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9. ABSTRACT

The purpose of this study was to develop a conceptual analysis for the identification, development, and adoption of technologies appropriate for rural development that benefits the rural poor in less economically developed nations. Rural development is defined as a process by which the rural poor are assisted in improving their levels of output and living, on a self-sustaining basis, through their mass participation in the development process. The conceptual analysis was based on and can be applied to the selected case study area of twenty Andean communities in the Province of Huari in Peru. Investigated were the rationale for using technologies to stimulate rural development, the rationale for helping the rural poor, and the role of technology in rural development. The discussion of selection of appropriate technologies stresses physical, economic, and social-political criteria. If the rural poor are to benefit from new technologies in rural areas, the technologies need to be non-capital-intensive. An analysis of the case study area is focused on the rural development program of the Lutheran World Federation--World Service Department in Huari, Peru, where the rural poor have per capita incomes of about $100 and low levels of output. Recommended is the development of a research-training-service center in Huari, where rural poor, working with scientists, could jointly develop appropriate technologies which meet the physical, economic, and social-political conditions of the local area.

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by

Mark Alan Lund

An Abstract of

A Dissertation Submitted to the

Graduate Faculty in Partial Fulfillment of

The Requirements for the Degree of

DOCTOR OF PHILOSOPHY

Approved:

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In Charge of Major Work

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For the Major Department

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For the Graduate College

Iowa State University
Ames, Iowa

1975

Identifying, developing, and adopting technologies appropriate for rural development with applications to Huari Province in Peru

Mark Alan Lund

Under the supervision of John F. Timmons
From the Department of Economics
Iowa State University

Recent concern for the rural poor in less economically developed nations has been emerging as it appears they do not share in the creation or benefits of economic growth. The rural poor often do not achieve the minimum needs of food, clothing, shelter, health, education, and employment.

Two concepts, rural development and appropriate technologies, are developing in response to the inability to generate widespread economic growth. Rural development is defined as a process by which the rural poor are assisted in improving their levels of output and living on a self-sustaining basis through the method of mass participation.

The main purpose of this study was to develop a conceptual analysis for the identification, development, and adoption of technologies appropriate for rural development. The conceptual analysis was based on and can be applied to the selected case study area of twenty Andean communities involved in rural development, located in the province of Huari in Peru.

An analytical framework was used to delimit and diagnose the problem addressed in this study and to present remedial action. The specific goal of the case study area was to use technologies to improve the levels of output and living of the rural poor. The urgency of using technologies to

stimulate rural development, the rationale for helping the rural poor, and the role of technology in rural development were investigated. The existing use of technology indicated a stagnant situation. Thus, the elimination of the problematic gap between the goal and existing situation in the case study area became the main purpose of this study.

To eliminate the problematic gap, success and failure elements were diagnosed and remedial action was formulated for identifying, developing, and adopting technologies appropriate for rural development. The role of institutions, and the need for mass participation and making the development process self-sustaining were stressed. Identification of needed technologies was determined by the rural poor themselves through their community organization. Development of appropriate technologies stressed physical, economic, and social-political criteria and the need for predictive technologies capable of generating dynamic growth. For the adoption of appropriate technologies, the study recommends a two tier organizational system where education and the creation of discipline regarding the economic principles of saving and investing are combined with technical assistance.

Future research is needed to apply and perfect this conceptual analysis and rural development is expected to evolve slowly. The economist can serve a vital role by determining the local demand for technologies, advising the engineer in the development of appropriate technologies, and stressing the need for creating economic discipline in the institutions for adopting technologies. In summary, the concept of appropriate technologies for rural development appears to offer the rural poor hope.

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CHAPTER I. INTRODUCTION

Rural development in less developed nations is receiving much attention in the 1970's. In this study, less developed nations are defined as those nations with average annual per capita incomes less than $800. According to 1972 data, this included 84 of the 112 countries with populations over one million (57, p. 7). Total population of these 84 countries was estimated at 2.59 billions (57, p.6).

The definition of rural development used in this study is similar to the concept developed by Lele (21, p. 17) and Butterfield (3, p. 2). Rural development is a process by which the rural poor are assisted in improving their levels of output and living on a self-sustaining basis through the method of mass participation. The rural poor are defined in this study as those living outside major cities whose annual per capita income is: 1) below one-third of the annual national per capita income in their respective countries; or 2) less than $150.

There are three major dimensions within the definition of rural development which provide important implications for the design and implementation of rural development programs. These three dimensions treat rural development as an objective, a method, and a process. The objective of rural development is to improve the levels of output and living of the rural poor. The method of rural development involves mass participation of the rural poor in the economic, social, political, and cultural affairs of their country. The process of rural development involves the transition from low levels of living to high levels of living. Making this

process self-sustaining is an important requirement (9, p. 21).

Problems treated in this study refer to the identification, development, and adoption of technologies which are appropriate for the rural poor to whom rural development is directed. The technologies must fulfill the requirements of the objective, method, and process dimensions of rural development.

The content of this introductory chapter includes five sections. The first section describes the nature of rural development problems in the less developed nations. It emphasizes the magnitude of the rural development problems by discussing the total number of the rural poor in less developed nations. Section two introduces the role of technology in rural development and the area of study in Peru. Objectives of the study, and methods and procedures used in pursuing these objectives, comprise sections three and four. The last section briefly introduces the six remaining chapters into which the report is organized.

Nature of Rural Development Problems in Less Developed Nations

Rural development is receiving increasing emphasis today by both less developed nations and international organizations. This increasing emphasis on rural development is partially at least, a result of the failure of past development programs, conducted by international and national development agencies, to bring improved levels of living to rural poor within less developed nations.

Officials of the International Bank for Reconstruction and Development (henceforth referred to as the World Bank) have described, in their

sector policy paper on rural development, the objectives and failures of development programs to help the rural poor as follows:

> Past strategies in most developing countries have tended to emphasize national economic growth without specifically considering the manner in which the benefits of growth per se would lead to improved levels of living of the rural poor as the benefits of an expanding economy spread among the people. Accordingly the emphasis has been on increasing the rate of growth with a corresponding concentration of effort on the 'high growth' modern sectors of the economy to the exclusion of the traditional sector where the bulk of the rural poor live. Although, in the long run, the economic development for the growing rural poor will depend on expansion of the modern sector and on nonagricultural pursuits, too strong an emphasis on the modern sector is apt to neglect the growth potential of the rural areas. Failure to recognize this has been a major reason why rural growth has been slow. . . . At the other extreme, a few governments preoccupied with promoting public services in the rural areas, may have discouraged investment in growth to the point where economic stagnation has resulted. With rapidly growing populations, per capita incomes in rural areas have declined (56, p. 16).

Two specific rural development programs which occurred in many less developed nations and which have also provided dismal results for the rural poor are: 1) the community development approach of the 1950's; and 2) the green revolution technological package approach of the 1960's. The community development approach did not achieve the success which planners had expected, and disenchantment with its results, combined with new technological discoveries, led to the package programs of the green revolution approach. The green revolution brought much success, but benefits were spread unevenly and the rural poor, because they did not have access to necessary new technologies, did not benefit from the program. The technologies needed by the rural poor include new and more efficient inputs, innovations in the productive process, and improved cultural practices.

Despite per capita growth rates ranging from 2 to 6 percent (57, p. 7) experienced in less developed nations, and efforts of community development and the green revolution, the rural poor today face severe problems of low productivity, high and increasing unemployment, inadequate food supplies, serious malnutrition, widespread ill-health, and low rates of literacy. Underlying these problems are: 1) the current distribution of income that prevents the rural poor from gaining access to modern technologies which could increase their incomes; and 2) excessive population growth (3, p. 1). To summarize, the rural poor have received few benefits from the economic growth of their nation, despite their rising expectations for a better life of improved income, shelter, health and education.

The magnitude of the rural development problem and insights into the setting of the problem can be better understood by applying the concept of the rural poor to less developed nations.

The term, rural poor, is a concept used and defined by both the International Bank for Reconstruction and Development (World Bank) and the United States Agency for International Development. The organizations have similar definitions which are based on estimated annual per capita incomes. The annual per capita income estimates used, include all goods and services produced by the rural poor whether they are sold in the market or consumed by the rural poor family at home.

The United States Agency for International Development uses the following definition of rural poor for its program development purposes. The rural poor are those persons living outside major cities who can be classified in two categories: 1) absolute terms; and 2) relative terms. The

rural population classified as poor in absolute terms is defined as those people with annual per capita income equivalent to $150 or less (in 1969 prices). The value of $150 equates with estimated minimal nutrition, health, and shelter needs. People with annual per capita incomes above $150 but below one-third of the average annual per capita income of the nation in which they live, are the rural poor based on relative terms (3, p. 2).

Complementing the definition of rural poor used by the United States Agency for International Development, is the concept of the rural poor found in the World Bank's sector policy paper on rural development. Although officials of the World Bank recognize there is no uniquely correct way to define the rural poor, they have chosen certain criteria on which to base their definition. Their criteria for defining the rural poor in absolute terms differ from that of the United States Agency for International Development. An annual per capita income equivalent to or below $50 is used instead of $150. In relative terms, both international organizations used the same criteria of one-third of the average annual per capita income of the nation as the upper bound for defining the rural poor based on relative terms (56, pp. 19, 20).

The World Bank applied these criteria to persons living within major cities in addition to outside major cities. Their results show that approximately 750 million, or 40 percent of the total population of developing countries, which are members of the World Bank, must be considered poor in absolute and relative terms (56, p. 20). This fact was used in Mr. McNamara's 1973 Nairobi speech where he emphasized the need for pro-

Table 1. Distribution of poor and rural poor in less developed nations[a]

Less developed countries[b] by region	Total area			Rural area		
	Total population 1969	Population with incomes below $50 per capita plus population with incomes below 1/3 of national average per capita income	Percent of poor in total population	Rural population 1969	Population with incomes below $50 per capita plus population with incomes below 1/3 of national average per capita income	Percent of poor in rural population
	(millions)		(%)	(millions)		(%)
Africa	360	125	35	280	115	41
America	260	80	30	120	45	38
Asia	1080	440	41	855	370	43
Developing countries total	1700	645	38	1255	530	42

[a]Source: Adapted from (57, pp. 79-80).

[b]World Bank members.

grams that are designed to help approximately 40 percent of the population of the less developed countries who have neither been able to contribute significantly to national economic growth, nor share in benefits of economic progress (27, p. 1).

An estimated 80 percent of the 750 million poor or 600 million people live in rural areas and comprise the rural poor. These data are rough projections for 1975, based on the 1969 estimates in Table 1 (56, p. 19). Table 1 indicates that the rural poor constituted approximately 42 percent of the rural population in less developed nations in 1969. The World Bank characterizes the rural poor as those who lack effective access to technology, public services, and the institutions which could provide higher levels of output and living (56, p. 21).

Data concerning activities of small land holders, tenants, and landless who make up the bulk of the rural poor are scarce. Agricultural employment is the principal occupation for 80 percent of the rural poor representing 480 million people, and the remainder depend on jobs in rural industry, commerce, transport, and services (56, p. 21). Therefore, rural development programs need to center on agricultural development. Rural development requires increasing productivity within rural areas. Improved yields of crops and livestock are important ingredients of increased productivity. If the rural poor are to share in this increased productivity, they must be able to participate more fully in the production process and in the income resulting therefrom.

A rural development strategy emphasizing increased agricultural production as the engine for rural development, seems to provide the essential basis for a solution to multiple problems of the rural poor.

A strategy for rural development was suggested by Butterfield (3, p. 3). With the aid of research, education, new technologies, and new organization, the rural poor could increase their annual output per acre and per capita, by using increasing amounts of unemployed and underemployed labor, as well as complementary capital inputs. Out of higher income arising from sales, savings are mobilized for further investment. This is accompanied by land improvements and an increase of purchases by farmers, of seeds, fertilizers, and other inputs. Also, demand for such consumer goods as basic foodstuffs, clothing, and low cost housing, usually produced by labor intensive technologies, will be stimulated.

These increased purchases help fuel a general program to increase off farm employment, which in turn expands markets for: 1) increased agricultural production; and 2) the production of consumer goods, public services, and economic infrastructure. In this way the wheel of production begins moving more rapidly. People work more days and produce more. Employment and incomes rise. Effective demand increases, providing a basis for higher levels of production, through participation of the rural poor in both the production and income distribution process.

Resolution of the problem of rural development in less developed nations can be summarized as developing a strategy that enables the rural poor to participate in the process of improving their levels of output and living. A critical component is the importance of making this process self-sustaining.

Technologies Appropriate for Rural Development

This study analyzes the role of technologies in fulfilling the three dimensional aspect of rural development mentioned earlier in terms of objective, method, and process. In proceeding with the role of technologies, technologies demanded by the rural poor must be identified. Next, technologies which are appropriate for the rural poor must be developed, and adopted, so that: 1) the levels of output and living of the rural poor are improved; 2) the rural poor have access to benefits from increased production so that they may participate more fully in rural and national development; and 3) the process of rural development becomes self-sustaining.

This study also analyzes institutions that support the stages of: 1) identifying demands of the rural poor for technologies; 2) developing technologies; and 3) adopting technologies. Economic analysis has an important role in these three stages. The three stages coincide with the three basic economic questions of what to produce, how to organize production, and how to distribute output which in this study, is technology. First, the identification of technologies desired by the rural poor is related to the concept of demand. With each good and service demanded there is an associated technology needed to produce the product or service. Second, the economist can provide suggestions concerning the production process to engineers and technicians who are responsible for the development of the production function and supply of technologies. Third, the economist can emphasize economic principles of institutions which are

needed to adopt and distribute technologies appropriate for the rural poor and self-sustaining rural development. Technologies for the rural poor should provide benefits that are widely dispersed.

Objectives of Study

The purpose of this study is to develop a conceptual analysis for identifying, developing, and adopting technologies which enable the rural poor to participate in a self-sustaining process of rural development. The conceptual analysis is based on, and applied to the existing situation of a case study area in Peru.

The broad purpose of this study can be specified in terms of the following six objectives.

1) To show that there is an urgency for rural development strategies directed primarily to the rural poor, and to provide a rationale that such strategies contribute to the development of the nation.
2) To examine the role of technologies which fulfill the rural development objective, method, and process dimensions, and the interrelationships of physical, economic, and institutional factors in the identification, development, and adoption of technologies.
3) To describe the existing situation in the Peruvian case study area which provides the basis for the conceptual analysis, and gives insight into the identification, development, and adoption of technologies appropriate for successful rural development.
4) To develop and apply a conceptual analysis for the identification and development of technologies appropriate for rural development of the rural poor in the Peruvian case study area.
5) To develop and apply a conceptual analysis for the adoption of

technologies appropriate for rural development of the rural poor in the Peruvian case study area.

6) To suggest further research needed to provide necessary data and policy recommendations.

Objective one supports the new emphasis being given the rural poor in rural development by summarizing: 1) recent research studies on the production efficiency of the rural poor; and 2) historical studies of nations involved in rural development. The United States Agency for International Development has undertaken a study on the efficiency of small scale farmers (55, p. 4), and Owens and Shaw (36), have analyzed the historical studies of the nations most successful in involving the rural poor in rural development. In addition, the urgency for placing more emphasis on developing rural areas is examined.

Objective two emphasizes the role of technology if the levels of output and living are to be improved. If rural development is to involve mass participation, and if the process is to become self-sustaining, technologies must be developed that are appropriate for the conditions of the rural poor. The process of identifying, developing, and adopting technologies, involves the interrelationships between physical resources, economics, and institutions. These interrelationships are discussed in objective two.

The third objective is to present the setting and existing situation of rural development in the Peruvian case study area. The rural development program in the case study area provides information for identifying the demands for technology by the rural poor. These technological demands provide guidance for developing technologies appropriate for the conditions

in the case study area. With respect to adopting technologies, the case study area provides insights into the institutions required to successfully adopt technologies.

The fourth objective concentrates on the identification and development of technologies. Once technological needs have been identified, developing technologies is vital to achieving improvements in the levels of output and living of the rural poor. However, much planning is needed to develop and then select from amongst the technologies developed, those technologies which: 1) meet the technological needs identified by the rural poor; 2) are most appropriate for involving mass participation of the rural poor; and 3) have the potential to make the rural development process self-sustaining. The objective is to construct a conceptual analysis which presents criteria for the development of technologies appropriate for the rural poor in the case study area.

Objective five involves the development and application of a conceptual analysis for adopting technologies appropriate for the rural poor in the case study area. Institutions that provide a delivery system which enables the rural poor to participate in the adoption of technologies are emphasized. Economic principles of institutions that facilitate the adoption of technologies are stressed under this objective.

Objective six suggests further research required as a basis for policy decisions. The nature of further research is an outgrowth of the conceptual analysis in this study.

Method and Procedures

The method used in this study is based on the case study. The problems of identifying, developing, and adopting technologies appropriate for rural development are applied to the rural poor in a specific area of Peru. The definition of the rural poor which relates to this study is based on the definition given by the United States Agency for International Development, as reviewed earlier. In summary, the rural poor are those persons living outside major cities whose annual per capita income is below one-third of their nation's annual per capita income or less than $150.

One of the areas in South America where the rural poor are found in large numbers and percentages is the Andean highlands where land is infertile and the climate is adverse (4, p. 22). The specific area of study, is a rural development program involving twenty Andean highland communities of which seventeen communities are located in the province of Huari in the department of Ancash in Peru. The remaining three communities are located along the border of the province of Huari. In addition to the twenty communities, one government cooperative is involved in the program.

These twenty communities comprise approximately 17,500 people and cultivate approximately 6000 hectares. Using data for the rural Peruvian Sierra region as a proxy, their annual per capita income was estimated at $99 in 1970, which was 22/100 of the national annual per capita income in Peru, thus fulfilling the definition applied to rural poor in this study (32, p. 112). The rural poor in these communities consist of small landholders, who depend on agriculture for an occupation.

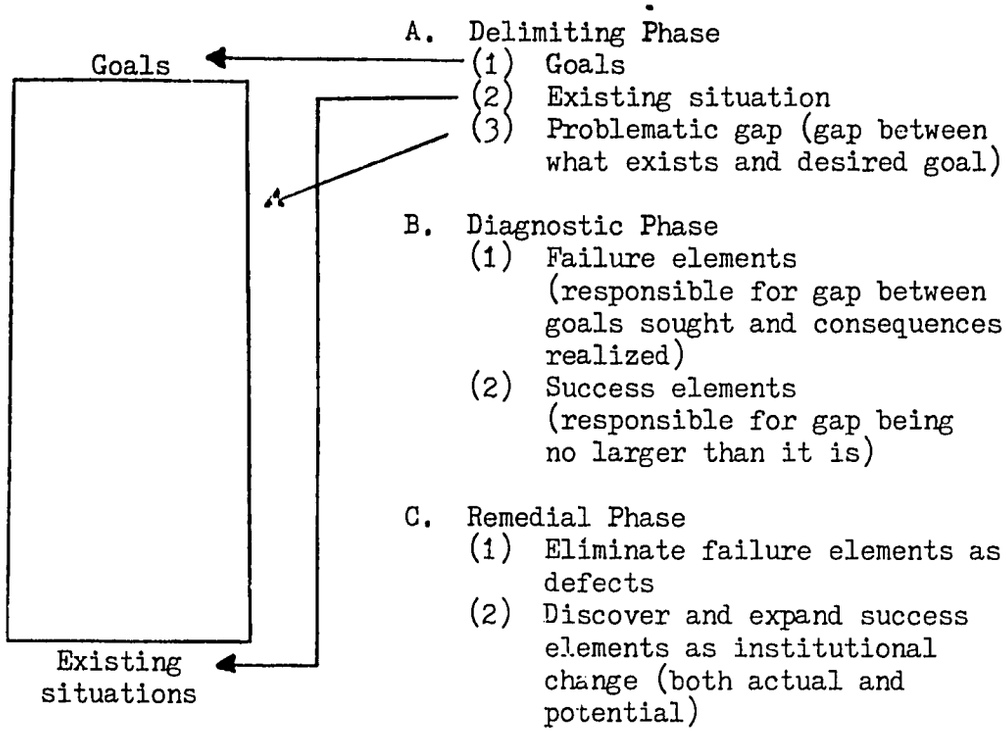


Figure 1. Analytical framework (44, p. 88).

The problems of identifying, developing, and adopting technologies appropriate for the rural poor in the case study area are analyzed, in this study, by using a framework developed by Timmons. Figure 1 shows the main components of the Timmons' analytical framework.

Timmons explains the analytical framework as follows:

> Under the Delimiting Phase, goals are identified; the existing situation is stated; and the problematic gap between the goals sought and the existing situation is indicated. The Diagnostic Phase identifies and measures, insofar as possible, the failure elements and the success elements. The failure elements are those factors that cause the existing situation to differ from the desired goal. The success elements are the factors that have prevented the gap from being larger than it is. The Remedial Phase consists of corrective action. This phase includes two parts. Part one consists of the removal of failure elements that were identified and measured in the diagnostic phase.

> In part two, the success elements that were identified in the diagnostic phase are expanded. Also, in part two new success elements are developed (44, p. 88).

In the delimiting phase, the specific goal of using technology to promote rural development in the case study area is presented and then related to similar goals which the Government of Peru has set for rural Peruvian Sierra regions. Next, the existing situation regarding the use of technology for rural development in the case study area is discussed. Between the goal and existing situation is the problematic gap of this study. This study examines eliminating the problematic gap through the identification, development, and adoption of technologies which enable the rural poor to participate in self-sustaining rural development.

The diagnostic phase analyzes the failure and success elements existing in the case study area which relate to the identification, development, and adoption of technologies by the rural poor. A description of the current rural development program in the case study area provides information from which the failure and success elements are derived.

The remedial phase is divided into two sections. The first section develops a conceptual analysis for the identification and development of technologies that: 1) fulfill the three dimensions of rural development; and 2) apply to the case study area. Existing success elements in the case study area are emphasized and new success elements are suggested to eliminate the failure elements.

The second section develops a conceptual analysis for the adoption of technologies, which are appropriate for the case study area and that meet the rural development dimensions. Again, the success and failure

elements derived from the rural development program in the case study area, are used to provide information for the conceptual analysis. New success elements are developed to further eliminate the problematic gap.

The nature of the data specified by the delimiting, diagnostic, and remedial phases differed. Data for the existing situation and goal of the delimiting phase were collected from sources relating to the rural Peruvian Sierra and the case study area. The case study area also provided: 1) the data for the diagnostic pnase; and 2) the setting on which the conceptual analysis of the remedial phase was based.

Data relating to new success elements for the development of technologies appropriate for rural development were gathered from practitioners, and international, national, and private organizations currently working in this area of research. Data on the adoption of technologies and institutions associated with technologies were gathered from historical studies of rural development programs. In particular, the Comilla project in East Pakistan from 1959 to 1970, provided many useful insights (20) and (39).

Data concerning the case study area were collected from February to July of 1974 while in Peru. Data for the development of new success elements relating to the development and adoption of technologies for rural development were collected from August 1974, to April 1975. Conferences on small-scale technologies and rural development were attended, and many useful sources, both in written material and personal experience were acquired.

Organization of Report

Chapter two presents the three dimensional concept of rural development in detail. Then, the interrelationship between physical resources, economics, and institutions as they relate to technology is discussed.

The delimiting phase which includes the goal and existing situation of this study is discussed in chapter three. In addition, the physical and social-cultural setting for the case study is presented.

Chapter four contains the diagnostic phase. A description of the rural development program in the case study area provides the basis for analyzing the success and failure elements as they relate to eliminating the problematic gap of this study.

Chapters five and six present the remedial phase. In chapter five, existing success elements in the case study are combined with new success elements to develop a conceptual analysis for the identification and development of technologies appropriate for rural development. Chapter six constructs a conceptual analysis for the adoption of technologies, using the same approach as in chapter five. The remedial phase is applied to the case study area. Chapter seven summarizes the conclusions of this study.

CHAPTER II. TECHNOLOGIES APPROPRIATE FOR RURAL DEVELOPMENT WITHIN PHYSICAL, ECONOMIC, AND INSTITUTIONAL POSSIBILITIES

Chapter two is divided into five sections. The first section refers to the concept of rural development. Rural development is further defined with respect to the objective, method, and process dimensions. The role of mass participation in rural development is examined in section two. The need to involve all the rural poor is discussed.

Section three presents in greater detail the nature of and reasons for increasing emphasis that is being placed on the rural poor and rural development in the 1970's. The fourth section examines the role of technologies which are appropriate for creating a self-sustaining process of rural development by the rural poor. Finally, the fifth section discusses the interrelationship of physical, economic, and institutional factors for identifying, developing, and adopting technologies for rural development.

Rural Development Concept

The current concept of rural development, defined earlier as "assisting the rural poor, through the method of mass participation, to improve their levels of output and living on a self-sustaining basis", has been evolving slowly over the last twenty-five years. However, the rural development objective of improving the levels of output and living for the rural poor, has always existed to some degree in development plans. The objective of improving agricultural production and rural services (such as health, education, and housing) has been at the center of development

programs for rural areas. The capital development model of W. A. Lewis (22), which provided the economic development theory for many less developed nations during the 1950's and 1960's, included this objective. However, the rural poor did not achieve the objective.

Lewis' approach involved a capital accumulation model where rural labor and resources would move to the more productive modern sector of the economy so that productivity could be increased. By keeping wages low, a surplus was to be generated and reinvested in new capital which would contribute to economic growth and more jobs. In this manner, the modern sector would expand rapidly and absorb the rural poor who resided in the traditional sector of the rural areas. But high wages, poor reinvestment, the use of labor saving capital, and rapid population growth, prevented the benefits of rapid economic growth in the modern sector to trickle down to the poor. Because the Lewis model placed emphasis on industrialization, the rural poor remained poor as they had for centuries.

Likewise, the minimum package approach of the green revolution, as introduced earlier, ostensibly embraced the objective of improving agricultural production and rural services. However, in practice, the approach was limited mainly to the most progressive farmers who possessed adequate access to resources needed to make the green revolution viable. Once again, benefits did not trickle down to the rural poor as development theorists had hoped.

The community development approach of the 1950's, as mentioned earlier, stressed the method of mass participation by the rural poor in programs with objectives of increased agricultural productivity and improved

rural services. Community development was intended to develop more of a bottom up than a top down approach to solve rural problems. But little was known about the method of initiating mass participation in the rural areas. When participation was successful, the community development program was unable to develop permanent institutional change to make the development process self-sustaining. Either administrators of community development did not understand the development process, or the rural poor were not permitted a time horizon long enough to allow institutions to evolve to the point of predictable and permanent change. Disenchantment with results of the community development approach brought its demise (9, pp. 7, 11) and (41, p. 5).

In the 1970's, after more than a decade of relative neglect, rural development is once again receiving stronger emphasis in development policy. Robert S. McNamara, president of the World Bank, has pledged his organization to redirect its resources toward improving the productivity and welfare of the rural poor in the poorest countries (27). The United States Congress has directed the United States Agency for International Development to redirect its effort toward meeting the basic needs of the poorest people in the developing countries (48, p. 15).

This current concern is a reaction against the distortions produced by the production-oriented development efforts of the green revolution approach of the 1960's; which were, in turn, a reaction against the economic failures of the community development programs of the 1950's (41, p. 2).

The approach of the 1970's has been termed, rural development, and is

a major concern of this study. Within this approach, rural development has been defined as improving the levels of output and living of the rural poor through the method of mass participation and making the process of their development self-sustaining. The concept of rural development, as suggested earlier, can be broken into three dimensions. It is an objective, a method, and a process.

First, the objective dimension of rural development involves improving the levels of output and living. This improvement includes increasing per capita productivity, and rural employment opportunities which bring higher per capita incomes, enabling the rural poor to improve their levels of nutrition, shelter, education, and health (30, p. 22). Thus, production, physical infrastructures, and public services are all interrelated ingredients of the objective of rural development.

The issue of income distribution is fundamental to the rural development concept. Adler states the income distribution problem as follows:

> Figures (from 21 developing nations) over the last 20 years have shown that it is virtually impossible to mitigate the plight of the lower income groups by redistributive fiscal operations. . . . Moreover there is evidence which suggests that in the great majority of the developing countries the benefits of economic development accrue chiefly to the upper income groups. . . and that in some countries the poorest 20 percent or even a larger percentage do not participate in the process of economic advancement at all (2, p. 2).

Adler lists the causes of inequality in income as uneven distribution of technology, unemployment and underemployment, rapid population growth (where birth rates are higher among the lower income groups) and the educational level (2, p. 3). Next, he suggests that income distribution be improved through rural development. Directing a larger share of develop-

ment expenditures into rural areas, especially agriculture, for the purposes of introducing technologies and improving education can help increase the incomes of the rural poor to whom rural development is addressed. In this manner, the income distribution problem is attacked directly (2, p. 4).

Although emphasis is placed on improving agricultural productivity which provides the rural poor with higher incomes, basic public services such as health and education not only improve directly the levels of living for the rural poor, but they can also indirectly increase their productivity. If education is made relevant to rural areas, it can provide a minimum learning package of reading and arithmetic, through functional literacy, and knowledge and training about agricultural production activities. Health facilities and education about health, nutrition, sanitation, and child care enable the rural poor to develop to their full capacity both physically and mentally, thus making them potentially more productive as workers.

Improvement of the levels of living can be initiated in two ways. Better public services like health and education can be provided for the rural poor in government programs. If people accept them as merely free gifts, but do not make the changes to increase their productivity, these programs can be harmful because the rural poor will continue to expect public services without pursuing productive increases to support the public services. However, in many cases, public services can contribute effective means of inducing and stimulating the rural poor to increase their productivity. This increase in productivity leads to higher incomes

and the poor can then acquire the better health, education, and shelter they desire. The second approach is to attack the problem of productivity directly. Improved inputs and technology are basic components of this approach.

Secondly, the method dimension of rural development involves mass participation of the rural poor in the economic, social-cultural, and political affairs of their nation. Because development takes place through peoples' institutions, rural development should start by involving all the people in the development process if all the people are to benefit. One of the most profound lessons to be learned from past rural development is that the people expected to benefit from development, must themselves be involved in development. No amount of money spent on rural development, nor all the might of government, can do for the people what people can do for themselves (9, p. 19).

Mass participation enables the rural poor to identify their own needs, plan how to meet these needs, and carry out the implementation. The result is better information, better planning, and a much higher commitment and sense of responsibility to rural development. This leads to successful and effective rural development if it is coordinated at the national level. Participation in rural development allows the poor to have control over their lives, and thus, a problem solving climate, rather than a dependency climate is created. Capturing the characteristics of participatory activity, and using them for the benefit of rural development is perhaps the most difficult, yet the most promising and important new approach (55, p. 44).

Thirdly, the process dimension of rural development involves making the development of rural areas self-sustaining. This task is much more difficult than initiating rural development. The process of rural development includes change, in addition to growth. Growth is represented by quantifiable improvements in the levels of living of the rural poor. Change involves the development of institutions where attitudes and values slowly evolve from a traditionally oriented setting to one that depends on science and technology.

If the process of rural development is to be self-sustaining, the rural poor need to have access to new technologies, and present institutions require fundamental changes. Technologies, which meet the technical needs and physical, social, and economic requirements of the rural poor, need to be developed and tested in the local area. Institutions which allow the rural poor to acquire this technology and to participate on a continuous basis in the process of rural development, also need to be created.

Waterston (53, p. 23) stresses the concept that for rural development to be self-sustaining, it is essential that it include a self-supporting agriculture which can consistently provide surpluses for financing a reasonable proportion of its public services and infrastructure like feeder roads, irrigation, schoolhouses and clinics. Thus, a major emphasis on technologies and institutions for the rural poor must initially be related to agricultural development.

Role of Mass Participation in Rural Development

This section emphasizes the importance of the method dimension of mass participation by the rural poor in rural development. Mass participation of the rural poor refers to the active and willing participation of rural poor in the process of moving from low levels of output and living to high levels of output and living. Such participation requires that these people not only share in the distribution of the benefits of rural development, but that they also share in the task of creating these benefits. New opportunities must be made available, and people must be helped to develop their abilities so that they can take advantage of the new opportunities.

Past rural development programs have experienced two problems in generating mass participation. First, despite the fact that rural development states that the entire rural poor population share in the benefits and planning of rural development through mass participation, evidence to date shows that women have been left out of the production oriented development programs of most less developed nations, and the developed nations have reinforced the exclusion (55, p. 23).

More attention should be focused on ensuring access for women to information, modernizing inputs, and a voice in designing rural development programs in areas in which they normally do part of the work, or exercise a decision-making role. If mass participation is to be complete, methods for including women in rural development programs should be examined.

Second, past planning for development has usually been from the top

down to the rural poor. When top down planning by central government authorities is done in the capital city to the exclusion of planning at the local level by the rural poor, failure can result for many reasons.

First, if never asked about his ideas, the peasant often refuses to cooperate even when the plan is well designed. Second, misconceptions of the value of programs to the rural poor are frequent and technical requirements are often misunderstood. Third, bad memories of past development experiences cause the rural poor to be suspicious of the motives of top down development planners. Finally, good rural development plans that threaten special interest elite groups, seldom are implemented (26, p. 29).

The rural development concept is a response to this problem of top down planning "for" and not "with" the rural poor. A renewed emphasis is being placed on the human factor at the local level in planning and implementing development programs. Development must start with all the people, because it is through people and their institutions that development occurs. People are the principal components and beneficiaries of rural development. If benefits are to be achieved, the rural poor must be involved in decision making.

Just as a lack of emphasis on grass roots or bottom up planning can prevent successful rural development, planners must be careful not to overemphasize bottom up planning to the neglect of the importance of top down planning. A balance must be achieved between the two approaches. Detailed plans can be developed by mass participation of the rural poor and then moved up until they are aggregated at the appropriate level. Then, according to criteria understood by everyone, resources can be allocated.

