APPROPRIATE DEVELOPMENT STRATEGIES FOR DEVELOPING COUNTRIES: LESSONS AND POLICY IMPLICATIONS FOR PROMOTING SMALL-SCALE AGRICULTURE IN NIGERIA

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ABSTRACT

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The dilemma facing most developing countries is that not one developmental problem--but a set of inter-related problems (e.g., food shortage, housing, health and nutrition inadequacies, illiteracy)--must be solved through comprehensive national planning. Perhaps the most serious of these problems is the inability to adequately feed their teeming population. While population growth rates have increased in most of these countries, domestic food production has, in contrast, declined.

This study is devoted to exploring the feasibility of using appropriate production technologies as a means for increasing agricultural productivity among small landholders in the developing world. This focus is noteworthy in light of the fact that significant production and productivity increases can be generally achieved in the small farm sector of these countries.

The study objectives are to 1) review older and

new conceptualizations of national development as they relate to agricultural development; 2) define the nature and essential elements of an "appropriate" technology; 3) review various approaches that have been used to introduce new agricultural technologies; and 4) analyze examples of Third World agricultural growth and development strategies.

The major policy recommendations drawn from the study include: 1) greater emphasis is placed on a basic needs strategy for achieving appropriate development in the 1980s; 2) promotion of a "bottom-up" approach with active citizen participation in program planning and implementation; 3) reliance on the development and dissemination of appropriate production technologies for enhancing productivity levels on small farms; 4) restructuring of the public service incentive system as a means to encourage indigenous researchers to engage in "grass roots" action research directly related to the needs of small producers and the rural sector; 5) establishment of an active linkage between agricultural research and the extension education functions of the Ministries of Agriculture and Natural Resources; and 6) promotion of the formation of relevant small-farmer based organizations to articulate the needs of small holders and serve as their bargaining "voice".

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CHAPTER I

INTRODUCTION

Food Insufficiency in Sub-Saharan Africa: The Nature and Scope of the Problem

The dilemma of most developing countries, including Nigeria, stems primarily from the urgent need to boost the domestic production of staple food items for feeding their teeming populace. While population growth rates have continued to increase in most of these countries, domestic food production has, in contrast, declined.

The consequences of this declining food production have been reflected in several ways. Inadequate human nutrition and per capita calorie intake, which are clearly estimated to be below minimum nutritional standards, have been reported in several countries (see Table 1-1). It has also been reported in a 1980 World Bank Study (cited in USDA, 1981) that about 193 million people--estimated to be more than 60 percent of Africa's total population--suffered from "seriously inadequate calorie intake."

The irony of the current situation stems from the fact that, in the decades of the 50s and early 60s, several African countries (including Nigeria) were net exporters of certain basic food commodities. But, since the

TABLE 1-1

CALORIES PER CAPITA, SELECTED COUNTRIES, SUB-SAHARAN AFRICA, 1977

Region and country	Percentage of nutritional requirements	Region and country	Percentage of nutritional requirements
	Percent		Percent
The Sahel:		Central Africa-- continued	
Chad	74	Equatorial Guinea	--
Gambia	--	Gabon	--
Mali		Zaire	--
Mauritania	86		
Niger	91	East Africa:	
Senegal	95	Burundi	97
Upper Volta	79	Ethiopia	75
		Kenya	88
West Africa:		Rwanda	98
Benin	98	Somalia	88
Cameroon	89	Sudan	--
Ghana	86	Tanzania	93
Guinea	84	Uganda	91
Guinea-Bissau	--		
Ivory Coast	105	Southern Africa:	
Liberia	104	Botswana	--
Nigeria	83	Lesotho	99
Sierra Leone	93	Madagascar	115
Togo	90	Malawi	90
		Mozambique	81
Central Africa:		Zambia	87
Angola	91	Zimbabwe	108
Central African Republic	99		
Congo	103		

-- = Not available.

Source: USDA (1981:4).

70s, most of these countries have been increasingly unable to foster the domestic production of their food requirements. Food import costs have continued to soar and balance-of-payment deficits have been reported. The previously referenced USDA Report (1981:7) reported that:

> . . . if domestic production trends continue, Africa's demand for food imports will be two to three times its present level by 1990--even without significant income growth.

A number of reasons have been advanced by scholars and researchers to explain the precarious food balance situation in most of these African countries. These reasons include: increases in population growth rates, underdeveloped human resources, political instability, and "insecurely rooted and ill-suited institutions, to such external factors as balance-of-payments deterioration and consequent unfavorable terms of trade (World Bank, 1981).

However, much of the food production problem has been attributed to the supply-side dilemma. This notion appears to have been supported by the USDA Report (1981:8), which indicated that:

> While the population growth rate of Sub-Saharan Africa is high, there has been poor growth in productivity and aggregate food production.

In addition, a recent United Nations study (1977) showed Sub-Saharan Africa as the only developing area of the world where population growth rates will continue to increase throughout the decade of the 80s (see Figure 1-1). In contrast, however, available evidence amply suggests that

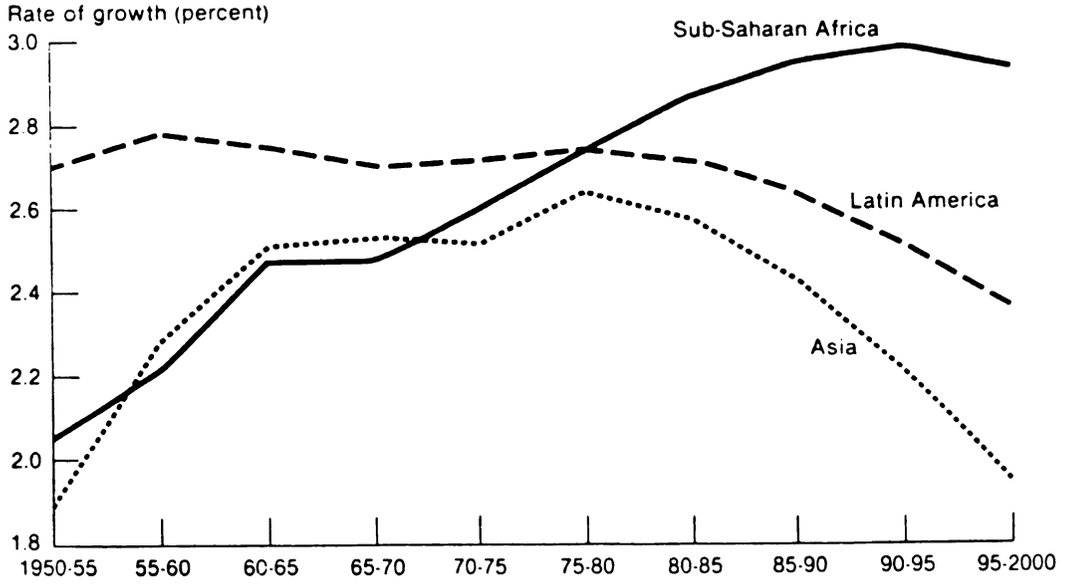


Figure I-1. Population Growth Rates (1950-2000) in Sub-Saharan Africa, Asia and Latin America

SOURCE: UN (1977).

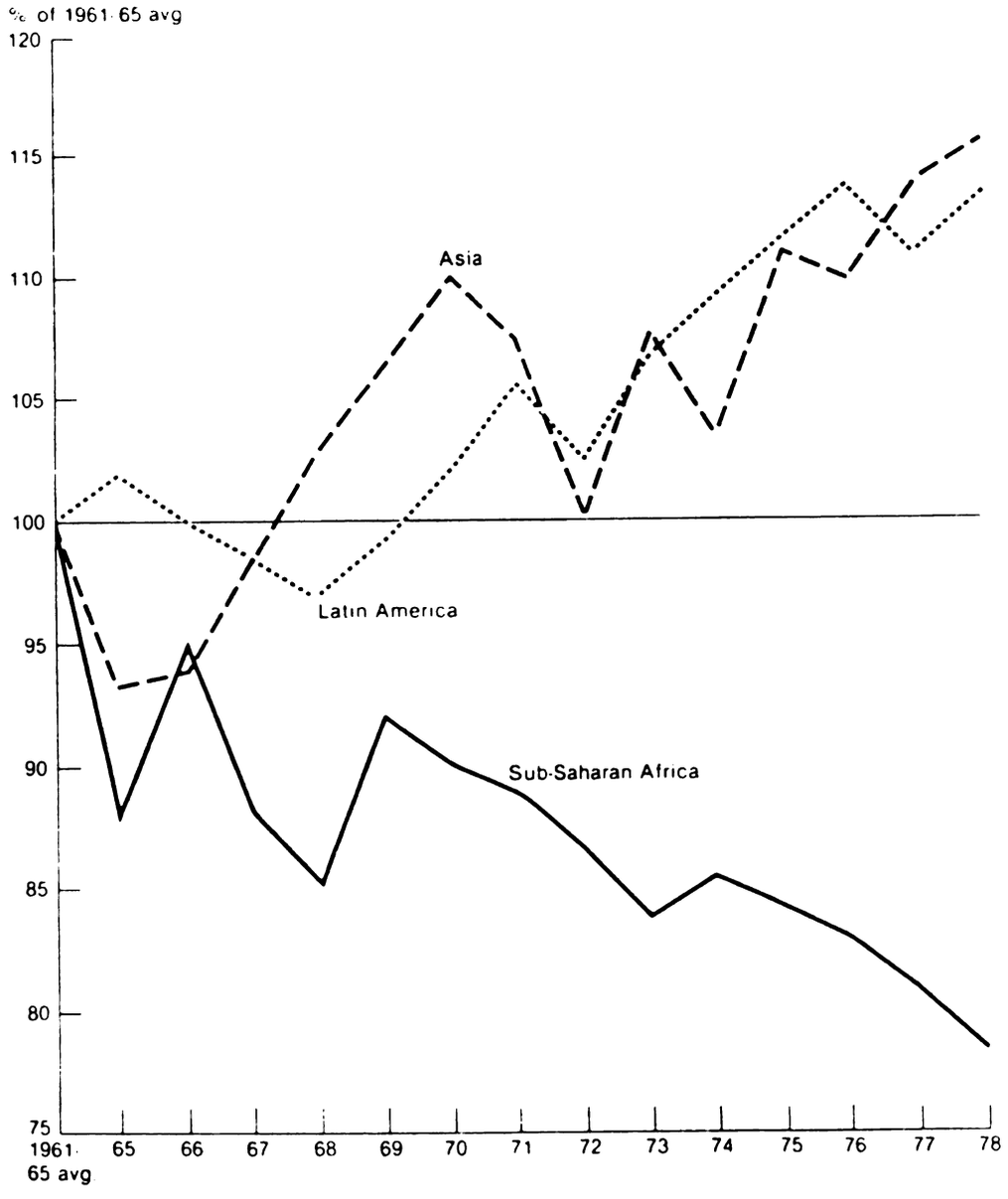


Figure I-2. Index of Food Production Per Capita in Sub-Saharan Africa

SOURCE: USDA (1981).

aggregate food production and productivity have been remarkably low, if not stagnated, in several African countries. Data presented in Figure 1-2 reveal that, in comparison with the other developing regions of the world, Sub-Saharan Africa has been described as the only region where per capita food production declined over the past two decades. The USDA Report (1981:10) also indicated that the aggregate production of major staple food crops in Sub-Saharan Africa show the following trends:

> . . . has grown very slowly--about 1.8 percent per year . . . (and) is below the aggregate growth rate of Asia or Latin America (the other two comparatively equally developing areas of the world and so with apparently similar development problems--see Figure 1-3).

The serious implications of the foregoing observations for the African continent in general, and for Nigeria (the primary focus of this study), are quite evident. It can be contended that this dangerous trend poses a serious threat to the survival of the continent in the near future. Achievement of a reliable food surplus has been described as one of the most fundamental prerequisites for national development. Therefore, the need for African nations to attain this goal cannot be overemphasized. Thus, this study is one of many recent efforts aimed at a diagnosis of the food production problems facing Sub-Saharan Africa.

Problem Statement

As already indicated, several reasons have been adduced to explain the poor performance of the economy of

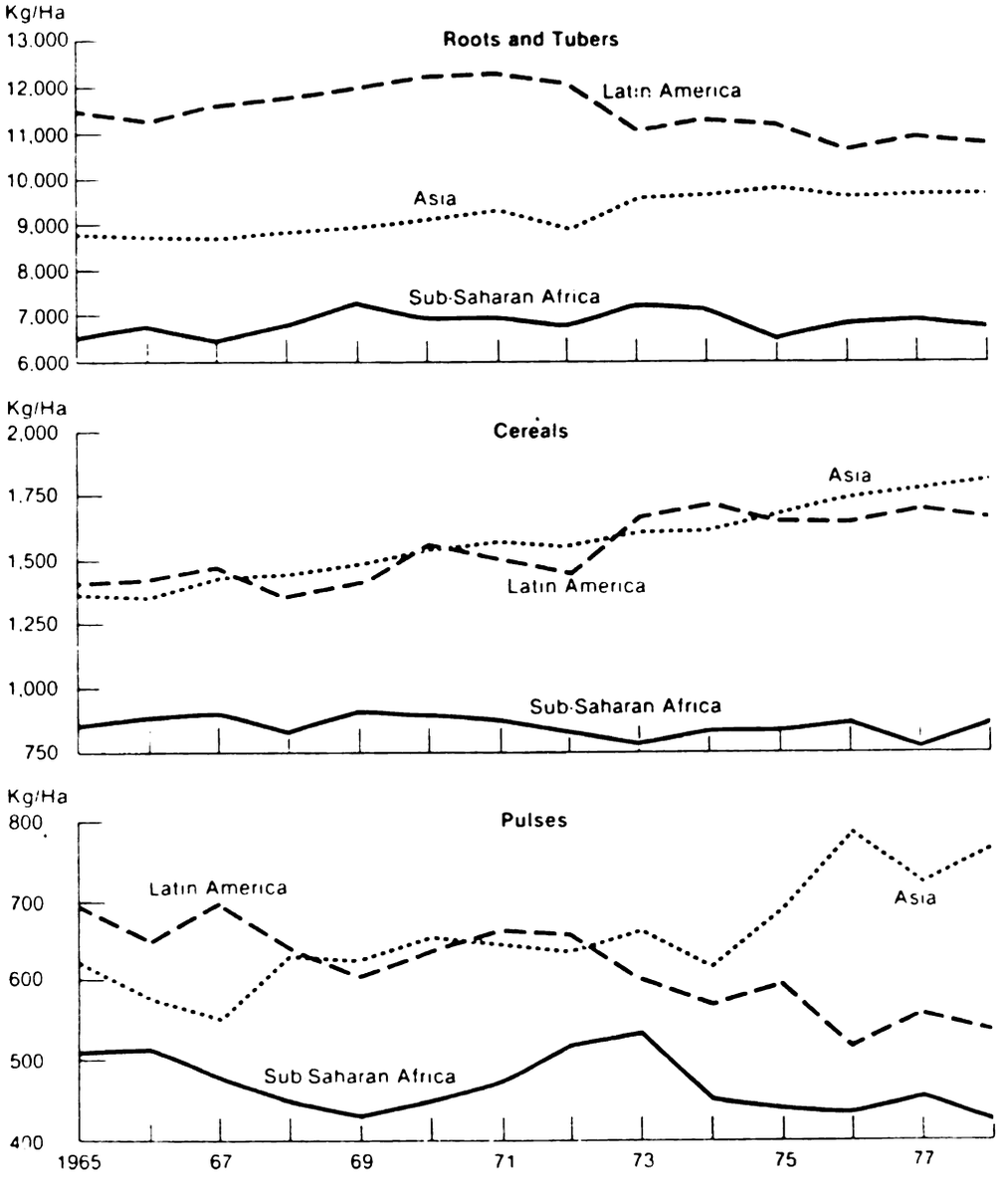


Figure I-3. Yields of Staple Crops in Sub-Saharan Africa, Asia and Latin America

SOURCE: USDA (1981).

Sub-Saharan African countries in recent times. The dominant internal factors include: 1) rapid increases in population growth rates (as high as 2.5 percent per year in the 1960s and 2.7 percent annually in the 1970s); 2) underdeveloped human capital in terms of a scarcity of educated people with requisite managerial skills and technical expertise; 3) unimproved health programs (e.g. poor family planning); 4) mass illiteracy; and 5) the dominance of land-extensive agricultural systems (in a region where high population pressure has drastically reduced the land area available for farming (USDA, 1981; World Bank, 1981). It has also been reported that the great diversity of ethnic and cultural groups in Sub-Saharan Africa has resulted in frequent political fragility and turmoil, thereby hampering economic progress and development. The major external factors often cited include the increasing balance-of-payments deficits and the consequent unfavorable terms of trade that face many Sub-Saharan African countries.

However, it would not be feasible to deal with all of these issues/problems in this study. Because the achievement of a reliable staple food surplus through domestic production has been described as the fundamental prerequisite for appropriate development, this study will explore ways of boosting the domestic supply of staple food through land intensive agricultural systems (as compared to land extensive means).

