Measuring the poverty impact of ACIAR projects — a broad framework

ACIAR

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MEASURING THE POVERTY IMPACT OF ACIAR PROJECTS—A BROAD FRAMEWORK

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1 Introduction

1.1 This Report

This report sets out some broad ideas about how poverty evaluation could be conducted for ACIAR research projects. As with good benefit–cost analysis, there are good practices that need to be observed when undertaking poverty analysis. While poverty is a broad concept, and can be addressed through many means, these need to be grounded in some common understanding of the economics of poverty.

This report is concerned mostly with quantitative evaluation, in the same sense that current ACIAR project evaluations are quantitative. That is, it is concerned with saying something about the order of magnitude of the effects of the project. Of course, qualitative analysis is important, and in most cases is a prelude to quantification — there is little point quantifying if you don't understand what you are talking about. Quantification, however, provides a discipline and focus for qualitative speculation and provides an important extra dimension when comparing the effects of different projects.

When quantifying, there are many sensible approaches that could be adopted. We will focus here on approaches that are broadly consistent with the current approaches to benefit–cost analysis and that could readily be used to augment those approaches.

The report begins by reviewing some basic notions of poverty (Chapter 2) and then goes on (Chapter 3) to discuss in principle the ways that agricultural research could influence poverty. Chapter 4 explains, with the use of some examples, a range of analytical approaches that could be taken, and Chapter 5 draws some specific implications for ACIAR.

1.2 Poverty Evaluation versus Benefit–Cost Evaluation

Standard benefit–cost project evaluation requires a good understanding of:

- how to measure the technical impact of the project;
- how to assess the impact of the project on the economic agents affected;

- how to value this impact (which includes an understanding of how to deal with externalities, taxes, subsidies and other market distortions);
- how to convert a stream of costs and benefits to comparable single measures (using discount rates and so on);
- the merits and pitfalls of various summary measures, including benefit–cost ratios, internal rates of return, net present values and so on; and
- the merits and pitfalls in using these summary measures to compare projects.

For poverty evaluation there is an analogous list. Measuring the impacts of a project on poverty requires a good understanding of:

- the technical impacts of the project;
- the pathways by which the project will affect the incomes and expenditure of different groups within the affected community;
- the merits and pitfalls of different definitions of poverty;
- the merits and pitfalls of different quantitative measures of poverty within any given definition (when will the headcount ratio be misleading? when should inequality be measured? how should a poverty line be established? and so on);
- how to establish a baseline estimate of poverty, including the use of household surveys and other data-collecting techniques;
- how to measure and simulate the income and expenditure patterns of different groups within the affected community; and
- how to asses economic interactions between different groups in the community.

Clearly, poverty evaluation is very much more complex than standard benefit–cost evaluation, as it requires that something be said about the impact of the projects on different groups. Further, some of the largest poverty effects of a project may be indirect, so more attention must be paid to the interactions between those groups affected.

1.3 Understanding the Assumptions

There are many assumptions implicit in standard benefit–cost analysis. These are generally widely understood and so do not usually get in the way of sensible interpretation of the results. Poverty analysis is a minefield of hidden assumptions, and often these are not clearly understood. The simplest poverty measures, such as the headcount ratio, are loaded with hidden analytical assumptions. In poverty analysis, the analyst must be particularly careful to draw out all the assumptions behind the findings.

Most of the approaches we consider will amount to different ways of determining the impact of the research on the net incomes of different (poor) household groups. Changes in net income will, in one way or another, be used to measure changes in poverty. It is important to be clear, however, that income is not itself an objective, but is an instrument to achieve the various things that households have reason to value. Analysis of income implicitly assumes that poor households will use their additional income to do things they value, but this will not necessarily be the case. In many regions with high poverty, households are not free to choose how they use (or earn) their income. Rather, they face many impediments. For the poverty analysis to be meaningful in the fullest sense, it must be placed in this broader context.

2 Defining, Measuring and Identifying Poverty

2.1 Background

There is an enormous literature on poverty and associated issues. Apart from the academic literature on the subject, most development agencies (in particular the World Bank, the Asian Development Bank and the United Nations Development Program) have their own manuals, approaches and research programs into the various analytical and practical issues involved.

The literature ranges from highly technical and abstract (e.g. Duclos 2002) to empirical and practical (e.g. Deaton 1997).

There are three web sites that are particularly useful:

- the World Bank's PovertyNet (www.worldbank.org/poverty/);
- the World Bank's various research publications on poverty (econ.worldbank.org); and
- the web site of the MIMAP (Micro Impacts of Macroeconomic and Adjustment Policies) network, sponsored by Canada's International Development Research Centre (www.mimap.org).

In terms of books, three of the many works by Amartya Sen (Sen 1981, 1992, 1999) and Angus Deaton's book on household surveys (Deaton 1997) are especially useful.

2.2 Poverty Is Multidimensional

Poverty involves some sort of deprivation, but there is no single view on the nature of that deprivation. There is also no one view as to whether poverty is a relative or an absolute concept. It is generally agreed that there are many dimensions to poverty and that each approach contributes to an understanding of poverty and its causes and potential cures.

There are three broad views of poverty that have emerged from a large literature. Each of these is distinct from, but not independent of the others.

2.2.1 Income Deprivation

The most common understanding of poverty links to a lack of income. The income approach to poverty is the most developed in terms of its analytics and approaches to analysis. Despite that, it has many drawbacks as a measure. In particular, there is no single mapping between income and human welfare, mostly because income is not an end in itself, but a means to other ends. This has led to many proposals for other approaches to poverty.

2.2.2 Inability to Meet Basic Needs

This approach considers that poverty lies in the inability of individuals to achieve a set of basic human needs, particularly nutrition, clothing and shelter, and social and family interaction.

A common manifestation of this approach is in notions of poverty lines or food poverty lines, below which an individual is unable to function

adequately. This closely relates to the income approach, as it is possible to impute the income needed to purchase these basic needs. Those with less than this minimum income are below the poverty line and classified as poor.

The inability to meet basic needs can also be expressed in non-income dimensions, particularly in terms of health and education.