The method of mass participation is very important in the development process. If successful rural development is to take place, the rural poor need to become more active producers for the market. But there are many constraints perceived by the rural poor which make them reluctant to produce more. Information from the rural poor is necessary because planners are seldom capable of understanding these constraints.

Thus, mass participation by the rural poor generates better information and facilitates better planning. This information is a valuable input, because it enables rural development to come from within the rural poor themselves. Before resources and new technologies can be used, it must be the will of the rural poor to adopt the necessary changes.

Furthermore, the method of mass participation results in higher commitments of resources and energy to the implementation of development programs. Development is not a gift, but the result of an effort of hard work. Not until the plan belongs to the rural poor, do they feel responsibility for its implementation, and are ready to participate on a level essential for success.

Hunter has given the following reason for involving all the rural poor:

> To neglect the simple power motive of the individual to do better for himself and his family is certainly to throw away the strongest dynamic of growth. It is also to throw away the flexibility, inventiveness, and opportunism of the individual (28, p. 110).

The method of mass participation is based on the proposition that the motivation of the rural poor to achieve the objective of rural development is greatest when they can: 1) identify their own needs with maximum reli-

ance on their own resources; 2) plan how to meet those needs; 3) have decision making power to call in the particular resources which they feel are appropriate to meeting their needs; 4) experience either success or failure of their own planning as well as of their physical efforts; 5) evaluate the causes of success or failure; and 6) feed-back the results of that self-evaluation into a new planning-acting cycle. When these conditions are met, the rural poor are operating in a problem solving climate, rather than a dependency climate (55, pp. 44, 45).

Two additional features of mass participation are important in analyzing its role in rural development. First, the rural poor have had little interest in improving their levels of output and of living because much of the increase is too often taken by traders or moneylenders. Effective mass participation through group organization can overcome this exploitation and give the rural poor power in a nonrevolutionary manner (7, p. 1).

Secondly, nations must be aware of the fact that promoting mass participation is a slow, uneven, and difficult task. Success in mass participation requires patient, continuous, day to day involvement at the local level (9, p. 21).

Owens and Shaw have analyzed historical evidence from the last twenty years of development experience in less developed nations. They conclude that: 1) development should involve a broader participation; 2) institutions should be established to facilitate such participation, because this enables the rural poor to participate in decisions, invest in their future, raise their incomes through higher production, and have a greater say in

the distribution of that production; and 3) emphasizing mass participation instead of investing in a small number of capital intensive projects benefits the economy, because it provides more jobs, maximizes the efficient use of resources, and accelerates rather than retards growth in less developed nations (36, pp. xvii, 3, 65).

Nations which do not encourage mass participation, but emphasize investing in a few capital intensive projects, do not give the rural poor an opportunity to improve their levels of living. Although some information about increasing production trickles down, there is no systematic effort to build up in local communities the knowledge base on an improved production system. Local initiative is not created and the poor who receive some physical signs of development such as schools or a road, are dependent on the central government to solve their problems for them when and if they so desire.

Table 2 reproduces portions of a table developed by Owens and Shaw to show the development characteristics of nations which stress mass participation in development as opposed to nations which do not stress mass participation. The nations of prewar Japan, Taiwan, Korea, Egypt, Yugoslavia, Israel, Puerto Rico, and the Comilla project in Bangladesh were analyzed to determine characteristics of nations that are considered relatively successful in generating mass participation. Characteristics of policies, attitudes, values, and trends by nations with respect to production, local government and organization, and education are summarized. They provide insights for nations which desire to involve all their children in development.

Table 2. Development characteristics of nations stressing mass participation compared with nations not stressing mass participation[a]

Development characteristics	Mass participation not stressed	Mass participation stressed
Production characteristics		
Government believes poor can pay cost of own improvement	no	yes
Efficiency generally equated with bigness and latest machines	yes	no
Subsidized capital which benefits mostly the rich	considerable	little
Geographical dispersion of industry	some	considerable
Tenancy and land reform	lip service lax enforcement	enforced
Support of small producers	little	much
Investment in local level infrastructure	inadequate	adequate
Systematic extension of the financial system to local levels	no	yes
Number of investors	few; increasing slowly	few initially; rising rapidly
Income distribution	inequality increasing	inequality decreasing
Underemployment and unemployment	rising	falling

[a]Source: Adopted from (36, pp. 12, 13).

Table 2 (Continued)

Development characteristics	Mass participation not stressed	Mass participation stressed
Local government and local organization		
Organized problem solving system	inadequate	adequate
Decision making authority	nominal	considerable
Financial resources	limited, essentially static	considerable and rising
Written records for both	rare, not increasing; rely on memory	considerable, and increasing; reliance on memory declining
Leadership positions	few; not increasing	many; number increasing
Planned effort to induce transfer of loyalty from traditional to new institutions	no	yes
Education		
Rely on formal educational system	yes	yes
Willingness to introduce variety of nonformal education programs	little	much

Urgency and Rationale for Rural Development

The rationale for emphasizing rural development aimed at the rural poor has been strengthened over the last decades. The rationale is based on the following three factors. First, the desire of the rural poor to improve their current levels of output and living is increasing. Second, the rural nonpoor and urban dwellers also benefit from rural development. Finally, the rural poor small scale farmer is an efficient producer and contributes to the development of the nation.

The first set of arguments relates to the existing situation of the rural poor themselves. Because of better communications and transportation, they are aware of the modern urban world. This awareness brings rising expectations of improved levels of living. For the reason that they want to develop, a broad based rural development should be near the top of the agenda in the development policy of a nation concerned about all its citizens.

The existing situation of the rural poor when compared to the objective, method, and process dimensions of rural development, indicates the need for emphasizing programs to improve the levels of living of the rural poor. With respect to the rural development objective of improving the levels of living of the poor, sources show that the existing situation is stagnant, and in many cases declining.

Ensminger in his paper states:

> There is today 25 years of experience with the economic development approach relying on the trickle down theory. It clearly documents that those at the bottom not only don't benefit, their plight worsens since they are not involved as participants in development. . . . Little has

> changed in the rural areas of the developing countries. Few are they among the millions of small farmers that think of how they might maximize production to have additional money to bring the things they want. They produce to meet family minimum and survival needs, and look to their government to provide the community institutions and services (9, pp. 7, 10).

Ruttan also supports the promise that the rural poor have not benefited from development:

> The shifts in development thought (since World War II) have, however, had relatively little impact on the life of most rural people. . . . There is growing evidence that large elements of the rural population have not shared at all in the impressive gains in agricultural and industrial production that have been achieved in many developing countries over the last several decades. In some areas the welfare of substantial elements of the rural population, particularly the landless, has declined both relatively and absolutely (41, p. 2).

Because the rural poor are not involved in improving their productivity, and because they are not receiving benefits from the economic gains by other sectors of the nation, they are unable to improve their levels of living in health, education, and housing. Their expectations of higher levels of output and living are not being fulfilled.

Regarding the rural development method of mass participation, few less developed nations provide the opportunity for the rural poor to take an active role in improving their levels of living. Instead of becoming involved in rural development, the rural poor remain essentially self-contained within their traditional and static way of life. Owens and Shaw list the following nations of Taiwan, Israel, Puerto Rico, Yugoslavia, Korea, Egypt, and one program in Bangladesh, as those which have attempted to involve mass participation by their people (36, p. 3). Information coming out of China and Tanzania indicates that they may also be

added to the list of less developed nations which stress participation of all its people in developing rural areas (9, p. 18).

The process of self-sustained rural development is the most difficult dimension to achieve. Moving from a traditionally oriented society, to one that depends on science and technology, and to make this transition self-sustaining, is a complex process. Less developed nations which have not succeeded in improving the levels of living for their rural poor cannot, by definition, be involved in the process of self-sustained rural development. The improvements in nations that have been made, such as in health, education or production, have not necessarily led to continued growth. Often they have been a one-shot improvement.

A second line of arguments, expressing the urgency for helping the rural poor, concerns the nonrural poor population in the nation who benefit from the rural development of the rural poor. In the rural areas, the inhabitants who have resources, especially fertile land and adequate water, and access to technology are making great advances. The rural poor can see for themselves that they need not continue to be poor forever. Rising expectations that are not fulfilled can breed discontent and revolution affecting all people living in the rural areas.

In addition, the nonpoor rural population engaged in small-scale industry also benefit from development of the rural poor. As productivity rises and the increased output is sold, effective demand for nonagricultural and agricultural goods and services result.

The urban population also benefits from rural development. Increased food output is a direct benefit. However, there are other benefits. The

limited capacity of the urban sector to expand employment opportunities, combined with overall high rates of population growth, give many rural poor no choice but to remain in the rural area and to be dependent on agriculture (36, p. 54). Yet, despite the lack of urban employment opportunities, the rural poor go to the city. Rapid rural-urban migration is the result of the combination of urban pull and rural push. Urban pull is the attraction of additional public services, glamour of the cities, and the attraction of higher wages although there is lack of jobs. Rural push is the desire to escape from the stagnation of rural life and an atmosphere of despair and defeat. The city is the universal magnet, while rural life is losing its vitality.

Governments which succeed in achieving urban industrial development but do little for improving the levels of output and living for rural areas contribute to the rural-urban migration problem. Successful industrial development in the cities often destroys the economic structure in the rural areas by producing products of lower cost which are more competitive than the same products produced by traditional means in rural areas. Unemployment results and the rural poor take their revenge by migrating to the cities. Although many do not find employment, they still require the basic necessities of food, clothing, and shelter. They become a problem for the urban dwellers and government who must support them. The rural areas need to be developed to prevent the rural poor from migrating to urban areas before jobs are created. Rural development can contribute to the solution of rapid unemployment growth in urban areas.

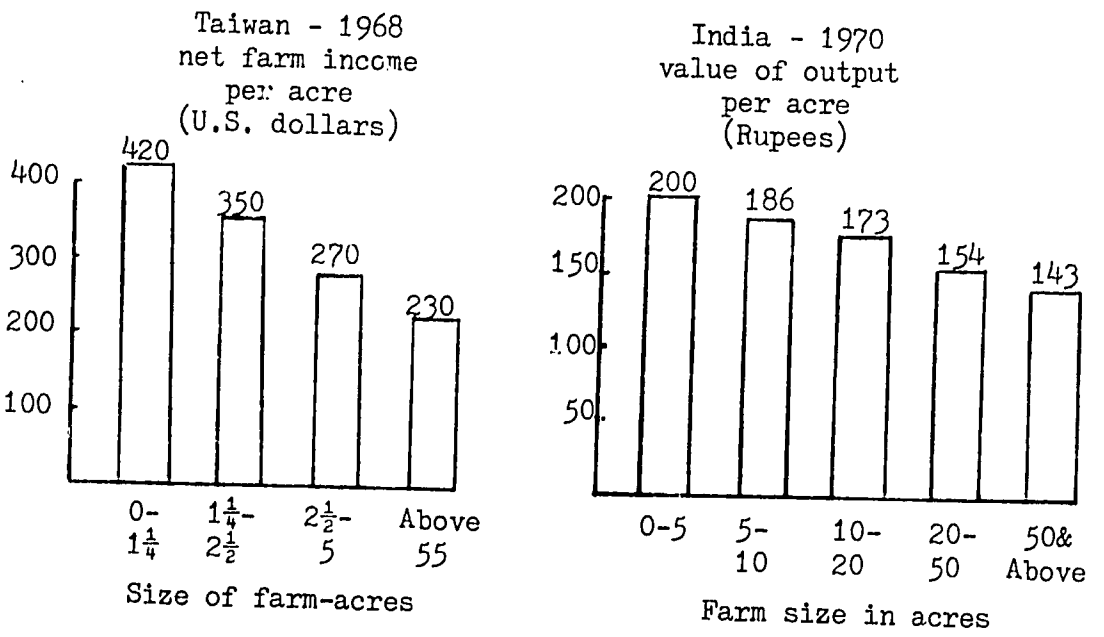
The third factor for emphasizing rural development is based on two

recent studies which present strong arguments for concentrating on the rural poor in rural development programs. Owens and Shaw state:

> From the history of recently successful countries (in development) and the little research that has been done to this point, it now appears that the savings rate of lower income groups can be very high - if they own their own economic facilities and if governments create a nation-wide network of financial institutions and economic incentives. . . . That small farmers can save and build up capital has been demonstrated in Japan, Taiwan, and Korea and by successful regional or local cooperatives in other countries. In Taiwan, for example, the farmer cooperatives by 1968 were financing 4/5 of individual loans from their own resources (36, pp. xviii, 93).

Because increasing investment and savings ratios by the rural poor are essential to capital formation and attainment of higher growth rates, the enormous number of the rural poor should be tapped as a source of saving.

Table 3. Small farm efficiency[a]



[a]Source: (36, p. 60).

Table 4. Labor-intensive, small-scale agricultural efficiency[a]

Country	Agricultural workers per 100 acres - 1965	Yield per acre for foodgrains (pounds per acre) 1948-50	1968-70	increase
Japan	87	2920	4585	1665
Taiwan	79	1800	3510	1710
Korea	79	1640	2850	1210
Egypt	71	2120	3370	1250
Yugoslavia	29	1145	2185	1040
United States	<2	1495	2895	1400
India	36	640	945	305
Phillipines	29	930	1145	215
Columbia	20	915	1480	565
Brazil	17	1170	1225	55
Mexico	12	700	1265	565

[a]Source: Adopted from (36, pp. 58, 73).

Tables 3 and 4 indicate that small-farm labor-intensive agriculture can be more efficient in terms of yield per acre than larger farm agriculture. Taiwan and India experienced higher output yields on smaller sized farms as shown in Table 3. Table 4 compares the yields per acre for foodgrains of countries with varying numbers of agricultural workers per acre.

Based on Tables 3 and 4, Owens and Shaw conclude that low agricultural output in many less developed nations is not the result of too many people on the land, but it is the result of the failure to organize the small-farm labor-intensive agriculture which has been successful in less developed nations such as Taiwan, Korea, and Egypt. The technologies used are primarily chemical and biological. The machines and tools used complement human labor rather than displace it. When these methods and

suitable institutions for organizing small farmers exist, the rural poor can be provided with higher levels of output and living, and not forced to the city for employment (36, p. 58).

The Working Group on the Rural Poor of the United States Agency for International Development has summarized the evidence on the economics of small producers (55, p. 4). The following premises represent current thinking of the Agency for International Development. If the small rural farmer has access to production inputs, technology, credit, and markets: 1) output per acre will be higher on small farms than on large farms; 2) production will be increased at the lowest cost; 3) the largest possible number of jobs will be created as small-farm labor-intensive agriculture creates more employment than any other economic activity; and 4) income distribution should be improved since large numbers of the poor will be increasing their incomes.

The above four premises indicate that the small rural farmer can be efficient, and development programs directed toward the rural poor can increase employment opportunities and raise incomes of the poor. These results meet the goals of development expressed by Mahbub ul Haq of more production, better distribution, and increased employment which improve the levels of nutrition, education, health, and housing standards (47, p. 66).

The rationale that has been developing recently for helping the rural poor, can be summarized as follows: 1) the rural poor want to improve their levels of output and living; 2) if they are not helped, decaying rural areas will cause many problems for urban dwellers and governments;

and 3) they are efficient producers with the ability to contribute to national development by generating their own savings and investments if given the opportunity.

Role of Technology in Rural Development

This study examines the role of technology in fulfilling the three dimensions of rural development. As the rural poor seek to improve their levels of output and living there is associated a need for new or improved inputs, if output is to be increased. Schultz (42, pp. 37, 47) has stated that traditional societies use their resources efficiently. Therefore, existing physical resources by themselves, cannot provide increases in output. However, development of new technologies is feasible and must provide the means for increasing per capita and per hectare output, which, in turn, supports a continuous process of improved levels of living for the rural poor.

Technology in this study refers to technical inputs other than raw materials and labor which go into each economic activity, for example, equipment and tools. Technology also includes the particular process in which the various resources of land, capital, and labor are combined (18, p. 3).

The emphasis in this study applies to the analysis of technologies which best serve the method of mass participation by the rural poor, and which promote the process of self-sustaining rural development. Although agricultural output has central importance, other technologies for rural areas, which include public services, infrastructure, and basic small-

scale consumer good industries, such as clothing and shelter, are all analyzed.

Improving technology is a precondition for a continuing self-generating basis for rural development. Labor productivity must increase if the earning capacity of the rural poor is to rise. The application of capital to labor makes the worker more productive. Recent studies have shown a close correlation between capital intensity and labor productivity. This does not ignore the fact that productivity can also be improved by a new technical process, education, higher skills or better management. However, if the levels of output and living of the rural poor are to be improved, substantial injections of new technologies, especially capital, are required (24, p. 482).

Ruttan has expressed the important role of technology in rural development in the following way:

> During the early stages of economic development the capacity of rural areas to successfully respond to the opportunities for growth that are potentially available to them depends critically on the achievement of rapid technical change leading to productivity growth in agriculture. Significant growth in agricultural productivity can rarely be realized by the reallocation of resources within traditional agricultural systems. The capacity to respond to growth opportunities becomes available primarily through technical changes embodied in new and more efficient inputs - better crop varieties, cheaper plant nutrients, and more efficient sources of power - capable of releasing the constraints on growth of agricultural output (41, p. 15).

Mellor has also expressed the need for technology in the development of agriculture if rural development is to occur:

> There are two aspects of the agricultural sector which give a key role to science and technology. First, in low income countries a program for broad participation of the poor in

> growth requires rapid expansion of food supplies. As the poor obtain employment and receive higher income they spend a high proportion of that added income on foodgrains and other agricultural commodities. . . . Second, under traditional technologies agriculture is subject to rapidly diminishing returns and rising costs. . . . In this context technological advance breaks the bottlenecks of diminishing returns. . . . It is the interaction of diminishing returns and rising demand that give a key role to science and technology for agriculture (29, pp. 3, 4).

In addition, Mellor provides insight into the characteristics of agriculture and small-scale industry, and their relevance to the need for emphasizing a change in past technology strategy:

> Agriculture may be a source of important development lessons because of the well documented history of first, inattention and then misdirected attention to science and technology. . . . Despite the frequently erroneous definition of the (agricultural technology) problems, there is now developing a substantial international research system tuned to the needs of agriculture in low income countries. . . . Agriculture has three key characteristics which substantially influence the nature of an optimal science and technology system. First, agriculture is comprised of a myriad of small-scale units. . . . Second, agriculture is highly varied in the conditions under which production occurs. . . . Third, because of its size, its initial dominance as an employer and its potentials for intensification through technological change, agriculture itself must provide a major portion of future increases in low income countries. . . . The small-scale industries sector is the part of the industrial sector most obviously analogous to agriculture. It is comprised of large numbers of small scale units, often geographically dispersed, operating under diverse physical conditions and serving complex markets. . . . The small scale sector typically produces commodities which lend themselves to labor intensive production which, in turn, fosters a highly labor intensive approach within the given structure of production. . . . Labor intensive small scale industries pose substantial problems likely to require indigenous science and technology input (29, pp. 4-7).

Thus, there is a need to develop technologies to increase output, and to design them to meet the unique characteristics of small scale agriculture and industry.

Technologies can also increase employment opportunities for the rural poor in rural areas, in addition to increasing per capita productivity. A study by the Development Center of the Organization for Economic Cooperation and Development (58) discusses the affect of agricultural technology in increasing the incomes and employment of the households directly involved in agricultural production. The study reflects the concern being given to families that must remain dependent on agriculture because of the rapid rates of increase in the labor force and the limited opportunities for remunerative employment outside of agriculture (58, p. 161).

The study cautions the reader that sample surveys were small and that regional differences should be taken into account when evaluating the results. With these cautions in mind, the study summarized three types of agricultural technological change as follows:

> The surveys indicated that land-augmenting technolgical changes (high-yielding varieties of seeds, inorganic fertilizers, chemical weed and pest controls, and irrigation) increased labor requirements by around 30 percent. . . . Increased yields require more labor at harvest and threshing seasons and new cultural practices require more labor for land preparation, fertilization and water control. . . . Large scale mechanization tended to reduce labor requirements between 17 percent and 27 percent depending on the case examined. . . . Selective mechanization used only during the peak of seasonal labor demand, which is short of complete mechanization, would add to output without unduly displacing farm labor (58, pp. 70, 163).

As technologies increase the agricultural output and employment of the rural poor, effective demand for nonagricultural outputs rises, which further improves their levels of living. Technologies can also be used effectively to increase the output in these nonagricultural product areas.

Currently, there are two basic categories of technology available to the rural poor: 1) traditional; and 2) modern (18, p. 4). Traditional

technologies are defined as those that have existed in less developed countries prior to modernization and contact with the outside world. They involve simple techniques which have low capital input and high labor requirements. The rural poor who use these technologies are unable to produce the kind of surplus that might lead to greater specialization of labor and to rapid growth in capital stock.

At the other end of the spectrum are the modern technologies of the most developed nations. These technologies are characterized by a conscious attempt to maximize output per unit of input within the cost structure. The results are highly capital-intensive and distinctly labor saving technologies, because capital is relatively cheap and labor relatively expensive.

Modern technologies are not appropriate for many goods and services of the rural poor, given their resource base. They are designed for the needs of rich countries. Yet, less developed countries have often emphasized a strategy of using large scale industries and modern technologies borrowed from rich industrial nations. Modern technology which has a high productivity per worker, was supposed to generate high rates of saving needed to maximize aggregate economic growth. The results of the crash modernization strategy emphasizing modern technologies have been disappointing. The benefits have gone to few citizens, employment creation has been low, rapid migration to the modern sectors has brought rapid expansion to urban areas, and the rural poor have not been able to participate in development simply for the reason that the technological costs were extremely high.

The technological problem of rural development analyzed in this study has been the lack of attention given to technologies appropriate for the rural poor. The question of technological choice is very close to the every day life of the rural inhabitants. It is central to their very hope for development. If the levels of living are to be improved significantly for the rural poor, a change in technology strategy is required to spread capital over a larger number of rural poor. This implies that the question of technology and production is not solved. Much research and work are still needed, especially for small-scale industries. In the case of agriculture, land-augmenting technologies appropriate for the rural poor are potentially available, but either have not been locally adapted and tested or institutions for adopting the technologies are absent.

The rural poor need to be involved in the research because there is a dual relationship of dependency between mass participation and technology. First, the identification of technologies appropriate for the rural poor is dependent on mass participation. It is through mass participation of the rural poor that demands for goods and services that improve the levels of output and living are expressed. Rather than listen to the request of rural leaders who present their biased needs, all the rural poor should be participating in decisions that have an impact on their future. When they identify their own needs in a manner that includes their willingness to work at achieving these needs, the economist can be relatively assured that the demand was honestly expressed. The dual relationship of mass participation and technology is the dependency of mass participation on technologies that are appropriate for the rural

poor. If the technologies are not accessible financially to the poor, or do not adapt to the local conditions, they are seldom adopted.

To summarize, there is a need for developing technologies for and with the rural poor which will help fill the gap between traditional and modern technologies. Technology is a critical input if the levels of output of the rural poor are to be raised. Technology, if it is appropriate, can stimulate mass participation through local initiative and encourage a certain degree of self-reliance for making the process of rural development self-sustaining.

Interrelationships between Technology and Physical, Economic, and Institutional Factors in Rural Development

In the process of identifying, developing, and adopting technologies for rural development the expertise and information existing in many disciplines are required. The essence of interdisciplinary research does not result from the contributions of separate disciplines acting alone, although their contributions are important. The essence of interdisciplinary research aimed at identification, development, and adoption of technologies involves cooperative efforts among several disciplines.

Figure 2 illustrates the interrelationships involved in this study between the disciplines for carrying out research in the subject area of technologies for the rural poor in rural development. This simplified conceptual illustration suggests some of the important linkages between the physical, economic, and institutional factors relating to technology.

In Figure 2 the physical factors include the natural resources, bio-

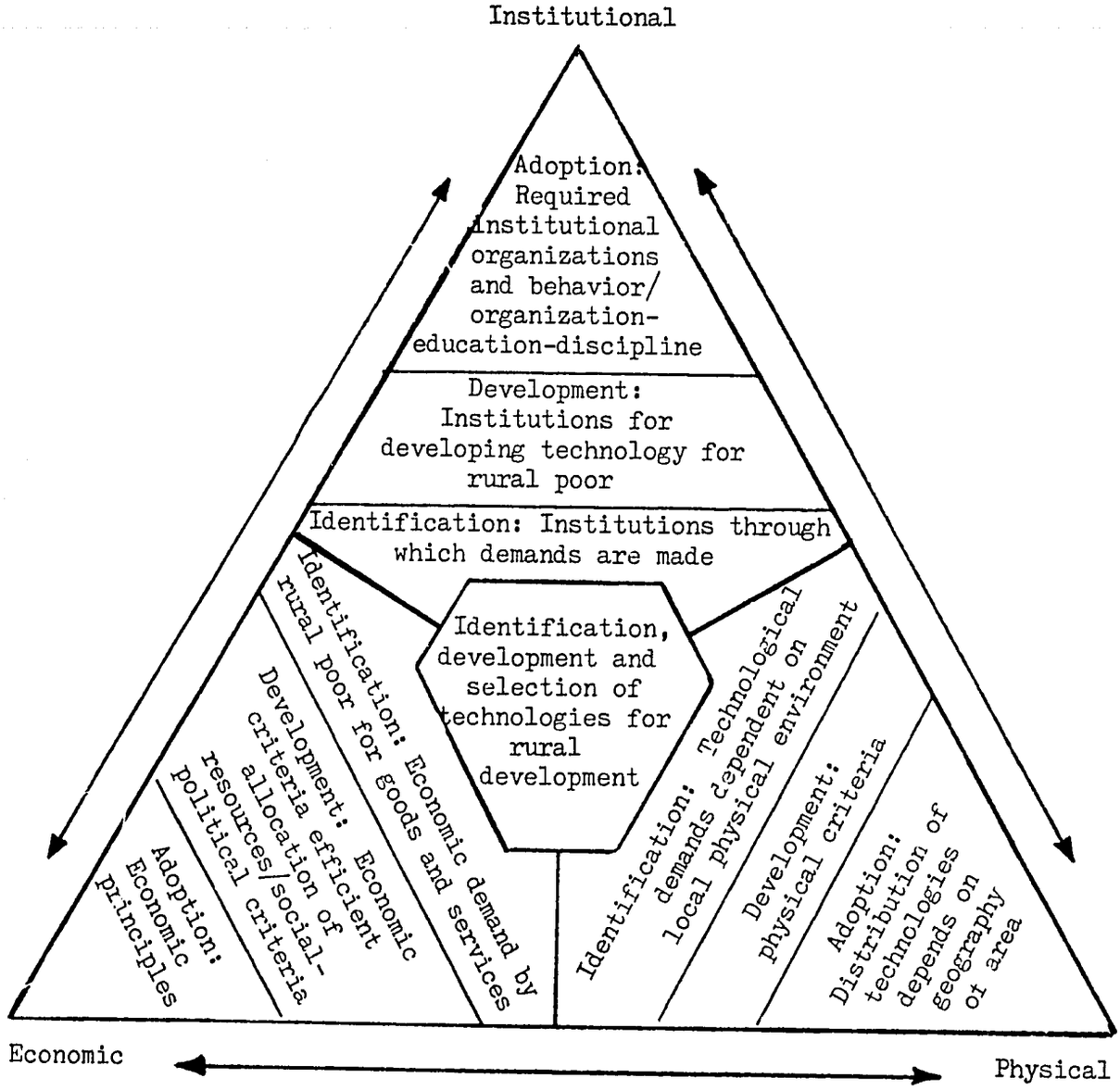


Figure 2. Conceptual illustration of physical, economic, and institutional relationships in the identification, development, and adoption of technologies for rural development.

logical and chemical, and engineering disciplines. The economic factors include supply and demand, prices, efficient allocation of resources, and social-political factors related to rural economic development.

Institutions enable the physical and economic disciplines to interact in the process of creating technologies for rural development. Institutions can be defined as a patterned way of life through which collective action controls, liberates, and expands individual action (45, p. 1131). In simplified terms, this study views institutions as comprising two elements. The first is the social organization which reflects the institutions. Through these organizations, people group themselves together to fulfill human needs and solve basic problems of human life, which individuals on their own could not achieve. Skills and techniques which are normal ways of doing things are learned in these organizations and are easily seen and observed. The second element is the behavioral or cultural aspect. The norms of institutions determine the values, attitudes, and prescribed patterns of behavior expected of its members.

The definition of institutions used in this study becomes clearer when several functions of institutions are listed. Institutions: 1) have as an objective the creation of a problem solving nature to meet the basic needs of society; 2) are an instrument of collective action and commitment to a common cause; 3) set up skill and technical procedures expected of society to meet these needs; 4) transmit values and attitudes to individuals by specifying well defined sanctions and punishments; 5) regulate recurring situations, thus making action predictable and giving permanence; 6) integrate action and behavior; and 7) pertain to

a group of people in a specific area.

Merely increasing the number of institutions which are similar to traditional institutions does not necessarily help the rural poor increase their use of technologies. Rural development implies more than growth of the number of institutions which are merely changes in scale. In addition, rural development requires behavioral change. The different institutions for identifying, developing, and adopting technologies need to be transformed in their mode of behavior (8, p. 9).

Viewed in similar terms, rural development is much more than the concept of encouraging the use of technologies within a given or expanded social structure. Instead, existing and new institutions need to restructure society, so that the rural poor can actively participate in improving their levels of output and living by adopting technologies. Change in behavior is required for successful rural development. Institutions need an open process of creative learning whereby new behavioral changes become those of the individual, and the values and procedures for generating and sustaining change become part of the problem solving process of rural development.

The development of permanent changes in the structural and behavioral elements of institutions, needs an extended time period. Thus, creating institutions appropriate for identifying, developing, and adopting technologies for mass participation in rural development often require the minimum of a decade before: 1) both the members of the organization and the persons with whom they interact accept technology for rural development fully; and 2) rural development's new values and actions relating

to technology become predictable. The process of institutional change is not a quick solution to providing technologies for rural development, but rather a part of a strategy of creating a capacity of the rural poor for identifying and solving technological problems in rural development as they emerge. Rural development is an evolutionary process which requires much patience (49, p. 99).

Ensminger has summarized the evolutionary aspect of transforming traditional rural cultures. He states that:

> It takes time and the process is extremely complicated. Small gains and consistent progress through involvement of the people with modest amounts of money available over time as needed will produce lasting results (9, pp. 20, 21).

Rural development is carried out in a complex social, cultural, economic, political, and historical framework. Because of this complexity, broad-scale technological changes which benefit the rural poor need to be induced in a gradual evolutionary process that begins with a few functions. New technologies can be added later as the organizations acquire the capacity to handle them. Forcing the pace of rural development might become counter-productive (55, p. 43).

The technological change process is inherently disruptive. But step by step change, dependent on the willingness and ability of the rural poor to manage it, minimizes the disruption. A critical issue of technological use for rural development becomes how quickly, and, what amount of institutional change the rural poor can absorb, if given the opportunity. Foster has stated that "with perceived opportunity and supportive conditions that make the realization of success a reasonable hope, social, cultural,

and psychological barriers can weaken or dissolve in remarkably short order" (10, p. 148).

Given the institutional background, the relationship of physical, economic, and institutional factors shown in Figure 2 can be analyzed. The physical, economic, and institutional factors are interrelated in the identification, development, and adoption of technologies in the following way. Identification of technologies for rural development requires institutions through which the rural poor can express their demand for goods and services that are appropriate for their physical environment. The economic question of what to produce is closely associated with the identification of technologies. The rural poor need to decide what goods and services will most fully satisfy their wants. Institutions, whether it be the market system of demand and supply, or some other means through which the rural poor can voice their demands, are also interrelated with the identification of technologies.

The development of technologies for rural development requires both institutional organization and attitudes that facilitate research for technologies. This study analyzes physical, economic, and social-political conditions of rural areas.

Adoption of technologies for rural development is dependent on the institutions. Economic behavior of institutions which facilitates the adoption of technologies is emphasized in this study. The location of institutions for adopting technologies depends on the geographical conditions and spatial organization of the rural poor.

In summary, the identification, development, and adoption of technol-

ogies that meet the objective, method, and process dimensions of rural development are complex issues. Many disciplines are essential to understanding the problems and providing solutions. For this reason, the study embraces interdisciplinary aspects of technologies as introduced in Figure 2.

CHAPTER III. THE DELIMITING PHASE RELATED TO THE RDP/LWF-WS IN PERU

Chapter three which is divided into three sections, develops the delimiting phase and provides background information on the geographic area of study. Section one discusses reasons for selecting the case study area. Next, section two provides the geographical and social-cultural-political setting of the case study area. Section three develops the problematic gap. The existing situation of the people in the case study area is presented and then compared to the stated goal of the case study area.

