts learned using the workshop approach

Farm/household level impacts	Village/community level impacts
1. Improved Fallows — Zambia	
More firewood and produced locally (time and distance spent fetching reduced)	Grazing area reduced. Others thought that grazing area would increase
More sesbania poles available for construction of storage bins and other structures	Community spirit of working together enhanced (more group nurseries)
More cash available (earnings from maize and savings from buying fertilizer)	Greater need for community regulation of grazing and fires
Improved standard of living	More production, food supply, food security
Improved nutrition	More rain (one said in forest areas)
Stover available for supplementary feed	More stover available for livestock
Increased harvest, increased food supply	Medicine produced from fallow trees (e.g. tephrosia)
More area devoted to cash crops	Saving of natural trees and trees in forest
Poles used for fencing (number of people with fences from sesbania poles)	More wildlife from saving of natural woodlands
More time available to do other things because of reduced firewood collection, e.g. growing dimba vegetables, looking after families, cooking. Others thought improved fallows required more time	More mushrooms collected in forest
Pesticide from tephrosia used to protect harvested crops	
2. Biomass transfer/improved fallows in western Kenya	
Improvement of cash flow due to higher sales of crops and seeds	Increased interest in other types of agroforestry systems
Less cash needed to spend on food, fertilizers and firewood	Greater sense of unity and togetherness; communication among households increased
More food security	Theft reduced when everyone is able to harvest food
Children less likely to miss school	More short-term employment opportunities
Men taking greater interest in farm, leading to less domestic violence	
Better health and nutrition for children	Greater networking between organizations and different villages; contribution to adoption of agroforestry practices in other village
Saves labour, soils are easier to work	Greater farmer confidence with improved understanding, leading to more contacts with extension, NGOs, etc. for assistance

(Table continued on next page)

Table 2 (*continued*)

Farm/household level impacts	Village/community level impacts
	More time by everyone spent on farms, creating hardships for mother and female-headed households
3. Improved dual-purpose cowpea in northern Nigeria	
Cash from sale of beans and fodder (or savings from not having to purchase fodder)	Cash from sale of cowpea may be used to improve village infrastructure
Fewer medical expenses (e.g. children healthier from eating high protein cowpea)	More cash available to have social functions that boost community morale
Higher yields of cereal crops following cowpea; opportunity to plant a second crop during the same season	Cash from cowpea used to register a co-operative and group members can jointly purchase inputs, get credit, etc.
Cash from sale of animals fed cowpea fodder	More stover available for livestock
Savings from not having to purchase fertilizer and insectides for cereal crop sown in rotation with cowpea	More employment and income opportunities for labourers, particularly women for harvesting, threshing, making and selling snack foods

At the household level, most researchers had a few ideas a priori as to what kinds of impacts would be perceived as important by participants, but in general, were fairly ignorant going in to the workshops. For example, in the case of improved dual-purpose cowpea in northern Nigeria, on exploring the relative importance of grain for food versus stover for animal feed, a surprising finding was that virtually none of the participants were selling fodder (it was so much in demand as a source of high-quality feed for their own small ruminants). Thus, in this particular area, the level or percentage of income from fodder sales is currently not an important poverty indicator (but percentage of income from small ruminant sales may be). However, percentage of income from fodder sales may become an increasingly important indicator in the future, as these households produce more cowpea fodder and are able to sell it more regularly (as they indicated a desire to be able to do; Kristjanson et al., 1999).

Interesting household-level impacts of improved fallows in western Kenya included a reduction in domestic disputes as men were taking more interest in, and getting more satisfaction from, farming activities. On the other hand, participants noted that in cases where women were trying new practices on "their" plots and their husbands were not, it led to more domestic disputes. In Mali, women claimed that live fences reduce disputes with their husbands because they permit women to cultivate off-season gardens; when women are employed outside the home they will quarrel less with their spouses! Men in Mali appreciate live fences because, by expanding dry season vegetable gardening, they permit men to be employed in their villages, instead of having to migrate to cities or to neighbouring countries during the off-season to look for work.