2.2.3 Capability Deprivation

The capability approach to poverty considers the ability of someone to live the life they value. A person's capability set measures the set of things ('functionings') that the individual can achieve. Hence, this view of poverty considers the *ends* of human welfare, rather than the *means*. The end is to live a good life, or to live the kind of life that people have reason to value, such as a long, healthy life with access to education and infrastructure (see Sen 1999).

Income is, of course, one instrument to achieve these ends, but it is not the only one. The capability approach does not exclude income from its consideration, but is in some ways more general, broadening the number of dimensions within which notions of poverty are examined.

An important aspect of the capability approach, particularly as expounded by Sen (1999), is a focus on the substantive freedoms that individuals have to pursue their objectives. Income, health and education are things that add to these freedoms, and it is the attainment of these freedoms that defines human development.

2.3 ACIAR's Criteria

These different dimensions of poverty map directly and indirectly to ACIAR's seven qualitative criteria for assessing specific projects (Table 1).

These criteria, or any broad definitions, are not themselves sufficient to say anything quantitative about how much a project might have reduced poverty. Indeed, the qualitative criteria do not allow one to distinguish between the relative merits of different projects in reducing poverty.

Table 1. ACIAR's qualitative criteria and broad poverty approaches

Criteria	Relation to broad poverty approaches.
Improve incomes of poor producers	Related to income deprivation.
Provide benefits (price reduction) to rural and urban consumers	Related to income deprivation (prices are a component of real incomes).
Provide improved health benefits	Related to basic needs and capability approaches. Indirectly related to income deprivation in that healthier households produce more.
Provide other environmental benefits	Relates to income deprivation to the extent that the environmental benefits enhance future income. Also relates to capability approach.
Lead to the implementation of pro-poor policies	Relates to income approach (if pro-poor policies involve clarifying property rights). Also relates to capability approach if pro-poor policies increase substantive freedoms.
Empower poor people	Relates to income and capability approaches.
Reduce the impact of unforeseen events	Relates most directly to income deprivation.

2.4 Identification and Measurement

How poverty is measured will depend on the definition of poverty used. Nevertheless, there are several common measures that form the basis of much of the discussion on poverty issues.

2.4.1 The Poverty Line

Most poverty measures relate in some way to the idea of a poverty line, a line below which people are considered to be poor, and above which they are not poor. Sometimes the poverty line is expressed as an absolute (the minimum income needed to purchase basic needs, for example) and sometimes it is expressed in relative terms (for example, as the income level at the bottom quartile of the income distribution, which will differ by country or region). Either way, the poverty line envisages a level at which people cease to be poor.

In principle, the poverty line is a crude concept. The idea that people cease to be poor the instant they reach the poverty line and are no longer poor once their income moves a cent above it is a curious one. Human deprivation is not really so clear cut; there is rarely a sharp line separating the poor from the non-poor. Implicitly, poverty measures based around a poverty line no longer measure the fortunes of the 'poor' once they have moved above the line. Thus, if some policy or program makes people just above the line worse off (but doesn't put them below the poverty line), their welfare is not covered by poverty measures based on a poverty line.

In practice, the position of the poverty line is notoriously difficult to determine. It is generally constructed around some notion of basic needs. But what is the objective measure of basic human needs? Nutritionists may declare so many calories and so much fibre etc., but often these minimal requirements bear no relation to what humans would freely choose. The choice of an objective line often hides a value judgment. Deaton (1997) provides several further criticisms of poverty lines.

Despite the problem of conceptual simplicity, the poverty line is nevertheless indispensable to poverty analysis. It is important, however, to be aware of its defects and to treat all measures constructed from it with caution.

The various measures constructed using a poverty line each have strengths and weaknesses, as discussed below.

2.4.2 The Headcount Ratio

The most common poverty measure is the headcount ratio: the fraction of the population below the poverty line. This is the measure most likely to be quoted when someone says something like '30% of the people in country X are living in poverty'.

The headcount ratio is typically defined relative to an income poverty line, but this does not have to be the case. It could be defined relative to some minimal educational attainment, or access to clean water, or some other welfare indicator where it is meaningful to talk about a poverty line.

The headcount ratio is defined as:

$$P_0 = \frac{1}{N}\sum_{i=1}^{N} f\left(x_i \le z\right)$$

where:

P_0 is the poverty headcount ratio
N is the size of the population
x_i is the welfare indicator for individual i (usually income)
z is the poverty line
$f(.)$ is a function that is 1 when the argument is true (i.e. income is less than the poverty line) and 0 otherwise.

This function simply adds up the number of cases where individual income is less than that of the poverty line, and expresses this as a proportion of the total population.

The headcount ratio is a very crude measure of poverty, as it takes no account of the amount by which people fall short of the poverty line. Further, it is completely insensitive to income changes below the poverty line. If those below the poverty line had their income halved, this would have no effect on the headcount ratio. Thus, it is possible for the headcount ratio to indicate an apparent reduction in poverty, when things have become a lot worse for the poor.

2.4.3 Depth of Poverty, or Poverty Gap

The poverty gap is designed to provide an average measure of the amount by which the poor fall below the poverty line. It can be interpreted as a per capita measure of the total shortfall of individual welfare levels below the poverty line.

The poverty gap is defined as:

$$P_1 = \frac{1}{N}\sum_{i=1}^{N}\left(1-\frac{x_i}{z}\right)f\left(x_i \le z\right)$$

where P_1 is the poverty gap and other variables are as previously defined.

With the poverty gap measure, the poorer individual i is, the greater their contribution to the total index. The smaller is x_i relative to z, the larger is $1 - x_i/z$, and so the larger is the contribution that individual i makes to the overall index.

This measure is sensitive to movements in income across the poverty line. For example, it is sensitive to transfers from the poor (those below the poverty line) to the non-poor (those above the poverty line). It is also sensitive to transfers between poor and poor if some of them move above the poverty line as a result.

While an improvement on the headcount index, the poverty gap ratio is insensitive to the number of people suffering a particular gap, and transfers among the poor have no effect on the measure; that is, it is not sensitive to the distribution of income among the poor.

2.4.4 The Sen Index

To remedy some of the problems of the headcount and poverty gap measures, Sen (1981) proposed a measure that combines both the headcount and the poverty gap with a measure of inequality amongst the poor.

