Globalizing Integrated Pest Management

A Participatory Research Process

Edited by George W. Norton, E. A. Heinrichs,
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Blackwell Publishing

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Blackwell Publishing Professional
2121 State Avenue, Ames, Iowa 50014, USA

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9600 Garsington Road, Oxford OX4 2DQ, UK
Tel.: +44 (0)1865 776868

Blackwell Publishing Asia
550 Swanston Street, Carlton, Victoria 3053, Australia
Tel.: +61 (0)3 8359 1011

This book was produced from camera-ready copy supplied by the authors.

First edition, 2005

ISBN-10: 0-8138-0490-6
ISBN-13: 978-0-8138-0490-3

Library of Congress Cataloging-in-Publication Data available on request

The last digit is the print number: 9 8 7 6 5 4 3 2 1

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Evaluating Socio-Economic Impacts of IPM

George W. Norton, Keith Moore, David Quishpe, Victor Barrera, Thomas Debass, Sibusiso Moyo, and Daniel B. Taylor

Introduction

Economic, social, and environmental impacts of IPM are felt by producers, by household members, and by society at large. IPM programs can influence pest control costs, the level and variability of production and income, and the health of pesticide applicators. They can affect food safety, water quality, and the long-run sustainability of agricultural systems. These effects may be felt unevenly by region, farm size, income level, gender, and consumers versus producers.

IPM programs *can* have these effects, but the question remains: what effects *have* specific IPM programs had or what effects *will* they have on one or more of the various factors and groups mentioned above? Answers to these questions are important to producers, to those involved in recommending IPM strategies, and to those who fund IPM research and extension programs. Practical assessment methods are needed to provide credible answers without absorbing an inordinate share of an IPM budget.

A variety of IPM evaluation methods have been applied, and the methods and issues addressed have broadened considerably from the initial field and farm-level budgeting of IPM alternatives. Recent studies have considered risk effects, pest-practice dynamics, and aggregate impacts of IPM programs across regions, gender, and other social dimensions. Health and environmental effects have also been considered, as discussed in Chapter 13. The purpose of this chapter is to briefly describe some basic methods for evaluating economic and social impacts and to suggest what may be a workable evaluation protocol for a participatory IPM program. It describes methods, presents a protocol, and then provides examples based on analyses completed on the IPM and Peanut CRSPs.

Overview of Evaluation Methods[1]

IPM programs are implemented to meet multiple objectives. User objectives include improved profitability, reduced production and income risk, and improved health and safety of workers, among others. Societal objectives often relate to environmental and health concerns associated with pesticide use (see Chapter 13), meeting export standards (see Chapter 11), raising incomes, keeping food prices low, and helping disadvantaged farmers. Because of multiple economic and social objectives and the user/household versus societal level distinction, more than one evaluation technique is usually required. It can be helpful to divide the IPM impact-evaluation problem into three basic components: (1) assessing IPM adoption, (2) identifying economic and social impacts, and (3) assessing health and environmental effects. This chapter focuses on the first two components, with the third one left to the next chapter. The adoption component can be divided into: (a) defining an IPM adoption measure and (b) assessing the degree of adoption. The economic and social/gender evaluation can be split into: (a) assessing user/household-level economic effects and (b) assessing aggregate, market, or societal level effects. The section below summarizes the most common methods used to accomplish these components.

Assessing Adoption

IPM programs may involve several individual practices or strategies, but measuring the impacts of an IPM program can require an aggregate assessment of the program. Therefore, defining what is meant by IPM and determining its degree of adoption are frequently the first steps in an evaluation.

Defining an IPM adoption measure

A commonly understood commodity- and location- specific definition of IPM is needed before the level of adoption can be measured for a specific program. The breadth and complexity of an IPM program often complicates the task of defining what is being measured. PIPM involves local stakeholders in identifying the goals of the IPM program, and can use those stakeholders to define levels of adoption. Levels need defining because producers may selectively adopt IPM practices; therefore IPM adoption can be a matter of degree. In most cases, IPM is defined in terms of the use of

[1] This section draws heavily on the discussion in Norton et al. (2001).

various production practices, although it could be defined in terms of specific outcomes, such as improving some measure of environmental risk. Defining in terms of practices is helpful because the purpose of the evaluation is often to assess the impacts of technologies or practices developed by an IPM program.

