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9. ABSTRACT
This text for the Data and Economic Analysis weeks of the Development Studies program of AID follows the course presentation closely, and it provides relevant source material and background information. This segment of the course gives the participant data and measurement techniques as they relate to Mandate oriented AID projects. The context of the discussion is generally economic and financial. The focus of the first week is measurement. The second segment deals with the data required to measure the Mandate related objectives and the data gathering techniques which may be used to obtain the data. The final segment focuses on techniques for interpreting or analyzing data. The context of the discussion is the AID project cycle. The focus is on projects directed at the rural poor. Measurement and analysis enter the project cycle at all stages, at the pre-project sector assessment stage, in project selection and design, and in project monitoring and evaluation. Certain measurement techniques are more suited to the purposes, timing, and budget constraints of these different AID project stages. The manual presents ideas about the appropriate stage at which each discussd technique fits into the AID project cycle.

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AN OVERVIEW OF ECONOMIC AND DATA ANALYSIS TECHNIQUES FOR PROJECT DESIGN AND EVALUATION

Development Studies Program
Course Manual for Data and Economic Analysis Weeks

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For
The Agency for International Development
and
U.S. Department of Agriculture

The ideas presented in this document have not been approved by AID or any of its offices, and therefore do not represent or imply a position on the part of the Agency for International Development

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INTRODUCTION

1. PURPOSE OF THIS MANUAL

This manual is the text for the Data and Economic Analysis weeks of the Development Studies program of AID The discussion in the manual follows the course presentation closely and provides the participant with relevant source material and background information.

2. HOW THE DATA AND ECONOMIC ANALYSIS WEEKS RELATE TO THE REST OF DSP

The objectives of DSP state:

"Each participant who has completed DSP should have an appreciation for and understanding of the following

1. The congressional Mandate, its theory and purposes
2. Theories and new program approaches in the AID sector areas of agriculture and rural development, population, health, nutrition and education.
3. Techniques relevant to the improvement of decision making by AID officers with respect to the design of new programs and projects consistent with the Mandate, including systems and cost benefit analysis
4. Theories of development derived from the social sciences, including economics, anthropology, geography, political science and public administration.
5. Social science methodologies related to the collection and interpretation of data necessary for program and project design
6. The practical utility of these theories, concepts, analytic and methodological tools in fulfilling the Aid requirements contained in the AID guidelines, specifically technical, economic and financial, social, institutional, and ecological soundness " (1)

Inside these overall objectives, the Data week focuses on objective 5, and the Economic Analysis week on objective 3 The intent of this segment of the course is to familiarize the participant with data and measurement techniques as they relate to Mandate oriented AID projects While the data gathering and measurement techniques are generalizable to analysis of social, institutional, ecological and technical soundness, the context of the discussion is generally economic and financial.

The focus of the initial week is "measurement." It begins with a dicussion of measurable definitions of Mandate related objectives, an exploration of WHAT is to be measured. The second segment deals with the data required to measure these objectives, and the data gathering techniques which may be used to obtain the data. The final segment focuses on techniques for interpreting or analyzing data .

There are many techniques for data gathering, manipulation and interpretation, and two weeks is a very short time to attempt even the lightest exposure to them. The wide differences in background of DSP participants further complicates the presentation since many

may already be acquainted with some of these techniques. Based on the experience of two DSP courses, this manual will strike a compromise between in-depth treatment of a few specific techniques, and exposure to a wider range It is recognized, for example,

> "that most participants will not carry out survey research or cost benefit analysis However, the DSP assumes that all officers will be confronted with the necessity to understand and utilize the data and concepts derived from these disciplines The effective management of contractors requires a greater ability to communicate with, direct, and evaluate, whatever consultative services the Agency employs " (1)

3. *IMPLICATIONS OF THE CONGRESSIONAL MANDATE FOR DATA AND ECONOMIC ANALYSIS*

In all analytical efforts there is a subtle interaction between the methodology and the substance, between the technique of measurement and the thing measured. Measurement methodologies are not neutral to the nature of the measurement. For example, rather different data and measurement techniques are used to deal with income distribution than for simple income estimates. If two weeks are to provide a useful overview to such a broad field, intellectual energy must be conserved, criteria must be sought to help limit the field.

The most useful tool to reduce the scope of the data and economic analysis weeks is the Mandate itself. At first blush the Mandate seems so general that it might appear to be opening more issues than it eliminates, more of a "Pandora's box" than a mechanism for reducing the measurement and analysis job to manageable dimensions. While it is true that at one time or another, someone has argued the connection of every imaginable factor to a Mandate objective, the context in which the Mandate will be viewed for this section of the course is a much more limited one. In part this more limited view of the Mandate is an artificial creation to keep the scope of measurement and analysis within the reach of a two week treatment. However, the simplification is not a fiction created by DSP, it flows directly from AID's attempt, as outlined in its reply to Congress in 1975, to define the Mandate and to characterize the agency's implementation strategy.

The Agency's reply to Congress in *"Implementation of the 'New Directions' in Development Assistance" (2)* defines the characteristics of the "poor majority" and thereby sets a framework for measurement, for data collection, and for analysis. The objective of the Data and Economic Analysis weeks is to explore how to define these Mandate objectives in measurable terms, how to gather data to measure them, and how to interpret or analyze the data.

The context of this discussion is the AID project cycle. The focus will be on projects directed at the rural poor. Measurement and analysis should enter the project cycle at all stages, at the pre-project sector assessment stage (DAP), in project selection and design (PID,PP), and in project monitoring and evaluation. Certain measurement techniques are

more suited to the purposes, timing, and budget constraints of these different AID project stages. While the manual and the instructors will present ideas about the appropriate stage at which each discussed technique fits into the AID project cycle, the participant should form his own view. These participant views of the project cycle will be the subject of discussion the last day.

The discussion will be limited to the objectives actually mentioned and emphasized in the Committee documents. While there may be many other related and supporting objectives, the focus of this two week segment of the DSP course and manual will be the participation of the "Poor Majority" in the major Mandate objectives called "AID Targets" or "Benchmarks" in the Committee documents. They are as follows (3):

1. Income
2. Nutrition
3. Health
4. Rural Production
5. Population
6. Education.

FOOTNOTES TO THE INTRODUCTION

(1) Richard Blue and Staff, *The Objectives of the Development Studies Program*, Unpublished AID Memorandum, 1976, p. 3.

(2) Agency for International Development, *Implementation of "New Directions" in Development Assistance*, Report to the Committee on International Relations, 94th Congress Committee Print, Washington, D.C., 1975.

(3) Agency for International Development, *The Congressional Mandate: Aiding the Poor Majority*, Appendix 5, 94th Congress Committee Print, Washington, D C., 1975, p. 63.

PART A

DEFINING MEASURABLE "MANDATE" OBJECTIVES

1. CONNECTING PROJECTS TO MANDATE OBJECTIVES

One of the most useful products of measurement in the project cycle is the discipline it forces in defining project objectives. Mandate Projects should begin with complete sentences describing what the project seeks to achieve. While lists or outlines are useful in structuring a project document, they lack the precision necessary for measurement.

If the statements of objectives are written out, and then made more specific in supporting sentences which amplify and explain the objective, then the definitional elements for measurement are present While this approach may seem unfairly elementary to the seasoned DSP participant, confusion in measurement technique is usually due to imprecise initial language in stating the project objectives, and therefore what was to be measured.

The purpose of Part A of the manual is to explore alternative ways of stating Mandate objectives in measurable terms.

A "Mandate Project" is defined as a project which seeks to achieve one or a combination of the Mandate objectives. A Mandate project would have as its purpose to increase level and participation of the poor majority in income, nutrition, health, production, or education. A project which does not have one or more of these objectives as its main purpose would by definition not be a Mandate project. The manner in which these objectives is reached may be circuitous, but unless there is a stated connection to one of these objectives the project will not be considered a "Mandate Project" for the purposes of this manual.

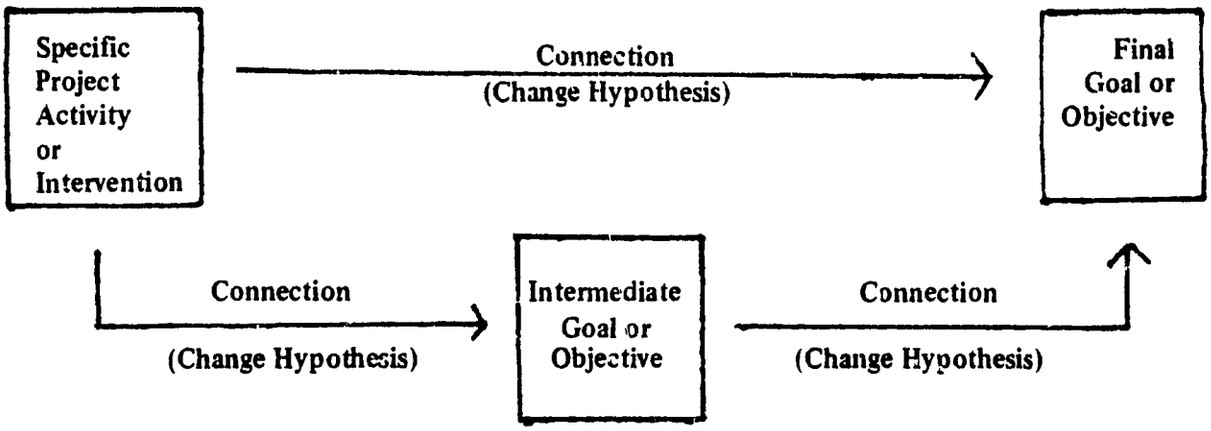
Many of the connections between specific project activities and final mandate objectives are complex and difficult to state, let alone measure, yet the struggle to express the objectives and the *CONNECTIONS* in complete sentences is the only way to begin serious measurement and analysis and to build a basis for useful evaluation.

A disadvantage of stating specific mandate objectives, and outlining a project's hypotheses about "connections" between specific project activities and changes or improvements in these objectives, is that it opens the project to almost cettain and, often, career-threatening criticism. Little is known about which connections really work, that is which project activities will actually cause improvement in the final mandate objectives in the real world. Many theories exist, and there has been considerable project experience. Yet there is surprisingly little measurement of the actual impact of specific project activities on final mandate objectives. In this confusing situation, that project which selects a specific objective, like increasing the net family income of 0-5 Ha. farmers in region x, and to accomplish this objective by increasing the quality and quantity of technical assistance to these farmers, is

likely to draw criticism. Enough development fads have passed through the agency to leave behind examples of almost every conceivable project type which are said to have failed. A careful review of these projects would probably reveal that their final impact on mandate objectives is unknown because it was never measured; but at least in AID'S oral and written development tradition they constitute "sobering" examples of failure.

Figure 1

Schematization of Project Objectives and "Connections"



With all of this development project lore in the AID atmosphere, it is little wonder that project designers are reluctant to be too crisp about the specific objectives and "connections" of their projects; if specifics are stated, even the least informed reviewer can suggest supposed examples where this specific "connection" did not work. If few specific and measurable final objectives are stated, and if the connections are left implicit, the project may be better protected for its journey through the approval process.

Perhaps the proponents of the hypothetical project mentioned in the last paragraph would have been safer if they had used the following sentence in describing their project objectives: "to improve the technological base of small farm agriculture and to expand the provision of vital rural technical services to the disadvantaged small farmer." The possibilities of fending off criticism at the various stages of project defense (including final evaluation) are greatly improved by the second formulation. Anyone who has guided a project through AID, and has had his/her career affected by the process, is aware of the benefits of ambiguity in the definition of project objectives and "connections."

An oft-utilized technique which strikes a middle ground and gives the appearance of mandate relevance to a project, and which even the most insightful project review committee has been known to accept as genuine, is the practice of stating the objectives clearly and then moving on to other topics without any explicit *CONNECTIONS*, and without a plan to measure any final impacts. This transition is fairly easy to make in project documents since there are always sufficiently complex project details which can be discussed and which the reader/project reviewer will find interesting.

The foregoing discussion overstates the degree to which ambiguity in projects is a protective device; but whether it is protective or motivated by other factors, the fact remains that ambiguity in objectives and connection statements is prevalent in AID project documents The fact that all relationships are not known, that the state of the development art will not allow us to speak with clarity about the process itself, does not excuse project ambiguity. Every project operates on some hypothesis about change. If it is a mandate project it supposes that a set of activities will result in increases in income, nutrition, health, production, or education for a sub-group of the poor majority. The project hypotheses may be partially or completely valid, the measurements to evaluate the hypotheses may be difficult and unsatisfying, but the project hypotheses themselves need not be ambiguous.

Including measurement of the project impact on final objectives, and of intermediate "connections" in the project plan, is helpful in the process of forcing the proponents to avoid ambiguity. It is interesting to note that the *LOGFRAME* contains the necessary logic for such a measurement process, but in practice it can often take attention from measuring final mandate impacts on target group families, and focus it on intricate chains of intra-project resource flows and commitments.

Measurement in mandate projects can be defined as seeking the answers to the following three questions at different stages in the project cycle:

1. *Project Selection & Design.* Is this project likely to result in increased income, nutrition, health, production or education for target group families, and what is the evidence and the expected magnitude of the increase?

2. *Project Monitoring.* Is the project resulting in more income, nutrition, health, production or education for target group families, and in what magnitude?

3. *Project Evaluation.* Did the project result in increased income, nutrition, health, production, or education in the target group families, and what was the magnitude of that result?

2. *DEFINING MEASURABLE TARGET GROUPS: WHO ARE THE POOR MAJORITY?*

Measurements in the Mandate project context may be either estimates of project potential appropriate during selection and design, or estimates of actual project impact during monitoring and evaluation. In either case a wide variety of definitions must be made before mandate oriented measurements can take place. One of the most important concepts which must be defined in a measurable way is the idea of a target group.

Nothing is clearer in the mandate literature than that income, nutrition, health, production, and education increases are only "mandate" benefits if they happen to the poor majority.

It makes sense that the characteristics which constitute the mandate objectives should be used to define the target group; that is, the target group is composed of people below a certain level of income, nutrition, health, production, or education. AID's reply to Congress, *THE CONGRESSIONAL MANDATE. AIDING THE POOR MAJORITY (3)* (hereafter referred to as the *MANDATE)* defines the poor majority in measurable terms. In answer to the question "Who Are the Poor Majority?," the *MANDATE* replies:

> "The choice between absolute and relative standards is never easy when the relative well-off are poor by our own standards While serious problems of oversimplification inevitably arise, we use broadly uniform benchmarks generally comparable throughout AID assisted LDC's so poverty can be assessed without regard to political boundaries These benchmarks are not intended to define any sharp breakpoint between poverty and prosperity, between the 'have-nots' and the 'haves', rather, they try to identify people who are indisputably poor and clearly among the world's have-nots . Every effort should be made to assure AID funds benefit that fraction of the recipient country's population that is poor by AID's benchmark standards " (4)

Three sets of measurable benchmarks were chosen by AID in its reply to Congress as a definition of the "poor majority," income, nutrition, and health. The AID position to Congress can be found in *IMPLEMENTATION OF "NEW DIRECTION" IN DEVELOPMENT ASSISTANCE* (herafter referred to as *NEW DIRECTIONS)* (2). It states:

> "The following benchmarks are used
> (a) Per capita income below $150 per year
> (b) Daily diet of less than 2,160 to 2,670 calories
> (c) Several health indicators. life expectancy at birth of below 55 years, infant mortality over 33 per 1,000 population, or access to broadly defined health services for under 40 percent of the population." (5)

The target group is defined in income, nutrition and health terms, and the mandate definitions are relatively clear and measurable. Since these bench marks are also among the mandate objectives, definitional difficulties in obtaining measurable concepts will be dealt with in the relevant section below.

3. DEFINING MANDATE PROJECT OBJECTIVES: WHAT DO WE SEEK TO ACHIEVE?

In answer to the question "What Do We Seek to Achieve?" the MANDATE states:

> "Determining the suitable goal must, of course, be the responsibility of the developing countries; nevertheless AID must set targets as well if we are to assess our own performance. The benchmarks used to define the poor majority suggest themselves as targets. Could not AID, in cooperation with the LDC's help move the poor majority beyond these milestones in the next decade or so?" (6)

As a target the document explains, moving all of the poor majority beyond these benchmarks may not be feasible; but as objectives, the benchmarks, income, nutrition, and health; plus production, population, and education are outlined as the mandate objectives.

The next sections in Part A focus on the problems involved in defining these six objectives in terms which are measurable so that they can become operational criteria for project selection, design, monitoring and evaluation.

4. INCREASING THE INCOME OF THE POOR MAJORITY

a. Defining Income for the Rural Poor

With all of its conceptual and measurement problems, income is perhaps the best single indicator of welfare. It is, however, inadequate to capture enough of what Congress and AID mean by "welfare" to be used alone. While income is not a sufficient measure, it is a necessary dimension in estimating welfare.

The focus of the MANDATE on income as a principal benchmark may have left many intellectually unsatisfied in that it fails to capture the essence of development, but it has the advantage of being operationally usable in project selection and evaluation. Compare the project selection and evaluation difficulties of operating with the following definition in comparison to the MANDATE.

> "Authentic development aims at the full realization of human capabilities: men and women become makers of their own histories, personal and societal. They free themselves from every servitude imposed by nature or by oppressive systems,

> they achieve wisdom in their mastery over nature and over their own wants, they create new webs of solidarity based not on a domination but on reciprocity among themselves, they achieve a rich symbiosis between contemplation and transformation action, between efficiency and free expression. This total concept of development can perhaps best be expressed as the 'human ascent'--the ascent of all men in their integral humanity, including the economic, biological, psychological, social , cultural, ideological, spiritual, mystical, and transcendental dimensions." (7)

This section investigates the difficulties involved with defining income in a way which captures as much of the welfare concept as possible, is measurable for the rural poor in LDC's, and adjusts for an may potential distortions as possible.

b. Money and Subsistence Income

If income is to be a useful measurement for the rural poor it must include the value of the food and other goods which are produced and consumed by small farm families. In some cases a large proportion of "welfare" comes from these home produced products. These products may be added into income if they are valued in money terms. The income definition for the rural poor must include income in-kind. In-kind income may come form a variety of sources, from home produced food or clothing, from payments in-kind for services rendered by members of the rural family, or from barter exchanges of farm produce.

Two difficulties arise with measuring this expanded income definition. First, selecting a unit price at which to value the in-kind commodities, and second estimating the quantities. Since both of these issues are more related to measurement methodology and data gathering than definition, and examination of the techniques used for confronting them will be postponed to the accounting and data gathering sections. Largely satisfactory valuations can be made if the quantities can be estimated.

A subsistence farmer may be defined as one who consumes most of what he produces and sells very little. It is important not to confuse subsistence and poverty; many very poor small farmers are not subsistence farmers, but sell almost all of their produce. For example, in Costa Rica, target group farms sell more than 90 percent of their produce, and the level of subsistence actually rises as farms increase in size. Simply because target group farmers produce and consume large quantities of the same product does not mean that they are necessarily "subsistence" farmers.

In the example given in Table 1, from Costa Rica, the target group farmers were principally corn and bean producers and corn and beans were also important consumption items. Table 1 shows that even when small producers consume the same type of commodities they produce they may sell their own produce and purchase the same commodities on the market for consumption.

Rural income estimates must include estimates of the monetary value of in-kind consumption and transactions.

Table 1

Subsistence "Income" on Poor Small Farms in Costa Rica
Value of Farm Produce Consumed as a Percent of Total Farm Product

Farm Size	%of Farm Product Consumed Target Group Farms (Less than US $150 net family income per capita)
0 to 1 Ha.	4.0
1 to 2 Ha.	5.3
2 to 5 Ha.	6.4
5 to 10 Ha.	5.8
10 to 20 Ha.	5.6

Note: Farm consumption valued at average farm gate prices for comparable products in the relevant Canton.

Source: Richard Kreitman, Costa Rica Agriculture Sector Assessment Working Papers, Agency for International Development, Washington 1976, p 100 & 107

c. Net Income

In the event that the rural poor are landless laborers the income estimate is relatively easy: their income is largely net of expenses because they are not businessmen. They may have some expenses related to their wage incomes, transportation, tools, etc., but relatively simple accounting procedures can provide reasonable net income estimates. For the small farmer, arriving at a net farm income estimate is no small task. The difficulty is not principally because the small farmer does not keep records and does not therefore have his own net income figure calculated; even if he did, the figure would be largely useless because of the difficulty of comparing net income figures for different farmers using different accounting conventions. The only way to obtain reliable net farm income estimates is to gather crop by crop input and output data and then reconstruct farm accounts using consistent accounting conventions for all farms included. In addition one should anticipate "other income" which can be substantial to very small farmers.

If the process of project selection, monitoring and evaluation is to be serious there is no excaping the necessity of estimating net farm income of target group families. AID and Congress realized the futility of aggregate national income averages, and the importance of farm and family level net income estimates in the MANDATE:

> "Actual income can be difficult to measure. National averages for per capita income are inappropriate, of course, since they would place whole countries in or out of the poor majority We need more microlevel data, ideally for individuals, that permit isolating persons in a given country with income below $150 But such data are scarce in LDC's and expensive to collect, particularly for the poor whose 'income' may consist largely of subsistence output produced and consumed outside the market economy." (8)

Since the Mandate definition of net income per capita is in the US $ at 1969 prices, there are difficulties in comparing measurements over time due to inflation, and comparing local estimates with the Mandate US $ standard due to conceptual problems with exchange rates. There are obvious computational methods for handling the inflation issue, but the exchange rate was in effect in the year in which the net income estimates were made, the exchange rate used in comparing the farming and landless populations with the Mandate standard of US $150 had a significant impact on the size of the target group.

Table 2

Proportion of the Rural Population Classed as Poor by the Mandate Standard of US $150 per Capita using Each of the Existing Multiple Exchange Rates 1973

Exchange Rate	Percent of Rural Population with Net Income Capita Below US $150 in 1973	
	Farming Population	Landless Population
Coffee Rate	51.3%	49.2 %
Mixed Rate	60.1	61.3
Free Market Rate	67.0	70.5

SOURCE Richard Kreitman, Costa Rica, Rural Poor Profile, Agency for International Development, Washington 1976, p. 28

Net income on small farms is possible to measure, but it is unfortunately a costly and painstaking accounting task. However, if Mandate projects are to be undertaken with the intent of increasing the net income of the target group, there is no way to avoid measuring it. If net income is the objective it will be impossible to answer the three underlying project questions posed in the introduction without direct measurement of net income changes or differences in target families. The MANDATE states the necessity of using income measurements as one of the prime project selection and evaluation criteria as follows:

> "Targets for AID assisted programs and projects should reflect unique local circumstances, but to the greatest degree possible they should be cast in terms of their contribution in the long term–5 to 10 Year–goals of improving the status of the poor. Working in cooperation with the LDC's targets should be defined in terms of "output" indicators--changes in income, health, et cetera--where possible to assure that we focus on the relative effectiveness of alternative programs and that we are able to evaluate and assess their impact on development objectives." (9)

4. DEFINING MEASURABLE NUTRITION OBJECTIVES

The Mandate establishes improved nutrition as a major objective as well as a benchmark characterizing the poor. Measurable indicators of nutrition are divided into two general types:

1. Measures of nutrient intake or diet.
2. Measures of nutritional status.

If a project aims to improve nutrition in a selected target population, it would follow that its success or failure should be judged in terms of its nutritional impact. Food intake can be measured directly and the nutrient intake can be estimated from these food accounts. The difficulty of using only diet indicators is that they do not provide a complete basis for making comparisons between different sub-groups inside the poor, or for us in intercountry comparisons. Using only average caloric intake as a nutritional indicator is not sufficient, but it is an obvious beginning. Very few projects aimed at nutritional improvement have ever measured the actual impact on the caloric intake of the target group.

Two problems make the nutrient intake approach insufficient; first, there are sizeable differences in the nutritional needs of different healthy people, and secondly, the efficiency with which the body absorbs nutrients is significantly affected by different types of health conditions.

The MANDATE emphasizes the importance of disaggregating project measurements of nutrient intake as follows:

> "Adequate diet requirements vary with age, sex, size, health status, occupation, and climate. Pregnant and lactating women generally require 300 to 500 additional calories daily. Sick persons, particularly children, require additonal calories especially when their illnesses inhibit absorption of what nutrients they do receive. Those engaged in active labor need hundreds of calories more as do those living in cold climates." (10)

Even for nutrient intake, adequate measurements would require that the target group affected must be divided on the basis of age, sex, climate, health status, etc.

More direct measures of nutritional status are available and in most cases they are easier to obtain than diet measurements. These measures are directed at the health and physical effects of malnutrition; they attempt to measure the results of nutritional intake rather than the intake itself. Three general types of measures are available.

1. Body measurements.
2. Measurements of nutrition-related illnesses.
3. Blood chemistry.

Body measurements most commonly used are height, weight, arm circumfrence and "fatty-fold" measurements. These measurements may be taken by non-medical personnel, and except for "fatty fold" and blood chemistry measurements they are relatively inexpensive to obtain. Body growth and size measurements are only reliable as indicators for project selection and evaluation purposes on children up to about 16 years of age. Beyond that age the measurements provide only sketchy indications of nutrition in earlier periods.

A wide variety of illnesses are related to nutrition. Measuring the incidence and gravity of these illnesses can be used as an indicator of nutritional status. Oedema, anemia, and goiter are among the most commonly used, but a wide variety of others may be as important in particular areas. For target populations, morbidity indicators are more difficult to use as project selection and evaluation criteria because they require clinical examinations and cannot be gathered by non-professional survey personnel.

Biochemical blood examinations may be useful, but are not really practical as project indicators. These measurements are more suited to in-depth clinical studies of nutrition.

In project terms the nutritional objective may be defined: to increase nutritional intake levels, to reduce the incidence of nutritionally related morbidity, and to improve the physical growth characteristics of the target population.

Mandate benchmarks in nutrition are in terms of calories only. Daily caloric intake of less than 2,160-2,670, depending on the country, places the average person in the target group. Table 3 from the MANDATE outlines these target group averages as they appear in the committee print.

The project cycle for a nutrition project should include direct measurement of some of the above mentioned nutrition indicators on the target population to be affected. The nutrition system is so interrelated with the income, employment, food production, education and health situation of the target group family that most successful mandate oriented projects will have important nutritional impacts. Estimating the nutrition impacts should be an element of most Mandate projects.

Table 3

Average Per Capita Daily Energy Requirements

Country	Calories	Country	Calories	Country	Calories
Uruguay	2,670	Mali	2,340	El Salvador	2,300
Turkey	2,520	Niger	2,340	Ghana	2,300
Egypt	2,500	Rwanda	2,340	Guinea	2,300
Cyprus	2,480	Ethiopia	2,330	Ecuador	2,290
Syrian Rep	2,480	Malawi	2,330	Gyuana	2,280
Chile	2,450	Mozambique	2,330	Honduras	2,280
Afganistan	2,440	Pakistan	2,330	Madagascar	2,280
Trinidad/Tob.	2,430	Burundi	2,320	Dominican Rep.	2,260
Yemen Rep.	2,430	Cameroon	2.320	Philippines	2,260
Moroco	2,420	Colombia	2,320	Cent. Afr. Rep.	2,250
Bolivia	2,410	Ivory Coast	2,320	Costa Rica	2,250
Tunisia	2,400	Jordan	2,320	Haiti	2,250
Brazil	2,390	Kenya	2,320	Jamaica	2,250
Upper Volta	2,380	Mauritania	2,320	Nicaragua	2,250
Chad	2,370	Somalia	2,320	Khmer Rep.	2,320
Mauritius	2,370	Zambia	2,320	Thailand	2,320
Nigeria	2,370	Dahomey	2,310	Laos	2,220
Senegal	2,370	Liberia	2,310	Sri Lanka	2,220
Angola	2,360	Panama	2,310	Zaire	2,220
Korea, Rep.	2,360	Paraguay	2,310	India	2,210
Botswana	2,350	S. Leone	2,310	Guatemala	2,200
Peru	2,350	Tanzania	2,310	Nepal	2,190
Sudan	2,350	Togo	2,310	Vietnam, Rep.	2,170
Gabon	2,340	Bangladesh	2,300	Indonesia	2,160

SOURCE Calculated from Annex Table Population, food supply and demand for food in individual countries; ASSMENT OF THE WORLD FOOD SITUATION, PRESENT AND FUTURE, Item 8 of the Provisional Agenda, United Nations, World Food Conference, November 1974, as it appeared in IMPLEMENTATION OF "NEW DIRECTIONS" IN DEVELOPMENT ASSISTANCE, AID, U S Government Printing Office, Washington 1975, p. 75.

5. DEFINING MEASURABLE HEALTH OBJECTIVES

Health objectives appear as important components in the Mandate. The Mandate lists four measurable indicators of health:

1. Life expectancy.
2. Infant mortality.
3. Birth rate.

Acceptable health status is obviously difficult to define Projects with health objectives have found it very difficult to define in measurable terms what the final benefits are. For many years there was an effort by health project analysts to attempt to measure the outcomes of health projects in monetary terms This approach, sometimes called the "costs of disease" approach has been largely unsatisfactory. It is encouraging that the Mandate avoids this approach and focuses the discussion directly on final indicators of health. Proponents of measuring health benefits in monetary terms argued that bad health reduces income in two ways· The productivity of the sick is lowered, and treating disease uses resources which could be producing added income

The problem of defining measurable objectives for health projects (or mandate projects with important health impacts) is not easily solved by suggesting that the final intent is really to increase income, via improved health. There is no hint that this is what is meant in the MANDATE; it speaks of "good health" as an objective to be pursued as an end in

Even more than nutrition, impacts on objective indicators of health are likely to be long run impacts. A health project may expect to affect the life expectancy of the target population, but it may take considerable time to measure the effect even if it is successful. Lowered incidence of particular illnesses, reduced days seriously ill, and reduced infant mortality are indicators which have been used as measurable project objectives.

The last of the mandate health benchmarks is access to health services. Using access (a "means") rather than improved health (an "end") as an objective is a reflection of the measurement problem outlined above. This is the first mention in the Mandate of access objectives. The variety of health benefits, their differences in kind and degree, and the high cost of gathering data using scarce medical personnel have all worked together to make health among the most difficult areas for objective measurement. Beyond the benchmarks mentioned in the Mandate (life expectancy, infant mortality, and birth rates) and simple morbidity measures (incidence of particular diseases, number of days incapacitated, etc.) lies a set of extremely costly and complex measurements which have been used to evaluate health expenditures. Most of these benefit measurements are unsatisfying because they cannot be reduced to similar units, and even inside health projects few comparisons are possible.

Measurable objectives for health will probably be limited in most cases to reducing infant mortality, extending life expectancy, and reducing the incidence of specified diseases or the amount of time incapacitated.

Using increased access to health facilities as the final objective of a health project, without even attempting to measure its final impact on more 'final' or direct measures of health status, has many disadvantages. Most important, no reliable experience is accumulated on the relative merits of different approaches to improving health. If no measurements can be made associating project activities and final results, no serious evaluation can be made. Even though the above mentioned indicators of health status are much less complete than might be desired, they are substantial improvements over access objectives.

4. INCREASING RURAL PRODUCTION

Increasing production in rural areas is an objective which requires conceptual clarification before it can be measured and used as a project design and evaluation criterion. Production increases in and of themselves are not necessarily beneficial to the target group. To illustrate this point let us take the example of a small farmer who increases his production of corn by using increased fertilizer which costs him more than the added production is worth. Additionally there are many well known examples where farmers increase the production of a particular crop, resulting in a sharp decrease in the market price and an actual reduction in the net income of the farmer. Added production of a particular crop is a poor indicator of added "production," since it may be substituting for other crops or livestock products in the farm.

With all of these conceptual problems it might appear that increased production is a useless indicator of welfare for target group farmers, and that net income, and not its proxy "production" is the only adequate measure. As long as the benefit is narrowly defined as a direct farm level benefit that is largely true, however, if the project takes a broader societal view of benefits, there is a residual of benefits to the target group which is not captured by the direct farm level net income benefit which may be addressed by properly formulated measures of increased rural production.