The so-called Sen index can be defined as:

$$P_S = P_0 + P_1(1 - G)$$

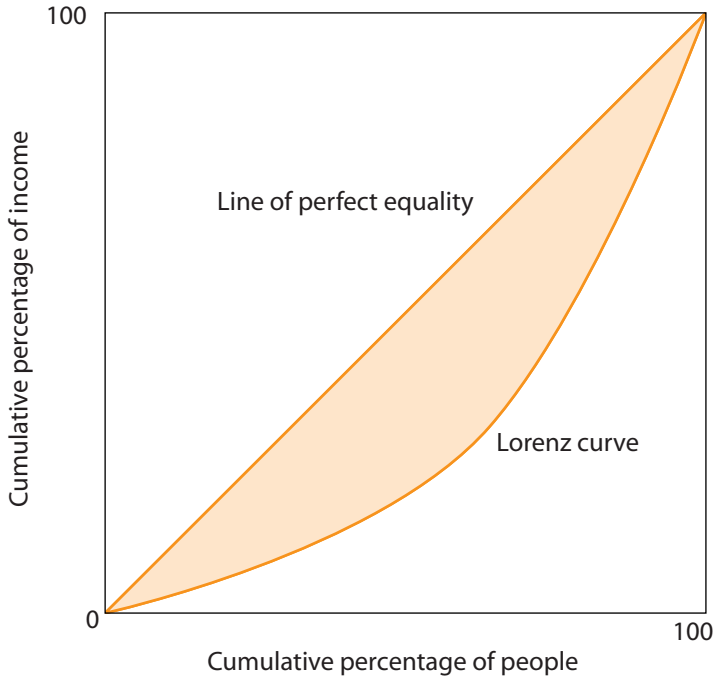
where G is the Gini coefficient of inequality within the poor population (see below).

When there is no inequality within the population of the poor, the Gini coefficient is zero, and the Sen index reduces to the headcount ratio. There are many alternative formulations of this type of index, but they all take some account of inequality within the population of the poor.

2.4.5 An Aside: Measuring Inequality

The most common tool for measuring the inequality of income distribution within a given population is a graphical one known as the Lorenz curve, named after the statistician Max O. Lorenz (1880–1962), who published the idea in 1905. The Lorenz curve (Figure 1) is a plot of the cumulative fraction of the population (starting from the poorest) against the cumulative fraction of income.

Figure 1. The Lorenz curve



If income were equally distributed, then the cumulative fraction of the population would exactly match the cumulative fraction of income, and the Lorenz curve would be a 45° straight line. For most populations, the Lorenz curve diverges from the 45° line of perfect equality, reflecting that the rich have a greater proportion of the income than the poor. The further away the Lorenz curve from the 45° straight line, the greater is the inequality within a population.

The Gini coefficient is a single measure of the amount by which the Lorenz curve deviates from 45°.[1] The Gini coefficient is equal to the area between the Lorenz curve and the 45° line, divided by the total area under the 45° line. With perfect equality, the Gini coefficient is zero.

2.4.6 *Higher-order Measures*

The headcount and poverty gap measures are a subset of a general set of measures that can be expressed as:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{N}\left(1-\frac{x_i}{z}\right)^\alpha f\left(x_i \le z\right)$$

where α is a positive parameter and other variables are as previously defined.

Equivalently, they can also be expressed as:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{N}\left(\max\left[1-\frac{x_i}{z},0\right]\right)^\alpha$$

When α is 0, both of the above equations reduce to the headcount index (using the convention that any number other than zero raised to the power zero is equal to 1, and that 0 raised to the power 0 is 0). When α is 1, the above equations reduce to the poverty gap previously discussed (any number raised to the power 1 is equal to itself). As α increases, the resulting measure takes more account of the differences between incomes of the poor households and the poverty line. As α increases, the resulting measure takes more account of the poverty gaps. When α is 2, the associated measure is similar to the Sen index, in that it is sensitive to income distribution amongst the poor. With this measure, if the distribution of income among the poor worsens without anyone necessarily falling below the poverty line, the index will nevertheless show a worsening of poverty.

[1] The Gini coefficient was developed by the Italian demographer, sociologist and statistician Corrado Gini (1884–1965), one of the pioneers in the study of the measurable characteristics of populations.

2.4.7 *Social Welfare Functions*

Poverty analysis is a subset of a more general welfare analysis in which the value of particular projects or programs is condensed into a single index or measure. The means of getting from the changes in welfare of many groups to a single measure of social welfare is called a social welfare function. Typically, the social welfare function will specify aggregate welfare as a function of the welfare of the individuals or groups making up the population of interest.

Social welfare functions differ from the various poverty indexes in that they do not identify a poverty line that defines the weighting that particular individuals get in the social welfare function. With the various poverty measures discussed above, particular projects will appear valuable only if they move people above the poverty line. Under the more general social welfare functions, projects that increase welfare will also be valued even if they do not necessarily lead to movements around the poverty line.

The differences between social welfare functions and poverty analysis are very important for policy analysis. As Deaton (1997, p. 141) argues:

> a Pareto-improving project is surely socially desirable even when it fails to reduce poverty, and it makes no sense to ignore policies that would improve the lot of those who are poor by many definitions, but whose incomes place them just above some arbitrary poverty line.

Social welfare functions can, of course, be constructed to give high weights to those with initially low incomes, but they do not do so by focusing around a poverty line.

2.4.8 *The Human Development Index*

An alternative, non-income approach to poverty has been devised by the United Nations Development Program (UNDP). The Human Development Index (HDI) and the associated Human Poverty Index (HPI) consider development in terms of particular human capabilities, including education, life expectancy and other measures such as access to clean water.

These indexes are constructed by comparing the actual attainment in a particular country with some estimated maximum attainment. The shortfalls for different measures are then added together (using various weighting schemes) to generate an overall index.

In principle, the indexes could be calculated for subsets of the population or for groups of people specifically affected by a particular project. The HDI and HPI are not, however, decomposable. This means there is no way of getting from the subset measures to a measure for the aggregate population.