In Zambia, farmers disagreed over what the indirect effects on labour requirements would be if improved fallows became common. Some felt more labour would be required because livestock would have to be closely controlled, whereas others thought that less labour would be required because they would not have to travel as far to get firewood.

In thinking about how to turn some of the impacts mentioned by participants into measurable impact indicators, it became evident that many would be costly and impractical. For example, "children are more active" or "our skin is much better" may be difficult to measure quantitatively, yet they may be good information for follow-up survey questions in ex post impact assessments for qualitative measures. With respect to measuring environmental impact, more work with biophysical scientists such as ecologists or soil scientists is needed to turn subjective measures of improved soil fertility such as "more fertile soils are darker" into objectively verifiable indicators. In fact, a general lesson from all the workshops was that little progress was made towards objective 3 (development of specific indicators and a monitoring strategy) and while the impact workshops contributed to this objective, more work is required with other stakeholders to accomplish that objective. In Zambia, for example, a follow-up impact workshop was held for policy makers, and a lesson from that was that it perhaps provided a better forum for insight into monitoring of impact across villages/sites than did the farmer workshops.

Community-level impacts were the least likely to be anticipated by researchers. Those identified in the workshops included a greater sense of community, such as better communication among villagers, more knowledge and resource-sharing among villages, and more incentives to improve management practices. These benefits would be difficult to measure empirically, but were described in all of the workshops. Others noted changes in the village landscape that would be fairly straightforward to measure, such as more or less grazing land available in the case of improved fallows in Zambia or more stover available for livestock with the adoption of dual purpose cowpea.

Environmental benefits were also frequently cited at the community or watershed level. In Zambia, farmers noted that wood produced in improved fallows would substitute for wood from forests and would thus help conserve them. Similarly, farmers appreciated live fences in Mali because they would help conserve forests by reducing the amount of wood used in constructing and maintaining fences. Farmers were interested in conserving forests for several reasons: to maintain or increase rainfall, to reduce desertification, and to collect products from the forest such as mushrooms.

3.4. Conditioning factors affecting impacts

When the groups were asked to identify factors that would tend to increase or lessen the impact of the technology in question, interesting lessons regarding some of the factors affecting adoption and impact were learned. In all workshops, farmers were asked about adoption rates between men and women and between the wealthy and poor. Surprisingly, farmers in Zambia agreed that neither gender nor wealth was an important factor in adoption of improved fallows. As a result, researchers incorporated variables into a formal survey to test this perception by farmers. Analysis of survey data later confirmed this finding (Franzel et al., 2001).

The kind of information farmers are receiving about technologies plays an important role in determining if and how they are adopted, and as noted above, this in turn influences what kind of an impact they will have. The lesson that came up repeatedly in all workshops is that farmers are eager to receive more information and to visit others who are trying out new technologies.

In the case of improved dual-purpose cowpea in northern Nigeria, difficulties arose in separating out impacts specific to the on-farm research trial that gave farmers experience with the new variety from those associated with the technology itself. For example, a community-level impact expressed as stimulation of cooperative behaviour between farmers could have been a result of more income derived from cowpea, or a result of activities (such as visits from researchers) arising due to the trial.

In western Kenya, one workshop finding was that female-headed households generally had higher labour constraints and smaller plots, so they tended to benefit less from the relatively labour-intensive biomass transfer system than male-headed households. In Nigeria, men plant the cowpea, while women "own" the small ruminants the cowpea fodder is fed to. The women saw benefits from the increase in employment opportunities arising from cowpea, such as making and selling snack foods, or harvesting and threshing activities, whereas the men were more interested in the plot-level impacts.

3.5. Attribution links between agricultural technology and poverty

Comprehensive impact assessment requires looking at "poverty" in its widest sense, such that it is applicable to individuals or households, communities, countries and regions. Moreover, we need to look at poverty as a concept that covers the general quality of life and environment as well as strict economic poverty (lack of money and resources). When poverty is interpreted in its widest sense, the ability to attribute a particular technology directly to an improvement in poverty status becomes extremely difficult, and this attribution cannot be made from this initial impact assessment activity.