The private profit or net income interest of small farmers is not always consistent with society's interest in maximum total welfare, or even maximum total welfare of the poor majority. Economic theory would tell us that if product and factor markets operate freely, and if there are no significant factor immobilities, the private profit or net income drive of each producer will result in the greatest possible total welfare. Unfortunately these optimal conditions are not characteristic of most underdeveloped rural settings, land and credit are seldom priced and distributed in freely operating markets, and a wide variety of communication and exaggerated transportation and other barriers prevent equitable access to the scarce markets which do exist. Public interventions of all sorts distort the system to such a degree that it is unclear to what extent the individual net income measure is a valid proxy for overall welfare.

An example of the possible divergence between the private profits interest of the farmer and societal interest in the welfare of the total poor majority may be seen easily in the case of expanded production of a particular commodity by a wide variety of small farmers. Let us assume in the case of Costa Rica outlined in Table 1, where the target group farmers were producing corn, an expansion of corn production might result in a decreased corn price, and in reduced net incomes to small farmers if measured in simple direct farm level crop accounts. However, the reduced corn price means that both urban AND rural poor who consume corn will be able to buy more corn for less money, resulting in increased welfare. Thus, if the program is judged based only on direct farm level net income impact on small farmers, the important overall welfare benefits would be ignored. It is not infeasible that these indirect benefits may outweigh farm level losses. The example given is only one of a wide

variety of difficulties which make farm level net income a less than fully adequate measure of overall target group welfare. This section is not the place, nor DSP an adequate setting for the examinatio of these difficulties; their conceptual complexity and the methodological difficulty of measurement in this area preclude any serious treatment. It is important to realize only that increased production is only a useful measure when it is used at the economy level and not for a particular farm or group of farms. If production increases on a particular farm or group of farms, we cannot say that their net income has increased until net income itself is measured, and therefore increased production is a meaningless farm level indicator; we might just as well measure the real thing, net income, directly.

To measure the societal benefits which are not captured by the farm level net income measures, added refinements must be made to the concept of "rural production."' These refinements may be divided into two categories, first netting gross production to arrive at estimates of "value added," and adjusting observed market prices to reflect market distortions (shadow pricing) Neither of these techniques will be dealt with in depth in DSP because of their conceptual and methodological complexity. It is important for project personnel to realize that only when these adjustments are made can measures of increased production be obtained which are useful as project selection and evaluation guides. Of all the Mandate objectives, increased production is the most difficult to measure in a way which is useful for AID programming For most agricultural projects the size will not justify the necessary expenditure on analysis and measurement required to measure indirect benefits, and it may be tempting to select production increases as the project target instead of income because it is easier to measure or is thought to be a valid short-term or intermediate step. Speaking of rural production, the MANDATE addresses this issue as follows:

> "In some cases it may be necessary to restrict targets to certain short-term achievements .. rather than final outputs like improved income However, the program should be designed with a view toward AID's overarching goals of moving the poor beyond the poverty level and links with those goals should be explained " (11)

5. POPULATION

The population objective of AID as explained in the MANDATE is an intermediate objective presented in the committee print as a means for increasing per capita living standards. If we were to treat it like increased production as a means to increased income, health, and nutrition, we would wish to measure the final desired objectives and not simply achievements on the intermediate means. Population programs, like production increases, can be easily measured in terms of a single indicator, birth rate. The difficulties all begin when we attempt to link the population variable to the final objectives of increased income, health and nutrition. While considerable reserch has been undertaken on what factors influence fertility, little is known about the reverse, what effect altered fertility has on net income, health, nutrition and education The mandate specifically enjoins production projects

to "be designed with a view toward AID's overarching goals of moving the poor beyond the poverty level" and further requires that "links with those goals should be explained." (1) In the case of population no such linkage is asked for; the MANDATE simply states.

> "Increasing the size of the pie by providing more food and health services is essential to improving per capita living standards; substantial progress will only be possible if population growth abates " (12)

Taken at face value, the MANDATE discussion of population bypasses the issue of linkage of population projects to the three "overarching goals" (income, health, nutrition) and allows project designers to look at the intermediate objective of reduced fertility as if it were a final objective.

6. EDUCATION

The MANDATE outlines six objectives, three of which are presented as final objectives or desired "ends" (income, health, nutrition), and three which are presented as intermediate objectives or "means" to achieve the final desired improvements (increased rural production, population, education). It is important to note that while education might have been argued as a good independent of its impact on income, health, or nutrition, the MANDATE makes it clear that this is not the case for AID programs.

> "In a world of plenty, "education" may connote literacy and wide learning, truth for its own sake as well as a means to progress. In a world of want education must unfortunately of necessity be something far more restrictive and practical–as a means to improving living standards rather than an end in itself." (13)

Unlike population, considerable serious research has been undertaken to attempt to understand the impact of increased education on the final objectives of income, health, and nutrition. While the research has been extensive, the results are far from clear, and are usually unable to clarify project design and evaluation issues. Given the current state of the art, it will probably be some time before design and evaluation can be guided by measurement of project impacts on final AID objectives. Recognizing this difficulty the MANDATE defines "minimum practical education" as the proxy for the education objective.

7. PARTICIPATION

The congressional committee documents and AID's replies emphasize another objective of assistance under the rubric of "participation." The MANDATE explains the sense in which this objective is taken in the following terms:

WHAT IS THE MEANING OF "PARTICIPATION"?

Development progress for the poor will require time-consuming systemic change Programs most likely to succeed, and which receive highest priority emphasis under the congressional mandate and AID policy, are those involving the active and effective participation of the poor in all facets of the development process. This is clearly not a simple proposition to implement, especially as it has important political implications We shall refer to participation frequently in the following section of the report, but to briefly describe the participation approach to our staff we have used the following

- *Economic benefits are widely and significantly shared by the poor* with the objective of narrowing the relative income gap between rich and poor, for example, the co-op which benefits small farmers
- *Decisions concerning the activities to be carried out are made, preferably, by those benefited (for example, the poor)*, or if not, at least with effective consultation and substantial acceptance by those benefited
- *The activity in which they participate is, ideally, a learning experience for benefited persons*, which increases their technical skills and/or their capacity to organize for common purposes and for greater access to the benefits of development.
- *The poor make a significant contribution* in effort and resources to the activities from which they benefit, for example, through personal savings, or serving as members of local planning or project implementation committees, or through actual project implementation
- *The participation and contribution of women* should be explicitly taken into account under the above-mentioned considerations, for example, any of the above or other examples when the participants are women.

Only the first dimension, that of participation of the poor in the BENEFITS, outlined in the MANDATE will be dealt with directly in this manual and segment of the course. The other four dimensions, which relate to participation in the PROCESS will be addressed in other segments of the course.

FOOTNOTES TO PART A: DEFINING MEASURABLE "MANDATE" OBJECTIVES

(4) Agency for International Development, *The Congressional Mandate: Aiding the Poor Majority*, 94th Congress Committee Print, Washington, D.C., 1975, p. 65.

(5) Agency for International Development, *Implementation of "New Directions" in Development Assistance*, Report to the Committee on International Relations, 94th Congress Committee Print, Washington, D.C., 1975, p. 6.

(6) Agency for International Development, *The Congressional Mandate: Aiding the Poor Majority*, 94th Congress Committee Print, Washington, D.C., 1975, p. 68.

(7) Denis Goulet, "An Ethical Model for the Study of Values," *Harvard Educational Review*, May 1971, 41:206-207, as cited in Development Alternatives, Inc., *Strategies for Small Farmer Development*, Washington, D.C., 1975.

(8) Agency for International Development, *The Congressional Mandate: Aiding the Poor Majority*, 94th Congress Committee Print, Washington, D.C., 1975, p. 65.

(9) *Ibid.*, p. 64.

(10) *Ibid.*, p. 66

(11) *Ibid.*, p. 71.

(12) *Ibid.*, p. 73.

(13) *Ibid.*

(14) *Ibid.*, p. 74.

PART B

OBTAINING DATA FOR MEASUREMENT AND ANALYSIS OF MANDATE OBJECTIVES

1. UTILIZING EXISTING DATA

Different stages in the project cycle may require different types of data. At the DAP stage much heavier reliance can be made on secondary macro-data sources, while serious project evaluation can only proceed with original micro-level data gathered on project participants and beneficiaries. When data requirements are discussed it is important to specify the project stage. In particularly data rich countries it would be possible to visualize almost all of the data requirements of the DAP, PID, and PP supplied from existing sources, without the necessity of any primary data gathering efforts such as surveys. In data poor countries it would be difficult to complete even the DAP Sector Assessment chapters which present a profile of the rural poor without the gathering of new direct survey information. Because of this diversity in the availability of data between countries it is difficult to elaborate any rules of thumb about the gathering of original data, except in the case of the project evaluation stage where original data would need to be gathered in every case.

Existing data may be divided into three classes:

1. Existing Macro data and indicators.
2. Existing Micro data which have been processed and summarized.
3. Existing Micro data which are raw or only partially processed.

Locating and utilizing already processed and summarized micro and macro data may be a troublesome process in practice since much of it is buried in reports and documents which may be difficlut to access, and may require considerable effort to organize and present in a coherent fashion. While finding and organizing already processed and summarized data may be a time-consuming job, it is not conceptually or methodologically complicated; if the analysts keep their attention focused on *MANDATE* objectives, no special skills or techniques are necessary to assemble these data types into AID project documents.

Dealing with raw or only partially processed primary data requires much more sophisticated statistical and analytical skills and techniques. Existing primary data sets may be found in almost all AID countries and represent one of the best and usually untapped sources of data for AID project analysis. Among the most common types of this class of data are agricultural, housing, industrial, service and population/housing censuses, household surveys, client records of government rural service entities (credit, technical assistance, health services, etc.) and rural organizations (cooperatives, grower federations, etc.). These data sets usually require sampling procedures, and always require processing and analysis before they are usable for project purposes.

It is unfortunate that most project analysis proceeds without the benefit of these rich original data sources. There are two common reasons which accoaunt for most of the lack of use of existing primary data files; First, it costs money, takes time, and requires special technical skills and equipment to access, process, and analyze the data, and secondly it is not usually known to AID officials that these sets exist. Studies, reports, and other summarized data which have been published or informally distributed most often find their way into the AID/IBRD/UN project and program literature, and in most underdeveloped countries the literature on the rural sector is not so abundant that is is impossible to indentify and locate rather rapidly. Perhaps it is the cost and time implications of using existing primary data files which has resulted in their obscurity; it is usually harder to identify the 5-10 primary data files which exist in a country on the rural poor than it is to identify the 50-100 studies which are available in summarized form.

Existing primary data files tend to be large and it is usually impractical to process the whole file for AID project analysis purposes. In order to utilize the file, a representative sample of the original questionnaires or records must be selected for processing and analysis. Utilizing existing primary data files involves the same sampling process as a sample survey. Since sample survey procedures are discussed in some detail in the next sections of Part B, there is no need to duplicate that discussion here.

It is important to underscore the potential importance of existing primary data sets for the analysis of Mandate projects. The recent standards developed by the UN for agricultural and industrial censuses utilized in most censuses taken after 1969 provide the analyst with a depth of information on small farms and agroindustries comparable to many in-depth sample surveys. For example, the 1971 agriculture census of El Salvador contained 668 separate figures or pieces of information on each of over 200,000 small farmers, and the 1973 agriculture census of Costa Rica contains 523 descriptive statistics on each farm. Both of these censuses were utilized by AID to provide detailed profiles of the characteristics of the target group and to suggest project directions (15). In the case of El Salvador the semi-processed census was subsampled and reprocessed and analyzed: in the case of Costa Rica the complete agriculture census file was combined with the housing and population census and processed without sampling. In both cases a reasonably complete picture of the income, employment, production, and technological patterns of the target group was obtained. To have gathered these data in a separate sample survey would have cost at least 10 times the cost of reprocessing the already gathered sources. In the case of Colombia a sub-sample of 3,000 small farm records was drawn from the files of a public supervised credit entity with a small farm clientele of over 50,000. These records included financial and technical data sufficient for in-depth evaluation of the credit program, and for the design of a wide variety of rural target group projects (16).

Care should be taken to locate and evaluate the potential for existing primary data sources before planning costly sample surveys, or settling for inadequate secondary or macro-data. While the above examples are drawn from agriculture, there are also similar possibilities in health, housing, nutrition, education, education and population areas.

There is so much difference in the volume and quality of the primary data available from country to country that it is difficult to discuss data gathering in the abstract.

In many countries agriculture censuses have never been taken and it is probable in some data-poor countries that primary data sets do not exist. The above discussion must therefore be taken in context. What is interesting is that AID officials in even relatively data-poor countries are often not aware of the existence and potential of the few primary data sets which do exist.

2. *GATHERING ORIGINAL PRIMARY DATA. THE SAMPLE SURVEY*

There are many methods of obtaining original primary data relevant to M projects. These methods vary in the degree to which they are formalized. Informal methods include field trips, discussions with host country officials, etc. In some cases, the field trip may be an attempt to visit a small number of farms with the idea of getting a "feel" for rural situations, and may be thought of as a kind of survey. Instead of writing all of what is seen and heard, it is kept in memory and its meaning distilled at a later date when a report is written or an opinion or judgment proferred about what projects are needed, etc. In almost all cases the field trip covers only a small part of the small farms, target group households, rural schools, health posts or other units which are the subject of the analyst's interest. In almost all cases, after a field trip the analyst should wonder if the units he visited are really representative of the total group, if the information he solicited was consistent enough between visits to allow him to make rational comparisons, did he talk to enough subjects to get generalizable insights, was the information given biased either by the respondent or perhaps even by the analyst? All of these questions are of vital importance; the techniques which have been developed to improve the quality of the process of original data gathering are loosely termed survey research techniques.

a. Standardization in Gathering Original Primary Data

An important problem in gathering original primary data is assuring the comparability of data gathered by different people on widely dispersed and in some cases heterogeneous types of people, businesses, or institutions. The problem of standardization may be thought of as separate problems.

-Conceptual Standardization.
-Definitional Standardization.

i. Conceptual Comparability

Obtaining differing perspectives on the same problem is an important element in getting a realistic picture of complex development situations. However, it is sometimes difficult to interpret these perspectives unless some method is found to standardize the concepts about which data are gathered. For example, one of the commonest methods used in AID for informal original primary data gathering is the "team field trip." A group of

specialists in different fields fan out into the rural areas or into the institutions serving the rural poor and then return to pool their ideas and formulate approaches for AID action. It is impossible to participate in or observe many of these efforts before noting a troubling pattern. If the team is composed of livestock expert, a credit specialist, a cooperative expert and a soils conservationist, the report of each indicates that his field trip revealed the importance of action in livestock credit, cooperatives, or soils conservation. If the four are forced to present a joint report it will almost always suggest that something be done in each area. A series of difficulties in the process of gathering original primary data is obvious. Part of the problem is one of conceptual standardization, part of it is professional bias, part is a difference in the kind of data gathered, and part a result of the fact that they talked to different people and looked at different situations. The field of survey research is that body of knowledge, technique, or methodology which has been developed to help formalize the data gathering process to reduce the inaccuracy and incomparability caused by these difficulties. It must be remembered that there are no sure ways of eliminating problems like professional bias or conceptual ambiguity; survey research methods are only ways of structuring the process to reduce their influence.

Structuring the process begins with conceptual or problem definition. The MANDATE itself assists AID programmers by formulating the general issues about which AID business is to revolve. Unfortunately, AID practitioners may think that all of these issues are implicit, well understood, and need not be restated in the data gathering process. For example, in the above mentioned field team, the livestock expert may well think that his mission is to discover how the feed/meat ratio in swine can be improved on small farms, or the conservationist to explore how small farms should crop to increase vegetative ground cover during the rainy season. If there is no careful specification of the problem it may be impossible to know exactly what is in the mind of the data gatherer as the objective of his mission. Too often if this conceptual or problem definition is left to the expert he focuses on a sub-issue or problem which his current research interests are concentrating on in "Iowa." There are two approaches to overcoming this difficulty; one is to use the MANDATE objectives, to specify the problem, and then outline the information needed to illuminate it. The other is to obtain less biased, less specialized, and more experienced experts.

Using generalists (like economists instead of livestock specialists) has the obvious weakness that important detail is lost–the generalist simply cannot know enough about each sub-area to provide reliable and satisfying solutions to complex problems. Neither should the generalists be seen as arbiters, overseeing the various specialists and filtering the final solutions; their disciplines (economics, for example) carry their own set of biases.

While survey research is no panacea to all of these difficulties, it does provide a way of structuring the problem and if properly planned can provide some insulation from the vagaries of individual opinions. In order to illustrate the survey research alternative and how it would provide a way of structuring a problem, let us take a simplified example of a M issue.

How could AID structure programs to increase the net income of the poor small farmer in country X? The problem or overall issue is farmer net per capita income and how to increase it. The information gathering process would begin outlining a conceptual framework by asking questions such as what is the current income structure of the target group, what are the major factors which influence it, and how could programs cause favorable changes in these factors? These three statements, while oversimplified, focus the data gathering process explicitly on a central issue and the start is laid for a serious survey research effort. The MANDATE objectives if taken seriously provide considerable conceptual basis for program and project-oriented measurement

With the explicit MANDATE objective always on the surface, the next question would be what information is needed to indicate the structure of target group incomes, the factors which influence it, and how can they be changed Experts from various fields might then begin to outline what information is needed about livestock (and all other income sources) on target group farms to estimate livestock income; perhaps the same hypothetical livestock specialist would be called on to make this outline. He will probably say that we must know the number, age, and type of livestock, information on births, deaths, slaughter, and live sales. In addition, production, sales, and consumption of dairy products, wool, and eggs will be required. If net income is to be estimated, some accounting of the costs of livestock production will be needed, and the specialist will make a list of probable cost items When he turns to outline the information needed to explore the factors which influence livestock income, he may well include his area of research interest; and if particularly biased, may exclude from his list any other factors. The survey discipline cannot prevent that bias from showing through, but the narrowness of focus is more obvious to collaborators, and indeed more obvious to the specialist himself as he struggles to specify the information needed to understand what livestock factors influence small farmer income.

The first step in structuring data gathering is to outline in writing the MANDATE objective to be explored, and to list the kinds of information which would illuminate that issue. Whatever specialists are involved should agree on these overall issues and conform their information requirements and analysis to them. This is what we have defined for this manual as conceptual standardization.

Outlining the problem requires a certain level of knowledge about it. The level of current understanding and the stage at which the survey enters in the AID project cycle will have much to do with the conceptual formulation of the problem and the issues to be examined. Surveys may be used to identify and measure the target group and their apparent problems, to provide a profile of target group characteristics, to explore the potential of particular project interventions, to test hypotheses about cause and effect in the target group, to evaluate the effectiveness of AID projects, and in fact to clarify any issue which requires systematic information from the field.

Where little is known about the problem, considerable pre-survey exploration and discussion may be required. Warwick and Linnger indicate.

> "Humility is a virtue in survey research as elsewhere There are times when we may be vitally interested in a problem, but simply not know enough about it to design even a rudimentary descriptive study. In these cases it is better to clarify the problem itself before taking to the field. The sample survey is usually not the most appropriate vehicle for pursuing essentially exploratory research " (17)

While Congress and the MANDATE give considerable conceptual guidance on the problems which are to constitute AID's data gathering activities is that the pressure of the project cycle forces programmers and analysts alike to move very quickly from exploration and description to project design; that is, to bypass description and focus on prescription. For example, before knowing how significant swine income is to the target farmer, or what the current meat/feed conversion ratio is, the project cycle may force the specialist to prescribe a project to increase the ratio.

On the importance of exploratory and descriptive surveys Warwick and Lininger state:

> "An essential task shared by descriptive and explanatory studies is conceptualizing the phenomenon in question.... Description in other words can lay the groundwork for the pursuit of other objectives including explanation and hypothesis testing, evaluation, prediction, and the development of indicators." (18)

Establishing conceptual clarity and outlining the nature of the problem to be studied in a sample survey is not a single exercise, rather it is a process in which exploratory and descriptive surveys may themselves provide useful feedback for further survey work.

Beyond exploratory and descriptive surveys the MANDATE indicates the need for using a variety of data which may be gathered by survey.

> "The Agency now requires as a condition of approval, that all project designs incorporate evaluative elements (for example baseline data, verifiable targets, progress indicators, and explicit design assumptions) as well as an evaluation action plan." (19)

In all types of surveys a consistent conceptual formulation of the problem or issue studied is a first and vital step.

ii. Definitional Standardization

In order to insure that the data gathered are comparable from one respondent to another, it is important to make certain that a consistent set of definitions is used. Each interviewer and respondent should have the same definition for each data item or characteristic to be gathered by the survey. Three techniques are commonly utilized in survey research to standardize this consistency.

The first is the development of a consistent set of definitions in an interviewer's manual, and the participation of all interviewers in an interviewer training course. These manuals vary in length according to the complexity of the survey.

The second method is the use of a printed questionnaire in all interviews containing the actual wording of questions to be repeated by the interviewer. It is impossible to assure that all persons being interviewed have the same perception of a concept. For example, if the issue to be measured is literacy, it would be fatal to leave the formulation of the question to the judgment of each interviewer. Even if the question is phrased carefully, and asked consistently the same way, there is potential for deliberate respondent distortion. This is particularly true for issues like literacy where the question itself is sensitive In formulating questionnaires it is important to rework the questions until they are specific, simple, and cast in words familiar to all respondents. Before proceeding to the full field exercise, a field test is necessary to adjust the formulation of the questions.

The third technique for standardizing is to use interviewers who are *not* profesionally related to the subject matter under study. Selecting interviewers is a difficult task for survey research; ideally, they should understand the subject matter and the definitions well enough to be able to explain questions about the survey to respondents, and to avoid conceptual misunderstandings. On the other hand, it is best if the interviewer has no preconceptions about the outcome of the study or any intellectual commitment to any particular pattern of responses. For example, extension agents are not the best interviewers in agricultural studies because they tend to search for particular responses and to give the respondent subtle indications of what he ought to be saying. An expert also faces the temptation to ask questions in a leading fashion or to substitute his own impressions for the actual response. The ideal interviewer does not exist; if he has enough understanding to conduct a good interview, it is likely that he will also have a bias. There is no easy solution to this problem; a balance must be sought in selecting interviewers between expertise and subject matter neutrality.

Assuring that the same questions are asked of all respondents, that the interviewers have in mind consistent definitions, and that professional bias is minimized, all contribute to definitional standardization of the data gathered.

b. Techniques for Obtaining a Representative Sample

A survey may be taken of every small farm household in a country, in which case it would be called a census. If a smaller number of households are selected for interviews on the basis that they are representative of the whole population, the selected group is known as a "sample." The process of selecting this sub-group is called "Sampling," its objective is to assure as far as is possible that the sub-group is representative of the whole population so that inferences about the whole will be reliable.

i. Reliability and Sampling

When a small number of people or farms is used to estimate the characteristics of a whole population, the confidence which we may place in these estimates depends on many factors. Before examining these factors it is important to understand the survey research concept of reliability. To the survey statistician "reliability" really means "replicability" in the total population. For example, when political surveys are taken to ascertain voting preference three months before an election, the fact that 80% indicate a preference for candidate X, and Y wins by a landslide three months later does not necessarily mean that the 80% estimate was "unreliable" in statistical terms. When the statistician publishes his results and indicates that the 80% estimate is 95% reliable, he does not mean that there is a 95% chance that three months later X would win, or even that 80% would actually vote for X if the election were taken on the date of the survey. He means that if the same survey question had been asked of 100% of the voters on the date of the survey there is a 95% chance that they would have answered the questions in the same proportion as the sampled voters. It may be that inside the voter's box people react differently than they do when asked in a survey. Political, personal, economic, and social events will probably intervene in the three-month interval between the sample and the election to change opinions. The questions in the survey may have been ambigouously phrased, or the interviewers inadequately trained. Hence inaccuracy or error in estimates may be divided into two classes: sample and non-sample error. Sample error is that error which results because only a sub-group of the population was interviewed; it is the difference in the pattern of responses obtained from the sampled voters and the pattern of responses which would have been obtained if all of the voters had been given the same questions at the same time in the same fashion. Non-sample error includes all other sources of distortion such as conceptual ambiguity, inadequate training for interviewers, inadequate quality control in coding, processing and interpretation, respondent distortion, etc. In the previous section the discussion focused on standardizing the gathering process to minimize non-sample error; this section deals with techniques to assure that sample error is minimized.

The techniques explained in the last section to minimize non-sample error fit with common sense, quite the reverse is true for the techniques used to reduce sample error–they usually run counter to the intuition of most people unfamiliar with survey research. It has been proven that the reliability (the degree to which the sample responses represent the total population) depends principally on the degree to which *chance* procedures are used to select the sub-group interviewed, and the *absolute* size of the sub-group. The purpose of this section is to explore the influence on reliability of alternative sample selection procedures and sample sizes.

ii. Probability and Non-Probability Sample Selection Procedures

Probability samples are drawn from the whole population using chance procedures non-probability samples use other methods. In order to understand this difference we must explore the statistician's meaning of the words "chance" and "random." If an inter-

viewer were told to interview at random any ten people, the result would not likely be "random" or "chance" selection which could be used to make reliable estimates about any population. The interviewer might well find the "easiest" ten people to interview, people not at home would be excluded, he might even interview his family and friends. The group selected would not bear any systematic statistical resemblance to the population as a whole. In common usage the words "random" and "chance" are often used synonomously with "haphazard." To most people a process which is systematic is not random As we shall see, the processes for sampling referred to by statisticians as "random" or "chance" are in fact very systematic. Warwick and Lininger emphasize this point as follows.

> "An example will illustrate the dangers of using nonchance sampling procedures, or of mixing them with chance procedures. A study of women began with a chance selection of dwellings in the study area However, bias arose when chance procedures were abandoned in selecting the respondents. If the women in the selected dwellings were not at home when the interviewer called, next-door neighbors were substituted At first sight, this may seem like a perfectly reasonable procedure, especially in a study with limited budget and a tight deadline. The results, however, revealed a decided bias in the respondents actually chosen for interviews Working and socially active women were seriously underrepresented in by a sampling method favoring those who stayed at home during the day. Hence a seemingly innocent departure from chance procedures was highly damaging to the results of the study." (19)

It is important to note that the most troubling difficulty caused by non-chance sampling procedures is that it is virtually impossible to estimate or detect bias without a census covering the whole population, or without conducting a properly chance selected sample survey for comparison. In the Warwick and Lininger example the bias entered would be impossible to detect and measure unless some superior data source is available. Chance selections are the only methods for which carefully elaborated statistical methods are available to estimate their own reliability. In most sample surveys, there is no superior data source available; if there is, the survey itself would not be justified It is therefore important to be able to estimate reliability without reference to external standards.

Non-probability methods of sample selection are often used in practice The method used in most field trips by AID officials uses the professional opinion of the expert as the selection procedure. he visits farms which he thinks are representative. Limited budget and time are poor excuses for ignoring the statistical power of random and chance methods in gathering sample information. Even field trips would provide improved information if simple but serious attempts were made to see chance selected areas and visit chance selected farms or households. All too many field trips visit the health post that the AID driver knows how to get to. the farm owned by a friend of our local hire technician, or the corn field where the local extension agent takes us.

iii. Random Techniques for Sample Selection

Sampling situations may be divided into two groups--situations in which a list of all sample units (people, farms, households, health posts, etc.) exists, and situations in which there is no complete inventory available. Discussion begins with simple list samples, since the availability of a list permits us to avoid most of the difficult and costly sampling alternatives, but illustrates the principles of random selection.

SIMPLE RANDOM SAMPLING

All samples begin with a clear definition of the population studied. If the population to be studied is defined as all small farms, then "small" must be defined. If a census is available with names of producers and farm locations for all farms, and if the census also identifies farm size, a list can be compiled containing all farms under 10 Ha., for example. The name of each small farm producer could be put in a large urn. Determining the size of the sample required is the topic of the next section, so let us assume that the number of farms to be included in the sample is 1,000. A blindfolded assistant could pick 1,000 names from the urn and a perfect simple random sample would result with predictable statistical characteristics, and a measurable relationship to all small farms.

Table 4

Excerpt from Tables of Random Numbers

98	08	62	48	26	45	24	02	84	04	44	99	90	88	96	39	09	47	34	07	35	44	13	18	80
33	18	51	62	32	41	94	15	09	49	89	43	54	85	81	88	69	54	49	94	37	54	87	30	43
80	95	10	04	06	96	38	27	07	74	20	15	12	33	87	25	01	62	52	98	94	62	46	11	74
79	75	24	91	40	71	96	12	82	96	69	86	10	25	91	74	85	22	05	39	00	38	75	95	79
18	63	33	25	37	98	14	50	65	71	31	01	01	46	74	05	45	56	14	27	77	93	89	19	36
74	02	94	39	02	77	55	73	22	70	97	79	01	71	19	52	52	75	80	21	80	81	45	17	48
54	17	84	56	11	80	99	33	71	43	05	33	51	29	69	56	12	71	92	55	36	04	09	03	24
11	66	44	98	83	52	07	98	48	27	59	38	17	15	39	09	97	33	34	40	88	46	12	33	56
48	32	47	79	28	31	24	96	47	10	02	29	53	68	70	32	30	75	75	46	15	02	00	99	94
69	07	49	41	38	87	63	79	19	76	35	58	40	44	01	10	51	82	16	15	01	84	87	69	38
09	18	82	00	97	32	82	53	95	27	04	22	08	63	04	83	38	98	73	74	64	27	85	80	44
90	04	58	54	97	51	98	15	06	54	94	93	88	19	97	91	87	07	61	50	68	47	66	46	59
73	18	95	02	07	47	67	72	52	69	62	29	06	44	64	27	12	46	70	18	41	36	18	27	60
75	76	87	64	90	20	97	18	17	49	90	42	91	22	72	95	37	50	58	71	93	82	34	31	78
54	01	64	40	56	66	28	13	10	03	00	68	22	73	98	20	71	45	32	95	07	70	61	78	13

While the method described is satisfactory, it is physically cumbersome and statistical techniques have been developed to provide easier ways to accomplish the same randomizing effect. Many variants are available on the theme of random number tables which are used to make random selections from lists including a complete population. A table of random numbers, like the preceeding one, is generated by a computer using a method for selecting numbers in a specified interval in which each number in the interval has an equal chance of being selected. The result is a table of numbers from 00-99 in which the order is purely random, or selected by chance.

Before the proliferation of computers these printed random number tables were often used to generate simple random samples. If there are 270,000 small farms in the total population, and if 1,000 farms are to be included in the sample, a random number table with six-digit numbers could be used. Starting any place on the table numbers would be selected in any systematic fashion; for example, from right to left or left to right, taking each number or every fifth one, etc. The list of all farms would be organized according to the alphabetical order of the last names of the producers, and the farms would be numbered from 000001 to 270000. Each time a number is encountered in the table which corresponds to one of the farms it would be included in the sample. This procedure would continue until 1,000 farms were selected. A simpler method is to use the same computer program which generated the random number tables to produce 1,000 random numbers between 0 and 270,000.

VARIATIONS OF SIMPLE RANDOM SAMPLING FROM LISTS

There are a number of reasons for subdividing the universe for sample purposes and treating each segment as a separate sample. One may be an interest in using different questionnaires; for example, a sample of the rural target group may be usefully divided between farmers and landless rural worker families so that a different income questionnaire might be taken to the two groups It may be that age sub-groups are divided up in order to improve the representative nature of the sample on the age variable. This technique of subdividing the population is called stratification. Three important problems must be faced if stratification is used. First there must be information available on the stratification characteristic for each of the households or sample units; if age is to be used to form strata, then age must be known before the sample is formed. Secondly, if separate interview procedures or questionnaires are used it will be impossible to be certain that the data are truly comparable between strata; stratification can often result in forcing a stratification in the analysis as well as in the sample, with the consequence that two separate studies must be produced. Thirdly, while most complicated stratification schemes start out with the intent of adding reliability and representativeness, they are often defeated by their own weight. Warwick and Lininger explain:

> "Elaborate schemes of stratification in survey research are often not worth the effort Sometimes social researchers are so anxious to improve the representativeness of their samples on key variables that they produce designs that are

unworkable in practice. At best there may be only slight gains in reprsentativeness and at worst the sample may be less representative than a simpler design because of difficulties in complying with the overly complex procedures. The information from the survey itself should provide an excellent basis for subsequent classification of individuals on complicated variables such as class. This task can be done well only at the analysis stage when the relevant questionnaire responses are available." (20)

Stratification is a subject beyond the reach of this manual; all that need be known by the DSP participant is that in some cases it may be useful, or even necessary to separate the population into separate groups, on which essentially separate samples are drawn. Once the separation is made, simple random sampling techniques are applied to each group separately.