Available evidence clearly indicates that much of

the staple food production in many African countries (e.g., Nigeria, Kenya) takes place in small peasant farm holdings. It is also known that the majority of the rural population is largely engaged in what has often been described as "subsistence-type" agriculture. Growth in food production has been generally achieved through increases in the cultivated area, in contrast to increasing aggregate production through increases in yield per acre or productivity. But, with the ever increasing population pressure and the encroaching urbanization on farm land, the declining productivity of these peasant farms can no longer be offset by continued increases in the cultivated area. The constant land resource base (and the decreasing farm land), coupled with the steady increase in population growth rates, makes the effectuation of the law of diminishing returns almost inevitable in the near future. This increasing awareness has been the basis of the recent calls for alternative agricultural strategies for fostering rapid increases in productivity of the remaining farm land areas.

The basic tenet of this study is that productivity increases in small-scale farm sector can be achieved through the design and introduction of appropriate production technologies for use by small holders. Nigeria (a typical developing country in Sub-Saharan Africa--at least in terms of national development problems and needs) will be used as the analytic "case in point" in this study. It should be pointed out that the proposed tenet of this study is in

direct contrast to the relatively recent advancement of, and concentration on, the development of large-scale, capital and energy-intensive, commercial farms by several governments in Nigeria. In this study, therefore, the precise determinants of the "appropriateness" of the advocated alternative technologies, especially designed for the small-scale farms (as well as the strategies for their successful development and diffusion among the identified target population [viz., the small holders]), will be extensively reviewed.

Rationale for the Study

The prevalent farming systems in Nigeria, as well as in most African countries, exhibit a characteristic "dualistic structure." This dualism consists, firstly, of small-scale peasant farms. Here labor inputs are typically supplied by family members who utilize relatively simple traditional farming tools and production techniques. The accessibility of the small farmers to modern production techniques or agricultural innovations, where it is possible, has often been limited by numerous environmental, as well as institutional, constraints. Large-scale commercial farms also exist and they employ substantial amounts of wage labor as well as modern, highly sophisticated, capital and energy-intensive farming tools and production techniques. According to Eicher and Baker (1982), large-scale farming in Sub-Saharan Africa dates back to the colonial era when plantations and large European farms were introduced in order to

produce "cash or export crops" for the "mother country."

However, studies on the essential differences between the above mentioned farming systems have revealed several significant findings. For example, Reynolds (1975:4) has observed:

> Research from countries as diverse as Colombia and India indicates that the small farms apply more labor and other variable inputs per acre of land and achieve higher yields per acre. Large farms are less labor-intensive and achieve lower yields per acre but higher yields per man-hour.

It is plausible that the advocated emphasis on the design and introduction of appropriate production technologies can result in higher yields per man-hour on small-scale peasant farms. Also taking cognizance of the abundant labor supply conditions (relative to capital), as well as the high demand for profitable employment opportunities in Nigeria (and in several other African countries), it can be contended that aggregate food production and productivity increases can best be achieved through the development and introduction of appropriate technologies for the small farmers.

It is also pertinent to note that the new conceptualizations of national development call for the provision of: 1) minimum adequate standards of the basic human needs (e.g. food, employment, and shelter); and 2) equity in income distribution (Streeten, 1979). In contrast, the scarcity of capital, as well as skilled manpower supplies in the developing nations, clearly suggest the

inappropriateness of heavy reliance on large-scale, highly sophisticated, capital and energy-intensive technologies for agricultural production.

Another major rationale for this study arises from the following observations by Evenson (1975:192):

> Programs designed to transplant modern technology have continuously come up against the realization that the technology offered often had little or no advantage over the traditional methods, given the economic, soil, and climatic conditions facing producers.

A case can, therefore, be made for the fact that there are many significant socio-cultural, political and institutional constraints facing the small farmers that ought to be identified and carefully analyzed. It is only through such critical analyses that one can begin to comprehend the small farmers' environment and, subsequently, can design the types of production technologies aimed at enhancing agricultural production on small-scale farms.

Objectives and Organization of the Study

The present study is aimed at accomplishing the following objectives:

Objective 1

The first objective of this research is to review--in Chapter 11--older and newer conceptualizations of national development and to relate the current paradigms of development to the process of agricultural development in Nigeria.

More specifically, it is hypothesized that the appropriate development of Nigeria (or many other developing

countries for that matter) should have as a fundamental starting point the design and introduction of appropriate technologies for the agricultural development of small-scale peasant farms. Based on the essential elements of the new models of development, and also recognizing that the majority of the poor in Nigeria are still mainly engaged in small-scale peasant farming with its characteristic low productivity, a case will be made for the injection of appropriate production technologies to enhance the productivity of this farming system.

Objective 2

The second objective of this study is to explore the full meaning of technology and to identify, and then describe, the essential elements of new production technologies that can be classified as "appropriate" for a specified target population (namely, the small-scale or large-scale farmers). Therefore, Objective 2, which will be treated in Chapter III, seeks to establish the precise determinants of the "appropriateness" of any given production technology or agricultural innovation for an identified farming system. Specific attention will be devoted to the description of the characteristics of appropriate technologies for small-scale peasant farmers.

Objective 3

The third objective--to be considered in Chapter IV --is to discuss and review the models and current approaches

that have been used for the design and introduction of new technologies (more specifically, agricultural innovations) on the prevalent farming systems in Nigeria.

Therefore, this chapter will, first, review the "dual structure"of the existing farming systems in Nigeria. Historically, it has been assumed that accelerated food production could only be achieved through the introduction of highly mechanized and capital-intensive agricultural production patterns. But available evidence suggests that this approach has not only failed to solve the food production problems of the country but, more importantly, has largely ignored the needs and production problems of the poor majority of small farmers who produce the bulk of the staple food needs of the populace. Current approaches, such as the Farming Systems Research [FSR] (which gives "voice" and attention to the needs of small-scale farmers) will be reviewed.

Objective 4

The fourth objective of this study (the focus of Chapter V) will be to review the process and models of agricultural growth and development in the Third World, in general, and in Nigeria, in particular. The significance of the new emphasis on small farm development, as well as the strategies and conceptual frameworks for analyzing small farm development problems, will be discussed.

In order to draw clear lessons for planning and policy making in Nigeria, this chapter will also include a

review of relevant case studies and pilot projects that have been designed to improve the welfare of small holders through the enhancement of productivity in their small farms. Also, future research needs for agricultural growth and development of the small-farm sector will be discussed.

The final chapter (that is, Chapter VI) will include the conclusions of this study, and based on those conclusions, a set of policy recommentations.

CHAPTER II

TOWARD A NEW PARADIGM FOR NATIONAL DEVELOPMENT IN THE DEVELOPING COUNTRIES: IMPLICATIONS FOR AGRICULTURAL DEVELOPMENT

An Early Conceptualization of National Development

The decades of the 50s and 60s were characterized by the gaining of political independence by many colonies of Western European countries. Concurrently, the indigenous power elites, who took over the control and management of national governments, strived for ways to effectively accelerate the growth and development process in their former colonies. These leaders believed that political independence would automatically bestow economic independence to the new nation-states. Little did they know that several latent economic and institutional "strings" would remain unsevered.

Abundant supply of unskilled labor appeared to be the most conspicuous factor of production that was readily available in most of these former colonies. There was an obvious scarcity of capital and skilled level manpower supply. It, therefore, became imperative to rely on Western scholars and a handful of indigenous experts (whose academic backgrounds were frequently of Western origin) to

design ways of, and strategies for, achieving the rapid national development of the former colonies. But, as one might expect, the thinking of these scholars and policy makers was greatly influenced by the historical development patterns of the industrialized western Euro-American countries.

Consequently, the early definitions of national development centered around the criterion of economic growth--i.e., economic growth was seen as the basic ingredient for national improvement. Within this perspective, industrialization was regarded as the most important tool for achieving economic growth and, hence, development. Additionally, the socio-economic transformation of Western Europe and the United States, which resulted largely from Industrial Revolution, was seen as the primary rationale for this mode of thinking. The significantly different socio-economic and institutional settings, such as the abundance of unskilled labor and limited technology supplies (in contrast to scarce capital and improved technologies), did not suggest the need for exploring alternative development routes for the new nation-states. Likewise, the non-existence of colonies (which had provided the much-needed raw materials and other resources at exceedingly low prices for the industrialization of the West), did not seem to provide a rationale for seeking alternative development pathways. In essence, the apparent differences in culture, values, and aspirations between the peoples of the developed and the developing world did not surface as strong reasons

for looking at the issue of national development differently (Rogers, 1976).

Beltran (1974:11) accurately described this early approach as the "classical materialistic model" of national development. The GNP has been described as the main basic index of this model of development. Rogers and Svenning (1969:18) also described this early model of development as essentially consisting of:

> . . . a type of social change in which new ideas are introduced into a social system in order to produce higher per capita incomes and levels of living through more modern production methods and improved social systems.

Reactions to the Early Concept of National Development

The early model of development failed to generate the expected increases in rate of growth and development of the new nation-states. It was also observed that rather than "bridge the gap" between the rich and the poor, this model of development appeared to ignore the equity concerns associated with growth and development. In other words, even where there were recorded increases in GNP, there were no observable improvements in the welfare and livelihood of the poor majority in these newly independent countries.

To support the above assertions, Uphoff (1973) has observed that:

> . . . there can be growth without development (changes only in scale) and development without growth (changes only in structure). . . there

> is no assurance that resources generated from a "growth" strategy will or can be diverted or devoted to developmental investments as is commonly assumed by conventional economists . . . Development to be productive must of course lead to growth in some longer run.

Following a similar line of reasoning, Rockefeller (1969: 1-2) has contended that:

> Growth is primarily an economic phenomenon, a process of expansion or improvement of the basic productive elements of land, labor and capital . . . Development, on the other hand, is much broader in scope and concept. It is often used as a synonym for progress, and progress involves a host of social, cultural, political and psychological factors that may be much more significant over the longer run than purely economic factors.

Axinn (1977) has also refuted this early conceptualization of development in which it was assumed that the process was linear and irreversible. It is strongly contended that the process may, after all, be cyclical in nature. In arguing against this early "materialistic model" of national development, Beltran (1974:13) has concluded:

> It entails a dehumanized vision of progress which stems from the eminently mercantile mentality that rules much of life in the nations which have reached the highest levels of advancement. It equates having more with being better. It does indeed confuse means with ends; sacrificing the highest values of human beings -- dignity, justice and freedom--to abundance and prosperity at any price . . . for the prvileged minorities.

It should be noted that several development scholars (Rogers, 1976; Seers, 1977; Wignaraja, 1976) have characterized this early model of national development as consisting of the following elements:

1. *The achievement of economic growth and development was conceived primarily through industrialization and accompanying ubranization.*

The obvious assumption here was that the rate of national development and performance could only be quantified in economic terms, such as, through GNP and per capita income. It was also wrongly assumed that the benefits of growth would automatically "trickle down" to the large unprivileged majority, mostly located in the rural areas and urban slums. Rogers (1976:125) remarked that the concentration of national incomes in a few hands and the subsequent inequality were erroneously "thought to provide incentives for hard work and sacrifice and to act as a motivating force for individuals to invest in a lengthy formal education . . ." Moreover, the ease of measuring economic growth through the use of such indices as GNP and per capita income appeared to be enough rationale for their acceptance as indicators of national development. But, unfortunately, the dearth of high-level manpower and technical skills, which are essential for the industrialization process in the developing countries, was not considered a major hindrance to the success of the process.

2. *The indiscriminate importation of complex, highly sophisticated, capital and energy-intensive technologies from the industrialized countries was witnessed in most Third World nations.*

Despite the obvious scarcity of capital and indigenous high-level manpower during this period, the "gospel of big is better" was enthusiastically spread by many Western

development scholars. The indigenous power elites at the helms of national governments unquestionably embraced that gospel with similar zeal. Massive importation of complex, high-energy technologies was embarked upon--sometimes with foreign assistance loans. This approach to development not only increased dependency on the industrialized economies but, more importantly, worsened unemployment and poverty conditions of the populace. The welfare of the masses was apparently ignored, and living conditions deteriorated in several countries. Igbozurike (1976:29) reported that in Nigeria, for instance, industrialization programs were characterized by:

> Plans (that) were ill-conceived and poorly executed, with little or no feasibility studies. In many cases, narrow political motives guided the siting of projects and industrial plants . . . (and) Earnings from peasant agriculture, which was virtually left to take care of itself, were ploughed into questionable industrial ventures.

Amin (1974) also noted that the limited success of the industrialization efforts could be attributed to the peripheral character of Third World development. According to Amin (1974:9), the peripheral systems are:

> . . . dominated by production of luxury goods and exports and the consequent lack of internal mass markets. This leads to growing inequality, technological dependence . . . (and) . . . marginalization.

The assumption at this point was: economic growth constitutes the primary goal of development. Its necessary accomplishment could only be possible through the

importation of sophisticated, capital and energy-intensive technologies. Problems of poverty, inequality, and social justice were considered to be of secondary importance. Several writers (Seers, 1977; Rogers, 1976) have noted that the classic argument advanced in defense of this development strategy was: inequality was necessary, not only to generate savings, but also to act as an incentive for hard work and productivity. This strategy, it was argued, would invariably promote economic growth--the indicator of national development during the period.

Available evidence also indicates that the marked dissimilarity of the physical, socio-cultural and economic characteristics of the tropical environments of most developing countries (in contrast to the temperate environments of the industrialized nations), was not given much consideration in the technology transfer process. They were mostly ignored. Even the problems of environmental pollution and degradation of the industrialized nations, which have resulted, in part, from the massive and indiscriminate use of high-energy technologies, were not seen as strongly persuasive arguments for prescribing alternative development pathways for Third World countries. It seemed as if the rationale was merely as follows: Because the Western countries achieved development via the industrialization route, it is only reasonable to expect the developing countries to follow a similar pathway.

3. *The idea of centralized economic planning and national decision-making (a "vertical" or "top-down" approach) was advocated by Western scholars and practiced by indigenous power elites.*

Rogers (1976:215) has observed that one of the characteristic features of Third World development was that:

> . . . almost every country in Asia, Africa and Latin America established a national development commission during the 1950s and 1960s.

Mostly four-year, but sometimes five-year, development plans were painstakingly formulated to guide economic development activities of national governments. In other words, a "top-down" approach to program design, planning, and execution was the rule--rather than the exception--in most developing countries during this period. Western scholars and development economists were often relied upon to provide the blueprint for national development and "modernization" of the indigenous population. The indigenous power elites often colluded with Western planners and academics in dismissing the populace as merely "conservative," "primitive" and "illiterate peasants" who did not know what they needed. A "needs assessment" approach to program planning and development was considered unnecessary and futile. Neither was local or "grass roots" participation in problem identification and decision-making thought to be of any value or consequence. Development programs, which were supposedly aimed at improving the welfare and quality of life of the populace, were merely imposed from "above."

4. *The early conceptualization of development assumed that the developing countries themselves were directly accountable and responsible for their underdevelopment and economic backwardness.*

In other words, the early models of development assumed that the causes of poverty, mass deprivation, and economic stagnation were to be found within the developing countries themselves, rather than in their external relationships with the industrialized nations (Rogers, 1976). Most scholars found it convenient to down-play the adverse effects of colonial exploitation on the fragile economies of most Third World nations. The heavy taxation of these former colonies with respect to their human and material resources for achieving growth and socio-economic transformations of the industrialized countries was not given the deserved attention in world development literature. Even the resulting ecological destruction, as well as the environmental degradation, of the former colonies were not considered sufficiently strong reasons for the socio-economic stagnation of most Third World countries at independence.

But Franke and Chasin (1980:63) have strongly argued that "African historical development was harshly interrupted by the expansion of European colonialism." They also remarked that, before the colonial intervention, the people of most Third World nations evolved very effective means of using their environmental resources and for organizing their unique types of productive systems that

were well-suited to their specific ecological conditions (Franke and Chasin 1980:40). Empirical research findings reported by several scholars (e.g., Norman, 1980; Okigbo, 1976) strongly support these assertions. However, the ecological destruction of the mostly tropical environments of the developing nation-states largely resulted from the indiscriminate colonial exploitation of these former colonies.

Franke and Chasin (1980:4) have also argued that:

> The relationship between ecological destruction and food production is thus direct and close. Whenever an environment is degraded, deprived of its basic resources--or often of even one of the key resources--that environment becomes a part of the world food crisis, and the people who live there becomes its victims.

In the light of the above, it is not surprising today that several developing countries experience an acute indigenous food shortage.

Redefinition of the Approaches to, and Perspectives on, National Development

The deficiencies associated with the early model of development soon became apparent to development scholars and planners alike. The indiscriminate importation of complex, capital and energy-intensive technologies from the industrialized nations failed to generate the expected increases in growth and productivity. Old (1977:VII) observed that, by the late 60s, there was an obvious awareness among scholars that there were:

> . . . apparent incongruities between the goals of the developing countries, their labor conditions and other resource endowments, and

> the technologies these countries were importing.

The consequences of this early development approach, which merely aimed at rapidly transforming the fundamentally traditional agrarian societies of the developing countries into highly mechanized industrial societies, are also evidenced in the following observations from Wijewardene (1979:1):

> Derelict remains of agricultural machinery piled high on government and 'large-scale' farms all over the tropical belt offer mute testimony to the failure to impose the tools and systems of temperate European and American agriculture upon the totally different conditions of the tropical environment.