Reasons for Selecting the Case Study Area

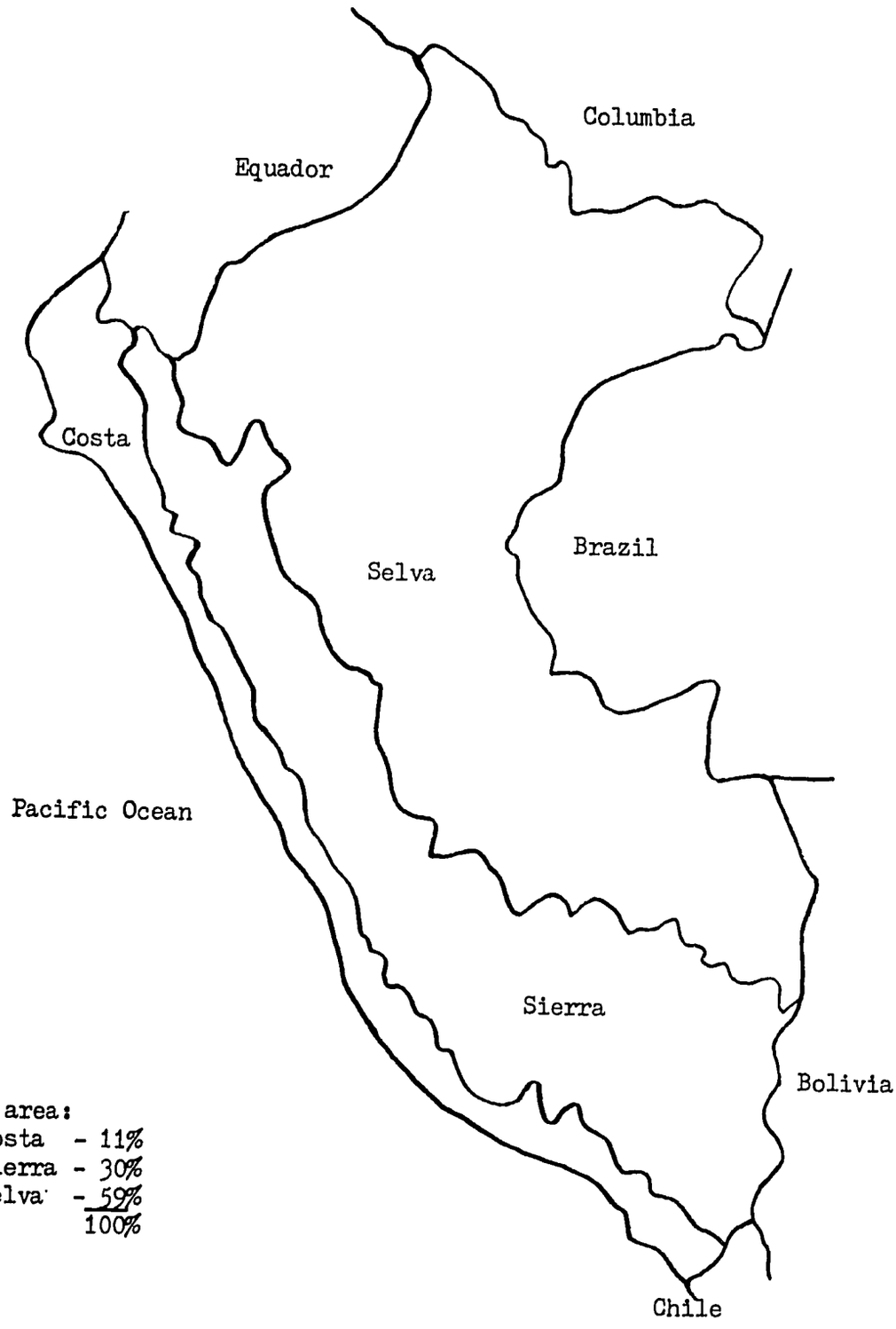
The case study area was selected according to the following two criteria. First, the area must be inhabitated by the rural poor. Secondly, the rural poor must be actively involved in pursuing a program of rural development.

Table 5. Index of per capita gross domestic income in Peru, 1970[a,b]

Population	Costa region	Sierra region	Selva region	Peru
		(Index numbers)		
Urban	365	105	110	170
Rural	98	22	25	40
Total	189	52	57	100

[a]Source: (32, p. 112).

[b]National annual per capita income in 1970 = $450.



Map 1. Regions of Peru

Table 6. Index of projected per capita gross domestic income in Peru, 1980[a,b]

Population	Costa region	Sierra region	Selva region	Peru
		(Index numbers)		
Urban	440	102	116	190
Rural	130	19	25	35
Total	234	46	58	100

[a]Source: (32, p. 112a).

[b]Projected national annual per capita income in 1980 = $545.

In Peru, there are two regions where the annual per capita income for the region is less than one-third of the national annual per capita income. Tables 5 and 6 show that they are the rural Sierra and rural Selva regions. Map 1 shows the location of the Costa, Sierra, and Selva regions in Peru.

Table 5 indicates that the average per capita income for the rural Peruvian Sierra population in 1970 was 22/100 of the national average annual per capita income. Projections for 1980, found in Table 6, show that their average annual per capita incomes will be only 19/100 of the national average annual per capita income. These data clearly show that the rural Peruvian Sierra population falls within the definition of rural poor used in this study. Based on Tables 5 and 6, the average annual per capita income of the rural Peruvian Sierra population in 1970 was $99 and will be $103 in 1980.

In 1980, 24 percent of the Peruvian population, or approximately 4,500,000 will be classified as rural Peruvian Sierra dwellers (32, p. 112). Most of the Peruvian Sierra rural poor live in either cooperatives or indigenous communities. The cooperatives were formed after the agrarian reform in Peru expropriated large land holdings in the Sierra and turned them over to the workers in the form of a communal operation. This form of organization is the "sociedades agrícolas de interés social", hereafter referred to as SAIS. The government of Peru is giving much emphasis to these cooperative organizations (32, p. 135).

In the Peruvian Sierra, there exist approximately 45,000 indigenous communities of which 1,800 are recognized and protected by special legislation (46, p. 12). These indigenous communities are a special entity in Peru, having legal status outside the administrative system which applies to the remaining population of Peru (33, p. xii). An objective of the Peruvian government is to encourage these communities to join a SAIS or to form their own associations (31, p. 18). However, these communities have been independent for centuries, and there is often little desire to join a SAIS. The case study in this report analyzes the problems of identifying, developing, and adopting technologies that are appropriate for the rural poor living in indigenous communities. These technologies would permit the indigenous communities to experience rural development without joining a SAIS.

The second criteria for selecting an area stated that the indigenous communities must be involved in rural development. A small international organization operating out of Geneva, Switzerland, is involved in a rural

development project in and near the province of Huari located in the department of Ancash in Peru. The organization is the World Service Department of Lutheran World Federation. Its objective is to help areas recover from natural disasters such as drought, floods, or earthquakes. Following the recovery, the purpose of the World Service Department of the Lutheran World Federation is to initiate a program to help the area develop in economic and social terms. Religious and political ideologies are not a part of the program.

The province of Huari was partially damaged by the May 1970, earthquake. Although the initial work of the World Service Development branch of Lutheran World Federation was to provide immediate relief for the earthquake victims, the program soon became a project of rural development, through which the rural poor had an active role. Although this study applies to the rural development program of the World Service Development department of Lutheran World Federation currently being undertaken in twenty communities and one government cooperative in and near the province of Huari, it is intended to provide insights and suggestions into programs that might apply to other communities in the rural Sierra of Peru. Thus, when reading the diagnostic and remedial phases the reader might look for analysis that applies to conditions elsewhere in the Peruvian Sierra.

The rural development program of Lutheran World Federation - World Service Department in the twenty communities and government cooperative in and near the province of Huari (henceforth referred to as the RDP/LWF-WS area in Peru) was chosen because of the four year experience of the organization in involving mass participation of the rural poor. Officials

of Lutheran World Federation spend from six to eight months of the year traveling from community to community, and know the people in the area well. Failure and success elements gathered from the RDP/LWF-WS area in Peru for the diagnostic phase of this study, provide numerous insights on which the remedial phase is based. The willingness of officials to share this information on successes and failures made the RDP/LWF-WS in Peru a good area to study. Because Lutheran World Federation officials, which included native Peruvians, were working as outsiders to the community, they could be analogous to outside Peruvian government officials working with the communities.

In choosing the RDP/LWF-WS area in Peru, a decision was made between having access to good data on the existing situation regarding levels of output and living in the communities or good data on a rural development program in which the rural poor were involved. Because the emphasis in this study is on the diagnostic and remedial phase of identifying, developing, and adopting technologies appropriate for the rural poor, the RDP/LWF-WS area in Peru was chosen. Thus, data on the existing situations are inadequate and good data collection is required in the future.

RDP/LWF-WS Setting in Peru

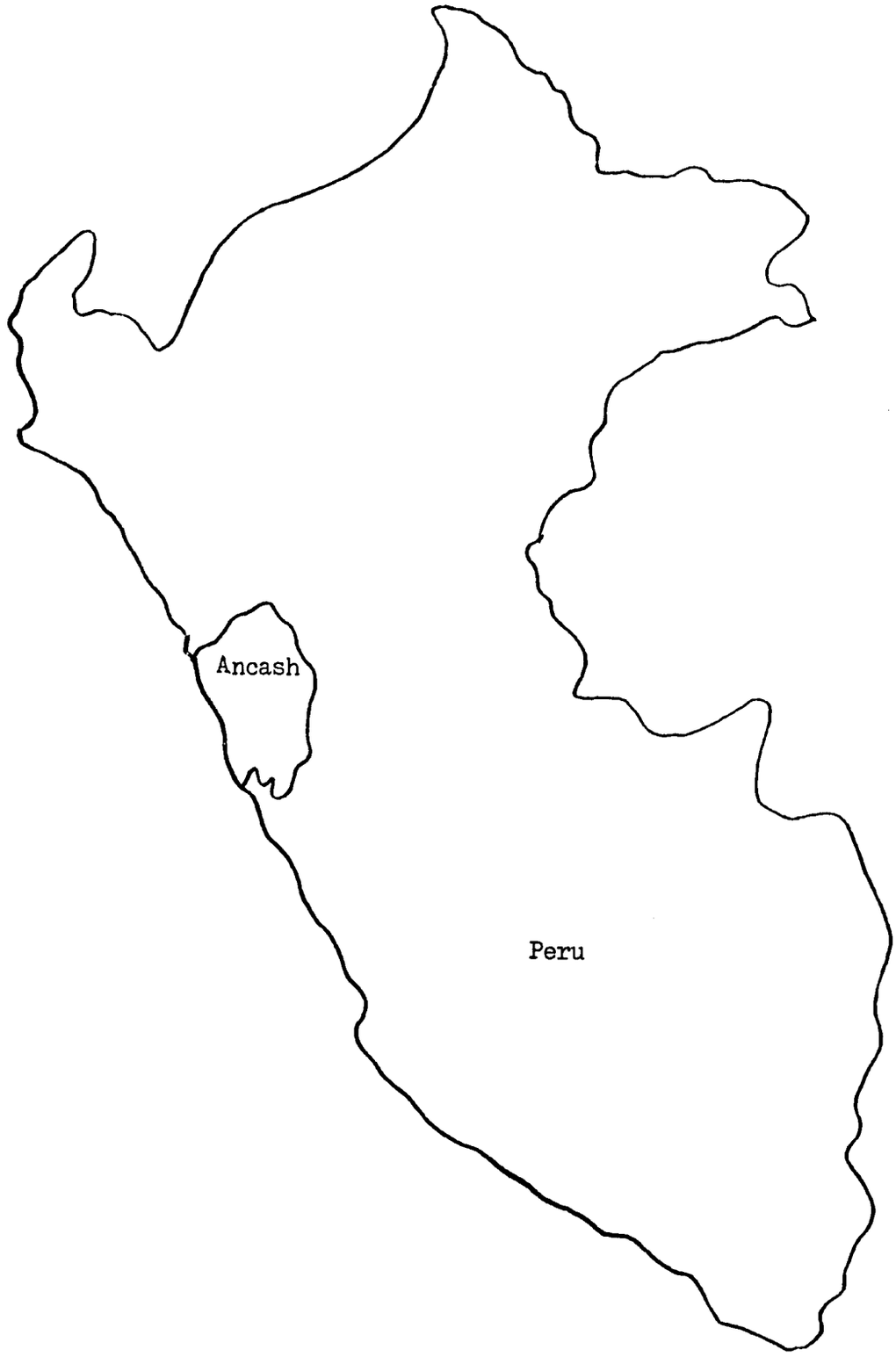
The geographical location of the twenty communities and one government cooperative analyzed in this study are presented in Maps 2, 3, and 4. The government cooperative and 17 communities are located in the province of Huari. The other three communities are in the province of Antonio Raimondi, and lie near the border of the province of Huari. Thus, the

map of the province of Huari is used to show the RDP/LWF-WS area in Peru.

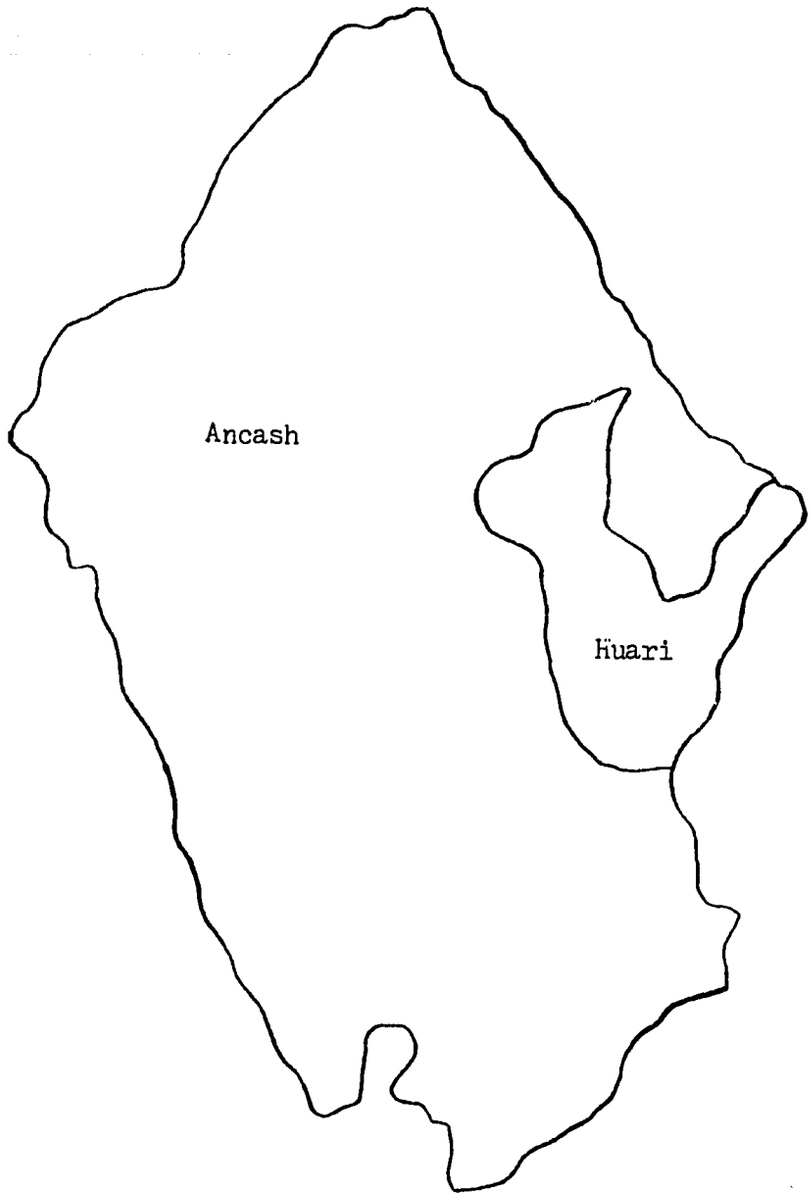
Map 2 shows the location of the department of Ancash in which the province of Huari is found. Map 3 shows the location of the province of Huari within the department of Ancash. Map 4 shows the location of the twenty communities and government cooperative in the RDP/LWF-WS area.

This study divides the twenty communities and government cooperative in the RDP/LWF-WS area into four geographical regions. The first region is centered around the community of Huari, which has 3500 inhabitants and lies at an altitude of 3200 meters. It is 500 kilometers from Lima and the trip takes about 14 hours over difficult roads. Huari is the capital of the province of Huari. It also has the only hospital in the area and is the only city with electricity. Huari is used as the headquarters for the RDP/LWF-WS officials while they are in the project area. Because a road leading to Pomabamba, a large city in the north, will soon be completed, the town has a good location and is likely to become industrialized in the future. Huari is certainly the most progressive community in the province and none of the other communities approaches Huari's levels of living.

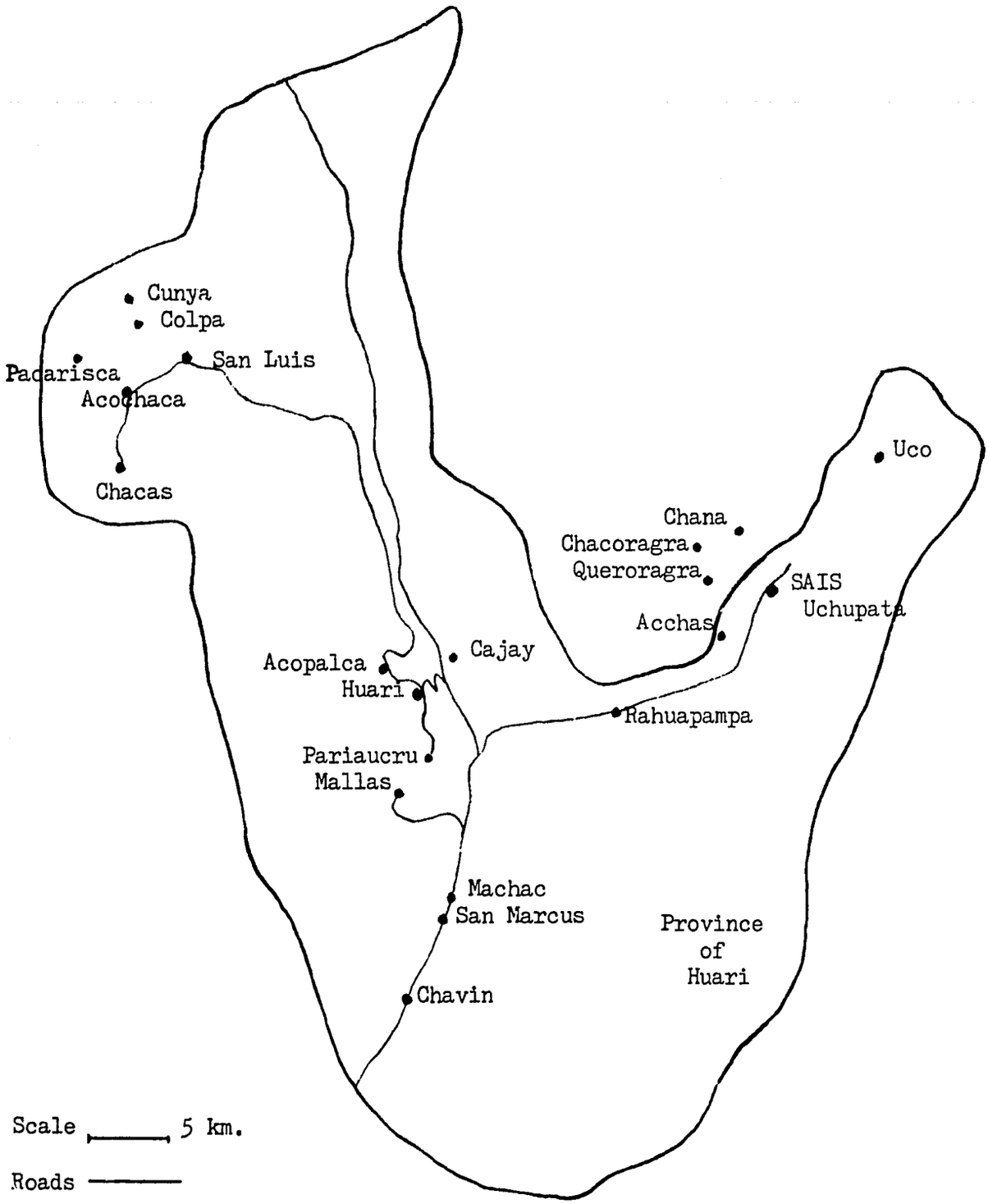
Five of the twenty communities studied are located near the community of Huari. They are Rahuapampa, Acopalca, Cajay, Pariaucru, and Mallas. All of the communities have access to roads. In Rahuapampa, 1100 children come from neighboring communities to study in this community of 800 inhabitants. Acopalca is a small community of 400 inhabitants located 3 kilometers from Huari, and is well-known because its members never wash since they believe that infectious illnesses live in water.



Map 2. Department of Ancash in Peru



Map 3. Province of Huari in the Department of Ancash



Map 4. RDP/LWF-WS area in Peru

Cajay, with 500 inhabitants, lies at the same altitude as Huari and can easily be seen from Huari. However, a deeply cut valley lies between them. Pariaucru, surrounded by eucalyptus trees, has 600 inhabitants and is located four kilometers south of Huari. They depend on sheep and beef cattle for a living. Mallas is a large community of 2100 and has been the recipient of the most projects. It is 3200 meters high.

In the second region, the communities of Acchas, Queroragra, Chacoragra, Uco and Chana center around the government SAIS, Uchupata. They are examples of remote indigenous communities and 95 percent of the inhabitants in these communities are classified as rural poor. The SAIS which is basically concerned with the production of livestock is involved in a pig breeding project.

Acchas, Queroragra, and Chacoragra are all very similar. They are about 3200 to 3600 meters high and each has a population around 300. Located far from roads, they are situated in lonely places with almost no contact with civilization. The social structure is well-defined and every man and woman is assigned his or her part in the common work. Uco has 2000 inhabitants and is about a 14 hour walk from Uchupata. It lies at 3990 meters. Like Uco, Chana is also a long distance from the road, but has only 300 inhabitants.

In the third region, the communities of Colpa, Cunya, Acochaca, and Pacarisca, center on San Luis and Chacas. San Luis can be reached by road from Huari. This road goes through a 4500 meter high pass. In San Luis live 500 inhabitants who are familiar with life in the modern areas of Peru because of its location on a well-traveled road. Chacas which also

has access to roads, is 3300 meters in altitude and has 1200 inhabitants. There are many small mines in the areas where some of the people work.

Colpa, with 1100 inhabitants and a central location, has been designated by the Peruvian Ministry of Education as a community in which a secondary school will be built. Cunya is a small community of approximately 300 inhabitants, about one hour by foot from Colpa. Both communities lie at about 3250 meters. Acochaca has 400 inhabitants and access to roads. The RDP/LWF-WS officials use facilities in this community to store supplies for projects in the area. Pacarisca with approximately 300 people, is very isolated. Belief in demons is very strong and influences the people greatly.

The fourth and final region has experienced little success in rural development projects. San Marcos, 1800 inhabitants, Chavin, 2000 inhabitants, and Machac, approximately 600 inhabitants, are all located along the road from Recuay to Huari.

The twenty communities and government cooperative are located on the eastern slopes of the Cordillera Blanca (White Mountains). The natural environment of the Sierra can be summarized as rugged terrain, with relatively thin soil, and adversely affected by a scanty road system. Rains last from October to March. April to September is comparatively dry. The rugged terrain reduces arable land to less sloping river valleys and high plateaus, while other lands are only suitable for natural pastures (32, p. 90).

Transportation and communication for production related activities and public services are very difficult in the RDP/LWF-WS area. There are

very few roads which accommodate wheeled vehicles. During the rainy season from October to March, roads are often blocked by avalanches and large stones. Where roads do not exist and when roads are closed, the movement of goods is accomplished by human transport or pack animals, and people travel by horseback or on foot.

Formerly, there were Indian communities in all parts of Peru, but now they are limited to the Sierra region. General characteristics of the communities, including those in the RDP/LWF-WS area, can be summarized as follows. Politically, the indigenous communities established a community organization which serves as the local level government. The community organization brings government closer to the people than the local level of the national government, which is the district level. The provinces in Peru are divided into districts which are roughly equivalent to a county in the United States (1, p. 35). The function of the district officers is to keep order, collect taxes, and carry out instructions for the provincial, departmental, and national governments.

The community organization of the indigenous community, hereafter referred to as COIC, is a political administrative unit designed to meet the needs of the small agriculturally oriented community. This governmental form is in direct opposition to the centralized tradition of Peru, and it establishes a type of local autonomy and government which serves the rural poor at the grass roots level (1, p. 49).

The COIC has principal authority over the specific property which the community owns. Its main interest is in public welfare projects for the community. Road and bridge construction and maintenance, irrigation, and

school building projects are examples. Social responsibility and collective work patterns are practiced with respect to these public welfare projects and represent the most cohesive element of the community.

The COIC can be categorized as democratic. All the members of the community may attend meetings but women seldom attend. Indigenous communities recognized by the central government are required to elect officers to conduct the ordinary business of the community. The officials administer community property, collect fees which members must contribute periodically, organize work, and act as judges in community affairs.

Regarding cropland, the members of the community act much like private operators, even though they have no legal title to their plots. The community often behaves more like an association of small farmers than a communal entity. Natural grasslands are not divided and given to members for individual use, as is the case for cropland. Instead, each year different areas are assigned for their livestock. The communities suffer from lack of good lands. Each family cultivates one or two hectares annually. The average natural pasture land per family is 25 to 30 hectares which supports three to four cattle and 15 to 20 sheep.

The number of people in a community varies from twenty families to several hundred families. According to the Lutheran World Federation officials, approximately 90 percent of the population in indigenous communities are rural poor Indians, who speak the native Quechua language. The rural poor in RDP/LWF-WS area have many problems which can be summarized as follows:

Birthrates, around 45 per 1000 inhabitants a year, cause over-

> population of the small communities. The result is the migration of young people to the cities to look for good jobs. The rural poor adults are usually illiterate and handicapped through lack of training, through malnutrition, and through disease, which includes alcoholism. The population lives mainly on potatoes and corn, since only the very few privileged can afford meat. Few vegetables are grown, and the high altitude makes it impossible to produce fruit. Lack of protein and an unbalanced diet often coupled with consumption of alcohol and coca, severely undermines the health of the people. Few live past the age of 40 (11, p. 4).

In the indigenous communities about 90 percent of the members depend on agriculture. This figure is based on interviews with the Lutheran World Federation officials who have worked in the area for four years, because little data exist for the small communities in the rural Sierra. Few rural poor are willing to give information about their work and property to strangers.

Agriculture is a family matter. The man, his wife, and children work together. The men usually do the plowing, and other tasks such as planting, cultivating, harvesting, and transporting are done by all members of the family. When the father and sons are capable of doing the field work, the women herd animals, do the domestic work and tend small stores in their homes. Home crafts and services are sold in these stores located in the homes. They provide secondary sources of income for the rural poor. Some of the goods and services include the skills of baker, barber, blacksmith, carpenter, mason, seamstress, and weaver. These occupations are secondary to the primary activity of agriculture.

Delimiting the Problematic Gap within the RDP/LWF-WS Area in Peru

The delimiting phase develops the problematic gap which this study addresses. First, the goal of the RDP/LWF-WS area was identified. Second, the existing situation in the RDP/LWF-WS area was ascertained. The problematic gap was delimited in analyzing the relationship between the existing situation and the goal of this study within the RDP/LWF-WS area.

The goal of the RDP/LWF-WS area analyzed in this study is to use technologies that promote rural development of the rural poor. These technologies must: 1) be capable of providing improved levels of output and living; 2) be accessible to the rural poor in technical, economic, and social-political terms; and 3) be conducive to the process of self-sustained development.

In support of this goal, the Peruvian Ministry of Agriculture and Agency for International Development have stated the needs of Peruvian agriculture. Those needs that relate to technologies for rural development were listed as: 1) improving the levels of living (income, nutrition and health) on a self-sustaining basis in the rural areas of the Sierra by increasing agricultural productivity; 2) promoting active participation of the small farmer component of the rural poor in the market economy of the nation; and 3) examining the state of technical knowledge or technical alternatives of transferring technical research findings to the rural population (31, p. 17) and (32, p. 107).

The existing situation regarding the ability of technology to meet the objective of rural development in the RDP/LWF-WS area is analyzed in

the following four areas: 1) productivity and income; 2) employment; 3) nutrition, health, and education; and 4) shelter. The purpose of technology is to make the rural poor more productive. As indicated earlier, about 90 percent of the rural poor are engaged in agriculture in the RDP/LWF-WS area, and the remaining 10 percent are schoolteachers, government officers, and merchants. Thus, technologies for agriculture are of major concern to the rural poor.

Table 7 shows potatoes, corn, barley, wheat, and beans are the major crops of the province of Huari and the Peruvian Sierra. Of the total 20,463 hectares cultivated in the province of Huari, 16,961 (83 percent) were used for these five crops, 1,188 were used for alfalfa, and the remaining 2,314 hectares were used for other crops (51, p. 12). Because the rural poor live along the river valleys, farm at high altitudes where adequate rain and temperate zone agriculture occurs, and depend on subsistence crops, the pattern of life and levels of living are quite similar for the rural poor throughout the Peruvian Sierra and RDP/LWF-WS area. Therefore, data on the province of Huari and the Peruvian Sierra are used as proxies to represent the RDP/LWF-WS area which does not have good data on production.

The use of land-augmenting chemical and biological technologies is very important to the RDP/LWF-WS area. Expansion of cropland is not feasible either in physical or economic terms, and it has been suggested that cropland be reduced 10 to 15 percent in the Peruvian Sierra for soil conservation reasons (31, p. 9). Thus, intensification on existing farms is needed to increase output.

Table 7. Production of selected crops in Peru, Sierra, and Huari Province[a]

Crop	1964 total for Peru	1970 total for Peru	1964 yield for Peru	1970 yield for Peru	1964 total for Sierra	1967[b] total for Huari province
	(hectares)		(kg/hectare)		(hectares)	
Potato	261,000	312,000	5855	7250	254,000	4370
Corn	349,640	370,000	1450	1620	222,000	2570
Barley	179,000	-	1019	-	177,000	4278
Wheat	149,300	155,000	960	930	147,000	4510
Beans	40,580	75,000	950	920	29,000	1233

[a]Source: Adopted from (32, p. 51) and (51, p. 12).

[b]Nearest data to 1970 for which data are available for Huari Province.

Except for potatoes, technologies for other crops cultivated in the RDP/LWF-WS area are not well developed or tested (31, p. 12). Average potato yields for Peru increased from 5855 to 7250 kg/hectare between 1964 and 1970. These increases are the result of large farms in the Sierra adopting new technologies. The increased yield in corn shown in Table 7 reflects the use of improved hybrids and fertilizers which has occurred only in the coastal region (31, p. 50). However, sufficient knowledge is available to permit considerable advances in the productivity of the other crops and livestock if local research can be undertaken. The major commodities that enter the local market economy or are moved to urban centers are sheep, beef cattle, potatoes, wheat, and beans.

Potatoes are the major crop of the rural poor in the RDP/LWF-WS area and are well adapted to the climate. Recent technological developments at the International Potato Institute in Lima, permit relatively high yields per hectare. However, officials of Lutheran World Federation stated in interviews that in the RDP/LWF-WS area yields have not increased, because new potato technologies have not been adopted. In terms of current production possibilities, it is believed that available technologies, if promoted more actively, probably would at least double average yields (13, p. 30). The technologies include, improved varieties, disease free planting stock, insect pests and disease control, and better cultural practices, such as the amount of seed to plant, time of planting, tillage, and weed control.

Corn is also well adapted to the Sierra conditions. It has a wider usefulness than any crop other than potatoes. Most of the corn is cur-

rently consumed for human food. High protein hybrids are becoming available and could improve the nutritional content of the staple food among the rural poor. In addition, available high yielding hybrids which respond well to fertilizer have the potential to double output (31, p. 11). Increased yields of corn can provide an essential supplement to natural pasture for feeding sheep and cattle during the dry season to sustain their growth and avoid weight loss. Because livestock provide cash incomes for the rural poor, corn used as feedstuff for sheep, cattle, poultry, and pigs can indirectly increase income. Corn consumed directly by the rural poor improves the supply of protein in their diets.

Wheat and barley are produced to meet local food needs. Improved varieties for the Sierra have been developed. With fertilization, new wheat varieties can yield 2000 kg. per hectare compared to approximately 950 kg. per hectare currently produced (32, p. 99). Barley replaces wheat in localities where frosts constitute a hazard to wheat during fruiting. Barley is more resistant to the frosts that make wheat undependable.

Beans rank behind potatoes and corn as a useful crop for food protein and cash income. They provide an important protein source for local consumption and are taken to markets in urban centers. The cost of transportation is less than other crops. Fertilizer costs for common beans are low because as legumes they fix nitrogen from the soil air through root nodules. Improved varieties that respond well to phosphate fertilizer are available. Broad beans, similar to the American lima bean, adapt so favorably to the climate of the Sierra, that little research has been done on them (32, p. 98).

Sheep and beef cattle in the RDP/LWF-WS area are produced principally on native unimproved pastures. The carrying capacity per hectare of unimproved pasture is 0.13 animal units. One animal unit equals one cow or five sheep. Pasture improvement by controlled grazing and fertilization can greatly increase the carrying capacity. Controlled grazing requires a consistent program of herding or fencing, to insure proper livestock numbers for the carrying capacity and the application of nitrogen fertilizers at least once per year. One hectare with fertilizer and controlled grazing can support 1.5 to 2.6 animal units (32, p. 49).

Sheep provide meat and wool for the rural poor in the RDP/LWF-WS area. The wool is used for making most of the clothing and hats. Although sheep are well adapted to high altitudes and steep pastures, disease control is important and technicians are needed to use the technology for disease control.

Beef cattle can be grazed in sequence on the same pastures as sheep, because their preferences for forage species are complementary, rather than competitive. Cows are milked, and bulls are used as oxen or fattened for market. Improved pastures and supplemental feed crops, such as corn, would lower the time required to grow beef animals for market from 5 years to 2 or 3 years (32, p. 92).

To summarize, agricultural productivity in the RDP/LWF-WS area is stagnant, because new technologies are not being adopted by the rural poor. As population grows and food production remains constant, per capita food production declines, unless the rural poor migrate out of the area or import food. Technical levels of crops and livestock production are low.