Another commonly used variation of simple random sampling is to use a preselected interval on a list. For example, if the list of small farmers numbers 270,000 and a sample of 1,000 is desired, a starting place on the list could be selected at random, and every 270th farmer from the starting point (both forward and backward) would be selected for inclusion in the sample. A similar technique is often used in urban surveys without a list in which every 10th dwelling is selected for interview.

By adjusting the level at which the sample is taken, a wide variety of these techniques can be imagined. For example, suppose that in a survey aimed at school children, the school could be taken as the sample unit. Schools could be listed and sampled at random, then inside each selected school all children could be interviewed. Most of these techniques are aimed at overcoming two problems. First is the unavailability of complete lists; it is easier to find a list of schools than a list of all school children. Second is to overcome the added costs of transportation and time wastage in interviewing a widely dispersed population. If schools are the sample unit the interviews will cluster in a limited number of geographical locations, thus reducing the distance between interviews. These techniques are referred to as "clustering."

AREA SAMPLING

Using geography as the sample unit has many advantages; the principal alternative to using lists for samples is called area sampling. Area sampling has the advantage of not requiring lists of sample units as a starting point. It does, however, presume the existence of mapping in sufficient detail to allow for reasonably detailed geographic subdivisions. Area sampling proceeds by dividing the geographic area in which the subject population exists into definable segments. These segments are then sampled on a random, or stratified random selection basis. All of the subjects in the selected area segments are then interviewed. In order to assure some control over the size of the final number of households included in the sample, the country is usually stratified into four or five overall areas based on the expected density of households.

A useful variation on the area sampling theme involves drawing the sample in two or even more successive steps. First the area segments would be sampled so that only a small randomly selected number of the areas are included. All of the households or farms in each of these selected areas would then be given a short interview or enumerated to gather just enough information for sampling purposes; no subject matter information would be gathered. A simple or stratified random sample would be drawn inside each of the segments from the lists generated in the enumeration stage, and the final interview made. The existence of the area frame (a selected number of geographic areas) allows the sampler to reuse the same areas but select a new list of households or farms each year from the lists generated in the enumeration.

Area frames for sampling may be drawn on almost any consistent basis from maps. They may be divided by artificial grid lines superimposed on the map, or by natural boundaries such as streets, highways, rivers, mountains, etc.

As can be seen from the more complicated area frame sample structure, all of the sampling elements (area, stratification, randomization, clustering) can be combined. All that is necessary is that the system be random, and that the sampling system adopted assure that non-chance influences are minimized.

NON-CHANCE INFLUENCES

One of the most important non-chance influences in the most carefully designed sampling system is the unavailability, or the refusal of a selected respondent to participate. There is always difficulty in finding selected people at home, or on their farms. If the budget for the survey is slim it may be difficult to go to the nearest town to locate the farmer for an interview. If a selected farm or farmer is left out, the statistical basis for the sample is injured; there are methods for overselecting such that the number of farms desired is obtained, but the bias of not having the one selected is impossible to erase. The reason for this bias is that "unavailability" is not a random phenomenon. Especially busy farmers with lots of transactions in town may be more often unavailable than the average farmer. This unavailable group is usually small and it is worth spending much more than the average interview cost to find and include them.

Another troublesome type of non-random influences are those sampled units (households, farms, etc) whose questionnaires must be discarded because of inconsistencies or errors. There is good reason to believe that these errors are not random; farmers intent on confusing the untutored interviewer in a cost of production survey, for example, may give information whose internal inconsistency only becomes clear in the analysis phase. Farmers trying to hide high incomes may not be a random group Consistency checking and questionnaire review in the field is the only adequate solution to this class of non-random influence. If the errors are identified in the field, a reinterview will usually correct the

problem. Surveys of small farmers in most LDC's should include budgeting to reinterview almost one-third of the households to clear up problems. Field control in all surveys is needed if a high discard rate is to be avoided. In some cases these inconsistencies and errors are adjusted automatically by the computer, and the questionnaire is retained. The technique used identifies values in any questionnaire which do not lie within pre-set limits; these supposed erroneous values are then erased in the computer memory and replaced by the average for that value in the balance of the questionnaires. This allows the sample to remain intact, while neutralizing the influence of a strange value. This technique has the disadvantage of distorting the amount of variation in the sample, and because the pre-set limits are usually established too broadly to capture a large part of the erroneous entries, it is a questionable practice. In general, errors which leave the field are uncorrectable; the only chance for reasonable adjustment is in a field re-interview.

Earlier it was noted that there are two types of errors in survey research: sample and non-sample error. Quality control in the interviewing process was mentioned as a source of non-sample error. From the previous paragraphs it can be seen that where quality control in the field is lacking, the resultant questionnaire discards can indeed lead to significant sample error; there is therefore an interaction between these two classes of error.

A final area in which sample and non-sample error interact is in refusal of selected subjects to participate in the interview. In addition there is the concern, particularly in questionnaires requiring long or multiple visits, that the respondent will begin hesitantly but refuse to complete, or he may tire and give inaccurate responses toward the end of the interview process. One of the counter-intuitive phenomena in survey research is the surprising willingness of the overwhelming majority of respondents, particularly in underdeveloped countries, to participate in surveys. There are, of course, many sensitive subject areas, and culturally sensitive groups of people that do not fit this generalization. Except for population, MANDATE issues are not generally difficult to survey, and rural populations in most developing nations are particularly receptive to appropriately administered surveys.

iv. Sample Size

The number of respondents has an important influence on the reliability of sample survey information. The absolute size, and not the proportion of the population sampled, is the principal size factor which determines the reliability of samples. Samples of the same size would result in roughly the same reliability levels in a country with 3 million in the total survey population, as in a country with 200 million. For most people this is counter-intuitive; they would expect reliability to be related to the proportion of the population which is included in the sample. Warwick and Lininger explain this phenomenon as follows:

> "The greatest intellectual hurdle to the acceptance of sampling concerns the reliability of estimates. The potential user of survey research will often ask how

> one can possibly take a sample of 2,000 people in a country of over 200 million people and arrive at a reliable estimate of the number of multiple-car families, potential voters who favor one or another candidate, and so forth.
>
> Usually the most important factor in reducing the standard error is the *absolute size* of the sample . . Newcomers to the field sometimes advance the common-sense hypothesis that sampling error depends primarily on the *proportion* of the sample to the total population. They might argue, for example, that a 5 percent sample of a national census will be five times more reliable than a 1 percent sample, a 10 percent sample twice as reliable as a 5 percent sample and so on. While this argument may seem plausible, it is erroneous." (21)

In the short time devoted to sampling in DSP it is impossible carefully to outline the algebraic proof of the concepts presented, and it is additionally true that in simplifying and summarizing these concepts the presentation leaves out important exceptions to the rules stated. There are cases where the proportion sampled is important, yet they are exceptions and not the rule.

Since the absolute size of a sample is more important than its proportion of the total population, some general comments should be possible about necessary size of samples which is independent of the subject matter, and the size of the total population in question. A factor which has an important influence on the necessary sample size is the degree to which the final estimates are to be disaggregated. For example, if the political preference poll is to be reported by state, with analysis of the position of voters in Virginia separate from each of the other fifty states, then for sample purposes there are essentially fifty samples, each with its own absolute size requirements, to achieve and acceptable level of reliability. If the preference patterns of male voters is to be discussed as a separate topic with estimates from the survey and by each state, then it is best to visualize the sample size requirements in terms of 100 separate samples. While these issues are not nearly as simple as they are here presented, the underlying point about the importance of the absolute size of the sample, and the influence of regional and other stratifications on sample size is essentially valid.

Since the absolute and not the proportional size of the sample is the principal size criterion, it is possible to talk about sample size in the abstract without reference to the size of the population studied. It is important to remember that each region or classification stratum for which results will be presented separately constitutes a separate sample for size determination purposes. The important question for this section is, how many observations (sampled units) are needed to reach acceptable levels of statistical reliability? While there is no simple answer to this question which will work for all situations regardless of the variation present in the population, it is possible to suggest a minimum size below which reliable estimates are not likely to occur. That minimum is around thirty, that is, for any region, or sub-type within a sample, it is necessary to have at least thirty observations (sampled households, farms, etc.) before the sample error is reduced to acceptable levels. The reliability acceptable is, of course, a relative idea and there are methods by which statisticians can

estimate the probability that a particular sample finding would be inside a specified range. For example, in a small farmer survey a statistician might say that the estimated average income is $128 per capita, and that there is a 95% probability that the true population figure is between $114-137. This range is called the 95% confidence interval.

Small samples under thirty observations do not generally have statistical properties resulting in acceptable confidence levels. Warwick and Lininger outline this phenomenon in slightly more explicit statistical terms as follows:

> "It is worth noting that, except for small samples of about 30 or less, the attribute to be estimated (such as income) does not have to be normally distributed in the population in order for the distribution of sample means to approximate the normal curve... . This means that it is not necessary for family income to be normally distributed in the population for the distribution of sample means of income to approximate the normal curve." (22)

While the thirty minimum rule of thumb may be useful to establish a general range for the necessary sample size, it is not a sufficient guide to arrive at the correct figure; each case may require the special skills of a sampling expert to establish the required number of observations. It is important to remember that the structure of the sample will determine the breakdowns possible in the analysis. For example, if a sample is designed to give reliable estimates only on the national level, it is impossible to conduct analysis later at the regional level and expect to maintain acceptable reliability. The basic structure of the analysis must be known at the time the sample is structured.

c. Time Phasing the Sample Survey

The data requirements of the AID project cycle vary at each stage, and the survey design which is most appropriate follows these differences. The different ways surveys can be designed to fit the time phasing of the project is discussed in this section. For the purposes of this discussion we will divide the project cycle into three stages. First is the sector overview stage (DAP and Sector Assessment) in which the general characteristics of the target group are outlined and the principal constraints which limit their improvement are identified. The second stage includes project selection and design (PID, PP) in which data provide guidance on the feasibility, costs and benefits of proposed projects. The third stage is project monitoring and evaluation in which data provide a measurement of the actual impact of the project.

There are no clean lines dividing these stages from the point of view of survey design; almost any of the survey types which will be discussed in this section would shed some light on all of the project stages. Nonetheless certain of the survey designs fit more closely the data needs of certain stages.

i. Simple Cross Sectional Surveys

A cross sectional survey is one taken at one point in time and not repeated. It is an attempt to obtain a single snapshot of the situation studied at one point in time. Cross sectional surveys are particularly appropriate for the first stage in the project cycle. For sector overview a cross sectional survey will give a very detailed profile of the target group. From this profile their major problems and potentials can be studied. Cross sectional surveys are much easier to administer than the other survey types, and the costs are more manageable.

The cross sectional survey can be used also to investigate cause-effect relationships, and can also be used for the kind of analysis usually thought of as control group analysis. After discussing longitudinal survey techniques aimed at assessing the factors associated with change and control group surveys, we will re-open the subject of cross sectional surveys and explore how they can be used as substitutes for both of these alternatives.

ii. Control Group Surveys

Control group surveys are surveys in which two (or in some cases more) samples are selected and given the same questionnaire. The objective of a control group survey is to investigate causation in a semi-controlled quasi-experimental setting. The two groups are called the experimental group and the control group. The characteristics of the two groups are to be as similar as possible in all categories except those characteristics which are the hypothetical causes, and those characteristics which are hypothetically affected. The idea is to hold everything constant *except* for the supposed cause, and then to measure the characteristic affected by that cause. Control group surveys test hypotheses about cause and effect.

For example, fertilizer is supposed to increase yields in corn. That is a causation hypothesis and it can be tested in a control group survey. Two groups of farmers would be selected; first, a random group of farms growing corn and using fertilizer–this is the "experimental" group. A control group of farmers would then be selected who grew corn but did not use fertilizer, however this second group would not be selected at random. The second group would be farms whose characteristics match those of the experimental group in every respect except two–they did not use fertilizer in corn, and their corn yields need not match the experimental group. Notice only the supposed cause (fertilizer) and the supposed effect (yields in corn) are allowed to be different in the two groups. The selection of the control group is costly and difficult, farms of similar size, similar soil, similar managerial talent, similar climate, similar seeds, similar disease problems, similar credit situation, and so on until every factor which may cause yields to increase has been controlled. If a difference in yields is observed the analyst is willing to say that fertilizer, since it was the only significant difference between the two sets of farms, is an apparent cause of the yield increase.

Control group techniques are particularly useful in project selection, design and evaluation. In project selection and design, the cost benefit analysis technique requires "with project" and "without project" data on costs and benefits. With-project situations are essentially experiment groups, and without-project situations essentially control groups in a control group survey. Evaluation can be done through the medium of carefully designed control groups.

The underlying idea of the control group is one which underpins much of the survey research field and it is important to understand both the theory and its defects in order to understand data gathering and interpretive techniques. Cross sectional control groups have two important disadvantages. The first is that it is very costly and difficult to find farms (or households, etc.) which match on a wide variety of characteristics but differ in just the one which is to be studied. In order to be properly undertaken, a preliminary survey must be conducted on a large population simply to identify their characteristics for the purposes of selecting the control group. This difficulty has led to the use of experiment farm and laboratory experiments where it is much less costly to control all of these factors. While the experiment farm seems a solution to the agronomist, it is not so for AID. It has long been known that the most difficult part of the agricultural chain of causation which stands between the small and poor farmer and prosperity is not captured very well in these controlled experiment farm studies. Too much is controlled, and too much of that which is vital in the causation of increased corn production in actual small farms is thereby ignored.

The second problem related to control group techniques is a conceptual one dealing with the choice of which factors are to be controlled and which factors are to be left uncontrolled. The problem is to decide which characteristics of the experimental group of farms (fertilizer users) we wish to match with similarities in the control group farm, and in which characteristics we will tolerate differences. In order to highlight this problem let us take the example of the fertilizer control group survey discussed above. We can make a list of the factors which we wish to be similar in both the control and experimental group farms, and the residual or all the rest we are willing to leave uncontrolled; they may be similar or dissimilar. First let us make the list of characteristics we wish to be similar--significant acreage in corn, similar soils, similar climate, similar management skills, similar amount of labor, similar pesticides, similar irrigation, and many others. Factors like irrigation need to be controlled because of their independent power to increase yields, if one farm used no fertilizer, but irrigated heavily, while the other farm fertilized but did not have any irrigation water, if both farms are in dry climates, the results could be erroneous with reference to fertilizer. However, there are problems with our formulation; let us take labor for example. Labor is like irrigation in some respects; that is, a sizeable increase in the labor input for weeding and cultivation may overcome the fertilizer advantage. However, if labor is therefore controlled, or kept constant between the two groups of farms, it will be impossible to observe a yield increase difference due to fertilizer even if there is one, because it will obviously require added

labor to harvest the added production, and to apply the fertilizer, transport it, etc. This leads us to the core of the second difficulty of control group surveys, they are only really useful when there is already fairly complete evidence of the nature of the cause and effect relationship such that all of the related links in that chain (added labor, increased credit for fertilizer, etc.) are well enough known that they can be left uncontrolled without clouding the interpretation of the experiment. Control group techniques are theoretically complicated and can be misleading where our understanding of the situation studied is not sophisticated prior to the study. In many project selection situations it may be necessary to draw control group data to supply cost benefit analyses, even when the level of prior understanding of what causes the benefits is poor.

iii. Successive and Panel Surveys

Up to this point only cross sectional control group surveys have been discussed. There are also longitudinal (successive) control group surveys. In this type of survey an experimental group and a control group would be picked as in the cross sectional case. The difference is that instead of a single survey taken at only one point in time, the two groups would be re-surveyed at least on one later date, and perhaps often over a long period of time. Since a survey in which the same units are sampled repeatedly over time is called a "panel," the technique of re-surveying an experimental and a control group over time is often referred to as a panel study with a control group.

To track changes which occur over time may be useful for evaluation purposes to identify the impact of an AID program which takes time to implement and mature. Project participants may be observed over time to see if their participation results in observable differences, both positive and negative. Since differences which occur over time may be due to non-project influences it is often necessary to also include a panel group of non-project participants in the form of a control group to observe over-time differences which occur without the project. Successive surveys are those taken in different time periods with the same questionnaire but with different sample units (farms, households, etc.).

While the three survey types are different in some respects, they may each be used for similar purposes. A panel study may be thought of as a control group study in which the control group is the subject in the first observed survey; the experimental group is the subject (farm, household, etc.) in later year surveys. Cross sectional surveys may be used to identify cause and effect in control group fashion. Cross sectional surveys even on a post-hoc basis can be used for project evaluation if properly designed.

After short exposure to these different types of surveys, it is usually easier for the newcomer to survey research to select which of these types would be most appropriate to each AID project stage than it is for the experienced survey researcher. Practical factors like budget availability, availability of trained supervisory personnel, availability of maps and lists, existence of rapid inflation, etc., will often have more influence on which design would be chosen than do the theoretical issues mentioned in the earlier discussion.

FOOTNOTES TO PART B: OBTAINING DATA FOR MEASUREMENT AND ANALYSIS OF MANDATE OBJECTIVES

(15) See Samuel Daines, *Analysis of the Rural Poor,* Agency for International Development, Washington, D.C., 1976, 153 pp.; and Samuel Daines and Dwight Steen, *Statistical Analysis of the Rural Poor Target Group,* Agency for International Development, San Salvador, 1977, 176 pp.

(16) Dana Dalrymple and Samuel Daines, *Small Farm Economics: Preliminary Results of a 474 Farm Subsample of Incora Borrowers,* Agency for International Development, Washington, D.C.,1972, 28 pp.; and Samuel Daines et al., *Small Farm Economics: Land Use: Profitability Farm Consumption and Capital Structure on 2901 Incora Farms,* Agency for International Development, Washington, D.C., 1972, 19 pp.

(17) Donald Warwick and Charles Lininger, *The Sample Survey: Theory and Practice,* McGraw Hill Book Company, New York, 1975, p. 47.

(18) *Ibid.,* p. 49.

(19) *Ibid.,* p. 70.

(20) *Ibid.,* p. 98.

(21) *Ibid.,* pp. 82 and 92.

(22) *Ibid.,* p. 82.

PART C

ACCOUNTING AND MEASUREMENT OF MANDATE OBJECTIVES

1. The Role of Accounting in Mandate Measurement

Accounting serves two important functions in the measurement of Mandate projects. Appropriately undertaken accounting procedures can be used as a technique for final analysis and interpretation of data gathered on the target group. Accounting is also a necessary intermediate data processing step in preparing survey information for analysis in the event that the measurement involves income or nutrition. It is a fortunate coincidence that the principal "overarching" mandate objective, income, is most adequately analyzed using cost accounting techniques familiar to almost all AID personnel.

The purpose of this section is to outline how simple accounting techniques may be used both as intermediate data processing and final analytical procedures in measuring mandate objectives.

The section begins with an outline of farm level accounting procedures in the context of the small farmer in developing country. The section concludes with an examination of the use of accounting as an interpretive and final analytical tool.

2. Farm Level Accounting

Of the six mandate objectives only income and nutrition require detailed accounting. For the purpose of illustrating the use of accounting techniques, income will be used as the example, and the small farm will be the subject.

The small farm is a complex business from an accounting point of view-almost all of the techniques used in accounting for large enterprises must be employed in order to arrive at acceptable small farm estimates of net income. It is important to recognize at the outset that net income cannot be estimated directly on small farms; that is, it would be impossible to simply ask the small farmer what his "income" is. The first problem which makes a direct estimate impossible is that very few small farms keep records which would be the basis for such an estimate; and even if they did, the accounting conventions used on each farm would be so different that the estimate would be useless for comparison purposes. The only way to estimate small farm net income reliably is to gather accounting information on the farm business and then use this information to elaborate a set of consistent income accounts for all of the farms in the survey.

A small farm, drawn haphazardly from a sample of supervised credit borrowers in Colombia, will be used as a case study to explore income accounting. The first characteristic to note about the 4.48 Ha. sampled farm is the complexity of the business. This

particular farm is really made up of seven different sub-enterprises, which must be dealt with individually from an accounting point of view if the income pattern of the farm is to be understood. The individual crop and livestock activities are called "enterprises," and the accounting which deals with them separately is called "enterprise accounting" or "partial budgeting." In the sampled farm these separate enterprises are potatoes (.5 Ha.), corn interplanted with beans (1.56 Ha.), wheat (1.24 Ha.), barley (.64 Ha.), sheep (2), milk cows (2), and swine (1).

a. Enterprise Accounts

Enterprise accounts are simply tables which contain the inputs and outputs for a particular crop or livestock activity. The inputs and outputs may be indicated in either physical quantities, or values, or preferably both. Table 5 is a part of the enterprise account for potatoes in the sampled Colombian small farm for the crop year 1968-1969.

Table 5

Enterprise Account for Potatoes 1968-69 (0.5 Ha.) for a Sample Small Farm in the Department of Boyaca Colombia

	Quantity	Values in 1968 Col. Pesos	Values in 1968 US$ (at 16.0 Pesos/$)
PRODUCTION			
Total	4,625 Kg.		
Sold	4,375 Kg.	$6,150	$384
Consumed	250 Kg.	(350)*	(22)*
COSTS (Direct)			
Seed		300	19
Fertilizer		1,006	63
Pesticides		290	18
Rented Machinery/Animals		60	4
Sacks		240	15
Transport		180	11
Labor-Hired	15 man days	280	18
-Family	69 man days	(1,242)*	(77)*
Total Direct Costs Without Imputed Fam. Labor		$2,356	$147

SOURCE Incora Solicitud De Servicio Y Plan De Crédito Supervisado (AID Subsample of farm budgets), Bogota, 1970.

** Consumed produce valued at the same price as the produce sold of $1 40 Kg.*

*** Family labor given an imputed value at the wage rate paid to hired labor.*

b. "Welfare" and "Efficiency" Definitions of Net Income

Before attempting to calculate net income for this farm we must choose a definition for "net income." Net income from potatoes on this farm could be defined as the total value of production including the value of consumed produce (US$384+US$22= US$406) minus the value of inputs, not including family labor (US$147) resulting in US$259 net income. Care must be taken in this definition to assure comparability and to guarantee that the definition fits the intended analytical use. We might pick the economist's definition of "pure profit" as the definition, in which case reasonable payments to all factors must be removed in addition to the direct costs which are listed in Table 5. Factor payments would be subtracted to family labor, to family management or entrepreneureship, to capital, and to land. If the intent of the analysis is to evaluate the bare technical efficiency of enterprise alternatives, this pure profit definition is perhaps the best. If the estimates are to provide a basis for comparison of family welfare, then an alternative definition must be sought. To the degree that the net income measure is accurate as a welfare measure, it loses its accuracy as an efficiency measure. The reason for this difficulty is that family welfare depends as much upon the ownership patterns of factors as on the efficiency with which they are used. For example, land is not subtracted as a direct cost in Table 5 because the small farmer owns his land and pays no rent; if he were a renter, in his region he would have to pay approximately $35 for the 5 Ha. of high quality land used in potatoes.

Land is an important agricultural input; if we subtract its cost from the renter, but not from the small farmer who owns his land, the resulting net income figure will be a better measure of true welfare, but an inferior measure of the efficiency with which net income is generated. To make matters more complicated, many small farmers hold their land in more than one form of tenure; it is common for them to own a part of the land they use, rent a part, and even have another portion in a sharecropping arrangement. If there is no accounting adjustment, the net income from potatoes will depend as much on the plot in which it is planted as on the inherent efficiency of its production

If the population to be studied has reasonably homogeneous patterns of land ownership, there is no need to employ accounting adjustments, cash flow accounts will give acceptable efficiency measures and will provide accurate measures of welfare If the tenure patterns vary, then two separate measures are required, one which focuses on efficiency-subtracting and actual or imputed cost to all factors-, and one which focuses on welfare-subtracting only payments for non-owned factors. What has been said of land is also true for other factors such as capital (either financial or capital goods like equipment), labor, and management.

Capital presents special accounting problems for small farms. Any businessman knows that before he arrives at a net income figure, he must subtract the costs of his capital goods which are wearing out through use and decay No allowance is made in the costs outlined in Table 5 for wearing out the farmer's tools, his milk cows, buildings, fences, or

equipment. The cost of rented equipment is included, but in the case of the sampled farm the farmer has US$102 of tools and US$225 invested in milk cows. The wearing out of these capital assets must be subtracted in order to get a reasonable estimate of his true net income. The purchase of capital goods tends to be "lumpier" for small farmers than for large ones because they are more infrequent and represent a relatively larger proportion of annual transactions when they occur. For example, the sampled farmer purchased a new milk cow for US$113 in 1968 and received only US$34 worth of milk, all of which was consumed in the farm. If a simple unadjusted cash flow account were taken, the farmer would have a substantial dificit from the milk enterprise. If the cost of the milk cow (minus salvage value) is divided as a cost among the seven years of useful life (US$113-salvage value of US$50= US$63/7 years=US$9 cost per year), the milk enterprise looks much different as an income producing alternative.

Using the adjustments which have been described, Table 6 re-estimates the potato enterprise account for the sampled small farmer.

The difference between the welfare and the efficiency measure of net income is substantial. Accounting for potatoes is relatively easy compared with livestock activities interplanted and tree crops.

c. Farm and Household Income Accounts

A complete farm account is simply the sum of the individual crop accounts In most analyses it is important to see the differences in welfare contribution and efficiency between the various farm enterprises. If all that is sought is a single estimate of the average family income, the allocation of indirect and capital costs explained in Table 6 can be avoided, and the data can be aggregated at the start to the farm level. Leaving out the enterprise budgeting step is tempting directly to farm or household income accounts. This had two dangers. The first is that inaccurate inferences will be drawn about crop level efficiency, and secondly the important potential of altering crop mix to increase income will be obscured. Without knowing the net income contribution of each crop or enterprise, it is difficult to understand the factors which influence and determine net income. The net income contribution of different crops ranges widely, some crops on small farms have 20 times the income potential of others; with these wide ranges in income potential, it is difficult to understand income patterns without enterprise budgeting. To illustrate these ranges, Table 7 presents the net income obtained on a sample of small farms in Guatemala.

Most farm level accounts are the product of aggregated enterprise accounts rather than direct estimates.

In order to move from farm to household income accounts, data are required on off-farm income and expenses of individuals defined as a part of the household. It is common for farm families to work for wages outside the farm, and it is also possible that non-farm business activities are undertaken by the farm family.

Table 6
Adjusted Enterprise Account for Potatoes in a Sampled Small Farm in Colombia, 1968-69
Farm Size 4.48 Ha. with 0.5 Ha. in Potatoes

Output		
Production	Value of Output 1968-1969	
	in 1968 Colombian Pesos	in 1968 US$
Total Potatoes (4,625 Kg.)	$6,500	$406
Sold (4,375 Kg.)	6,150	384
Consumed (250 Kg.)	350	22

Input		
Costs	Costs in US$ 1968	
	Welfare Measure	Efficiency Measure
Materials	US$115	US$115
Transport	11	7
Machinery and Animal Power (Operating + Depreciation)	7[a]	7
Direct Labor	18	95[b]
Indrect Labor and Management	------	16[c]
Depreciation of Buildings + Installations	2	2[d]
Land (Imputed 10% Return or Rental)	------	35[e]
Capital (Non-Land Durables and Circulating Capital)	20[f]	43[g]
Taxes, Commissions, etc.	3	3
Total Costs	US$176	US$313
Net Income	$230	$ 93

SOURCE Incora Solicitud De Servicio y Plan de Crédito Supervisado' (AID subsample of farm budgets), Bogota, 1970

[a] *Rentals ($4) plus depreciation on tools and equipment owned ($102-10 years X 25=$2 55), where 25 is the proportion of all general expenses allocated to potatoes Total $4 plus 2 6 = $6 6 rounded =$7*

[b] *Hired $18 plus family $77*

[c] *Estimated at 4 percent of gross value of production*

[d] *$187 in buildings and improvements, useful life 30 years, salvage value equals 0, X 25.*

[e] *Average rental for like potato property in this region equals $35 per year*

[f] *Actual interest paid for loans*

[g] *Imputed return to farmer's non-land capital plus actual interest paid Imputed return calculated at 10 percent*

Table 7

Net Income per Ha. in Selected Crops (US$) on Small Farms in Guatemala, 1974

Range in Net Income per Hectare in US$				
US$100-199	US$500-599	US$700-899	US$1,000-2,999	US$5,000-8,999
Corn	Tomatoes	Peppers	Avocado	Flowers
Wheat	Carrots	Oranges	Onions	Apples
Corn + Beans		Cauliflower	Garlic	
Corn + Sorghum		Potatoes		
Sorghum				
Beans				
Sesame				
Peas				
Chickpeas				
Peanuts				

SOURCE Samuel Daines et al, Analisis Del Impacto Del Credito De Fincas Pequeñs Sobre Ingreso, Empleo, Y Produccion Agropecauria, Volume II, Analisis de Rentabilidad de Cultivos y Produccion Pecuaria, AID and Guatemalan National Planning Council, Washington, D.C., 1976, 64 pp., p. 25.

3. ACCOUNTING AS AN ANALYTICAL TECHNIQUE

While we have treated accounting as a way of preparing data for analysis, it can also be used as an analytical technique in its own right. Many of the concepts or computations found in farm level income accounts, for example, provide important analytical conclusions about the target group which can be used for project selection design, monitoring, and evaluation. This section explores a selected number of examples of how the results of simple accounting exercises have been used in AID project analysis related to the Mandate.

Part A outlined AID Mandate objectives in measurable form suggesting what types of data are required, Part B discussed ways of gathering that data, and Part C has so far explored the use of accounts to format the data so that it could be readily analyzed and interpreted. Parts D, E, and F explore techniques of interpreting and analyzing data. The last section of Part C, which commences here, is a bridge between the accounting discussion and the data interpretation parts which follow.

Net income accounts are the most difficult to elaborate, but they are by no means the only type of account which may be useful for mandate measurement. Income, employment, production and land use accounts will be discussed below.

a. Income Accounts

In the short space of a few paragraphs it is difficult to illustrate the variety of ways in which income account data can be utilized in the AID project cycle. The examples given below are only indicative of the many ways this data could be used.

To illustrate the use of net income accounts in project identification and selection, sample tables from the Costa Rica AID mission documents will be presented. Table 9 shows excerpts from the basic small farm net income accounts. This is the basic source from which the latter tables are drawn. This net income account table was produced for each province and canton which allowed the AID personnel to pinpoint areas of concentrated poverty.

Table 8

Farm Family Income in Costa Rican Colones (1USSñ7.7 Colones)
Poor Farms Only (A)
(National Averages)

Farm Size Category Income Sources (0)	Less than 1 Hectare	2 to 4.9 Hectares	5 to 9.9 Hectares
(1) Number of Farms	8,988	6,501	3,841
(2) Wage Income	1,593.4	2,026.7	2,504.4
(3) On-Farm	441.9	1,581.6	2,129.5
(4) Off-Farm	1,151.5	445.0	374.8
(5) Ag. Sector	166 5	72.0	85.5
(6) Other Sectors	985 0	372.9	289.3
(7) Farm Production Income	1,164.4	1,952.7	1,894.5
(8) Gross Farm Sales	1987.9	4,613.9	6,297 5
(9) Production Costs	823.5	2,661.1	4,403 0
(10) Hired Labor	62.3	249.5	571.0
(11) Materials	722.8	2,124.3	3,357 4
(12) Transportation	38.2	287.2	474.5
(13) Other Income	305 0	528.7	606.7
(14) Auto Consumption	79.7	297.4	366 3
(15) Housing	225.6	231.2	240 4
(16) Total Net Family Income	3,063.3	4,508.1	5,005 7
(17) Non-Cash Income	747.3	2,110 4	2,736 3
(18) Cash Income	2,316 0	2,397.7	2,269 3

SOURCE Richard Kreitman, Rural Poor Profile, Costa Rica, Agency for International Development Washington, D C 1976, p 100

[a] *A poor farm is a farm of less than 20 hectares in which total net per capita income (line 16) is less than 1400 colones per family member, equivalent to the aid poverty definition of $150 per capita per year in 1969 prices All values in 197[illegible]3 colones*

This basic income account was used to identify the number and size of target group farms as indicated in Table 9, and to focus in depth examination of project alternatives in province. (see Table 10) and Cantones (not illustrated here) with a high incidence of small farm poverty.