In addition, McLaughlin (1976:44) remarked that, during this early period of national development history, the developing countries were merely:

> . . . littered with inoperative tractors, trucks, generators, pieces of road equipment, and pumps that are rusty from lack of maintenance and spare parts.

The imported tools and equipment were not only capital and energy-intensive, but were equally so complex that they could not be easily understood or effectively used by the populace that they were meant to benefit. Thus, the inappropriateness of such imported technologies cannot be overemphasized.

Even when there were recorded increases in economic growth and productivity from the use of such high-energy technologies, Misra (1981:52) noted that the:

> . . . developing countries found to their dismay that the poverty of the masses continued to be appalling.

Because of the non-participatory nature of the early development strategies, as well as the "top-down" approach to the design and execution of development programs, it was apparent that such recorded increases in economic growth and productivity did not benefit the poor majority. Consequently, mass unemployment, absolute poverty, and the associated social strife and violence have continued to rise unabated in several developing nations. It has also been reported that, in most of the Third World nations, the "quality of life" witnessed further deterioration--even when the GNP and per capita incomes have risen (Misra, 1981).

The implications of the foregoing seem to be obvious: an unsuccessful attempt to impose an alien pattern--Western European and American styles of, and strategies for, development upon the different socio-cultural, economic, and political conditions of the developing countries. In contrast, it is now being recognized that national development involves more than mere economic growth, and therefore, cannot be synonymous with, or substituted for, it. Development has now come to involve human beings--meeting their basic human needs and, subsequently, aiming at the improvement of the general welfare of all citizens of any one nation-state. It is, therefore, not surprising to notice recent intensified efforts by development scholars and planners to propose alternative pathways of, and strategies

for, national development of the Third World nations.

Alternative Conceptualizations of National Development

It is now strongly argued that the process of national development requires a more complex picture of the nature of societies--their socio-economic, cultural and political patterns--than had been previously considered. It is becoming increasingly evident that development cannot be considered as being synonymous with an increase in GNP and per capita incomes--irrespective of the distributional effects of such increases in economic growth. Employment patterns, health and nutritional standards of the populace, and equity in income distribution have all become important indicators of the level of national development. Eradication of mass poverty and deprivation has also become a major objective of the emerging paradigm of development. Schumacher (1973:168) has made the following pertinent remarks:

> Development does not start with goods; it starts with people and their education, organization, and discipline.

It is in the light of this new awareness about the important ramifications of national development that Case and Niehoff (1976:9) have also observed that:

> . . . one of the most significant changes in the theory and practice of development may be described as the 'demise of the GNP concept," i.e., the repudiation of the assumption that if the gross national product (GNP) is increased, the benefits of such increase somehow automatically 'trickle down" to large numbers of people (cited by Woods 1977:1).

Therefore, there is now a tendency to incorporate distributive justice, mass poverty eradication, and other socio-economic, cultural, and political goals as essential elements of the new paradigm of development. More precisely, the social welfare and economic well-being of the poor in the developing nations are now regarded as the fundamental concern of the new development paradigm.

The rising unemployment, inequality, and deteriorating "quality of life" of the poor in the developing nations have also led to the "loss of faith" in the early model of development. Moreover, several writers (Hag, 1971; Ladejinsky, 1970) have predicted that the rising unemployment levels, coupled with the continued concentration of wealth and subsequent mass deprivation, may create serious social tensions and lead to increased crime rates and violence. This dangerous trend may promote serious social, as well as political, instability in most Third World countries. The new national development paradigm addresses these concerns.

1. The Basic Needs Approach is now viewed as central to national development

This strategy of national development stresses the need for equality of distribution and also strongly urges the provision of minimally adequate levels of essential human needs. These basic human needs include: the provision of profitable employment, adequate nutrition,

shelter, water, education, transport, electricity, simple household goods, as well as non-material needs, such as "grass-roots" public participation in program design, planning and implementation. There is also great emphasis on cultural identity and the establishment of a high sense of purpose in life and work; these important elements interact with the material needs of humans (Streeten, 1979).

The "new" approach to development does not seem to be an entirely new concept. It can be easily likened to the "subsistence norm" concept, which had been advanced long ago as a basis for ensuring optimum income distribution in any given society or target population. Schickele (1944:9) had suggested that the best income distribution is essentially "one that equalizes opportunities among all individuals of society . . . The implication of this assertion, when translated in practical terms, is that "everyone should grow up and live in an environment of at least minimum adequate standards of health, nutrition, clothing, shelter and education" (Schickele, 1944:9). However, according to Schickele (1944), the exact determinants and quantitative contents of the minimum adequate standards of the essential needs may vary with the "cultural patterns, the state of the arts, and the size of the social product relative to population." In other words, it may be unrealistic, if not preposterous, to expect the same or similar levels of "minimum adequate standards" in, for example, a highly industrialized and

prosperous country "X", as compared to a developing and perhaps economically stagnant country "Y".

Nevertheless, it is now strongly argued that nation-states will derive more social benefits through the provision of subsistence claims to the populace rather than the denial of such claims. In most Third World countries, where such claims have not been met directly, or the opportunities for their realization seem to be non-existent, the consequences have been grave--in terms of absolute poverty and starvation, and subsequent increases in social strife and violence. Therefore, the urgent need for the incorporation of a basic needs approach to national development programs in these countries cannot be overemphasized.

2. *Greater emphasis is now placed on the introduction of profitable small-scale, labor-intensive, and capital-saving as well as energy-saving, technologies.*

Considerable concern is now being expressed by development scholars for the need to concentrate efforts on the development of simple, low-cost technologies that are accessible to the poor of the developing countries. Most modern high-energy technologies are not only expensive, but are also difficult to comprehend and effectively utilize, especially by the illiterate mass majority in most Third World countries. In other words, these technologies are often highly taxing of those scarce resources (such as, energy, capital and high-level or skilled manpower) that are not easily available in the developing countries.

Thus, several writers (Rogers and Shoemaker, 1971; Zaltman and Duncan, 1977) have found that the complexity and non-compatibility of innovations are inversely related to their rate of adoption by a target population. Other researchers (Norman, 1980; Navarro, 1977) have also observed that a sound developmental approach should always aim at building upon, rather than destroying, what is already in place. This assertion seems to have arisen out of the increasing realization--backed by empirical evidence--that many relatively simple traditional production systems, which have been used for generations in the Third World countries, are quite sound (Norman, 1980; Jodha, 1978). Therefore, a case is now being made for the preservation, as well as the improvement of, such hitherto ignored, production systems and practices. In other words, there is an advocation for the integration of traditional or endogenous production systems with modern or exogenous production systems in the design and development of simple, low-cost, and small-scale technologies for the populace in the developing nations. By so doing, it is envisaged that the values, aspirations, and cultural patterns of the target populations, as well as the resource endowments of their environments, are taken into due consideration in the design of improved technologies for their profitable use.

3. *Another essential element of the new paradigm of national development is an emphasis on the need for a socio-cultural identity and self-reliance in development.*

This strategy for national development stresses the importance of introducing citizen participation in decentralized program planning and decision-making. It, therefore, calls for a "grass roots" involvement in, or a "bottom-up" approach to, problem identification as well as program planning and implementation. This new approach to national development is in direct contrast to the early dominant paradigm which, among other things, emphasized centralized planning and decision-making--a "top-down" approach to problem identification, program design and execution.

Misra (1981:53) has reported that the early conceptualization of development was based on the following assumptions:

> . . . that all of human society is homogeneous and is imbued with the same culture, history and level of development--no matter how one defines development.

As stated earlier in this study, there was also the faulty assumption that it would be appropriate to base development strategies on purely Western life-styles and experiences. But as Misra (1981:53) has remarked, those Western experiences and development styles were peculiar "not only in terms of time but also in terms of history and circumstances."

It has therefore been suggested that appropriate development must fundamentally emanate from "within." It

has also been proposed that real development should be channelled through the avenues that each identified socio-cultural system provides. On this score, Misra (1981:52) has observed that:

> . . . a culture-neutral development can disrupt the identities of peoples and societies leaving the so-called developed man completely bewildered and lost.

Thus, the case is now being made that, for development to be real and meaningful, the target population should be actively involved in the design, planning, and implementation of all development programs. In other words, rather than impose development programs from above, the populace should be directly involved (i.e., actively participate) in problem identification as well as in making decisions that affect their lives.

4. *Finally, the new conceptualization of development emphasizes the precise identification and analysis of both the internal (or endogenous) and external (or exogenous) causes of underdevelopment in any given nation-state.*

Rogers (1976:219) has reported that the early model of development "assumed that the main causes of underdevelopment lay within the underdeveloped nation rather than external to it." It was customary for researchers and writers to dismiss the populace in the Third World countries during this period as being highly conservative, fatalistic, and unresponsive to innovations and efforts to improve their lives. Tradition and modernity were simply regarded as antitheses of each other, without any linkage whatsoever.

But it is now known that the early model of development failed to recognize the devastating effects of such external constraints and relationships as the:

> . . . international terms of trade, the economic imperialism of international corporations, and the vulnerability and dependence of the recipients (mostly Third World nations) of technical assistance programs (Rogers, 1976:219).

Furthermore, Misra (1981) has established that tradition and modernity appear to lie on a continuum with a large transitional zone. This suggests that a direct linkage exists between them. It can also be asserted that the several points on this transitional zone may indicate the various positions or levels of national development that have been achieved by the various developing countries (see Figure II-1). In other words, the individual broken lines in Figure II-1 illustrate the identifiable development pathways and strategies that any one developing country may opt to follow in the quest to achieve national development. Also realizing that the shortest distance between two points is a straight line, and that some of the broken lines in Figure II-1 are neither straight nor parallel to each other, it is easy to infer that some developing countries may inadvertently opt for a "longer and rougher" development route. This may entail the choice of unproductive, if not inappropriate, styles of, and strategies for, national development. But the nation-state that follows the "straight line" pathway to national development appears to be one that incorporates the new elements of development

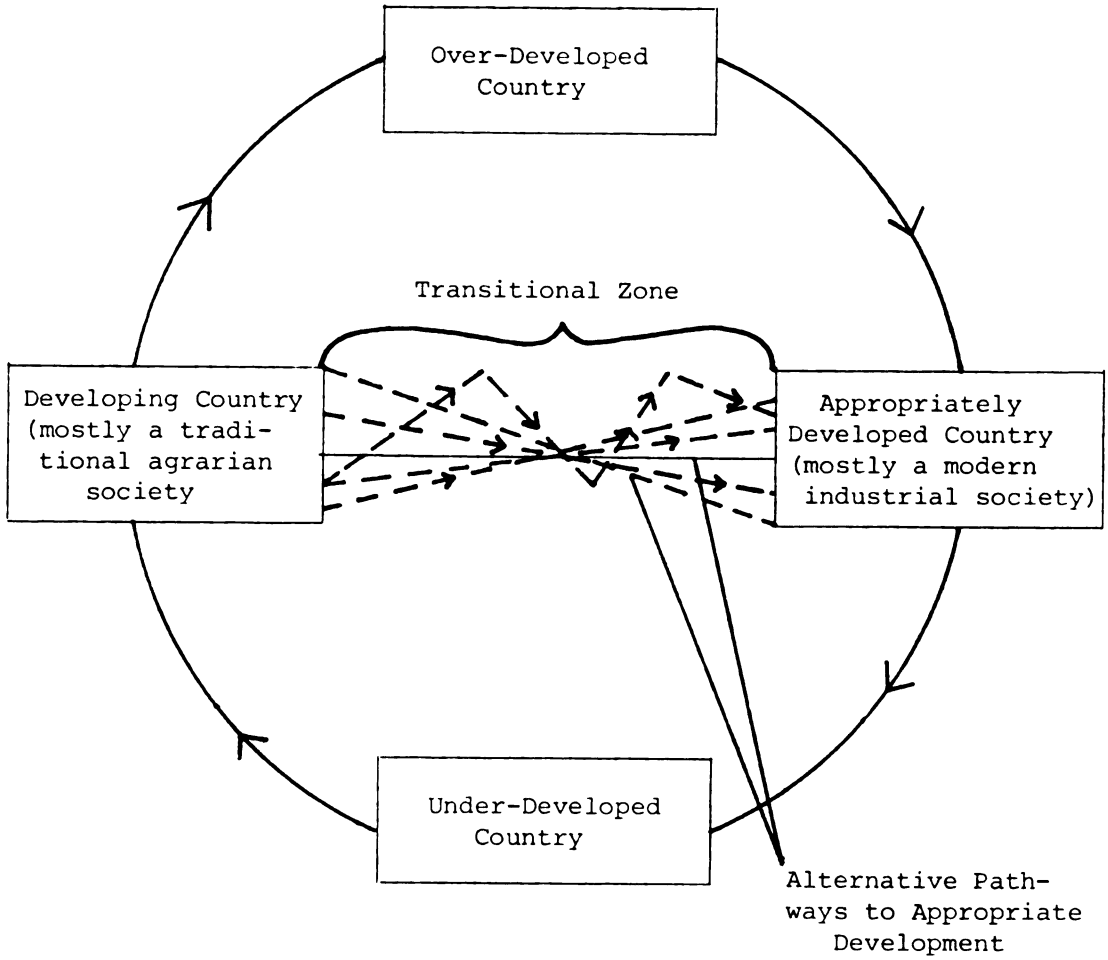


Figure II-1. Continuum of a Developing Country--An Appropriately Developed Country and the Alternative Routes to Appropriate Development

into its national development plans and strategies.

In view of the negative externalities that have been associated with the Western styles of development, it can be argued that few developed countries can now be described as "appropriately" developed. Therefore, it is possible to locate some industrialized nations at some points on the transitional zone and further suggest that, in recent times, these countries appear to be striving to be appropriately developed. Until these industrialized countries can effectively combat the pollution and environmental degradation problems that have been directly linked with their strategies for development, they cannot lay valid claims to appropriate development.

Thus, it is tempting to conclude that the cyclical pattern of development, which appears to depict the Western model of development, may, after all, not be ideal for the developing nations (see Figure II-1). For one thing, it pre-supposes that there still exists the colony (under-developed country), whose natural resources (human and materials) had been indiscriminately over-exploited in the colonial era for the industrialization of "mother country" (over-developed country). In this sense, it becomes easy to visualize why and how the former colonies were being "under-developed" and why and how the imperialist countries were being "over-developed." But, today, with the limited resources available within the national boundaries of each independent nation-state, and the fact that the transfer of these

resources from one national boundary to the other are usually preceded by active bargaining between the governments of the countries involved, it is inconceivable that some nations can still afford to "over-develop." This appears to be the reason why each nation-state--developed or developing--is now striving to be appropriately developed.

In the light of the foregoing, the view is, therefore, strongly expressed that each nation-state should opt to follow the "shortest" routes to appropriate development. The decision regarding which developmental pathway should be followed will depend, among other things, on the unique needs of that country as well as on her resource endowments. The guiding principle should be based on the provision of the "greatest good" for the greatest number of the citizens for the longest time. This appears, given current development thinking, to be the ultimate goal of national development.

Consequently, several writers (Schramm and Lerner, 1976; Rogers, 1976) now view development as the specific societal transformation towards the kind of social, political and economic system that a country ultimately decides it needs. Rogers (1976:225) also views it in the following, more holistic manner:

> . . . as a widely participatory process of social change in a society, intended to bring about both social and material advancement (including greater equality, freedom, and other valued qualities) for the majority of the people through their gaining greater control over their environment.

In order to further stress the recent people-oriented, as well as culture-centered nature of the new conceptualization of national development, Beltran (1974: 13) contends that:

> National development is a directed and widely participatory process of deep and accelerated socio-political change geared towards producing substantial changes in the economy, the technology, the ecology and the overall culture of a country, so that the moral and material advancement of the majority of its population can be obtained within conditions of generalized equality, dignity, justice, and liberty.

It is, therefore, fair to state that the new concepts of national development are not only people and culture-oriented, but they also stress the need to ensure that development takes place in accordance with sound ecological principles. The citizens are not only expected to be actively involved in making decisions that will affect and change their lives, but it is also absolutely essential to ensure that the implementation of such decisions do not disrupt the balanced relationships that should exist between humans and their natural environments. In other words, a call is now being made for new policies and development programs that will not only be physically and biologically sound, but must be equally economically feasible, institutionally acceptable, and administratively workable (Barlowe, 1976).

The Place of Agriculture in the Third World

Because agriculture has been identified as the primary industry and the "engine" for growth in most Third World countries, it is necessary that a section of the study deal with the place and importance of agriculture in national development.

To many, agriculture has been described as the "heart" of the economy of most developing countries. It is the primary sector that provides employment and means of livelihood for the majority of the population--especially those living in the rural areas. Loerbrooks (1965) has identified the key roles that the agricultural sector is expected to play in a developing economy:

1. To provide the food requirements of a rapidly growing population;
2. To serve as a major source of raw materials for the developing industrial sector;
3. To provide the volume of exports needed to pay for the import of capital goods;
4. To generate employment opportunities for the additional agricultural working population; and
5. To provide a substantial share of the capital needed to finance the development of the whole economy.