Access to agricultural knowledge is uncommon and the rural poor do not usually use fertilizer, pesticides, selected seeds, or improved varieties. Their methods of cultivation are traditional, and some of the techniques used by their Inca ancestors for preventing erosion and management of water have been discarded. Credit is seldom used and products are taken to the nearest village where the middleman collects them. The rural poor market approximately 30 percent of their livestock and crop production, amounting to approximately 30 dollars per capita annual income, and use the rest for family subsistence (32, p. 158).

The government of Peru and the United States Agency for International Development suggest the following reason for the stagnant agriculture in areas such as the RDP/LWF-WS. It is the failure to effectively transfer agricultural science and technology to the farm level. This in turn is due to a lack of a systems approach to organize and implement new production methods in rural areas (32, p. 66).

The technology relating to agricultural equipment is simple and labor-intensive. About 90 percent of the rural poor farmers own steel hoes, small spades, bars, and sickles. The hoes are used to work the soil. Where no plows exist the work is done by hoe. To break up rocks, uproot stumps, or dig holes, the rural poor have a five foot iron bar with one end chisel-bladed and one end pointed. Sickles are commonly used to harvest grains and alfalfa.

Approximately one half of the rural poor have a wooden plow. The plow is patterned after the old Spanish wooden model and is used for breaking the land and for some cultivation. The plow is rarely tipped

with a metal point. Axes and steel cross-cut saws are owned by about one-third of the poor and serve the purpose of felling trees, cutting firewood, and shaping timber. No agricultural power machines are used.

Technology relating to wool is diversified. Wool is used to make bags for storing and transporting dry commodities. Braided wool makes ropes for securing loads to be carried by humans or animals. Wool ponchos, dresses, and men's suits are commonly made by local weavers who use looms to produce the woolen materials. Hard brimmed hats to protect their faces from the sun's intensive rays are also made of wool.

Table 8. Incomes and their sources for farm residents in the Peruvian Sierra and province of Huari[a]

Area	1961 annual per capita farm resident income	Percent of farm incomes from crop production	Percent of farm incomes from livestock production
	(soles[b])	(percent)	
Peruvian Sierra	5200	60	40
Province of Huari	5100	59	41

[a]Source: Adopted from (54, p. 41).

[b]Sol for dollar exchange rate was 26.81 soles = 1 dollar in 1961.

Productivity determines the incomes of the rural poor. Although little data have been collected on incomes in the rural Peruvian Sierra, one such study was conducted by Webb (54). The data in Table 8 show that

the province of Huari is fairly representative of the Peruvian Sierra. The rural farm income in the two areas varies by only 100 soles (roughly 4 dollars per year). By assuming that the incomes of the RDP/LWF-WS (which lies basically in the province of Huari) are similar to the Huari Province averages, the average annual income for the rural Peruvian Sierra region is used as a proxy.

Referring back to Tables 5 and 6, on pages 52 and 54, the income distribution indicates that the relative position of the rural poor in the Sierras will fall from 22 percent to 19 percent of the nation's annual average per capita income, while most other geographical areas will benefit relatively, although to various degrees, from economic growth. Thus, while urban areas acquire the largest benefits, the rural poor in the Sierras will not share equally in increased benefits, and in fact, their relative position is becoming worse. Technology and productivity growth in Peru are not benefitting the rural poor in the RDP/LWF-WS area. This existing situation shows the need for identifying, developing, and selecting technologies for rural development which directly improve the income levels of the rural poor in the RDP/LWF-WS area.

The second area of technological concern is its effect on the employment objective of rural development. Lack of technologies to increase productivity also prevents the rural poor from experiencing economic growth. Without increasing output and income, effective demand for goods and services remains low and new job opportunities are not created to employ the increasing population. Data on employment in the province of Huari are used as proxies to represent the RDP/LWF-WS area.

A study by Van de Wetering (50) using 1967 data shows that large amounts of both unemployment and underemployment exist amongst the rural poor engaged in agriculture in the province of Huari. When subtracting the amount of labor demand (represented by the month with the highest labor demand) from the supply of labor for each month, the total work days of unemployment were calculated. Of the 5,392,100 available work days in the province of Huari, 990,200 were not required. Thus, 990,200 work days of labor or 19 percent unemployment exists. In addition, 1,420,700 work days are not required because of seasonal variation in labor demand. This represents an underemployment rate of 26 percent. Thus, a total of 2,410,900 available work days are not used. Technologies are required that promote increased employment opportunities.

These percentages are higher than the real situation suggests, because the survey analyzed labor demand related only to crop and livestock production. Community work and nonagricultural activities such as weaving, carpentry, masonry, and pottery also require work days. However, many unemployed work days still exist.

At the other extreme, the unemployment rate in the RDP/LWF-WS area, as represented by the province of Huari, would be higher except for the reason that many migrate to the cities hoping to find a better source of income. This migration is reflected in the population growth rates for different regions of Peru (32, p. 112). The growth rates between 1970 and 1980 based on present trends are: 1) 3.1 percent for Peru; 2) 4.2 percent for urban areas in Peru; 3) 1.8 percent for rural areas in Peru; and 4) only 0.8 percent for the rural Sierra region in Peru. Despite

birth rates of 45 per 1000 and higher in rural areas, the population growth is only 0.8 percent because of rural population migration to urban areas.

The third area of technological use as it relates to the rural development objective is nutrition, health, and education. Low technological levels, incomes, and productivity are often associated with low levels of nutrition and health. The FAO recommended daily minimums of 2410 calories and 65.1 grams of protein (13, p. 20) for the Peruvian Sierra region are not fulfilled. Although recent data exist for average consumption levels of Peru (total food availability divided by total population), data for the Peruvian Sierra region alone, are old. These data are used because no data were available for either the RDP/LWF-WS area or the province of Huari. The 1951-1958 daily calorie intake was 1794 and the daily protein intake was 47 for the Peruvian Sierra region (56, p. 82).

Studies on indigenous community nutrition are more scarce. One study suggests that vitamin, mineral, and calcium deficiencies may exist and that the diet is quite monotonous because of the reliance upon a limited number of staple foods (33, pp. 115, 117). The only hospital in the RDP/LWF-WS area is in the community of Huari. The only doctor is faced with 110,000 inhabitants throughout the area. Thus, many rural poor go to a local brujero, who is similar to a witch doctor. These men know how to cure certain ailments with plants and herbs, but are unable to provide needed medicines for many illnesses (11, p. 5).

The education levels are improving in the RDP/LWF-WS area. Since the present military government took over in 1968, a large scale educational reform has sought to lower the illiteracy rate in all communities in the

Peruvian Sierra.

Fourthly, technologies for improving the rural development objective of better shelter are slowly improving. Adobe brick has been the main construction material. But a newer form of construction is also used. Frames for the house are put up first and the clay is put into the form and allowed to dry in position. Making homes earthquake proof is seldom practiced. Technical improvements that have occurred are due to improved carpentry and masonry skills. Lines are straighter, walls smoother, and beams more cleanly cut.

To conclude, the existing technology situation in the RDP/LWF-WS area as it relates to the rural development objectives of the entire RDP/LWF-WS area indicates that agricultural productivity is low and new employment opportunities are needed. Traditional technologies are not capable of increasing production appreciably. Modern technologies which are usually designed for capital-intensive, large-scale agriculture or industry are not appropriate in economic or physical terms for the rural poor in the RDP/LWF-WS area. In situations where technologies do exist that can help the poor, the institutional organizations needed for adopting the technologies often are not present. The low levels of output and lack of employment possibilities lead to low levels of living in nutrition, health, education, and shelter. This existing situation contributes to the problematic gap as defined by the difference between the goal and existing situation in the RDP/LWF-WS area.

The above conclusion applies to the general situation in the RDP/LWF-WS area. However, isolated cases in which technologies that meet the rur-

al development objective and method dimensions are being developed by the Lutheran World Federation officials. The technological areas which are few in number include water supplies, building construction, vegetable gardens, and potato production. They are discussed in more detail in the diagnostic section of chapter four. These technologies permit mass participation by the rural poor. However, many more technologies and widespread adoption which allow mass participation, need to be created.

The self-sustaining process of rural development has not been promoted by technology in the RDP/LWF-WS area. The potato is the only crop for which technologies are being tested locally. Technologies that increase productivity in other crops and livestock and small-scale industry are absent.

To eliminate the problematic gaps caused by the inability of the existing technological situation in the RDP/LWF-WS area to fulfill the three dimensions of rural development, this study develops a conceptual analysis for identifying, developing, and adopting technologies appropriate for rural development of the rural poor in the RDP/LWF-WS area in Peru.

CHAPTER IV. DIAGNOSTIC PHASE APPLIED TO THE RDP/LWF-WS AREA IN PERU

Chapter four presents the diagnostic phase in which the RDP/LWF-WS in Peru was analyzed to determine failure and success elements as they related to the elimination of the problematic gap. The first of three sections provides information on the four year history of the RDP/LWF-WS in Peru. The types of rural development technological projects demanded by the rural poor, rationale for identifying technological demands, and lessons learned from working on these projects in the RDP/LWF-WS area are emphasized. Section two summarizes the program procedure used for identifying, developing, and adopting technologies for rural development in the RDP/LWF-WS in Peru. Section three relates the rural development program in the RDP/LWF-WS area in Peru to the diagnostic phase of this study. Failure and success elements regarding the identification, development, and adoption of technologies appropriate for rural development are presented. These failure and success elements were based on the rural development experience in the RDP/LWF-WS in Peru discussed in the first two sections of this chapter.

Four Year History of the Use of Technology for Rural Development in the RDP/LWF-WS Area in Peru

This section describes the types of technologies used for rural development in the RDP/LWF-WS area in Peru. As previously stated, the case study analysis was based on a four year program which was originally planned to help the RDP/LWF-WS area in Peru recover from the destruction

of an earthquake in 1970. The recovery became the beginning of a rural development program which stressed mass participation of the rural poor and the use of technologies.

The source of the information given in this chapter came from experiences gained from data and personal interviews in the RDP/LWF-WS area in Peru. Observations of project work and at community meetings where projects were planned provided much insight. Interviews and conversations with Peruvian officials of the Lutheran World Federation-World Service Department responsible for the projects were used to analyze success and failure elements, and to summarize the rural development program procedure used in the RDP/LWF-WS in Peru. The interviews, conversations, and record analyses were conducted while traveling between communities, when visiting a community, and in the Lima office of the Lutheran World Federation-World Service.

A prerequisite to rural development success required the desire of the rural poor in the communities of the RDP/LWF-WS area in Peru to improve their levels of output and living. Only two of the ten rural development projects initially proposed in the program were completed after two years. It should be stressed that those ten projects were not initiated by the rural poor, but instead, by planners outside the community. The ten projects were selected by officials of the Lutheran World Federation. The criterion used by these officials was based on the need of the rural poor to overcome urgent problems. Instead of listening to the needs of the rural poor, the priority of needs used were those perceived by the officials who did not understand the people or geographical area well.

Nevertheless, news of these projects spread, and in the third year approximately fifteen requests were made by the rural poor themselves. Of the fifteen projects desired by the rural poor, twelve were completed within a year. As a result, there were one hundred and fifty new requests in the fourth year (12, p. 1).

When initiating rural development in the RDP/LWF-WS area in Peru, it was important to work on rural development projects that the whole community wanted to do, because the rural poor needed and desired to work together and unite. To understand what the local needs were, the rural development officials of the Lutheran World Federation adopted a procedure that identified project needs from project requests prepared by the rural poor.

As the requests by the rural poor in the communities of the RDP/LWF-WS area in Peru were made, the priority which was given to projects, showed that projects concerning improvements in public services, particularly schools, health, and access to water, were often initially ranked higher than agricultural productivity increases as a means to improving their levels of living. Those public services given the highest priority usually were simple in design and easy to implement. The rural poor desired those simple needs more than increasing their agricultural productivity, because in some cases, they did not understand that the way to get the things they wanted was to increase their agricultural production, and thus, have increased income to pay for the things they placed a value on having for their community (9, p. 10).

Although public service projects often preceded productivity increases

in the RDP/LWF-WS area in Peru, there are in any rural development program two different reactions of the rural poor to public service projects. The first has a negative effect on rural development. The rural poor accept public services offered by the government or some outside organization as a gift. No further change is initiated by the rural poor and they become more dependent on the government for future free public services.

The second reaction is explained by Hirschman's unbalanced growth theory in which decision making is stimulated (17). Hirschman classifies public services such as education, health, water supply, roads, irrigation, and communications, as social overhead capital (SOC). When these activities under the category of SOC are developed, they induce the individuals to undertake directly productive activities (DPA). For example, better health, production education, and irrigation can stimulate the rural poor to increase their agricultural productivity.

As DPA increase, funds are provided for investing in more SOC and additional pressures are put on the government to provide large-scale infrastructures. As investment in both SOC and DPA occurs, complex public services can be undertaken which depend on: 1) increased incomes and demand; 2) the development of local capabilities for planning, coordinating, and implementing; and 3) institutions for raising fiscal resources. Such a public service would be a locally supported health clinic. To summarize, SOC which includes public services can induce DPA. The increases in production enable the rural poor to increase their levels of output and living.

As already stated, communities in the RDP/LWF-WS area in Peru ini-

tially gave priority to improvements in public services over improvements in agricultural output to improve their levels of living. However, after three years of project work, many requests for help in improving potato production were made. It appeared that increasing potato production was stimulated by public welfare projects and the fact that the rural poor after three years had confidence and trust in the Lutheran World Federation officials outside the community, who wanted to help them. The rural poor were not willing to risk their potato yields until this relationship of trust and confidence was established.

Table 9. Ten component projects by category and community in the RDP/LWF-WS area in Peru

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Public services

1) Schools: Chacaragra, Colpa, Cunya, Mallas
2) Educational programs: Various programs found in all the communities
3) Drinking water: Acchas, Cajay, Chacas, Mallas, Pariaucru, Queroragra

Agricultural production

1) Irrigation: Mallas, Uco
2) Animal husbandry: Acopalca, Uchupata
3) Potato production: Programs found in most communities
4) Vegetable production: Programs found in most communities

Small-scale industry

1) Electrification - mining - sawmill: Acochacas, Chacas, San Luis
2) Forestry: Programs found in most communities
3) Gas station - repair shop - metal workshop - carpentry: Huari

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The projects in the RDP/LWF-WS area in Peru can be divided into three categories: 1) public services; 2) agricultural production; and 3) small scale industry. Table 9 specifies ten basic projects under the three categories, and the communities involved in the projects. These projects required the use of technologies to improve the levels of output and living for the rural poor.

Schoolhouses were a high priority for the rural poor in several of these communities. Forty of the one hundred and fifty requests in 1974 were for schools (12, p.2). The need for schools was illustrated by the community of Colpa. Sixty-five percent of the population had no formal education, and the community had a one room school for its 1100 total inhabitants.

The Ministry of Education in Peru, which is currently undergoing a large scale campaign to upgrade education, did not have resources to provide funds for a school in Colpa. However, the Ministry of Education promised to provide teachers once a school had been built from local means. After the school building in Colpa was finished, it fit well into the educational reform of the Peruvian government. It served as a center used for a four year obligatory basic curriculum. Many of the students who attended the new school were over twenty years of age.

Most community schools were like dark caves with no windows, so that light came in only through open doors. Poor eyesight was common, and malnutrition added to this problem. The need for windows was important in the construction of new schools. Therefore, a better building construction technology was adopted. The basic material used in the new school-

houses was dried bricks. Adobe, a type of claylike plaster found throughout the Peruvian Sierra region, was mixed with chopped straw or puna grass. The result was a reinforced concrete like brick. Deep foundations for the new schoolhouses were made of large stones held together with cement, gravel, and sand. Between each pair of windows a reinforcement column was placed to carry the weight of the roof. There was a support beam over each door and window which ran under the roof all around the building and gave much stability. This construction was relatively earthquake proof. The same construction could be used by the rural poor to build their homes. This construction represented an advancement in building technology because it provided more daylight, and protection against the frequent earth tremors.

Desks, chairs, benches, and blackboards were made by members of the community to furnish the schools because most schools had little equipment. Despite the new structure and supplies, two problems existed in education for some communities. First, teachers in many cases were not dedicated to their assigned jobs. Pay was low and young teachers were sent from the large cities to the rural areas to teach. Life in the small community lacked the amenities to which they were accustomed, and the teachers often desired to return to life in the city. Secondly, many small farmers did not understand the value of schools. This often caused difficulty in acquiring approval for school projects and willingness of the small rural poor farmer to help build the schoolhouse.

Educational programs, the second project heading in Table 9, were quite varied. Some of the programs were related to a newly built school

or some other project in the community, while others were independent of any projects. Education provided a means for distributing technologies to improve the levels of output and living. These programs can be divided into four areas: 1) health; 2) nutrition; 3) adult education; and 4) youth programs.

The health program was centered in the community of Mallas. A nurse and two nutritionists traveled on foot or by horseback to outlying communities. At the Mallas clinic, an average of 50 patients were treated daily and medicine was given (11, p. 4). As part of the medical program, personal hygiene and family planning were taught. However, religious opposition and a lack of understanding, prevented successes in population control. Sanitary conditions were improved in the new schools being built, and showers were also added. Medicines, birth control, and improved sanitation all represented technological advancement.

The nutrition programs coincided with a vegetable project. Cooking instructions helped the rural poor improve their diets. Women have been taught to prepare infant food from local products, and education stressed the diet for babies, as infant death from malnutrition and lack of fluids was about 15 per 1000 (11, p. 4). These examples indicated that new methods of technology brought new food products to the area. However, much more health, education, and training is needed to diminish existing malnutrition among young children.

Adult education classes involved a variety of courses that introduced new technologies. Sewing, handicrafts, and child care were offered to the women. The use and repair of tools and simple carpentry courses on con-

struction of tables, chairs, and windows served the men. A program for construction of earthquake resistent homes was also available in some communities.

A program which had early successes was the youth activity program. There were few forms of entertainment or possibilities for sport available in these communities. To improve communication and attitudes among the young, soccer fields and volleyball courts were built and supplied with equipment in Rahuapampa and Acochaca, while musical and folklore dance groups were formed in Acopalca, Chacas, and Cajay. The successes of those programs depended on the interest and initiative of the teachers to encourage and organize those activities.

The third category of public services is drinking water projects. In communities less than 1000 inhabitants, a sanitary water supply seldom existed. The water they drank was taken from the community brook which either flowed through pasture land and contained both animal and human excrement or, even if it did not flow through pastures, it was unsanitary by the time it reached the community. As a result, the most common illnesses of those communities next to tuberculosis and pneumonia, were enteric, including typhoid fever.

Most communities in the RDP/LWF-WS area in Peru were located close to glacial streams or springs which could be directed in its purified form through pipes to the community. If an uncontaminated source was not found in communities with a water project, a water cleaning plant was used to filter the drinking water. This water was then stored in a reservoir from thirty to fifty cubic meters is size, and then channeled by pipe to

as many as a dozen outlets in the community. At some outlets, cement sinks for washing were built. The water supply technologies emphasized the use of local physical and labor resources.

Circular water fountains were usually provided in the plaza because pride and prestige rested in the possession of an impressive plaza. Much of the cultural life took place around this plaza.

The economic basis of the rural poor in these communities for improving their levels of living was agricultural production. Four rural development programs are placed in this category: 1) irrigation; 2) animal husbandry; 3) vegetable garden production; and 4) potato production.

The availability of water is important for agricultural production in the Peruvian Sierra. The mountain streams provide sources, and if new seeds and chemical inputs are to be applied in agricultural development programs, the timely use of water becomes more important. Therefore, irrigation projects provide a useful role. Although irrigation projects offered technical and geological difficulties in the RDP/LWF-WS area, it was quite easy to attract the rural poor small farmer to the excavation, blasting, and general construction work required. He could see the direct advantage of water. In the Uco project, a 140 meter long dam was built to provide the supply of water. The Mallas irrigation project provided the potential to irrigate 600 hectares and greatly improve the yield of potatoes, corn and alfalfa. During the dry season, 140 liters of water per second could be provided by the irrigation system (11, p. 3). The irrigation technologies were among the most ingenious developments of the Lutheran World Federation officials. They used local resources, made the

system relatively earthquake proof, and solved major geographical construction problems.

Animal husbandry was not viewed as an important project, despite the fact that poor diets and lack of protein led to serious malnutrition amongst the rural poor in the RDP/LWF-WS area in Peru. In Acopalca a building was constructed for raising and feeding guinea pigs. A one hectare field of alfalfa was used for feed. This helped alleviate part of the chronic lack of protein in Acopalca.

In Pacarisca, a second guinea pig breeding project was being undertaken. Guinea pigs are a delicacy for mountain people, and for some of the rural poor, they are the chief source of meat. They have the advantage that after six months, they are of eating size, and for food the pigs eat cactus and straw when no better fodder such as alfalfa is available.

A large sty for pig breeding was built at the government SAIS, Uchupata. An improved boar, used widely for breeding, has produced many offspring of which many have been sold as breeding animals.

Improving pastures and their carrying capacity for sheep and beef cattle, received little attention. Women, who were responsible for caring for the livestock, were dependent on the man for his consent or dissent. Because livestock concerned the men only to a limited degree, and because thievery of livestock was easy in the Sierra, the desire to increase livestock output was minimal.

One of the most successful programs in the RDP/LWF-WS area was the introduction, planting, and preparation of vegetables. They were almost

unknown as human food and were considered animal fodder. After a slow start, where much resistance from some communities was encountered, vegetables, chiefly cabbages and carrots were being grown in more than 200 various sized gardens. One man, a resident of the RDP/LWF-WS area, was responsible for this achievement. He taught classes on technical information applying to gardens in the schools, helped families with their gardens, and was complemented by classes taught by others on food preparation. As a result, many of the families now prepare vegetables they have grown themselves, and thus, improve their nutritional diet. Some rural poor sold their products in the community of Huari. Beekeeping was another project which many communities were undertaking. Forty-two swarms provided honey for the rural poor in the RDP/LWF-WS area in 1974 (12, p. 4).

The desire to improve the production of potatoes was characteristic of all the communities in the RDP/LWF-WS area in Peru. Although this concern did not surface until the third year of project work, most of the communities wanted help once they had confidence and the knowledge that assistance was available. Diseases which were decreasing potato yields, were a major reason for this concern of the rural poor.

The third category of projects, small-scale industry, had the fewest number of requested projects. A hydroelectric plant, not yet completed by 1974, will have the potential to produce electricity for the three communities of Acochaca, Chacas, and San Luis. Upon the completion of the hydroelectric plant, a small sawmill is to be built in San Luis. In the past, wood was taken to Lima and cut into planks and returned. Small

mines in the area of the hydroelectric plant will use the current for illumination and other small-scale industries can use this potential source of power. The existence of electricity provides the energy source for many technological advancements.

In most of the communities where schools, drinking water supplies, and irrigation facilities were built, tree nurseries were also started. Eucalyptus trees, which have the qualities of a hardwood, were planted with the intention of being used someday for building purposes. The rural poor were instructed in special courses to watch over the nursery and to recognize diseases. Each farmer could keep 70 percent of the wood for himself, and was required to contribute the remainder to community projects.

In the community of Huari, two small-scale industries were started. They included a: 1) locksmith's shop, where young men were trained to weld and make doors and windows; and 2) filling station where gasoline for cars and trucks and kerosene for cooking and lighting were sold.

The three categories of projects just described developed over a four year period in the RDP/LWF-WS area. They provided many useful insights into the types of technologies demanded that led to successful rural development.

The use of technologies for rural development required changing the attitudes and behavior of the rural poor. This in turn required knowing the characteristics, traditions, values, and way of life of the people in the area, so that the human factor was not neglected. The ability to start from where the people were, to create an environment that gave

people control over their destinies, and to do so within the boundaries of their own culture and tradition brought success.

Thus, one of the fundamentals of providing technologies for rural development consisted of knowing the people in the area. The first two years of the RDP/LWF-WS in Peru were basically a learning experience. Countless mistakes led to failures. However, these were critical years, as lessons were learned from mistakes and a good reputation of confidence and trust in the RDP/LWF-WS officials was established. The following ten lessons summarize the experiences of the RDP/LWF-WS officials. These lessons apply mostly to the humanistic social-cultural element of technology and rural development.

The first lessons related to the characteristics required of the people who were helping the rural poor identify, develop, and adopt technologies for rural development. There needed to be a sincere concern by officials of supporting institutions for the rural poor, combined with patience and understanding. It was easy for the rural poor to detect an official from outside the community who had little concern and was only performing a job.

The second lesson emphasized the difference between the two racial groups in the communities. They were the Mestizos, of mixed Indian and Spanish blood, and the Indian. The first communities that accepted projects were the larger ones which had access to roads, better communications with the modern sector, and Mestizos living in them. The Mestizo had had experience with and knowledge of people outside the community, and therefore, knew how to interact with them. The smaller Indian communities,

without Mestizos, were not very willing to accept strangers. The Indian was shy and uncommunicative by nature. Unlike the Mestizo, he seldom spoke Spanish, but used the Inca language of Quechua.

Funk has summarized the Mestizo social class in the following description:

> The Mestizos are usually the community authorities, have a position of political power in local organization, and achieve economic power from the small stores they own which bring incomes high enough so that they are not classified as (rural) poor. They own better houses, better clothes, finer horses, more land and cattle, and have some luxuries like a radio and oil lamps. As small store merchants, they often sell the Indian necessities such as candles, flour, coca, and alcohol, and make sure it is a little more than he can afford. The difference is made up when the Indian works in the Mestizos' fields (12, p. 2).

The original projects in communities with a Mestizo contingent, usually met with countless problems, such as: 1) the unwillingness to meet work commitments in Chacas; 2) project contract disputes in Huari; and 3) theft of materials in San Luis. In the isolated Indian communities, the Mestizo influence was minimal, and this made rural development work much easier. Successes in communities without Mestizos caused those communities with Mestizos to become somewhat jealous. As a result, the Mestizos became more willing to fulfill the requirements of the project.

The third lesson involved the creation of confidence and trust of the rural poor towards those helping them. Bad experiences with the Spanish and past governments lingered in their memories. Many promises and contracts had been broken. The establishment of confidence and trust required sincerity and honesty. It was very difficult to achieve, and was a slow process. Once established, it spread rapidly as word passed

quickly from community to community, despite the difficult geographical terrain. Proof of this rapid willingness to participate was evidenced by the increasing number of project requests during the four years.

Fourth, outsiders needed to prove themselves, regarding technical expertise, on a human level. Academic degrees meant nothing in the mountain areas. But if you could climb a mountain faster, produce a better potato or pull a better cow behind you, they were impressed. This lesson shows the importance of the personnel providing technical help.

The personnel needed to have technical adequacy so that the level of knowledge and skill needed for the relevant crop, livestock, or project, and the production practices and physical environment was understood. In addition, the technical knowledge needed to be appropriate. This required that the knowledge be appropriate to the rural poor's educational, social, and economic situation, and that it be adequately tested (4).

Fifth, the rural poor did respond and had the desire to improve their levels of living if they were given the opportunity, and had confidence in those helping them. The rural poor functioned from their known viewpoint, and although the rural poor seldom assessed alternatives or made long range plans, it was important to create new opportunities. When opportunities existed, they saw a need and became motivated. The work and observation of other projects brought the rural poor new opportunities which were feasible.

Sixth, successful projects needed to originate from the rural poor. The first twelve projects in the RDP/LWF-WS area were not initiated by the rural poor. This was by necessity because the rural poor could not

request help for projects with men outside their communities who were unknown to them. When help was offered, they were still skeptical. But the news of successful use of technologies in community projects made the rural poor in other communities aware of new opportunities. They associated their needs with these new opportunities and became motivated. The will to work was created and responsibility for the projects resulted.

All of the projects which were initiated by the rural poor were completed within two years, and most within a year. However, they were not free from problems, as motivation often lost its vitality after the project was underway. This motivation problem was overcome and the rural poor, who planned their projects, were very successful in the completion of projects in the communities in the RDP/LWF-WS area in Peru.

Seventh, the human factor needed to be understood if use of technologies for rural development were to succeed. Characteristics and nature of the rural poor themselves were important aspects in analyzing the human element. In the RDP/LWF-WS area successful interaction with representatives of the community required an outsider to possess the ability to judge the potential of the rural poor and their sincerity about the project. A dishonest person was quite easily recognized when characteristics of the rural poor were understood.

Identifying technologies and especially the adoption of technologies, required knowledge of the social, cultural, and political structures and institutions. The RDP/LWF-WS area indicated that it was essential that the people and their institutions be respected, and that outsiders be required to work through them to prevent the alienation of important people.

The objective was to help the rural poor, not to destroy their institutional systems. Although the institutions of the rural poor needed to be understood, it was not necessary to know the intimate working relationships among the rural poor within a community. Different tasks could not be assigned by people from outside the community, for it would take years before one understood the complex interrelationships within the community. The rural poor must delegate responsibilities amongst themselves.

Social events of great importance to the rural poor were used to promote development. In the RDP/LWF-WS area, fiestas and celebrations were a means to stimulate group interest. Fiestas symbolized important events.

Eighth, contracts recorded in municipal records and certified by the district government were needed to insure that project commitments were honored. This was especially true of communities with Mestizos who preferred to receive projects free without working. A component of the contract was a system of punishments for those who did not fulfill their obligation. When punishments were enforced, the rural poor were impressed. It was a sign that those aiding them were serious about their work and had a sincere desire to help.

The ninth lesson was that successful use of existing structures and institutions to plan and implement projects, eliminated the necessity for one person to live in a community for many months or years to make a project successful. The use of existing community institutions permitted one organization or group of officials to work simultaneously with many communities.

The tenth lesson involved the use of the rural poor themselves to pro-

mote ideas and to give technical advice. Project foremen, and teachers of nutrition, carpentry, and vegetable garden growing, who were selected from the rural poor were respected by their communities. A native of the RDP/LWF-WS area was able to communicate with and motivate the people much more effectively than an outsider. Working with the rural poor required methods which were simple in content. With respect to projects, precision and perfection were not expected at the beginning.

Program Procedures for Identifying, Developing, and Adopting Technologies Appropriate for Rural Development in the RDP/LWF-WS Area

The ten lessons provided part of the foundation for developing the program procedure relating to the identification, development, and adoption of technologies appropriate for rural development of the rural poor in the RDP/LWF-WS area. The following program procedure took four years to evolve and is still being perfected. It assumes that the rural poor have confidence and trust in those from whom they are seeking assistance.

The procedure used in the RDP/LWF-WS area had eight different steps which are summarized in Table 10. The initial request of step one was made orally when officials of the RDP/LWF-WS projects were in the area of the community which was seeking help. Representatives who were chosen in the community organization of the indigenous communities (COIC), were sent to make this request. The standard reply was never "yes" or "no", but "We need more information". At this time the community representatives were told that a written request must be made, what information must be

Table 10. Procedure for rural development in the RDP/LWF-WS area

Step one:	Oral request
Step two:	Written request
Step three:	Analysis of the community
Step four:	Financial approval
Step five:	Implementation plan
Step six:	Authorization of project
Step seven:	Evaluation of project
Step eight:	Inauguration of project

in the request, and where and to whom the request should be sent.

This initial request was extremely important because it came from the rural poor in the communities. It showed their willingness to work for improvements in their levels of living. From the beginning, the work became a partnership between the community and those helping them. The rural poor were not dependent on outside initiative. In addition, the requests identified the technological needs of the rural poor.

Step two, the written request, provided much information about the community. The oral request was easily made. However, a written request required that someone sit down and write it. Because many could not write, and did not know Spanish, the task was not easy. After the request was written, it had to be authorized by the government of Peru, usually at the district level within the province. The written request included a statement defining the project desired by the community, and a promise

to supply labor, local materials and transportation at no cost.

The time needed to complete the written request indicated the urgency of the project and the amount of energy the community had. Finally, the request had to be signed by a minimum of 80 percent of the working men. To insure honesty in the signing of names, it was done in an open assembly of the COIC and recorded in the community record book. Thus, a small group of men could not go door to door and force members to sign. The written request overcame the weakness of the oral request which often represented only the interests of a small group in the community.

Before approval was given to support a project, the community was analyzed. This was the third step. Through four basic tests, the potential for a successful project was determined.

The first test was to visit with members of neighboring communities. They had a remarkable ability to know the strengths and weaknesses of their neighbors. Although weaknesses were often exaggerated, it was best to know about them.

The second test was to visit the community unexpectedly, and to ask the people what they knew about the project. For example, had they heard about the project? Who would benefit? What were their commitments to the project? A well organized community informed each member properly and honestly.

The third test involved the initial reception of the sponsoring officials of the RDP/LWF-WS by the community. Communities with a strong desire for a project received them well. Most of the people came, the authorities, men, women, schoolchildren, and grandparents. Few people were found in a

community with little interest.

The fourth test was the request by the sponsoring officials for help in studying the project. When ropes, shovels and other tools were needed to survey the project area, the response of the rural poor varied widely. A well organized community with good leaders, functioned smoothly. The tools were acquired rapidly and with amazing efficiency. In other communities it took hours to achieve a simple task. This test showed the ability of the community authorities to organize, and provided insights into the respect and response people gave their leaders.

Step four was the approval or rejection of the project by the Lutheran World Federation-World Service Department. The decision depended heavily on the four tests in step three. If accepted, funds were budgeted for the project.

The implementation plan in step five was probably the most important, if a project in the RDP/LWF-WS area was to succeed. Implementation took place through existing social structures and institutions. The implementation plan required a written document which was prepared in an open community assembly of the COIC where all the men in the community attended. Communications were important, and everything was spoken in Spanish and repeated in Quechua. Five basic sections were included in the implementation plan. Each topic was explained and discussed until an agreement was reached.

The first section restated the written request. The requirements of each member were explained. The responsibility and commitment of free labor, transportation, and local resources specified in the written re-

quest were once again agreed upon.