Dasgupta (1999) has proposed a minimum set of well-being indicators as comprising private consumption per head, life expectancy at birth, literacy, and civil and political liberties. It is interesting that 'liberties' do not directly enter into the HDI or HPI, so while attempting to provide an alternative measure of human development, the UN indexes are far from complete.

3 The Economics of Agricultural Research and Poverty

It is widely agreed that improving agricultural productivity is the first step in achieving sustained growth and poverty reduction.

There are many ways that agricultural research can reduce poverty. The most obvious is through the direct effect of the research on the farming household or enterprise income. The research may lower costs or improve productivity and so directly increase income. The research could also lead to lower food prices and so deliver an increase in the real purchasing power of consumers, whether or not their income is based on farm products.

Figure 2 illustrates a broad scheme for thinking about some of the implications of agricultural research. Generally, we would expect the research to affect both factor (input) markets and product markets, although the factor market effects may be indirect. The changes in the factor and product markets will tend to change the prices of factors and products, and this will induce change in income sources and expenditure patterns of households which will in turn feed back to the factor and product markets.

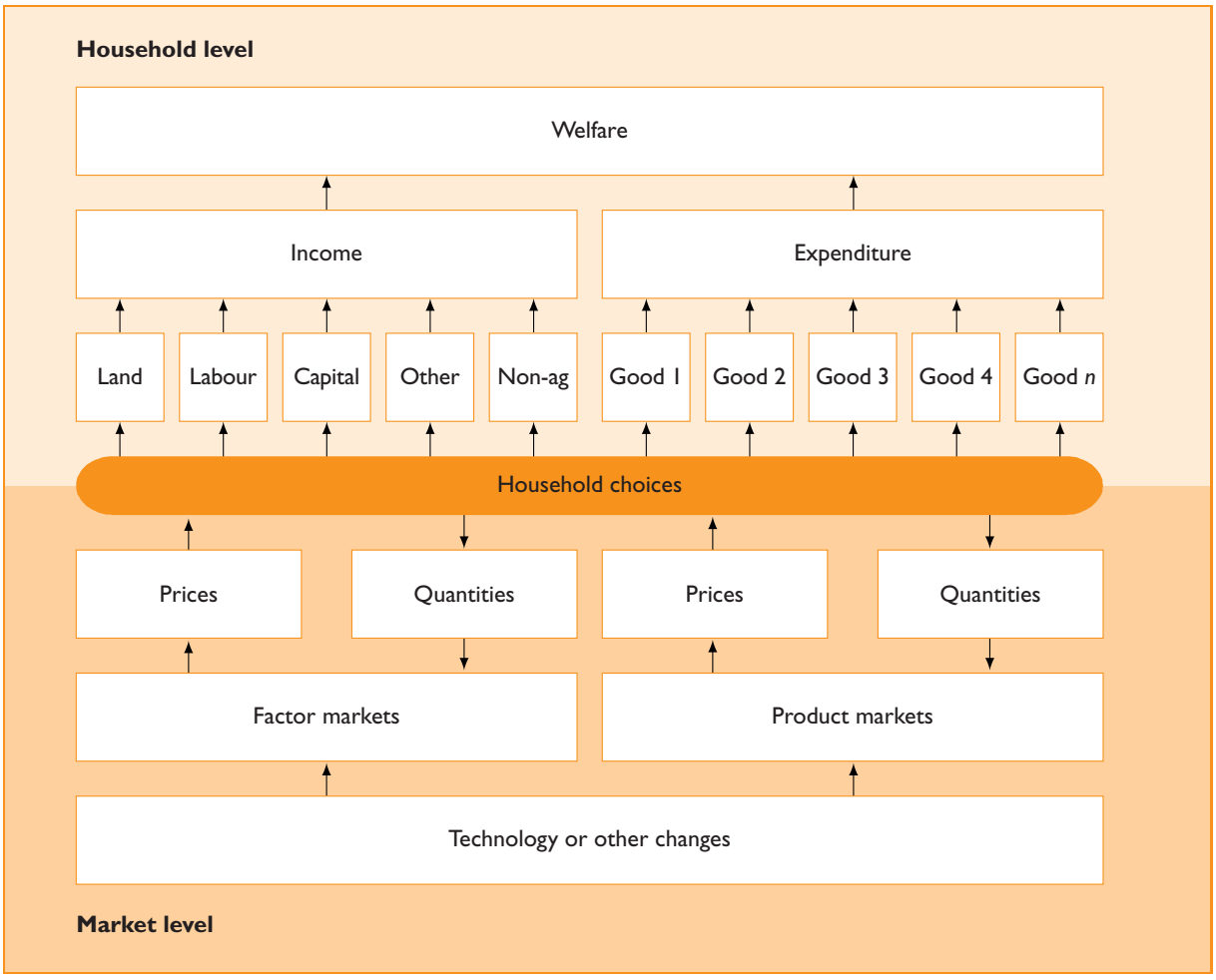
As Figure 2 illustrates, the impact of agricultural research on the welfare of a household will depend on the balance of changes to their income and expenditure patterns. For the farming household, the research may directly change their costs and so increase their income from a particular source. This will change the household's production decisions and may lead them to demand more or fewer factors of production. This will have an effect on

factor markets that will feed through to other households that are not necessarily directly affected by the research.

The farming household's production decisions will also influence product markets. They may increase output, which will lead to a decline in prices via interactions in product markets. This will, in turn, change the spending and income patterns of other households, which will lead to further effects in factor and product markets.

The key point is that the poverty effects of the agricultural research will come through both the income and expenditure sides of the household budget.

Figure 2. Household and market interactions



This point is illustrated more explicitly in Figure 3, which presents a notional income and expenditure account for a farming household. Farm income can come from a variety of commodities, and the difference

between sales revenues and costs is the net income from the product. Household income can also come from other sources, including selling labour.

Each household will also spend some of its net income on the various commodities it needs or desires. Following any particular economic change, the welfare of the family will depend on the balance of the changes in expenditure and income.

Figure 3. Notional income and expenditure account

Income account

Farm	*Revenue*	*Cost*	*Net income*
Commodity 1			
Commodity 2			
…			
Commodity *n*			
Non farm			
Hired labour			
Capital			
Land			

Expenditure account

	Expenditure
Commodity 1	
Commodity 2	
…	
Commodity *n*	

This is illustrated for a number of hypothetical cases in Figure 4. The top half of the figure is concerned with the direct effects of a technological improvement in the production of commodity A. The first two rows look at the effect on net sellers and net buyers of commodity A in the region where the technology improvement takes place.