It is estimated that, in most developing countries, as much as 85 percent of the population is engaged in subsistence agriculture; nearly 90 percent of the rural

population is engaged in various forms of farm and non-farm enterprises (Lele, 1981). Available evidence also suggests that the agricultural sector, with an average growth rate of 2.5 to 3 percent, contributes as much as 50 to 60 percent of the GDP in most developing countries. It has also been reported that, with the population of most developing countries growing at 2 to 3 percent per annum and the per capita income consumption rising at only 1 percent, there will be an estimated annual increase of 4 percent in demand for food (USDA, 1981). The World Bank (1981) has further re-emphasized this unwholesome trend by observing that, in the 60s, the agricultural production of several developing nations grew in volume by 2.3 percent per annum--or roughly at the same rate as their population growth. But, in the 70s, agricultural production dropped to about 1.3 percent per annum, while population growth rates had risen to about 2.7 percent.

The implications of the above trend seem obvious: the data amply suggest the poor performance of the agricultural sector in most developing countries in recent years. These gloomy data can, therefore, provide the basis for calling for a thorough re-examination of the past patterns and strategies for agricultural development in these countries.

The World Bank (1981:45) has recently observed that the crisis in African agriculture can be traced to the following unique problems or causes:

1. The growth rate of agricultural production began to decline and, in the 1970s, was less than the rate of population growth almost everywhere;
2. Agricultural exports stagnated and African shares in world trade declined for many commodities;
3. Food production per capita was, at best, stagnant in the 1960s and fell in the 1970s;
4. Commercial imports of food grains grew more than three times as fast as population and food aid increased substantially; and
5. More of the population shifted its consumption to wheat and rice (as evidenced by the soaring imports of these food grains), which increased food dependency and created in many countries a mismatch between local production possibilities and consumer demand, since wheat and rice in these countries can only be grown at costs far above import parities.

Several factors have been held accountable for the poor performance of the agricultural sector in Third World economies. Prominent among the identified factors is the misallocation of investment, most notably the excessive emphasis on the importation and introduction of large-scale, capital and energy-intensive technologies for agricultural production. The World Bank (1981) has reported that, during

the 60s and 70s, for instance, many African nations directed a substantial proportion of their agricultural investment to large-scale, government-operated estates--involving heavy capital outlays for mechanization (as with the rainfed crops) or irrigation schemes, or both. It was erroneously assumed that only such a "rapid transition (transformation approach) to mechanized, high productivity schemes, as practiced in the industrialized world, would overcome the stagnation linked with the traditional low-input, low-output methods" (World Bank, 1981:51). Apart from the fact that the basis for the establishment of these agricultural schemes was often political in nature (as opposed to scientifically based), it has also been reported that the schemes were equally beset with problems of management, overemployment of staff, under-utilization of expensive machinery, and maintenance of equipment and infrastructure (World Bank, 1981). Furthermore, it has been established that the contribution of these large-scale agricultural schemes to growth was quite small when compared to their cost.

But, ironically, available research evidence amply suggests that small-scale peasant farms are frequently far more productive than large-scale, estate farms. In comparing the relative importance and significance of the large-scale, estate farms with the small-scale, peasant farms, Lele (1981:548) remarked that, although the estate sector makes a noteworthy contribution to production:

> . . . a major share of the total production and marketed surplus nevertheless comes from the small-holder sector.

More importantly, even the need to raise the income levels of the rural poor and to generate profitable employment opportunities in the rural sector, now make it mandatory for shifting emphasis to the development and introduction of small-scale and low-cost technologies that will be more beneficial to small farmers.

Therefore, this research will focus on the strategies for developing suitable technologies for agricultural production on small-scale peasant farms. It has been established that the bulk of food production in most African countries takes place on these small-scale farms. It is also noted that the majority of the rural population is engaged in small-scale farming for meeting their food requirements and other relevant needs that are vital for their livelihood and well-being.

On the basis of this information, this study therefore posits that agricultural development is fundamental for the socio-economic transformation of several African countries. Since technology has been described as the "engine" or "life-blood" for achieving rapid agricultural development, this study further asserts that appropriate development of African countries can best be achieved through the development and introduction of appropriate technologies for enhancing production on small-scale

peasant farms. According to Ventura (1981), technology should simply not be regarded as a mode of production. Rather, for technology to be meaningful and appropriate, it should embody the economic, social, political, cultural and cognitive modes of the target population in which it is to be introduced and utilized.

The Place of Agriculture in the Development of Nigeria

Agriculture has been described as the "back bone" of the Nigerian economy. This sector was once the most important source of foreign exchange for the country--until the relative recent growth in petroleum production. Over the years, the agricultural sector has also provided employment for a large majority of the rural population. The position and relative importance of agriculture in Nigerian economy were expressly stated in the Second National Development Plan (1970-74):

> Agriculture is still the mainstay of the Nigerian economy, with about 70 percent of the country's labor force employed in this sector. At independence in 1960, the percentage contribution of the sector to GDP was about 70 percent, although by 1966 it had declined to 55 percent.

As displayed in Table II-1, further declines in the contribution of this sector have also been reported. By 1970, the agricultural sector accounted for only 33 percent of the total export potential of the country. Furthermore, a significant decline in the percentage of the population engaged in farming has also been reported. People have

TABLE II-1

EXPORTS OF MAJOR COMMODITIES IN NIGERIA BY ECONOMIC SECTORS

Commodity	Quality (thousand tons)			Value (N's million)			Percentage of Total Export Value		
	1968	1969[1]	1970[2]	1968	1969[1]	1970[2]	1968	1969	1970
Major agricultural (including forest products	-	-	-	137.2	144.1	144.6	65.0	45.3	32.6
Cocoa and products	224.0	192.1	211.2	57.3	61.1	73.2	27.1	19.2	16.5
Cocoa beans	(203.1)	(170.8)	(192.6)	(51.2)	(52.6)	(66.5)	(24.2)[3]	(16.5)	(14.0)[3]
Cocoa butter	-	(10.7)	(9.2)	-	(7.0)	(6.6)	-	(2.2)	(1.4)[3]
Cocoa cake	-	(10.4)	(8.9)	-	(1.3)	(1.1)	-	(0.4)	(0.2)
Cocoa powder	(20.9)	(0.2)	(0.5)	(6.1)	(0.2)	(0.1)	2.9	(0.1)	-[4]
Cotton (raw)	14.1	13.7	28.7	3.3	3.3	6.6	1.6	1.1[3]	1.4
Groundnuts and products	963.2	782.5	534.1	52.3	51.4	38.7	24.8	16.2	8.7
Groundnuts	(686.6)	(517.6)	(287.1)	(38.0)	(35.8)	(21.8)	(18.0)	(11.3)	(4.9)
Groundnut cake	(170.3)	(167.9)	(159.5)	(4.9)	(5.0)	(5.5)	(2.3)	(1.6)	(1.2)
Groundnut oil	(103.3)	(97.0)	(87.5)	(9.4)	(10.6)	(11.4	(4.5)	(3.3)	(2.6)
Hides and skins	7.1	7.1	4.6	4.0	4.2	2.8	1.9	1.3	0.7[3]
Palm produce	160.1	184.4	189.2	10.2	10.3	11.4	4.8	3.2	2.6
Palm kernels	(138.6)	(177.1)	(181.9)	(10.1)	(9.9)	(10.8)	(4.8)	(3.1)	(2.4)
Palm oil	(1.5)	(7.3)	(7.3)	(0.1)	(0.4)	(0.6)	(-)[4]	(0.1)	(0.2)[3]
Rubber (natural)	31.0	56.8	58.4	6.4	9.6	8.8	3.0	3.0	2.0
Timber (logs and sawn) (cu. ft.)	10,822.1	11,453.3	7,827.2	3.7	4.2	3.1	1.8	1.3	0.7
Manufactures and semi-manufactures	-	-	-	2.4	3.0	2.7	1.1	1.0	0.6
Minerals and products	6,982.4	26,560.0	51,144.7	51.3	143.7	272.3	24.3	45.2	61.4
Columbite	1.4	1.1	1.6	0.6	0.6	1.0	0.3	0.2	0.2
Petroleum (crude)	6,969.6	26,549.6	51,132.6	37.0	131.0	254.7	17.5	41.2	57.4
Tin metal	11.4	9.3	10.5	13.7	12.1	16.6	6.5	3.8	3.8[3]
Other exports	-	-	-	15.6	23.9	19.7	7.4	7.5	4.4
Total domestic exports	-	-	-	206.5	314.7	439.7	97.8	98.9	99.0
Re-exports	-	-	-	4.6	3.5	4.3	2.2	1.1	1.0
Total Exports	-	-	-	211.1	318.2	443.6	100.0	100.0	100.0

SOURCE: Federal Office of Statistics, Lagos (1970).
(as cited by Anthonio, 1972).

[1] Revised

[2] Provisional

[3] Rounded

[4] Negligible

continued to abandon the agricultural sector--mostly as a result of its unprofitability and the drudgery associated with farming with unimproved tools and production techniques. Consequently, the migration of people to urban centers, high unemployment levels, over-crowding in urban slums, increased crime rates, and violence in cities, have been common features. Increased scarcity of staple food commodities and the associated rising food prices have also been reported. Lele (1981:547) has observed similar trends in several other African countries where the production of "many subsistence food crops appear to have stagnated or even declined." A recent study by USDA (1981) revealed that, as a result of the higher population growth rate, it is estimated that the annual increase in production required to meet the consumption need of Sub-Saharan Africa by 1990 may be as high as 4.5 percent. It is pertinent to note that this figure is much higher than that reported for other regions of the Third World, reflecting the differences in population growth rates as well as food production potentials.

With respect to food production in Africa, Gardiner (1968:6) also made the following observations:

> . . . one of the paradoxes of developing countries, and of Africa in particular, is that their societies, although predominantly agricultural, are becoming acutely short of food.

Available evidence clearly indicates that the food deficit situation in Nigeria, since the early 1970s, is an apt

reflection of the above description. Anthonio (1972) has confirmed that, in the past decade, the importation of food in Nigeria reached an annual average of ₦22.4 million Naira (equivalent to about $336 million dollars--see Table II-2). Furthermore, a close inspection and analysis of these food imports revealed, according to Anthonio (1972:26), that:

> . . . Nigeria can conveniently produce most of these foods provided enough impetus in the right direction has been forthcoming from government towards the structural transformation of the rural sector with respect to food production.

Because the bulk of food production is carried out under the small-scale, peasant farming conditions, it is the premise of this research that a major part of the required "structural transformation" can be achieved through the development and introduction of appropriate production technologies for enhancing production on small-scale farms. It is also asserted that such technologies can only become "appropriate" if they reflect and embody the socio-cultural, economic, political and acceptable institutional frameworks that prevail among the target population (i.e., the small-scale peasant farmers of Nigeria). Therefore, it is suggested that such improved technologies have to emanate from an integration of the traditional or indigenous production systems with the modern or exogenous production systems. In other words, for the new technologies to be labelled "appropriate" within the context of the small farmers and their farming environment, they have to be "built upon" the original traditional production techniques

TABLE II-2

NIGERIAN FOOD IMPORTS, 1960-70

Year	Total Import Value N million	Food Value N million	Import as % of Total Import
1960	220.9	23.9	10.81
1961	222.5	22.7	10.20
1962	203.2	23.5	11.36
1963	207.6	21.9	10.54
1964	253.7	20.6	8.11
1965	275.0	23.0	8.36
1966	256.4	23.8	10.06
1967	220.6	21.3	9.65
1968	192.7	14.2	7.36
1969	248.6	20.9	8.40
1970	376.2	28.8	7.65
Total Av. 1960-70	243.4	22.4	9.20

SOURCE: Anthonio (1972).

that are already in existence. This is the basis of the new approaches to agricultural development for the benefit of the small farmers in the developing countries.

Therefore, the next chapter will, among other things, identify and analyze the essential characteristics of technologies that may be considered "appropriate" for the prevalent farming systems in Nigeria.

CHAPTER III

THE MEANING, NATURE AND SCOPE OF APPROPRIATE TECHNOLOGY: IMPLICATIONS FOR THE DEVELOPMENT OF SMALL-SCALE, PEASANT AGRICULTURE

Appropriate Technology in Perspective

In the past decade, various labels have been coined by scholars to describe the technologies considered most suitable for use in the developing countries. The labels that have been used to describe these new technologies include: "labor intensive," "low-cost," "capital-saving," "village-level," "intermediate," and "small-scale." In recent times, however, the term "appropriate technology" appears to have gained wide acceptability among scholars. It has been suggested that this wide acceptance has arisen out of sheer recognition of the fact that there are several pre-conditions that determine the degree of suitability of any given technology within a particular environment. In other words, the degree of suitability of a particular technology will largely depend upon the socio-cultural structure and functioning of the target population, the socio-economic and political objectives of the country, as well as on the availability and quality of its productive resources (Old, 1977).

The nature and development of the concept, "Appropriate Technology" is examined in this chapter. This will be accomplished through an exploration of its meaning, scope and characteristics. The socio-cultural, economic, political and environmental dimensions of appropriate technology will also be explored. Finally, the relevance of appropriate technology for the agricultural development of small-scale, peasant farms in Nigeria will be considered.

Toward an Understanding of the Concept, "Appropriate Technology"

Technology is one word that may mean different things to different persons under different circumstances. Therefore, for the purpose of this study, it is essential to review the different perspectives on the word.

What is Technology?

The use of the word "technology" had been previously limited to the development and utilization of machinery and equipment. It had been narrowly used to describe the levels of sophistication and efficiency of engineering tools and equipment. This use of the word "technology" has, therefore, not surprisingly led many to believe that the concept originates from the industrialized Western Euro-American nation-states. But Wagner (1979:11) has aptly observed:

> . . . in fact technologies have been manifest in all modes of human existence since the use of the first tool.

Therefore, Wagner (1979:11) views technology in a much broader manner:

> . . . a technical method or capability for achieving a practical purpose. In other words, it is a methodology or system of employment of tools (a process, if you will) to accomplish some task or create some product. It is not a passive or inert object or a philosophy. Technology is an active dynamic process. Technology is the working arm of experience or science, but is essentially different from either.

The product of technology, therefore, is often seen as tangible or a means toward the solution of human problem(s). But Edwards et al. (1980:XI) view technology in a slightly different way: they view it as the industrial arts, that is, the production processes of industry, commerce and agriculture, which comprises the following essential elements:

1. Materials--which refer to the substances that are manipulated;

2. Inanimate Objects--(such as machine and tools) that are employed in the manipulation process;

3. Humans (and also lower animals)--who accomplish the manipulation process for productive purposes; and

4. Technical Expertise--which include the requisite human knowledge, experience and skills that are applied at the following levels:

    a. available expertise are needed to "select, grade, modify, accept or reject materials for inputs to the production process, or outputs for the market process;" and

    b. such expertise are also needed to "design, or build, or operate, or maintain, or adapt to local conditions--the machines or tools of the process."

Along the same lines, Ogbuobiri (1980:176) has suggested that technology is:

> . . . any process, application, or system which makes use of available resources to effect a product for, or effect some impact on, the world of man (or humans).

This view of technology, including its dimensions, and characteristics of its product impacts, is illustrated in Figure III-1.

From the above perspectives, it is evident that the use of the word "technology" should not be narrowly limited to the modern production of tools and equipment. Furthermore, it should not be erroneously conceived as originating from the industrialized West. Although the levels of sophistication and efficiency may differ, humans of all ages and in all parts of the globe have used various forms of technology to solve their problems. This is because "technology" refers to the native ability of humans to utilize their intellectual skills, wisdom, and experience for the solution of practical problems through several methods or techniques (Brown and Usui, 1974). This mode of thinking has been supported by the following conceptualization of technology:

> . . . a systematic application of scientific and other organized knowledge to practical tasks (Galbraith, 1967:12).

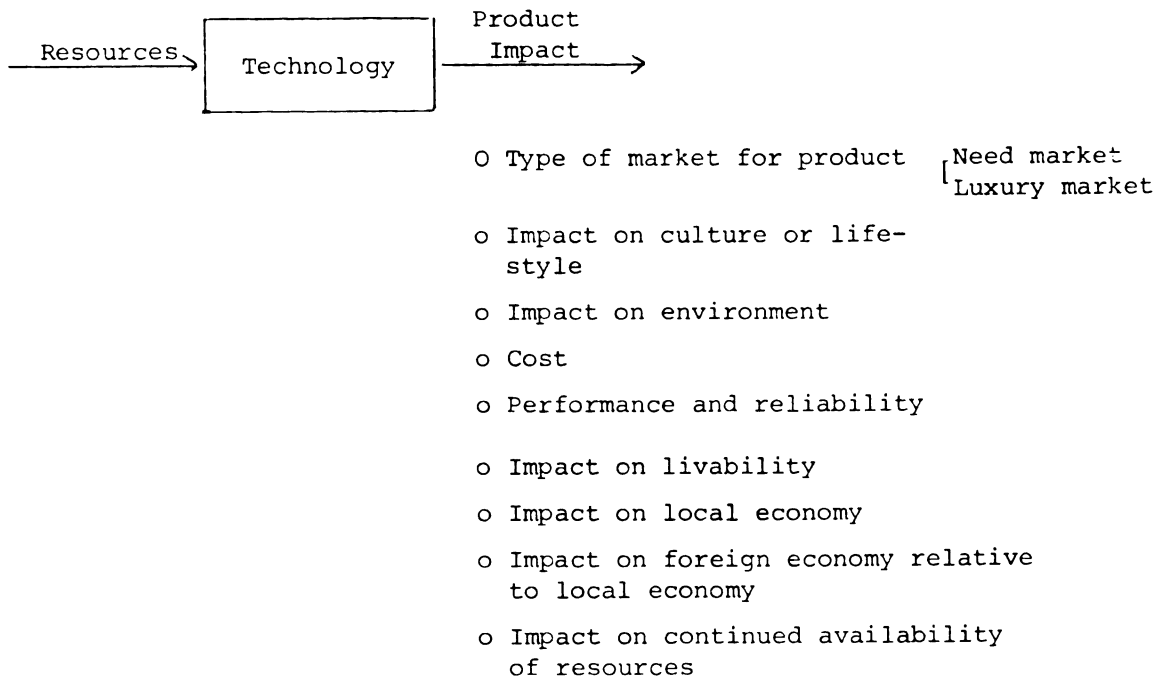


Figure III-1. Technology Defined as an Input/Output System

SOURCE: Ogbuobiri (1980).