In the second section, a logical ordering of steps to follow was given. Technical knowledge was provided at this time. The rural poor were told that the conditions of each step had to be fulfilled before the next step could be started. Materials provided by the sponsoring agency were not provided until all complementary work was completed. Experiences such as the schoolhouse in Colpa, proved that early delivery of materials did not motivate the rural poor and often had a negative effect. To summarize, the sponsoring agency contributed to the rural development project by: 1) helping the rural poor organize the project; 2) furnishing materials which the rural poor did not possess; 3) providing technical assistance; and 4) providing financial assistance.

Section three of the implementation plan involved the selection of rural development project authorities from the community. Each phase of the project had someone in charge. In some communities individual authorities were selected, while in other communities, committees were selected. Anyone was eligible for the leadership roles. However, existing political authorities of the COIC were usually chosen. After the project leaders were chosen, officials of the sponsoring agency could work through the authorities with the knowledge and assurance that the people supported them as their leaders.

In section four, specific working responsibilities were delegated to community members by project authorities and committees. The decisions, and in many cases, arguments regarding the working schedule, were left to the community. An individual outside of the community could not be in-

volved in these decisions on a successful basis. If the Lutheran World Federation-World Service officials had aligned themselves with a group, it would have alienated others and prevented mass participation to occur.

Each community had its own methods for delegating work. Some assigned each segment of the work to different sectors of the community. Other communities worked together on the whole project. When this was done, each man provided a set amount of days when needed. Project work was not undertaken during weeks of planting and harvesting because labor hours needed for project work were not available.

The fifth section of the implementation plan concerned a system of punishments for those who did not work. Those sanctions were written into the implementation plan which was an official document recognized by the government. This was necessary, effective, and well accepted by the rural poor. They were impressed with power and for centuries have been living with it.

The sixth step was the authorization. This step was simple, but carried heavy consequences for those who failed to meet their requirements. The community members, by signing their names to the implementation plans, assured the sponsoring agency officials that the rural poor understood the project, accepted their leaders, and it clarified their commitment to the project. The signatures consisted of thumb prints, for those who could not write, or signed names with a complex design drawn under them which was difficult to forge. In the past many signatures were forged, and as a result, the rural poor lost land and other possessions. For additional security, some signatures included thumb prints.

Step seven involved an evaluation of projects by the representatives of the Lutheran World Federation-World Service officials. Unannounced visits were made frequently. During those visits progress was observed, problems were recorded so that future mistakes could be avoided, and technical assistance and advice were given. At the same time, the people usually needed some additional motivation, because after the project was half completed, the people frequently lost their desire to work, as it was difficult for them to see the advantages of the completed project.

The eighth, and final step, completed the project. Large fiestas were planned to celebrate and inaugurate the project. A completed project was considered the work of the community, and they were proud of it. This increased the confidence of the community in its ability to improve its levels of living. At the inauguration, the responsibility to maintain and operate it efficiently became the task of the community.

This program procedure for identifying, developing, and adopting technologies for rural development projects evolved to meet the needs of the communities and took advantage of the characteristics of the rural poor and their institutions. The community meeting of the COIC and election of authorities was a well established system in the RDP/LWF-WS area. The program procedure worked well, and once a technological improvement was made by a project, the same community or a neighboring community, soon sent in a new request (12, p.2).

The program procedure applied best to the public service projects of schools, drinking water, and irrigation, which involved the whole community. Educational programs and vegetable garden projects usually accompanied

public service community projects.

In the RDP/LWF-WS area, the public service projects provided the trust and groundwork required to pursue a more important goal of increasing agricultural productivity by using new technologies. The respected record of past projects, permitted officials of Lutheran World Federation to introduce progressive ideas relating to agriculture that initially would not have been accepted. The procedures for undertaking the potato project, which was just beginning in 1974, represented a community approach to increasing agricultural production.

Increasing agricultural productivity is basically an individual decision. Yet, the involvement of the entire community was an important aspect of increasing productivity in the communities of the RDP/LWF-WS area. The community made a written request in contract form for improving the potato crop.

In that request they agreed to fulfill the requirements specified by the Lutheran World Federation officials. At the time research was undertaken in Peru for this study, the requests were still being written. The following description of the potato project represents the plans of the Lutheran World Federation-World Service officials. The community will select one representative to attend classes at the training center in SAIS Uchupata. The representative then returns to the community and presents the information he has learned to those in his community.

A second requirement states that each community will provide at no cost, a one hectare community demonstration plot. The entire community is responsible for cultivating it. The demonstration plot is very important

because every member of the community is given an equal opportunity to learn about new cultivation methods. No one person is favored.

The working schedule for the demonstration plot is to be determined by the community project authorities. Because the rural poor often do not understand why new seeds should be used when they already have potatoes in their field, the community demonstration plot is a useful method for showing potential improvements. A third requirement states that each community will be responsible for presenting classes on new methods of potato cultivation to students in the schools.

A six hectare plot of land at the SAIS Uchupata has been provided for the production of potato seeds. Agricultural technicians will work on new methods in these fields. Their successes will then be transferred to community demonstration plots. Protecting the potato from disease is the first task. Improved seeds and insecticides are under experimentation. Seeds, and insecticide sprays to be used on community plots, will be paid for by the community. The present plan permits the payment to be made in the form of potatoes at harvest time.

A potato technician hired by Lutheran World Federation-World Service will introduce the potato program to a community after the soil of the community demonstration plot has been prepared, the community representative has taught classes, and a large fiesta planned. The fiesta will denote that the day is very important and that the project should be taken seriously. Frequent visits, by potato technicians, to the community will follow, to supervise, and help with problems that arise. Agricultural help in the form of demonstrations and advice, is more useful to the rural poor

farmer than reading prepared pamphlets. The advice should be simple and comprehensive so that it can be passed on easily in Quechua. Plans for future agricultural help were being planned in soil analysis, use of fertilizers, and in the cultivation of corn, wheat, and barley.

In summary, the use of new technologies in rural development projects, by the rural poor in the RDP/LWF-WS area in Peru, has begun. The program procedure brought improvements in the levels of living through the use of technologies. Education, nutrition, and health levels were improving, and the potential to increase agricultural production and incomes can soon be realized with irrigation, new seeds, and improved methods of cultivation for the potato.

Steps one, two and three of the program procedure provide insights into the identification of technological demands of the rural poor. Step five relates to the development and adoption of technologies for rural development projects. Steps six, seven, and eight stress procedures such as contracts, evaluations, and social-cultural characteristics that facilitate the adoption of technologies.

Failure and Success Elements in the Diagnostic Phase

Applying the methodology outlined in chapter one, the failure and success elements of the diagnostic analysis, which are based on the RDP/LWF-WS area in Peru, are divided into two sections. First, the success and failure elements are related to the identification and development of technologies appropriate for rural development. Second, the relationship of the failure and success elements to the adoption of technologies appro-

priate for rural development are discussed.

In section one, the analysis of failure and success elements for the identification and development of technologies are discussed under two categories: 1) their relationship to the rural development method of mass participation; and 2) their relationship to the self-sustaining process of rural development.

The first category examines the failure and success elements as they relate to the identification and development of technologies for mass participation of the rural poor in rural development. Major failure elements were not detected in the identification of technologies but were evident in the development of technologies.

The major failure elements in the development of technologies, which prevented mass participation by the rural poor in the RDP/LWF-WS area, were the: 1) lack of technologies appropriate for the rural poor; and 2) lack of local research and testing related to existing technologies.

Before the Lutheran World Federation officials developed technologies relating to building construction, irrigation, hydroelectric power, water supply, potato production, and vegetable gardens, there were no efforts being undertaken to develop technologies appropriate for the rural poor. In the case of agricultural production, technologies that were well adapted to the physical conditions of the RDP/LWF-WS area had not been tested. Improvements in small-scale consumer good production did not exist either.

The reasons for the failure to develop technologies appropriate for the rural poor in rural development were many. First, large scale industrial development of the modern sector received the emphasis in research

and development plans in Peru. Little attention was given to developing technologies for rural development and the rural poor did not have funds to undertake their own research. Those trends coincided with the economic development theory of the 1950's and 1960's. Secondly, the rural poor did not have savings or access to low interest rate loans which they could use for investment in technologies for increasing agricultural production. Thirdly, low rural incomes prevented increases in the effective demand for nonagricultural goods which would, in turn, stimulate the demand for new technologies to increase production. Thus, a lack of effective demand by the rural poor for technology combined with government emphasis in large scale technology caused a dearth of technologies appropriate for mass participation in rural development in the RDP/LWF-WS area.

The rural poor in the RDP/LWF-WS area did provide success elements that permitted the identification and development of technologies that facilitated mass participation in rural development. Through the requests expressed by the COIC, the rural poor identified the technologies they needed to produce the goods and services that they demanded. Requests such as those provided the Lutheran World Federation officials with information regarding the areas of technological demand. The rural poor, if expected to use the technologies, must be willing and able to demand the technologies. The requests by the rural poor identified the desire for new technologies.

The technologies developed for the rural poor were small-scale and designed to use local resources. Officials of the Lutheran World Federation-World Service Department in Peru used sources from other countries

such as the Village Technology Handbook (51) prepared by VITA (Volunteers for International Technical Assistance), which provided information on technologies well suited to the rural poor. In addition, much ingenuity on irrigation, water supply, and building projects were used. Although those technologies were few in number and related to community public services and infrastructure projects, they indicated the potential of technologies to stimulate mass participation if they were: 1) developed for use by the rural poor; and 2) adapted to local physical conditions.

The second category to which failure and success elements for the identification and development of technologies are applied, is the self-sustaining process of rural development. The major failure elements relating to self-sustaining growth, during the first three years of rural development projects in the RDP/LWF-WS area, was that approximately 75 percent of the technologies identified and developed applied to public services. Except in the case of irrigation, electrification, and small-scale industries, the public service projects did not cause immediate increases in productivity. Thus, with incomes not rising, the financial means to support continued investment in new technologies were lacking. During the first three years of the program, it appeared that public service projects would not lead to self-sustaining rural development.

During the fourth year of project work, success elements relating to the identification and development of technologies for self-sustained growth began to appear. The rural poor were anxious to achieve increases in their potato yields. Although the potato technologies have not yet been used by the rural poor, they may lead to increased output, more potato out-

put marketed, and higher incomes. Thus, the basis for self-supporting rural development may begin. Also, increased production of vegetable gardens led to permanent improvements in nutrition and provided extra cash earnings.

The second section discusses the failure and success elements in the RDP/LWF-WS area as they relate to the adoption of technologies appropriate for rural development. Like the preceding section, the failures and successes are discussed under two categories: 1) their relationship to the rural development method of mass participation; and 2) their relationship to the self-sustaining process of rural development.

Under the first category, the failure elements in the adoption of technologies that did not enable the rural poor to participate in rural development were few in number but very important. Three failure elements were identified. First, the Mestizo social class in some cases prevented the rural poor from adopting technologies because of their leadership role in the community. The threat of lost economic power to the Mestizo prevented the Mestizo from cooperating in the projects.

Secondly, when the planning and implementation schemes were done by officials outside the community, the rural poor were unlikely to adopt the technology. Thus, failures resulted when the rural poor did not take an active part in all steps of the program procedure used for rural development projects. Third, the rural poor did not appear to grasp the concept of saving and investment that is required to improve the levels of output and living of all the rural poor.

The success elements in the adoption of technologies are numerous. They are divided into five areas. First, the existing COIC was utilized

advantageously. Through community meetings all the rural poor were made aware of requirements for adopting the technology. Second, the officials outside the community were sincere and operated on a human level, in addition to having command over their technical field of expertise. They operated on a technical level appropriate to the rural poor which enabled the rural poor to comprehend the information and adopt the technology.

Third, the rural poor were accustomed to teaching each other. Outsiders were not required to work directly with each individual. Selecting good leaders to train and direct their own community members was crucial if the adoption of technologies was to succeed. Fourth, an understanding of the social-cultural characteristics of the community greatly promoted mass participation in the adoption of technologies to promote rural development. Proper use of fiestas and allowing project work to be assigned by community leaders are good examples. Fifth, contracts, and frequent evaluation trips were used. The affect of written contracts containing sanctions and evaluations benefited the adoption of technologies.

The second category, to which failure and success elements for adopting technologies for the rural poor are applied, is the process of self-sustaining rural development. Failures and successes in the RDP/LWF-WS area related basically to the institutions for adopting technologies. The most obvious failure element which this study addresses was the lack of economic discipline found in the RDP/LWF-WS area institutions. The disciplined use of saving and credit for investment was not practiced. Part of the problem was annual interest rates as high as 50 percent charged by money lenders, and the lack of government loans. In addition, the discipline of saving

money to improve the levels of output and living through investment was lacking. Without saving and credit programs, the investment process needed for self-sustaining rural development was lacking.

Secondly, the length of the RDP/LWF-WS in Peru in terms of years, was not long enough to determine whether the process of adopting technologies could become self-sustaining. Patience is needed in rural development.

The success elements for adopting technologies which relate to the self-sustaining process of rural development were useful and promising. First, the COIC, which was already present, provided a base for self-supporting and self-sustaining rural development. The COIC functioned quite well in adopting technologies for development projects. Therefore, the existing structure should be strengthened and improved.

Secondly, a second tier organization existed that trained and supported the COIC. The second tier organization was the Lutheran World Federation-World Service Department in Peru working in the area. Although it was small in the amount of financial funds and number of personnel, and lacking in an interdisciplinary staff, it showed the important role of a second tier organization in creating self-sustained rural development. The second tier organization, by working through the leaders of the communities, provided technical information, supervised the projects, and acted as an intermediary between the community and higher level institutions.

The failure and success elements listed in this chapter, that relate to the identification, development, and adoption of technologies appropriate for rural development provide the basis for the remedial conceptual analysis discussed in the next two chapters. The Peruvian Ministry of

Agriculture and the United States Agency for International Development have also presented the following conclusions which coincide with the diagnostic analysis of the rural poor in the RDP/LWF-WS area. Their conclusions, directed towards the Peruvian Sierra, reflect the failures found in the RDP/LWF-WS area. The disappointing situation of Peruvian agriculture and rural development in the Sierra, appears to be the inability to: 1) develop and effectively utilize the potential of the human and physical resources of the Sierra; 2) effectively transfer agricultural science and technology to the farm level; and 3) organize and implement viable institutions for promoting increased agricultural production (32, p. 66).

CHAPTER V. IDENTIFICATION AND DEVELOPMENT OF TECHNOLOGIES APPROPRIATE FOR RURAL DEVELOPMENT IN THE RDP/LWF-WS AREA IN PERU

Chapter five contains the remedial phase for the identification and development of technologies appropriate for rural development in the RDP/LWF-WS area. The remedial phase is divided into three sections. Section one restates the success elements of the diagnostic phase which need to be strengthened for identifying and developing technologies. Section two develops new success elements for the identification and development of technologies, and the last section relates the remedial phase more specifically to the RDP/LWF-WS area in Peru.

Strengthening Existing Success Elements for Identifying and Developing Technologies in the RDP/LWF-WS in Peru

The economist, as a student of the theory of economic growth and development, can provide useful insights and suggestions for the identification and development of technologies appropriate for improving the levels of output and living for the rural poor that are consistent with the method of mass participation and self-sustaining process of rural development. The important factor is that the economic analysis is made appropriate for rural development of the rural poor. If the rural poor are to participate in a self-sustaining process of rural development, they must have access to technologies that provide self-supporting development and self-reliance.

With respect to the identification and development of technologies appropriate for rural development, the communities in the RDP/LWF-WS area

offered two basic success elements. First, the rural poor identified their demand for technologies through the COIC requests. Secondly, successful development of technologies for projects such as irrigation, water supply, and building construction, showed that rural development can be achieved by using relatively labor-intensive methods which maximize the use of local resources and which are simple in design.

These two success elements need to be strengthened and expanded. The information on technologies, developed for community public welfare projects of the rural poor by the Lutheran World Federation-World Service officials in Peru, can be made known to other communities in the RDP/LWF-WS area, and then applied in projects. These technologies need to be documented so that other rural poor can benefit.

The success element in the RDP/LWF-WS area that merits much attention, is the identification of demand for new technologies by the rural poor. The community rural development projects indicated that projects not planned or desired by the rural poor had less chance of being adopted. Therefore, rural development planners need to encourage the rural poor to identify their demands through the COIC. Then, research work to develop technologies appropriate for the rural poor in the RDP/LWF-WS area in Peru should be pursued.

Table 11 lists potential technological areas for which the rural poor have demands. These areas extend beyond those listed in the book of requests held by the Lutheran World Federation-World Service Department in Peru. However, as rural development occurs, many new requests are likely to arise. Technologies are needed that are appropriate for the rural poor

Table 11. Areas of technological demand by the rural poor

I. Agriculture
  A. Food and nonfood crop processes
    1. Land improvement
      a. Irrigation
      b. Soil and fertility conservation
    2. Cultivation and management methods
      a. Land preparation
      b. Sowing and planting
      c. Tending crops
      d. Harvesting
      e. Multiple croppings
      f. Crop rotation
      g. Contour plowing
    3. Crop husbandry
      a. Pest and weather resistant crops
      b. High yielding, improved varieties
      c. Fertilizer, insecticides, pesticides
    4. Storage
  B. Animal husbandry
  C. Equipment for small farmers
    1. Hand tools
    2. Animal drought equipment

II. Small-scale consumer good industries
  A. Clothing and shoes
  B. Shelter - building and construction
  C. Household goods - furniture, utensils
  D. First stage agricultural processing
  E. Transportation
  F. Forestry products

III. Public services
  A. Nutrition
  B. Education
  C. Water supply
  D. Health - medicine
  E. Sanitation
  F. Energy
  G. Roads

in all these areas. Rural development changes may accelerate the desire of the rural poor to seek new technological suggestions if they have been researched and tested.

The list of technologies in Table 11 are divided into three categories for which technologies need to be developed. These product areas do not require highly sophisticated modern technologies. Small-scale labor-intensive technologies appear capable of providing the rural poor with solutions to these three technological categories (43, p. 175).

Because, as stated earlier, 90 percent of the rural poor in the RDP/LWF-WS area depend on agriculture, self-generating growth which makes the rural development process self-sustaining, must depend on increased agricultural output. Self-supporting agriculture has the potential to consistently provide surpluses to finance investments, and to create effective demand needed for growth.

Now that agricultural help in the form of potato production has been requested by the communities in the RDP/LWF-WS area, it is important that research stress the development of agricultural technologies for the local area. Increases in agricultural production raise incomes, and provide the source for improved levels of living. When increased production of foodgrains are spread amongst a large number of rural poor, an effective demand for other goods is created, provided this production is sold. If increases in the production of nonfoodgrains and nonagricultural goods occur simultaneously or soon after the output of foodgrains increase, the improvements in production yields can become a self-sustaining process of rural development. Agricultural output increases provide new jobs and gen-

erate the income needed to buy goods and services. Through improvements in agricultural productivity, the economic base needed to support rural development is established.

In addition to improving agricultural output, small-scale consumer good industries could also contribute to a self-sustaining process of rural development by providing employment, increased incomes, and supplying goods and services to the rural poor at low costs. Public services generally do not, by themselves, constitute a basis for self-sustaining increases in productivity and income. Rather, they are complementary to, or components of programs with productivity and income increase objectives.

New Success Elements for the Development of Technologies Appropriate for Rural Development

New success elements are needed to minimize the failure elements that exist in the RDP/LWF-WS area. The basic failure element was the lack of technologies appropriate for the rural poor. As stated earlier, the cause of this failure was a lack of demand by the rural poor for new technologies because incomes were low and credit was seldom made available by monopoly moneylenders at interest rates that reflected demand and supply. Also, research for supplying the technologies was not oriented towards the rural poor or the traditional sector.

The lack of appropriate technologies in agriculture was caused by the absence of research and local testing of new agricultural technologies which met the physical, social, and economic conditions of the rural poor in the RDP/LWF-WS area. Chapter three indicated the potential increases in

potatoes, corn, wheat, barley, and livestock production. However, these must be developed to conform to the rural poor in the RDP/LWF-WS area if rural development is to occur. Technologies for small-scale consumer goods, such as looms to make clothing, building construction, and household goods production were produced by traditional processes. As rural development occurs, improved technologies will be required to increase productivity.

Developing new success elements for overcoming the lack of technologies appropriate for the existing and potential technological demands identified in Table 11, is the major concern of this section. A conceptual analysis is developed for determining the criteria for the development of appropriate technologies. This conceptual analysis is based on studies relating to the concept of appropriate technologies. Issues regarding appropriate technologies that are relevant to the RDP/LWF-WS area are incorporated into the analysis.

The conceptual analysis is intended to permit the development of appropriate technologies for each technological area identified by the rural poor in the RDP/LWF-WS area. Because the term appropriate technology is difficult to define, criteria for the development of appropriate technologies are given, and these criteria are used for the definition.

The criteria used in this study for the development of appropriate technologies are based on <u>two factors</u>. The <u>first</u> factor is the historical criteria used to develop technologies for development in all nations. The <u>second</u> factor is the economic institutions found in Peru that apply to the RDP/LWF-WS area.

Historical criteria for developing technologies are analyzed for the following three areas: 1) physical-engineering; 2) social; and 3) economic. These criteria show the interrelationships between the physical-biological and economic-social disciplines for developing technologies presented in Figure 2 in chapter two. Most professional engineers are trained to do research for the modern sector of less developed nations, or for developed nations. The result of their work is a blueprint which saves labor and favors an equipment-intensive production process.

Because the engineer's criteria involve technical efficiency so that the maximum output from given inputs is extracted, he usually turns to machines which are more reliable, more precise, and commit fewer errors than man. In a country short on labor, this viewpoint is laudable. However, the need in less developed nations is to save on capital and use more of the available labor resource (37, p. 51).

Until recently, social criteria have carried little weight amongst development planners. Rapid growth was expected to create new employment and spread the benefits to the rural poor. Therefore, the social disruptions resulting from the use of modern technologies were considered temporary costs of development. The breakdown of cultures and the traditional sector were acceptable because a rapidly growing modern sector would soon replace it. Thus, employment, distribution of development benefits, and investment in the traditional rural areas were not basic development objectives. Employment and widespread distribution of benefits were to follow as economic growth occurred.

Economists choosing economic criteria for analyzing the efficiency of

the allocation of resources in less developed nations, or stated differently, the criteria for selecting the best technological method of production, have experienced problems. In particular, the use of private profit maximization where output per unit cost is maximized, causes resource allocation problems in either the modern or traditional sector of less developed nations.

In the modern sector, factor prices represented by their market values are often unreliable guides for determining the maximization of profits or the optimal allocation of resources. Capital is subsidized by artificially low interest rates, over valued foreign exchange, lowered tariffs on capital imports, and accelerated depreciation allowances and tax holidays on investments, while wages have risen above the levels that ought to prevail in a society with an abundance of labor due to minimum wages, fringe benefit legislation, and union organization.

In the traditional sector, moneylenders charge the rural poor varying interest rates from 25 to 100 percent per annum which are much higher than the modern sector. Wages are kept very low because of the abundance of unemployed and underemployed workers and the absence of labor unions.

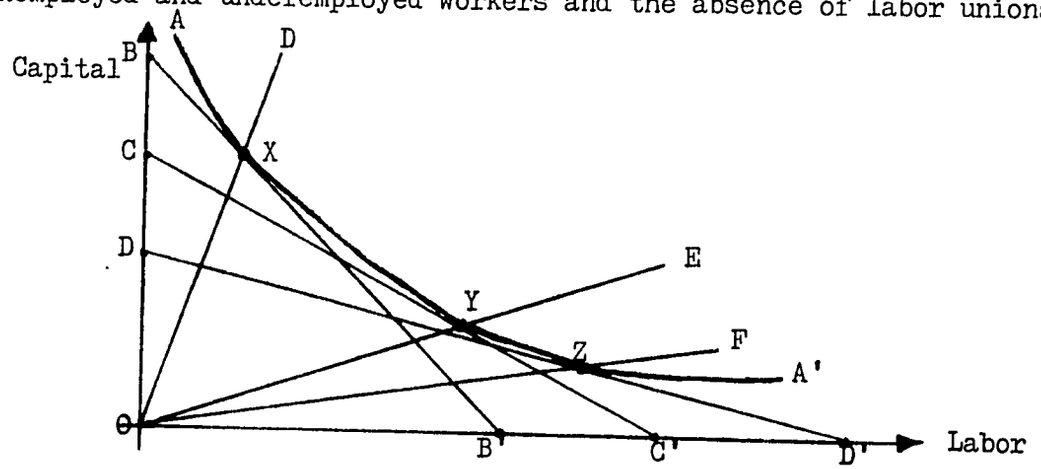


Figure 3. Factor prices and capital-labor ratios.

Figure 3 shows the problem presented by distorted prices. Curve AA' represents the production function showing the possible methods of producing a given level of output. Line BB' and DD' represent the distorted factor prices, found in the modern sector and traditional sector respectively. Factor prices determine the amounts of inputs that can be purchased. Line CC' is assumed to be representative of the true factor price lines of the nation if supply and demand functioned without interference by government or unions. Entrepreneurs in the modern sector and large landowners or industrialists in rural areas would face line BB'. The rural poor often face factor prices represented by line DD'.

According to economic theory, the capital-labor ratio which represents the efficient allocation of resources is determined by the tangency of the factor prices and production function. Because the price line BB' prevails for the investing class in the modern sector and large landowners and industrialists in the rural sectors, point X would be produced using a capital-labor ratio of OD. However, the true market prices of scarce capital and abundant labor in the nation should be represented by the lower capital-labor ratio OE. The production process would be more labor-intensive. Likewise, the rural poor need to progressively increase their capital investment per worker from OF to OE.

Ruttan has argued for induced technological change in which factor prices reflect supply and demand, and therefore, make it economic to use the appropriate mix of factors (40). If the difficult task of making factor prices reflect relative scarcities can be achieved, countries with shortages of capital and an abundance of labor would be induced by market

prices to use small-scale and more labor-intensive technologies. Japan, Taiwan, and Korea have used this method to create the incentive for firms to use more labor and less capital (36, p. 57).

The value of understanding the technical, social, and economic criteria used in the past for developing and selecting technologies provides several insights for creating criteria to develop appropriate technologies for the rural development of the rural poor.

First, when developing and selecting appropriate technologies for the rural poor, the physical-engineering criteria for maximizing efficiency by using the most modern technologies needs to be replaced with new criteria. The new criteria would provide technologies appropriate to the resources, labor availability, financial, educational, aptitude, and organizing skills of the rural poor. Therefore, technical efficiency to the rural poor should not be equated with the most modern and sophisticated technology. Such technologies remain to be adapted to and replaced by technologies which respond to the above criteria.

Second, the social criteria must be incorporated into the criteria for developing appropriate technologies. They cannot be an afterthought, such as the case where the modern technology which has the least social-cultural disruption cost is selected because it is the most appropriate available. Social criteria should not be used only in the selection process of the most appropriate technology, but should be a vital component in the criteria for developing appropriate technology.

Third, the use of economic efficiency criteria is difficult to apply to rural areas in less developed nations. This does not mean they are

unimportant and should not be perfected and used. However, weaknesses must be considered when the economic tools are used. The fact that social cost-benefit analysis (23) and the marginal social productivity criteria (5) are tools of the economist shows the increasing importance of social criteria. This fact reemphasizes the need to include social criteria as a vital part of the development criteria for appropriate technologies.

Economic criteria are necessary to ascertain the economic feasibility of alternative technologies. To determine the efficient allocation of resources, linear programming can be used for the small rural poor farmer. One applied study which would be very relevant to the allocation of resources of the rural Sierra farmer in the Andes of South America was done by Pou (38). In the case where several alternative technologies, involving increased investments, need to be compared, net cost-benefit analysis could be applied. As explained later in this study, the output-capital ratio is a unique tool which can be used for determining resource allocation efficiency in the case study area.

Price policies greatly effect the actual allocation of resources when linear programming and cost-benefit analysis are used. If prices were made to reflect the supply and demand for the resources, different factor proportions would often result. However, the inclusion of price policy would require additional research and is not included in this study. Instead, the potential of technology to lower per unit costs and increase productivity and income given the existing price structure is stressed.

To summarize, the purpose of the criteria used in this study for developing appropriate technology is to enable the rural poor to become active participants in the development process. By using criteria that include

physical and social elements in addition to economics, the rural poor have a better opportunity for participation which in turn may lead to behavioral, value, and institutional changes, thus, further affecting the rate of development.

Therefore, the emphasis is on generating widespread economic growth. The importance of technology, which includes capital formation and innovations in new technological processes, and the dynamics of growth through efficient use of capital investment and increased saving, are explained in this chapter for developing appropriate technologies.

The second factor on which the criteria are based in this study for developing appropriate technologies identified by the rural poor, is the economic institutions in the RDP/LWF-WS area in Peru. Unlike the large government cooperatives in the Peruvian Sierra, the indigenous communities consist of agriculturally dependent small farmers working individual plots. Thus, in most cases, the technologies must be appropriate for the individual small farmer rather than a large cooperative.

The small-scale industries that are planned for the communities of the RDP/LWF-WS area, should meet the requirements of the economic reform of the government of Peru which is based on the concept of "social property" (propiedad social). Social property is the essence of the Peruvian revolution and implies a new social and economic order (14).

Peru's social property law creates enterprises, or in the case of the rural poor, it creates small-scale industries that can be state-financed, are worker owned, and self-managed. The concept is borrowed from Yugoslavia. Although social property will eventually become the largest sector

of the Peruvian economy, the government of Peru plans to implement the concept slowly, and it may take a decade or two. This time horizon coincides with evolutionary development.

Social property represents a new society which is neither capitalist nor Marxist. It is claimed to be a humanistic approach to development. The worker is not at the service of the state as he might be in a Marxist system, nor does he work for a boss as he might in a capitalist system. All workers in a social property enterprise are the collective owners, but no single worker owns anything individually.

Small-scale social property is formed exclusively by the workers and the state will finance the enterprise. With the return from the investment, the small-scale industry repays the state and assigns a small additional portion of its income to a national fund which will be used to finance other social property enterprises. The industries are designed to make money, but the workers do not produce only for their income. They also produce because they are the owners and managers of their own enterprise. They contribute both to nation building, and to the benefit of their fellow workers. Through social property the worker is integrated into the economy and society.

There are several characteristics pertaining to both the rural poor small farmer, and rural poor small-scale industrial worker that have implications for the development of appropriate technologies. First, the rural poor must invest in themselves. Consideration of this characteristic is essential when determining criteria for developing appropriate technologies. When the rural poor make an investment, they must be able to pay back the

amount of the loan and accumulated interest.

Second, wages are not paid directly on an hourly or daily wage. When the rural poor combine their labor with raw material resources and technology, the value they add becomes their return or income. Therefore, profits and wages are the same. No outside owner of capital can exploit the rural poor.

Thirdly, the raw materials used in new appropriate technologies which would in many cases be similar to those used in traditional technologies, can be found locally, and are low cost. Thus, the key to increasing the income of the rural poor, is technology which includes the use of capital and new technological processes. The technology enables the rural poor to become more productive as they combine the use of technology with their raw materials and labor.

Table 12. Criteria for the development of appropriate technologies for the rural poor

I. Purposeful and normative criteria
A. Development of appropriate technologies
1. Economic criteria
2. Physical-engineering criteria
3. Social-political criteria
B. Selection of the most appropriate technologies
II. Dynamic criteria
III. Predictive criteria

The criteria presented in this study for the development of technologies which are appropriate to the conditions of the rural poor are based on: 1) the physical-engineering, social, and economic historical setting of nations for developing and selecting technologies; and 2) the characteristics of the economic institutions in the RDP/LWF-WS area. The criteria are divided into the following categories: 1) purposeful and normative; 2) dynamic; and 3) predictive. In Table 12 a summary of the appropriate technology development criteria is presented.

The purposeful and normative criteria set the objectives which are to be attained. They answer the question of what goals the technologies are designed to meet when developed for rural development of the rural poor. Dynamic criteria involves developing technologies which are capable of generating a continuous self-sustaining process of growth which is widespread amongst the rural poor. Predictive criteria requires that the technology be well tested and that its consequences be studied as best possible so that unwanted effects can be minimized.

The purposeful and normative criteria which technologies should meet if they are to be appropriate for the rural poor, are divided into two components: 1) the development of technologies; and 2) the selection of the most appropriate technology. Purposeful and normative criteria for developing technologies are discussed under three headings: 1) economic 2) physical-engineering; and 3) social-political.

Following the pattern set when analyzing the history of technological criteria for nations, the purposeful and normative criteria for the development of appropriate technologies for the rural poor include the

economic, physical-engineering, and social components. The economic criterion applies to the rural poor as they must fit into economic institutions of the RDP/LWF-WS area. The physical-engineering and social criteria are included to overcome the lack of emphasis or misguidance they have received in the past when applied to rural development. Although the purposeful and normative criteria for the development of appropriate technologies are designed in this study for the RDP/LWF-WS area, they can also provide direction and guidelines for the engineers of all disciplines who are responsible for research leading to the development of alternative potential appropriate technologies for the rural poor.

The purposeful and normative criteria for the development of appropriate technologies for the rural poor classified under economic terms include developing technologies that are:

1) capable of increasing the productivity of the worker, and providing a surplus.
2) suitable for small-scale operation and small markets.
3) cheap enough so that they are accessible to the rural poor.
4) able to give mass economic benefits to the producers instead of middlemen, and that obtain a greater integration of producers into the monetary market system.

The economist serves two roles with respect to the development of appropriate technology. First, he can give advice to engineers so that they might have guidelines in the development of technologies appropriate for the rural poor. Second, he determines which process or method of production developed by engineers uses the scarce resources most efficient-

ly. The above four purposeful and normative economic criteria provide practical guidelines for technical engineers.