Table 9

Costa Rica 1973
Income Level of Farm Families by Farm Size

Farm Size	No. Poor Farms	Average Income per Capita of Poor Farms	Average Income per Capita of Non-Poor Farms	Poor Income as a% of Non-Poor
"Landless" Farms	2,870	470	3,258	14.4
0 to 1 Ha	9,018	494	3,622	13.6
1 to 2 Ha	4,336	562	3,847	14.6
2 to 5 Ha	6,550	636	4,017	15.8
5 to 10 Ha	5,896	643	4,634	13.9
10 to 20 Ha	4,079	582	4,722	12.3
Over 20 Ha	0	na	4,771	na
All Farms	30,739	562	4,449	12.6

SOURCE: Kreitman, Rural Poor Profiles, Tables 1A and 1B.

Table 10

Costa Rica 1973
Distribution of Poor Farms by Province

Province	No. of Poor Farms	Percent of Nat. Poor Farms	Average Income per Capita	Income as a % of Nat. Ave. for Poor Farms
San Jose	8,593	28.2	558	99.3
Alajuela	6,767	22.2	587	104.4
Cartago	3,314	10.9	521	93.9
Heredia	1,146	3.8	426	75.8
Guanacaste	4,422	14.5	588	104.6
Puntarenas	4,626	15.2	566	100.7
Limon	1,653	5.4	na	na
Total	30,521	100.0	562	100.0

SOURCE Kreitman, Rural Poor Profiles, Table 1A

Comparisons of enterprise income accounts revealed that almost all of the income difference between the poor and the non-poor small farms could be accounted for by differences in the amount of coffee cultivated. Thus a simple examination of a well elaborated set of enterprise accounts pinpointed the factor which differentiates the poor small farmer from the non-poor.

Income accounts are vital to cost/benefit and other analysis used during the project selection phase.

Project evaluation may use simple comparisons from income accounts between the group involved in the project and a control group. This technique was utilized in evaluating the income impact of a small farm credit project in Guatemala. Table 11 illustrates the use of the income accounting information in this evaluation context.

Table 11

Guatemala Net Income Per Family Laborer on Small Farms in the Central Highlands by Farm Size and Credit Type

Farm Size	Credit Farms	No-Credit Farms
o - 1 Ha.	324	75
1 - 3 Ha.	124	124
3 - 5 Ha.	105	-26
5 - 10 Ha.	147	137
Average for All Small Farms 0-10 Ha.	140	86

SOURCE Survey of the Sector Público Agrícola, 1974

b Production Accounts

Production accounts showing the distribution of production by crop type, region, farm size, etc., can be used at all project stages. The example cited in Table 12 showing the production difference between credit and non-credit farms could be used either to evaluate a credit project, to provide data for a cost benefit analysis of a proposed credit program, or to monitor an ongoing project.

Table 12

Guatemala
Credit Impact on Output by Farm Size and Region
(South Coast Excluded)
(Percentage Superiority of Value of Output on Credit Farms)

	Central Highlands	Southeast Highlands	Northeast	All Regions
0 - 1 Hectares	112 %	94%	255%	147 %
1 - 3 Hectares	54	39	61	37
3 - 5 Hectares	99	17	-3	20
5 - 10 Hectares	-3	22	88	12
10 +Hectares	-23	5	41	17

SOURCE. Survey of the Sector Público Agrícola Guatemala, 1974.

c. *Employment Accounts*

An employment account contains a statistical description of the available working days and their use for a particular population. Table 13 shows the summary of an annual employment account for Guatemala in the minifundia area of the Central Highlands. Table 14 illustrates the monthly on-farm employment rate drawn from a monthly employment account.

Table 13

Guatemala Employment Account[a]
(Central Highlands)

	% of Available Family Labor Utilized On Farm	% of Available Family Labor Employed Off Farm	Total Employment Rate. Percent of Family Available Man Days Employed On and Off Farm
Small Farms Total	18.5 %	23.5%	42.0%
Credit	24.3	31.3	55.6
No - Credit	14.6	17.5	32.1
Large Farms Total	20.9%	52.2%	73.1 %
Credit	30.0	70.0	101.3
No - Credit	10.3	47.4	64.9

[a]*Employment rates for family labor by farm size and region (percent of available family man days utilized) (280 days equals 1 year).*
SOURCE· Survey of the Sector Público Agrícola.

Table 14

Guatemala Small Farm Monthly Employment
(On-farm Employment Only)

	All Small Farms	0-1 Ha. Farms
January	14.1	7.2
February	11.6	4.4
March	14.8	6.4
April	29.1	4.4
May	42.9	6.1
June	41.6	5.6
July	26.6	4.2
August	30.6	3.4
September	28.0	3.5
October	18.9	6.8
November	25.3	6.2
December	33.9	8.8

SOURCE Survey of the Sector Público Agrícola Guatemala, 1974

d. Land Use Accounts

An account showing the availability and use of land in small farms is termed a land use account. Table 15 presents a land use account for small and poor farms in Costa Rica, and Table 16 illustrates how comparisons from these land use accounts between poor and non-poor farms can be used to identify differences which could have project implications. Note in Table 16 how consistently the poor farms have a larger percent of their land in annual crops and fallow. This might lead to a preliminary project hypothesis that a project aimed at assisting small poor farmers to cultivate more permanent crops would lead to an increase in their income.

Table 15

Land Use Account by Farm Size
Totals per Size Category [a]
Poor Farms [b]
Costa Rica

Farm Size Category Land Use Category [c]	"Landless" Farms	Less than 1 Hectare	1 to 1.9 Hectares	2 to 4.9 Hectares
(1) Number of Farms	2,870	9,019	4,336	6,550
(2) Total Area	0.0	3,906.5	5,844.6	20,530.3
(3) Cultivated Crop Land	0.0	1,218.5	2,247.0	7,131.1
(4) Annual Crops	88.9	1,450.0	2,525.0	6,811.3
(5) Cereals	86.9	1,233.2	2,234.3	6,308.8
(6) Vegetables	1.5	87.5	67.1	97.9
(7) Tubers	0.4	81.3	102.3	170.2
(8) Tobacco	0.0	47.8	121.2	234.2
(9) Land in Fallow	-88.9	-231.4	-278.0	319.8
(10) Land in Permanent Crops	0.0	2,061.8	2,250.7	5,115.0
(11) Coffee	0.0	1,525.1	1,511.5	2,911.6
(12) Cocoa and Coconut	0.0	12.0	64.3	479.6
(13) Sugar Cane	0.0	165.2	245.6	583.9
(14) Fruit Trees	0.0	73.5	99.6	289.0
(15) Pastures	0.0	359.8	904.7	6,021.3
(16) Forest	0.0	28.3	61.6	415.7
(17) Other	0.0	237.9	380.4	1,843.0

[a] *A poor farm is a farm of less than 20 Hectares on which total annual per capita income is less than 1400 Colones per family member. Equivalent to AID poverty definition of $150 per capita per year in 1969 prices.*

[b] *In Hectares.*

[c] *Definitions of land-use categories are.*
(2) Total area equals (3)+ (10)+ (15)+ (16)+ (17).
(3) Cultivated crop land equals (4)+ (9). Permanent crops are not included in this category.
(9) Land in fallow. When negative indicates multiple cropping.
(10) Land in permanent crops equals (11)+ (12)+ (13)+ (14).
(17) Other land uses include buildings, roads, windbreaks, corrals, etc.

SOURCE. Richard Kreitman, Rural Poor Profile Costa Rica, Agency for International Development, Washington D.C., 1976, p. 109.

Table 16

Costa Rica 1973
Land Use by General Use Category
Percent of All Land in Each Use Category

Farm Size	Percent Cultivated Annual Crops or in Fallow	Percent in Permanent Crops
0 - 1 Ha.		
Poor	31.1	52.7
Non-poor	20.4	61.9
1 - 2 Ha.		
Poor	38.4	38.5
Non-poor	24.4	58.0
2 - 5 Ha.		
Poor	34.7	24.9
Non-poor	20.3	48.8
5 - 10 Ha.		
Poor	25.4	14.5
Non- poor	17.7	36.2
10 - 20 Ha.		
Poor	22.0	7.1
Non-poor	17.6	20.9

SOURCE Kreitman, Rural Profiles, Tables 2D and 2B

e. Summary

With a set of the above described accounts in hand, a wide variety of analytical and interpretive work can be undertaken. It is unfortunate that much analysis of the target group bypasses this necessary step in analysis and proceeds directly to interpretation and prescription. Small farms are complex business enterprises, and we are likely to understand them only if care is taken to capture the accounting relationships which describe that business.

PART D

ANALYTICAL AND STATISTICAL TECHNIQUES FOR INTERPRETING DATA ON MANDATE PROJECTS

The earlier parts of this manual discuss what data are required for the analysis of Mandate projects, how to gather them, and how to arrange them in accounts for analysis. This section begins the discussion of techniques for analysis and interpretation of these data. Parts D, E, and F deal with three separate classes of techniques. Part D provides a brief overview of the range of statistical techniques for displaying and interpreting data, Part E deals with the cost/benefit technique, and Part F with sector level assessment techniques which are broader than a single project.

1. SIMPLE COMPARISONS, INDICES AND CROSS TABULAR DISPLAYS

This subject does not require exposition; all DSP participants are familiar with the use of inventive tables and indices to display data and to illustrate project characteristics. The reason for including this section is simply to emphasize the importance of these quantifications in project analysis. The science of project analysis has developed to such a stage that many AID practitioners hesitate to attempt such analysis on the grounds that it requires specialized analytical skills. In most project analysis cases, the major deficiency is not analysis, but data. Most often a clear concise table displaying relevant project impact data would be a major improvement in the quality of project analysis. The fact that such information is not presented is not the fault of insufficient analysis, it is usually because the basic project data simply do not exist. As the discussion in the manual now shifts from data gathering to analysis, it should be remembered that extensive and sophisticated analysis of inaccurate and only partially relevant data, while retaining the appearance, lacks the substance of good project analysis. A common mistake in AID project analysis is to expend the large majority of project analysis funds on analysis and interpretation, and little on data gathering and accounting.

The techniques of project analysis have progressed far beyond their data base. The desire of AID to have improved project analysis has unfortunately focused on analytical technique and not on basic data and simple accounting which are required to achieve believable results.

It is often true that sophisticated analytical techniques are used as substitutes for accurate data: that is, in the absence of a direct measure of a characteristic or phenomenon, a complex technique can be used to elaborate an "estimate". For example, benefit/cost analysis begins with an estimate of a difference which the project will make in some characteristic of the target population. If there are data on what this difference actually is in similar projects, almost all of the benefit/cost work is already done, and the usefulness of

the result is assured. If such data do not exist it can be estimated by the use of complex analytical techniques. If data are available indicating the difference which the project will make based on measured experience in the field, a simple table comparing project to non-project populations suffices to display that data; no added analytical technique is needed. Performing regression analysis, or complex inter-temporal discounting will add very little analytical strength to such a finding. A gram of accurate project data is worth a kilo of project analysis.

2. *OPERATING RATIOS*

The next step up in the complexity of analytical technique is the elaboration of accounting or "operating" ratios which capture per unit characteristics of the target group household, farm, or business. These ratios combine various accounting characteristics into a fraction, the intent of which is to increase the comparability between farms or firms. The DSP participant should refer frequently back to the farm and enterprise accounts in the last part to visualize the origin of these operating ratios. For example, let us take employment or labor characteristics. We may wish to compare the labor intensity between farms, or even types or sizes of farms, to explore the project hypothesis that small farms use more labor, and therefore a small farm project will have better employment impact than a large one. It would not be useful to compare the absolute amount of labor (in man days) used on large farms with small ones, since one would expect the large farm to use more labor simply because it is larger. To make labor comparable between farms of different size, three different labor operating ratios could be devised. The first might be a labor/land ratio, with the number of man days utilized in the numerator and the number of hectares in the denominator. Since large farms also have a larger proportion of unusable land, this ratio might not be as accurate as a ratio using either arable or cultivated land in the denominator. Table 17 contains labor/land ratios which follow this definition for small farms in Guatemala.

Table 17

Labor/Land Operating Ratios for Small Farms in Guatemala 1974
Man Days Utilized per Arable Ha.

Farm Size	Credit Farms	No-Credit Farms
0 - 1 Ha.	227	160
1 - 3 Ha.	111	93
3 - 5 Ha.	82	64
5 - 10 Ha.	75	54
10 - 20 Ha.	44	42
20 - 50 Ha.	40	27
50 - 100 Ha.	24	20

SOURCE Survey of the Sector Público Agrícola, 1974.

By carefully designing the comparisons of these operating ratios, a substantial amount of interpretive meaning can be obtained. For example, in Table 17 the comparisons are not only by farm size, but also between small farms with and without institutional credit. Two project hypotheses appear to be supported by this simple comparison, first that smaller farms are significantly more labor intensive than larger ones, and secondly that for farms of similar size, credit appears to be associated with higher labor intensity.

From a different perspective, labor intensity might be viewed as the quantity of labor utilized per capital unit, as distinct from land unit. To measure this concept a different operating ratio relating labor and capital might be formulated with man days in the numerator and value of capital in the denominator The sample measure presented in Table 18 differs from the one defined only in that the labor unit is a man year not a man day. Capital is given using two definitions, one which includes the value of the land, and one which excludes it. By extending the comparisons beyond the country studied, added perspective may be gained on the particular issue analyzed. Table 18 appears to confirm the project hypothesis that small farms are more labor intensive using an operating ratio with a different perspective on the same labor intensity concept.

Table 18

Labor/Capital Operating Ratios for Selected Countries

(All Values are in 1973 US$)	US$ per Full Time Workplace in Agriculture (Non Land Capital)	US$ per Full Time Workplace in Agriculture (Including Land)
United States (1974)	41,117	111,126
United States (1968)	30,956	83,581
Switzerland (1968)	23,583	30,893
Germany (1968)	15,061	18,374
United States (1960)	13,283	35,864
Austria (1968)11,512	15,310	
Guatemala		
Northeast & Southeast Large Farms	2,072	5,600
South Coast Large Farms	1,739	4,700
Central Highlands Large Farms	1,480	4,000
Central Highlands Small Farms (Credit Technology)	1,147	3,110
South Coast (East) Small Farms	925	2,546
South Coast (West) Small Farms (No-Credit Technology)	550	1,474
South Coast(East) Small Farms (Credit Technology)	370	1,077

SOURCE Samuel Daines et al., Guatemala Farm Policy Analysis, The Impact of Small Farm Credit on Income, Employment and Food Production, Agency for International Development, Washington, D C., 1975, p 56

The number of examples which could be given of operating ratios are almost endless, almost any of the accounting characteristics described in the accounting section could be combined into a ratio To illustrate a few more examples with relevance to planning and evaluating mandate projects, small farm capital operating ratios will be used. You will note that the most useful operating ratios grow out of a project hypothesis. Let us explore with capital operating ratios the hypothesis that small farms are less capital intensive than large ones, and a corollary that farms in developing countries use less capital than developed country farms. First we need a definition for capital, for example US$ of value of all non-land farm assets used in production. Next, we need a denominator to make the capital comparable among farms of different sizes and with land of varying quality. A reasonable denominator is arable land. Table 19 presents this comparison among farms in Guatemala and with selected countries. The ratios appear to reject our project hypothesis, the amount of capital per arable hectare is higher on the smaller farms in Guatemala, and there appears to be little relationship between the level of development of a country and the capital intensity of its agriculture. The smaller Guatemalan farms are actually more capital intensive than the average US farm and by a substantital margin. On closer examination it appears that capital intensity may be more related to the mix of crops grown than either size of farm or country development level.

A final example of a capital operating ratio is taken from El Salvador on the issue of small farm access to credit. Credit is a kind of capital asset; a common mandate project hypothesis suggests that small farms receive less than their fair share of credit, and that additional credit access would result in increased income and production. To explore the first part of that hypothesis, that small farms receive less than their share of credit, we might formulate a credit intensity operating ratio. Credit used per arable Ha. or per cultivated hectare might be suggested as relevant ratios. Since it is already known that much land in larger farms is uncropped, and that hilly land which is apt for coffee and other high value tree crops is classed as nonarable, area cropped should be a more accurate denominator than arable land. The ratio formulated, therefore, would be US$ of credit utilized per hectare cropped. The comparison would be by farm size to see if larger farms really have access to more credit per hectare cropped; Table 20 presents this comparison of credit operating ratios. The ratios strongly confirm the project hypothesis that small farms do not receive their proportionate share of credit. The conceptual meaning of the ratio is strengthened by the fact that a large part of difficult to measure informal credit is included. The statistical reliability of the finding is strong because all of the 270,000 farms in El Salvador were included.

The objective of presenting examples of operating ratios is to suggest to the DSP participant the meaning and potential of this analytical alternative. It should be obvious that while the technique is simple it can be very useful in AID project analysis.

Table 19

Capital Intensity Operating Ratios for Guatemalan Small Farms and Selected Countries

Country	US$ of Non-Land Value of Capital per Arable Hectare*	Index of Capital Intensity Guatemala =100 ($337/Ha.)**	$ of Output per $ of Total Capital Value
Switzerland	2,957	877	n a.
Japan	2,644	785	.11
Belgium	2,470	733	.08
Denmark	1,936	574	.14
Austria	1,399	415	.25
Guatemala			
Credit Farms (0-1 Ha.)	945	280	.56
Greece	588	174	.16
Guatemala			
Credit 1-3 Ha.	452	134	.34
No-Credit 0-1 Ha.	452	134	.34
Credit 3-5 Ha.	309	92	.38
Credit 5-10 Ha.	305	91	.40
United States	278	82	.10
Guatemala			
Credit 20-50 Ha.	260	77	.33
No-Credit 3-5 Ha.	252	75	.38
Credit 10-20 Ha.	252	75	.29
No-Credit 1-3 Ha.	238	71	.49
No-Credit 50-100 Ha.	229	68	.33
No-Credit 20-50 Ha.	224	66	.31
Canada	221	66	n a.
Guatemala			
No-Credit 5-10 Ha.	219	65	.39
Credit 50-100 Ha.	188	56	.15
No-Credit 10-20 Ha.	154	46	.35

SOURCE Samuel Daines et al, Guatemala Farm Policy Analysis, The Impact of Small Farm Credit on Income, Employment and Food Production, Agency for International Development, Washington, D C 1975, p 40

**Guatemala figures are in US$ for 1973 Other countries are for earlier years inflated assuming US$ (1968) x 1 31 equals US$ (1973)*

***The Guatemala average is for all small credit farms 0-10 hectares Sources are various government documents filed with OECD Basic data came from the cited government source, but the author is responsible for interpretation and calculation of these coefficients*

Switzerland National Survey of Book-keeping Farms 1967

Japan Farm Household Economy Survey 1966 and data from Nippon Research Institute on Real estate

Belgium Survey of Professional Farms Including Horticulture 1967

Denmark Survey of Book-keeping Farms by Detlandkomiske Driftsbureau 1967

Austria National Survey of Book keeping Farms 1967

Greece National Accounts of Greece 1967

United States 1968 National Balance Sheet of Agriculture USDA (for all farms with annual sales of US$2,500)

Canada 1966 National Census of Commercial Farms

Table 20

Credit Operating Ratios for El Salvador by Farm Size

Farm Size	USS of Credit per Cropped Hectare	Credit per Cropped Ha. as a % of National Average
0-.49 Hectares	USS 3.01	4.3
.5-.99 Hectares	3.11	4.6
1-1.9 Hectares	5.70	8.2
2-2.9 Hectares	8.52	12.2
3-3.9 Hectares	10.59	15.1
4-4.9 Hectares	14.00	20.0
5-9.9 Hectares	19.24	27.5
10-19.9 Hectares	29.29	41.9
20-49.9 Hectares	78.04	111.7
50-99.9 Hectares	158.72	227.0
100-199.9 Hectares	137.70	196.9
200-499.9 Hectares	110.18	157.6
500-999.9 Hectares	140.02	200.2
1,000-2,499.9 Hectares	95.03	135.9
2,500 Hectares and Over	153.20	219.2
Average for All Farms	USS 69.83	100.0

SOURCE: Samuel Daines and Dwight Steen, El Salvador: Statistical Analysis of the Rural Poor Target Group, Agency for International Development, Washington, D.C., 1977, Tables 37 and 39

3. PRODUCTIVITY RATIOS

Productivity ratios are fractions with some desired outcome or output in the numerator, and some resource or input factor in the denominator. These ratios are particularly useful in project analysis because they focus on the resource efficiency of the process, project, farm, or household involved. Productivity ratios fall into types corresponding to different classes of desired outcomes (numerators) and classes of inputs or resources used to produce those outcomes (denominators). Table 21 presents the major classes of productivity ratios in common use for project analysis.

If only one resource like land, or class of resources like capital, is used as the denominator, these ratios are relatively easy to compute. If all resources are to be included, the methodology can become rather complex as we shall see when the section on benefit/cost is opened. In using single resource productivity ratios it should be remembered that all of the desired outcome is not caused by the single resource selected for the denominator, other resources are used up as well; In order to get a full picture, the three resource productivity ratios must be used together, or must be summed into a composite productivity ratio.

Table 21

Outline of Productivity Ratio Types Useful in Mandate Project Analysis

Numerators Desired Outcomes	Classes of Input Factors or Resources Utilized			
	Land	Labor	Capital	Total Resources
Net Income	Land Profit Ratios		Profitability Ratios	Benefit/Cost Ratios
Rural Production	Land Productivity Ratios (if production is in physical quantities these are called "Yields")	Labor Productivity Ratios	Capital/ Output Ratios	Composite Productivity Ratios
Nutrition				Benefit/Cost Ratios
Health				Benefit/Cost Ratios
Population				Benefit/Cost Ratios
Education				Benefit/Cost Ratios

a. Productivity Ratios and Resource Scarcity

The usefulness of productivity ratios in project analysis derives from the idea of relative resource scarcity. Productivity ratios tell us how much of some resource it takes to produce a given quantity of a desired outcome. This idea is only useful if the resource in question is a scarce one. The idea of productivity ratios is associated closely with the idea of resource efficiency, that we will obtain the largest volume of desired outcomes if we select project alternatives which produce the largest outcomes per scarce resource unit. Resource scarcity varies widely even inside the rural target group. Even the safest general rules have important exceptions; what is scarce for one part of the target group in a particular country may be relatively abundant in another. The general rules of scarcity for the rural target group are:

1. Arable land is scarce.
2. Unskilled labor is not scarce.
3. Capital is scarce.

In many areas, such as the colonization areas on the Altantic slope in Central America and the Amazon slope in South America, land is not scarce for the rural poor In other areas irrigation water, not land, is the scarcest physical resource Even though labor is generally not scarce, there are many areas where seasonal peaks in labor demand cause temporary scarcities In order for productivity ratios to be useful they must be guides to resource efficiency, and they will only be accurate guides when the resource in the denominator is truly scarce for the population or project studied. The choice of productivity ratio depends on the relative scarcity of resources If the project considered is in an area in which irrigation water is the critical scarce small farmer resource then output per cubic meter of water would be a useful productivity ratio The principal misuse of productivity ratios in Mandate project analysis has come through inaccurate selection of denominators, that is, using productivity ratios which do not represent true relative resource scarcity in the project environment studied. This misuse is best illustrated in the case of labor productivity ratios. In US industry for many years the very word "productivity" has been used in a very narrow sense, to mean the "gross output productivity of labor." Today publications present these ratios without even stating that labor in man-hours is the denominator, and gross value of output is in the numerator. This productivity concept makes sense as a rough efficiency guide where labor is the resource thought to be scarce relative to others, and makes even more sense if there is evidence that its relative scarcity is deepening By and large labor has been a scarce resource for US industry and in this context the most useful productivity ratio may very well be labor productivity, but such a ratio loses its value when used as an efficiency guide in project environments where labor is not relatively scarce.

b. Composite Productivity Ratios, Resource Prices, and Attribution of Cause

It has been argued that single resource productivity ratios are deceptive because they exclude other important "causes" of the desired outcome and therefore depend on subjective assessments of resource scarcity. This argument suggests that all resources are partially scarce and should be included in the ratio. All that is needed to construct a composite productivity ratio is a set of prices at which to value each of the consumed resources. Benefit/cost ratios are the commonest of this variety; methodology to account for prices which do not reflect true scarcity will be discussed in Part E. Composite productivity ratios are not without their weaknesses, their very comprehensiveness implies a loss of detail. With a composite ratio the analyst cannot see the influence of land, separate from capital, or of differences between total, arable, and cultivated land ratios. This loss of detail can obscure important project interactions.

While the disadvantage of the composite ratio is that it obscures the contribution of each separate resource to the desired outcome, the parallel weakness of the single resource ratio is that it attributes all of the outcome to a single resource. Unless carefully used either

of these ratios can be misleading. Two solutions to this quandary have been used with varying degrees of success. The first is to compute both single and composite productivity ratios and use them in conjunction, realizing the weaknesses of each. The second technique is to add still another computation to the analysis known as the "production function." This technique will be discussed briefly later in this section; at this point it is only necessary to know that this is a rather complex method for assigning or attributing a proportionate share of production to each major resource factor. While the technique appears at this stage as if it provides a comprehensive solution to the problems caused by obscured and distorted attribution in productivity ratios, there are a number of weaknesses both conceptual and logistical which weaken the potential of production function analysis for mandate projects. The productivity ratio, with all of its difficulties, remains in practice perhaps the most useful project analysis technique. Much of this usefulness stems from its conceptual simplicity, the relative ease and low expense of implementation, and the relatively reduced data requirements.

The paragraphs which follow describe selected common types of productivity ratios and present examples from actual AID documents where these ratios have been used to guide project selection, monitoring, and evaluation. Productivity ratios will be arbitrarily grouped according to desired outcomes (numerators).

c. Net Income Productivity Ratios

Net income productivity ratios are most commonly referred to as profitability ratios because the desired outcome represents profits. Except for the composite benefit/cost variety, these ratios focus on the net profits of the direct project beneficiary.

i. Land Profit Ratios

Land profit ratios indicate the net income produced per land unit. Land may be defined as total land in the farm, arable land in the farm, cropped land, or cultivated land. Each of these different denominators will have a different conceptual meaning. An example of this difference may be seen in the AID comparison of land profit ratios in Chile. The attempt in this case was to see if land reform or traditional "minifundistas" were more efficient in their net income production from land. Table 22 presents this comparison Note that when total land is the divisor the reform farms are insignificantly less efficient, yet when the divisor is cultivated land they are almost one-third less efficient.

These two ratios measure a different concept of land efficiency. The "all land" ratio indicates differences in the efficiency of the use of all of the land in the farm: if large amounts of the land in the farm are not cultivated, this ratio will be relatively low, it is a broad measure of many factors, some of which may be related to how intensively the farmer uses all of his land, but also may vary widely if there are large differences in the quality of land. The "cultivated" land ratio is a narrower technical measure indicating how much income

the farmer obtains from the land he actually cultivates Where there is a significant amount of arable land uncultivated, the "total farm" ratio would be the better indicator of efficiency: where almost all usable land is cultivated, the "cultivated" land ratio would be better. The land ratio which adjusts for differences in the proportion of usable land and for the proportion of land under cultivation is the "arable" land profit ratio If only one land profit ratio can be used it should be this one. Table 23 presents "arable " land profit ratios for small farms in the Highlands of Guatemala

Table 22

Land Profit Ratios for Small Farms in Chile 1975

	USS of Net Income per Hectare	
	All Land in Farm	Cultivated Land
Land Reform Beneficiaries	$145.60	$165 80
Traditional "Minifundistas"	$152.60	$246 00
Land Reform as a percent of Minifundista	95.4	67.4

SOURCE William Rusch, Small Farmer Sample Survey of the Central Irrigated Agriculture Region of Chile, Prepared for AID by American Technical Assistance Corp , McLean, 1975, pp 8, 12, and 21

Table 23

Land Profitablility Ratios for Small Farms in the Highland Regions of Guatemala 1974
Net Income per Arable Hectare in USS
(simple Average of Central and Southeast Highlands)

Farm Size	USS Net Income per Arable Ha.	
	Farms with Credit	Farms without Credit
0-1 Hectare	$469	$183
1-3 Hectares	(insufficient sample)	167
3-5 Hectares	102	62
5-10 Hectares	96	78

SOURCE Samuel Daines et al, Analisis del Impacto del Crédito de Fincas Pequeñas Sobre Ingreso, Empleo, y Producción Agropecuaria, Volumen I, Secretaria del Consejo Nacional de Planificación Económica and Agency for International Development, Guatemala 1975, p. 107

Table 23 provides an example of how these land profit ratios can provide information for evaluation (in this case an evaluation of a small farmer credit project) or to test simple project hypotheses in the project selection phase. From this table it appears that small farms are more efficient land users, and that credit appears to increase land use efficiency.

Different formulations of the land/profit ratios may be used not only to improve the accuracy of the ratio for a particular concept, but also to understand more fully the underlying reasons for observed differences in any specific ratio. For example, from Table 23 it can be seen that small farms have significantly higher land profitability than relatively larger ones-why? Exploring further we note that small farms cultivate a different mix of crops than larger farms. In order to explore the project meaning of this difference in crop mix, we might formulate another land profitability ratio. In this ratio we might want to see the net income per hectare cultivated not by farm size but by crop for all farm sizes. The project hypothesis to be tested is whether differences in crop mix may be as important in creating more income as credit differences. Table 24 presents the crop by crop land profit ratio for farms under 10 Ha. including credit and no credit farms in Guatemala.

Table 24

Land Profit Ratios by Crop for Small Guatemalan Farms 1974
(Sample not representative of all small farms)

USS of Net Income per Cultivated Hectare					
$100-250		$500-1,000		$1,000-10,000	
Sorghum	$100.7	Tomatoes	$522.4	Garlic	$1,484.1
Peanuts	107.4	Carrots	571.6	Onions	1,551 4
Wheat	116.4	Oranges	749.7	Avacado	2,435 3
Sesame	117.7	Peppers	815.8	Flowers	5,245.8
Corn	120.7	Cauliflower	825.4	Apples	8,586.8
Chickpeas	150.9	Potatoes	848.4		
Beans	168 0				
Corn+Sorg.	177.3				
Corn+Beans	196.3				
Rice	215.2				
Corn+Sesame	233.9				

SOURCE Samuel Daines et al, Analisis de Rentabilidad de Cultivos y Producción Pecuaria, Volumen II, Secretaría del Consejo Nacional de Planificacion Económica and Agency for International Development, Guatemala 1975, p. 24.

By simply comparing the proportions of each crop in the crop mix of the size and credit groups in Table 23 with the land profitabilities of each crop from Table 24, it was observed that the differences in the mix of crops accounts for most of the differences in land profitability.

These kinds of project data, formulated into productivity ratios can be very useful at all project stages In the selection and design stage it can lead to new projects or lead to changes in project design. In the case of Guatemala, the credit agency (BANDESA) is now requesting a special line of small farmer credit specifically for the higher value crops, and a wide variety of complementary marketing studies and infrastructure projects have grown out of the calculation of these simple productivity ratios.

ii Capital Profitability Ratios

Profitability ratios using capital as the denominator are common in project analysis because they indicate the financial feasibility of a project. Table 25 presents capital net income ratios for small Guatemalan farms.