Because the desired impacts are usually in terms of improving production, income, or the environment, practices considered to be part of an IPM program should influence those factors. And clearly the practices should be somehow related to the program being evaluated. For example, crop rotation is often cited as an IPM practice, but may or may not be the product of an IPM research program.

Once practices are identified, grouping them to signify levels of IPM adoption (such as low, medium, and high), or relating them to an adoption scale by assigning points to particular practices are common ways to measure the degree of adoption. For example, Rajotte et al. (1987), Napit et al. (1988), Vandeman et al. (1994), and Williams (2000) develop crop-specific definitions of IPM levels based on sets of practices, while Hollingsworth et al. (1992), Petzoldt et al. (1998), and Beddow (2000) developed IPM point systems in the United States. Stakeholders can vary the points they assign depending on their weights on economic versus environmental goals.

There are drawbacks to each approach. Point-system scales can be costly to establish because every technique must be identified and subjectively weighted according to its impact. Whenever a new practice is developed, points for all practices need to be reconsidered. For use in quantitative economic assessments, levels are required, and thus the scale would eventually need to be divided into levels.

If adoption is based on levels representing groups of practices, rather than as a binary indicator or continuous scale, someone must decide how each level is defined. Ideally, levels of adoption would be based on how well the groups of practices met the goals of the IPM program. For example, high adoption would meet nearly all goals of the program, while low adopters would meet few. Such groupings are necessarily somewhat arbitrary.

Representatives of the stakeholder groups can be asked in a participatory process to identify existing strategies or practices available to manage the pest problem(s) within the program boundaries. Once the strategies or practices are identified, they can be grouped into levels or scored on a scale. The more data that can be supplied by experts on the effects of these practices on production or pesticide use, the easier it will be to group or score them. Even with accurate data, the grouping or scoring may vary with the implicit weights attached by stakeholders to income versus other goals.

Assessing the degree of IPM adoption

After creating a measure of adoption, the extent of adoption can be assessed using producer surveys, expert opinion, or secondary data analysis. The method used will depend on the accuracy required, the availability of secondary data, resources available, and whether the study is evaluating IPM practices already adopted or projecting future adoption. Measuring the extent of adoption assumes that one is interested in the aggregate effects of the IPM program. If the interest is only in the relative profitability of IPM practices for making producer-level recommendations, it may be possible to skip the adoption analysis.

The preferred technique for obtaining adoption data on IPM practices already released is to survey potential adopters. Interviews can be conducted in households or in meetings, although, with the latter, subsequent analysis must account for the fact that people self select to attend meetings, which may affect the results. Surveys are relatively expensive and time consuming. In a few cases one may be fortunate to have secondary data that list the adoption of particular IPM practices, but such data are rare. More often, even if there are some secondary data, total or even partial adoption may not have occurred yet. Therefore it becomes necessary to project future adoption. Extension agents or other industry experts may provide reasonable estimates of IPM adoption in the program served, although reliability may vary. Suggestions for predicting future adoption of a technology are found in Alston et al. (1995).

Assessing the determinants of IPM adoption

Even if people adopt IPM practices, it is still necessary to ascertain if a particular IPM program was responsible. The issue of attribution is critical to program evaluation, especially for extension programs. In scientific experiments, a control treatment is designated to determine how much change would take place in the absence of the experimental treatment. Where people are concerned, especially for educational programs, it is often inappropriate or unethical to exclude a control group from the program. Unfortunately, many IPM programs also fail to gather baseline information on the extent to which current practices at the outset of the program already include IPM. In this instance, the only practical way to untangle the effects of natural information diffusion from the added effect of an IPM extension or on-farm research program is to collect survey data and analyze it with regression techniques that allow separation of program effects from other factors that might favor IPM adoption.