The first objective is critical if the rural poor in the RDP/LWF-WS area are to improve their levels of output and living. If the ultimate goal involves aspects of improved levels of living such as better nourishment, better living conditions, better health, better education, and expanded opportunities for employment, then a rise in per capita productivity and income is necessary for their attainment. In fact, economic development, when viewed as self-sustaining increases in productivity, is a means for overcoming low levels of output and living.

Nurkse has discussed the vicious circle of poverty in which the rural poor are trapped. Low productivity leads to low incomes, which lead to low savings and low effective demand, which leads to low investment, which leads to low levels of technology use, which leads back to low productivity (34, p. 5). Therefore, the rural poor must increase their productivity, thus, providing a surplus which increases the effective demand for both food and nonfood products. In order to increase productivity, the rural poor require access to appropriate technologies and institutions. Technologies such as new processes, improved inputs, or capital formation, can improve the productivity of the rural poor.

The second and third economic criteria stress two important constraints on the development of technologies for the rural poor which engineers need to take into consideration. The second economic criteria, which is the first constraint, is the scale of production. Because the size of the farms are small, the rural poor in the communities usually work with only one to two hectares of land. Therefore, small-scale land augmenting technology

such as biological, chemical, and peak season selective mechanization are required to offset the inelastic supply of land. Rather than follow the mechanical technology of the United States, the rural poor need to use biological and chemical technologies as Japan has (36, p. 58).

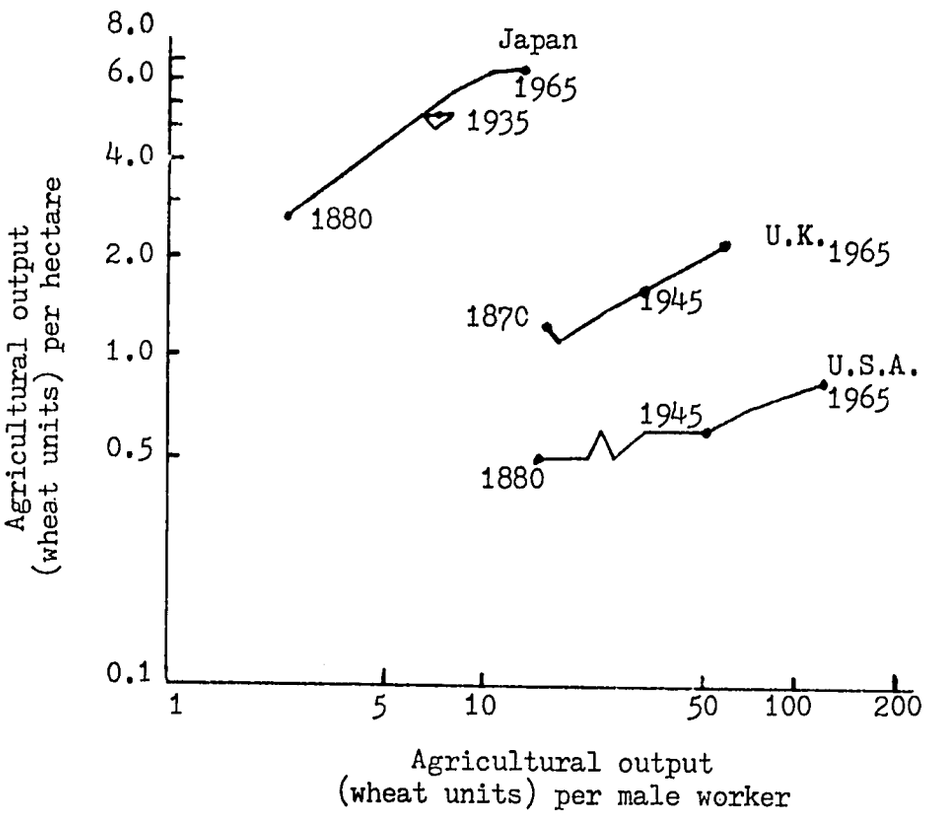


Figure 4. Agricultural output alternatives by country (Adopted from 40, p. 2).

Ruttan (40, p. 2) has indicated that each nation has followed its own path of agricultural development, depending on its resource base. The resource in scarce supply, be it land or labor, is usually made more productive by the appropriate use of technology. Figure 4 shows the many technological alternatives by presenting the various agricultural development

paths for wheat in different nations.

Small scales of production also apply to industry. Because the size of the markets are small in rural areas, small-scale operations are needed that coincide with current economic demand. If large-scale technologies are used, the output generated per unit of invested capital is often much lower in the rural areas of less developed nations, compared to the same technology being used in developed nations. Small, scattered, and seasonal markets combined with poor transport, poor worker discipline and management, and lack of technical know-how to repair breakdowns, contribute to the inefficiency. If large-scale technology is to be efficient, it requires large markets or large farms, a work force trained to use it, and sophisticated infrastructure.

The third economic criterion which is the second constraint, refers to the amount of investment the rural poor can generate. The cost of technological improvements in agriculture and industry must be within financial range of the rural poor. Because the communities do not belong to cooperative farms, and because of the social property concept, the rural poor are required to invest individually in themselves. A small farmer cannot be expected to invest in large expensive pieces of equipment or in many crop and livestock technologies simultaneously. Likewise, for small-scale industry, the investment cost per workplace must be accessible to the rural poor.

The investment costs need to be related to the levels of income of the rural poor or the group of people, who plan to produce the goods resulting from the investment. Schumacher concludes that the upper limit for the

average amount of capital investment per workplace equal the annual income of a worker. Thus, a worker by saving one month's earnings for twelve years could pay for the investment. To summarize, the amount of money that the rural poor have to invest is critical in the development of appropriate technologies (43, pp. 169, 170).

During the historical growth of the United States, capital investment per worker was 1.7 times his annual income in 1880, and 1.8 times his annual income in 1948. The variation of capital investment between industries was not greater than 3:1 during the same time period. Capital investment per worker never ran ahead of society's ability to save out of past and current incomes. Thus, a less developed nation cannot expect to invest heavily in one worker if the benefits of development are to be widespread (24, p. 484).

The fourth economic criterion stresses the need for technologies that permit the rural poor to become the main beneficiaries of increases in output. Technologies are also needed that encourage the rural poor to trade surpluses in the money market.

To summarize, the economist emphasizes the criteria with which engineers must work. First, technology is needed if the rural poor are to improve their levels of output and living. Second, the size of the farms, and market demand for goods is small for the rural poor living in the communities. Third, the rural poor are required to invest in themselves. Because the rural poor in the RDP/LWF-WS area have incomes of approximately $100 per year, the types of technologies which are within their financial range are limited. Thus the capital-labor ratio is relatively fixed.

The purposeful and normative criteria for the development of appropriate technologies for the rural poor classified under physical-engineering terms include developing technologies that:

1) use locally available and easily accessible materials while minimizing the content of materials imported from outside the RDP/LWF-WS area.
2) adapt the equipment and processes to the climate, terrain, and geography of the RDP/LWF-WS area.
3) reduce the need for transportation of raw materials and end products, yet ensure that the product can be conveyed to market by available transportation without deterioration.
4) ensure that the product be produced in sufficient quantity, with adequate regularity and acceptable quality, to encourage demand.
5) employ production methods that are relatively simple, and use equipment designed so that it can be easily maintained by local workers.
6) operate on low amounts of local energy resources, use methods which do not irreversibly disperse nonrenewable resources, and respect the ecological system by not producing waste products at a greater rate than they can be absorbed by the natural cycling rate.

The first physical-engineering criterion refers to the need for developing technologies which do not use scarce capital supplies to replace available labor. Rural areas need to take advantage of the vast labor resource that already exists and add small amounts of capital wisely, which

complement labor and make it more productive. Importing capital from outside rural areas is expensive and takes away money that could be used to stimulate local incomes.

The second criterion of adapting to the geographical setting is important if the rural poor are to adopt the new method. This requires local research, if the technology is to be viable and feasible for the RDP/LWF-WS area. Because transport is extremely difficult in the RDP/LWF-WS area, the third criterion which involves transport of raw materials and finished products, requires special attention. Roads are scarce and technologies relating to transport of goods, and technologies which can minimize transport of inputs, make the product much more appealing to the rural poor because costs and difficult labor are reduced.

The fourth criterion requires that production occur at the time when the output is needed, and most importantly, that the quality of the product is acceptable to the rural poor and competitive with qualities of similar goods produced by modern technology. Technologies that are fairly simple and can be understood by the rural poor are the fifth criterion. The repair of equipment should be such that the local population is capable of learning how to perform these duties. In addition, simple equipment is less dependent on raw materials of great purity and exact specifications and unlike sophisticated modern technology, simpler technology can be easily adapted to market fluctuations. Technical requirements for producing increased agricultural outputs should also be understood by the rural poor. The final physical-engineering criterion on energy sources and ecological requirements applies more to a developed nation than the RDP/LWF-WS area

in Peru. Yet, the situation in the world of high energy prices and pollution can serve as a warning to the rural poor.

The existing availability of technological alternatives is small for the rural poor, and the solution of technical production problems is not a matter of simply choosing from developed nations. New technological alternatives which meet the physical-engineering criteria need to be developed. These technological criteria apply to engineering aspects of the production function.

Development of appropriate technologies for the rural poor which meet these physical-engineering criteria require much imagination and innovation. There is a need for fresh thinking amongst technical engineers. Solutions are needed where labor, unlike many of the developed nations, is not in short supply. Technology, especially the use of capital, should make the workers more productive without replacing them.

Thus, the development of new technology becomes an engineering one, subject to broad economic constraints. A decision is taken to establish a more productive farmer or to build a small-scale industry to produce a given output. The economist must give advice on the economic constraints and suggest guidelines for the agricultural or industrial engineer to follow. For each product, an upper level on capital investment per workplace or small farmer is set so that the rural poor can invest in themselves. Then an engineer may design on paper as many production processes as he likes within this capital-labor ratio. This represents an exciting challenge to the competence of an engineer.

In addition to economic constraints, the agricultural and industrial

engineer should also be subjected to social-political criteria when developing alternative appropriate technologies. The purposeful and normative criteria for the development of appropriate technologies for the rural poor classified under social-political terms, include developing technologies that:

1) provide an expanding number of productive jobs from the limited amount of capital available while minimizing the displacement of labor and the creation of more unemployment.
2) spread the benefits of growth more widely amongst the rural population.
3) involve local rural poor in the RDP/LWF-WS area in planning of what new products, production processes, and services are demanded and in the development of new technologies.
4) fit into work patterns of the rural poor in the RDP/LWF-WS area.
5) take into account the occupational role of both men and women, and the participation of children in the production process.
6) are satisfying psychologically to those who use them.
7) stimulate rather than displace the traditional sector of the economy.
8) use existing or easily transferrable human skills.
9) make the fullest use of existing organizations and institutions.
10) meet the political and ideological concept of what society should be.

Technologies which lead to increased employment and allow the benefits of growth to be spread more widely, fulfill the first and second social

criteria. Increased incomes which result from the creation of new jobs contribute greatly to the stimulation of effective demand for marketable goods in traditional consumer products. In addition, creation of jobs is important if the poor are to be able to work their way out of poverty. For the rural poor, the opportunity to do productive work is among the greatest of all needs (43, p. 103).

When appropriate technologies are developed that are subject to a capital-labor constraint which is dependent on the incomes of the investors, large increases in unemployment are avoided. As output expands from the use of the new technology, and new effective demand increases, new jobs will be created. Thus, technologies designed to meet the income levels of the rural poor also consider the employment issue. Stressing the rural development objective of increasing the levels of output and living for the rural poor, by its definition of helping the poorest population, helps make the distribution of income more equal and disributes benefits of growth more widely.

A study session by practitioners on low-cost technologies, sponsored by the Organization for Economic Cooperation and Development (OECD), concluded that the rural poor need to be involved in the development of appropriate technologies (35, p. 18). When this occurs, criteria three through six, which include work patterns, occupational roles by sex and age, and psychological and cultural conditions, can easily be taken into account. Engineers can benefit from the input received from the rural poor as they work together on developing appropriate technologies.

For example, technologies must fit the work pattern and occupational

roles by sex and age. During sowing and harvesting, farmers work long hours compared to short hours during slack seasons. In some cases women are often better suited to certain types of jobs, but the technology is developed for male workers. Equipment for women is not commonly found, and small lightweight agricultural tools and equipment for children are seldom manufactured.

Criterion seven states that technologies which are appropriate socially and culturally, should stimulate the traditional sectors. When technologies are small-scale and labor-intensive, fewer jobs are eliminated and incomes and effective demands increase. Linkages both backward and forward develop between agriculture and industries, which in turn stimulate effective demands for more goods. Increased agricultural output creates forward linkages by providing inputs for agricultural processing and backward linkages in its demand for agricultural inputs.

If technology is to be accepted successfully, criteria eight and nine state that they fit the existing human resources and institutions in the RDP/LWF-WS area. Skills which are time consuming and costly to learn are not feasible. Likewise, technologies should coincide with the rural poor's ability to work with them and to integrate them into the structures of the community. When equipment is simple, it is more easily understandable and suitable for maintenance, men are easily trained, and control and organization are simpler.

Appropriate technology for the poor also has a political dimension, since it is oriented primarily toward the most underprivileged group in society. Political ideology concerning the vision of what society should

be, is important to the success of the development of appropriate technologies. Political leaders should know what kind of society culturally and economically they want to evolve and emerge out of development. Objectives relating to the involvement and employment of all the people, nutritionally adequate diets, education and health services, clothing and shelter for all, and distribution of development benefits comprise the rural development ideology (9, p. 16).

Rural development as defined in this paper, emphasizes involvement of all the rural poor so that they all benefit from development. The rural poor need to be involved and employed as active participants so that their levels of living will improve. This ideology has important repercussions on the type of technology that is to be developed. If governments oppose this view of rural development, it naturally becomes difficult to develop technologies appropriate for the rural poor.

In summary, appropriate technologies for the rural poor should be developed by the rural poor and engineers to meet the economic, physical-engineering, and social-political criteria for each product. The task is challenging and is not easy. Once several alternatives are designed for a product, the problem becomes one of selection.

Selecting the most appropriate technologies for the rural poor in the RDP/LWF-WS area in Peru is also part of the normative and purposeful criteria. This study suggests <u>two steps</u> in selecting the most appropriate technology for a given good. First, the most appropriate technology is selected from the alternative technologies designed by the engineers. Second, the appropriate technology chosen is compared to the existing tradi-

tional technologies and modern technologies.

In the first step, the criterion used in this study for selecting the most appropriate of the potential technologies which were developed according to the purposeful and normative economic, technical, and social criteria, is the incremental output-capital ratio. This ratio is used to compare the alternative appropriate technologies in economic terms.

The incremental output-capital ratio measures the increase in output resulting from an increase in capital investment during a given time period. It is assumed in this study that a capital investment includes investment in existing capital, newly developed capital, and new technological processes. Thus, diminishing returns to capital can be offset by the use of newly developed capital and new technological processes.

Two important limitations of the incremental output-capital ratio must be taken into consideration when this criterion is used. First, is the time required for a project to mature.

Table 13. Projects with different life expectancies

	A	B
Δ Capital investment	$100	$100
Δ Output/yr.	$40	$25
Life expectancy	4 yr.	20 yr.
Δ Total output	$160	$500
$\Delta y/\Delta k$ (incremental output-capital ratio)	.4	.25
Δ Total $y/\Delta k$	160/100 = 1.6	500/100 = 5.0
Present value (at 5% interest rate)	$142	$249

Table 13 indicates the problems involved when projects do not mature at the same time. When the life expectancy of two projects differ, the present value should be calculated for both projects A and B to determine the most efficient use of capital.

Secondly, the investment in fixed and working capital (not including raw materials) should be computed in the calculation of capital. In the case of agriculture, this enables the researcher to include items such as fertilizer and new seeds in capital investment.

Although the incremental output-capital criteria is not as complex as many economic tools, it fulfills the economic conditions of the rural poor in the RDP/LWF-WS area in Peru and provides practical guidelines for investment decisions in technology. In the RDP/LWF-WS area, increases in income result from the use of improved technologies as they are applied to raw material resource inputs. Wages are not paid on a fixed hourly or daily basis to the rural poor analyzed in this study. Thus, the procedure for the rural poor to increase their incomes is to use capital which includes new technological processes that will increase their output and thus, their income. It follows, that given their income constraint on the amount they can invest in new technology, the rural poor will want to maximize the increase in output for their given capital expenditure, so that income is maximized.

The economic criterion of maximizing the productivity of additional capital investments, or stated differently, obtaining the largest increase in output for a given increase in capital expenditures, is important in countries where capital is scarce and labor abundant. When a number of

alternative appropriate technologies for producing a given output have been developed within the capital-labor constraint, the technology which achieves the highest incremental output capital ratio should be selected.

Although the maximization of the incremental output-capital ratio is an economic criterion, the ratio is closely related to the physical-engineering efficiency concept because the engineer maximizes the efficiency of capital in physical terms while the economist adds prices to the analysis of production data given to him by the engineer. Physical or engineering efficiency requires the maximum increase in output for a given increase in physical capital. In developing appropriate technologies for the rural poor, the engineer's constraint is not a specified set of physical inputs, but rather a dollar (Peruvian sol) constraint on the amount of different types of capital and technical processes he can use in the production function. This provides the engineer with much flexibility. The dollar constraint is represented by the capital per worker ratio dictated by the amount of investment the rural poor can place in a small farm or small-scale industry. The dollar constraint per worker can be invested in any type of capital or technological process, as long as the process is appropriate for the given capital-labor ratio. Then the process which maximizes the increase in output should be chosen.

The economic criteria of maximizing the dollar value increase in output for an additional capital expenditure relates to the rural poor in the RDP/LWF-WS area, who, as managers of their own small-scale industries under social property, or owners of their land, depend on value added, rather than wages or rents for their incomes. The application of capital and new

technological processes to existing resources provides increases in output and income. The technical process of the engineer which maximizes the increase in output for a given increase in capital expenditures simultaneously maximizes the economic efficiency of the additional use of capital. Maximizing the incremental output-capital ratio for the rural poor involves the most economic use of the scarcest factor, while using more of the plentiful labor factor in the production process than would occur if capital-intensive technologies were applied.

Selecting the most appropriate technology by using the incremental output-capital ratio does not violate social-political objectives of rural development. It is assumed that all appropriate technologies are developed to meet the purposeful and normative social-political criteria of developing technologies for the rural poor. When these criteria are met and combined with a fixed capital-labor ratio, minimization of social and cultural disruption results.

In the second step of selecting appropriate technologies, the selection is based on the competitiveness of the newly developed appropriate technologies when they are compared to existing traditional technologies and modern technologies. The modern technologies are represented by products of large-scale industry within the country. According to appropriate technology practitioners, newly developed appropriate technologies which have the greatest chance for success are the ones which are most competitive according to their economic viability when compared to modern and traditional technologies (35, p. 56).

This study suggests the criteria of choosing the highest average out-

put-capital ratio, for measuring the economic competitiveness of appropriate technology when compared to modern technologies. The average output-capital ratio measures the annual output produced divided by the value of the total capital stock. In this case, the output is maximized for given total capital costs.

When the average output-capital ratio of the most economically efficient appropriate technology is compared to a modern technology, producing the same product by a large-scale, sophisticated technology, a number of products may fail to be as economically efficient in average output-capital terms, when undertaken on a small-scale level of technical simplicity. In these cases, a large-scale approach based on a more sophisticated technology may be the only efficient way to produce a good in a less developed country. Examples would be heavy chemicals, oil refining, iron and steel. These products are not normally an urgent need of the poor and should not be adopted by them (43, p. 175).

Modern capital-intensive technologies usually require large markets, and a highly trained labor and managerial force. If placed in rural areas, the average output-capital ratio would fall because of the likelihood of labor inefficiencies, inability to repair breakdowns and poor management. Even if the average output-capital ratio did not fall when large-scale capital-intensive modern technology was transferred to the rural area, the capital cost per workplace would be far beyond the reach of the rural poor.

When comparing appropriate technologies for the rural poor, and modern technologies in economic terms, an appropriate technology with a higher average output-capital ratio than a modern technology producing the same

good is most likely to give the rural poor the highest income, assuming the price of both outputs is similar. A higher average output-capital ratio would yield more output for the total capital investment. In addition, transport costs and overhead costs are likely to be lower for small-scale labor-intensive industries, because lower rural costs can offset many of the economies of scale characteristic of large-scale modern industry.

When appropriate technologies meet the social-political criteria, they are usually more acceptable to the rural poor than modern technologies. Appropriate technologies minimize social disruption when productivity is increased by successive small increments, rather than by large single steps. Successive small increments prevent rapid increases in unemployment and encourage gradual change in cultural behavior and institutions. Large-scale modern technologies can seldom meet the requirements of minimum social and cultural disruption. Thus, the social acceptability of appropriate technologies is usually greater than the acceptability of modern technologies.

The characteristic of appropriate technologies, which makes them more acceptable in social and cultural terms, is largely due to the capital-labor ratio which is set by the amount of capital that is within financial reach of the rural poor. Therefore, capital complements the worker and prevents capital-intensive technologies from creating large amounts of unemployment. Maximizing the incremental output-capital ratio for capital investments subject to the capital-labor constraint causes incomes for the rural poor to rise. Thus, income improves, and effective demand for traditional goods increases, leading to more employment.

The selected appropriate technology must also be compared to tradition-

al technologies in terms of income generation. In this comparison, incremental output-capital ratios should be used. Although investments in technologies may increase output, the new output increases must be marketed and result in an increased income above the new costs of the technology. Thus, the marginal revenue generated by the new technology must be greater than the marginal costs of the technology. If the difference between marginal revenue minus marginal cost is minimal, for example only a few dollars, and the rural poor are required to work longer hours, the incentive to use the appropriate technology may be lacking.

The criterion of maximizing the incremental output-capital ratio is applied differently to agricultural and small-scale industrial production processes. In both processes it is assumed that capital and new technical investment per worker are set. The amount suggested would be within financial range of the rural poor. (Using Schumacher's suggestion discussed earlier, the amount would equal the annual income of the rural worker.)

In the case of the small farmer, it becomes the task of the engineer to experiment with different types of capital and production processes within this capital constraint, and to develop appropriate technologies that fulfill the technical, economic, and social criteria. The range of alternative technologies is quite broad, but much creativity and imagination is still required. The appropriate technology which maximized the incremental output-capital ratio subject to the capital-labor ratio would be selected. Next the economic viability of the appropriate technology should be compared to modern and traditional technologies to determine whether the rural poor will adopt the technology.

Development and selection of appropriate technologies for small-scale industries differ somewhat in approach. Instead of working with one farmer and a fixed size of land, the critical element is the market size and scale of production. First, output for a product which is based on effective demand should be calculated to determine the needed scale of production. Then engineers should experiment with different forms of capital and production processes that use a capital investment per workplace, which permits the rural poor to invest in themselves in a manner that enables them to pay back the loan. Other economic, technical, and social criteria also need to be pursued. The selection of the most appropriate technology is based on the technology that minimizes the use of capital required to produce the fixed output, subject to the capital-labor constraint. The average output-capital ratio for the selected small-scale appropriate technology must be compared to modern technologies. The small-scale appropriate technology should not be adopted unless it uses capital more efficiently, in terms of average output-capital ratios, than the modern sector.

The development of public service and infrastructure technologies differs from technologies involved in the agricultural and industrial process. Public service projects and infrastructure contribute to the productivity of the rural poor, but they do not usually produce an output directly on a continuous basis, such as an agricultural or industrial product to be sold in the market. Thus, it is more important to provide the service or infrastructure with as little capital expenditure as possible. This requires the use of many man hours and local raw materials to undertake the

project. Such projects should be planned during the slack seasons when more labor hours are available. Because all the farmers would benefit from irrigation or the entire community would benefit from a drinking water project, increased productivity in agricultural and small-scale industry should be emphasized to provide funds for financing public service and infrastructure projects.

In summary, this study suggests the use of the highest incremental output-capital ratio, subject to the capital-labor constraint for selecting the most appropriate technology. When appropriate technologies are developed which meet the purposeful and normative technical, economic, and social criteria, the amount of capital used to raise productivity is increased and the capital per worker ratio is accessible to the rural poor. Therefore, with a fixed capital cost per worker, both the engineer and economist should be concerned with maximizing the increase in physical output or value of output for a fixed capital expenditure in appropriate technologies.

Because the incremental output-capital ratio for appropriate technologies is calculated with a capital-labor ratio lower than exists in modern technologies, the unemployment problem is also minimized. Making labor more productive by maximizing the incremental output-capital ratio subject to capital-labor constraints appears to make appropriate technologies more socially acceptable to the rural poor than modern technologies. When compared to modern technologies, the highest average output-capital ratio should be adopted to produce a good. When the modern technology has the highest average output-capital ratio, the product should be produced by the modern sector.

The second category for developing technologies appropriate for the rural poor is the dynamic criteria. Appropriate technologies should not be analyzed in static terms. Instead, questions must be raised regarding the growth potential of appropriate technologies as they apply to the rural poor in the RDP/LWF-WS area and to the nation. The process of moving from low levels of output and living, to higher levels of living, requires using technologies which provide a self-sustaining growth.

To analyze the ability of appropriate technologies to improve the levels of living for the rural poor in the RDP/LWF-WS area, the basic concept of the Harrod-Domar growth models is presented (6) and (16).

Table 14. Basic concept of the Harrod-Domar growth model

$$\Delta y/y = (s/y) \times (\Delta y/\Delta k)$$

$\Delta y/y$ = change in output
s/y = average propensity to save
$\Delta y/\Delta k$ = incremental output-capital ratio

Table 14 indicates that the change in output depends on the average propensity to save, of the rural poor and the incremental output-capital ratio of the appropriate technology. The higher the savings ratio and the incremental output-capital ratio, the faster will be the rate of growth of output. This assumes that the savings are used for net investment in capital or new technical processes.

Before analyzing the potential of appropriate technologies in the RDP/LWF-WS area in Peru to contribute to growth of output for the area and the

nation, the dynamic characteristic of appropriate technologies is examined. Appropriate technologies are dynamic because they open up possibilities to the rural poor. Growth becomes accessible when the capital-labor ratios are within their financial reach and the organization and education levels required for appropriate technologies can be fulfilled. The capital-labor ratios of appropriate technologies, which are lower than capital-intensive technologies, enable new amounts of capital investment to be spread to more people, particularly the rural poor. As the rural poor increase their incomes by using appropriate technologies: 1) their potential for saving rises; and 2) the effective demand for agricultural and small-scale consumer goods increases. Unlike the situation when increased incomes resulting from capital-intensive investment are often used by the rich minority in a nation to increase the effective demand for luxury and imported goods, the rural poor when given access to increased productivity, have the potential to participate in a dynamic growth process of rural development, which brings widespread benefits. Thus, a variety of markets requiring locally produced products are expanded rather than a very few luxury good markets. Widespread increases in effective demand create dynamic forces for growth.

The dynamic criteria also include an evolutionary nature whereby the rural poor, by using appropriate technologies, can build up an innovative capacity so that they are capable of responding to changes in the physical-engineering, economic, and social nature of the country. This is necessary because technologies which are appropriate at one point in time, can change rapidly. Appropriate technologies must be progressive and keep pace with the process of constant change.

To analyze the potential for growth among the rural poor, the saving habits of the rural poor and the incremental and average output-capital ratios of small-scale labor-intensive technologies need to be examined. This study presents data which were collected from other nations because data on these variables were not available for the rural poor in the RDP/LWF-WS area.

The purpose of using these data are to show the potential of: 1) the rural poor to save; and 2) the availability of appropriate technologies with high incremental and average output-capital ratios. When utilizing data from other nations, it must be emphasized that these data often rely heavily on the economic, social-cultural, and political institutions within the nations. Data on the savings potential of the rural poor are presented in chapter six under the discussion on economic principles required to adopt technologies.

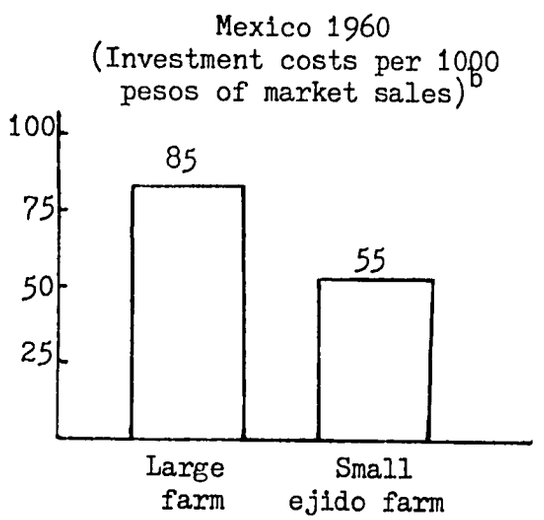
Although the basic concept of the Harrod-Domar growth model does not use the average output-capital ratio, this study has stressed its importance if the appropriate technology is to be competitive with modern technologies because a high incremental output-capital ratio may not necessarily coincide with a high average output-capital ratio.

Once the most appropriate technology has been selected the average output-capital ratio is compared to the modern sector. As stated earlier, products such as oil processing and steel that are produced by sophisticated technologies have higher average output-capital ratios than small-scale technologies producing the same product. These products are not usually the urgent needs of the rural poor. However, the goods urgently

needed, such as clothing, building construction, food, and household goods, usually have lower average output-capital ratios when produced by modern large-scale capital-intensive technologies, instead of small-scale technologies. This is partially explained by the kind of technology needed to employ people in small-scale labor-intensive processes. The costs of these technologies compared to the high costs of sophisticated technologies are relatively low (36, p. 67).

Three examples, one relating to agricultural production, another to small-scale industry, and a third to shoe production, show the potential of appropriate technologies for goods urgently needed by the rural poor to compete with large-scale technologies when comparing average output-capital ratios.

Table 15. Investment cost for the same quantity of agricultural marketable sales[a]



[a]Source: (36, p. 60).

[b]Investment costs of seeds, fertilizers, and production inputs.

Table 16. Capital productivity for different scale industries[a]

Country and industry scale	Capital per worker	Productivity of capital (average output-capital ratio)
Japan industries	(yen)	
10-29 workers	78,000	3.70
10,000+ workers	651,000	1.37
Taiwan industries	(New Taiwan dollars)	
Less than 25 workers	3,800	1.75
More than 1000 workers	106,380	.20
Chile industries		
5-19 workers	-	.93
20-199 workers	-	.72
200+ workers	-	.57

[a]Source: Adapted from (25, pp. 410, 411).

Table 15 indicates that the cost of investment per 1000 pesos of agricultural market sales is less on small farms than on large farms in Mexico. The cost of seeds, fertilizer and other production inputs for large farms is 30 pesos more per 1000 pesos of market sales than the ejido farms. The ejido farms are the name given to the small farm beneficiaries of Mexico's land reform program.

Secondly, Marsden states that census data for a number of countries indicate that smaller enterprises with a lower level of investment per worker, tend to achieve a higher average output-capital ratio (25, p. 410).

Table 16 presents the results of some of Marsden's findings. The case studies which include Japanese, Taiwan, and Chilean industries show that small-scale industries which have a lower level of capital investment per worker tend to achieve a higher productivity of capital than do larger more capital-intensive industries.

Thirdly, a study on the choice of technology for a given output in the shoe industries in Ethiopia and Ghana has related the capital-labor ratio to: 1) the average output-capital ratio; 2) private and social profitability as measured by net present value and internal rate of return; and 3) employment (37). The study summarized in Table 17 indicates that the lower capital-labor ratios in the shoe industry had a higher average output-capital ratio, provided the highest net present value and internal rate of return and increased employment.

Relatively small-scale labor-intensive technologies which have higher average output-capital ratios are also likely to have, in many cases, a higher incremental output-capital ratio. Research has shown that the incremental output-capital ratio of nations using small-scale labor-intensive technologies is often higher than that of large-scale capital-intensive technology nations.

In Table 18 the incremental output-capital ratio is analyzed on a national average. Table 18 lists the investment cost of increasing production by one dollar (incremental capital-output ratio) and the incremental output-capital ratios for the same countries from 1960-1969. Korea and Taiwan, which are characterized by small-scale labor-intensive technologies have used their capital efficiently. The Latin American countries, which

Table 17. Effect of capital-labor ratio on profitability and employment[a]

Factory	Capital labor ratio	Private profitability: Net present value at 10%	Private profitability: Internal rate of return	Social cost-benefit: Net present value at 10%	Social cost-benefit: Internal rate of return	Employment increase from factory A to B	Output-capital ratio
	(cedis 000)		(%)	(cedis 000)	(%)	(%)	(shoes/cedis)
Ghana shoe factory							
Factory A	4960	912	19.9	2615	34.3	-	$\frac{300,000}{683,000}$
Factory B	1420	1113	27.1	3033	51.5	37	$\frac{300,000}{276,000}$
Ethiopia shoe factory	(Eth. $)			(Eth. $)			(shoes/Eth. $)
Factory A	7450	1535	19.9	6873	55.9	-	$\frac{300,000}{1,043,000}$
Factory B	2620	1783	24.3	7252	81.7	28	$\frac{300,000}{512,000}$

[a]Source: Adopted from (21, p. 50).

Table 18. Incremental output-capital ratios for selected nations[a,b]

Country	Incremental capital-output ratios (Capital cost of increasing output by $1)	Incremental output-capital ratios (output increase from $1 invested)
Korea	$1.70	$.59
Taiwan	2.10	.48
Israel	2.90	.34
Japan	2.90	.34
Mexico	$3.10	$.32
Phillipines	3.50	.29
U.S.A.	3.70	.27
India	3.90	.26
Peru	4.00	.25
Chile	4.00	.25
Venezuela	4.90	.20
Argentina	5.60	.18

[a]Source: Adapted from (36, p. 67).