Table 25

Capital Profitability Ratios for Small Farms
Guatemala 1974
Simple Average for Highland Regions

Farm Size	$ of Net Income per $ of Capital Value	
	Credit Farms	No Credit Farms
0-1 Hectare	$.66	$.32
1-3 Hectares	(insufficient sample)	.24
3-5 Hectares	.16	.12
5-10 Hectares	.14	.10
Over 10 Hectares	.06	.09

SOURCE Samuel Daines et al, Guatemala Farm Policy Analysis, Agency for International Development, Washington, D C 1974, p 46

d. Output Productivity Ratios

Output productivity ratios are the most often used ratios for general project analysis. In most cases the numerator is gross value of output, for careful AID project analysis it should be value added.

i Land Output Productivities

The most frequently seen productivity ratio is that ratio which has physical quantities of a particular crop in the numerator and land area cultivated in the denominator. This is know as the "yield" ratio. Table 26 presents sample yield figures for rice in selected countries.

Table 26

Rice Yields in Kilograms per Hectare Cultivated

Country	Kilos of Rice per Ha.
India	1,480
Indonesia	1,790
Pakistan	1,600
Philippines	1,200

SOURCE: FAO The State of Food and Agriculture 1966, Rome, 1966, p. 140.

The fact that yields have been used so frequently as an indicator of agricultural efficiency reveals the strong agronomic bias of AID agricultural personnel. Yield ratios say very little about efficiency; for one thing they are not even comparable between crops since they are in physical terms. Secondly, increased yields usually imply increased costs, and without comparisons of the net income figure it is impossible to even infer that increased yields in any particular crop result in increased welfare or even value added. An improved version of this ratio is the value product per hectare in which the various crops can be added together. Table 27 presents land output productivity ratios for Costa Rica.

ii. Capital Output Ratios

Capital output ratios may in some circumstances provide a better guide to societal efficiency in the use of capital than capital profitability ratios. Table 28 presents capital output ratios for agriculture and for selected groups of small farms from Guatemala.

iii. Labor Productivity Ratios

Labor productivity ratios are not particularly useful in analysis of mandate projects simply because labor is not usually scarce. In those situations where labor is either seasonally or structurally scarce, labor productivity ratios might be very useful project efficiency guides.

e. Nutrition, Health, Population, and Education Productivity Ratios

Benefit/cost ratios are the most useful productivity ratios for these fields. The discussion of benefit cost techniques will be postponed for Part E

Table 27

Land Output Productivity Ratios for Small Farms
Costa Rica 1973

Farm Size	Gross Value of Output per Arable Ha. in US$	
	Poor Farms	Non-Poor Farms
	Less than $150 per Capita	More than $150 per Capita
0-1 Hectare	$670	$1,430
1-2 Hectares	435	1,086
2-5 Hectares	372	857
5-10 Hectares	374	736
10-20 Hectares	385	630

SOURCE: Richard Kreitman, Rural Poor Profile, Agency for International Development, Washington, D.C., 1976,

Table 28

Capital output Ratios for Agriculture for Selected Countries and for Selected Groups of Small Farms in Guatemala 1974

Guatemala	$ of Output per $ of Capital Value	Selected Country Comparisons	$ of Output per $ of Capital Value
Guatemala		Austria	.25
0-1 Ha		Greece	.16
Credit Farms	.56	Denmark	.14
No Credit Farms	.30	Japan	.11
1-3 Ha.		United States	.10
Credit Farms	.34	Belgium	.08
No Credit Farms	.49		
3-5 Ha.			
Credit Farms	.38		
No Credit Farms	.38		

SOURCE United States, 1968 National Balance Sheet of Agriculture, USDA.
Japan, Farm Household Economy Survey, 1966, Nippon Research Institute.
Belgium, Survey of Professional Farms Including Horticulture, 1967
Denmark, Survey of Book-keeping Farms 1967 by Detlandkomiske Driftsburear
Austria, National Survey of Book-keeping Farms 1967
Greece, National Accounts of Greece 1967
Guatemala, Survey of Sector Publico Agricola 1974

4. ELABORATING INDICES TO CAPTURE SIMPLE PROJECT INTERRELATIONSHIPS

Index numbers convert otherwise noncomparable values to a relative averaging device which serves as a common yardstick. Price indices attempt to convert all observed prices to a common base year in order to remove inflation. In its simplest form, the index is an easy concept to understand and apply. The idea of index numbers has been extended to relatively complex situations which permit the technique to be used in project analysis to capture simple interrelationships.

The paragraphs which follow outline an example of how indices can be used in project design and evaluation. The example is the same case study used in the last section, an evaluation of a supervised small farmer credit project in Guatemala.

From simple statistical tests it was observed that the credit recipients showed a large increase in the value of production over the non-participant control group. Such an increase in the value of production could have come from many sources:

1. Increase in the area cultivated
2. Change in the mix of crops cultivated (a higher proportion of high value crops)
3. Increased yields per Ha. in particular crops
4. Higher prices per unit (better quality, better marketing connections etc.)

Any one of these changes would result in an increase in the gross value of production, even without a change in any of the other factors. Thus a small farmer could increase the value of his production without any change in yields, by growing less corn and more tomatoes since tomatoes (even at his current yield) is likely to produce more gross value per hectare. Since the project working hypothesis was that increased small farmer use of modern inputs in basic grains would increase yields and thereby increase production and income, it was important for project evaluation not just to see if production increased but if it increased in the way the project hypothesis suggested. In order to see if yields increased, and what proportion of the increased value of production can be explained by the yield increases, a system of indices was elaborated. The problem is not an easy one, each of these four factors are interacting at the same time, and in different magnitudes.

To complicate matters, increasing the area cultivated may itself be accomplished in more than one way The farmer may bring uncultivated land into cultivation, he may increase the amount of land in crops by planting more than one crop at the same time in the same soil (interplanting), or he may increase the amount of land cropped by planting and harvesting two or even three crops successively on the same plot (multiple cropping) Thus factor 1 could be decomposed into three separate factors.

Table 29 presents the results of the indicies elaborated by Hunt Howell of AID's Sector Analysis Division to explore the proportionate contribution of each of these factors to the increases or differences in output associated with the supervised credit project

Table 29

Sources of Change in the Value of Output
Between Credit and No-Credit Small Farms in Guatemala 1974

Farm Size	Total* Difference In Value	Crop Mix	Yields	Prices	Area Cropped			
					Total	Gross Area Cult.	Interplanting	Multiple Cropping
(Percentage superiority of Credit over N0-Credit Farms)								
0-1 Ha	126%	140%	-4 %	-2 %	-9%	(-6%)	(-6%)	(3 %)
1-3 Ha.	29	23	-5	3	8	(6)	(-2)	(4)
3-5 Ha	18	-3	15	-7	13	(9)	(4)	(0)
5-10 Ha.	23	11	5	-11	18	(8)	(6)	(4)
10 Ha.	-4	2	-3	-22	19	(17)	(6)	(-4)

** These differences have been netted for the small differences which existed between the experimental group and the control group in size of farm*

SOURCE Samuel Daines et al, Guatemala Analisis Del Impacto Del Crédito De Fincas Pequeñas Sobre Ingreso, Empleo, Y Producción Agropecuaria, Secretárial del Consejo Nacional de Planificación Económico, and AID, Volume I, Guatemala, 1976 p 63 and 75 For an exposition of the index technique employed see Hunt Howell, Apéndice B ibid, p 142

From these indices a series of important project evaluation and design conclusions can be drawn. First, credit appears to be associated with the most important changes on the smallest farms, for farms over 10 Ha. the impact if any was negative. It would appear that the project did not accomplish its narrow objectives of increasing production by increasing yields except in the 3-5 Ha. group. Where the difference is most notable, in the smallest farm category, more than the total difference can be accounted for by differences in crop mix; in fact, yields, prices and area cropped are all lower on the participant credit farms. As farm size increases, increase in the area cropped becomes the most important explanatory factor.

Many other hypotheses and conclusions can be drawn from this example, but our purpose here is to simply suggest the project relevance of index number techniques. Though they are slightly more complicated than the earlier techniques discussed, index construction is considerably less costly and elaborate than the regression and modeling methods discussed below.

Indices may be constructed for virtually any project characteristic. Table 30 presents project evaluation indices which attempt to capture the level of agricultural knowledge, self help, and overall project success.

Table 30

Indices of Project Performance Based On Three Project Criteria

Project and Country	Agricultural Knowledge Index	Self Help Index	Self Sustaining Index	Overall Success Index
Uboma Nigeria	2.209	1.557	1.429	1.854
Tiv Bams Nigeria	1.473	1.924	727	1.784
IBRD/IDB The Gambia	1.473	.761	1 195	1.157
Tetu Kenya	-.736	-1.713	- .909	- 857
Thaba Bodiu Lesotho	-1.104	-1.713	-1.611	NA

SOURCE Development Alternatives Inc, STRATEGIES FOR SMALL FARMER DEVELOPMENT, AN EMPIRICAL STUDY OF RURAL DEVELOPMENT PROJECTS, Volume I, p 38 For an exposition of the index methodology see Appendix One, Methodology ibid p 347, Washington D C 1975

These indices were used to compare the performance of each of these projects in order to discover the most effective project machanisms for reaching and affecting small farmers. Project data were gathered by non-survey methods to construct these indices, indicating the possibility of working from secondary non-survey sources The overall success index is a composite of the three indices in Table 30 plus an income/cost ratio similiar to the benefit/cost ratios to be discussed in the next part of this manual.

5. DESCRIPTIVE STATISTICS

Cross tabular comparisons, operating ratios, and productivity ratios are equally applicable to single farms and households, or large populations. Descriptive statistics is the term used in this manual to include techniques employed to provide insight into the patterns of distribution and variance which exist in groups of farms, households or other mandate project clientele. These techniques attempt to quantify the degree of homogeneity and heterogeniety which exist in the studied group. There are three general types of these techniques:

1. Indicators of Central Tendency
2. Indicators of Dispersion
3. Techniques to Analyze Variance

a. Central Tendency

The common average (arithmetic mean) is the commonest measure of central tendency and has been used as the only "statistic" in all of the previous sections. The mode is another of these measures which is computed by taking the most frequently observed value

in the population. The median is the value in the middle of the population when the values are arrayed in ascending or descending order of magnitudes.

Many Mandate projects are based on hypotheses which require a certain homogeneity of target group response, or homogeneity of characteristic. For example, the very idea of a target group presupposes a group with incomes "typically" below a certain level, or farm sizes which "tend" to be inside a certain range. They are assumed to be "typically" without access to credit, operating at low levels of technology etc Descriptive statistics can help to illuminate the central tendency (homogeneity) or lack thereof (dispersion), which can in turn make a project choices clearer.

b. Dispersion

Various techniques are available to describe the way in which a particular population (farms, households, individuals etc.) is distributed with reference to a particular value like income. It is very possible that the "typical" values obtained by the measures of central tendency are really respresentative of very few units in the population. This is an important concept for AID programming since projects are generally designed and implemented to reach a "typical" population, whose numbers and characteristics are usually described using simple averages. The numbers of target group families who fit this "typical" description, and the degree to which they distribute themselves closely around it are issues of vital import to project analysis.

Three general techniques are used to indicate the degree of dispersion. The first is a direct visual method in which all of the observations are plotted on a graph called a Histogram. The second involves simply subdividing the population into smaller segements and calculating "typical" values for the segments instead of for the total. This second technique is named according to the number of segments, quartiles (four segments), deciles (ten segments), and percentiles (100 segments) being the most common. The third method involves direct statistical estimates of dispersion using one of three estimates, range, mean deviation, or standard deviation.

i. Histograms

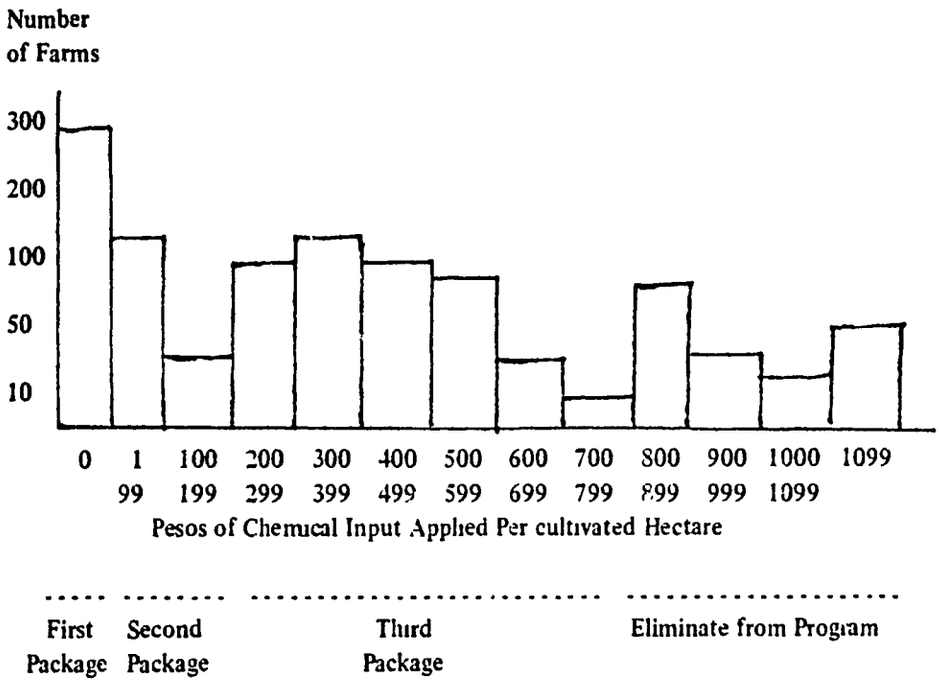
Histograms are often called frequency distributions since they represent the frequency or number of observations which fall within a set of ranges for the particular characteristic measured. To illustrate the project use of this technique an example will be drawn from an AID project aimed at providing technical assistance to small farmers. A major part of the technical assistance was to be focused on increasing the use of fertilizers, pesticides and herbicides in the production process. It was assumed that most small farmers used very little fertilizer, but the averages available indicated that typically small farmers applied 323 pesos of chemicals per hectare, The mode (the most frequent level of chemical values applied)

was zero, that is more small farmers applied no chemicals at all, than applied any other of the measured ranges in chemical value. Should the project design a technological and extension package for the typical small farmer based on the mean or the mode? Or should two or three separate packages be designed to fit the most "typical" sub-groups in the small farmer population?

The histogram shown below as Table 31 shows the actual distribution of a sample of 1120 randomly selected small farmers among the target group which such projects hope to reach.

Table 31

Histogram or Frequency Distribution of Chemical Use
On a Sample of 1120 Small Farms 1969 Colombia



SOURCE Thomas Walker, DISAGGREGATION METHODOLOGY WORKING DOCUMENT Sector Analysis Division, AID Washington 1974

Table 32

Income Characteristics of Farm Families in Costa Rica 1973
(US$)

Population Segments	Number of Farm Families	Mean Per Capita Income	Range in Percapita Income: Total	Range in Percapita Income: Upper Limit	Range in Percapita Income: Lower Limit	Standard Deviation	Cofficient of Variation	% of Income	% of Income
All Deciles	73,399	$ 728	$118,000	$77,000	$-42,000	72,556	1.97	100 %	100%
1st Decile	7,340	-350	42,000	31	-42,000	79,502	5.17	-4	10
Lower 1/2	7,340	-709	42,000	2	-42,000	110,053	3.48	-4	5
Upper 1/2	7,340	21	30	31	2	344	.37	0*	5
2nd Decile	7,340	48	39	70	31	489	.23	1	10
3rd Decile	7,340	105	81	152	71	1,197	.24	1	10
4th Decile	7,340	194	102	251	153	1,351	.15	2	10
5th Decile	7,340	315	153	405	252	2,439	.15	4	10
6th Decile	7,340	510	236	642	406	3,731	.14	7	10
7th Decile	7,340	770	276	919	643	4,562	.11	11	10
8th Decile	7,340	1,033	243	1,162	920	3,789	.07	15	10
9th Decile	7,340	1,316	484	1,647	1,163	9,122	.12	20	10
10th Decile	7,340	2,449	75,000	77,000	1,648	156,438	.98	43	10
Lower 1/2	3,670	1,727	372	2,020	1,648	9,179	.08	15	5
Upper 1/2	3,670	3,127	75,000	77,000	2,021	203,965	.99	28	5

* Rounded to the nearest percent

SOURCE: Samuel Daines computation based on data from the 1973 Agriculture Census partially processed in Alberto diMare et al, ALGUNAS CONDICIONES DE VIDA DE LA PROBLACION RURAL DE COSTA RICA, financed and published by AID, San Jose, 1976, Table 1C-0

Based on these findings, three separate packages would appear best for inclusion in a small farmer technical assistance project. The first package, for those small farmers not using chemicals, covers 26% of the target group, the second package covers 12%, and the third 41%. The mode was typical of only 26% of the farmers, and the mean only 9%. Those small farmers who use substantial amounts of chemicals represent 21% of the target group and should be eliminated from this project entirely. If almost all of the farms had grouped closely around the 323 peso value, the mode and the mean would have been very close to each other, and either one would have been a reliable indicator.

ii. Quartiles, Deciles or Percentiles

Segmenting the population into smaller parts is conceptually the reverse of the Histogram approach which segments the range in values and then measures the number in the population in that range. In the decile approach, in contrast, the population (not the value) is sorted into ranges and the values are measured. Table 32 illustrates this technique from an actual AID project applicaiton in Costa Rica. This table also serves to illustrate the other measures of dispersion.

As one would expect, the average of US$728 income per capita is typical of only a small part of the population, those with between US$643-919 represent 10% of the farm population and which control only 11% of the income. Separating the population into deciles is a way of getting a much improved view of the way the population is dispersed with reference to income. The first two columns of Table 32 comprise the information which would be displayed in order to study dispersion by segmenting. Even inside the deciles it can be important to disaggregate further. This can be seen in the first and tenth deciles which have been further divided into 5 percent segments. The lower half of the first decile is not really "poor" in Mandate terms, but rather rich families who suffered immense losses this particular year. Using these segments it is possible to estimate the absolute size of the Mandate group of farm families. Using US$150 as the benchmark the upper half of the first decile (3,670 families), the 2nd, 3rd (14,680 families), and half of the 4th decile (3,670) would be included. This computation results in an estimated target group of farm families of 22,020 and a target group farming population of 141,589.

iii. Range

A further indicator of dispersion is the range in observed values. This could be displayed for a population whether or not it had been segmented, as Table 32 is, and would indicate the total difference (ignoring sign) from the highest to the lowest value along with the upper and lower limit. These figures can be seen in Table 32 columns 3, 4, and 5. The farmer with the highest income in Costa Rica was estimated to have earned US$77,000 per capita or $648.340 in 1973; the lowest estimated income was $-42,000 per capita. These extremes, because of their absolute size, will have a distorting influence on any arithmetic mean calculated. Note how the range is manageable in all but the lowest and highest 5 percentile groups.

iv. Standard Deviation

The standard deviation is an "absolute" measure of the average distance of each value from the arithemtic mean of all values. It is therefore a measure of how disperse the values are, or how much on the average they differ from the mean. The standard deviation is not the simple average of the distance from the mean, but the quadratic mean of the distances. This accounts for the difficulty in making easy comparisons between the range figures and the standard deviation figures. The least dispersion observed in any decile in Table 32 is in the 2nd decile. The standard deviation measure is computed in the same measurement units as are found in the values themselves. In Table 32 these units are USS. The measure of dispersion found in Table 32 could not be compared with a standard deviation measure for the number of children in the same population because the units are different. As one would expect, where the absolute numbers are low, in the upper half of the first decile and the second decile, the standard deviation is itself low. In order to get a measure of "relative" dispersion which can be used as an abstract measure of heterogeneity regardless of the units we must use the Coefficient of Variation.

v. Coefficient of Variation

The coefficient of variation is a measure of relative dispersion. It can be observed in Table 32 that the relative dispersion (heterogeneity) is rather high (.37) where the standard deviation or absolute dispersion is lowest. The true dispersion is highest in the negative income class where a few very heavy losers create extremely high heterogeniety. The variation is least in the 8th decile in incomes between US$920-1,162.

In AID project terms, a target population which has a high degree of variation on a characteristic which is critical to the project working hypothesis could lead to ineffective project results. Using the example of the technical assistance project to increase fertilizer use on small farms, if the variation in the amount of fertilizer used on target group farms is high the project may have problems. Design changes are in order, either to re-select the target group, segment the specific approach to the major target group classes, or return to the project drawing board.

6. ANALYSIS OF VARIANCE

Though the terms "variance" and "variation" come from the same root, they mean rather different things to statisticians. While variation is a measure of the dispersions inside a group, the analysis of variance is aimed at estimating the significance of differences observed BETWEEN different groups or samples of groups. The analysis of variance is particularly useful to Mandate project analysis because it is a way of testing project hypotheses. The process of analysis of variance begins with two or more groups of farms, households, individuals, etc. Samples are taken from these groups, and differences in some characteristics identified. The analysis of variance tells us whether this observed difference is statistically significant, or if it may simply be due to sampling fluctuations or chance occurrence.

Table 33

Comparison of Selected Characteristics of Small Guatemalan Farms for 1974
(Comparisons are made between participants in an AID supervised credit project and a control group of similiar size farms)
(Figures are for a sub-sample of farms under 1 Ha.)

Characteristic Measured	No. of Farms Sampled	Average of Sampled Farms: Supervised Credit Participants	Average of Sampled Farms: Control Group	Difference Between Groups	T Stat.	% Reliability
Age of Farmer	113	41.0 Yrs	41 3 Yrs.	-1%	-0.13	55.0%
Distance to Market	98	13.6 Km.	8.3 Km	64	5.11	99 9
Value of Crops Sold	52	415 0 USS	130 0 USS	320	8 62	99.9
Gross value of Prod./Ha.	113	1750.0 USS	472.0 USS	370	3 83	99.9
Size of Family	113	6.13	6.33	-3	-0.57	70 0
Net Income per Ha Cult.	113	958 0 USS	192.0 USS	498	3 26	99.9
Net Income per $ Capital	113	.296	.334	-13	-0.36	65.0

SOURCE Charles MacDonald, STATISTICS FROM THE 1974 GUATEMALA SMALL FARM SURVEY, Sector Analysis Division, AID, Washington D C., 1975, p 22 For a discussion of the sample design and derivation of the t-statistic see Samuel Daines, GUATEMALA FARM POLICY ANALYSIS, AID, Washington D C 1975, p 121.

For example in an evaluation of a small farmer supervised credit program in Guatemala, a sample was taken of 774 randomly selected participant farmers and 774 matched small farms with similiar characteristics. Table 33 presents selected findings from this survey.

The number of farms sampled under 1 Ha. is only about one tenth of the total sample size. The purpose of the t-statistic is to give an estimate of the probability that the observed differences between the sample group are the result of chance. At the end of most statistical handbooks there is a table giving the reliability estimate based on the size of the sample and the value of the t-statistic.

In the context of the evaluation of small farmer credit in Guatemala it was important to decide which of the observed differences between the participants and the control group were chance occurrences and which could be relied upon as statistically significant. There is only a slight difference in the ages of the farmers (1%) and by looking up the value of reliability for a t-statistic value of .13 and a sample size of 113 it appears that there are 45 chances out of 100 that such a difference is mere coincidence. In general, reliabilities under 90% are felt to be so low that unless there is some special reason to believe the result on non-statistical grounds, the result is disregarded.

To say that the difference is statistically significant is not to say that credit necessarily "caûsed" the difference, but if the control group is similar in all respects except credit such a significant difference would at least strengthen belief in such a hypothesis. It is interesting to note that while the credit farm achieved a reliable difference in net income of almost 500%, and a superior output productivity of land of 370%, the profitability of capital was not significantly different. For project evaluation purposes such a finding would indicate that the additional credit increased the productivity of land, but made no difference in the productivity of capital. The efficiency of capital use did not increase, but income and land productivity did. Even when the t-statistic is low, there is analytical and interpretive value since it disproves a significant difference.

The F test measures a conceptually similar phenomenon of statistical significance, but is able to handle more than one factor at a time.

Analysis of variance can be a useful project analysis tool to test simple operating hypotheses for project selection or evaluation.

7. REGRESSION TECHNIQUES AND PRODUCTION FUNCTION ANALYSIS

The explanation of observed differences is one of the principal analytical and interpretive processes involved in project analysis. It can be approached in many different ways: simple logic and field observation fitting the observation informally to a theoretical structure, elaborating indices, using control groups, etc. As we observed in the case of the Guatemals production indices, many factors may be affecting a particular project outcome and it may be impractical to formulate enough control groups with different characteristics to control for all of these factors, or to hold them constant.

Regression analysis is a partial solution to some of these analytical difficulties. Let us take the simple case of fertilizer in corn. In the case of Colombian small farmers, the histogram earlier presented showed that there is a wide variation in the level of chemicals used. Three methods might be employed to explore the role of fertilizer use in corn yields on small farms in Colombia. First might be the experimental approach; a representative plot of land in a small farm area might be selected and divided into 13 sections. One of the plots would be given no fertilizer, and each of the other 12 would be given increasing doses. At the harvest the quantities of corn would be carefully measured and the differences in yield would be attributed to the differences in fertilizer since all other factors were held constant. A second approach to the same problem would be to utilize the actual farm data which underpin the fertilizer use histogram to create small farmer average corn yields for each of the 13 use levels. These yields would be different, and the differences could be attributed to the differences in fertilizer use. But many other differences may exist between these farmers; all other factors are not held constant as they were in the experimental plot.

The third alternative is regression analysis. Regression is a technique which relates two or more patterns of variation. For example, it could relate the pattern of variation which is observed in the level of fertilizer application, and the pattern of variation in corn yields. Regression theory is based on the intuitive belief most people share that events or phenomena which occur together are somehow related: Such a belief is a relative one, a single coincidence is less convincing than many hundreds of thousands of observations in which the two factors are both present when an event occurs. The consistency in degree of variation between two factors like fertilizer and yields is also intuitively convincing evidence that there is a causative relationship between them; for example, if a graph were plotted showing variations in yield, and a similar graph of fertilizer use were superimposed on it, and the two were to be seen to move consistently in the same directions even where there was an erratic pattern in both, most people would be convinced of some direct link between the two.

A simple regression tests the consistency of this variation. If there is little observed variation, the technique has little to work with. In regression analysis accurate results are usually only possible when there is considerable variation in both the dependent variable (the factor to be explained such as yields), and the independent variable (the explanatory factor, such as fertilizer). While a simple regression (one dependent and one independent variable) does not explicitly hold other factors constant, if there is wide variation in these two factors one might believe the result on the basis that the probability that other factors are moving in an identical fashion is very low. Unfortunately closer examination of most such simple regression experiments reveals other factors which may be exerting confusing influences. An important source of this distortion is the possibility that the explained and explanatory factors are tautologically defined, that is the posited cause and the posited effect are really measuring the same thing, or nearly the same thing For example to say that the number of man days of harvest labor correlates highly (explains a large proportion of the variation) with harvest quantity or yield is tautological, each is a different measure of the same thing, volume harvested.

Multiple regressions allow for contributing causation of many different factors, but it is important that each factor be theoretically independent. With this brief background in mind, let us examine some AID Mandate project applications of this technique. Regression analysis was used to examine the interrelationships between the project performance indices presented in Table 30. The results of this analysis are described as follows:

> "Stepwise multiple regression analysis was used to identify the most significant success determinants from our listing of possible determinants Attention was given to the determinants of each of our success measures, and the results are reported separately in the sections below (23)

Let us examine this regression analysis, treating each separate test individually. The first mentioned experiment related "local action" (the explanatory variable) to "overall success" (the explained variable). The results indicated that 49% of the variation in overall success could be explained by variation in local action. In order to understand the meaning of this finding we must explore the definitions of the two related variables. "Overall success" is made up of four component factors, an index of income/costs, and index of agricultural knowledge which measured farmers individual acquisition of information, an index of the degree of self help which measures "benefits obtained from group participation, formal or informal, which complement the project's economic activities," (24) and a self sustaining index which measures "the ability of the project to draw upon increased income from project costs paid for by domestic sources." (25)

Having explored what is defined as the explanatory factor we must now understand what is meant by the explained factor "local action". As the definitions are read, watch carefully for tautology. Is the thing explained simply a different way of stating that the factor which is posited to explain it?

> "We start by defining local action. By this term, we refer to two types of small farmer activity The first relates to his involvement in project decision-making in: (a) the idea evolution and project design phase, and (b) the project implementation phase The second type of small farmer activity in local action relates to the resource commitment he makes to the project defined as:
>
> .The ratio of the value of the increased family labor commitment to family income
> .The ratio of his increased money commitment to family income
> .The sum of the above two ratios (called total resource commitment)
>
> Following standardization of the four independent measures, their values were added together gether. The resulting sum was then taken as our comprehensive measure of local action." (26)

Compared to the simple case of increased fertilizer and increased yields, this project performance regression analysis seems extremely complicated. Part of the added complexity comes from the difficulty of explaining in logical or well established theoretical terms the connections tested in the regression. Most people understand what is meant by the cookbook kind of connection between added fertilizer and increased corn. The theory and logic is less well developed between ideas like "local action" and "information acquisition". Regression is a useful tool to the degree that the problem is itself well understood, it should

be viewed as a way of slightly extending the edge of experimental knowledge, rather than as a tool for exploration into little understood areas. In areas where the definitions and theory are little developed, the potential for tautology is very high.

Where theory is reasonably developed, where definitions are clear, and the logic of posited causation is direct, regression analysis can be a powerful project analysis tool. Its principal advantage is its ability to account for the simultaneous impact of a number of independent influences, while avoiding the cost of such safeguards if achieved by control group samples.

8. COMPLEX PROJECT ANALYSIS TECHNIQUES

Beyond the simpler methods already outlined lie a group of techniques for project analysis involving quantitative models, whose complexity and cost prohibit their use in more than a handful of experimental cases. DSP is not the forum for even a brief exploration of these techniques. All that will be attempted is a paragraph of two of description so that DSP participants will be aware of what the technique purports to accomplish and a numerical example from a project application in AID.

a. Mathematical Programming

Mathematical programming, and the most common sub-type, linear programming, are characterized as optimization models. They examine the way a complex set of resources would be allocated in a farm, household, or other system, to produce the largest possible quantity of some output. They have been used to explore resource allocation possibilities for small farms and to explore the potential impact of Mandate projects. Small farms are complex businesses and models like these are sometimes useful to trace out the accounting relationships between the many crop alternatives and limited resources.

Table 34 presents results from a series of small farm linear programming models based on data from the Guatemalan Highlands.

Table 34

The Impact of Credit Restrictions on Small Farm Income
$ of Added Income Generated by 1$ of Added Credit
Above $450 of Credit per Farm

Technological Level	$ of Income/$ of Credit
Low	.394
Average	.605
High	.787
Very High	1.048

SOURCE. Samuel Daines et al, ANALYSIS DEL IMPACTO DEL CREDITO DE FINCAS PEQUEÑAS SOBRE INGRESO, EMPLEO, Y PRODUCCION AGROPECUARIA Volume IV, Secretaria del Consejo Nacional de Planificacion Economica and AID, Guatemala 1976, p 100.

The study found that above $500 of credit most small farm situations could not increase income with additional credit, at that point other factors like land and markets restricted income. The findings indicated that even for farmers at lower than average small farm technological levels, additional credit has a high income potential.

The advantage of linear programming as a technique is its capacity to explore the interrelationship between limiting resources. Linear programming techniques have been used extensively to explore nutrition project impacts.

b Econometric Models

Econometric models could include all of the quantitative exercises here-to-fore examined since the word econometric means simply to measure economic phenomena. In common professional usage the term has assumed a more delimited meaning, but the limits vary with the professional Most often econometric models focus on empirical estimation of the structural coefficients which are central to neo-classical economic theory These are usually price related phenomena, and explore how price affects production and consumption decisions. These models may use computational routines from any of those described, production functions, regression, mathematical programming etc.

An example of the type of computations obtained in econometric estimates if presented in Table 35. These estimates indicate the percentage increase in the quantity which would be demanded if the price were to be reduced by one percent.