A typical regression model to assess the importance of an outreach program would employ a dependent variable representing IPM adoption. This variable could be binary for a single level of IPM, categorical for multiple levels of IPM, or continuous for an index of IPM practices adopted. Explanatory variables would include those factors that would normally be expected to affect technology adoption, such as input and product prices, farmer characteristics, major farm resources, and the physical and institutional setting. Finally, the explanatory variables would include one or more measures of exposure to the IPM program. The significance of the IPM program exposure variable(s) would determine whether observed changes in IPM adoption were attributable to the program or not.

Evaluating Economic Effects

Economic impacts of IPM can be assessed at both the user and societal levels. User effects primarily include changes in costs or profitability, but can include changes in income risk. Societal impacts include changes in the economic welfare of producers and consumers resulting from market-level changes in prices and supply.

User-level Economic Effects

At the user level, IPM adoption implies changes in practices used by producers, with certain practices used more and others less. The result is changes in costs and returns. For example, use of pesticides might decrease while pest monitoring might increase. Decreased use of pesticides would reduce the costs of pesticides, labor, and equipment, while increased monitoring would raise labor costs. Budgets can be used to derive the overall change in net revenue associated with the change in practices. Partial, enterprise, or whole-farm budgets can be constructed. Partial budgets include only benefit and cost items expected to change significantly as a result of the change in practices, while enterprise budgets list all income and expenses (variable and fixed) associated with a particular enterprise. A whole-farm budget includes all enterprises on a farm, and therefore can consider second-order changes in any activity as a result of introducing IPM practices. Partial budgets are the most common and practical type of budget used for assessing IPM impacts. Budgets are constructed for each adoption level (group of practices). A typical partial budget form is presented in Figure 12-1.

By developing a budget for each level of adoption, changes in net revenue can be associated with levels of IPM adoption. Data will be required on inputs, outputs, and their prices. Several options are available for gathering the necessary data. One is to use information on yields and cost of all inputs from on-farm trials conducted by the IPM program. However, the costs and yields for farm-scale IPM adoption may differ from those in the trials. Another option is to conduct a survey of producers in the area targeted by the IPM program using an interview questionnaire. Questions can be included on the same survey used to obtain information on extent of IPM adoption. A sample list of data, to be obtained by farmer recall using such a survey, is provided in Table 12-1.

A third option is to construct enterprise budgets by collecting information on all inputs by operation, preferably by having the farmers collect them in a standard tabular format as they complete each operation, such as land preparation, planting, fertilizing, pest management, cultivating, and harvesting. Data are collected on quantities and prices for inputs such as seeds, fertilizer, pesticides, labor, machinery use, and water and for outputs.

Additions to Net Revenue	Reductions in Net Revenue
Increased Returns:	Decreased Returns:
1. __________ $______	4. __________ $______
2. __________ $______	5. __________ $______
3. __________ $______	6. __________ $______
Total $______ (A)	Total $______ (B)
Decreased Costs:	Increased Costs:
7. __________ $______	10. __________ $______
8. __________ $______	11. __________ $______
9. __________ $______	12. __________ $______
Total $______ (C)	Total $______ (D)
A+C = $______ (E)	B+D = $______ (F)
Change in Net Returns = E - F = $________	

Figure 12-1. Partial Budget Form.

Table 12-1. Example of survey data for economic analysis of IPM.

1. Inputs and outputs	Product yield, and price; percent acreage treated, number of times treated, method of treatment for pesticides, custom spraying, labor for pest management; pest monitoring & prediction information management (pheromone traps, scouting (self or hired), weather models, etc.); beneficial organisms.
2. Extent of IPM adoption	Practices used and percent of acres on which particular practices were used
3. Pest problems and densities	Arthropods, diseases, nematodes, rodents, birds, weeds, elephants.
4. User and farm characteristics	Farm size, acreage of crop, age and education of farmer, gender, years farming, ethnic identification, approximate value of farm products sold, percent of income from farming

Pest population or pressure is measured as well (Figure 12-2). Data are collected on producer and farm characteristics.