[b]Data based on 1960-69 averages.

are dominated by the modern sector, and the United States, use relatively more capital-intensive technologies compared to Taiwan and Korea. The result is a lower incremental output-capital ratio (36, p. 68). Thus, Table 15 indicates that incremental output-capital ratios are high when using small-scale labor-intensive technologies.

Although research on small-scale labor-intensive technologies is scarce, these early findings indicate that appropriate technologies relating to goods demanded by the rural poor often have higher average and incremental output-capital ratios than modern technologies producing the same product.

Thus, according to the Harrod-Domar concept for growth, appropriate technologies can lead to more rapid dynamic growth because of their higher incremental output-capital ratios.

A final comment on the incremental output-capital ratio relates to the selection of the most appropriate technology from the alternatives developed by the engineers. According to Table 14, choosing the appropriate technology with the highest incremental output-capital ratio also contributes to the most rapid growth of output for the rural poor and thus, the nation.

In summary, the rural poor in the RDP/LWF-WS area can improve their levels of output and living by cummulatively applying relatively simple improvements in technology, which do not depart radically from tradition or require large units of new investment. By adopting appropriate technologies with the highest incremental output-capital ratio, which are available to the rural poor financially and which are competitive because their average output-capital ratios are higher than in the capital-intensive modern sector, the dynamic growth process should be accelerated in rural areas. Output, incomes, and employment of the rural poor will increase, and encourage further savings and investment in appropriate technologies with the highest incremental output-capital ratios. Thus, appropriate technologies with higher output-capital ratios than modern technologies, increase the supply of output more rapidly. Simultaneously, the appropriate technologies stimulate effective demand for goods in many markets of the rural poor.

Based on the data in this section on incremental and average output-capital ratios, the potential for developing small-scale labor-intensive

technologies with high incremental output-capital ratios which have higher average output-capital ratios than those found in the modern sector, appears promising. Much technical research is required, but if this is done, technologies appropriate for the rural poor in the RDP/LWF-WS area in Peru should be found to exist.

The third major category for developing and selecting technology appropriate for the rural poor is the predictive criteria. Technologies which have the potential to improve the levels of living for the rural poor also have unforeseen side effects on society.

If technologies are to be appropriate, the probable impacts they will have on the rural poor must be analyzed so that any adverse effects will be known and alleviated if possible. In the case of increasing agricultural production amongst the rural poor, new technologies can be tested on community demonstration plots. It is more difficult to predict the future impact of new technologies in public services, infrastructures, and small-scale industries.

Despite these difficulties, much effort must be committed to understand the repercussions on the society which the technologies bring. In the case of appropriate technology, the purposeful and normative criteria, if met, eliminate many of the negative effects of technology. Nevertheless, careful thought and planning are required to prevent the adoption of technologies that are not appropriate for the rural poor.

In summary, technologies which are carefully developed according to the normative and purposeful, dynamic, and predictive criteria, are defined as appropriate technologies for the rural poor. The concept of ap-

propriate technology or the choice of technology is receiving a revival of interest. However, this concern is not new. Articles in the 1950's and 1960's anticipated the debates of today. One difference is that recent interest is more concerned about the employment question than simply investment criteria. This study includes more than the employment issues, and stresses the relationship of appropriate technologies for the concept of rural development.

India is one country in which appropriate technology is not new, for it has several decades of practical experience. China, along with India, is considered one of the two foremost proponents of appropriate technology (35, p. 15). Because China's development effort, unlike most other countries, has focused on the rural areas, it also has much practical experience to offer to the development of appropriate technology designed for the rural poor.

Around the world there is a growing interest of national governments and aid-giving agencies in appropriate technology. The World Bank, International Labor Organization, Organization for Economic Co-operation and Development, and the United Nations, along with private and public organizations in Canada, England, the Netherlands, Sweden, the United States, and West Germany, consider appropriate technology an effective tool in the development process (35, p. 65).

The work being done by these various appropriate technology groups shows that it is technically possible to develop new products, production processes, and services which are better adapted to the resource environment of the rural poor than the capital-intensive modern technologies.

Their contribution provides hope for the rural poor by showing that these alternative approaches can mobilize the human and physical resources in the rural areas more effectively than they are now being used (35, p. 48).

The Potential of and Need for Appropriate Technology Research in the RDP/LWF-WS Area

The rural development goal expressed earlier in this study, stated that the levels of living of the rural poor in the RDP/LWF-WS area were to be improved by the use of technology. Economic development has continually extracted a surplus and taken innovative and educated people from the rural areas to support urban industrial development, to the relative neglect of rural development. It is now time to focus intellectual and technical resources on the rural areas. If this is to be done, a wide range of technologies appropriate for the rural poor in the RDP/LWF-WS area need to be developed. These technologies should emphasize agricultural production for rural development because few countries have experienced widespread development except on the basis of an agricultural base.

What makes the economy in the RDP/LWF-WS area in Peru function, is thousands of small farmers, craftsmen, merchants, and traders who, on a small-scale, provide the rural population with a vast range of products and services. Appropriate technologies accessible to these thousands of people are needed if their levels of living are to increase.

Large-scale modern technology, tends to accentuate the economic and social differences between a small minority which benefit as producers and consumers, and the large majority living in the rural areas. The artificial

acceleration of large-scale modern technology tends to destroy the process of traditional technology and the hope of the rural population. Because the world's technology is designed mainly for the rich developed countries, a change in strategy is needed to bring about improvements in the levels of living of the rural poor.

Given this setting, appropriate technology is viewed as a survival technology for the rural poor in the RDP/LWF-WS area who are not able to participate in the development process of large-scale capital-intensive technologies. Stated differently, appropriate technology may be the most promising solution to the development and survival of the rural communities in the RDP/LWF-WS area. For the rural poor, who cannot afford the amenities of the modern consumer society, appropriate technology represents a big step forward as an effective means of meeting some of their basic needs for food, health, and shelter.

Appropriate technologies, understood by everyone and capable of being produced by local farmers and craftsmen, will not only improve the levels of living, but show the rural poor in the RDP/LWF-WS area that they themselves can be the major agents of change. The potential of appropriate technologies to turn rural development into an autonomous self-sustaining process of innovation and growth by the rural poor can be an effective means of stimulating rural development.

Appropriate small-scale labor-intensive technologies are able to stimulate the entire rural economy. Because of their small scale, they: 1) can be located throughout the country and in small towns; 2) are accessible to the rural poor; and 3) are more likely to interact with traditional

craft sectors and agriculture than modern technologies.

Increased employment through more appropriate technologies would raise incomes and thus, generate a greater and much needed effective demand for traditional consumer goods. Lack of effective demand seriously dampens the growth of rural area small-scale industries. Capital-intensive technologies and their associated high wages, shape demand away from traditional consumer goods in favor of Western-type goods which require foreign imports in goods or production inputs.

If appropriate technology is to be developed for the rural poor in the RDP/LWF-WS area, a research center is needed. Such a research center could be a pilot study. Technologies appropriate for the rural poor in the RDP/LWF-WS area could be transferred to other areas of the rural Peruvian Sierra where they would be tested and modified if needed.

The expense in terms of dollars and manpower of developing alternative technologies would be high if each province were to have its own program. However, once alternative technologies have been developed in strategically located areas, they can be distributed to province centers where modifications and suggestions can be made to improve their appropriateness. It should be noted that the purpose of appropriate technology research is not to substitute for modern technology research but to complement it.

The research should be done locally with the involvement of the rural poor in the RDP/LWF-WS area who will be using it. Local research promotes a much closer convergence between the real needs of the local communities and the research activities of those developing and selecting appropriate technologies. The method for identification and the criteria used in this

study for developing and selecting appropriate technologies would be adopted by the research center. Through the COIC, the rural poor would make their requests for new technologies. The procedure of the oral and written requests combined with the community analysis enables the researchers to get good information on technological demands.

To make the technological research more appropriate for rural development, the research team might consist of: 1) older community members who would question the technical and attitudinal change; 2) young community members who desire change and have youthful vitality; and 3) trained scientists, engineers, and social scientists. Research teams would be stationed at an experiment station located in the RDP/LWF-WS area, and would periodically travel around to the communities. Basic research carried on at the department and national levels could support work done at the province level in the RDP/LWF-WS area.

There are many methods for developing appropriate technologies for the rural poor. Possible methods would include the following four approaches. First, would be the development or invention of entirely new technologies. Secondly, existing indigenous technologies can be improved and modified. Thirdly, modern technology can be adopted or modified to the local conditions. This would include scaling down in certain production areas. Fourthly, old technologies can be revived. Old designs and processes and second hand machinery, which were developed when incomes in the developed nations more closely represented those in the less developed nations today, can be used.

The most important appropriate technology needs in the RDP/LWF-WS area

in Peru relate to agricultural production. Agricultural output should be increased by making available, within financial means, new inputs such as improved seed varieties, fertilizer, other biological-chemical forms of capital, improved implements useful for breaking seasonal bottlenecks, and improved technical knowledge which complements the land and labor resources of the rural poor. These technical improvements are primarily labor-intensive, chemical, and biological, and not mechanical. Machines and tools needed would complement or augment human labor rather than displace it. Field testing and demonstration plots in the communities are required to show the rural poor that the appropriate technologies can benefit them.

Public service projects are important to the rural poor in the RDP/LWF-WS area. Because they are willing to provide the labor and local resources free to improve their community, technologies requiring the lowest capital input for the given output are appropriate. The benefits of these projects to production, although indirect, can be large when compared to the costs. Infrastructure such as community irrigation projects can also be treated in the same manner.

Small-scale industries depend on demand. The effective demand for agricultural tools, transportation, food processing, building materials and clothing is small now, but should increase as outputs and incomes rise.

CHAPTER VI. ADOPTION OF TECHNOLOGIES APPROPRIATE FOR RURAL DEVELOPMENT IN THE RDP/LWF-WS AREA IN PERU

Chapter six presents the remedial phase for the adoption of appropriate technologies for rural development. The role of institutions which are accessible to the rural poor in the RDP/LWF-WS area in Peru, and which facilitate the adoption of appropriate technologies are emphasized.

Section one of the three sections into which this chapter is divided, restates the success elements introduced in chapter four that need to be strengthened. These success elements for the adoption of appropriate technologies promote the method dimension of mass participation and the process dimension of self-sustaining growth in rural development. Section two develops new success elements and section three extends and applies the remedial phase analysis of the first two sections to the RDP/LWF-WS area in Peru.

Strengthening Success Elements for Adopting Appropriate Technologies in the RDP/LWF-WS Area in Peru

In the RDP/LWF-WS area, many success elements existed for the adoption of appropriate technologies. First, public service and agricultural production projects were adopted through the community organization of the indigenous community, referred to as the COIC in this study. The COIC of the rural poor in the RDP/LWF-WS area have been used to serve the function of local government. Officials have been elected to organize community activities, carry out administrative roles and act as judges. In chapters four and five, the role of the COIC in identifying technological needs was presented in detail.

The COIC also provided the basic institution for the adoption of appropriate technologies and is, therein, an initial major success element. As the communities of the RDP/LWF-WS area adopted technologies, they provided the following success elements with respect to institutions needed to adopt appropriate technologies: 1) rather than creating institutions and new organizations, existing organizations were used successfully to adopt technologies; 2) local leaders were used to teach the rural poor and to implement the adoption of technologies; 3) the rural poor responded well to contracts and sanctions placed on them; and 4) when the rural poor were actively involved in organizing the adoption of technologies, success resulted.

A second major success element was the role of the Lutheran World Federation-World Service Department in Peru. This role provided success elements regarding the different functions that a second tier organization, one step above the COIC, could provide in strengthening institutions needed to adopt appropriate technologies. These functions included providing technical and organizational assistance, inputs, and financial support.

While performing these functions, the officials of the Lutheran World Federation-World Service Department in Peru provided insights into the additional success elements of: 1) respecting existing rural poor institutions; 2) understanding the culture of the rural poor; 3) allowing the rural poor to plan the procedure for the adoption of technologies; 4) demonstrating dedication to the rural poor; and 5) providing the use of appropriate technical expertise required for adopting technologies appropriate for rural development.

These success elements should be retained and strengthened. Strengthening the COIC's and a second tier organization to support the COIC's in the adoption of appropriate technologies, requires placing increased emphasis on these two organizations. These organizations should be encouraged by the government of Peru to continue their role in facilitating adoption of technologies appropriate for rural development. In addition, new success elements are presented in the next section, which also strengthen existing success elements while simultaneously eliminating failure elements. The reason for this rests in the philosophy that the development of new success elements should take into consideration the success as well as the failure elements of existing institutions.

New Success Elements for the Adoption of Appropriate Technologies for Rural Development

New success elements are required to minimize the failure elements that existed in the RDP/LWF-WS area in Peru. The three failure elements for adopting appropriate technologies, introduced in chapter four, were the: 1) opposition to rural development projects by leaders from the Mestizo class; 2) absence of adherence to economic principles in the COIC that facilitate adoption of appropriate technologies; and 3) lack of an understanding of the evolutionary characteristic of rural development.

In this section, new success elements for adopting appropriate technologies in rural development are proposed using the following two step procedure. First, the economic principles that were absent in the COIC are defined. It should be stressed that this study focuses on the economic as-

pects of institutions which were introduced in Figure 2 of chapter two under the discussion referring to the physical, economic, and institutional interrelationships for adopting appropriate technologies. Social, cultural, and political chatacteristics although important, are not examined in detail. Second, the evolutionary nature of the organization, education, and discipline required to develop and make the economic principles premanent and predictable institutional characteristics of the COIC is presented. Eliminating the failure element regarding the Mestizo class is included in this second section.

The rural poor in the communities of the RDP/LWF-WS area possess the institutional organization, which is the COIC, needed to adopt appropriate technologies. However, the COIC lacks basic economic principles required for the adoption of the technologies. These economic principles can augment the existing institutional capacity of the COIC to adopt appropriate technologies so that rural development of the rural poor becomes viable.

Table 19. Economic principles needed in institutions for adopting appropriate technologies

1. Role of technology in increasing production and in enhancing distribution of productivity.
2. Low-cost delivery of inputs and marketing outputs.
3. Role of savings for investment.
4. Financial intermediary of credit for investment.

Table 19 specifies the economic principles lacking in the institution represented by the COIC of the RDP/LWF-WS area in Peru. The first economic principle for COIC's to use in adopting appropriate technologies is the fundamental role of technology for increasing production and enhancing distribution of productivity. Through the COIC, information can be provided for the rural poor concerning appropriate technologies that: 1) have the potential to improve their levels of output and living; 2) are most efficient in the use of capital; and 3) enable mass participation in rural development. The role of technology and capital formation in increasing output, is an essential economic concept to teach the rural poor.

The second economic principle emphasizes the role of the COIC in providing efficient, low-cost, and trustworthy delivery of inputs for increasing production and building infrastructure and public service projects. Marketing the output can also be handled by the COIC. Good communications, information on prices, transportation, and storage, are all important components of marketing which the COIC can provide the rural poor.

Accumulating savings and acquiring access to credit for financing investments in appropriate technologies, are the third and fourth economic principles. Credit can come from outside sources, such as the government or commercial banks, as well as from within the communities. In the beginning, financial help from outside is needed because the rural poor will not be able to save sufficient funds until their incomes begin to rise. However, the COIC should strive to build up savings from its own members to finance investments and to become less dependent on outside sources. The rural poor require access to credit and savings facilities if they are

to invest in appropriate technologies, which increase their productivity. Developing financial institutions that are conveniently accessible to all producers is an important condition of the process of self-sustaining rural development.

Schumacher has stressed the need for the organization, education, and discipline of people for successful development (43, p. 159). These three characteristics are required if the rural poor in the RDP/LWF-WS area are to apply the four economic principles needed in institutions for the adoption of appropriate technologies. Through organization, education, and discipline, a strong economic base can be developed in the COIC. These economic principles, which enable the rural poor to understand the role of technology and have access to appropriate technologies, simultaneously contribute to a self-supporting and self-sustaining process of rural development because of their emphasis on savings and investment to increase productivity.

Organization provides the structure whereby individuals can work together to solve common problems. Once the people are organized, the means for educating and developing discipline among the rural poor regarding the economic principles, can be achieved. Education and discipline are needed so that the attitudes and values of the rural poor, with respect to the four economic principles required of institutions to adopt technology, become a permanent part of the rural poor behavior.

The importance of organization, education, and discipline was evidenced by the rapid recovery of Europe after World War II. Only capital and money were needed to regain and even surpass the economic standing experienced

before the war, because the strong organizational, educational, and disciplinary base still existed. Yet, money and capital sent to a nation which has not developed the organization, education, and discipline of its people, cannot achieve rapid and widespread growth for the population.

For these reasons, rural development cannot be ordered by the politician, bought with money from overseas or domestic resources, or merely planned in economic terms. Rural development is evolutionary. Organization, education, and discipline do not occur instantaneously, but gradually evolve step by step as they become the property of the rural poor. The process of rural development should attempt to speed up the evolutionary process. However, if new appropriate technologies or economic activities are introduced that depend on organization, education, and discipline which the rural poor do not have, the activity will have little opportunity to succeed (43, pp. 159, 160).

It cannot be assumed that the required institutional organization, behavior, and discipline needed to adopt the technologies will develop, as if by some "invisible hand" once appropriate technologies have been identified and developed (40, p. 7). Special attention needs to be given to the development of institutional organization, behavior and discipline required for adopting appropriate technologies, because facilitating institutions are a necessary condition for accelerated rural development. When the rural poor do not have access to the means of adopting technologies which are appropriate, the result can often be frustration, despair, and dissatisfaction of those who would like to change. This frustration can cause the rural poor to migrate to the urban areas hoping to improve their

levels of living. Both appropriate technologies and appropriate institutions are needed for the rural poor. Either by themselves will achieve only small gains (49, p. xi).

The nature of the institutional organization through which the rural poor can acquire an understanding of the economic principles for adopting appropriate technologies, merits special emphasis. Five issues relating to local organizations for adopting appropriate technologies are discussed. The issues include: 1) the importance of using existing organizations; 2) reasons for working through local organizations; 3) the choice between single or multiple purpose local organizations; 4) a two-tier approach; and 5) the geographical dimension.

The first issue relates to the important lesson of working through the existing organizations whenever possible. These organizations can be slowly modified to incorporate new ideas. It is very easy to destroy an old system, but experience proves it is not easy to build new organizations to replace old ones. Orderly and productive change builds upon existing organizations to minimize the disruption of development (19, p. 2).

The second issue relating to local organizations suggests four basic reasons that indicate the importance of a local organization such as the COIC, if the rural poor are to acquire appropriate technologies for rural development. First, the rural poor are helpless without local organizations in gaining access to essential services, or to express their needs. One person acting by himself, carries little political or economic weight when he is poor. Higher level officials may not listen to him, he can seldom acquire access to credit for investment, and he has little power in the

relevant markets. The rural poor need to group themselves together to solve common problems.

Secondly, the rural poor should organize, because local organization supplements the need for governments and agencies in supporting rural development through dealing with each individual and family in such economic functions as providing credit, agricultural extension and production inputs. If government personnel are required to work directly with all the rural poor, work is slow and tedious, and shortages of trained personnel exist. The cost and administrative feasibility of providing services individually to the large number of rural poor is prohibitive. When rural poor organizations exist, governments rather than working directly with the rural poor, work with the local organizations and rely upon the leaders of these organizations to work with their own people. Effective forms of local group organization can: 1) bring economies of scale in the management of saving and credit; 2) supply inputs on credit terms; and 3) provide knowledge through extension and marketing services. An efficient low-cost delivery system for appropriate technologies is the result of effective organization at the community level.

Thirdly, successful rural development should allow decisions to be made at the appropriate level. Therefore, community level organizations are essential, if all the rural poor are to have access to, and benefit from appropriate technologies. Small basic units at the community level are more likely to share a common identity and common interests. Membership is small enough so that all persons know each other and their participation in collective ventures can be rewarded by local esteem and sanc-

tioned by local pressure. Community organizations have operational advantages. Labor can be pooled effectively in common projects, planning meetings are easily arranged, and credit and savings programs more easily controlled.

Fourthly, local organizations provide a viable base for the evolution of self-sustaining growth by the rural poor. However, local organizations represent opportunities for action, but no more than that. Through organization, a problem solving climate can be developed and decision making promoted at the local level. The rural poor can unleash, mobilize, and direct local energies toward the adoption of new appropriate technologies as the economic principles, which became part of the COIC, provide the foundation for future rural development.

The base for changing economic behavior and creating economic discipline conducive to the adoption of appropriate technologies also exists in these local organizations. Social pressures encourage the rural poor to participate. Changes in attitudes, values, and behavior can be facilitated by participation in group activities and decision making. In addition, an ongoing and supportive group organization reinforces these behavioral changes. Finally, local organizations can collect useful economic and social data, so that activities at the community level can be analyzed and understood.

The third issue relating to local organizations for adopting appropriate technologies is the choice between a single purpose or a comprehensive multiple purpose local organization. Both have their advantages. However, multiple purpose local organizations appear to provide more features for the rural poor. Multiple purpose local organizations provide one center,

where the rural poor can obtain the services, technical advice, and finances needed for appropriate technologies. By providing various functions, the organization has the capacity to integrate various acitivities related to the economic principles required for adopting technologies. When inputs, technical advice, and credit are provided by different organizations within the community, bottlenecks develop and communications are difficult.

If a multiple purpose local organization is to be successful, a number of precautions should be taken. Different leaders should be appointed for each activity, so that the power is not concentrated in the hands of a few, making corruption very tempting. Activities should not be added before the organization has trained personnel responsible for the activity, because resources will be used inefficiently without the required trained personnel and economic discipline. Finally, political functions should be kept separate from appropriate technology activities. If political leaders dominate economic functions and make economic activity dependent on political criteria, the rural poor can lose confidence that inputs are distributed fairly, or that savings are secure.

Although the COIC in the RDP/LWF-WS area provides the structure for the rural poor whereby they can receive technical advice and inputs, and manage savings and credit for investment, the COIC needs to be knit into some larger organization. A two-tier approach to local organization is needed. This two-tier approach comprises the fourth issue presented in this section relating to local organizations for adopting appropriate technologies. A larger organization has the resources to provide the manageri-

al and physical facilities, which permit the handling of large amounts of money and physical inputs, and the personnel for training the rural poor.

As indicated in chapter four, the higher level tier in the RDP/LWF-WS area in Peru was the Lutheran World Federation-World Service Department in Peru. Although it provided technical advice and inputs and supervised projects, it was not involved in a large-scale training program relating to the economic principles of saving and use of credit by the rural poor. Despite these weaknesses, a higher level tier organization such as the Lutheran World Federation-World Service Department in Peru provides the institutional basis for the following new success elements.

A higher level tier, henceforth referred to as a research, training, and service center (RTSC), could: 1) undertake research on technologies appropriate for the local area; 2) train elected leaders of the local COIC, who, in turn, teach their own members; and 3) bring services, such as credit and inputs to the lower level COIC tier, and supervise the adoption of appropriate technologies by sending officials periodically to the communities to assist in problems and give advice. Thus, the RTSC would be responsible for assisting the COIC in the adoption of appropriate technologies by providing support, training and supervision. A second tier organization, whether supported by the Lutheran World Federation or Peruvian government, would also serve as an intermediary between the rural poor and the central government. In this manner, linkages would be established and information could be passed from the top down and bottom up.

A final issue of local organization involves the geographical dimension. Spatial organization is important in rural development. Rural de-

velopment does not begin and end with a community, rather it is the reconstruction of rural society and the integration of agriculture and local small-scale industry. Each activity related to appropriate technology should be designed so that the level of the organization responsible for adopting the activity be appropriate for the spatial size. Communities can manage local savings and education of its members. However, training leaders, providing financial intermediaries for government credit, and planning infrastructure for a large area, require a higher level organization, such as the RTSC. Thus, the activity should be organized at the appropriate level.

Once the local organization structure has been developed, education of its members is crucial in teaching needed economic principles and developing new economic attitudes, values, and behavior, so that the rural poor can adopt appropriate technologies. The method of education treated in this study is nonformal. It occurs outside the formal school system and in the COIC and RTSC. Education can provide the rural poor with the economic confidence, knowledge, and skills to use appropriate technologies.

Two roles regarding the nonformal education of the rural poor are analyzed in this study. First, the role of education in creating, through the COIC, an awareness amongst the rural poor of the economic principles needed in institutions for adopting appropriate technologies is discussed. Secondly, the role of creating and educating new leaders from the rural poor who will lead the rural poor in rural development is examined.

The nonformal education process can be used to make the rural poor aware of the economic principles needed to adopt appropriate technologies.

These principles were specified in Table 19. Concerning the first economic principle of the role of technology in increasing productivity, nonformal education methods should be used to create an awareness amongst the rural poor of the potential benefits from adopting appropriate technologies. The rural poor who are short of capital and seldom use new technological processes, should be encouraged to take advantage of the concept of adopting appropriate technology which includes capital formation and new technological processes. The process of using appropriate technologies to increase productivity, and therefore, output and income which lead to higher levels of living, is a fundamental principle that needs to be taught to the rural poor so that they understand the basis of a self-sustaining process of rural development.

Once appropriate technologies have been identified and developed, information on the nature and use of technology remains to be given to the rural poor. In the case of agriculture, the advantages of the technology and manner in which it is used can be presented through on the job training, and shown visually by using community demonstration plots. Training can be given for producing and operating small-scale industrial tools or machines. Skills required for effectively using the technology are a vital part of the training. A local knowledge base relating to types of appropriate technologies available and their potential benefits could be built so that the rural poor could adopt appropriate technologies to increase their levels of living.

The second economic principle, which relates to the delivery of inputs and outputs, can also be emphasized in nonformal education. Timely avail-

ability of inputs is critical in agricultural production. A community that is organized can arrange for mass transportation and purchasing of inputs which it distributes to its members. Economies of scale result. Also, a large group can exert pressure on the suppliers of inputs.

Marketing the output requires technology on storage and transportation. If good information and communication on output prices are accessible and collected, marketing can yield higher benefits for the rural poor. Because this study concerns the adoption of appropriate technologies, the complex problems of marketing are not addressed in more detail.

The third economic principle which should be taught the rural poor through nonformal education, concerns savings for investment in new technologies. The rural poor often outbid each other for credit, and pay exorbitant rates to acquire small amounts of capital. Then the traders and merchants, when in a monopoly position, offer low prices for products of the rural poor and collect large profits as middlemen. Thus, the power of capital, while helping the wealthy improve their levels of living, is not easily accessible to the rural poor.

However, if the rural poor unite in COIC's, they no longer need to remain helpless individuals, but can learn to possess and control capital through the use of appropriate technologies. The COIC's can teach the rural poor how to acquire capital by emphasizing thrift and savings. If all work together through mutual aid and trust, and pool their meager resources, savings can be created. Increased savings provide the foundation for self-sustained growth by providing the source for investment in appropriate technologies.

The failure element regarding the Mestizos' opposition to rural development can partially be eliminated as the rural poor accumulate their own savings. The Mestizos, as moneylenders, are a source of credit for the rural poor. However, their monopoly position allows them to establish interest rates for loans at the rate they desire. Local savings can provide lower interest rate loans and weaken the economic power of the Mestizo.

Output expands more rapidly as the average propensity to save of the rural poor increases, providing the savings are used wisely in investments. If appropriate technologies are properly developed, capital investments are used efficiently, and output growth results. Surpluses which are created by output growth should primarily be kept in the rural areas for reinvestment, so that the process of output growth becomes dynamic for the rural poor.

To summarize, rural poor COIC's that stress saving, thrift, and investment, can overcome the exploitation of the moneylenders and traders, and the helplessness of individuals acting alone to accumulate capital. The teachings of capital formation through appropriate technologies involve the same principles of savings and investment used by all developing nations.

There are two approaches in which savings can be used to increase investment. First, the rural poor can save their own money to be placed in a community cooperative for the members to borrow. This method is best for output growth which is self-supporting and self-generating. Outside sources of credit are no longer needed. Second, savings can be used to pay back a loan received from a source outside the community. In either case, savings lead to new investment and growth. However, in the first method, the rural

poor have a self-generating process of rural development and thus, should be encouraged, as soon as productivity rises, to increase their savings.

Appropriate technologies can potentially increase the ability of the rural poor to save because they: 1) allow more rural poor to participate in increasing their incomes so that more potential savers exist; and 2) give the rural poor an opportunity to invest in technologies developed for their technical, economic, and social-political environment so that the motivation for saving is created.

Because savings are so important to increasing productivity, an important issue concerns the ability of the rural poor to save. Because data are not available on savings in the RDP/LWF-WS area, data from other areas are used to show the potential of the rural poor to save.

Until the 1970's, the average savings ratio of the poor was thought to be much lower than the average savings of the modern sector (25, p. 413). However, current research is casting doubts on this assumption.

First, the rich in the modern sector may not save as much as classical economic theory suggests. The rich who have limited opportunities for profitable investment because large effective demands are lacking, often spend their income on luxury consumer goods and land, or transfer their savings abroad because they feel the opportunities for profitable investment are better there than at home (36, p. 66).

Secondly, recent rural development projects show that the rural poor can and do save large amounts of their income, to be invested in technologies which are accessible to them. This requires that they perceive a profitable opportunity for investment that leads to increased incomes, and

that the institutions and their structures permit the rural poor to acquire the new technologies.

A first example that the rural poor can save and build up capital is demonstrated by the Comilla project in Bangladesh. Savings were low in the beginning because of low incomes, and outside government help was needed. In ten years, savings were raised to $140,000 per year for Comilla county which is approximately 100 square miles. In 1970 the rural poor involved in the Comilla project which had spread to 20 counties in the Comilla district, were supplying 35 percent of their total investment loans (39, p. 67).

A second example pertains to China. Rural development programs were able to generate a high savings rate amongst the rural poor. Most of China's overall performance can be explained simply in terms of the very high saving and investment ratios which were attained by 1953 and maintained thereafter. Savings were stressed for self-financed investment. Rural areas were encouraged to produce by small-scale indigenous methods which used relative factor supplies to good advantage and were financed from their own savings. These savings ratios generated from production by the rural poor were from 15 to 20 percent of their income (15, pp. 399, 400).

A third example refers to the fact that the rural small farms in Japan provide 84 percent of the working capital; in Taiwan, 76 percent; and in Korea, 50 percent (36, p. 93). In these countries the small farmers have demonstrated an ability to save money and increase production, which in turn, leads to higher savings and consumption. They have invested in production inputs, built permanent homes to replace traditional shelters, and are able to afford household furnishings, consumer goods, better education,

and health, and other improvements. No matter how poor a person is, he can usually be persuaded to save and invest a portion of his income, if his income is rising due to increased productivity. By keeping the capital per worker low, more rural poor have access to increased productivity methods, and a way of tapping the savings of a large group of people that would not invest at all is created. The major problem in the less developed nations is not a shortage of willing savers, but lack of institutions to channel the savings into productive investment (36, p. 95).

The fourth area of nonformal educational training needed by the rural poor relates to the economic principles of credit. Credit from the government or commercial banks is initially needed to supplement the meager savings of the rural poor. These outside sources overcome the inelastic supply of traditional credit, and check the monopoly situation of local moneylenders.

The rural poor need to understand the process of borrowing and repaying loans from outside creditors and from community savings. COIC financial programs should be designed, organized, and managed on the principle of viable business enterprises. When revenues exceed or equal expenditures, the organization is able to provide a viable base for self-sustaining growth (55, p. 43).

By uniting through group action, the rural poor can protect themselves from outside exploitation by moneylenders, and traders. An understanding of this exploitation process should stimulate local organizations to become stronger and more numerous. The potential of poor people to organize has been shown by urban factory workers who were exploited by capitalists.

They organized in trade unions to overcome exploitation. As peasants become more educated, they too have the potential to unite to use technology to benefit themselves.

Nonformal education training should also be used to develop a system to record, communicate, apply, and preserve knowledge which is needed to effectively adopt appropriate technology. This requires good management, so that records and data are generated, upon which future decisions and policies can be based. Data on credit, loans, community demonstration plots, and agricultural yields represent some of the desired data.

The second role of nonformal education for the rural poor is creating and educating new leaders. It is the leaders who are elected by the rural poor from amongst themselves that can educate the rural poor in the needed economic principles. Although many existing community leaders favor the adoption of new technologies, several leaders oppose this adoption. The task of eliminating community leaders opposed to adopting technologies for rural development is difficult. However, there are a number of solutions for creating leaders with positive attitudes towards using appropriate technologies that the people desire. These solutions can be applied to the RDP/LWF-WS area to weaken the political power of the Mestizo.

The first is that the training programs at the RTSC can cause old leaders to change their attitude and behavior toward rural development. Secondly, if the leaders are made accountable and responsible to the rural poor and subject to sanctions, they may be removed if they continue to be obstacles to the adoption of appropriate technologies.

A final solution involves electing more leaders than currently exist

in the COIC. This solution can be supported by several reasons. First, rural development programs require more work, and therefore, more leadership roles are needed. Secondly, more leaders force changes in the stratified social structures characteristic of traditional societies, making behavioral changes easier. Thirdly, when old leaders compete with the new leaders, the ineffective leaders may lose their positions. Developing new leaders is slow, and new leaders will have to learn to fend for themselves. When new leaders are successfully developed, the organizations of the rural poor become dynamic (36, p. 27).

The successful achievement of both roles of the nonformal educational process would function best through a two-tier structure in the RDP/LWF-WS area. The rural poor in the lower tier or COIC, would elect their leaders who are to become their teachers. Once elected, the leaders would go to the RTSC at the second level tier. At the RTSC, leaders from several communities would gather to: 1) share problems and ideas; 2) receive training on new technologies; and 3) learn methods for adopting appropriate technologies. Several leaders would be elected from each community, each representing a different economic function of adopting appropriate technologies.