Table 35

Price Elasticities of Demand by Product Group
Mexico 1969

Product Group	Price Elasticity of Demand
Cereals	-.10
Pulses	-.35
Fruits	-2.00
Vegetables	-.40
Oils	-1.20

SOURCE Duloy and Norton, CHAC MODEL, in MULTI-LEVEL PLANNING: CASE STUDIES IN MEXICO, North Holland Publishing Co, Amsterdam 1973, p 317 (summarized for Table 35)

These estimates indicate for example that if the price of cereals were to drop by 10% in Mexico, consumers would purchase 1% more cereals products. If the price of fruits were to drop by 10%, consumers would purchase 20% added fruit products. These figures can be useful in selecting small farmer projects which will depend on added demand for a market.

c. Input/Output Techniques

Input/output models analyze the interrelationships which exist between different production sectors in an economy. Because of their capacity to show how each sub-sector enters as a processor of another sector's output and in turn supplies its product as an input into some other sector, these models are often used to reveal the indirect impact of projects.

Most often, input/output models are used for sector or economy wide analysis as opposed to project analysis. They tend to be very costly and are seldom justifiable on the basis of one, or even a group of projects. Where an input/output model exists, and where the detail in the model is sufficient to distinguish between project alternatives, it makes sense to use the model for project selection. Table 36 presents the results of a pre-project selection application of input/output. In this case three projects were being considered, a banana development project, a Cocoa plantation, and a poultry installation. The input output model was used to estimate direct and indirect income benefits which would accrue in all parts of the economy as a result of these three possible projects.

Table 36

Estimates of the Impacts of Three Projects in Colombia 1972
$ of Income per $ of Investment
Income includes direct and indirect income generated.

Direct and Indirect Benefit Type	Banana	Cocoa	Poultry
Total Income	1.82	2.56	2.06
Rural Income	.81	1.11	.70
Rural Income to Unskilled Laborers	.48	.32	.12
Enterprenurial Profits	.91	1.22	.99
Rural Profits	.55	.69	.50
Urban Profits	.36	.52	.49
Foreign Exchange	+ .04	+ .03	-.01

SOURCE. Clara Lopez, PARTIAL APPLICATION OF INPUT/OUTPUT ANALYSIS TO THE EVALUATION OF PROJECTS. THE CASES OF BANANA, COCOA AND POULTRY IN COLOMBIA, Agency for International Development, Washington, D C, 1972, p. 8

Using an input/output model for project analysis has the advantage of allowing one to see the ripple effect of benefits and costs of a particular project on the total economy. The best example of such a project analysis is Walter Isard, *REGIONAL INPUT/OUTPUT STUDY: RECOLLECTIONS, REFLECTIONS, AND DIVERSE NOTES ON THE PHILADELPHIA EXPERIENCE*, MIT Press 1971, in which the author evaluated the impacts of a military installation project using input/output techniques. The technique is generally too costly for AID use, but may become practical as more and more LDC'S generate Input/output models for other uses, in which case there is little added expense to harness them for project appraisal.

d. Computer Simulation

Computer simulation generally involves a complex set of statements about the quantitative relationship between variables in an economic system. The system could be a farm, household or project. This technique has been used widely for sector level modeling but its application to project analysis has not yet been exploited in the AID context. Interested participants should examine the Nigerian and Korean Agriculture Sector Analysis efforts of Michigan State University. (27)

FOOTNOTES TO PART D

(23) Development Alternatives, Inc., *Strategies for Small Farmer Development: An Empirical Study of Rural Development Projects,* Vol. I, Washington, D.C., 1974, p. 43.

(24) *Ibid.*, p. 45.

(25) *Ibid.*

(26) *Ibid.*, p. 46.

(27) See Glen Johnson et al., *Strategies and Recommendations for Nigerian Rural Development,* 1969-1985, Consortium for the Study of Nigerian Rural Development, AID, Washington, D.C., 1969. Also see George Rossmiller et al., *Korean Agricultural Sector Analysis and Recommended Development Strategies,* 1971-1985, Michigan State University, East Lansing, 1972.

PART E

COMPARING THE BENEFITS AND COSTS OF MANDATE ORIENTED AID PROJECTS

1. BENEFIT/COST AND COST EFFECTIVENESS ANALYSIS AND THE AID PROJECT CYCLE

Each project analysis technique has its strengths and its weaknesses, the particular strength of the techniques covered in this Part lie in the light they shed on project selection and evaluation where more than one project with similiar objectives are compared. This strength is mostly lost when projects of essentially different type are compared, or where there are really no alternatives projects under serious consideration. Conceptually benefit cost analysis should provide equally strong guidance where projects of different type are compared, but the difficulties inherent in measuring and defining both costs and benefits on terms sufficiently comparable between projects of differing types render such judgements ineffectual.

It is most important, therefore, to discuss at the outset of this Part the appropriate stage in the project cycle where these techniques fit best.

a. Project Selection

In the project selection stage this "comparability" strength of benefit/cost techniques is particularly important. If the benefit/cost analysis enters the scene only after project selection has taken place and there is only one project under serious consideration, the technique has missed its chance to make its unique contribution. Such analysis can conceivably still provide useful comparisons with investment alternatives in other sectors or in other countries, and some would even argue that it can indicate the true or "absolute advisability" of undertaking the project. In practice benefit/cost ratios have been used by Regional Bureaus to decide between projects of different types and in different countries, however, measurement difficulties and conceptual uncertainty make this a questionable practice. Using benefit/cost techniques as a tool for project justification makes sense only when the justification is vis-a-vis projects of similiar type in the same country. The AID Handbook outlines this point as follows:

> "In other words, a principal value of good analysis is that it help the project designer clarify and systematize alternative ideas and designs for his own benefit, well before he presents the final results of his analysis to reviewers and decision makers ... The real purpose of economic feasibility analysis is to aid in the CHOICE OF ALTERNATIVE projects and ALTERNATIVE PROJECT DESIGNS Thus it is essential that analysis be done early in the project identification and design process. Otherwise there is a danger that analysis will be employed—as is unfortunately all too often the case—to JUSTIFY already determined projects and project designs." (28)

The staging and role of benefit cost or cost effectiveness analysis is related closely to the usefulness of the result. The time constraints and staff limitations imposed on most AID missions have resulted in a project preparation process far from ideal. Only rare situations exist in which a variety of project alternatives are under consideration at a late enough stage to permit benefit/cost analysis of all of them

Almost all AID benefit/cost analyses can be divided into two classes. First are situations in which the project has already been selected on other grounds. the benefit cost exercise was taken as a serious statistical effort for comparison with projects of other sectors, or with other countries. The second type is the situation in which no actual data are available on which to base the analysis, but estimates are made anyway to meet the AID-W requirement. There have been some exceptions in which the benefit cost analysis was properly staged and permitted the rational selection between alternatives, but such cases are rare. Since the special strength of benefit/cost is comparison among alternatives, if circumstances prevent such comparison it loses its unique contribution and perhaps other project analysis techniques such as those discussed in Part D would be more appropriate.

Another strength of the benefit/cost technique is its ability to deal with long project time horizons, that is to capture the influence of time on project selection. This strength can be misleading however, since the benefit/cost technique provides a framework for comparing benefits and costs which occur at different times, but it does not assist in estimating the benefits themselves This implies that project analysis can take advantage of this strength if reliable information is already in place about the timing and amounts of benefits and costs at future points in time. If little is known about exactly when and in what amount project benefits will happen, the benefit/cost method adds only the appearance of sophistication to the analysis and no substance. As will be mentioned in the next section, benefit/cost, like other techniques for project analysis, has far outrun its data base.

b. Project Evaluation

The same benefit/cost and cost effectiveness techniques could apply with eaual utility to project evaluation as to project selection. The fact that they have seldom been so applied is perhaps the result of the organizational environment (World Bank and others) in which they were refined during the fifties and sixties where the principal interest was in selection not evaluation. There are no reasons which would make these techniques less applicable in the ex post than in the ex ante situation.

2. DATA AND MEASUREMENT TECHNIQUE FOR ESTIMATING THE DIFFERENCE MADE BY THE PROJECT

A project is undertaken because of the anticipation that a series of benefits will result. Estimating the quantities of these benefits is the most difficult and costly part of a good benefit/cost or cost effectiveness analysis. Unfortunately this stage is not commonly thought of as a part of the analysis but rather as a data requirement of the analysis. Most

benefit/cost manuals refer to this as an estimate of "with" and "without" project situations. The idea is simple, to estimate the amount of income (or other benefit) which the subject population would have had "without" the project, then "with" the project, the difference being the result of the project. Once these project impacts are estimated, by whatever means, and based on whatever data, the well developed arithmetic of benefit/cost (discounting, BCR, IRR) can easily be applied to yield final ratios. Benefit/cost techniques provide no methodology however, for estimating those "with" and "without" differences in the first place. For example if the project is a small farmer credit project, and the objective is increased income, before a benefit/cost analysis can be undertaken, estimates must be made of the difference in income which the project will cause. In order to be reliable grounds for project choice these estimates should be based on in-country data on similar projects, for example on the observed differences in income between small farmers in the project country with and without credit. The techniques which would be used to gather such impact data, and to analyze it are those outlined in Parts B, C, and D. If the estimates for the benefit/cost analysis are not based on actual in-country data, there is no reason to think that the arithmetic of cost/benefit can build a useful result from inaccurate basic data.

The most important failing of benefit/cost as it is practiced in AID project analysis is not in the method utilized but in the simple fact that no reasonable data stand behind the "with" and "without" project impact and cost estimates. Most often there are no data at all, the estimates of the difference the project will make are based on the subjective judgements of "experts" and in many cases by the benefit/cost analysts themselves.

The sequence in which this manual is presented has the intent of showing a process of data specification, data gathering, data formatting, analysis, and finally benefit cost analysis. It is important to realize that benefit/cost is not a technique which escapes the necessity of reliable data. It is unfortunate indeed that project decision makers have been given the impression that while all other analytical techniques require original data, benefit/cost can proceed whether or not such data exist. The large bulk of the investments and analytical energy in any benefit/cost effort must inevitably center in gathering and analyzing data to estimate the "with" and "without" situation. Once reasonable and statistically believable estimates are available, little added effort is required to subject these estimates to the arithmetic of benefit/cost computations. There is a tendency in AID practice to ignore the data stage and proceed to the arithmetic of the computations, and for project reviewers to be more interested in the resulting ratios than in the validity of the evidence and data on anticipated project impact.

How can data be obtained which would help to estimate the anticipated impacts of a project which has not yet been undertaken? This question has been suggested as an excuse for doing benefit/cost without data. Reflection on the content of Parts C, and D should suggest a variety of different data gathering and interpretation techniques which could assemble evidence relevant to the ex ante estimation of the difference a project will make.

All projects operate on a hypothesis about change, that change which will result from a particular intervention or service. For example, a project which would increase fertilizer use to improve income operates on the hypothesis that increased technical assistance will result in increased fertilizer use, which will in turn increase yields, and in turn farmer net income. Data on the result of each of these sub-hypotheses can either be obtained from direct measurement in similiar projects, or by measuring the differences observed by "with" and "without" farms in the general population. For example, to test the last of the sub-hypotheses that increased yields result from increased technical assistance, small farmers in the general population who are receiving such assistance could be compared with those who are not. The observed difference in yields between these two groups might be used as the basis for an estimate of the "with technical assistance" difference to be used in a benefit cost analysis of a technical assistance project aimed at expanding coverage Thus the only case in which expert judgement must be relied on is the case in which there are no small farms in the country with the intervention which the project proposes. Almost always, AID projects aim to extend, expand, or intensify some service, project, program or intervention which has already existed in a more limited scale. Some experience in the same area or in a neighboring region usually can be observed, and its results measured to provide the basis for the AID benefit/cost analysis.

If it is impossible to obtain or to generate data on the size and probability of the anticipated impacts and costs of the project, then project proponents and analysts should ask themselves if the undertaking of a benefit/cost analysis without such data will add anything to the selection process. In many cases where there are either conceptual difficulties which render measurement unsatisfying, or data problems which are insuperable, benefit/cost analysis may in fact be a disservice to project decisionmaking by obscuring the central issues and providing an outwardly consistent but empty basis for project choice. Rather than calculate a series of ratios which are based on someone's rough "expert judgement" it may be better to express those judgements without the gloss of the benefit/cost arithmetic since the arithmetic may lead the project discussion away from central issues and to meaningless distinctions between the numerical magnitudes of the ratios themselves.

3. BENEFIT/COST AND COST EFFECTIVENESS ANALYSIS: BASIC DEFINITIONS

Many definitions for these terms are in current use among project analysts and they are not always consistent. Without arguing for or against any of the definitions we will adopt for the purpose of its manual the definition used in the AID Handbook:

> "COST BENEFIT AND COST EFFECTIVENESS
> For the purposes of this discussion, there are two main types of economic analysis which design personnel should consider in developing projects. (a) "cost-benefit" .... analysis and (b) "cost effectiveness" analysis In broad general terms, cost-benefit analysis will usually be the more appropriate technique when a project's outputs are primarily marketable items or when they at least can realistically be valued in monetary value. Cost-benefit analysis should normally be performed for any revenue producing project or for any project whose outputs translate

> realistically into monetary equivalents. .. On the other hand, cost-effectiveness normally will be done for those "social" or "nonrevenue producing" projects (i.e., those without significant income streams) whose output can nonetheless meaningfully be quantified. For example, health projects to reduce child mortality or specific disease rates, education projects to increase literacy rates, or family planning projects with specific fertility reduction goals all have (conceptually) quantifiable outputs and therefore are excellent candidates for cost-effectiveness analysis." (29)

Where income is the objective the numerator in the Benefit/cost ratio is income. Where the objective of a project is something besides income (like increased nutritional status) the numerator in the ratio would be units of improved nutritional status and the ratio would no longer be called a benefit/cost but a cost effectiveness ratio. Whether a ratio is termed benefit/cost or cost effectiveness using AID's definition depends not on the methodology used to compute it but whether the numerator is income.

4. COMPARING THE BENEFITS AND COSTS OF MANDATE ORIENTED AGRICULTURAL PROJECTS

The balance of Part E will be organized by the general project types or mandate objectives as outlined in the Committee Print and discussed in Part A. Three types of analysis will be examined;

1. Financial Benefit/Cost Analysis
2. Economic (Social) Benefit/Cost Analysis
3. Cost Effectiveness Analysis

Financial Benefit/Cost attempts to measure the benefits and costs as they are actually paid or received by the the individual beneficiary or project participant. For agricultural projects this is the farmer, his direct costs and income benefits are taken unadjusted by societal or indirect effects. The objective of financial analysis is to evaluate the direct financial feasibility of the project and to see if market incentives will encourage participants to engage in project activities.

Economic or "Social" benefit/cost analysis takes broader view of both costs and benefits and includes both direct and indirect effects felt by the larger community, and adjust the prices at which cost and benefit items are valued to reflect either market distortions or public policy.

The following quote explains in more detail the reasons for going beyond financial analysis to economic or social benefit cost analysis.

> But why bother with [economic or social] cost-benefit analysis at all? What is wrong with deciding whether or not to undertake any specific investment, or to choose among a number of specific investment opportunities, guided simply by proper accounting practices [financial analysis] and, therefore, guided ultimately by reference to profitability The answer is provided by the familiar thesis that what counts as a benefit or a loss to one part of the economy – to one or more persons or groups – does not necessarily count as a benefit or loss to the economy as a whole And in cost-benefit analysis we are concerned with the economy as a whole, with the welfare of a defined society, and not any smaller part of it.
>
> A private enterprise, or even a public enterprise, comprises only a segment of the economy, often a very small segment. More important whatever the means it employs in pursuing its objectives .., the private enterprise, at least, is guided by ordinary commercial criteria that require revenues to exceed costs. ...
>
> There is, of course, the metaphor of the 'invisible hand', the *deus ex machina* discovered by Adam Smith that so directs the self-seeking proclivities of the business world that it confers benefits on society as a whole. And one can, indeed, lay down simple and sufficient conditions under which the uncompromising pursuit of profits acts always to serve the public interest. These conditions can be boiled down to two: that all effects relevant to the welfare of all individuals be properly priced on the market, and that perfect competition prevail in all economic activities.
>
> Once we depart from this ideal economic setting, however, the set of outputs and prices to which the economy tends may not serve the public so well as some other set of outputs and prices. In addition to this possible misallocation of resources among the goods being produced, it is also possible that certain goods which can be economically justified are not produced at all, while others that cannot be economically justified continue to be produced. ...
>
> Again, certain goods having beneficial, though unpriced, spillover effects also quality for production on economic grounds, but they cannot be produced at a profit so long as the beneficial spillovers remain unpriced. The reverse is also true and more significant profitable commercial activities sometimes produce noxious spillover effects to such an extent that, on a more comprehensive pricing criterion, they would be regarded as uneconomic.
>
> 2. The economist engaged in the cost-benefit appraisal of a project is not, in essence then asking a different sort of question from that being asked by the accountant of a private firm. Rather, the same sort of question is being asked about a wider group of people – who comprise society – and is being asked more searchingly. Instead of asking whether the owners of the enterprise will become better off by the firm's engaging in one activity rather than another, the economist asks whether society as a whole will become better off by undertaking this project rather than not undertaking it, or by undertaking instead any of a number of alternative projects

5. *COMPARING THE COSTS AND BENEFITS OF RURAL PRODUCTION PROJECTS*

Rural production projects include projects aimed at farm production and income, agroindustry, marketing and other research, extension and indirect activities which seek to increase the incomes of the rural poor.

a. Financial Benefit Cost Analysis

i. "with" and "without" Project Estimates

The beginning point for a financial benefit/cost analysis is a year by year estimate of the financial situation of the project participant or beneficiary with and without the project. Examples of "with and without" estimates will be drawn from the benefit/cost analysis section of a highlands irrigation project for Peru financed by AID in 1976.

Table 37

Sample "With" and "Without" Estimates for Production in the Peru Highlands Irrigation Project

	Without Project	With Project
Potatoes	3,212	13 421
Beans, Peas	178	3,214
Vegetables	4,058	9,884
Fruits	56	2,807
Corn	695	2,328
Grains and Cereals	1,901	4,078

** Gross Value of annual output less farm and project operating costs (excluding farm labor costs).*

SOURCE. PERU Program for Improved Water and Land use in the Sierra Project Paper, Agency for International Development, 1975, Washington D C. p 67

The estimates in Table 37 indicate the estimated differences when the project reaches full production. These numbers unfortunately were not obtained from any direct data base and the authors of the project are the first to admit that the final ratios are "of little value, since data used to derive (them) have been estimated." (Ibid. p 84). Irrigation would cause a difference in the way land is used and the amount of land dedicated to different crops, it would also cause a change in the yields of each crop per hectare. The project would move the percent of land irrigated from 26% to 75%.

The yield and land use pattern differences would change the input and output values at the farm level resulting in a difference in family and percapita income which is the final objective. Table 38 indicates the with and without project farm revenues, and the resulting cash income differences for the farm families respectively.

Table 38

With and Without Project Estimates for the Peru Sierra Irrigation Project (Chupaca Sub Region)

	Without Project	With Project	
Amount Irrigated	1,328 Ha.	3,305 Ha.	Ha.
Gross Annual Output at Full Production	US$1,018,055	US$2,488,473	
Net Annual Output at Full Production	US$ 885,829	US$1,672,443	
Net Annual Output Per Farm Family	US$ 295	US$ 557	

SOURCE: Peru; Program for Improved Water and Land Use in the Sierra, Project Paper, Agency for International Development, 1975, Washington D.C. p. 54.

While the data base for the Peru figures is apparently non-existent (estimates were founded on educated guesses) the methodology is interesting. The interconnecting hypotheses start with the assumption that land use and yields will change and give rise to the differences in the "with" and "without" estimates in Table 37. These yield and land use changes would result in altered input and output values on the participating farms which would cause a difference in family cash incomes (table 37) which is the final objective of the project. This final difference in family incomes is known as the "cash flow". The reader should note that all of the Peru estimates are taken from the year in which the project reaches full production when all of the irrigation works are operating and all of the yield and cropping changes have occurred. In the earlier years of the project the costs would be higher and the outputs lower which would result in a lower "cash flow" for these years. The Peru project has a useful life of 40 years, if the "cash flow" (the net added benefits minus the added costs) for each year was added together the sum would be called the "Total Cash Flow".

DEFINITION: Cash Flow = Added income minus added costs for one year

DEFINITION: Total Cash Flow = Sum of each of the annual cash flows over the useful life of the project.

It should be noted that in the Peru project case, an excellent opportunity for obtaining the needed data was bypassed. Since important averages of the project areas are already under irrigation, a simple and inexpensive sample survey would have quantified the with and without irrigation differences which would have provided a serious and believable statistical basis for the benefit/cost measurements

ii. Accounting for the Time Value of Money: Discount Rates

Most AID projects take time to implement, and the benefits may take a long period of time to materialize. In the Peru Irrigation loan it will take many years to build the irrigation works, and additional time to see the farm level changes in practices which are required before the full benefits will be seen. Projects are not all equally long, some have relatively short time horizons such as a small farm credit project which aims at financing fertilizer. In order to be able to compare projects with different patterns in the timing of costs and benefits a mechanism must be used, which places benefits and costs which occur at different times on a comparable standing.

In Financial benefit cost analysis the basis on which this is done is rather simple, it is done using an interest rate. Money has a time value, one dollar in my hand today is worth more to me than the same dollar if I had to wait one year to obtain it. Similiarly, one dollar of cost is valued less one year from now than it would be if I had to pay it today. Likewise a project producing one million dollars of benefit ten years from now is less valueabe than a project producing the million dollars of benefits in three years, assuming the costs of the two projects are the same in quantity and invested at the same time. What could I use to measure the added value of a dollar today as contrasted to a dollar one year from now. One way is to ask what income I could earn from the one dollar if I were to invest it today and require it to be returned one year from now. If that amount is 10 cents, I might say that the dollar I cannot get for one year is worth only 90 cents today, for that is all I would be willing to pay for the right to receive it in one year if I believe that a reasonable interest rate is 10%. The 90 cents is defined in cost benefit analysis terms as the "present value" of the dollar I can receive in one year. The 10% interest rate used to arrive at the "present value" is called the "discount rate," and the simple arithmetic used (multiply 1 dollar by .9 which equals 1 minus the discount rate) is called "discounting."

With the use of a discount rate I can place moneys to be received at various points in the future on a common ground, that is they can all be discounted to their present worth and then added together. The interest rate which is chosen as the discount rate for financial analysis should be the interest rate which could be earned without extensive management on an average investment in the country in which the project is to be undertaken. This concept has often been referred to as the opportunity cost of capital. By using a discount rate, each project will be automatically compared with what could be alternatively accomplished with project funds if they were invested in the open market.

DEFINITION: Discount Rate = That interst rate which the average investment could securely earn in the country in which the project is undertaken. Sometimes called the 'opportunity cost" of capital.

In order to illustrate the arithmetic of discounting an example will be drawn from the North Shaba (Zaire) Maize Production Project. The benefit cost estimates for this project assumed a 10 year project life with no salvage value at the end of that period. The annual cash flows for the project are presented in Table 39.

Table 39

Annual Cash Flow, and Net Present Value Calculations for North Shaba Maize Production Project (Zaire) (values in 000 US$)

Year	Added Costs	Added Income	Annual Cash Flow	Discount Factor at 15% Discount	Net Present Value
1	$4,954	$ 378	$ -4,576	0.870	$ -3,981
2	1,919	756	-1,163	0.756	879
3	2,519	1,701	- 181	0.658	- 119
4	2,490	2,390	440	0.572	252
5	1,613	4,914	3,301	0.497	1,640
6	1,401	6,808	5,403	0.432	2,334
7	1,692	8,883	7,191	0.376	2,703
8	1,737	10,773	9,036	0.327	2,955
9	1,783	12,852	11,069	0.284	3,144
10	1,829	14,742	12,913	0.247	3,190
Net Present Value					$11,239

SOURCE: A Albert Green, AN APPROACH FOR ASSESSING RURAL DEVELOPMENT PROJECTS PART II, AN ILLUSTRATIVE APPLICATION' Agency for International Development Washington D.C. 1977 p. 58

If the cash flows for the North Shaba Maize Project are discounted at 15% their net present value is $11,239,000, that is the value today of all of the costs and income which will occur in the project in the next ten years is $11,239,000.

DEFINITION: Net Present Value = The sum of the present values of each of the annual cash flows.

The discount factor is the value which would be received at a future date at a particular discount rate. These factors may be found commonly in tables in which the actual values have been computed, thus in Table 40 the discount factor for 1 year at 15% is 0.870. The process of discounting involves simply multiplying the cash flow for each year by the relevant discount factor and then adding each year's present value together.

iii. Benefit/Cost Ratio

The benefit cost ratio is a way of computing the benefit per unit cost. By constructing a ratio we are able to compare projects of different absolute size. The net present value measure says nothing about the efficiency of the project; a large project would be expected to have a large net present value and a small project would be expected to have a low present worth. In order to view the efficiency of the use of scarce resources, a ratio is needed.

DEFINITION: Benefit/Cost Ratio = The present value of benefits divided by the present value of costs.

In order to compute the benefit/cost ratio the benefits and costs must be separately discounted and separately summed to provide a present value of benefits AND a separate present value of costs. The discounted benefits are then divided by the discounted costs.

DISCOUNT FACTOR–How much 1 at a future date is worth today.

Year	1%	3%	5%	6%	8%	10%	12%	14%	15%	16%	18%	20%	22%	24%	25%	26%	28%	30%	35%	40%	45%	50%
1	0.990	0.971	0.952	0.943	0.926	0.909	0.893	0.877	0.870	0.862	0.847	0.833	0.820	0.806	0.800	0.794	0.781	0.769	0.741	0.714	0.690	0.667
2	0.980	0.943	0.907	0.890	0.857	0.826	0.797	0.769	0.756	0.743	0.718	0.694	0.672	0.650	0.640	0.630	0.610	0.592	0.549	0.510	0.476	0.444
3	0.971	0.915	0.864	0.840	0.794	0.751	0.712	0.675	0.658	0.641	0.609	0.579	0.551	0.524	0.512	0.500	0.477	0.455	0.406	0.364	0.328	0.296
4	0.961	0.888	0.823	0.792	0.735	0.683	0.636	0.592	0.572	0.552	0.516	0.482	0.451	0.423	0.410	0.397	0.373	0.350	0.301	0.260	0.226	0.198
5	0.951	0.863	0.784	0.747	0.681	0.621	0.567	0.519	0.497	0.476	0.437	0.402	0.370	0.341	0.328	0.315	0.291	0.269	0.223	0.186	0.156	0.132
6	0.942	0.837	0.746	0.705	0.630	0.564	0.507	0.456	0.432	0.410	0.370	0.335	0.303	0.275	0.262	0.250	0.227	0.207	0.165	0.133	0.108	0.088
7	0.933	0.813	0.711	0.665	0.583	0.513	0.452	0.400	0.376	0.354	0.314	0.279	0.249	0.222	0.210	0.198	0.178	0.159	0.122	0.095	0.074	0.059
8	0.923	0.789	0.677	0.627	0.540	0.467	0.404	0.351	0.327	0.305	0.266	0.233	0.204	0.179	0.168	0.157	0.139	0.123	0.091	0.068	0.051	0.039
9	0.914	0.766	0.645	0.592	0.500	0.424	0.361	0.308	0.284	0.263	0.225	0.194	0.167	0.144	0.134	0.125	0.108	0.094	0.067	0.048	0.035	0.026
10	0.905	0.744	0.614	0.558	0.463	0.386	0.322	0.270	0.247	0.227	0.191	0.162	0.137	0.116	0.107	0.099	0.085	0.073	0.050	0.035	0.024	0.017
11	0.896	0.722	0.585	0.527	0.429	0.350	0.287	0.237	0.215	0.195	0.162	0.135	0.112	0.094	0.086	0.079	0.066	0.056	0.037	0.025	0.017	0.012
12	0.887	0.701	0.557	0.497	0.397	0.319	0.257	0.208	0.187	0.168	0.137	0.112	0.092	0.076	0.069	0.062	0.052	0.043	0.027	0.018	0.012	0.008
13	0.879	0.681	0.530	0.469	0.368	0.290	0.229	0.182	0.163	0.145	0.116	0.093	0.075	0.061	0.055	0.050	0.040	0.033	0.020	0.013	0.008	0.005
14	0.870	0.661	0.505	0.442	0.340	0.263	0.205	0.160	0.141	0.125	0.099	0.078	0.062	0.049	0.044	0.039	0.032	0.025	0.015	0.009	0.006	0.003
15	0.861	0.642	0.481	0.417	0.315	0.239	0.183	0.140	0.123	0.108	0.084	0.065	0.051	0.040	0.035	0.031	0.025	0.020	0.011	0.006	0.004	0.002
16	0.853	0.623	0.458	0.394	0.292	0.218	0.163	0.123	0.107	0.093	0.071	0.054	0.042	0.032	0.028	0.025	0.019	0.015	0.008	0.005	0.003	0.002
17	0.844	0.605	0.436	0.371	0.270	0.198	0.146	0.108	0.093	0.080	0.060	0.045	0.034	0.026	0.023	0.020	0.015	0.012	0.006	0.003	0.002	0.001
18	0.836	0.587	0.416	0.350	0.250	0.180	0.130	0.095	0.081	0.069	0.051	0.038	0.028	0.021	0.018	0.016	0.012	0.009	0.005	0.002	0.001	0.000
19	0.828	0.570	0.396	0.331	0.232	0.164	0.116	0.083	0.070	0.060	0.043	0.031	0.023	0.017	0.014	0.012	0.009	0.007	0.003	0.002	0.001	0.001
20	0.820	0.554	0.377	0.312	0.215	0.149	0.104	0.073	0.061	0.051	0.037	0.026	0.019	0.014	0.012	0.010	0.007	0.005	0.002	0.001	0.001	0.000
21	0.811	0.538	0.359	0.294	0.199	0.135	0.093	0.064	0.053	0.044	0.031	0.022	0.015	0.011	0.009	0.008	0.006	0.004	0.002	0.001	0.000	0.000
22	0.803	0.522	0.342	0.278	0.184	0.123	0.083	0.056	0.046	0.038	0.026	0.018	0.013	0.009	0.007	0.006	0.004	0.003	0.001	0.001	0.000	0.000
23	0.795	0.507	0.326	0.262	0.170	0.112	0.074	0.049	0.040	0.033	0.022	0.015	0.010	0.007	0.006	0.005	0.003	0.002	0.001	0.000	0.000	0.000
24	0.788	0.492	0.310	0.247	0.158	0.102	0.066	0.043	0.035	0.028	0.019	0.013	0.008	0.006	0.005	0.004	0.003	0.002	0.001	0.000	0.000	0.000
25	0.780	0.478	0.295	0.233	0.146	0.092	0.059	0.038	0.030	0.024	0.016	0.010	0.007	0.005	0.004	0.003	0.002	0.001	0.001	0.000	0.000	0.000
26	0.772	0.464	0.281	0.220	0.135	0.084	0.053	0.033	0.026	0.021	0.014	0.009	0.006	0.004	0.003	0.002	0.002	0.001	0.000	0.000	0.000	0.000
27	0.764	0.450	0.268	0.207	0.125	0.076	0.047	0.029	0.023	0.018	0.011	0.007	0.005	0.003	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000
28	0.757	0.437	0.255	0.196	0.116	0.069	0.042	0.026	0.020	0.016	0.010	0.006	0.004	0.002	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000
29	0.749	0.424	0.243	0.185	0.107	0.063	0.037	0.022	0.017	0.014	0.008	0.005	0.003	0.002	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000
30	0.794	0.412	0.231	0.174	0.099	0.057	0.033	0.020	0.015	0.012	0.007	0.004	0.003	0.002	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000
31	0.706	0.355	0.181	0.130	0.068	0.036	0.019	0.010	0.008	0.006	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.672	0.307	0.142	0.097	0.046	0.022	0.011	0.005	0.004	0.003	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	0.639	0.264	0.111	0.073	0.031	0.014	0.006	0.003	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	0.608	0.228	0.087	0.054	0.021	0.009	0.003	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

SOURCE: J. Price Gittinger, ECONOMIC ANALYSIS OF AGRICULTURAL PROJECTS, Johns Hopkins University Press, Baltimore 1972 p. 212 (a World Bank Publication)

If the present value of benefits is higher than the present value of costs the benefit/cost ratio will be more than 1 if the ratio is less than one this indicates that alternative investments available in the project country would produce more income than the project itself, the project would therefore be an inferior alternative to placing project funds on the open investment market.

iv. Internal Rate of Return

The internal rate of return measures the efficiency of the project directly without the necessity of pre-selecting a discount rate The usefulness of the IRR (internal rate of return) is that it does not depend on the accuracy or conceptual basis on which the discount rate is chosen. Since many analysts feel that the selection of the discount rate is fraught with conceptual problems, the IRR is a partially satisfactory alternative. The IRR is calculated by discounting the net present value (discounted cash flow as in Table 39) using different discount rates. Trial and error discounting exercises will indicate that the higher the discount rate the lower the net present value of the project. For example at 15% the net present value of the North Shaba project is $11,239 discounted at 25% it is $4,080 and at 40% it is negative $-109. At some discount rate between 25% and 40% the net present value will be zero. The internal rate of return is the discount rate which results in a zero net present value.