A fourth option is to acquire existing enterprise budgets from secondary sources and then to ask scientists or other knowledgeable people to estimate changes in affected categories of the budgets for the various IPM adoption levels. This approach is likely to be the least expensive option.

Testing for significant differences

If any of the first three options are selected, additional statistical analysis is needed to account for statistically significant differences and/or to control systematic differences across farms. Examples of t-tests and F-tests are found in Napit (1986), Norton and Mullen (1994), and Beddow (2000) for calculating differences in mean yields. If field trial data are used, the data will be obtained from experiments in which treatments were randomized, usually in blocks with three or four replications over at least two years. An Analysis of Variance (ANOVA) is conducted with the data to test for significant differences. If the interview-survey or farm-level data collection methods are used, a sample size of at least 30 per sample stratification group is required. For example, if pest management varies by farm

Figure 12-2. Recording field data on plantain experiment.

size group (small, medium, large), then the sample size should be at least 3 X 30 = 90. The cost of interviewing versus farm-level accounting for all costs can differ substantially, and the detailed collection of enterprise data by farm does not necessarily yield more accurate results if outputs and inputs vary significantly from year to year. An interview survey can ask for estimated levels of the most important variables for the past three years to help average out weather-, pest-, or price-induced differences across years. If the interview or farm-level data collection methods are used, regression analysis is the preferred method for testing for significant differences, as it can be used to account for factors affecting yield besides IPM adoption, such as farm size, education, and experience. For example, a yield response equation can be estimated in which dummy variables are included to account for differences in IPM adoption. The t-statistics are calculated for the coefficients on the dummy variables to test for significant differences, while other variables are included in the model to hold constant many of the non-IPM factors affecting yields.

Statistical tests of survey data should account for survey design in order to insure their validity. Many surveys use stratification and/or clustering to enhance the domain of extrapolation of results or to control survey costs. Both approaches have implications for the sample variance of variables collected. Likewise, surveys whose results are intended for future expansion will have probability weights necessary for extrapolation. Probability weights, number of strata, and number of clusters should be factored into survey data analysis to ensure that statistical tests are valid (Deaton, 1997).

Results of budgeting analysis can be used to judge the profitability of practices being developed or recommended to farmers. A second major use of budget information is as an input into a market or societal level assessment of the economic benefits and costs of an IPM program as discussed below. The primary audience in this case may be those responsible for funding the IPM program.

Before turning to market level economic assessments, brief mention should be made of methods for assessing economic risk. Producers who consider adopting IPM strategies may be interested in the degree of risk as well as profitability. Risk may arise from biological, technical, or economic factors. Methods for evaluating risk, such as payoff matrices, and stochastic dominance are summarized in Norton et al. (2001) with examples provided in Reichelderfer, Carlson, and Norton (1984), Greene et al. (1985), Musser et al. (1981), and Moffitt et al. (1983).

Market-level Economic Effects

Market- or societal-level economic impacts are obtained by combining cost, yield, and price changes with adoption estimates, or projections, and with information on responsiveness of supply and demand to price changes. The models used can involve calculation of *economic surplus* changes (as described below). These changes can then be included in a *benefit cost analysis* to account for discounting over time and to facilitate comparisons with other investments.