Since poverty alleviation is a process, however, impact assessment workshops can help identify the different pathways households employ to escape poverty and confirm whether researchers' interventions are on the right track. Workshop discussions can also be directed to illustrate the links between the intervention, plot-level impacts, household-level impacts, and community-level impacts. All of this information is valuable for designing quantitative impact assessment studies in terms of including appropriate variables and constructing models capable of demonstrating attribution links.

In most of the workshops, an approach taken towards eliciting possible poverty indicators for monitoring was to ask participants to describe what they would do with extra income derived from the new technology. In northern Nigeria, the women said they would buy higher quality cotton cloth, cement bricks, tin roofs, and more small ruminants from the extra income earned from sales of cowpea, cowpea fodder, or small ruminants. Since small ruminants are typically sold on an emergency needs basis, monitoring both the number of small ruminants owned by a household and the frequency of sales may be good poverty indicators, as more regular sales will indicate an increase in the wealth and security of the household. It also became apparent that timing of sales of grain could be used as an indicator of economic status or household wellbeing, since the poorest households often are forced to sell cowpea immediately upon harvest, while the wealthier households delay sales until prices are more favorable. Farmers in the other sites were also able to identify uses of extra cash and in some cases were able to demonstrate the sequencing of these impacts — for example, increased expenditures on education may be visible quickly while improved transportation assets may accrue more slowly.

Farmers in the workshops mentioned aspects of poverty other than cash income. In Nigeria participants mentioned that researchers would know that the households are better off "just by looking at them". Upon further probing, participants mentioned the following indicators: women and children would have better skin, be fatter, appear happier, and be better dressed. These indicators point towards improved nutritional and health security, two key components of improved wellbeing. Similarly, increased food security was mentioned by farmers in western Kenya as an important impact at the household and community levels. This included reduced theft due to better harvests.

For donors concerned with capturing impact of technologies on women in particular, these workshops were useful in several ways. In some cases, women raised different issues than the men during the discussions, leading to the development of alternative impact indicators. For example, in Zambia, the improved fallow system resulted in more firewood produced locally (thus decreasing the time and effort spent fetching). The women reported that this gave them more time to do other things such as growing vegetables, looking after their families, and cooking. Thus reduction in time spent on firewood collection or acreage sown to vegetable crops are possible indicators of improved welfare for women but possibly not for men.

4. Linking the results with broader-scale impact assessment approaches

Farmer-participatory impact assessments are only one component in a comprehensive assessment of research impacts. While impacts at plot, farm/household and (to a lesser extent) village/community levels can be evaluated using this approach, it does not establish qualitatively or quantitatively the relationship between the adoption of a certain technology and the particular impact (such as household income) in question. This requires more in-depth case studies (qualitative) or rigorous data collection and econometric analysis (quantitative). Furthermore, measuring impact at the country, region, national or continental scale generally requires the use of more highly aggregated approaches and, increasingly, the use of GIS. The household econometric approach and other broader-scale approaches are essentially complementary. To be effective, a broad-scale approach has to be done via linkages between the household level (approaches based on participatory rapid appraisals and more formal household models) and the broader scale, attempting to identify variables that are relatively easy to measure that can be used as proxies for poverty indicators. The calibration and validation of these methods can really only be done by case studies on the ground — hence the linkages required between the various levels.

4.1. Empirical examples

Two recent adoption studies followed upon the workshops in Nigeria (Kristjanson et al., 2001a) and in western Kenya (Place et al., 2001). The results of the Nigeria farmer impact workshops, held in two different areas, led to the hypothesis that important drivers of change and adoption of new cowpea varieties (and therefore impact) are market access and population pressure. This hypothesis was explored and verified in a follow-up household-level adoption and impact study that used the information from the impact workshops to make decisions as to how to stratify the large sample of households surveyed (Kristjanson et al., 2001b). This information was also used to define recommendation domains for the areas of West Africa where the new cowpea varieties are appropriate. These broad areas have been split up into smaller recommendation domains based on human population density and market access, and the impact workshops and other survey work are being used directly to develop measures of impacts and adoption levels that can be 'scaled up' to areas across West Africa with similar biophysical and socioeconomic conditions to those found in the areas where researchers have been working closely with farmers. All this information is being pulled together in an economic surplus framework to provide information for decision makers on the likely adoption levels and impacts of dual-purpose cowpea in the region over the next 20 years or so (Kristjanson et al., 2001a; Okike et al., 2000).