What is "Appropriate"?

Several writers have expressed concern over inconsistencies in the use of the word, "appropriate," when applied to the development and use of new technologies in Third World countries. As can be expected, there is little consensus regarding the meaning of the term. However, several distinguishing elements have continued to emerge from the various perspectives. These elements will now be reviewed.

The dictionary definition of "appropriate" is: something "attached as a peculiar attribute or quality, or more generally as something "specially suitable or proper." Rybczynski (1980:2) has used this definition as the basis for arguing that the pertinent issue here is how a technology can be "specially suitable." The relevance of this issue, according to Rybczynski (1980), stems from the fact that almost every technology must be suitable for accomplishing something. Similarly, Brown and Usui (1974) strongly argue that, in its correct usage, the word "appropriate" has meaning and empirical content only through specific reference to a particular situation involving the individual or human group using it. In other words, a new technology or innovation can only become "appropriate" (or "inappropriate," as the case may be) by specific reference to the criteria or objectives (stated in empirical terms) to be achieved by the identified target population/client system that intends to utilize the new technology. It is even possible, according to Brown and Usui (1974), that the advocated objectives may:

1. not be the most desirable (or appropriate) for the identified human group; or
2. the technology employed may not be consistent with reaching the stated objectives.

It has, therefore, been argued that the "logic" of the expression "appropriate" can easily allow the usage of the term "appropriate technology" even when referring to

incompatible situations. Thus, it is often possible to have different professional perspectives on what should be rightly labelled as an "appropriate technology" for any given human group or target population--especially if the objectives stressed are different. Herein lies the necessity for determining the essential characteristics of any technology or innovation that should be labelled "appropriate," for a particular target population. As previously mentioned, this is one of the primary concerns of this study.

Brown and Usui (1974) further maintain that the expression "appropriate technology" cannot be easily used in practice unless the context and the objectives for its usage are clearly specified. Furthermore, a new technology cannot become "appropriate" until it is found to be compatible with the goals, products, processes, culture, as well as the environment of the identified local target population, in particular, and the nation-state in general (Bhagavan, 1979). According to Bhagavan (1979:9), the pertinent questions to ask in the process of determining whether or not a particular technology is "appropriate" include:

1. Does the technology support the goals of national development policy?;
2. Are the products and services affordable by, and useful and acceptable to, the intended users?;

3. Do the production processes make economic use of inputs?;
4. Are the products, processes and related institutional arrangements compatible with the local environment and culture?

Based on a similar line of thought, Ogbuobiri (1980:177) has concluded that a technology should only be considered "appropriate" under the following conditions:

> . . . if it makes the best use of available resources to generate needed products which enhance livability, enhance culture and life-styles, enhance the environment, are competitive, durable, easy to install, operate and maintain, enhance local economy, conserve limited resources, recycle waste, or otherwise prolong life and promote comfort.

The "Semantics" of Appropriate Technology

Several development scholars and planners appear to have embraced the importance of introducing new types of technologies that are better suited to the unique socio-cultural, economic, political and environmental conditions of Third World countries. Three major terms that have been commonly used to describe these new technologies (even in anticipation of their discoveries) are: "low-cost," "intermediate," or "appropriate."

Bhagavan (1979) has observed that each of these expressions seems to possess a dominant trait that distinguishes it from the others. For example, while "low cost" seems to emphasize the economics of production and utilization (indicating that the new technology has to be

less expensive than the previous types); "intermediate" is regarded as being somewhere between traditional and modernized (thereby laying emphasis on the engineering components of the new technologies). But, according to Bhagavan (1979), the term "appropriate" appears to emphasize the "socio-cultural impact" and may even be further influenced by other ideological considerations and value judgements. Thus, in a period when the new conceptualization of national development, among other factors, strongly advocates for cultural identity and self-reliance in development, it is little wonder why the term "appropriate" appears to have gained wide popularity and acceptance.

It is, therefore, evident that the notion of "appropriate" seems to have gained a wider acceptability--primarily due to its concentration on the welfare and socio-cultural conditions of the indigenous populace of the developing countries for whom the new technologies are designed to benefit. Jeĉquier (1976:19) has also noted that the underlying rationale for this wide recognition stems from the fact that the value and relevance of any new technology are now believed to lie:

> . . . not only in its economic viability and its technical soundness, but in its adaptation to the local social and cultural environment.

However, it is fair to conclude that some writers have used the terms--"low cost," "intermediate," "appropriate," and even sometimes "soft," and "alternative" interchangeably. As aptly noted by Jeĉquier (1976:21), very

often the choice of one term in preference to another appears to be a matter of "reflection of differences in emphasis rather than of fundamental difference in nature." However, for the purposes of this study (as well as to maintain consistency) the term "appropriate" will be used.

Characteristics of an Appropriate Technology

As previously stated in this study, capital and skilled level manpower are two major production factors that are often scarce or in limited supply in most developing countries. These production inputs are also highly expensive and, subsequently, are highly taxing of the foreign exchange reserves of most Third World economies. In contrast, unskilled and semi-skilled labor supplies are often plentiful and cheap. In addition, rising unemployment levels and the ever increasing gap between the "haves" and the "have nots" are among the major social ills facing most developing countries.

It is in the light of these serious social conditions that Bhagavan (1979:9) has suggested that an appropriate technology for the developing countries should possess the following operational characteristics:

> . . . (make) intensive use of semi-skilled and unskilled labor, sparing use of capital and highly trained personnel. Foundation on locally and domestically produced inputs, and on national personnel, and not expatriates. Economic efficiency of small and medium scale production enterprises. Replication by local entrepreneurs. Production and services mainly for local and regional markets.

In the same vein, Huybrechts(1979), as cited by Igben (1981:13), has delineated these criteria for determining the appropriateness of any given technology or innovation. The technology should:

1. be compatible with the tradition (and value systems of the target population);
2. make maximum use of available local raw materials;
3. create the maximum number of jobs (especially in areas of high rates of unemployment or under-employment;
4. demand minimum training and maintenance;
5. be adapted to be used by local firms constrained by poor financial, technical and managerial expertise;
6. be decentralizable in its operational units, thus enabling establishments in rural communities;
7. be in line with meeting the basic needs of the poorest people (in a given community where the technology is to be applied); and finally,
8. be efficient, yet low-cost, and hence within the reach of the recipients--especially the poor peasants in most developing nations.

The Origins of, and Rationale for, the Development of Appropriate Technology

There are at least three major reasons for the contemporary emphasis on the design, development, and diffusion of appropriate technologies.

1. There has been disillusionment regarding "exogenous" and imported technologies.

Since the 1970s, many scholars and policy makers have expressed concern over the dependence of the developing countries on capital and energy-intensive technologies. Development programs based on the use of these technologies have had a limited effect on curbing food shortages, rising unemployment, and increasing absolute poverty in these countries. Widening income disparities between the "haves" and the "have nots" have also become a common feature in the Third World nation-states. Jéquier (1976: 16) has summarized the negative effects (and thus the "inappropriateness") of these large-scale technologies in the following manner:

> They are usually costly relative to the income of the local populations, they require an educational and industrial infrastructure which takes decades to build up and their disruptive social consequences tend to be much more sudden than in their culture of origin. But perhaps most important of all, their introduction often inhibits the growth of the indigenous innovative capabilities which are necessary if "development" is to take place.

Therefore, it is quite evident that the new development climate would call for a re-direction of emphasis: a search for "appropriate" technologies that would recognize

the real needs, as well as the limitations of, the populace and the environment in which the new technologies would be placed.

2. *There have been rising concerns over the negative externalities and environmental degradation associated with the heavy reliance on large-scale, capital and energy-intensive technologies.*

The early model of development has been characterized as a "growth-oriented" strategy that emphasized economic growth through industrialization and accompanying urbanization. Little or no attention was paid to the distributional effects that would result from growth. Similarly, little attention was paid to the environmental degradation or ecological imbalance that has often resulted from the excessive reliance on large-scale, capital, and energy-intensive technologies. It was erroneously argued that in the event of the on-set of any negative externalities, suitable technologies would be developed to counter-balance those adverse effects. Little did anyone realize that some of the resulting environmental damage or ecological destruction, once caused, would often prove extremely difficult, if not impossible, to reverse. For instance, one school of thought has strongly argued that the desertification and the associated drought conditions that now prevail in the northern half of Africa, including the Sahel regions, is due (in large part), to the ecological destruction of those areas of the world during the colonial era (Franke and Chasin, 1980).

But, according to Lodwick and Morrison (1980), the basic argument now seems to revolve around the relationships that exist between the level of economic development and the quality of life. While "growthists" or "capitalist-materialistic" development strategists appear to favor the enhancement of economic growth (misconstrued for national development) through massive industrialization, appropriate technology advocates assert that a point of diminishing, if not negative, returns may already have been reached (Morrison, 1978a--see Figure III-2).

It is within this vein that Jeéquier (1976:25) described the origin of appropriate technology:

> . . . the realization, shared by aid-giving and aid-receiving countries alike, that development aid and a Western style of industrialization have neither fulfilled the initial hopes which were placed in them nor been fully capable of solving the basic problems of development.

Jeéquier (1976:26) has also argued that, even within the industrialized world, there has been a growing concern regarding the widespread acceptance of the early development model:

> . . . the worldwide student revolts of the 1960's, the debates about "Limits to Growth," the ecology craze and the oil panic, the reactions against the consumer society, and the patterns of living imposed by industrial necessity, are the most conspicuous symptoms of Western society's growing doubts about its values, its way of life and its long term future.

In light of the foregoing, it is therefore not surprising to note the increased efforts by scholars and policy-makers toward the design and initiation of alternative

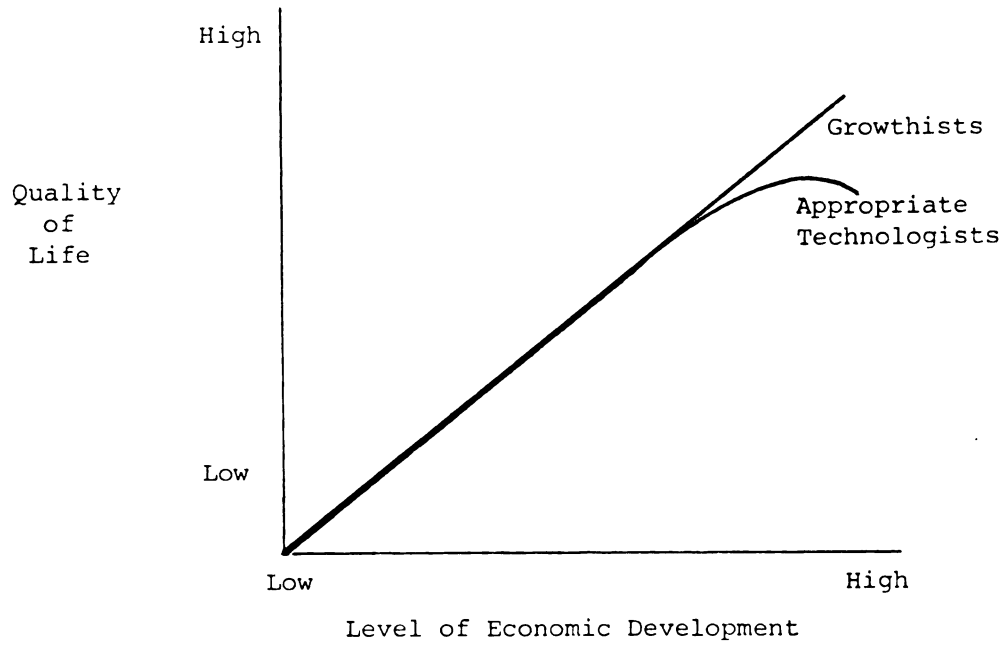


Figure III-2. Conflicting Growthist and Appropriate Technology Perspectives on the Relationship of Level of Economic Development and Quality of Life

SOURCE: Morrison (1978a).

development strategies. The new emphasis on the development of appropriate technologies is one of the products of such efforts.

3. The seminal work of E. F. Schumacher (1973) promoted appropriate technology thinking.

Much of the early popularity of the appropriate technology concept can be traced to E. F. Schumacher's (1973) influential book: Small is Beaufitul: Economics as if People Mattered. The appropriate technology idea

has been advanced as a needed substitute for the "exogenous" large-scale, capital and energy-intensive technologies of the developed countries. It has been contended that these technologies failed to eliminate, or even reduce, poverty, inequality and unemployment in the developing nations.

In a recent review of Schumacher's book, Alliband (1979:135) has noted Schumacher's strong opposition to the erroneous assumptions underlying the traditional Western economic development thinking--the idea of placing too much emphasis on:

> . . . macro-level, rational decision-making with insufficient attention given to the human impacts of change.

As an alternative, Schumacher (1973) has proposed a fundamentally "humanistic change strategy" that would be aimed at the systematic study of more cost-effective ways of achieving acceptable societal goals with minimal means. Alliband (1979) has described this mode of thinking as "Buddhist economics"--essentially stressing the need for a close examination of change situations in order to determine socially suitable and acceptable goals and then find least wasteful ways of accomplishing them.

The thrust of Schumacher's seminal work, according to Alliband (1979) is, therefore, the strong challenge of the underlying assumption of most orthodox economic thinkers--viz., that "competition and survival-of-the-fittest" are naturally inherited, immutable laws of human behavior. As a more feasible alternative, Schumacher

(1973) has proposed that the design, planning and execution of development programs should place maximum emphasis on dialogue and extensive consultation between planners and affected citizens.

In the final analysis, Alliband (1979:136) observed that much of Schumacher's views are in harmony with the key elements and concepts of community development, since he:

> . . . advocates the principle of local autonomy, consumer participation in decision making, and the evolvement of local problem-solving capacities . . . and need (for) less mass-production and more production for the masses.

In this sense, Schumacher (1973) strongly favored the proliferation of small-scale and inexpensive work-places (such as labor-intensive cottage industries), in contrast to the introduction of large-scale, capital and energy-intensive factories. Consequently, the much needed employment opportunities would be provided to the masses in poor rural areas.

Essential Principles of an Appropriate Technology for the Developing Countries

Technology has been described as the "engine" for national development. It has also been asserted in Chapter II that appropriate development of the developing countries should have as its starting point the introduction of appropriate technologies for fostering agricultural production--the primary occupation of the large poor majority in most Third World nations. The early approaches to national development (notably, heavy industrialization and

the "top-down" approach to program design and implementation) have not only failed to recognize the real needs of the poor but, more importantly, have stifled their initiatives and denied them an active involvement in the development process.

Conversely, the achievement of national development through the introduction and use of appropriate technologies has been proposed as one way of correcting these ills. Hence, Morrison (1978b:5) aptly views appropriate technology as a new and popular:

> . . . social movement---a deliberate attempt to mobilize collective action to change society in a way that defies the institutionalized direction and/or rate and/or method of change in society.

Wagner (1979:12) has proposed the following essential principles of appropriate technologies:

1. A technology can become appropriate when it is <u>adaptable and location-specific</u>. In other words, this principle recognizes the fact that different nation-states or socio-cultural systems have different physical environments, as well as varying ways and means, of satisfying their basic needs for food, shelter and clothing. Therefore, a new technology or innovation has to be adapted to a specific local condition in order to be applicable. It has to be an improvement (in other words, "built upon") over the indigenous process/product that

is already there, and so show a definite relative advantage over this previous process/ product it is to replace before it can be acceptable to the target population.

2. An appropriate technology has to be labor-intensive and capital saving. This principle arises out of the fact that capital has often been described as the most scarce production resource, whereas human labor frequently constitutes the most plentiful resource in most developing countries. Therefore, it makes sense that any new technology or innovation has to be designed in such a way as to make the best use of the most abundant production resource(s).
3. A technology becomes appropriate if it is specifically designed for, and purposefully direct at, assisting the poor peasant majorities of the Third World in meeting their basic needs. This principle stems from the fact that for these new technologies to be different and more beneficial to the populace, they should not only be aimed at decentralizing the means of production, but also be designed in such a way as to enhance primary production, utilizing local resources. They should also produce basically for the local markets.