When widespread adoption of IPM occurs across large areas, changes in crop prices, cropping patterns, producer profits, and societal welfare can occur. These changes arise because costs differ and because supplies may increase, affecting prices for producers and consumers. These changes are illustrated in Figure 12-3. In this figure, S_0 represents the supply curve before adoption of an IPM strategy, and Δ represents the demand curve. The initial price and quantity are P_0 and Q_0. Suppose IPM leads to savings of R in the average and marginal cost of production, reflected in a shift down in the supply curve to S_1. This shift leads to an increase in production and consumption of Q_1 (by $\Delta Q = Q_1 - Q_0$) and the market price falls to P_1 (by $\Delta P = P_0 - P_1$). Consumers are better off because they can consume more

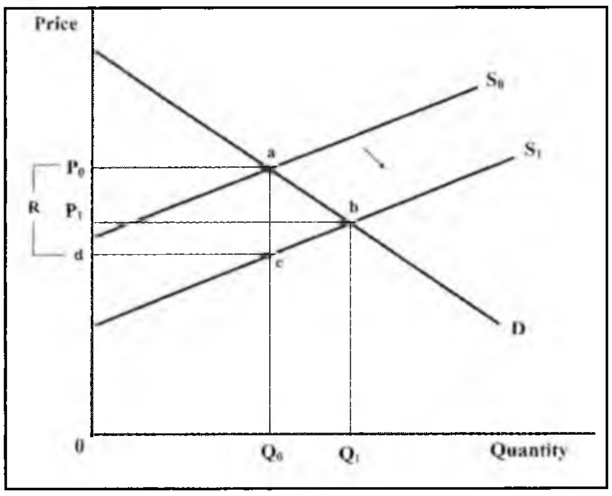

Figure 12-3. IPM benefits measured as changes in economic surplus.

of the commodity at a lower price. Consumers benefit from the lower price by an amount equal to their cost saving on the original quantity (Q_0 x ΔP) plus their net benefits from the increment to consumption. Total consumer benefits are represented by the area P_0abP_1

Although they may receive a lower price per unit, producers are better off too, because their costs have fallen by R per unit, an amount greater than the fall in price. Producers gain the increase in profits on the original quantity (Q_0 x (R- ΔP)) plus the profits earned on the additional output, for a total producer gain of P_1bcd. Total benefits are obtained as the sum of producer and consumer benefits. The distribution of benefits between producers and consumers depends on the size of the fall in price (DP) relative to the fall in costs (R) and on the nature of the supply shift. For example, if a commodity is traded and production in the area producing the commodity has little effect on price, most of the benefits would accrue to producers. If the supply curve shifts in more of a pivotal fashion as opposed to a parallel fashion, as illustrated in Figure 12-3, the benefits to producers would be reduced. Examples of IPM evaluation using this economic surplus approach are found in Napit et al. (1988) and Debass (2001). Formulas for calculating consumer and producer gains for a variety of market situations are found in Alston, Norton, and Pardey (1995). For example, the formula to measure the total economic benefits to producers and consumers in Figure 12-3, which assumes no trade, is $KP_0Q_0(1 + 0.5Zn)$, where: K = the proportionate cost change, P_0 = initial price, Q_0 = initial quantity, Z = Ke/(e +n), e = the supply elasticity, and n = the demand elasticity. Other formulas would be appropriate for other market situations. It is possible to combine economic surplus models with the results from a Geographic Information System (GIS) to assess the spillover of IPM benefits across regions (see Debass, 2001).

The most difficult aspect of an economic surplus analysis is the calculation or prediction of the proportionate shift in supply following IPM adoption. Cost differences as well as adoption rates must be calculated. The producer surveys, information on cost and yield changes in field trials and other methods discussed above can be used to obtain the information required to estimate the supply shifts. Once changes in economic surplus are calculated or projected over time, benefit/cost analysis can be completed in which net present values, internal rates of return, or benefit cost ratios are calculated. The benefits are the change in total economic surplus calculated for each year, and the costs are the public expenditures on the IPM program. The primary purpose of the benefit/cost analysis is to take into account the fact that benefits and costs need to be discounted, because the sooner they occur the more they are worth. The net present value (NPV) of discounted benefits and costs can be calculated as follows:

$$NPV = \sum_{t=1}^{T} \frac{R_t - C_t}{(1 + i)^t}$$

where: R_t = the return in year t = change in economic surplus
C_t = the cost in year t (the IPM program costs)
i = the discount rate

Changes in economic surplus can also be imbedded in mathematical programming models to further project interregional changes in production following the introduction of a widespread IPM program, or to predict the impacts of IPM following policy changes that encourage or discourage IPM use. In instances where IPM adoption is believed to trigger impacts that touch other sectors in the economy, those impacts may be estimated or projected using sector or computable general equilibrium models.