In the western Kenya village workshop, farmers noted that female headed households, which account for as much as 30% of all households, generally face greater difficulties in technology adoption due to information discrimination and lack of resources, particularly labour. The adoption study aimed to verify this through an analysis of use of alternative soil fertility options of over 1000 households. It was found that the impact of gender, labour, and land varied according to type of technology. For instance, the use of improved fallows was highly dependent upon having adequate farmsize, but not upon labour resources or gender of household head. A further step would then be to measure whether the impact of fallows on adopting households may differ between male and female headed households.

4.2. Incorporating spatial data

Detailed household surveys and econometric analysis can provide large amounts of information concerning impacts on household wellbeing and even address the attribution issue, but the effort and resources required to collect and analyze such data are substantial (e.g. Nicholson et al., 1999). In addition, without clear elicitation of the various linkages in the impact pathway (information the impact assessment workshops can provide), it is very difficult to draw general lessons from such studies and extrapolate the results to other regions. It is largely for these reasons that interest in the area of poverty indicators at the broad scale (also known as poverty mapping) is now burgeoning. This area may well be one of the major thrusts of the Consortium for Spatial Information of the CGIAR (Consultative Group for International Agricultural Research), an initiative aimed at co-ordinating the collation, collection and dissemination of spatial databases in the international agricultural research centres.

The emphasis on developing databases that will support the incorporation of spatial data (both biophysical and socio-economic) in economic analyses is well placed. Two important challenges for international agricultural research are to understand how to ensure that agricultural interventions have the greatest impact on the poor, and how to target interventions for impact in the future. A first step in attempting to meet these challenges is to find out where the poor are now, where they will be in the future, and how rapidly populations will change over the next few decades. For greatest use, such data have to be global in extent so that the relative impacts of different interventions in different regions of the world can be assessed. On the other hand, they must also be at a fine-enough resolution so that interventions can be targeted at the sub-national level.

Fine-resolution datasets for current human populations for Africa, Asia and Latin America now exist (Deichmann, 1996). However, efforts to target interventions are strongly limited because good global spatial datasets on socio-economic and demographic variables are either lacking or of uneven spatial coverage (human population growth and human development indicators only at the national level, for example). Much finer-resolution information is needed if we are to efficiently target research at the level of the agro-ecosystem or the ecoregion. ILRI researchers have made an initial attempt to use existing fine-resolution maps of human populations to create the first fine-resolution scenarios of human population growth for Africa (Reid et al., 2000). The same approach is being applied to Latin America and Asia.

Good datasets for certain regions on several poverty-related variables do exist (for West Africa, e.g. UNEP, 1997). Such datasets may contain human development indices such as the distribution and density of people below some "poverty line" defined in terms of real GDP per capita, the distribution of malnourished people, and educational attainment measured by surrogates such as adult female literacy rates and the proportion of children attending primary school. Also included may be other variables that may be suitable as proxies for measures of human wellbeing, such as human population density, agroclimatic variables, and accessibility indices based on infrastructure and market location data (Henninger, 1998).

The human development indices present substantial problems in terms of finding easily-observable proxies, but here again, farm-level methods can help to identify those that might be used (dwellings with tin roofs, for example). The situation is different for the biophysical variables; many of these can be remotely sensed (thus limiting the costs of data collection), and there are good prospects of identifying suitable proxies that will allow a first cut at poverty maps at a broad scale, particularly if these can then be tied to data sets of farming system types to provide the analyst with well-defined recommendation or impact domains. Farming system characterization using remotely-sensed data is a research area with important implications for impact assessment if successful. An example is the study of Wint and Rogers (1998) for FAO concerning farming systems in Kenya (Kruska et al., 2000).