For example, leaders can be elected to study at the RTSC in the following areas. First, leaders are needed to learn about appropriate technologies for different crop and livestock technologies. The information can then be applied on the community demonstration plot and shared with community members. Second, accountants need to develop accounting skills to operate the savings and credit programs of rural development. Third,

managers are required to manage the delivery of inputs. Fourth, leaders to oversee the technical problems of public service projects need to be trained. Finally, as small-scale industries develop, new leaders will be required. To make the leadership effective, leaders should be subjected to sanctions by the rural poor so corruption is minimized and supervised by officials of the RTSC who would check their work and records.

Successful education of the rural poor on the subject of appropriate technology and its adoption, demands that educators and trainers at the RTSC understand the rural poor, and the way they think. Leaders of the rural poor can help provide this information. Education needs to be geared to educational levels of the rural poor and their experiences so that they can comprehend it.

However, rather than requiring overtrained college graduates, training the rural poor leaders at a low technical level, if supervised well by qualified personnel at the RTSC, can provide the information desired. Knowledge that is adapted to the ability of the rural poor to comprehend it, can be transferred by rural poor leaders. As technologies become more complex, the knowledge and skill base can gradually be upgraded. However, the initial needs of the rural poor do not demand overtrained, overeducated personnel to instruct them.

The two-tier method of education has several advantages. First, it overcomes the shortage of teachers by allowing elected leaders from the rural poor to train the rural poor. Second, indigenous leaders, when trained at a RTSC and returned to their community to teach, eliminate the need for an outsider to train the rural poor in their community. Conceptually, this

is favorable. Outsiders lack complete understanding of the rural poor and find it difficult to obtain their trust and confidence. Instead, the outsiders should train, support, and make suggestions to the elected leaders at the RTSC.

Finally, the two-tier educational system has the potential of eliminating the exploiting middlemen, such as Mestizo moneylenders and traders, because the rural poor are taught to assume these roles. This is a major contribution toward self-managing, self-supporting rural development.

The concept of using rural poor leaders to train members of their community also provides positive features. First, teaching to groups in the COIC helps overcome individual pessimism and hopelessness. The rural poor can support each other, provide encouragement, and initiate optimism. Secondly, adults own the small farms and small-scale industries, and therefore, control the production facilities. They are the decision makers to which nonformal education should be directed. Because many are uneducated, it does not imply they are unwise, nor because many are illiterate does it mean they are ignorant. If the opportunity for improving their levels of output and living is understood and viable, the rural poor can change.

In addition to providing knowledge and training through the nonformal educational process, economic <u>discipline</u> needed to adopt technologies appropriate for self-sustained rural development should be created. The purpose of economic discipline is to develop regularized and predictable performance and activities of the rural poor which facilitate the adoption of appropriate technologies. To accomplish this, members of the COIC need to understand the role of organizations for adopting appropriate technologies,

and to develop economic attitudes, values, and behavior that are committed to the use of new technologies, and which enable the rural poor to acquire appropriate technologies. The rural poor should be disciplined in problem-solving organizations where they can acquire the knowledge, resources, and behavioral characteristics to pursue their own needs and make their own decisions.

Developing this economic discipline is not an easy task and the process is slow. An intensive effort is needed to develop regularized and predictable behavior. Lessons learned from religious training or political indoctrination show the importance of creating disciplined commitment by using habit forming ritual like training.

Economic discipline should first be created amongst the elected leaders who are to train the rural poor. By attending weekly meetings at the RTSC, leaders not only learn technical and managerial skills, but they become disciplined in the process of acquiring appropriate technologies. In the weekly meetings, despair and defeatism can be overcome by bringing together the active, energetic, and purposeful rural leaders. By taking rural leaders out of the stagnant village and putting them in contact with each other and with experts, they can be made receptive to new ideas, aspirations, and discipline. Then when the leaders return to their communities, they can transmit their confidence and new habits of economic discipline to the rural poor (39, p. 133).

Financing appropriate technology investments requires the economic discipline of saving. The rural poor should be required to meet regularly on a weekly basis, contribute weekly to community savings, and make regular

repayments on loans. Even if the amounts of money are small, the habit of saving is learned. As savings increase, the rural poor through self-management can slowly achieve a self-financing process of rural development.

Required attendance at COIC meetings and sessions of the RTSC can promote discipline if the majority are willing to put social pressure on those absent. Attendance can be used to indicate the desire of the rural poor to participate in accumulating appropriate technologies for rural development.

To conclude, the development of economic discipline requires continuous group interaction on a regular basis, which is supported by continuous education, training, and supervision. The attitudes and behavior of the rural poor must change in a manner which is predictable and regular, if appropriate technologies are to be adopted.

When developing the organization, education, and discipline of economic principles needed in institutions for adopting appropriate technologies, history can provide useful insights. Rather than study only the organizations currently used by nations, early stage development of institutions in the developed nations should be examined. Two useful examples were borrowed by the Comilla project in Bangladesh (20, pp. 18, 26). First, the producer cooperative concept in Denmark, around 1840, was borrowed by Comilla leaders. These producer cooperatives were designed to overcome the despair and lack of moral of its citizens. To remove the depression and pessimism brought about by isolation, adults were brought together to create a hope for development by uniting, planning, and mutual discussion. The second concept borrowed by the Comilla project, was the credit union organizations

found in Germany around 1850. They were developed to overcome the exploitation of the landlord, merchant-trader, and moneylender. The people were taught to unite, trust each other, and save, to provide their own sources for capital investment.

Although this chapter concentrates on the adoption of technologies, the role of the central government as it relates to the identification, development and adoption of appropriate technologies is briefly discussed. Successful identification, development, and adoption of appropriate technologies for rural development by the Lutheran World Federation-World Service Department and the COIC's in the RDP/LWF-WS area in Peru, are dependent on the active role of the central Peruvian government. In addition, a widespread rural development program in Peru would require central government financial and personnel support.

This study does not intend to analyze in detail the political aspects that relate to the role of appropriate technologies in rural development. However, several political issues are presented to complete the complexity of carrying out a widespread government rural development program in Peru. This analysis applies to the role of the Peruvian central government. The central government is needed to create a framework in which the rural poor can identify, develop, and adopt appropriate technologies on a continuing basis according to their needs and priorities, in such a way that local resources are mobilized for local needs.

There are many areas related to appropriate technologies for rural development which require government support. They include research on appropriate technology at the RTSC's, personnel to train and supervise rural

poor leaders, assistance in health and formal education, infrastructure for delivering inputs and marketing goods, land tenure systems appropriate for the rural poor, credit for investments, price policies, fiscal policies, spatial regional planning to locate RTSC's, and provision of resources which are not found locally. The government in power needs to provide a conscious political will and commitment which is supportive of self-generating rural development. If this will and commitment is lacking, the development and adoption of appropriate technologies are not likely to result.

Governments should decide what kind of society they desire in cultural, economic, and political terms. The issue of adopting a strategy which involves all the rural poor in development, and that assures that they benefit from development is the central issue. If mass participation is desired, an efficient, honest, and well organized government is needed to mobilize the enthusiasm and energy of the rural poor.

Pursuing rural development involves serious risks for the government officials and elites currently in power. The first risk refers to the pressure on politicians for development programs which bring quick results. Rural development based on small-scale labor-intensive techniques and organizations, education, and discipline of the rural poor in economic principles is slow and evolutionary.

Secondly, it is important that decision making power occur at the appropriate level. This would involve the devolution of some power by the central Peruvian government so that both decision making and operations be put in the hands of local organizations in situations where activities are

more responsive to local conditions. However, there is a risk involved in the devolution of decision making power and financial responsibility to the rural poor. As the rural poor elect leaders to express their interests and needs, and participate in local organization, they learn that local organizations have consequential powers. This brings new relationships and new balances of power with which political parties have to deal.

Finally, once the rural poor become a target of rural development, and receive research, personnel and financial support by the central government, it is politically dangerous for the central government to reduce its level of support for the continued development of the rural poor.

Applying New Success Elements for Adopting Appropriate Technologies to the RDP/LWF-WS Area

In the RDP/LWF-WS area, the existing success elements for adopting appropriate technologies should be retained and strengthened. The COIC enables mass participation by the rural poor, and provides leadership through elected leaders. Lutheran World Federation-World Service officials support the COIC with technical advice, supervision, and financial funds.

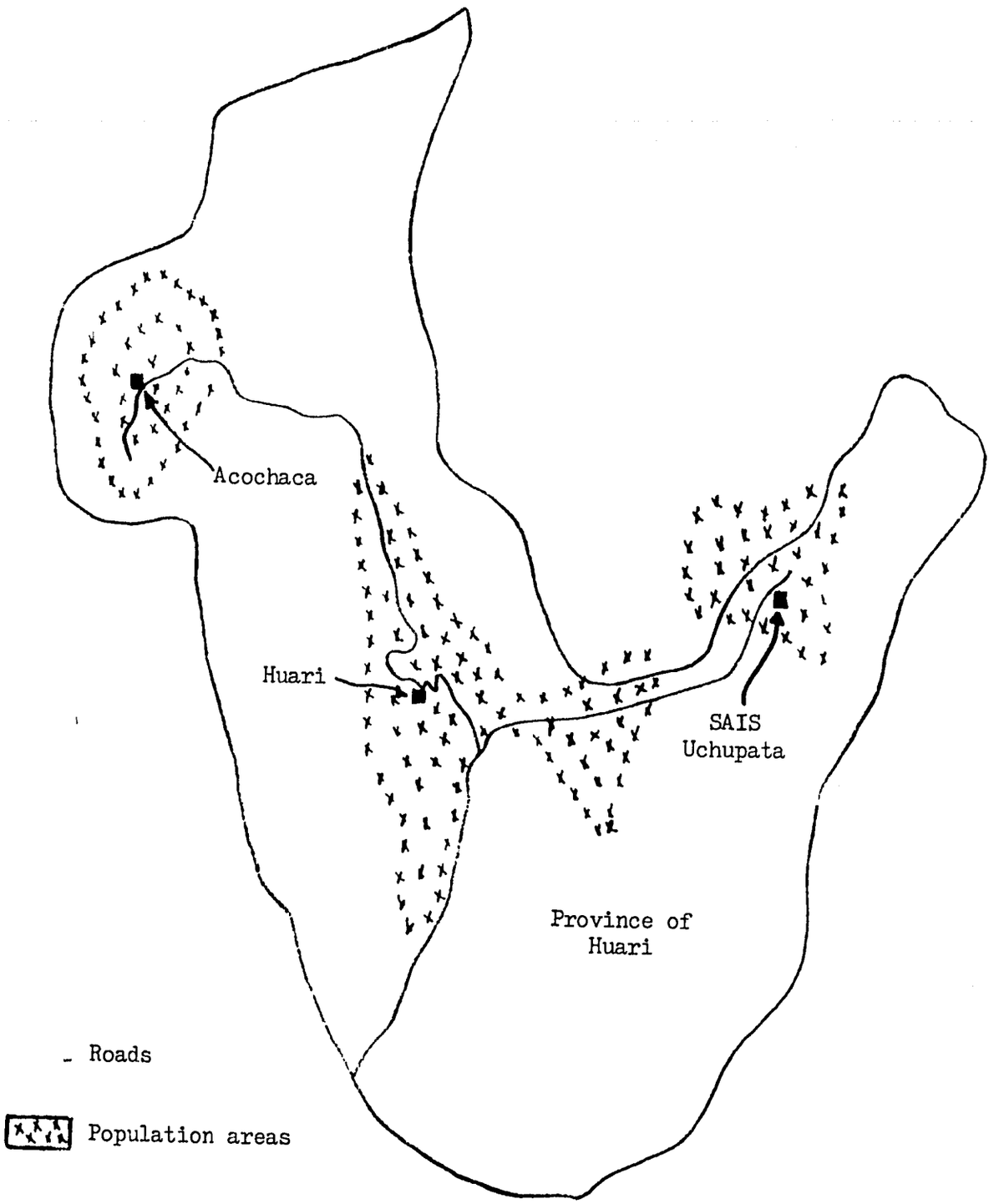
Despite these advantages for adopting appropriate technologies, the ability of the COIC's to adopt technology with the support of a second-tier organization, requires new success elements if the process of rural development is to become self-sustaining. The economic principles required of institutions to adopt technologies need to be developed and strengthened by an evolutionary process of education and discipline.

A research-training-service center (RTSC) is needed. To determine

its location, geographical factors need to be considered. Because transportation in the mountains of the RDP/LWF-WS area is difficult, one possibility for the center might include headquarters in the community of Huari with branches at Acochaca and the SAIS Uchupata. The three centers would be spread evenly geographically, and located in the center of population areas. The rural poor are concentrated in three areas of the RDP/LWF-WS area which are located along major rivers in the province of Huari. The remaining portion of the RDP/LWF-WS area is snow capped mountains or high isolated nonproductive agricultural land. Thus, most communities are located close to the proposed centers serving the area. Roads connecting the three centers are accessible by vehicle during most of the year. Map 5 shows the three centers, and approximate distribution of the population in the RDP/LWF-WS area.

Most of the research appropriate for the RDP/LWF-WS area would be undertaken at the community of Huari. However, the reaction of the communities to each of the three centers providing training and services would provide interesting data. Huari is the capital of the province and the most progressive community. The RTSC could easily interact with administrative government agencies already located in the province capital of Huari. In addition, the leaders who would attend sessions in Huari may be stimulated by the higher levels of living in Huari. Yet, the temptation of a larger rural city or Lima would be avoided, because Huari has only a few more amenities than the smaller communities.

SAIS Uchupata would provide information on how the indigenous communities reacted to a large government cooperative. They may either respond



Map 5. Three research-training-service centers in the RDP/LWF-WS area in Peru.

favorably and decide to join the cooperative, or they might attend the center only for training and services and return to their own style of life with the intention of improving it. The center at SAIS Uchupata would provide some economies of scale. Research which is applicable to both small-scale and large-scale agriculture could be pursued simultaneously. Examples would be improved seeds, fertilizer, and cultural practices. Also, services, such as credit and the provision of inputs, could be provided to both the large cooperative and small rural farmers simultaneously.

At Acochaca, the rural poor leaders would attend training in a community similar to their own. The levels of living and environment would be the same. Thus, each of the three centers would provide different settings. The reaction of the rural poor to each setting could provide useful insights into the most successful setting for a second tier organization. The RDP/LWF-WS area might serve as a useful pilot study for collecting data on which to base future rural development organizational decisions for other rural Sierra regions in Peru.

The RTSC in Huari would undertake <u>research</u> on appropriate technologies. Community requests for technology would be sent to the Huari RTSC indicating the demand for technology. Development should then be based on the physical, economic, and social-political criteria found in chapter five. Research would stress the agricultural productivity needs of small indigenous communities. Experimentation and collection of good data are required so that successes and failures can be analyzed, and local conditions can be understood first-hand. Many solutions are not yet known and can only be answered as research progresses. Research on the effectiveness of both levels of the two-tier organiza-

tional structure should also be collected.

The second function of the RTSC at all three locations would be training and education. Building an economic base for the adoption of appropriate technologies in the COIC's of the rural poor, is the central concern. Emphasis would be placed on the means of increasing productivity and financing the new technologies. The rural poor need to be taught the disciplines of saving, credit, and investment for improving outputs which, in turn, increase their incomes, providing them with a source for financing all types of rural development projects.

Leaders, appointed by the rural poor, are a crucial component of the training process. Selecting one leader who is responsible for many functions, should be avoided. The multipurpose worker of the community development strategy in the 1950's and the agricultural extention agent of the 1960's, had monopoly powers. They could not specialize in one area, and their presence prevented the process of creating new leaders. Instead, leaders should be selected for each area of training. New leaders could be added step by step as the COIC becomes capable of introducing new functions. Over time, the COIC of the rural poor in the RDP/LWF-WS area should become a multiple purpose organization.

Leaders are needed in many technological and economic areas. Leaders in charge of educating and training the rural poor in appropriate technologies for the process of rural development and organizing the means of financing technologies are the first requirement. A leader for agricultural technology is most important in the early stages of rural development. He can provide knowledge and training, through classes and the community dem-

onstration plot, on methods for increasing productivity. Leaders are also needed in the appropriate technology areas of community public services, and later on, in small-scale industries. As the rural poor learn to save, use credit, and take loans, a leader trained in financing and accounting methods is required. Business methods for these economic activities should be emphasized. The implementation of projects and distribution of inputs will necessitate additional leaders.

The decision on how regularly the leaders should meet at the training center is difficult to assess. Whatever decision is made, it should involve regular, well specified intervals. Transportation is very difficult and bimonthly meetings for two days at a time may be better than weekly one day meetings. Also, peak labor seasons must be taken into consideration. In some cases, one or two week training sessions may be required. Regardless of the meeting schedule, the atmosphere must be that of an open forum or a workshop where ideas are freely exchanged.

The third function of the research-training-service center is providing services for rural development. For example, the center acts as an intermediary between the rural poor and higher government levels. Central government agencies and ministries, such as agriculture, health, and education, can work through the center. The supply of inputs or needed resources, and credit, can be acquired from the government and passed on to the rural poor, through distribution centers and banking facilities. Sources of funds from outside the community for supporting projects need to be obtained. The RTSC could serve the role of seeking government, commercial bank, and international organization funds to supplement the meager initial savings.

In addition, the center provides the service of continuous supervision. Staff members at the center should visit communities to advise the rural poor on local problems and to oversee the projects. To summarize, the two-tier institutional organization, and the research-training-service function of the RTSC, provide the structures for developing attitudes and behavior needed to adopt and finance appropriate technologies. Thus, the process of rural development becomes self-supporting and self-sustaining.

The staff members of the RTSC require unique characteristics. They must form an interdisciplinary team. Physical sciences, social sciences, and public administration as they relate to agriculture and small-scale industry in rural areas, are some of the desired disciplines. The staff should meet daily, when possible, to share experiences and discuss mutual rural development problems which are related to appropriate technology. Frequent meetings provide a continuous process for trying to find technologies that meet the local conditions and needs of the communities.

To be most successful, capable, dedicated, and inspired staff personnel are needed. They should be good listeners, because many answers lie with the rural poor themselves. A good listener remembers and cares. Two way communications enable the staff to provide training at an appropriate educational level for the rural poor. The facilities for the staff at the RTSC should include classrooms, offices, laboratories, and demonstration plots for agriculture.

CHAPTER VII. SUMMARY AND CONCLUSIONS

The emergence of two concepts in the 1970's that relate to economic development of less developed nations are responsible for stimulating the content of this study. These two concepts are rural development and appropriate technologies.

Rural development which concentrates on the rural poor, contains three basic dimensions. First, the objective dimension involves increasing the levels of output and living of the rural poor. The method dimension of rural development concerns mass participation by the rural poor in seeking this objective. Finally, the process dimension is the self-sustaining manner by which the rural poor move from low levels to high levels of output and living.

The role of technologies is important in this self-sustaining process. Technologies enable increases both in output and in income, thus, providing funds for a self-sustaining process of rural development.

The concept of appropriate technologies introduces potential solutions to the problem of providing the rural poor with technologies for rural development. The term appropriate technology can apply to any nation or group of people. Appropriate technologies for rural development should: 1) be consonant with physical, economic, and social-political criteria of the environment in which they are to be used; 2) contribute to dynamic economic growth; and 3) be predictable.

Appropriate technologies for the rural poor are seldom capital-intensive and large-scale in nature because the rural poor: 1) do not have incomes large enough to purchase them; 2) usually operate on small farms or

in small-scale industry; and 3) possess underemployment. The use of capital-intensive, large-scale technologies in less developed nations usually benefits only a few of the already wealthy class who have the resources to adopt them. Although substantial growth in output results from capital-intensive investments in the modern sector (as contrasted with the traditional sector), these technologies contribute to: 1) unemployment in the nation as capital-intensive equipment replaces labor; and 2) the eventual migration of the rural population, seeking employment, to the urban centers where new jobs have not yet been created. Despite these negative effects on the economy, the modern sophisticated technologies remain appealing to the less developed nations because of their engineering efficiency and status.

The major contribution of this study is to bring together and integrate the concepts of appropriate technology and rural development. The major concern is the identification, development, and adoption of appropriate technologies for rural development of the rural poor. When appropriate technologies are used by the rural poor, they possess the potential to achieve all three dimensions of rural development. A self-sustaining process of mass participation for moving from low levels to high levels of output and living can be created.

Little research has been done or recorded, on either appropriate technologies or rural development. The purpose of this study is not to analyze in great depth one specific problem, which requires detailed data, and then to present a solution. Rather, it is to suggest remedies for the urgent problems of identifying, developing, and adopting technologies appropriate for rural development, for which there is need. Solutions to the problems

of initiating or generating the use of technology is the first step towards rural development for the rural poor. The rural poor need to become involved in rural development by adopting appropriate technologies consistent with their needs and with their labor, capital, land, and management resources.

The procedure used to integrate appropriate technologies with rural development has two components. First, an approach is used which involves the interrelationship between physical, economic, and institutional factors as they relate to the identification, development, and adoption of technologies appropriate for rural development. Secondly, a conceptual analysis for the identification, development, and adoption of appropriate technologies for rural development is developed, based on a methodology proposed by Timmons.

The methodology is applied to a rural development program area supported by the Lutheran World Federation-World Service Department in Peru. This area was selected because it had been involved in a four year program of rural development in which mass participation was used. In addition, some appropriate technologies had been developed and adopted in the area.

The methodology by which the conceptual analysis is derived for the RDP/LWF-WS area is as follows. First, the problematic gap between the goals of technology to achieve the rural development dimensions, and the existing technological situation is established. The goal of this study becomes the elimination of the problematic gap by identifying, developing, and selecting technologies appropriate for rural development in the RDP/LWF-WS area.

Second, the application of the diagnostic analysis of the Timmons' methodology provides the failure and success elements relating to the elim-

ination of the problematic gap. The remedial section which includes the conceptual analysis is based on the diagnostic analysis. New success elements for eliminating failures are developed for the conceptual analysis by introducing solutions used or proposed by officials around the world working on rural development and appropriate technologies, which are relevant to the RDP/LWF-WS area in Peru.

The value of the conceptual analysis lies in three potential uses. First, the RDP/LWF-WS area could benefit from it, providing the personnel and funds are available. Second, the government of Peru should be able to apply results of the analysis to other indigenous communities in the Peruvian Sierra which possess similar characteristics as those in the case study area. This depends on the political commitment to the rural poor and rural development.

Finally, many of the concepts, such as the criteria for developing appropriate technologies and the two-tier local organization approach to adopting appropriate technologies may have application in less developed nations. However, without comparative studies, this claim to universality can only be suggested.

The remainder of this chapter summarizes the conclusions and recommendations of the study as they apply to the RDP/LWF-WS area in Peru. The nature of the conceptual analysis suggests conclusions including recommendations, because the remedial phase in the Timmons' methodology provides new success elements which are equivalent to future recommendations.

The format used for summarizing the conclusions and recommendations of the study consists of restating the objectives and then presenting con-

clusions and recommendations as they relate to each objective.

The six objectives are:

1) To show that there is an urgency for rural development strategies directed primarily to the rural poor, and to provide a rationale that such strategies contribute to the development of the nation.
2) To examine the role of technologies which fulfill the rural development objective, method, and process dimensions, and the interrelationships of physical, economic, and institutional factors in the identification, development, and adoption of technologies.
3) To describe the existing situation in the Peruvian case study area which provides the basis for the conceptual analysis and gives insight into the identification, development, and adoption of technologies appropriate for successful rural development.
4) To develop and apply a conceptual analysis for the identification and development of technologies appropriate for rural development of the rural poor in the Peruvian case study area.
5) To develop and apply a conceptual analysis for the adoption of technologies appropriate for rural development of the rural poor in the Peruvian case study area.
6) To suggest further research needed to provide necessary data and policy recommendations.

The first objective is discussed in chapter two. The rationale for directing rural development strategies to the rural poor is based on: 1) the low levels of output and living of the rural poor who want to improve their living conditions; 2) the urgency of solving the unemployment and rural-urban migration problems that result when the rural poor move to the urban areas to flee the stagnancy of rural life; and 3) recent research that shows that small rural poor farmers are efficient producers.

If increased demands by the rural poor for improved levels of output

and living go unheeded, the potential for revolution increases. By emphasizing rural development, both the rural and urban areas benefit. Rural levels of output and living increase, and as more rural employment is created the rate of rural-urban migration to the cities can be reduced.

Although the first and second arguments in the rationale for rural development, which emphasize the need to help the rural poor, are basically humanitarian in nature, the third argument provides economic reasoning which supports the other two. The rural poor farmer, when given access to technologies, is more efficient in yield per acre than large-scale farmers, increases production at the lowest cost, and has the potential to create large numbers of jobs. Thus, rural development contributes efficiently to the output of the nation and minimizes the potential disruption caused by the discontent rural poor and rural-urban migration.

The second objective, also discussed in chapter two, concludes that technologies are required to increase the levels of output and living of the rural poor because: 1) reallocation of resources within traditional agriculture without the use of new technologies rarely increases agricultural productivity; 2) technology can overcome the rapidly diminishing returns and increasing costs of production in traditional agriculture; and 3) the use of technology makes the worker more productive.

If technologies are to fulfill the rural development method dimension of mass participation they should be designed to meet the characteristics of the rural poor. These characteristics include production on small-scale units, and small incomes. Therefore, small-scale labor-intensive technologies within the financial means of the rural poor need to be developed for

agriculture and industry. These technologies permit mass participation by the rural poor, increase their incomes, and provide a basis for a self-sustaining process of rural development.

The interrelationships between physical, economic, and institutional factors for identifying, developing, and adopting technologies are emphasized in this study to eliminate the problematic gap caused by the inability of technologies to fulfill the three dimensions of rural development in the RDP/LWF-WS area. The identification of technologies by the rural poor relates to economic demand, requires institutions so that the rural poor can voice their demands, and is determined to a large extent by the physical environment.

The development of technologies appropriate for rural development depends on institutional organizations and behavior that facilitate research on technologies which meet physical, economic, and social-political conditions of the rural poor. The adoption of appropriate technologies requires institutions which possess economic behavior that facilitates the adoption process. Geographical conditions and spatial organization also affect the adoption process.

The third objective is discussed in chapters three and four. The case study area, which is the rural development program of the Lutheran World Federation-World Service Department in Peru, is analyzed. The rural poor in this area, who have per capital annual incomes of approximately $100 or about 20 percent of the national average, experience low levels of output and living. Much of chapter three is a descriptive analysis of the problematic gap. The conclusion reached relating to the problematic gap,

is that appropriate technologies need to be identified, developed, and adopted to promote a self-sustaining process of mass participation by the rural poor in improving: 1) their levels of productivity, employment, and income; and 2) their levels of living which include nutrition, health, education, and shelter.

Chapter four presents the four year history and program procedures for rural development in the RDP/LWF-WS area, and introduces the success and failure elements for identifying, developing, and adopting appropriate technologies. The results are used to develop the remedial phase found in chapters five and six on which the conceptual analysis is based.

The fourth objective is discussed in chapter five. The conclusions and recommendation of the conceptual analysis with respect to the identification and development of rural development are summarized by examining the success elements in the RDP/LWF-WS area and the new success elements suggested in the remedial phase.

The identification of appropriate technology demand fulfills the objective, method, and process dimensions of rural development in the RDP/LWF-WS area. The rural poor seek the objective of rural development. The requests of the rural poor indicate a desire to improve their levels of output through increased potato yields, vegetable gardens, and irrigation. Improvements in the levels of living are also desired, as requests for better construction, education, nutrition, and health occur.

Through meetings of the community organization of the indigenous communities, referred to as the COIC, the rural poor in the RDP/LWF-WS area make their requests. Over 80 percent of the rural poor men are required to support each project. Thus, the method of mass participation in identi-

fying rural development demand is present. The discussion in chapter four concludes that the rural poor desire to participate when there is a feeling of opportunity, confidence, and trust. The COIC also provides a means for continuing a self-sustaining process of making requests for rural development projects. Currently all requests, including agricultural, come from the community. However, as incomes increase, requests for small-scale industry appropriate technologies may be initiated by individuals.

Appropriate technologies are being developed in the RDP/LWF-WS area that relate to the rural development objective of improving the levels of output and living. The different technological areas include potato production, irrigation techniques, building construction techniques, water sanitation systems, vegetable production, animal breeding, small-scale metal working and medical services. These technologies depend on local resources, are labor-intensive, and use capital effectively. However, much local research is still required to develop appropriate technologies, especially in the area of agricultural production. As agricultural production increases, the demand for developing small-scale industries will also rise.

With respect to the method of mass participation, development of appropriate technologies involves two components. First, the rural poor need to work with trained specialists. The rural poor can provide useful insights into the local conditions and specific needs of the people. Currently, in the RDP/LWF-WS area, the rural poor are not involved in developing technologies. Secondly, the technologies developed need to be designed so that they are appropriate for the rural poor. This requires that the development of appropriate technologies meet the purposeful and norma-

tive, dynamic, and predictive criteria. Physical, economic, and social-political criteria introduced under the purposeful and normative criteria in chapter five should be emphasized. Most importantly, the technologies should be accessible in financial terms to the rural poor, and should use capital efficiently so that productivity increases will be stimulated.

The problems of developing appropriate technologies are not solved. Research is required to find new and more appropriate technologies. Engineers confront the problem of being creative when developing technologies that use scarce capital and abundant labor. The technologies of immediate importance are those that increase productivity, especially in agriculture, where 90 percent of the rural poor receive their incomes. As the rural poor become involved in developing appropriate technologies, especially those related to increasing productivity, and as the technologies meet the criteria that make them appropriate for the rural poor, the process of a self-sustaining growth will be created.

A major recommendation involves the development of a research center (RTSC) in Huari where both young and old rural poor working with scientists and engineers could jointly develop appropriate technologies which meet the various purposeful and normative criteria, with respect to physical, economic, and social-political conditions of the local area, in addition to the dynamic and predictive criteria. Then after the economic viability of the appropriate technologies have been compared with traditional and modern technologies, the technologies can be rejected or accepted.

Objective number five is discussed in chapter six. Although much research in the development of appropriate technologies is still required,

the appropriate technologies which do exist and fulfill the rural development dimensions, can be adopted by the rural poor. The adoption of appropriate technologies requires institutions which possess the economic principles of: 1) understanding the role of technology as it relates to production; 2) delivering inputs and outputs; and 3) providing the means for financing investments. An important lesson stresses the need for using existing organizations rather than alienating them. Instead of destroying old organizations in the RDP/LWF-WS area and confronting the difficulties of building new organizations, an awareness of economic principles and appropriate technologies combined with the creation of new rural development leaders, should be developed within the existing community organization in the indigenous communities (COIC).

The RDP/LWF-WS area has many existing success elements which are advantageous to the adoption of appropriate technologies. First, the COIC enables the method of mass participation to occur. However, the COIC's do not possess many of the economic principles required to adopt technologies. The flow of technological information is not well developed. Inputs supplied by outside sources are delivered through the organization, but financial means for supporting the projects seldom exist.

Secondly, the COIC's are active in rural development projects. The rural poor plan how to adopt each project. Leaders have been chosen to represent the rural poor and the rural poor appear willing to adopt community-wide projects in which labor, locally available resources, such as sand, lumber, and adobe bricks, and transportation are provided free by the rural poor themselves.

Information on technologies for potato production is communicated to the rural poor through their leaders and the project involves the entire community. Demonstration plots, for which the community, rather than one designated farmer is responsible, have been provided for experimenting with new agricultural technologies. This enables all the rural poor to have access to technological information. The rural poor themselves are the best testers of whether a new agricultural technology will benefit them.

Thirdly, the communities do not experience a large degree of inequality in wealth. The rural poor farmers have similar sized plots. Only the Mestizo, who is usually the trader and moneylender, provides a threat to the rural poor. Because power is fairly evenly distributed, organizations can function much easier without the threat of large landholders. The small farmers make their own decisions and are therefore, motivated by their own goals for achievement.

Despite these advantages for adopting appropriate technologies, the rural poor need to strengthen a second tier organization to complete the organizational structure for adopting appropriate technologies. The process of rural development has little opportunity to become self-sustaining without a second tier organization to support the COIC in developing: 1) the education and discipline regarding the role of appropriate technologies in rural development; and 2) economic principles for adopting technologies.

The major recommendation for adopting appropriate technologies refers to the research-training-service center (RTSC). This RTSC center could support the COIC by training and educating new leaders, elected by the rural poor from amongst themselves, who would, in turn, educate the rural poor

in their communities regarding the importance of appropriate technologies and savings. The RTSC could also provide services such as distributing production inputs and credit to the COIC and supervising ongoing appropriate technology projects. Through the support of the RTSC, the COIC could acquire the economic principles for adopting technology in such a manner that rural development becomes self-sustaining. An important factor to remember is that the process would be evolutionary because of the nature of the task for creating the organization, education, and discipline required to adopt appropriate technologies for rural development.

Objective six applies to the role of the RTSC. The areas of needed research are many. Demands for technologies need to be continually identified. Research on the development of technologies which meet the local physical, economic, and social-cultural conditions needs to be pursued, perfected, and made dynamic so that the technologies change with the physical, economic, and social environment. Technical data on production, prices, and social-economic data are all needed to aid the development and adoption of appropriate technologies.

This study suggests a conceptual analysis whereby the RTSC and COIC can be instrumental in the undertaking of these research needs. The process is slow and complex, and the work will be difficult, but the hope offered to the rural poor by the concepts of appropriate technology and rural development may be the only feasible path for the rural poor to follow if they are to experience improvements in their levels of output and living.

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