Aggregate or market level economic effects can be distributed in a variety of ways and have other social and economic effects across and within households. Therefore assessment of welfare effects of an IPM program may not end but rather just begin with evaluation of market-level economic impacts.

Evaluating Social Impacts

Social impacts can be measured in many dimensions: economic (including poverty reduction), health, empowerment, attitudinal, among others. Economic and health dimensions are related to the degree to which IPM strategies are available to and suitable for producers with farms in various size classes, in advantaged or disadvantaged regions, and in different income brackets. Therefore, who adopts IPM and how soon is important. Any technology, including IPM, has impacts across different types of households within the farm and non-farm communities, and impacts within the household, including gendered effects. Measuring these effects can involve both quantitative and qualitative methods.

Quantitative Methods

The simplest method for arriving at basic social impacts is to use the same methods described above for measuring aggregate level economic impacts and to subdivide the benefits and costs by region, income level, farm size, urban consumers versus rural producers/consumers, laborers versus farm owners, etc. Fortunately, the economic surplus approach lends itself to such distributions. In some cases it can be helpful to use geo-referenced data to define homogeneous regions in a GIS. IPM adoption and cost differences can be included to shift out supply curves differentially by region, by farm size, and so forth (Binswanger, 1977; Scobie and Posada, 1978).

Regression analysis can also be used to identify who is likely to adopt IPM, differentiated by farm size, household characteristics, etc. It can be used as well to estimate the effects of IPM on household income, health, or other factors, taking into account farm size and household characteristics. Data for this type of analysis can be obtained from farm/household-level surveys. If gender analysis is intended, the surveys can be administered to both male and female respondents separately. The advantage of applying a quantitative statistical approach is the ability it gives the researcher to hold other factors constant when assessing the effects of IPM.

Increasingly, farm/household surveys are being conducted by international organizations such as the World Bank. Hence it may not be necessary for a program to conduct its own survey to assess social impacts. Data from these surveys can be combined with results from economic surplus analyses, and with poverty measures such as those developed by Foster et al. (1984) to assess the impacts of an IPM program on poverty in a specific country.

An example of such an analysis for a groundnut IPM strategy in Uganda is provided in Moyo (2004).

Qualitative Methods

Qualitative methods are particularly useful for obtaining in-depth assessments of IPM impacts at the household level, because they allow respondents to indicate not only what they are doing but why. They facilitate follow-up questions and group discussions. A common qualitative approach used in developed and developing countries alike is the focus group method. Focus groups are assembled to include members from typical households and structured questioning is used to ensure that all participants feel free to speak and to react to the comments of others. Focus groups can be stratified by gender or other personal or social characteristic. Given the time involved in running a focus group discussion, the approach usually cannot be administered in a way that allows sufficient observations for statistical analysis. But the method provides complementary information to that obtained from such analysis. The method also can be used to help structure the categories for the quantitative analysis.

Another common qualitative technique is the participatory appraisal mentioned in earlier chapters. Much of the one-on-one elicitation of information in a PA is very useful for providing in-depth answers and reasons why an IPM program may affect particular family members and groups in society in specific ways. It too can help structure the more quantitative assessments.

Impact Assessment Examples from the IPM CRSP

IPM impact assessments have been undertaken in Ecuador, the Philippines, Bangladesh, Uganda, and Mali, among other countries in recent years. Most have involved economic evaluations, but some have included social and gender assessments. The following brief examples from the Philippines, Ecuador, Bangladesh, and Uganda briefly illustrate the types of impact analyses that can be completed.