4.3. Linking survey and census data

Another method to map poverty variables is based on small area estimation procedures, where household survey data are linked to census data at the country level. What is required is census and household survey information (e.g. the World Bank's Welfare Monitoring Survey that is carried out in many developing countries) conducted roughly during the same time period. The econometric techniques allowing an extrapolation of poverty measures to the fifth or sixth level administrative level of a country (encompassing roughly several thousand households, whereas the poverty surveys only allow reporting at the second or third administrative level, encompassing tens or hundreds of thousands of households) are now well developed and have been applied by researchers in Ecuador, South Africa and Vietnam (Hentschel et al., 1998; Statistics South Africa, 2000; Minot, 2000). The outputs of this methodology include poverty and inequality figures at highly disaggregated geographical levels that can be used to evaluate the impact of projects on desired outcomes. Other empirical research such as the relationships between community level poverty and individual health outcomes, income inequality and crime, or land-use patterns and poverty are also made possible by the resulting fine resolution poverty and inequality data and maps. The drawbacks of this approach are that it is based on consumption-based welfare indicators, and the quality of the underlying survey may vary from country to country. Between and within countries, the consumption measure and the corresponding poverty lines vary considerably and can be based on different definitions for the basic items contained in a minimum 'food basket' and different proportions assigned to food and non-food expenditures.

There is a clear need to thoroughly validate these methods as they are developed and to provide robust examples of analyses using these data targeted at specific agricultural interventions. Validation requires a focus on specific areas where appropriate survey or participatory rapid appraisal data exist, or where researchers have been working closely with farmers as is the case with the farmer impact workshops. Without this 'ground-truthing', extrapolation of impacts on poverty to broader areas cannot be done with any confidence.

5. Conclusions

From a methodological point of view, showing impact on poverty is complicated because one often needs to work at different scales (individual, household, community and regional), and the processes involved in alleviating poverty are complex. Launching into a formal quantitative study of the impact of agricultural technology on poverty, at any scale, without first narrowing down the scope of the study to key impacts, is likely to result in a large waste of resources. Preliminary informal data collection via workshops such as those described above can help to establish the priority areas for impact assessment. Benefits from such workshops include allowing researchers to identify:

1. How technologies are used and managed by farmers.
2. The effects and impacts of new technologies at the various levels (plot, farm, community, watershed, region).
3. The conditioning factors affecting impacts.
4. The attribution linkages between agricultural technology and poverty.

The workshops provide information on what types of technologies or adaptations seem to be performing well under certain situations (e.g. community, household, plot factors). It also tells us who is being left out (e.g. communities, households, women). Incorporating a GIS component can then pick up on these factors and define extrapolation domains for more rigorous testing, perhaps through pilot development projects. For example, if markets for products are mentioned as critical, this could be more rigorously tested by offering the technology to communities with different market access. GIS data would be important in establishing proper sites for this. GIS can also help to test for relationships between factors associated with poverty. Are the poor in areas farther from livestock markets or forests? In areas with poorer soils? In areas with more male out-migration and female headed households? These are some of the possible relationships that have emerged from the impact workshops at a within-village scale. Do they hold at higher scales?

There is a need to integrate different approaches at various scales to provide the information that is really needed concerning assessment of impact on poverty. No one method is sufficient. Some pieces of the puzzle are well developed, but others, methodologically, are not — poverty mapping at a broad scale is a case in point. Clearly, there is a need to balance the cost and time involved in doing these assessments versus their utility and usefulness. While the underlying databases required for these comprehensive impact assessments are costly to collate and assemble, many people need them and they have many uses.

From an empirical point of view, several lessons can be drawn from the workshops. First, new technologies produce various impacts that are not at all consistent across households. Second, impacts from new technologies are often not visible, particularly at the household and community levels, and even at the plot level at relatively early stages of adoption. Third, women often perceive different impacts than do men, and at different levels. Finally, with more work, some of the qualitative impact indicators (“more stover available”) suggested in the farmer impact workshops can be made into quantitative, verifiable measures, but many of them would be too costly or impractical (“greater community spirit”). For the latter category, however, it may still be useful information in the sense that it can be followed up in future ex post impact assessments.

There is a need for continued methodology development aimed at linking more participatory, field-level research with broader-scale approaches that integrate spatial variables and analysis or that link surveys at different spatial scales (e.g. poverty mapping using small area estimation procedures). Outputs from such research efforts have potentially high payoffs in terms of improving research and project planning and technology and policy targeting.

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