The increased production of A (or lower cost of A) will be a positive for the net seller of commodity A, but the subsequent decline in the price of A will be a negative for the net seller. The overall effect is ambiguous in principle and needs to be measured in some way before concluding that the technology was beneficial to the net seller. We would expect, however, that the benefits of the cost reduction would outweigh any subsequent price decline, depending on the demand conditions for the product.

The situation is clearer for the net buyer of commodity A. A net buyer who is also a producer benefits from the increase in production and from the subsequent price decline, so the total effect is clearly positive.

The net sellers in the region without the technology improvement gain nothing on their production account, as they have not had the technology gain, but they lose from the price reduction (assuming there is some price

transmission between regions), so overall they clearly lose. The net buyers in the region without the technology improvement clearly gain from the price reduction.

It is interesting to note that the effects outside the region with the improvement are unambiguous, but the effects inside the region (for the net seller) are not clear.

Figure 4. Direct and indirect effects of agricultural research

Direct effects

	Increase production, decrease cost of A	Decrease price of A	Net effect
In the region with the technology improvement			
Net seller of commodity A	+	–	?
Net buyer of commodity A	+	+	+
In a region without the technology improvement			
Net seller of commodity A	na	–	–
Net buyer of commodity A	na	+	+

Direct and indirect effects

			Increase production, decrease cost of A	Decrease price of A	Increase demand for labour	Increase demand for other inputs	Net effect
Income source categories							
Commodity A	*Labour*	*Other*					
Net seller	Net seller	Net seller	+	–	+	+	?
Net seller	Net seller	Netbuyer	+	–	+	–	?
Net seller	Netbuyer	Netbuyer	+	–	–	–	?
Netbuyer	Netbuyer	Netbuyer	+	+	–	–	?
Netbuyer	Net seller	Net seller	+	+	+	+	+

The second half of Figure 4 looks a the direct and indirect effects of the research-induced productivity improvement. It adds to the analysis the demand for labour and other production inputs (fertiliser and so on). There are now extra categories to do with whether households are net buyers or sellers of labour and other inputs.

The first row looks at a net seller of all products. This seller gains from everything except the fall in the price of A, so as before the net effect is ambiguous (although there are good reasons to expect that it will be

positive). The subsequent rows look at different combinations of buyers and sellers of commodity A, labour and other inputs. In most cases, the overall effect is ambiguous, except for a net buyer of A and a net seller of labour and other inputs, who unambiguously gain.

This kind of analysis could be extended indefinitely to look at many kinds of households and various kinds of agricultural research. Clearly, without some overall analytical and empirical framework, the analysis would become unmanageable and not very interesting, because most of the effects will, in principle, be ambiguous.

To go further, it is important to know something about the actual structure of household incomes and expenditures, and to know something about the numbers of households that fall into various categories. And it is important to know something about the market or other indirect interactions that will take place as a result of the research. Combining all this information will let us say something about effects on different household groups and so allow us to make judgments about poverty reduction.

4 Techniques for Measuring Poverty Impacts

4.1 The Literature

Published reports examining ways of assessing the impacts of research and other development assistance programs on poverty include those of Baker (2000), Fujimura and Weiss (2001), and Kerr and Kolavalli (1999). A range of information is available also from the World Bank web sites cited previously.

4.2 Experimental Methods

In principle, the best way to assess the impact of a project is to conduct a controlled experiment. The analyst could select two groups that are similar in every regard (household composition, income, education and so on). One group (the experimental group) then receives the benefits of the research, and the other group (the control group) does not. Looking at the outcomes for these two groups will tell you the benefits of the research. And looking at the changes in poverty for the experimental group versus

the control group will provide information about how the project might have reduced poverty.

Variations on this broad approach are often used to evaluate the impact on poverty of particular development projects (projects such as cash transfers to the poor and so on). Baker (2000) discusses a variety of issues surrounding the design and implementation of such impact evaluations. The various approaches discussed involve extensive data collection and statistical analysis and often include follow up surveys, interviews and so on. The evaluations typically entail a large team and would generally be very expensive.

While it would be possible for ACIAR to adopt this type of approach, it is likely to be too expensive in practice. Moreover, there is a further in-principle objection to the approach. Even with unlimited funding, it will likely be almost impossible to identify the beneficiaries of the research and to separate them from the control group that the research does not affect. The reason for this is simply the large number of indirect interactions discussed in the previous chapter. It is extremely difficult, if not impossible, to construct a survey methodology that assesses, for example, the reasons why the demand for fertiliser has increased, or why the demand for unskilled labour has changed.

This means that we need to estimate the effects of the research using a combination of empirical and theoretical approaches.

4.3 Simulations versus Survey-based Experiments

The majority of current ACIAR evaluations involve establishing the difference between outcomes with and without the research using some form of 'simulation' analysis. The simplest method is to estimate the extent to which a supply curve (for say, wheat, or rice or bananas) has shifted as a result of the research. The post-research price can be calculated using information about demand, and the aggregate benefits of the research are easily added up. In this case, a rudimentary simulation of the market has been used to establish the 'with-research' and 'without-research' scenarios.