Philippines

Philippine farmers near San Jose, Nueva Ecija, apply insecticides to eggplant twice a week to control fruit and shoot borer. The IPM CRSP tested a series of alternative treatments, including spraying once per week, once every two weeks, once every three weeks, no spraying, and removing damaged fruits and tips at different intervals. An example of a partial budget constructed for one of the treatments in comparison to farmers' practice is shown in Table 12-2. Similar budgets were constructed for each combination in order to arrive at the recommended practice (which turned out not to be the one with the highest yield).

Ecuador

The potato IPM program in Ecuador, undertaken by the national agricultural research institute (INIAP) with the assistance of the International Potato Center and the IPM CRSP, has focused on three primary pests: late blight, Andean potato weevil, and Central American tuber moth. An assessment was made of the economic impacts of a specific potato variety with some resistance to late blight, a set of IPM practices to manage Andean weevil, and a set of IPM practices to manage tuber moth (Quishpe, 2001). The variety was released in the early 1990s and the insect IPM programs are currently being implemented; most of the benefits will occur in the future. Therefore the latter two assessments were basically *ex ante*.

Three producing regions were included in the analysis, and consumption was assumed to occur anywhere in the country and, through trade, in other countries. Data were collected on: costs of the research and extension efforts over time; production, consumption, prices, and trade for the past

Table 12-2. Partial budget for applying Brodan on eggplant every three weeks versus twice a week (farmers' practice)

Particular	Value
Added benefits	
Added revenue	P 168,160.00
Reduced cost	
Insecticide use	11,040.00
labor of applicator	8,333.30
Total Added Benefits	187,533.30
Added costs	
Added cost	
insecticide used	1,932.00
labor of applicator	1,458.30
Reduced revenue	130,240.00
Total Added Costs	133,630.30
Net Added Benefits	P 53,903.00

three years; budgeted costs of production in each region with and without the technologies; expert opinion of extension-type personnel on adoption rates; and price responsiveness (elasticities) of supply and demand.

Economic-surplus and benefit-cost analyses were conducted; calculations were performed using the DREAM program available from the International Food Policy Research Institute (IFPRI). Details of the results are available in the thesis by Quishpe and in Barrera et al. (2002), but, briefly, the research and extension on the late-blight resistant (partially resistant) improved variety (Fripapa 99) produced an internal rate of return of 27% and generated an additional $600 per hectare ($1700 versus $1100) compared to the native variety (Superchola), and roughly $50 million in net benefits.

The IPM program for Andean weevil was estimated to save $87 per hectare in the Central region and $42 per hectare in the South. That pest causes less damage in the North, where the Central American tuber moth is a serious problem. The IPM program against the tuber moth in the North was projected to generate net benefits of $62 per hectare.

Bangladesh

The IPM CRSP program began in 1998 in Bangladesh with a focus on vegetables (eggplant, cabbage, gourds, okra, tomatoes) in rice-based systems. Implemented through the Bangladesh Agricultural Research Council (BARC) and housed in the Horticultural Research Center of the Bangladesh Agricultural Research Institute (BARI), several promising technologies have been developed. Among these technologies are soil amendments to control soil-borne diseases in eggplant, grafting to control bacterial wilt in eggplant, improved weeding strategies for cabbage, and germplasm screened for eggplant fruit and shoot borer. An analysis of returns to the soil amendment (eggplant) and weed-management (cabbage) research was conducted as part of an MS thesis (Debass, 2001).

The evaluation commenced by classifying the country into relatively homogeneous growing areas using a GIS. Variables included for the classification included temperature, rainfall, elevation, population density, land tenancy, production of eggplant and cabbage, and administrative districts (Figure 12-1). Data were collected on production, prices, and elasticities by region for each commodity. Estimates were obtained of the likely per unit cost reductions using partial budgets from the IPM CRSP experiments. Probabilities of research success were estimated by the researchers, as the technologies had not yet been released. Expert opinion was also used to project the adoption profiles. The economic surplus models were solved using DREAM and the results simulated over 30 years and discounted at 5%. Net present values of $14–29 million were obtained for the soil amendment experiment and $15–26 million for the weed research spread over the next 30 years. Most of the benefits were spread over 2 of the 4 regions and one region actually lost in net as a result of the research. Such distributional effects are not uncommon, because some areas are better able to adopt the technologies while all areas feel the downward price pressure that can result from the increased production of commodities that are little traded.