DEFINITION: Internal Rate of Return = The discount rate at which the net present value of the project is equal to zero.

Table 41 illustrates the computation of the internal rate of return for the North Shaba Project.

Computing the IRR is a trial and error process. Observing that the net present value is only slightly ne[illegible] 40% and strongly positive at 25% it is obvious that the rate at which it will be zero [illegible] closer to 40% than 25% A discount rate of 37% is therefore attempted resulting in a positive NPV of $316 indicating that the Internal Rate of Return is above 37% and below 40%, closer to 40% than 37%. The final estimate of the IRR from the data displayed in Table 43 would be approximately 39%.

A 39% IRR implies that this project would be superior to an investment in the open market at any discount rate (opportunity cost of capital) below 39% Computing an IRR does not escape the difficult issue of selecting a discount rate entirely, it simply allows the project analyst to set an upper bound on discount rates which would imply that the project is not competitive with open market investments. In the North Shaba case, if the analyst felt that the opportunity cost of capital in the region is above 39% the project would not be justifiable in financial terms.

v Summary of Financial Benefit/Cost Analysis

The examples which have been given in the preceeding paragraphs are all drawn from farming situations, but the methods used apply equally well to any income generating project in rural or urban settings Agroindustrial, and marketing, projects maybe subjected to similar financial analysis.

Table 42

Internal Rate of Return Calculation for the North Shaba Maize Project (Zaire)

Year	Net Present Value at 15 %Discount Rate	Net Present Value at 25% Discount Rate	Net Present Value at 40% Discount Rate	Net Present Value at 37% Discount Rate	Undiscounted Annual Cash Flow
1	$-3,981	$-3,660	$-3,267	$-3,340	$-4,576
2	- 879	- 744	- 593	- 620	-1,163
3	- 119	- 93	- 66	- 77	- 181
4	252	186	114	125	440
5	1,640	1,083	614	684	3,301
6	2,334	1,416	719	817	5,403
7	2,703	1,110	680	794	7,101
8	2,955	1,518	614	728	9,036
9	3,144	1,483	531	651	11,069
10	3,190	1,382	452	554	12,913
Total NPV	$11,239	$ 4,080	$- 109	$ 316	

SOURCE H Albert Green, AN APPROACH FOR ASSESSING RURAL DEVELOPMENT PROJECTS PART II, AN ILLUSTRATIVE APPLICATION, Agency for International Development, Washington D C 1977, p 58.

The focus of financial benefit/cost analysis is the participant farm or household[T] and the changes in income which will result directly to this unit as a result of the project. Once these differences (with and without project) are measured, and projected over the useful life of the project, the financial benefit cost analysis can proceed. The benefit/cost measures most commonly used are cash flow (difference between added costs and added benefits), net present value (discounted cash flow), benefit/cost ratio (present value of benefits divided by present value of costs), and the internal rate of return (the discount rate at which net present value equals zero)

b Economic or Social Benefit/Cost Analysis

Financial analysis looks narrowly at the costs and benefits of the participating firm or household unit· economic or social analysis takes the broader perspecitive of the whole society of economy. A wide variety of differences in the analytical approach are required by the broader view, these differences may be grouped into three general categories:

1. Economic or social analysis must include indirect or side cost and benefit items which the individual firm or household may not pay for (costs) or receive (benefits).
2. Economic or social analysis may use different prices to value input (cost) and output (benefit) items than those which the individual faces in the actual market.
3. Economic or social analysis may use a discount rate which differs from the observed market rate or the opportunity cost of capital selected for financial analysis.

i. Indrect Costs in Economic or Social Benefit/Cost Analysis

Many costs may be caused to society by the project which are not paid for by the individual farms or households which participate directly. These costs may be thought of external, indrect or social overhead costs. Many examples might be presented, in the interest of conserving time and space this manual will describe only three, with the intent that the DSP participant can visualize from these three generic types the wide variety of costs which they are representative of.

Farmers in the North Shaba Maize Project may utilize the services of public technical assistance extension personnel without paying for the service. The benefit estimates may assume that these services are provided whether or not the project itself provides funds for financing extension. The cost of the technical assistance service must be included or the net benefit will be overestimated. Technical assistance services include the salary of the personnel, operating and depreciation costs of the vehicles they use, the overhead costs of the institution which are required to support the agents etc. The important concept to keep in mind when trying to decide what costs ought to be included is that resources used up by the project should be included as costs. Technical assistance vehicles and man days are being used up and therefore should be included.

If the project implies a substantial increase in marketed production from a particular region there may be an important amount of additional wear and tear on roads. Roads are a resource which the project uses up without paying for. The estimated road cost due to the project should be included as a cost for economic or social benefit/cost analysis.

Taxes which a farmer pays are actual cash outlays and hence must be included as costs in financial analysis, which looks narrowly at his financial benefit picture. In economic or social analysis these taxes should be excluded from the costs since they do not represent real resources used up by the project but rather transfer payments to other segments of the economy. One might argue that these taxes should be included as costs to represent the value of road use and other public services like technical assistance which the project beneficiaries use up. Taxes are poor proxies for actual resources used up in the public services received by a particular project group of participants, it is much more accurate to exclude taxes and include direct estimates of the roads, extension, and other real resources used up but not paid for by the project participants.

ii. Indirect or Secondary Benefits in Economic or Social Benefit/Cost Analysis

Many benefits may occur as a result of the project to others in the society outside the participating farmers or households. For example, if the production of maize increases dramatically as a result of the North Shaba project, urban consumers will probably benefit from a reduced corn price This benefit may be substantial and in fact may offset some loss in participant farmer income which results from this price drop While this benefit is not easy to estimate it must be included in economic or social benefit/cost analysis of projects whose principal income result comes through expanded agricultural production of a particular crop.

Another indirect or secondary benefit which should be included in economic analysis is the income benefit which accrues to households engaged in marketing and processing the increased farm production or producing inputs for the project These impacts are generally referred to as "income multiplier" effects. Multiplier effects are difficult to estimate unless a recent "Input/Output" model is available for the project country.

Economists speak of a third class of benefits as "externalities'. These benefits may be thought of as side products or by-products of the project activity. In the Peru Irrigation project it may be that the water ways created may give rise to a new fishing or transportation activity and thereby create added fishing or transportation incomes.

While all of these indirect or secondary income effects cannot be measured with confidence, good economic or social benefit/cost analyses should attempt to estimate the most important ones and present at least some narrative discussion about the residual.

iii. Using Shadow Prices of Opportunity Costs for Project Costs and Benefits

The underlying idea behind the use of the benefit/cost ratio is that using such a ratio as a project selection criterion will result in projects which produce more of what society wants (benefits) per unit of society's scarce resources Because of the fact that it is impossible to add costs in physical terms (tons of steel and bags of cement) prices are used to value these cost and benefit items so that they can be combined in the ratios The defense of this convention is that prices reflect the true value of the good or service In perfect markets this argument might be accepted without much debate, yet perfect factor and product markets are not characteristic of the underdeveloped economies in which Mandate projects are undertaken. In many situations non-market distortions have fixed prices at levels which most would agree bear no direct relation to the relative scarcity of resources For benefit cost analysis this is vital, for the principal purpose of benefit cost analysis is to find those projects which make best use of scarce resources. If the prices used for these resources (or for the benefits produced) are poor representations of scarcity, the results of the analysis cannot be expected to produce reliable project choices.

Three categories of products and services are common subjects of often price distortion in developing countries and their prices require adjustment for economic or social benefit/cost analysis. The adjusted prices, which are thought to approximate more closely true scarcity, are referred to as "shadow prices", and the process of adjustment "shadow pricing". The three items which must comonly be shadow priced are unskilled labor, internationally traded goods, and domestic goods which are the subject of public price supports or subsidies.

Underutilization of unskilled labor is characteristic of most developing economies. In many areas wages are set by fiat in the form of legislated minimum wages. Even though the minimum (and in many cases the effective wages) are low by international standards, many would argue that they do not reflect the over-abundance of labor. A shadow wage equal to the "opportunity cost" of labor has been argued as a more adequate price for labor which is utilized as an input in projects for benefit/cost purposes The opportunity cost of labor is the value of production forgone by removing the labor from its current occupation to work on the project. If the labor utilized for example in Peru Irrigation Project was drawn from heretofore totally unemployed workers one might argue that no production was forgone and hence the shadow wage should be zero. In areas where widespread unemployment is the pattern benefit/cost analysts have often used a zero price for labor based on this argument. They have argued that even if the laborers actually drawn into the project were working before, if they are unskilled, they will be replaced easily from the pool of unemployed and no actual production will be forgone.

The selection of the shadow wage depends on the level of underutilization of labor in the project area, and on the seasonality of the underutilization. If the underutilization rate is high, and if there are no seasonal shortages the shadow wage should be relatively low, and perhaps even zero. If the nominal wages paid in the project are above the average rural wage the project can be expected to draw currently employed workers away from production and production may be partially foregone until unemployed workers are found. A project may be able to insure that at least most of its workers are from the ranks of the unemployed by direct control over the hiring process. In practice this control process is very difficult to maintain and it is most often an unsatisfactory method of making certain that the laborers hired were heretofore unemployed.

Perhaps the best method is to use the general unemployment pattern in the project region as an adjustment indicator. This process was used in the Peru irrigation benefit cost analysis.

> "Shadow wages for the Cajamarca region are taken as 40 % of the official farm and construction wage rates: for the Mantaro region this shadow value if 50%'
> (31)

Internationally traded goods often require adjusted prices because of exchange rates which are poor reflections of the scarcity of foreign exchange. If imported fertilizer is included in the project the analyst may wish to increase the price used to value the quantities of fertilizer as a cost to the project above the domestic price on the belief that the actual exchange rate is a distorted one. If the output of the project is to be exported, it is often the case that the country may create a purposely biased exchange rate for the product in order to promote exports. While the elevated domestic price may be a wise policy choice it should not be used for economic benefit/cost analysis purposes, the price should be adjusted to reflect its value at the estimated equilibrium exchange rate. The shadow exchange rate (or equilibrium rate) is difficult to estimate in practice, the analyst can either simply make a best guess adjustment, or rely on more rigorous estimates often made by local national planning offices or central banks. The Peru Irrigation analysis simply states

> "The shadow value of foreign exhange is assumed to be 20% higher than the official rate of 43 38 soles per US$ These values reflect those estimated by the National Planning Instutute " (32)

Domestic price distortions may also occur through direct subsidies and price supports. For example it is possible that the public sector might choose to sell fertilizer to small farmers at 20% below the market rate in order to induce them to increase their fertilizer use. The intent of the policy may be to return the price to normal after initial adoption has taken place, or it may be to continue the subsidy as a way of preferentially benefitting small farmers. In either case the fertilizer price paid by the farmer should be adjusted up by 20% before inclusion in the cost side of the benefit/cost ledger. Domestic price supports to induce additional production may result in an overpricing of a particular crop which will need a downward adjusted shadow price before it is used to value benefits of added production resulting from the project.

Shadow prices may be used to adjust for the natural price distortions which take place due to factor immobility, lack of market information, or where explicit public intervention has forced prices to diverge from their equilibrium levels. The objective of shadow pricing is to use prices which represent the true scarcity of factors or true equilibrium prices for products in the project country or region.

iv. Social Discount Rate for Economic Analysis

As mentioned in the case of financial analysis, the choice of a discount rate for the benefit/cost computations is of central importance In financial analysis the rate chosen was that rate at which money could be invested without management in the project country.

A view of Table 42 will help to illustrate the importance of selecting the proper discount rate, and may help to understand why many governments (including our own) have selected discount rates considerably below market investment rates for the evaluation

of certain types of public investment projects. It can be observed that there is a relationship between the time horizon of the project and the discount rate. For example it has been suggested that in Peru the opportunity cost of capital is nearly 30%. If this rate were used for the discount rate it would imply that $100 benefit occurring 15 years from today would only be valued at $2, in 20 years at only 50 cents. Using a 30% discount rate implies that any benefits which occur after 12 years are valued so low as to be ignored. This has the direct result that projects with a long life span, whose benefits occur only after long period of time will never be undertaken if a high discount rate is used. For example let us compare two projects whose costs are equal and incurred in the same year but whose benefits are different in both timing and magnitude.

Table 43

Comparison of Benefits and Costs of Short Term and Long Term Hypothetical Projects
(values in thousands of US$)

Year	Year	Forest Renewal Project				Tree Fruit Project				
	Costs	Benefits				Costs	Benefits			
	Nominal	Nominal	PV 5%	PV 15%	PV 30%	Nominal	Nominal	PV 5 %	PV 15%	PV 30 %
1	2,000	0				2,000	0			
12	0	0				0	5,000	2,875	935935	215
25	0	0				0	5,000	1,475	150	5
35	0	0				0	5,000	905	40	0
50	0	100,000	8,700	100	0	0	5,000	435	5	0
Total PV of Benefits			8,700	100	0			5,600	2,000	220
Total PV of Costs			1,904	1,740	1,538			1,904	1,740	1,538

Benefit Cost Ratios

Discount Rate	Benefit/Cost Ratios Forest	Fruit
5 %	4.6	2.9
15 %	0.1	1.2
30 %	0.0	0.1

** PV 5% means the present value of benefits if discounted at 5%.*

We assume the forest project to involve simply planting pine trees which will take fifty years to mature and yield $100 million for each $2 million of planting cost, and the fruit tree alternative to yield a $5 million dollar harvest at the end of 10-13 years. The same $2 million could be used each 10-13 years to replant a new crop of fruit trees, that is the investment would generate four fruit tree cycles for each pine tree cycle It can be seen that the total undiscounted benefits from the forest renewal project are five times as large as the fruit project but occur further away in time. Using a 5% discount rate the pine project has a benefit cost ratio almost double the fruit project but at 15% and 30% its benefits are essentially zero, while the fruit project has a respectable 1 2 ratio at 15% and then drops to almost zero at 30% discount rate. What this implies is that if a 15% or higher rate is used forrests will never be renewed Some would argue that this is as it should be since there are probably short term activities which will yield benefit/cost ratios above 1 at 15% and therefore until all of these activities are funded none of the longer run activities should be funded.

Our own congress has argued that society must take a longer run view of benefits than the private capital markets may reflect in the market rates of return. Congress picked a discount rate far below the market rate to use for evaluation of water resource projects in the U.S Many developing countries have suggested that a Social Discount Rate well below the market opportunity cost of capital be used to evaluate public investment. The USDA Agriculture Projects Manual states this idea as follows:

> "A further element that is sometimes incorporated (into a social discount rate) is the fact that society collectively tends to be interested in long-run gains,whereas businessmen, farmers and other individuals place greater premium on quick returns. Other things being equal, this results in using a lower discount rate in economic analysis than in financial analysis" (33)

Among analysts there is no consensus on this point. Many benefit/cost manuals hold that the discount rate for economic analysis should be equal to the opportunity cost of capital as reflected in the existing capital markets. Both the U.S. Congress and the legislative and executive branches of many developing countries insist that society can legitimately have more interest in the welfare of future generations than is reflected in the individual time preferences which create the current interest rates observed in the markets

The common AID practice suggests that 15% is the most appropriate discount rate to be used in benefit/cost analysis. This solution fits neither of the positions of accepted economic or social benefit/cost analysis If an opportunity cost of capital approach is to be used, then it is inconceivable that the rate would be the same in all AID countries. No one would suggest that 15% is a figure to be used across the board as an estimate of the average market rate for capital in all developing countries If the opportunity costs of capital approach is to be used, then it is clear that the estimate must be made for the country in which the project is to be undertaken. If on the other hand a Social Discount Rate is to be used it should certainly be that rate chosen by the Host Country and may vary considerably depending on the degree to which the country wishes to trade current benefits for future ones. In either case a flat rate applied to all countries is unacceptable from a conceptual point of view.

v. Benefit/Cost Ratios for Selection of Mandate Projects: Reaching the Poor Majority

A final issue relating to the methodology for computing benefit/cost ratios inside the framework of the Mandate is the issue of who gets the benefits. Nothing is clearer in the Mandate literature than that income is only a "mandate" type berefit if it accrues to the "poor majority"'. The following paragraphs examine what alternations may be made in the benefit/cost methodology to assist project decision makers in the selection of projects which are most efficient in benefiting the poor majority.

Benefits comprise the numerator in the benefit/cost ratio, and it is there that whatever adjustments aimed at biasing the ratio in favor of the poor majority must focus. Three approaches can be used to make the ratio a "mandate" oriented ratio.

The first approach is to enter benefits in the numerator ONLY if they are income benefits to those households below the poverty line and ignore income which goes to other households. This would result in a ratio of income benefits to the rural poor, divided by total project costs. Using such a ratio, projects would be ranked according to how much income to the poor was produced per unit cost. As a comparative device to evaluate alternative projects aimed at this objective, such ratios should provide a very useful result. The significance of ratios over 1, would become less important since only a portion of the total income to be generated by the project is captured in the numerator, while all of the costs are in the denominator. If this lack of "absolute" significance of the ratio is kept in mind, this version of a "mandate" benefit cost ratio should be a useful guide to the comparative efficiency of projects to meet the mandate income objective.

The second approach is to include income to all households in the numerator but weight the income to each income strata differently to reflect a preference in providing income to the poor. For example, added income from the project which is captured by families with pre-project incomes over $1,000 per capita could be given a weight of 0.1, that for families from $150-1,000 a weight of .5, target group family income from $75-150 per capita a weight of 1.0, and those under $75 per capita a weight of 2.0. Many different weighting schemes could be envisioned each with its explicit relative valuation of income to different classes. The advantage of this approach is that it avoids the intellectually unsettling notion of a fixed line between rich and poor and admits to a more flexible valuation of relative poverty. The disadvantage of the weighting approach is that there is little actual ground on which to select the weights.

The final approach is to calculate the benefit/cost ratio including all income to any household as is the practice for non-mandate analysis, and then estimate separately the proportion of income which will result to each of the income strata. This percentage distribution could then be used on an informal basis to compare the income impact on the poor of project alternatives.

The problem with all of these approaches is the lack of data which would reveal the incidence of income distribution resulting from projects. Without a sophisticated input/output model (seldom justified for project analysis) it is virtually impossible to estimate the distribution of indirect income caused by a project. If the target group is carefully selected such that there is reasonable assurance that all direct project participants are inside the "poor majority" then at least project analysis can be confident that direct income benefits will accrue to the mandate group. If this is true, the same methods examined in the earlier sections would suffice to capture the income impact of the project on the poor.

c. Cost Effectiveness Analysis of Agricultural Projects

Cost effectiveness analysis has been defined in the AID Handbook as analysis where income is not the primary objective or where income may be the objective but cannot be measured. In the Mandate Congress and AID have made it clear that rural production projects should have income to the poor majority as their principal aim. There are, however, many rural projects aimed at income improvement where the income impact may be impossible to measure accurately. In these cases cost effectiveness analysis provides the only feasible way of assessing the comparative benefits and costs of alternative projects.

Cost effectiveness ratios would have the same denominator as benefit/cost ratios, composed of the direct and indirect project costs valued in the same way that was discussed in the economic or social analysis section. Careful accounting would be required to price inputs at the appropriate shadow price, to include indirect, secondary and external costs.

Cost effectiveness ratios should face the same discounting issues raised earlier to discount both future costs *and* future benefits. Future benefits should be discounted on the basis that society would prefer a benefit occurring today more than a benefit occurring ten years from now, whether that benefit is a monetary one or a non-monetary benefit like an added student educated, or a death averted.

Cost effectiveness ratios are then different from benefit/cost ratios only in that the numerator (benefit) is non-monetary.

Research, education and training are common activities undertaken with the intent of eventually increasing rural incomes, but since the connections between the activity undertaken and the increases in income may be immeasurable, cost effectiveness analysis represents the only viable project analysis alternative. Since most agricultural education, research and training activities present issues conceptually similar to education projects, a detailed discussion of cost effectiveness analysis will be postponed until the education section.

5. Comparing the Costs and Benefits of Rural Nutrition and Health Projects

a. Financial Analysis of Nutrition and Health Projects

Financial analysis of nutrition projects is of limited scope and relates mostly to assessing the financial and budgetary situation of the institution which undertakes the project. It may be very important to review the budget sources of both public health and treatment institutions to verify if they are likely to be able to sustain the budgetary implications of the project. There is no need, however, to undertake the intricate methodology examined under financial analysis of agricultural production projects.

b. Analysis of the Impact of Nutrition and Health Projects

Before passing to the examination of benefit/cost and cost effectiveness measures for nutrition and health projects it is important to distinguish two general methods for measuring the impacts or benefits from health and nutrition projects. The first of these methods is to attempt to measure the health, nutrition, or income change which occur directly to someone affected, or treated by the project itself; this we shall term the "direct participant impact" method. The second method is to measure the difference in the nutrition, health, or income level of the total population in the project area of influence or service and to compare that level with the level in the same area before the service, or with another area which is without the service. This second method we will call the "indirect incidence" method.

The direct method is very costly and subject to a wide variety of conceptual difficulties. It is usually undertaken with the assistance of the medical or health service personnel who keep records on the status and type of health interventions provided to particular project participants. Follow-up interviews are required to estimate the impact of the service on these particular patients or participants, to measure their income, etc. In general, these methods have proved relatively unsatisfying.

The indirect method has the disadvantages inherent in control group survey research discussed briefly in Part B. Most of the difficulties lie in the attribution of cause to the project. Carefully formulated regression analysis can sometimes provide a reasonable alternative to costly control group techniques.

c. Benefit/Cost Analysis of Nutrition and Health Projects

Following the above-mentioned definitions, benefit/cost ratios have income as their numerator. The Mandate indicates that congress and AID consider nutrition and health benefits as independent of income; that is, they are benefits in and of themselves and need not be justified in income terms. This is an important point for project analysis, since it implies that cost effectiveness analysis in which non-monetary health and nutrition benefits appear directly in the numerator is more responsive to the mandate for these projects than is income determined benefit cost analysis.

For many years analysts have been attempting to force the analysis of health and nutrition into the structure of benefit/cost analysis by measuring the results of these projects in income terms. By and large this approach has been inadequate both conceptually (it leaves most analysts feeling that most of what is intended by health projects is not captured in income) and empirically because of the difficulties in actual measurement.

Though the income (benefit/cost) approach is less responsive to the Mandate, and more difficult to undertake, the general outlines of the approach will be examined. The most common method is to estimate what is known as the "costs of disease" and then estimate the number of diseases averted as a result of the health or nutritional intervention. Chasse outlines the evolution of this technique as follows:

> "In the (costs of disease) stage, a standard method was developed and applied in a large number of studies, mostly in the United States. These studies tried to estimate how much disease was costing the country (Fein, 1958, Weisbrod, 1961, Rice, 1962, Mushkin, 1962, Klarman, 1965) Disease costs were divided into direct and indirect. Direct costs are costs of treatment—hospitals, medicines, beds used, ambulances and so forth Indirect costs are defined as the loss of . income caused by sickness and death among members of the work force These losses are divided into debility, disability and mortality. .. Work days lost due to sickness and death, then, were multiplied by the average wage ... summed, appropriately discounted and presented as a measure of the indirect cost of the disease. The criterion was called the discounted present value of future earnings " (34)

Many objections have been raised to the unsatisfactory nature of attempting to measure health and nutrition benefits in income terms. Chasse outlines one of these as follows:

> "The value of a life is to be determined by its value to the individual, to his family, and to society. There is no obvious connection between the individual's wage rate and the value of his life (or the aversion of his illness) either to himself or to others . Economists and administrators alike objected to the use of the discounted present value of future earnings for essentially practical reasons The discounted present value of future earnings does not reflect social judgements adequately enough to permit ranking of health programs among themselves It is biased against the young, the old, women, the infirm and the poor, because the implicit welfare weight is the earning power of the individual." (35)

This ratio could be estimated by taking the number of illnesses or deaths averted multiplied by the number of work days lost and in turn multiplied by the assumed wage rate per day. This is the cost of work lost to which would be added the treatment costs averted. This total would be discounted and divided by the present value of all project costs. This approach is costly, intellectually unsatisfying and unresponsive to the Mandate which encourages the justification of health and nutrition projects based on health and nutrition and not on income grounds.

d. Cost Effectiveness Analysis of Nutrition and Health Projects

It should be remembered that the denominator (costs) does not change as we move from benefit/cost analysis to cost effectiveness analysis. The only change is in the numerator, where cost effectiveness ratios use direct measures of health and nutritional status or other less final indicators of the efficiency in the provision of health and nutritional services.

There are two classes of health and nutrition cost effectiveness numerators:

1. Measures of final health and nutrition status indicators
2. Measures of health and nutrition services and nutritional intake

These two separate methods differ principally in the degree to which they represent "final" objectives of project achievements. Providing added health services may or may not result in improved health status, and projects providing similar amounts of services may have widely varying impacts on final health improvement. By far the most desirable measures are the measures of final health and nutrition status.

i. Cost Effectiveness Ratios with Final Status Indicators in the Numerator

Five types of cost effectiveness ratios are suggested below as appropriate measures for project selection and evaluation of mandate oriented health and nutrition projects.

REDUCED MORTALITY

The Mandate indicates that one of the principal objectives of health projects should be to reduce the mortality rate by providing death averting and life prolonging services. This ratio would have the following form:

$$\frac{\text{Number of Deaths Averted by Project}}{\text{Project Costs}}$$

As was mentioned earlier, the numerator in this ratio could be measured either by the direct participant impact method, or by the indirect incidence technique. In the direct method, project personnel would be called upon to keep records of the participants and estimate the number of deaths averted from project interventions. This is a largely unsatisfactory method. Much superior is the method of estimating before and after incidence of death in the project service population or area, or by comparing the incidence (frequency of illness or mortality rate) of the service or project area with a similar area without the services. For project selection purposes where the project has not yet been implemented, data would be generated by comparing the mortality rate in an area where the proposed service is provided currently with an area currently without such services; the difference would presumably be the impact of the service.

REDUCED INFANT MORTALITY

The Mandate places special emphasis on reducing infant mortality through health and nutrition projects. The cost effectiveness ratio appropriate for project evaluation and selection for this objective is conceptually similar to the ratio for reducing general mortality rates, except that deaths averted would be limited to those under a certain specified age. In the Mandate that age is chosen at 1 year.

$$\frac{\text{Deaths Averted of Children Under 1 Yr. Old}}{\text{Project Costs}}$$

Since many health and nutrition projects involve changes which may take many years to reach their full impact, long-time horizons may be necessary in structuring the most effective analysis. Where long-time horizons are required to capture the full benefits, the choice of a discount rate for both costs and benefits will be of considerable importance. As was discussed earlier, the same conceptual framework will operate for discounting non-monetary benefits such as deaths averted, as was used for discounting monetary benefits as long as there is a preference for benefits which occur sooner. A time preference for health benefits is usually apparent in the planning documents of most host countries.

REDUCED MORBIDITY

Morbidity is the term used in most health documents for illness. To reduce the incidence, gravity, and longevity of illnesses are all important objectives of both health and nutrition programs. A series of different cost effectiveness ratios may be used to analyze projects with this type of health and nutritional objective.

The first approach is to elaborate illness specific ratios which measure the number of illnesses of a particular type averted by project activities and divide that number by the project cost which is related to that particular illness.

$$\frac{\text{Number of Cases of Measles Averted}}{\text{Project Costs Related to Measles}}$$

One of the difficulties of this type of ratio is that many project costs are not disease specific. An alternative, therefore, is to attempt to add the most important illnesses averted together into a composite numerator and divide that total by all project costs. Since different illnesses and different degrees of gravity of illness should count more than others if averted, elaborate weighting schemes would be required. A more satisfactory alternative is to approach the numerator in a way which roughly captures the level of illness regardless of the particular disease which causes the incapacity. In this approach the numerator is some general indicator of health status or conversely of incapacity. For

example, the number of days incapacitated during the last year might be used as a general indicator of health. Incapacity is obviously a relative and subjective concept, yet if used only as a project comparison and evaluation mechanism, it is important only that the definition be consistent for all measurements and reasonably approximate a desired health result. For example, incapacity might be defined as the number of days confined by a disabling sickness. "Disabling" could be defined as an illness which prevented a working adult from reporting to work for more than five consecutive days, prevented a housewife from performing her normal functions for more than five consecutive days, forced confinement of non-working adults to bed for more than five consecutive days, or prevented school-age children from attending school for more than five consecutive days.

The ratio based on general health status measures might be formulated as follows.

$$\frac{\text{Number of Person Days of Incapacity Averted}}{\text{Project Costs}}$$

REDUCED MALNUTRITION

Nutrition projects might use two variations of reduced malnutrition ratios. The first would be the number of people moved from 2nd or 3rd degree malnutrition to either a lesser degree, or to sufficient nutritional status. These are symptomatic measures of malnutrition and must be measured by clinical personnel. The incidence of frequency of these different malnutrition conditions may be measured in either a cross sectional or longitudinal sample design to determine how much of this type of impact the project has had. Unfortunately, the necessary involvement of clinical personnel in the data gathering process limits severely the feasibility of gathering such data, due to elevated cost.

$$\frac{\text{Number of Persons Moved from a More Grave Degree of Malnutrition to a Lesser Degree (Or to Satisfactory Health)}}{\text{Project Costs}}$$

A small number of illnesses are related directly to malnutrition. Measuring the incidence of these specific illnesses is an alternative way of developing a cost effectiveness ratio for nutrition projects.

$$\frac{\text{Number of Cases of Oedema Averted}}{\text{Project Costs}}$$

IMPROVED BODY MEASUREMENTS (OR GROWTH CHARACTERISTICS) IN CHILDREN UNDER 16 YEARS OF AGE

Among the best indicators of nutritional status are body measurements in children under 16. These measurements may be gathered by non-clinical personnel and are reason-

ably inexpensive to obtain. Height, weight, arm circumference, and "fatty fold" measurements are the most useful. Cost effectiveness ratios for nutrition projects could utilize these measurements as numerators.

$$\frac{\text{Increase in the Height/Weight Ratio } (C_m/Kg)}{\text{Project Costs}}$$

ii. Intermediate Service Indicators and Nutritional Intake in Cost Effectiveness Analysis

While it is desirable to measure final impacts as opposed to intermediate objectives like the provision of services or the increase of nutrient intake, these intermediate objectives have been frequently used as health and nutritional project indicators. In health services the Mandate specifies that increased access to broadly defined health facilities and services is a goal in itself. Achievement of this access goal could give rise to a cost effectiveness ratio which may be either measured in terms of the number of people actually serviced, or the number who were given the possibility of service. These two ratios might be formulated as follows:

$$\frac{\text{Number of Persons Serviced}}{\text{Project Costs}} \qquad \frac{\text{Number of Added Persons Within Access Distance of Health Services}}{\text{Project Costs}}$$

In nutrition projects it may be important to achieve an increase in the quantities of nutrients consumed by the project population. Gathering data on nutrient intake is one of the costliest and most difficult data-gathering tasks outlined in this document. It is comparable only to the gathering of small farm income information in complexity and cost. It is therefore unlikely that nutrient intake measure would be feasible in any but the best financed and largest nutrition projects.

$$\frac{\text{Number of Calories of Increased Intake Caused by the Project}}{\text{Project Costs}} \qquad \frac{\text{Number of Unit Grams of Protein of Additional Consumption Caused by the Project}}{\text{Project Costs}}$$

6. Comparing the Costs and Benefits of Education Projects

a. Benefit/Cost Analysis of Education Projects

Unlike nutrition and health, which the Mandate argues are ends in themselves, education in the Mandate is seen only as an intermediate step in producing income and improved living standards. The Mandate states the dependent or derived nature of education project as follows:

> "In a world of plenty, 'education' may connote literacy and wide learning, truth for its own sake as well as a means to progress. In a world of want education must unfortunately of necessity be something far more restrictive and practical—as a means to improving living standards rather than an end in itself." (36)

For project analysis this implies that income should be the objective of education projects and that benefit/cost ratios are much more appropriate than cost effectiveness ratios for project selection and evaluation. Estimating the income benefit to education projects is fraught with difficulties. A large literature exists in which attempts have been made to estimate the income benefit to education; the most difficult problem has always been to isolate the "education" effect from a wide variety of other variables which are of obvious importance in explaining differences in income level. Education is a service for which access is more concentrated in the hands of the wealthy; to say that education is the "cause" of the higher incomes of those who are able to obtain more education can be circular. Family status, education level of parents, family income and many other variables are as much the cause of obtaining education as they are the result of education. It is additionally true that the observed income superiority of those with higher education levels may be due to their having obtained a "ticket" or degree which allows them to access certain preferred occupational roles irrespective of the knowledge or skills obtained. In this case education serves the function of allocating society's income, not necessarily increasing it.