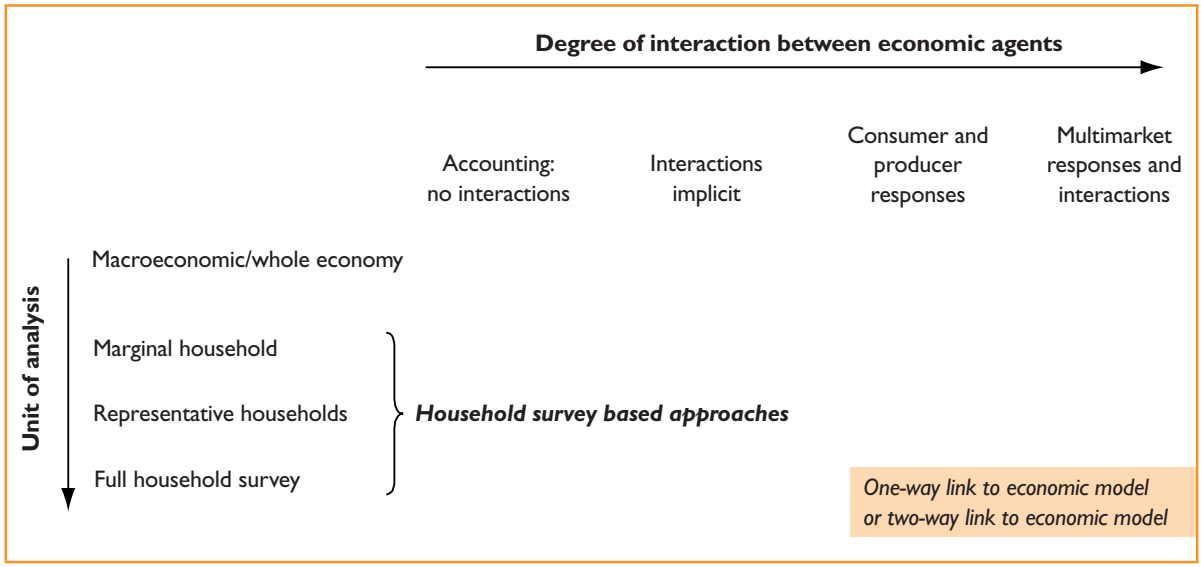
In what follows, we outline slightly more complicated simulation techniques that could be appended to standard ACIAR evaluations to measure the poverty impact of research.

Each of the approaches involves combining some sort of survey data with a simulation model of the market or economy under consideration.

4.4 Unit of Analysis and Degree of Interaction

There are wide varieties of options and approaches for analysing the poverty-reducing impact of projects and policies. To examine them, we will use a simple two-dimensional scheme, as illustrated in Figure 5. The vertical axis measures the unit of analysis (or the level of detail the analysis goes into), while the horizontal axis measures the degree of interaction between economic agents that the analysis captures.

Figure 5. The unit of analysis and the degree of interaction between economic agents



4.4.1 The Unit of Analysis

At one extreme, the analysis could account for the effect of the project on every individual (or individual household). This would give the most complete picture of the effect on poverty, as it would be possible to calculate the full range of poverty measures without any additional assumptions. Of course, this ideal is impractical, and so the analysis typically must survey a sample of households. Indeed, the survey of a sample of households is the basic unit of analysis for the microeconomics of poverty (see Deaton 1997).

There are several options in using household survey data for the analysis. At the most detailed level, the analysis could use all of the data in the survey (typically thousands of households) to calculate the various poverty measures. Alternatively, the analysis could use some summary of the full survey, including representative household groups (rich versus poor, or income quintiles) or summary data on the 'marginal household' (the average household sitting on the poverty line).

At the most aggregate level, it is possible to do some analysis without identifying households at all but using very broad macroeconomic data.

4.4.2 Behavioural Response and the Degree of Interaction between Agents

The horizontal axis of Figure 5 considers the degree of behavioural response and economic interaction that is accounted for in the analysis. The simplest is an accounting-type approach where particular magnitudes are varied without allowing for any subsequent response (by those directly or indirectly involved). For example, this could involve simply changing the magnitudes in the household account and then calculating the new net income. This approach could be applied to a full household survey and would allow the re-calculation of various poverty indexes.

Of course, as prices and incomes change, people will respond to these changes, so the next level of analysis allows for the responses of the economic agents directly affected. It allows, for example, for consumers and producers to change their consumption and production patterns in response to price changes. These higher levels of interaction will generally produce quite different results to the simple accounting approach.

The final level of analysis is to allow for interaction in many markets, a 'general equilibrium' response. This includes interactions in various factor markets as well as the markets for the commodities directly affected. As illustrated in the previous chapter, the indirect interactions may be a significant component of the poverty effects of a particular project.

The shaded area in the bottom right quadrant of Figure 5 represents approaches that use the full household survey and allow for either first round interactions, or multimarket interactions. In each of these cases, there are further options about how to combine the survey data with the economic model. One option is to take the results from the economic model (changes in income for broad household groups, changes in prices and so on) and apply them directly to the household survey without

allowing any subsequent changes to feed back into the economic model. This is often referred to as a 'top-down' approach as it allows for a one-way link from the economic model to the household survey.

The second option is the same as the first, except that this time the changes from the household survey are allowed to feed back into the economic model, which will lead to further second round effects and so on. This two-way link is generally much more difficult to establish in practice.