In the light of the above principles, Morrison (1978b:7) has attempted to distill the "essence" of the appropriate technology critique of the large-scale, capital and energy-intensive technology in the following manner:

> Means of production that are capital-intensive, complex, large-scale, centralized, resource-intensive and resource-exogenous have undesirable social impacts. They displace people, especially underdogs, from jobs, alienate the employed from their work and the unemployed from society, create over-abundance for a few while depriving the masses of their basic needs or at least make them dependent on others, create social units that are vulnerable to external events, are destructive of the environment, and are ultimately destructive of the affluence they seek to create. On the other side, soft (or appropriate) technology productive systems that involve light capital, are small in scale, decentralized, resource conserving, and resource indigenous are appropriate because they have desirable social impacts. They create meaningful work for all, supply the basic needs of all, allow self-sufficiency and create an ecologically sustainable, higher quality of life.

Key Dimensions of Appropriate Technology

A useful discussion on the need to design appropriate technologies for the Third World nations cannot be complete without an extensive review of how the new technologies can effectively fit into, or harmonize, with the unique socio-cultural, economic, political and environmental realities of these countries. In other words, it can be asserted that an improved technology or innovation cannot be described as "appropriate" if the technology fails to satisfy the institutional, as well as the natural resource, requirements of the specified locality in which it is to

be introduced. Therefore, the key dimensions of an improved technology that have been considered to be in harmony with the prevalent institutional and environmental conditions of the target population (namely, the Third World populace) in which it is to be used, will now be reviewed.

The Socio-Cultural Dimensions of Appropriate Technology

One of the key elements of the new development paradigm is the need to recognize the legitimate rights, as well as the real needs, of the large poor majority of the developing world through a participation-oriented strategy to national development. The new concept of development also calls for self-reliance in national development and the recognition of the cultural identities of all organized, geographically-identifiable human groups or nation-states.

Foster (1973:10) has viewed a traditional society (a village or a small town) as an organized group of people who have learned to live and work together, and who interact and cooperate in the pursuit of common ends. In order to be able to live and work together harmoniously, a patterned arrangement of relationships (structure and organization) invariably evolves, through the development of formal rules and regulations, to guide everyday intercourse among members of the group. This becomes the culture of the specified human group. As Foster (1973:11) has

noted, culture can be more specifically thought of as:

> . . . the common, learned way of life shared by the members of a society, (and) consisting of the totality of tools, techniques, social institutions, attitudes, beliefs, motivations, and systems of value known to the group.

It is thus evident that a traditional society constitutes an identifiable human group or people; and their culture refers to the institutionalized behavior patterns that characterize this human group. Foster (1973) has also identified the following basic characteristics of socio-cultural systems:

1. A socio-cultural system is a logically integrated, functional, sense-making whole-- (the totality of all socio-cultural systems within an identifiable geographic area comprises a nation-state);
2. All socio-cultural systems are constantly changing--none is completely static;
3. Every culture has a value system; and
4. Cultural forms, and the behavior of individual members of a society stem from (or are functions of cognitive orientations) of deep-seated premises.

But, the early model of development failed to recognize the existence of the above features about all human groups. Consequently, the early strategies for national development were mostly patterned on the values and experiences of the Western European and American nation-states. Misra (1981)

has observed that even the body of knowledge (primarily economics) on which these early development strategies were based relied almost exclusively on Western rationality and experiences.

However, as previously noted, it became increasingly evident, beginning in the 1970s, that national development could not be regarded as a neutral entity. Ventura (1981) has, therefore, suggested that technology (the "engine" for national development) must reflect the culture, environmental conditions, as well as the values and aspirations of the society for which it is designed to serve.

The Inter-Cultural Transfer of New Technology

Wagner (1979:12) has reported that the definition of "transfer" requires the existence and identification of a giver and a recipient (in other words, a "transferer" and a "transferee") and then an exchange or delivery of something from the former to the latter. However, available evidence suggests that in the technology-transfer process the recipient component of the transaction is often poorly identified and also seldom actively involved in the technology assessment and selection process. As with the "top-down" approach to program design and development, there is oftentimes the erroneous tendency to assume that "somewhere out there" there are societies (or human groups) that are "anxiously waiting" to receive the new

technology. But, in order to demonstrate the immense need to encourage trans-sociocultural (or even international) dissemination of technology, Foster (1973:16) observed that even though inventors and discoverers can be found in every society, no human group (or nation-state) "would progress rapidly if change could come about only through the ingenuity of its own members." In other words, it is of absolute importance that change towards that which is upheld to be in the best interest of the populace (and is invariably in accord with the new concepts of national development) be encouraged from both "within" and "outside" the identified socio-cultural system. In further support of this perspective, Foster (1973:16) asserts:

> As far as a particular society is concerned, its proneness to advancement is the result of its members' exposure to the tools, techniques, and ideas of other groups, their readiness to recognize advantages in ways and forms not their own, and their opportunity to accept these ways and forms, should they wish to do so.

Several scholars (Sauer, 1969; Vavilov, 1949) also appear to share this view. They strongly contend that the international, as well as the intercontinental, dissemination of domesticated plants and animals, tools, and husbandry practices have constituted a major source of productivity growth in prehistory and in the classical civilizations. For instance, it has been noted that the transfer and adaptation of "new" crops (such as potatoes, maize, and tobacco) from the "new continents to Europe after the discovery of America had a dramatic impact on

European Agriculture" (Lawani, 1982:7). It has also been recorded that the technological bases for the production of certain export crops in most Third World countries (such as cocoa in Nigeria and Ghana) were the results of this same international transfer of adaptable crop varieties.

It is remarkable that, unlike the early model of development, the new concepts of national development (including the new emphasis on appropriate technology approach) strongly advocate the need for, and the importance of, a systematic design and development (and subsequently the introduction and adaptation) of new technologies to local conditions. These new strategies for appropriate development also stress a "grass-roots," or "bottom-up," approach to the design, planning and implementation of development programs. The needs, as well as the aspirations, of the populace or target population must now be recognized and fully considered; their active involvement in the identification of those felt needs and in the design and execution of programs to meet those needs must also be encouraged.

The achievement of the above requires a thorough study and analysis of the organizational structure, patterns of relationships, and interactions of the identified target population. In other words, the uniqueness of the local culture, social values, needs and aspirations of this target population have to be fully appreciated and understood before an improvement in their quality of life

can be expected through the introduction of suitable technologies.

The Socio-economic Dimensions of Appropriate Technology

The advocates of massive industrialization through the importation of large-scale, capital and energy-intensive technologies have argued that it is one way of reducing the roles of human beings as "beasts of burden"--especially in the agricultural sector where human labor constitutes the primary source of power in most Third World nations. They have also contended that heavy industrialization and associated large-scale technologies are economic imperatives for achieving rapid increases in growth and productivity.

Available evidence, however, indicates that this development strategy has failed to fulfil the expectations of planners and policy makers in the developing countries (Igbozurike, 1976). Mass poverty and deprivation have persisted, even worsened, in some places. Mass unemployment and associated inequity in income and distribution have caused considerable widening of the gap between the "haves" and the "have nots." Igbozurike (1976) also cited studies by Amin (1974) to indicate the increasing dependence of the developing nations on the advanced or industrialized countries. Acute food shortages have been witnessed and rising food import bills, coupled with capital expenditure (or depletion of meagre foreign exchange earnings)

on the importation of large-scale technologies, have led to a balance-of-payment deficit for most of the developing world.

In the agricultural sector especially, many developing countries continue to witness sharp declines in domestic food production--despite massive government investments on imported heavy machinery and other large-scale technologies. The individuals displaced by the automated, large-scale technologies have migrated to the cities--where this rural-urban exodus has worsened the unemployment situation and urban congestion. For industrialized nations and multi-national corporations, the national development of the Third World nation-states has become reduced, or conveniently misconceived, to a simplified matter of merely marketing capital and energy-intensive technologies.

From the foregoing, it has now become quite clear that national development involves more than merely marketing new, albeit inappropriate technologies. It unquestionably involves the meeting of basic human needs. The new concept of development also calls for a recognition of the resource endowments, as well as the limitations of nation-states, upon which their development patterns or strategies are to be based. This is one of the unmistakable justifications for the new emphasis on the appropriate technology development approach. This new approach calls for the concentration of efforts on the design and development of improved technologies affordable to the populace.

These technologies are not only expected to be resource-conserving (especially of the non-renewal or scarce resources), but should equally be labor-intensive technologies--aimed at generating meaningful and profitable employment opportunities for the populace. Recognizing the low literacy levels of the large poor majority in the developing countries, these technologies are also expected to be simple in nature, low-cost and easily comprehensible.

According to McLaughlin (1976), some of the pertinent socio-economic questions to ask in order to determine the "appropriateness" of a new technology include:

1. Is the new technology or innovation within the financial means of the target population (i.e., the large poor majority in the developing countries)? For instance, it is absurd to develop or attempt to introduce a $5,000 tractor--or even a $1,000 tractor--to a farmer whose annual income is about $100.00;
2. Is the new technology easily understandable, and simple to operate, maintain, and even repair?
3. If the technology is in the form of an equipment or machinery, can it be manufactured locally, using local materials and workmanship? If it can be, then it may be assumed that it can achieve a fit into the local culture and production process;

4. If its use will generate more employment, more profit, or better service, has an equitable way of allocating those benefits been devised by, or through, the active participation of the populace?
5. Is the new technology or system a relevant improvement on an item or method traditionally in use, rather than a totally new item extraneous to the indigenous culture, values, or incentive system?
6. If use of the new technology or innovation will save time or lead to the displacement of some individuals, then what provisions have been made for the use of that time or the generation of meaningful employment in other areas?

If due consideration and adequate answers can be found to the questions and issues raised above, then one can reasonably expect that the socio-economic dimensions of the new technology are in accord with the socio-economic conditions of the target population.

The Political Dimensions of Appropriate Technology

Among the major elements of the early model of development is the idea of centralized, authoritarian planning and decision-making in which the populace (then regarded as merely passive, mostly illiterate, fatalistic

and conservative humans) were neither consulted nor encouraged to participate. A "top-down" approach to "need" identification, program design and implementation was the rule rather than the exception. A highly stratified organizational structure, with hierarchical and mechanistic modes of management and control, was strongly upheld by the indigenous, yet powerful, governmental ruling-elites. The early conceptualization of national development also placed exclusive emphasis on heavy industrialization, which clearly benefitted the privileged minority to a much higher extent, thereby widening the inequality and income gap between the rich and the poor.

But, as has been observed by Jéquier (1976:31), it has now become quite clear that large-scale technology is:

> . . . neither egalitarian nor socially neutral, and tends to accentuate the social and economic differences between the small minority which can profit or benefit from it as consumers or producers, and the vast majority of the population living at subsistence levels in the rural areas.

Several scholars (Hunter, 1978; Ruttam, 1977) have also indicated that even well-meaning programs, such as the Green Revolution Technology (i.e., the spectacular increase in cereal-grain production through the development of quick-maturing and fertilizer responsive varieties of wheat and rice in the 1960s), widened income disparities and did not benefit the small farmers as much as large land owners. Apart from the unfavorable institutional frameworks (such

as, relatively easy access to production inputs, credit facilities, and technical information from experts) which invariably favored the rich farmers and land owners, Hunter (1978:80) also noted that:

> . . . the demanding exacting conditions of controlled water supply and drainage and high credit for chemical inputs, was not designed either for the economic conditions or the risk-capacity of the small farmers.

But, in sharp contrast, the emphasis of the new concepts of development, as well as the appropriate technology approach, is on decentralization of the means of production and the promotion of local initiative and self-reliance in development. The appropriate technology strategy also calls for a "grass-roots" or "bottom-up" approach to problem(s) and/or need(s) identification, program planning and implementation. It also advocates for the active involvement of the populace in the decision-making processes that are aimed at changing or improving their livelihood. According to Jéquier (1976:36), what the proponents of appropriate technology are trying to accomplish is to "turn development into an autonomous process of innovation and growth from below." It is an endeavor designed to initiate the process of national development from "within" through the encouragement and stimulation of indigenous innovative capabilities that are already in existence in every community, village, and nation-state. The major focus of the new development paradigms is on the poor majorities in the Third World

nations whose welfare and livelihood have been largely ignored in the past. It seeks to stimulate the internal inventiveness and innovativeness of these neglected masses, as well as assist them in seeking the appropriate changes to improve their quality of life. In this regard, Jéquier (1976:31) believes that appropriate technology might be viewed as:

> . . . a 'survival technology' for the hundreds of millions of (small) farmers who have been completely left out of the development process.

It is, therefore, evident that appropriate technology tenets seek to restore the lost power, as well as a considerable degree of autonomy, to the masses. In this sense, their relevance and adequacy to the political realities in the Third World nation-states cannot be overemphasized.

The Ecological Dimensions of Appropriate Technology

The national development strategies of past years have been held largely responsible for the resulting disequilibrium in human-nature relationships or the ecological imbalance that are being witnessed in most Third World nations. Even the increasing pollution of air, land and sea--most conspicuous in the industrialized nations--have had adverse effects on human health, terrestrial and aquatic ecosystem (Morrison, 1978b). Little attention, if any, was paid to the long-term adverse effects on the environment of the indiscriminate and excessive dependence on the use of large-scale technologies for achieving growth

and productivity. It was merely assumed that environmental degradation was an inevitable component of the price to be paid by humans for the achievement of rapid increases in growth and productivity through industrialization (Morrison, 1978b). To make matters worse, it was also assumed that in the event of the on-set of any serious negative externalities, new technologies would be designed to combat them. Little did anyone realize that most environmental damage or ecological destruction, once caused, would prove to be irreversible.

But, since the 1970s, these notions are not only changing, but are now being seriously challenged. High priority is now being placed on the preservation and maintenance of the quality of the natural environment. According to Nortey (1976), the populace, especially in the developed world, is justifiably alarmed at the increasing deterioration of the environment due, to a large extent, to the excessive dependence on large-scale and energy-intensive technologies. As an indication of the serious nature of environmental deterioration, Nortey (1976) has pointed out that the capacity of rivers, lakes and the atmosphere to absorb waste loads is being severely taxed. It is, therefore, not surprising to find the increasing concern and search among scholars and planners, for new or alternative ways for protecting the natural communities, preserving the scenery, providing clean air and water, and reducing noise and urban congestion (Nortey,

1976). Herein lies one rationale for the new emphasis on the design, development and diffusion of appropriate technologies for achieving development.

In the light of the foregoing, Morrison (1978b:34) has remarked that:

> . . . fundamental to the appropriate technology conception (absolute or relative) is an emphasis on quality of life in comparison with the growthist emphasis on quantity of production and consumption.

As previously indicated in Figure III-1, Morrison (1978b: 34) has clearly advanced that the appropriate technology notion is that, beyond some definite point, "less" (in terms of resource use, economic growth, etc.) actually means "more" in terms of quality of life. In contrast, however, the growthist or "capitalist-materialistic" notion contends that the "relationship of economic growth and quality of life is positive monotonic." Morrison (1978b:34) has further suggested that the issue at hand involves:

> Getting developed countries <u>back</u> on top of the knee of the curve and getting developing countries <u>up</u> on top of the knee. . . (but) the developing countries must eventually move from soft (appropriate) technology to a mix of soft and hard technology if their welfare is ever to approximate that of the developed countries (see Figure III-3).

But it can be contended that the appropriate technology route to national development is being advocated as a solid foundation upon which to base other suitable development strategies.

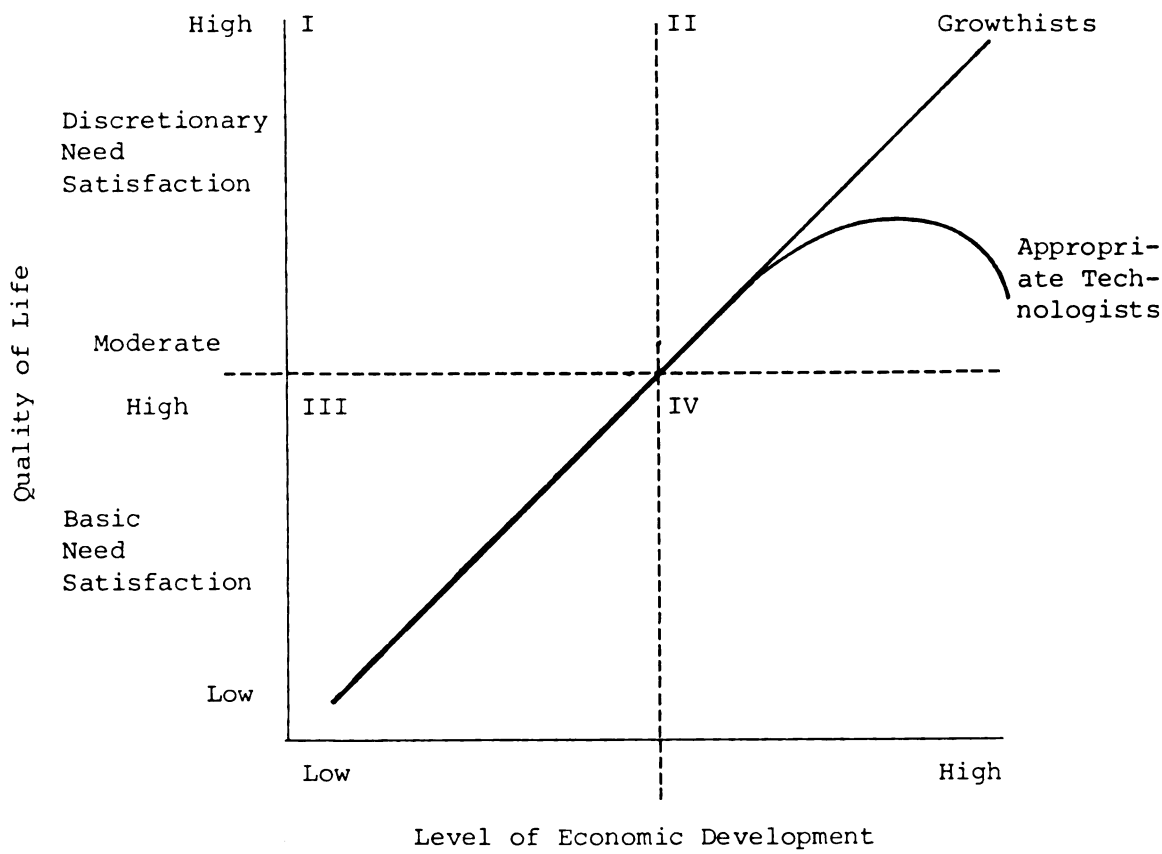


Figure III-3. Opposing Perspectives of the Growthists and Appropriate Technology Advocates on the Relationship of Level of Economic Development and Quality of Life

SOURCE: Morrison (1978b).