With all of these problems there is still the strong feeling that increased education contributes in vital ways to increasing the income of individuals and of increasing the overall national income level. To illustrate both the strengths and weaknesses of the principal methods used to estimate the income benefits of education, examples will be drawn from a review by Martin Carnoy.

> "On what basis, therefore, is the decision for rapid educational expansion made? The decision may be a political one marginal groups seeing that those in socially prestigious and economically rewarding positions have high levels of schooling, demand more schooling so that their children can have access to those positions. If the political pressure of these groups is great enough the government will provide schooling to satisfy them. The decision may be an economic one: it is now widely held that an educated population is a key to sustained economic growth and industrialization. If this were true, we should observe high rates of return to total investment in schooling (as compared with other possible public investments) across countries and over time. It is also widely held that increasing the average level of schooling will improve the distribution of income, increase social mobility, and make the political structure more democratic." (37)

In an attempt to answer his own question, does an increased average level of schooling increase economic growth and redistribute income?, Carnoy presents the data reproduced below in Table 44. Carnoy then comments as follows on the statistical results reported in Table 44.

Table 44
Social Rates of Return to Schooling, Enrollment Rates, Gross Domestic Product per Capita, and Economic Growth Rates by Country for Various Years, Primary Secondary, and University Levels of Schooling

Country	Year	Primary Rate of Return	Secondary Rate of Return	University Rate of Return	GDP/Capita	Economic Growth Rate
U.S.	1959	18%	14%	10%	$2,361	0.4%
Mexico	1963	25	17	23	374	1 6
Colombia	1965	40	24	8	320	1.4
Chile	1959	12	12	9	365	0 8
Brazil	1962	11	17	14	261	4.0
S. Korea	1967	12	9	5	146	6.6
Israel	1958	16	7	7	704	4.4
India	1960	20	13	13	73	1.8
Malaysia	1967	9	12	11	280	2.8
Philippines	1966	8	21	11	250	1.4
Kenya	1966	22	20	9	118	4.4
Uganda	1965	66	50	12	84	1.4

SOURCE. Martin Carnoy, The Economic Costs and Returns to Educational Television, in Evaluation Studies, Vol. I, 1976, p. 253. Original sources are varied by country and appear detailed in Table II of the Carnoy article.

"The rates are generally high, averaging in the underdeveloped countries about 17 percent for primary schooling, 15 percent for secondary, and 13 percent for university. In the developed countries, the rates are somewhat lower: 10 percent for secondary school and 8 percent for university. The rates are interpreted to mean that the total invested resources in primary schooling would be expected to earn 17 percent per annum, or $17 annually on each $100 invested in primary schooling." (38)

While these income benefits appear rather high, the method used to obtain them is suspect on the grounds earlier mentioned. Carnoy continues:

"The way these rates are estimated, all earnings differences among people with different levels of schooling are attributed to the fact that the people took different amounts of schooling. If people were assigned randomly to get varying amounts of schooling, it would be valid to assume that the reason that they earn more is primarily because they went to school. But we know that children are not randomly assigned to take more or less schooling. Those with more schooling have better educated and higher-income parents, they generally have higher ability (nonverbal and verbal) and they come from an urban rather than a rural environment. In countries where there is racial or sexual discrimination, those discriminated against get less schooling than those who are not.

The higher income we observe for those with more schooling is therefore not just the result of their additional schooling but of other factors as well. If we decided to give primary education to all those children now not in school, and even if the labor market could absorb them into the same kinds of jobs now given to primary graduates, they probably would not have the same average income as today's primary graduates. Although it is difficult (if not impossible) to separate out the supply-demand effect on wages from the quality of graduate effect, we would expect that for the same expenditures per pupil those from lower socioeconomic backgrounds and from rural areas will not do as well income-wise as those with the same amount of schooling from higher

social background and urban areas. Rates of return to schooling unadjusted for other factors are misleading indicators of the rates of return to investment in those currently not in that level of schooling.

The rates can be adjusted for other factors and are lower than the unadjusted ones. Based on work by Denison, Blaug, Carnoy, and Thias, we can make some hypothetical adjustments in the underdeveloped countries of .4 on the primary rates, .8 on the secondary rates, and .9 on the university rates. ... This leaves us with a 7 percent rate on primary, 12 percent on secondary, 11 percent on higher-education in investment in the underdeveloped countries. ... These rates are not particularly high, and, although hypothetical, they warn us that the economic payoff to expanding schooling may be lower than we had thought. Of course, the estimates are made without taking account of the nonpecuniary rewards of education, but most underdeveloped governments are not rationalizing schooling investment in terms of providing nonpecuniary rewards of education." (39)

While Carnoy made some "hypothetical" adjustments to separate out the non-educational income influences and arrived at low rates of return, the reliability of his adjustments is not such as to leave us with confidence that the rates are not lower than his adjusted rates. In any case his work illustrates the difficulty of obtaining reliable estimates of the income benefits of education projects.

While education is justified in the Mandate on economic grounds, the conclusion of this short review is that benefit/cost analysis of education projects must rely upon methodology as yet not well enough developed to yield useful ratios.

b. Cost Effectiveness Analysis of Education Projects

Using cost effectiveness ratios to measure the impact or potential of education projects is perhaps the only feasible project analysis alternative at the present time. It is unsatisfying because the justification for education projects in the Mandate is their income impact which the cost effectiveness measures fail to capture.

Measures commonly used are as follows:

$$\frac{\text{Increased Number of Students Enrolled as a Result of the Project}}{\text{Project Costs}} \qquad \frac{\text{Number of Added Student Years of Schooling as a Result of the Project}}{\text{Project Costs}}$$

$$\frac{\text{Increased Student Performance (Measured by Performance Test Scores) Caused by the Project}}{\text{Project Costs}}$$

These ratios may be used to examine the unit cost implications of alternative education projects, but lead to no link with increased welfare. Attempts have been made to link the performance measures directly to increased income as Carnoy reports:

"In order to assess the economic benefits of the test-score gains, we would ideally want to know how much more ... graduates with higher ... test scores earn when they enter the labor force. We could then determine how much a point of test score gain is worth in additional income for people with the same number of years of schooling.

These data are not available. But to show how the method would work if we had better data, we can use Griliches and Mason's estimates of test-score effect on income for a sample of male veterans. The results of their analysis show that a 1-point increase in the Air Force Qualifying Test, holding constant the effect of other variables such as race, age, and years of schooling, translates into a $6 34 increase in annual income. One point on the AFQT test is equivalent to approximately 1 school year, so a 1-school-year equivalent increase in ability is worth $6.34 in annual income.

This means that a man 29 years old and with 12.3 years of schooling (the average age and schooling in the Griliches-Mason sample) earns $6.34 more annually for each point higher of AFQT score Assuming that this gain in average income will be earned over the entire working life and that the . discount rate is 10 percent, an approximate present value of the increase in earnings is . $63 40. These are the benefits of a 1 point increase in test score, or a 1 school year equivalent ...." (40)

The analysis of education projects may be best left outside the scope of quantified benefit cost, and perhaps only the simplest cost effectiveness ratios make sense given the current state of the art.

7. Comparing the Costs and Benefits of Population Projects

Of all of the project types discussed, population projects are the easiest to analyze. The ease of analysis is the product of the special status given to population projects in the Mandate. Though population control is justified on the basis that favorable economic results will follow, the Mandate assumes this link exists and requires no evidence at the project level that the link is based in fact. This implies that all that population projects must show they accomplish is to reduce fertility rates. In Congress and AID terms, a simple cost effectiveness ratio of the following form will suffice for both project selection and evaluation of population projects.

$$\frac{\text{Number of Births Averted}}{\text{Project Costs}}$$

What is left for project analysts are the data gathering difficulties in estimating project impacts on fertility. The question of whether the Congressional and AID judgment that limited births leads to improved welfare is an issue which is avoided in the Mandate documents and by implication does not need to be raised in the evaluation and selection of population projects.

FOOTNOTES TO PART E

(28) Agency for International Development, *AID Handbook,* Washington, D.C., 1975, p. 6G-1.

(29) *Ibid.*, p. 6G2-3.

(30) E. J. Mishan, *Economics for Social Decisions: Elements of Cost Benefit Analysis,* Praeger, New York, 1973, p. 11-13.

(31) AID, Peru, *Program for Improved Water and Land Use in the Sierra.* (Project Paper.) Agency for International Development, Washington, D.C., 1975, p. 51.

(32) *Ibid.*

(33) USDA, *Agriculture Projects Manual,* Washington, D.C., 1973.

(34) John Chasse, *The Economic Appraisal of Health Projects in the Third World,* Office of International Health, Washington, D.C., 1976, p. 31.

(35) *Ibid.*, p. 41.

(36) Agency for International Development, *The Congressional Mandate: Aiding the Poor Majority,* 94th Congress Committee Print, Washington, D.C., 1975, p. 73.

(37) Martin Carnoy, The Economic Costs and Returns to Educational Television, *in Evaluation Studies,* Vol. I, 1976, p. 252.

(38) *Ibid.*, p. 254.

(39) *Ibid.*, p. 255.

(40) *Ibid.*, p. 247.

PART F
SECTOR ASSESSMENT AND SECTOR ANALYSIS TECHNIQUES

1. Weaknesses Inherent in Macro and Micro Analysis

The large majority of analytical efforts in developing economies fall into the two traditional categories of macro and micro analysis. The macro analytical efforts have dealt with development on an economy-wide basis, and have sought to quantify the interrelationships between macro variables like the foreign exchange balance, aggregate savings and investment, population growth, etc. At the other end of the spectrum are micro studies undertaken at the firms or farm level. These micro studies have usually been in-depth analyses of some rather narrow issue like the substitution of labor for capital in corn farms of region X. While both of these analytical types serve an important role in clarifying development options, there is a large gap between them where little analysis has traditionally been undertaken. The intermediate level between the individual farm or very narrowly defined farm type (corn farmers in region X) and the economy as a whole (to include all sectors, regions, etc.) could be thought of as any grouping of farms (like small farms or farms in region X, or poor farms) or branches of economic activity like agriculture, housing, health, etc.

A review of both AID and Host Country Institutions with which AID deals would probably reveal that most of their planning and project activity takes place in this intermediate range of aggregation larger than the micro and much smaller than the macro level. What this implies is that for most of the project and planning efforts undertaken in the AID context, the issues are not adequately addressed by either the existing micro firm level, nor the highly aggregate economy-wide analysis. To be sure, in the days when AID program loans were prevalent, the situation was different; a well elaborated macro model of the economy as a whole was probably the best possible analytical structure to illuminate the critical assistance issues. For current AID practice, however, with focus on key problems (health, nutrition, income, production) of a particular subset of the population, the poor majority, a different level of analysis is required which probably lies in between the level at which most studies are commonly undertaken.

The reasons for this gap in analysis are many. Micro and macro studies are much more manageable data exercises and can be undertaken on reasonably small budgets, even by individual academic scholars. Macro studies are usually based on national accounts data; if they are available there is little cost in manipulating them. Micro studies can be based on case study data where even the single Ph.D. candidate could manage the interviewing and data manipulation. Studies aimed at the intermediate sector or regional level would require a much larger data base which could not likely be assembled without deliberate intervention of some institution with resources far beyond the reach of the individual scholar. Data gathering would be required of representative samples of the studied

population, and some institutional interest, such as project funding provides, would be needed to carry the longer run analytical burden to process and interpret the results. In short, only macro and micro studies can arise on an ad-hoc basis motivated by individual scholarly interests or short-term modestly funded institutional interests.

Another reason for the prevalence of micro and macro studies is the theoretical structure of neo-classical economics which focused interest at two levels, the dynamics of decision making in the individual firm, and the interaction of all firms in an economy wide market. While there has been substantial theoretical interest in regional models and while individual commodity markets have been the subject of considerable economic research, there is still some bias in the theory itself which leads research to concentrate at one of these poles.

Whatever the reasons, the result of the tendency of economic analysis to ignore this intermediate range or level of investigation has left planners (both AID and Host Country) without the benefit of quantification focused at the level at which their principal projects and decisions are undertaken.

2. *Sector Analysis as a Response to the Lack of Intermediate Level Analysis*

The idea of a "sector" as an area of project and program focus gained popularity in the late 1960's; it was only natural that analysis to support these development initiatives should follow that lead. A series of analyses were undertaken in the early 1970's by AID and the World Bank in collaboration with Host Country planning institutions under the title of Sector Analysis. Sector analysis was used as the title for such a wide array of analytical exercises with so little in common that it is difficult to characterize what distinguishes them from the analyses which had preceded them. The only unifying idea was the "sector" idea which itself was so flexible that almost any grouping of activities, or geographic areas, or target clientele would quality as a "sector." It was in the agriculture sector that the methodology was most clearly defined and developed. The general characteristics outlined below which came to be more or less consistent between the larger agriculture sector analyses are not directly relevant to the variety of other definitions of "sector." The larger agriculture sector analyses were undertaken in Mexico (IBRD), Nigeria (AID/MSU), Colombia (AID), and Korea (AID/MSU). These analytical efforts attempted to meet the following rough analytical criteria.

a. *Coverage of the Whole Sector*

To be a "sector" analysis, the analysis should cover the whole sector; in agriculture, an analysis of corn, or marketing alone, would not be considered as "sector" analyses.

b. Dissaggregation

Even though a macro model would meet the "coverage" criterion, it would not qualify as a sector analysis because it lacks the necessary depth or dissaggregation to view the major components of the sector separately. For example, a sector analysis should allow for separate treatment of each of the major crops and farm types, etc.

c. Quantified Interrelationships Between Sub-Sectoral Components

Not only should each of the major parts be separable, but there should be a quantification of the interrelationships between the parts. A study which undertook an exhaustive description of each of the crop types, market structures, infrastructure, input supply, research, etc., and produced these individual studies without quantitative links would not be a "sector" analysis of the type undertaken in the four examples noted above. This criterion requires some kind of quantitative model, and is one of the reasons for the cost and complexity of sector analysis.

d. Multiple Objectives

The fourth criterion required that the analysis be able to deal with multiple objectives such as income, employment, income distribution, nutrition, etc. Most econometric models operate based on the assumptions of neo-classical theory—that the maximization of private incomes is the driving motive for choice in the firm and by aggregation at the economy level. Many developing countries are taking a broader view of their motives for project and program planning and wish to have analytical structures which were at least neutral to motive, and perhaps even able to embody nonprofit deliberate policy motivations. Integrating multiple objectives into sector analyses presented both sizeable data and troublesome methodological problems.

e. Training of Host Country Analysts and the Improvement of Planning Institutions

All of the above mentioned sector analysis efforts had as a central aim the assistance and training of a Host Country institutional capacity to undertake sophisticated analysis.

The experience with these efforts was not entirely positive. The time it took to complete these analyses (from 2-4 years) made it clear that they could not be used as a regular part of AID's programming cycle to illuminate project choice. The cost of the efforts (1-5 million) led most observers and participating analysts to wonder if the benefits justified the costs. Whatever may have been the value of these efforts in illuminating the dynamics of development at the sector level, they proved not to be cost effective

project analysis alternatives, nor even pre-project selection overviews of the sector situation which could be used as a prior step to project selection and analysis. Since this manual is focused on project analysis, no detailed description is necessary of these efforts.

3. Sector Assessments: An Alternative to Sector Analysis

With the widespread dissatisfaction with the time and costs required to undertake sector analyses, certain offices in AID coined a new variety of analysis "sector assessment" which was to be shorter, cheaper, and less ambitious than "sector analysis," yet retain the broader perspective implied by at least the coverage criterion. Sector assessments are presumably to be shorter, less quantitative and require less original data gathering than sector analyses. While the coverage should be the same, the dissaggregate level and quantification of interrelationships would have to be less complete and quantified. Multiple objectives would presumably still be discussed, but usually in narrative as opposed to quantitative format.

In the Latin American Bureau the sector assessment format for agriculture has recently focused on a detailed statistical profile of the target group using techniques discussed in Part D under the titles of "descriptive statistics" and "productivity ratios," and a discussion of the apparent constraints to increased income of target group households. Based on these "analytical" sections, an assistance strategy would be elaborated by reviewing the current AID and Host Country programs in light of these constraints and identifying gaps where additional assistance could address a critical constraint.

The target group would be dissaggregated into reasonably homogenous subgroups, and the constraints which appear to be most important based on the statistical profile identified for each group. Table 45 presents a summary of such constraint priorities drawn from the 1976 Agriculture Sector Assessment for AID Chile.

Without a review of the statistical profile of these different target groups, and the narrative definitions and discussion of each constraint type in the table, it is difficult to obtain a clear idea of the meaning of the table. It is presented simply as an example of how the target group would be subdivided into component subgroups who face roughly the same pattern of constraints. The diversity of the target group is a point obvious from the table; what appears to be constraining the improvement of income for one farm type in one region is not the critical factor in another. One of the benefits of simple but disaggregate statistical description is that it will help to surface important differences between subparts of the target group which have project implications.

Sector assessments are as varied in practice as were the earlier sector analyses. Their cost is however considerably lower (usually under $100,000) and the time frame considerably shorter (4-12 months). If care is taken to insure that the best statistical description possible is included (given time and budget constraints), a sector assessment can be a useful underpinning for project analysis.

Table 45
Chile Sector Assessment
Summary of Constraint Priorities for the Rural Target Group

	Number of Families	Farm Level Constraints				Secondary Level Constraints							
		Land & Water	Land Use	Crop Mix	Yields	Credit	Agro Indust.	Market-ing	Ag. Prices	Export	Institutional Constraints		
											Res. & Exten	Irrig. & Nat. Res	Trained Man-power
Arid North Total	23,000	-	-	-	-	-	-	-	-	-	3	-	-
Minifundistas	8,000	1	-	-	2	2	4	5	-	-	3	1	-
INDAP	2,000	1	-	-	2	2	4	5	-	-	3	1	-
Non-INDAP target	6,000	1	-	-	2	2	4	5	-	-	3	1	-
Reform	5,000	1	-	-	2	2	4	5	-		3	1	-
Landless Rural	10,000	1	-	-	-	-	1	-	-	-	-	-	-
Central Irrigated	189,000												
Minifundistas	114,000	-	-	-	-	-	-	-	-	-	-	-	0
INDAP	15,000	-	-	1	2	1	2	5	-	3	4	-	-
Non-INDAP Coast	21,000	2	-	1	3	1	3	5	-	4	6	2	-
Non-INDAP Central Valley	79,000	-	-	1	2	1	2	5	-	3	4	-	-
Reform	35,000	-	2	1	3	1	2	5	-	3	4	-	-
Landless Rural Poor	40,000	-	-	-	-	-	-	-	-	-	-	-	-
Ag Solution	15,000	-	-	1	-	1	2	-	-	3	-	-	-
Non Ag. Solution	25,000	-	-	-	-	-	1	2	-	-	-	-	-
Central South	110,000												
Minifundistas	57,000	-	-	-	-	-	-	-	-	-	-	-	-
INDAP	43,000	-	1	2	3	1	2	5	-	3	4	-	-
Other	14,000	-	1	2	3	1	2	5	-	3	4	-	-
Reform	19,000	-	1	2	3	1	2	5	-	3	4	-	-
Landless Rural Poor	34,000	-	-	-	-	-	2	5	-	3	4	-	-
Ag. Solution	17,000	-	1	2	-	1	2	5	-	3	4	-	-
Non Ag Solution	17,000	-	-	-	-	-	1	2	-	-	-	-	0

Note Not included in the above is the important area of producer organizations, the lack of which is not really an important constraint as such because many exist. However, the effecting of many of the above secondary constraints will require the improvement in the producer organization area. Similarly the important question of GOC budgetary is all pervading and therefore not included.

SOURCE: AID, Chile Agriculture Sector Assessment, Agency for International Development, Washington, D.C., 1976.

PART G
MANAGEMENT AND PROGRAMMING ISSUES RELATED TO MANDATE PROJECT ANALYSIS

1. Analysis and Data Gathering Activities in the AID Project Cycle

An AID mission engaged in the AID project cycle faces a wide variety of practical problems in attempting to select analytical alternatives, contract for them and monitor/evaluate their performance. This Part is to assist in illuminating some important aspects of management and programming where data and analysis are involved.

The danger in this presentation is that it oversimplifies a complex process and may mislead programming and contracting officers by suggesting what appear to be "cook book" classifications and over-generalized rules of thumb. It was felt, on the other hand, that even oversimplifications may help to clarify what is a very confusing, even bewildering subject for many programming and contracting officers. All of the materials presented in this part should be thought of as illustrative as opposed to definitive.

A wide variety of techniques have been presented in this manual, both for data gathering and for analysis or interpretation. Any of these techniques could be employed at any of the project stages, ranging from the pre-project sector overview (Assessment) through project selection and design (PID, PP) to project monitoring and evaluation. One of the first issues which a mission must focus on is the appropriate staging of data gathering and analysis activities in this project cycle. If all of these techniques are equally appropriate and feasible at all stages, the choice between them would be complex indeed. Fortunately (or unfortunately), all of the techniques are not equally appropriate and feasible at each of the project stages; some general selection information or guidance is therefore possible. There is, however, much overlap and imprecision in these general groupings which grow from the complexity of projects themselves; some projects are so large that much more ambitious data gathering and analysis than that described should be undertaken, while others are so small or short-term that little measurement is possible.

Table 46 attempts to classify each of the data gathering and analysis techniques discussed in the manual according to the stage in the project cycle at which they are most useful *and* feasible.

2. Writing Scopes of Works for Analytical and Data Gathering Activities

Writing scopes of work for data gathering and analytical activities is particularly difficult because the subject area is technical and most missions are not staffed with information system or statistical experts. Scopes must be written in most cases in stages, the first stage being drafted by the mission and covering the problem or issues to be ana-

Table 46
Illustrative Outline of the Most Appropriate Staging of Data Gathering and Analysis Techniques in the Project Cycle

Project Cycle Stage	Data Gathering Techniques	Analysis and Interpretation Techniques
Sector A Assessment (Pre-Project)	Use existing census or sample data. Sub-sample and process if necessary.	Simple Comparisons, Indices + Cross Tabs Descriptive Statistics Productivity Ratios
Project Identification (PID)	None	None
Project Paper (PP)	Small Targeted Random Cross-sectional Control Gp. survey Use available project data and data developed for assessment.	Farm and/or Household Accounts Operating Ratios Productivity Ratios Benefit/Cost Analysis for Agriculture Projects Cost Effectiveness Ratios for Nutrition, Health, Population and Education Projects Descriptive Statistics Productivity Ratios Farm and Household Accounts
Project Implementation and Monitoring	Successive or Longitudinal Control Group Sample	Productivity Ratios Cost Effectiveness Ratios Farm and Household Accounts
Project Evaluation	Successive or Longitudinal and Cross-sectional Control Group Survey	Productivity Ratios Benefit/Cost Analysis if there are Project Alternatives for Comparison Complex Indices Regression Analysis Cost Effectiveness Ratios

lyzed and setting the general time frame and budgetary possibilities. If there are subject matter specialists in the mission, the more detailed scope of work which indicates the data gathering procedures and analytical techniques to be used may be written in-house as well. Most often the mission is so staffed as to require specialized services to complete a detailed scope of work.

An alternative, often utilized, is to eliminate the second more detailed scope of work and allow the contractor hired under a first stage or simple scope to elaborate more and more detailed work plans during implementation of the data gathering or analytical activity itself. This class of data/analysis scope of work might be termed the "final results" oriented scope, in which the contractor is given essentially no guidelines about the data and analysis *'process'* by which he is expected to reach the "final results" or analytical product described in the scope of work. The alternative is to specify both the "final results" and the data/analysis "process" by which those results are to be obtained. A "process" scope is much more difficult to write, and usually requires the services of a specialist.

The obvious disadvantage of writing only a "results" scope is that the contractor may reach the results in a less reliable and adequate manner than was expected. There is a vast difference in the cost of determining, for example, the percent increase in income which project participants experienced as a result of project activity via reliable sample survey, as opposed to using expert judgment or educated guess. A scope of work which only specified the desired result (i.e., an estimate of income change) and failed to specify the process (sample size, control group procedures, and statistical analysis technique) would hardly be worthy to be considered a scope at all. In data and analysis activities the form and appearance of the final results may be indistinguishable between a careful, expensive, and statistically reliable process, and an ad-hoc, subjective, educated guess approach. The difference in reliability is insured only by the process and not by the form of the final product. Those scopes which fail to specify "process" leave to the whim of the contractor how to arrive at final judgments and conclusions.

What are the necessary elements of "process" which must be specified in a "process" oriented data/analysis scope of work? The following paragraphs describe the principal issues which should be addressed in a scope; the actual form and substance of the scope will, of course, vary widely by subject matter and project.

a. Data Issues

i. Specification of Data Sources

A "process" scope should outline in detail the data sources which are to be used. If sub-sampling of existing raw data files such as censuses or existing surveys is to be undertaken, the size of the sub-sample and specification of the data fields to be included should be outlined.

For situations in which a sample survey is to be undertaken, the scope is particularly difficult. Without a specification of sample size, sampling procedure, control group technique, and the number of variables, it is impossible to make even the most preliminary budget estimate. This is the best example of a situation in which it will probably be necessary to obtain expert assistance either from AID/W or from consultants simply to review the data gathering situation and write a scope of work which may be budgeted and released for bid.

Situations this complex have often been approached by simply circulating requests for proposals from competent contractors. The RFP would contain only the "final results" description, but respondents would be asked to outline in considerable detail the "process" by which they would arrive at those results. The difficulty with this approach for data gathering activities is that a review of the availability of on-site materials (such as lists of sampled populations, cartography, regional and sub-issue stratifications required) is almost always a prerequisite to making estimates of sample size and sampling procedures. Responding contractors would have to make field reconnaissance visits before submitting proposals at the level of detail necessary to provide the AID Mission with sufficient information on "process" to allow for a rational contractor choice. To obtain a week or two of professional services (either on TDY from another mission, from AID/W or from a consultant) to make the preliminary field review and to outline the scope at the process level is an acceptable alternative.

Once sample size and sample procedure have been determined, the two most important cost components can be estimated. As a broad rule of thumb, the field costs of gathering data on rural households in developing countries will range from $US 20-30 per observation if the instrument (questionnaire) is reasonably detailed (more than 100 possible data items per observation). The detail contained in the questionnaire will not affect substantially the costs of field work since most of the time spent is not in interviewing but in traveling between farms.

Sample frame development and sample selection tend to be large costs which are unfortunately not subject to even the broad rules of thumb. The importance of systematic randomizing procedures has been emphasized before, but it is worth repeating at this point that cost cutting in surveys should be done in other areas; sample frame construction and selection should be the last to be compromised.

Budget provisions should be made for re-interviewing approximately one-third of the respondents if the survey is aimed at gathering farm income information. If the questionnaire focuses on non-income items only, 10% allowance for re-interview is necessary. A ratio of one supervisor for every three interviewers is a recommended level. Even if this level of supervision is not chosen, the selected ratio should be specified in the scope. Quality control in the interviewing and coding and revision process is so important that it may be wise to provide for an independent observer to accompany the prime

contractor into the field, as it is impossible to identify "quality" in the questionnaires after they have left the field. No system of office checking procedures will suffice to identify, let alone correct what could have been accomplished by one "quality" observer in the field.

Interviewer training should be outlined in the scope. All interviewers should have completed at least three test interviews before actually commencing field work. For the type of data required to measure the indicators discussed in this manual, interviewers would probably require a training course (including test interviews) of not less than one full week.

Data processing, while extremely complicated, need not be the subject of detailed description in the scope. If the sample size and number of variables are properly specified in the data section, and if the analysis process is properly described in the analysis section of the scope, that will suffice to control the quality of the data processing. The only data processing quality control which is possible to insert in a scope is the number of errors per 1000 key punch strokes which will be allowable. Data processing is the area in the scope where general, non-detailed description can be most tolerated with the least potential damage.

ii. Specification of Analytical Procedures

The analytical procedures section of the scope should name the techniques which are to be used to arrive at the final conclusions desired. For example, if productivity ratios are to be used, the specific ratios should be described. If benefit/cost is one of the techniques to be used, more detail should be included. The factors and products to be shadow priced, the types of indirect and secondary benefits to be included, and the number of separate project alternatives of subproject segments for which separate ratios are desired should be outlined. It is necessary to specify the method by which the "with" and "without" differences are to be generated.

A scope which includes descriptive statistics should at least indicate the type (histograms, percentiles, and measures of central tendency or dispersion). By reviewing the table of contents of this manual a catalog of techniques should be apparent which would be sufficient in detail to include in a scope. After rereading the relevant section relating to the selected technique, the AID officer should be able not only to name the technique but add a paragraph of description of how this technique is to be applied.

Since virtually all analysis finally appears in the form of a statistical table, the most useful mechanism for specifying analytical scopes is to outline blank tables which describe the format of the final results. The column and row headings will usually contain enough detail to imply an analytical approach.

In summary, more process detail is required in the data gathering section of a data/analysis scope than in the analysis section. The analysis section will usually be sufficient if it contains the names of the techniques to be used and a few blank tables describing the format of the final statistical results desired.

3. Monitoring Data and Analysis Activities

Monitoring data and analysis activities is relatively easy if the scope is clear, and virtually impossible if it is not. Almost all of the troublesome aspects of tracking data and analysis contracts relate to ambiguity in scope. The contractor is usually given such wide-ranging discretion in selecting "process" alternatives that mission personnel are at a loss to set monitoring criteria or benchmarks against which to measure progress. The alternative usually adopted is to set target dates for the submission of reports containing results. To ask for progress reports instead of substantive reports begs the question; if the scope contains detailed progress description the monitor has easy benchmarks to track, if it does not the request for progress reports leaves the mission without any standard to decide if the progress is acceptable.

If the scope and work plan contain a schedule for data gathering, processing, and analytical steps, monitoring is relatively easy. Successful monitoring is therefore more dedependent on an adequate scope than on some special review procedures.

4. Evaluation of Data and Analysis Activities

Evaluation of data and analysis activities may be undertaken at three different levels.

- –Did the activity obtain the data and perform the analysis expected at the expected cost and in the expected time?
- –Did the data collected and analysis performed provide useful illumination of the project issues?
- –Did the results change project choice or favorably alter government policy?

Each of these levels reaches closer to a final objective of data and analysis activities. The first question is directed at evaluation of the particular contractor and the reasonableness of the scope as written. The second level of evaluation addresses the appropriateness of the technique and data selected. Did we ask the right questions, were the appropriate analytical techniques used, were the data gathered sufficient to answer the questions posed? This second level evaluation is directed more at the scope than at the implementing contractor. The last evaluation issue is directed at the final use made of the results and directs itself at the fundamental usefulness of such activities in the actual political and decision-making environment. Many well conceived and expertly undertaken data and analysis activities result in well reasoned and solidly evidenced recommendations which are rejected or ignored for other reasons.