4.5 Examples of Different Approaches

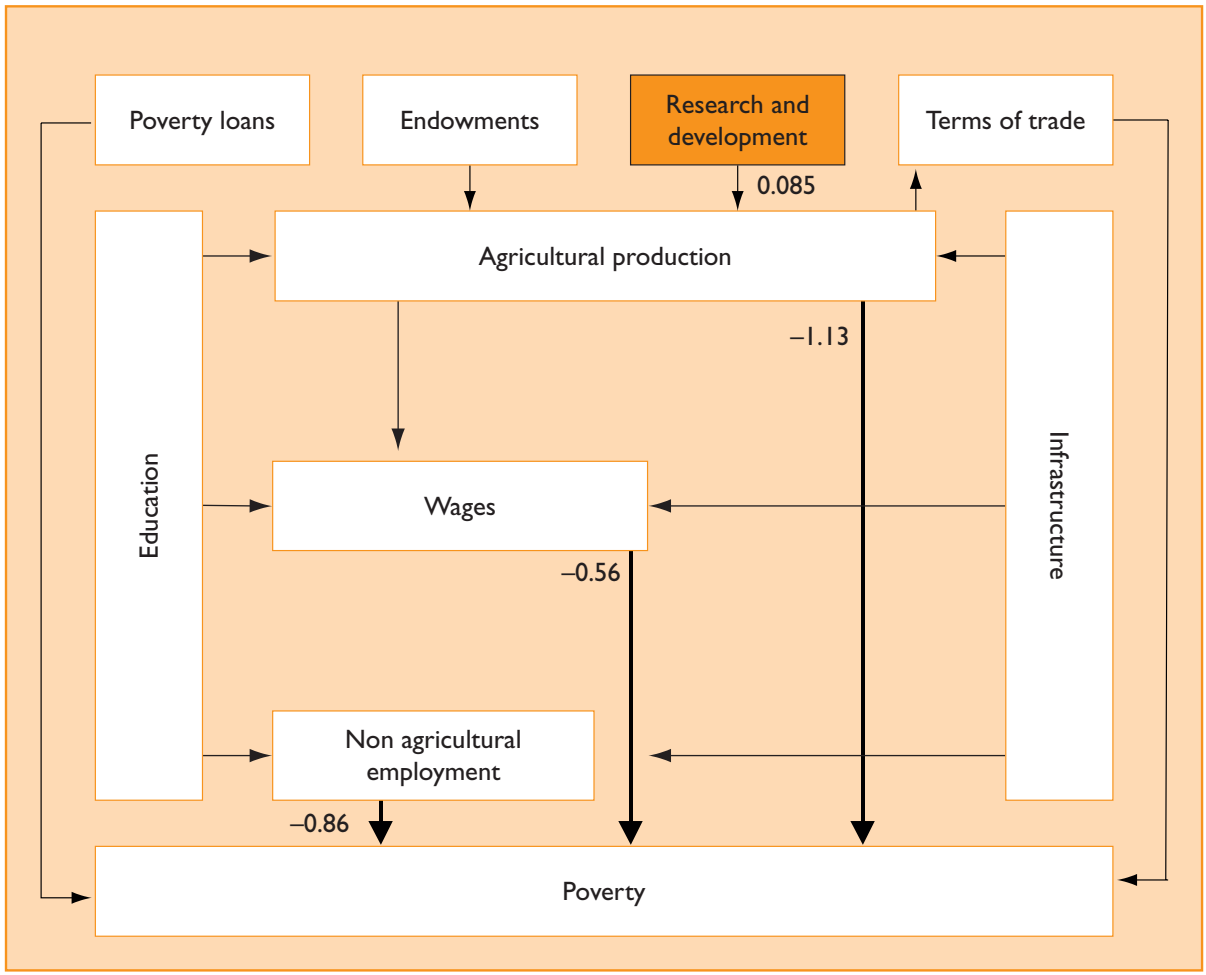
4.5.1 Macro Analysis: Infrastructure, Research and Poverty in China

Fan et al. (2002) examine the aggregate impact of various government investments [including agricultural research and development (R&D)] on poverty and regional inequality. They use a system of equations to econometrically estimate poverty impacts using aggregate time series data.

Figure 6 illustrates the key interactions captured in the analysis. Poverty is modelled as a function of agricultural production, wages, non-agricultural employment, terms-of-trade and poverty loans. Agricultural production is itself influenced by R&D, as well as by education and infrastructure. Wages and non-agricultural employment also depend on education and infrastructure. Agricultural production (lagged one year) also influences wages and the terms-of-trade. R&D can thus influence poverty through a direct effect on agricultural production and through an indirect effect on wages and the terms-of-trade.

This basic scheme uses what we know about the microeconomics of poverty effects applied to aggregate data. The study finds that each 10,000 yuan of spending on R&D reduces the number of poor by 6.79. This implies that the 1996 R&D spending would have reduced the number of poor by 1.5 million. The numbers in Figure 6 give the elasticities found by the study. They found, for example, that a 1% increase in agricultural production led to a 1.13% decline in the poverty headcount ratio.

Figure 6. Outline of the Chinese analysis



Data source: Based on Fan et al. (2002)

Benefits of the analysis

A benefit of such macroeconomic analysis is that it can be used to put bounds on the impact of agricultural research. The results indicate, for example, the magnitude of the effect on poverty of research over the past decades. If any subsequent project were to claim much larger (or smaller) benefits, then the reasons why these were different to the average would need to be clearly explained.

Drawbacks of the analysis

This analysis uses the poverty headcount ratio as its measure of poverty. This means that it gives no indication of the extent to which the depth of

poverty has been reduced, or the extent to which income distribution amongst the poor has changed. It is possible, therefore, that only the richest of the poor have benefitted.

Because the R&D expenditure is aggregated, it is hard to know what type of R&D the results apply to. The study provides no indication of the link between the R&D spending and the nature of the research outcome. This is in contrast to the approach taken to education and infrastructure, where a link between spending and measures such as the average years of schooling is explicitly made.

Could ACIAR apply this type of analysis?

An approach such as this could be useful to ACIAR in several ways. First, as noted above, it can be used to set bounds on the magnitude of any poverty impact. Second, in the absence of any more-detailed information, the elasticities from the aggregated analysis could be applied to an individual project to give some indication of the likely magnitude of the effect of the project on poverty.

4.5.2 Survey and Basic Interaction: Rice Market Liberalisation in Vietnam

A study by Minot and Goletti (2000) illustrates how a household survey can be combined with a market model to generate impacts at the household level.

Minot and Goletti (2000) are concerned with estimating the poverty impacts of rice market liberalisation in Vietnam. To do this, they construct a market model of the rice industry that provides projections of changes in prices that are likely to result from the liberalisation. These price changes are fed into a household survey to estimate the impact of the changes on household incomes.

Minot and Goletti calculate the household effects at two broad levels. First, they look at the 'net benefit ratio' (NBR) originally used by Deaton (1997) and others. This ratio is simply the household's value of net sales of a commodity to total income. In the absence of any other changes (a very strong assumption), then a NBR of 0.8 would imply that a 1% increase in the price of the commodity would increase income by 0.8%.

The NBR can be expressed in welfare terms for each household as:

$$\left(\frac{\Delta w}{y_0}\right) = \frac{\Delta pp}{pp_0} PR - \frac{\Delta cp}{cp_0} CR$$

where:

the first term on the left is the change in welfare expressed as a proportion of initial income
pp is the producer price and pp_0 is the initial producer price
cp is the consumer price and cp_0 is the initial consumer price
PR is the value of production as a proportion of initial income
CR is the value of consumption as a proportion of initial income.

NBRs can be positive or negative, and simply measure the net position of a household as set out in Figure 3.