Appropriate Technology for the Development of Small-scale Agriculture in the Third World

A recent study by the World Bank (1981:50) provided three major reasons why small holder agriculture should be the focus of more intensified development:

1. . . . although it accounts for the bulk of agricultural output in most African countries, its massive potential has yet to be realized: use of off-farm inputs (mostly improved technologies) is still quite limited, yields are very low, and specialization is uncommon.
2. . . . recent studies (Lal and Collier, 1980; Lele, 1981) confirm what most of the literature on African economies suggest--that poverty on this continent, unlike in Latin America, is predominantly a rural phenomenon. Thus, raising the output and income of small farmers (through the introduction of appropriate production technologies) is the best way to meet basic needs (in concert with the new conceptualization of national development).
3. Finally, attention to small holders is a more cost-effective way to raise output than other alternatives (such as large-scale mechanized agriculture) currently allow--at least for most crops and areas.

However, despite these observations, the decades of the 60s and 70s represented a period in African development history when most countries (including Nigeria) strongly emphasized the development of large-scale, government-sponsored agricultural ventures. Most of the agricultural development schemes involved substantial capital outlays for heavy mechanization and massive irrigation projects in some places. According to the World Bank (1981:51), it was then assumed that:

> . . . only a rapid transition (often referred to as the "transformation approach") to mechanized, high productivity schemes, as practiced in the industrialized world, would overcome the stagnation linked with the traditional low-input, low-output methods.

Furthermore, it was also assumed that this approach would provide the much needed solution to the prevalent problems of seasonal labor shortages (at peak farming periods) or the drought conditions (especially serious in arid and semi-arid regions), that most of those countries were experiencing. It was also argued that, even though productivity was often lower on such large-scale government farms, their share of marketable surplus would likely be higher in the long run (World Bank, 1981).

But available evidence now suggests that this development approach has failed to meet the expectations of most African governments; its contribution to growth having been found to be quite small, if not insignificant, when compared to the cost of those large-scale agricultural

schemes. According to the World Bank (1981:51), these large-scale capital and energy-intensive ventures were:

> . . . beset with problems of management over-employment of staff, under utilization of expensive machinery, and maintenance of equipment and infrastructure.

But, contrary to the above findings, this same World Bank Report remarked that the rapid agricultural growth in Kenya strongly attests to the desirability of promoting small-scale agriculture. It has been reported that several favorable institutional rearrangements in the small holder sector (notably, the widespread land distribution and settlement) resulted in significant increases in growth and productivity in this sector. According to the data provided by World Bank (1981:51), Kenya recorded a total agricultural production which increased at 4 percent per year from 1955-72. Perhaps more important was the finding that a "disproportionate amount of this growth came from small farmers" (World Bank, 1981). Equally important was the observation that this remarkable growth in production was accomplished through the expansion of the production of hybrid maize (i.e., an appropriate technology). From a comparative study of the adoption rates for hybrid maize, the World Bank (1981:51) also noted that the production of this crop:

> . . . spread more quickly among Kenyan small holders between 1964-73 than it had among American farmers during the 1930s.

The Bank's Report further asserts:

> . . . Kenya's experience shows that African small farmers are very responsive to opportunities for profitable innovation (i.e. they are responsive to appropriate technologies), and that small farms are frequently far more productive than large farms.

It can, therefore, be contended that the development and introduction of hybrid maize (an appropriate technology) among the small farmers, who already benefitted from the land redistribution and settlement schemes, were largely responsible for the recorded outstanding increases in the total production of this staple food crop in Kenya.

Several important lessons can also be learned from the Kenyan experience. First, it has been established that small farmers are not only responsive to new incentives, but are frequently quite willing to adopt and utilize improved technologies for enhancing production--provided that constraints to the successful adoption and utilization of such improved technologies are eliminated. In other words, a new or improved technology can only become "appropriate" <u>if</u> the relevant socio-cultural, economic, and institutional constraints that militate against its successful adoption are eliminated. This approach has been clearly demonstrated in the Kenyan situation where the impressive increase in total output was, in part, due to the new production on redistribution land--a previously limiting socio-economic or institutional constraint. But, of higher significance, has been the increased production per hectare made possible by the development and dissemination

of new hybrid maize into the small holder farming system. This is an obvious case of a design and diffusion of an appropriate technology to small farmers who adopted the new technology because of its beneficial impacts. Besides, the relevant production constraint (inaccessibility to land) that could have limited their acceptance of the new technology was eliminated through the land redistribution and settlement schemes. Finally, in accordance with the tenets of the new paradigms of development (notably, the need to provide food and profitable employment) World Bank (1981:51) has observed that:

> . . . small farms tended to have both higher output and higher employment per hectare than large farms.

In the light of the foregoing, it can be argued that there is enough justification for advocating the concentration of efforts on the development of small-scale agriculture in Nigeria. This development can be accomplished through the design and diffusion of appropriate technologies for enhancing productivity, and subsequently, improving the welfare of the poor majority of small farmers in Nigeria. The "dualistic" character (i.e., large and small-scale farming systems) of the Nigerian agricultural sector and a typology of improved technologies for fostering production especially in the small farms, will be discussed in the next chapter. Also, the most suitable strategies for the design, development, and diffusion of appropriate technologies to small farmers will be reviewed in Chapter IV.

CHAPTER IV

THE NATURE AND STRUCTURE OF NIGERIAN AGRICULTURE: IMPLICATIONS FOR THE DESIGN AND DIFFUSION OF APPROPRIATE TECHNOLOGIES FOR ENHANCING PRODUCTIVITY

The Nigerian Agricultural Sector: Background Information

The Federal Republic of Nigeria is located in a tropical environment between latitudes 4^{o} and 14^{o}N and longitudes 2^{o} 20' and 14^{o} 30'E (Olaloku, et al. 1979). It is specifically located on the gulf of Guinea in the Western coast of Africa and extends northward from the coastline for about 1,046 kilometers. The country has a total land area of 98.3 million hectares; about 34 million hectares, or roughly one-third, constitutes land that is presently under cultivation. The total cultivable land in the country is, however, estimated at about 71.2 million hectares (Olaloku, et al, 1979). In other words, less than half of the potential agricultural land in the country is presently being utilized. Given this fact, the authors of the Nigerian Third National Development Plan (1975-80) remarked:

> . . . not only does the country under-utilize its agricultural land in a quantitative sense, but the qualitative depreciation of most of the land under regular cultivation is even more apparent.

This qualitative depreciation of agricultural land has been held largely responsible for the characteristic low productivity of the Nigerian agriculture. The under-utilization of land is also strongly believed to be a function of unresolved environmental, as well as institutional, constraints. For instance, it has been suggested that the utilization of unimproved production tools and techniques, especially by small holders who produce the bulk of the food needs of the country, may account for the low productivity of Nigerian agriculture [Third National Development Plan (1975-80). In addition, the prevalence of such institutional constraints (such as the existing land tenure system and the inaccessibility of small farmers to modern production inputs) have also been held responsible for the fragmentation of holdings and the difficulty of modernizing agricultural production in most parts of the country.

The Nigerian agricultural sector is estimated to provide employment for about 70 percent of the country's working population--especially those residing in the rural areas. The two agricultural production systems that characterize the Nigerian situation are:

1. agricultural enterprise carried out by <u>small holders</u>; and
2. agriculture conducted on <u>large-scale commercial farms</u>.

Olayide (1976) has reported that about 95 percent of the

output of primary production in Nigeria occurs on small farms. But previous development efforts in Nigeria have largely ignored the needs and problems of the small producers, which include: production resource availability, poor farm yields, unimproved production technology, land-use limitations, a widening technological gap, and planning problems (Ebong, 1973; Olayide, 1976). As Olayide (1976:4) has remarked:

> The series of development programmes implemented (by the Nigerian governments) during the period (1960-75) failed to focus enough attention on solving these problems as they affect the small producers who supply well over 95.00 percent of the output of primary production.

In the 1980's, however, increasing attention is being paid to the needs and production problems that confront the small farmers in Nigeria. Therefore, in this chapter, the dualistic nature of the Nigerian agriculture [with special focus on the small-scale peasant farming system] will be extensively discussed. Then a typology of technologies for enhancing agricultural production under the existing farming systems in the country will be reviewed. Finally, the conceptual frameworks and strategies for the development of appropriate technologies for the small holders in Nigeria will be considered.

The Dualistic Nature of Nigerian Agriculture

The basic features of traditional agriculture, as practiced in Nigeria, do not differ significantly from

what prevails in many other developing countries of tropical Africa. Olatunbosun (1975:10) has characterized a typical Nigerian peasant farmer as:

> . . . usually a small holder, in most cases planting an area of some 1.5-2 hectares, frequently divided into small and sometimes scattered plots.

Olayemi (1976:25) also observed that agriculture in Nigeria is still practiced under a largely traditional system of cultivation whose characteristics include:

> Simple tools (hoe and cutlass) are used in tilling the soil. Farm inputs consist mainly of land and family labor. Capital investment is small and modern inputs like fertilizers, chemicals and improved seeds are still not widely used by farmers.

It is also pertinent to note that the actual size of farm or land area cultivated by an individual farmer is often influenced by the population pressure on land (as well as the prevailing land tenure system). Thus, as shown in Table IV-1, it is evident that the area farmed by an individual farmer is generally smaller in the southern than in the northern part of Nigeria where the land-man ratio appears to be more favorable. Eicher and Baker (1982) also note that because family labor is the most important factor of production in the traditional small holder farming system, and in light of the fact that most small farmers till their land with only human labor and hand tools, the area cultivated per farm family depends on the size and composition of the family labor force. It has been estimated that family labor inputs range from 80 to

TABLE IV-1

PERCENTAGE DISTRIBUTION OF FARMERS ACCORDING TO SIZE OF FARMS IN NIGERIA, 1972

Size of Area Farmed (hectares)	Northern Nigeria	Southern Nigeria	
	Northern States of Nigeria	Western States of Nigeria	Eastern States of Nigeria
Under 0.10	1.9	4.7	20.5
0.10 under 0.20	5.5	8.5	19.8
0.40 under 1.01	27.7	35.6	27.1
1.01 under 2.02	27.5	23.0	6.7
2.02 under 4.05	19.0	10.4	1.1
4.05 under 10.12	7.0	3.1	0.2
10.12 under 20.23	0.4	--	--
Over 20.23	0.0	--	--

SOURCE: Federal Office of Statistics, Lagos (1973).

90 percent of total labor inputs in the traditional farming system (Byerlee, 1980). It has also been suggested that a typical Nigerian farming household generally comprises between 6 to 10 family members. It is not uncommon for households to include more than one nuclear family.

With respect to division of labor in the traditional farming system, Eicher and Baker (1982) have reported that adult male farmers work an average of 5 hours per day or 1,000 to 1,500 hours per year in farming activities. However, a significant number of hours of labor is also devoted to off-farm activities, such as trading and small-scale industries. Although crop production appears to be the principal activity of most Nigerian traditional farmers,

it is important to recognize that they also devote a significant amount of their time to off-farm activities especially during the dry season(s). Women also play an essential role in farming, as well as in the processing and marketing of agricultural produce. But, as suggested by Eicher and Baker (1982), the extent of their participation may vary significantly by activity, ethnic group, and religion. Children also constitute a reliable source of farm labor for such tasks as weeding, bird scaring, and providing fodder for livestock.

The Relevance of Small-Scale, Peasant Agriculture in Nigeria

The small-scale peasant agriculture has also been variously described as the "subsistence," "primitive," and sometimes as the "traditional," or "indigenous" agricultural system. But, as with the semantics of Appropriate Technology, it is believed that the use of any of the above terms to describe this agricultural type largely depends on the area of emphasis and biases of the user. However, it may well be an erroneous assumption to assert that small-scale, peasant farms are "subsistence farms"--ones that are removed from market forces. For example, Mellor (1966:134) has succinctly stated that:

> In general, peasant farms produce in excess of what the farm family chooses to consume and sell that surplus in the market in order to purchase nonfarm goods and services. The extent of this surplus varies among farms, regions, and nations and with size of farm, state of technology, and the degree of specialization in production.

Eicher and Baker (1982:48) have cited studies by Norman et al.(1979) which found that 24 percent of the total value of small farm staple food production was marketed in Northern Nigeria.

With regard to the use of the word "primitive" to describe this farming system, it is also noteworthy that several writers (Norman, 1980; Jodha, 1978) have recognized the usefulness and importance of some of the age-old farming practices that are being carried out by small farmers in most developing countries. According to Norman (1980:2), there has been such new experiences as:

> . . . increased realization, supported by empirical evidence, that many traditional practices used by small farmers for generations are sound and should be preserved.

In further support of this view, Schultz (1963:188) adds that:

> . . . paradoxical as it may seem, farmers in traditional agriculture are generally more efficient by strict economic standards than farmers in the technically advanced countries in using the particular collection of land, labor, and material reproducible capital that they each have at their disposal.

In addition, many small farmers in Nigeria have benefitted from the use of such modern inputs as fertilizers and improved seeds. However, the use of a new technology has often been influenced by institutional constraints, such as the availability of the inputs (e.g. fertilizers) at the proper time and the accessibility to change agents, (i.e., government extension agents). With regard to the

latter constraint, it is common knowledge that agricultural extension field staff (often addressed as, "Agricultural Assistants" or AAs') in Nigeria are relatively ill-equipped for their jobs (in terms of training and practical experience). Further credence for this belief was provided by the findings of an evaluative study of the Nigerian agricultural extension education system conducted by Axinn and Thorat (1972). The existence of a considerable "social distance" between extension agents in Nigeria and their target population (comprising mostly of the rural small farmers and their families) has also been established. For example, Axinn (1981) has defined "social distance" in terms of differences in language, education, economic level, age, and family status. He further observed that the effectiveness of an individual change agent involved in an extension education program tends to vary inversely with the social distance between this change agent and the members of the target population.

However, Okigbo (1981:41) has described the Nigerian traditional farming pattern and the associated bush fallow system as a "stable, ecologically sound and efficient farming and land use systems." But, as a result of the increasing population pressure on land and the commercialization of production, the bush fallow periods have been reduced drastically, with such consequences as:

> . . . loss of soil organic matter and top soil through erosion, deterioration of the physical characteristics and nutrient status of the soil, changes in number and composition of soil microflora, and multiplication of pests and diseases and rampant weed growth (Okigbo, 1981:41).

These enormous production problems have not only lowered yields and aggregate production on the small farms but, more importantly, have called for the injection (design and introduction) of new and appropriate technologies into this farming system. This contention appears to have been supported by Mellor (1966:134), who has observed that:

> . . . Peasant agriculture tends to be characterized by low levels of utilization of certain resources, low levels of productivity, and relatively high levels of efficiency in combining resources and enterprises . . . Collectively they suggest little scope for rapidly increasing either total production or productivity per unit of the resources within the context of a traditional agriculture, but very great scope for increasing total production and resource productivity through technological change.

In further support of this reasoning, it has been suggested that "low pay-off" approaches be avoided and "high pay-off" approaches be encouraged. Shultz (1963:189) has explained that these high pay-off approaches predominantly involve "improvements in the quality of agricultural inputs." They range from such improved inputs as: commercial fertilizer, insecticides, tools and equipment and the development of genetically superior plants and animals. In other words, Shultz (1963:188) maintains that agricultural development programs that are merely designed to induce traditional farmers to increase their investment in:

> . . . precisely the same type of agricultural factors that they have been using for generations will fail for lack of acceptance, simply because the pay-off is too low.

It is, therefore, advanced that the development of small farms through the infusion of appropriate technologies, is a sine qua non for fostering agricultural production in Nigeria.