Uganda

Peanut production is constrained by the prevalence of several viruses and diseases, the most common being Groundnut Rosette disease, a viral infection first reported in Tanganyika (now Tanzania) as early as 1907. Groundnut Rosette disease continues to be responsible for major losses in peanut production in Africa. Through the auspices of The International Crop Research Institute for Semi-Arid Tropics (ICRISAT), as well as the USAID-funded Peanut CRSP, peanut varieties with resistance to Rosette virus were recently developed and released in Malawi and Uganda, countries with a high incidence of poverty. Benefits of the research that developed the virus-resistant peanut may have significant economic benefits, and may reduce poverty at the margin in these countries. Benefits may result from higher yields, reduced risk, lower production costs per quantity of peanuts produced, lower food prices, and increased marketed surplus, with possible positive effects on household income.

A study was conducted to estimate the overall economic impacts of the research that developed Rosette Virus-resistance peanut in Uganda, focusing on the regions in the two countries where peanuts are most prevalent, and quantifying the effects of research on the livelihoods of the poor (Moyo, 2004). The evaluation methods contained two major steps. The first involved calculating changes in economic surplus that result from adoption of virus-resistant peanut varieties. The second step involved taking those calculated changes and plugging them into Foster-Greer-Thorbecke additive measures of poverty to compute poverty changes. In short, household production, consumption and expenditure data were used to compute poverty indices that permitted poverty decomposition by income group. Realized research benefits from the economic surplus model were then incorporated into the poverty indexes to estimate how households of differing economic profiles moved relative to the poverty line as their incomes were affected by the improved technology.

To enable estimation of the economic surplus changes, interview and other data were gathered in Uganda along with data on production and output prices by region. Yield and cost data under traditional and virus-resistant varieties as well as realized and projected adoption and research costs were collected from breeders at research institutes, extension officers, farmers, and other industry experts. Data for calculation of poverty indexes were obtained from a national household survey that was conducted by the International Food Policy Research Institute (IFPRI). The data sets are extensive, enabling computation of the poverty indexes and providing a picture of other socio economic characteristics of producers.

Adoption of the virus-resistant peanut varieties in Uganda was estimated to result in a 67 percent increase in yield per hectare and a 50 percent increase in per-hectare input costs. Fifteen percent of the households growing peanuts were estimated to have adopted virus-resistant peanuts in the first year an improved variety was released (2002). Adoption is expected to continue to increase in the future until 50 percent of peanut growers adopt.

The net present value of economic benefits for the period from 2001–2015 was projected at $47 million at a 5 percent discount rate. Changes in poverty rates were then calculated under alternative assumptions about adoption by farmers in various income strata. A Probit model was used with the farm-household data to predict adoption by income strata.

The economic surplus results indicated that adoption of Rosette-resistant peanut seed would result in income derived from peanuts increasing from 75 and 81 percent depending on the future rate of adoption. To estimate the impact of this income change on welfare, three poverty measures were computed for peanut-producing households before and after the adoption of the improved seed. These measures showed a reduction of the poverty rates of approximately 1.5 percent for the region, a significant impact for a single technology.

Conclusions

IPM impact assessment is crucial for making meaningful recommendations to farmers, for demonstrating the value of IPM programs, and for assessing who will adopt so that programs can be tailored to audiences to obtain consistency with program goals. These assessments can be quantitative and qualitative and focus on economic, social, and gender goals. The methods available for impact assessment are relatively cost-effective, although the more data-intensive quantitative ones aimed at calculating factors such as reductions in poverty rates, require enough resources that they may only be conducted periodically in specific locations. Others such as partial budgeting should be routinely applied in virtually every IPM program before recommendations are made to farmers.

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