Minot and Goletti (2002) take this analysis further, however, by recognising that the households will respond to changes in prices. They modify the NBR to account for the price response, giving a formula similar to the one above, but incorporating demand and supply elasticities for each household.

With information on the changes in producer and consumer prices coming from the market model, the household welfare formulas can be used to estimate the change in income for each household in the survey. This information can then be used to assess the changes in various poverty measures.

The benefits of the approach

This approach provides a simple means for combining household survey information with a model of the market under examination. It is relatively simple to implement with an existing survey and can be used to provide a full range of poverty measures.

The drawbacks of the approach

The main disadvantage of this approach is that it does not account for any factor market interactions. As implemented by Minot and Goletti, the approach does not allow for interactions between commodities, although these could easily be incorporated into the general framework.

Could ACIAR use this approach?

This approach could be very fruitfully applied by ACIAR. A standard ACIAR evaluation could have involved either the use of a commodity model, or estimates of price and cost changes. The poverty analysis would then simply involve applying these estimates to a relevant existing survey.

4.5.3 The Marginal Household in General Equilibrium

A study by Hertel et al. (2001) summarises household survey data into a single notional 'marginal' household then applies these data to an economy-wide global model.

The economy-wide model forms the key analytical unit for the analysis, and allows the study to focus on both the income and expenditure impacts of the change under analysis. Rather than incorporating different households into the structure of the economy-wide model, this analysis focuses on the 'marginal household', a notional household that is just below the poverty line. Data on this marginal household are derived from survey data, and information on the budget and income shares for this household is combined with outputs from the economy-wide model to examine changes in household welfare.

This framework allows for interaction and response at the household level, by observing the difference between the marginal household and the average household. The average household in the model determines the feedbacks between the households and the factor and product markets, but the resulting price changes are applied to the marginal household.

The poverty measure used in the analysis is the poverty gap (not the simple headcount), although higher-order poverty measures could, in principle, also be used.

Benefits of the approach

This approach is potentially very powerful and could be fruitfully applied to many cases where an existing economy-wide model is available. It provides an efficient method of incorporating survey-level data into an existing model with a minimal (or no) requirement for adjustment of the existing model.

The marginal household could be interpreted at a regional level—it does not need to be a national marginal household—so survey data at many different levels could be incorporated.

Could ACIAR use this approach?

The Hertel et al. (2001) analysis is based around the multicountry GTAP model (view at <www.gtap.org>). This model could provide an excellent base framework for ACIAR to build on when dealing with reasonably significant projects in particular countries.

4.5.4 Representative Households in General Equilibrium

A very common approach to poverty or income distribution analysis involves having a number of representative households incorporated within an economy-wide model. The different households are chosen on the basis of some meaningful category, and the data for the households typically come from a household survey. The advantage of this approach is that it allows for full interaction between the representative households and factor and product markets.

If necessary, the representative household results, along with aggregate price and wage results, could be applied to a full household survey to generate a complete range of poverty measures. Alternatively, the model could contain the distribution of incomes within each of the representative household groups, and use this information to generate the poverty measures.

Decaluwé et al. (1999) and Thorbecke (2001) provide assessments of this approach.

Could ACIAR use this approach?

Constructing an economy-wide model with household detail is expensive. ACIAR could use this approach if such a model were already available.

4.5.5 A hybrid: Microsimulation and General Equilibrium

Recently, work has been undertaken on incorporating the full household detail from a survey (i.e. all the households) into an economy-wide model. This approach has typically involved combining a microsimulation model of household behaviour with an economy-wide model. Research in this area is in its early stages and is very technical. It is unlikely to provide a practical tool for ACIAR at present.

5 Implications for ACIAR

From the discussion of the previous chapters, we can draw some broad initial implications for ACIAR.

- The approach to poverty analysis depends to some extent on the purpose of that analysis. Poverty analysis can provide a useful indication of some of the broader effects of a project, but it should not be used as an evaluation tool. A project can be socially valuable without necessarily reducing poverty according to any of the standard measures.
  - For example, a project could significantly increase the incomes of the poor without actually moving them above the poverty line. Only the higher-order poverty measures would capture this as a benefit.
  - Alternatively, a project could significantly increase the incomes of those just above the poverty line, without actually moving anyone above or below the poverty line. In this case, the standard poverty measures would register no improvement, whereas the project had in fact delivered a valuable increase in welfare.
- There are several quantitative approaches that are complementary to current ACIAR evaluation methods that could be adopted to examine the poverty impact of ACIAR projects.
  - For example, applying the results of a market model used for standard benefit–cost analysis to an appropriate household survey provides a cost-effective means of generating some poverty measures.
- Precisely how the evaluations are undertaken will depend on the resources that ACIAR has to devote to a particular evaluation. Poverty analysis can be very expensive, but there are options to undertake it in a cost-effective manner.
  - For example, ACIAR could take advantage of existing household surveys and existing models where available. While this limits the extent to which the analysis can be customised, it does allow broad analysis to be undertaken rapidly.

- The greatest limitation to any analysis will be the availability of data. As a minimum, any poverty evaluation requires access to some form of household survey that reasonably applies to the population of interest.
- Poverty analysis needs to be undertaken by analysts with a basic understanding of the underlying concepts and methods. In particular, measures without second-round responses are likely to be misleading. This complicates the analyses, but necessarily so if something sensible is to be said about the impact of the project on poverty.
- ACIAR needs to be opportunistic about using the data and models available.

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IMPACT ASSESSMENT SERIES

No.	Author and year of publication	Title	ACIAR project numbers
1	Centre for International Economics (1998)	Control of Newcastle disease in village chickens	8334, 8717 and 93/222
2	George, P.S. (1998)	Increased efficiency of straw utilisation by cattle and buffalo	8203, 8601 and 8817
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7	Centre for International Economics (1998)	Reducing fish losses due to epizootic ulcerative syndrome — an ex ante evaluation	9130
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11	Chudleigh, P. (1998)	Post-harvest R&D concerning tropical fruits	8356 and 8844
12	Centre for International Economics (1998)	Biological control of the banana skipper in Papua New Guinea	8802-C
13	Chudleigh, P. (1999)	Breeding and quality analysis of rapeseed	CS1/1984/069 and CS1/1988/039
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