The Place of Large-scale, Commercialized Agriculture in Nigeria

In contrast to small-scale peasant farms, large-scale commercialized farms in Nigeria are characterized by the use of massive, capital and energy-intensive technologies. This farming system has also been variously described as the "state farms," or "plantation" type of agricultural production pattern. It is operated, although on a limited scale, as mostly a governmental, but sometimes as a private venture or enterprise. Eicher and Baker (1982:50) have cited studies by Saylor and Eicher (1970) which suggest that government plantations in Nigeria are generally found to be unprofitable ventures because of such limitations as:

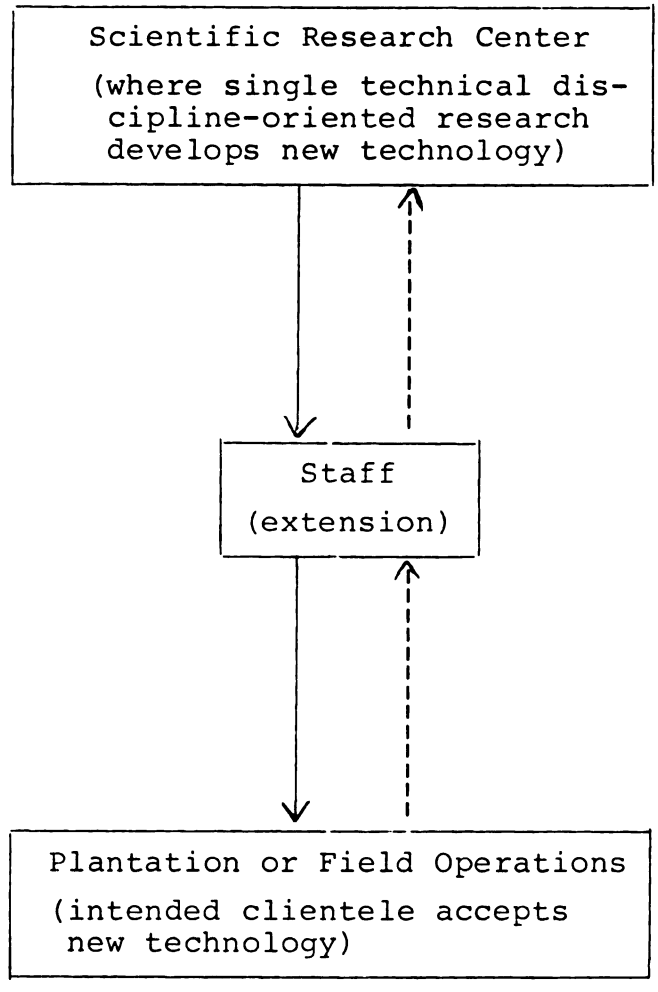
> . . . lack of technical data, poor management, and high turnover in unskilled labor (frequently 100 percent year year), etc.

Johnson (1968) also found that, even though the number of privately operated plantations in Nigeria appeared to have increased during the 1951-65 period, government marketing board taxes on plantation cash crops (such as oil palm and rubber) reduced the rate of return on these plantations to

nearly zero by the early 60s.

However, Whyte (1981:1) reported that these large-scale commercial farms were basically patterned after the European colonial "plantation model" in which research efforts were mainly concentrated on "production of crops for export--and particularly for export to the mother country." Whyte (1981) has further suggested that this plantation model, as well as other classical strategies of agricultural research and development, were primarily designed for the benefit and needs of the industrialized nations. The large-scale plantations or state farms were established in the former colonies for the specific task of producing export crops (notably, cocoa, oil palm and rubber) and other agricultural raw materials needed for the industrialization of the Western European countries.

As shown in Figure IV-1, the structure of the European colonial model is distinctly "vertical" in orientation. It has also been described as a mechanical and hierarchical model that is essentially based on a "top-down" approach to program design, planning, and implementation. In other words, this model is not only centralized and authoritarian in nature and operation, but has also been ladened with immense red-tape and bureaucracy. Whyte (1981) has also noted that, in this system, agricultural research is exclusively carried out in the laboratories. Research results, as well as other technical data, are then transmitted "down" to the plantations, where



The solid lines indicate a high frequency of communication. The broken lines show a relatively low frequency or feedback.

Figure IV-1. The "Vertical" or "Top-Down" Model of Agricultural Research and Development

SOURCE: Adapted from Whyte (1981).

production is closely supervised and controlled. Feedback, which is seldomly encouraged, is then taken "upwards" to the researcher who basically controls, as well as determines, the research priorities and needs. The paternalistic tendency of the approach, notwithstanding, it is also evident that under the colonial system,the development of indigenous initiatives and skills is rarely encouraged.

Nevertheless, Singh (1976) observed that as a result of continuous and sustained scientific research in the system, new technologies--which lead to higher productivity and returns to the use of some resources on the large-scale, commercialized farms--were often developed. Whyte (1981:1) has also reported that the plantations can be characterized as ones that:

> . . . developed a high degree of productivity and efficiency, based on thorough farm management backed up by high quality research in the plant sciences.

But, in view of the new conceptualization of national development, which--among other things--has stressed the need for self-reliance in development, as well as a participatory approach to program planning and implementation, it is evident that the colonial agricultural development model is an anachronism. Furthermore, recognizing the poor bargaining power of small farmers in Nigeria, who are often stereotypically dismissed as "passive" and "conservative" or "primitive" producers, the unsuitability of the European colonial model for addressing their production needs and

problems cannot be overemphasized. Besides, the classical model was never designed for, or aimed at solving, the food production problems confronting these small holders. Whyte (1981:1) has reported that, until shortly before the end of the colonial administration, agricultural research largely concentrated on export crops, and consequently:

> . . . provided little or no technical assistance to the small farmers who were raising crops for home consumption and for local marketing.

Okigbo (1976) has also observed that the "plantation-type" agriculture has not only been capital and energy-intensive but, more importantly, has never been "based on existing institutions." In addition, the World Bank (1981:51) has reported that several of the major problems and difficulties that have militated against the successful operation of large-scale commercialized agriculture in Nigeria include:

> . . . problems of management, overemployment of staff, under-utilization of expensive machinery, and maintenance of equipment and infrastructure.

To this list may be added the assertion that the contribution of large-scale farms to aggregate food production and provision of profitable employment for the populace, has been quite small, when compared to the cost of their establishment. It is also pertinent to indicate that, although the Nigerian governments prefer not to publicize the failures of many government-sponsored large-scale farming schemes, Eicher and Baker (1982:52) have reported that there is enough information to conclude that:

> . . . large-scale/capital-intensive food production complexes cannot compete with (Nigerian) small holders for meeting staple food needs in the 1980s.

Furthermore, the World Bank (1981:53) has reported that Nigeria is aiming at "plowing" part of her mineral oil wealth back to the rural areas, and consequently:

> . . . does not attach great importance to cost recovery and a financially self-sustaining agricultural sector.

But it can be argued that this approach has often led to gross mismanagement of project(s) as well as to the discouragement of evaluative studies of such large-scale agricultural schemes. In addition, there is a paucity of relevant quantitative data on the performance of most agricultural projects in Nigeria.

Small-scale Versus Large-scale Agriculture in Nigeria: Implications for the New Emphasis on Development of the Former

The continuing controversy over the rationale and profitability of assisting small holders versus promoting the development of large-scale farms (including plantations, state farms, and river basin development schemes) has been described as the "improvement" versus the "transformation" approach to agricultural development (Eicher and Baker, 1982). The transformation approach has been characterized by the development of a wide variety of large-scale farming and processing technology. Eicher and Baker (1982: 47) have observed that this approach has been essentially designed to "bypass the lengthy process of improving small

farms within the existing village structure." As previously indicated, the major ingredients of the transformation strategy include:

> . . . infusion of capital-intensive technologies, such as tractor mechanization, central management (often European), and mobilization and training of an unskilled labor force by removing people from their villages (Eicher and Baker, 1982:47).

The improvement strategy, on the other hand, includes the provision of appropriate technologies to small farmers and their farm families at affordable rates. These technologies may range from subsidized fertilizer, pesticides, and irrigation facilities, to the provision of credit and farmer training centers--including the development of an effective extension service system.

Both the transformation (large-scale) and improvement (small-scale) strategies were advanced by governments of different regions of Nigeria in the 60s--soon after the country gained political independence from the British government. Eicher and Baker (1982:50) observe:

> . . . During Nigeria's first Development Plan (1962-68), the three regions in the southern part of the country (Western, mid-Western, and Eastern) devoted some 70 percent of their capital and recurrent budgets in agriculture to the transformation approach (farm settlements, school leaver farms, and plantations). On the other hand, the Northern region pursued an improvement strategy during the 1962-68 plan to help small farms through subsidized fertilizer, credit, and farmer training centers.

Advocates of the transformation approach not only believed that large farms would benefit from economies-of-scale, but also assumed that it was the best strategy for

"bringing rapid development to the people," as well as meeting the political urgency of "getting on with development" (Eicher and Baker, 1982). In addition, it was also falsely assumed that such large schemes would provide rural employment for the increasing numbers of young school-leavers. Little attempt was made by the proponents of the transformation approach to bring to focus the fact that most advanced economies of the world did not necessarily achieve their present state-of-the-art via this route. In other words, available evidence suggests that the present large-scale, capital-intensive and labor-saving agricultural enterprises of industrialized nations appear to have reached the technologically advanced levels through an "improvement" process. It was gradual, but systematic--often dictated by changes in resource conditions and endowments, such as availability and cost of factors of production (including labor and land). An equally underlying elements of this advancement has been the indigenous breakthroughs in research and development of new and improved products, processes, and more effective ways of solving human problems.

But, while success stories of large-scale agriculture during the colonial period in Africa (such as the renowned Gezira scheme in the Sudan, and the tea plantations in East Africa) have often been offered as examples of the superiority of the transformation approach, Eicher and Baker (1982:49) have cited analytical studies from

several scholars (Baldwin, 1957; Lewis, 1964; Chambers, 1969; and FAO, 1976) to support their contention that proponents of large-scale agriculture have:

> . . . often overlooked or glossed over the horrendous failures of large-scale schemes such as the East African groundnut scheme introduced by the British colonial service in Tanganyika (now Tanzania) after World War II, the failure of Mokwa settlement scheme in Northern Nigeria . . . and the mixed results with land settlement schemes and state farms in Africa and throughout the world.

Eicher and Baker (1982:51) have also cited a detailed analysis of the Western Nigeria's settlement schemes by Roider (1971) which found:

> . . . that after six years of operation, the government had spent $11,200 per settler, or double the amount originally projected, while yields ranged from 25 percent (cotton) to 65 percent (rice) of the yields estimated in the feasibility study.

Similar analytical studies (e.g., Saylor and Eicher, 1970; Johnson, 1968; Andreou, 1981) found that, by the end of the '60s, both government and private large-scale agricultural projects have proved to be unprofitable ventures in Nigeria. Among the major reasons advanced for the dismal failure of the transformation approach in Nigeria include:

> Lack of technical data, superficial planning, poor management, high turnover in unskilled labor (frequently 100 percent per year), overinvestment in housing and social services, inappropriate mechanical technology, and lack of participation by settlers (Eicher and Baker, 1982).

To this list may be added the contention that most government-sponsored, large-scale agricultural projects are often

ill-located or wrongly sited for political reasons. This is in contrast to the need to determine the suitability of a project site on the basis of a comprehensive review of the relevant bio-physical and socio-economic criteria required for meeting the needs of the populace.

In the light of the foregoing, it is evident that empirical data do not appear to support the transformation approach as the appropriate route to agricultural development in Nigeria. According to Eicher and Baker (1982), the reports of failures of many large-scale farming schemes throughout Sub-Saharan Africa have amply suggested that large-scale/capital-intensive food production complexes cannot effectively compete with African small holders for meeting the staple food needs of the 80s. The answer must, therefore, be found in the development of small-scale farms through the infusion of appropriate production technologies for use by small farmers to enhance productivity. Furthermore, Eicher and Baker (1982:51) have cited studies by Eicher and Johnson (1970) who evaluated the consequences of pursuing transformation versus the improvement strategies in Nigeria, and concluded:

> . . . small holder improvement programs rather than land settlements or plantations should form the backbone of Nigeria's agricultural strategy over the 1969-85 period.

Wells (1974) has also made similar observations about the Nigerian agricultural development pattern during the First Plan period (1962-68). It is, therefore, contended that

the various governments in Nigeria (states, as well as federal ministries of agriculture) must design policies and initiate structures that encourage the development of small-scale agriculture in the country. The strategies for the accomplishment of this task will be reviewed in this study. Also the policy implications as well as recommendations based on the above findings and observations will be discussed in Chapter V.

The Need for a New Approach to Agricultural Development in Nigeria: Design of Appropriate Technologies for Small Farmers

It is widely recognized that the organizational frameworks for agricultural research and development, which have evolved over the past century, appear to have worked reasonably well for the industrialized nations. But researchers and development scholars are beginning to realize that this development approach (especially the transformation--capital and energy intensive, route) has not worked and is not likely to work as well in the developing countries. Aside from the glaring differences in the socio-economic, cultural, political and environmental conditions between the industrialized and most developing nations, the empirical evidence arising from the failure of agricultural development projects based on this approach attest to this fact. This new awareness has, therefore, prompted the search for alternative agricultural development strategies that are especially designed for improving the

productivity and, subsequently, the welfare of the millions of small farmers who constitute the rural poor majority in most developing countries.

Several reasons have also been advanced to account for this new awareness regarding the well-being of the small farmers in Nigeria, as well as in other developing countries. First, the new paradigms of national development have clearly stressed the need for improving the welfare and standard of living of the poor. In other words, the basic needs requirements, as well as the participatory approach to program design and implementation, are just two of the new elements of development that implicitly call for a repudiation of the old strategies of agricultural development. Then, as previously indicated in this study, available evidence suggests that small holders produce the bulk of the food needs of the populations in most developing countries. But, as Whyte (1981) has observed, most existing agricultural research and development strategies--often specifically designed for advanced economies--have not given much consideration and attention to the needs and problems of these small farmers. For instance, even such well-meaning and highly acclaimed new technologies as the "Green Revolution"--the plant breeding breakthroughs of the '60s that led to the production of new high-yielding cereal grain varieties--tended to "favor those large producers already in relatively advantageous positions and did much less to improve

the lot of the rural majority . . ." (Whyte, 1981:VII). But, in contrast, Whyte (1981:VII) has also cited studies that were sponsored by the International Rice Research Institute:

> . . . where small farmers were cultivating irrigated land, they tended to adopt the new technology (viz: the cultivation of Green Revolution cereal grains) about as rapidly as the larger farmers and to reap substantial benefits. Indeed, their more intensive use of labor produced higher yields per acre than on large, less intensively cultivated farms.

In the light of the foregoing, therefore, several needs become relevant. These include the need to:

1. abandon the transformation (large-scale) route to agricultural development in Nigeria, and embrace the improvement (small-scale) strategies;
2. provide the required production complements that the small farmers do not already possess --which will enable them to not only adopt new and improved (appropriate) technologies, but also to benefit from such adoption; and
3. design new strategies and programs of agricultural development that have the concerns, needs and production problems of small farmers as a central focus.

In due recognition of the above needs, the "requirement-limitations gap" model--as advanced by Swanberg (1980) as well as the farming systems research approach--as reported

by Norman (1980), have emerged. These approaches will now be discussed.

Models and Strategies for the Design and Introduction of Appropriate Technologies for Small-scale Farmers

Swanberg's "Requirements-Limitations Gap" Model

As indicated elsewhere in this study, the "vertical" or "trickle-down" strategy of technology development and dissemination assumes that:

> . . . if a better idea (say, an agricultural innovation) is discovered, the masses will immediately accept it (Woods, 1977).

This strategy does not appear to recognize the need for "tapping" the wealth of knowledge and experience gained by traditional farmers through generations of practical farming. Thus, the vertical approach ignores the need to consult with, or encourage the active participation of, peasant farmers in research efforts aimed at designing new production technologies for their use. Because of the non-participatory nature of the "trickle down" strategy, it can also be argued that the new technologies designed through that approach must be significantly different or exogenous to the existing traditional or indigenous production systems. In other words, the resulting technologies are not likely to have been "built upon" what is already in existence. If new technologies do not represent an improvement on what is already available, their compatibility is questionable. Zaltman and Duncan (1977:14) have

defined compatibility in terms of the "goodness of fit" an innovation must have with the situation in which it is to be used. They contend that an innovation (or any change for that matter) must be as consistent as possible with such things as:

> . . . group (target population's) values and beliefs . . . the other machinery with which the new equipment must be used, the type of soil available for agricultural and animal feeding purposes, literacy levels, the past history of change in an organization, and so forth.

It is, perhaps, in due recognition of the shortcomings of the "trickle-down" strategy and an appreciation of the need for compatibility, that Swanberg (1980) advanced the "requirements-limitations gap" model. Swanberg (1980) has proposed that an improved technology has to be adjusted to the small farmers' reality or production environment [X] before it can be meaningful and acceptable to them. In other words, although new technologies are typically designed at the research stations where field trials are conventionally conducted (see Points #1, 2, and 3 in Figure IV-2), the existence of environmental barriers (Points #4, 5, 6) makes it imperative that further trials be carried out on the small farmers' fields and that necessary adjustments and on-farm adaptations be made (Points #6, 7).

According to Swanberg (1980), the adjustment process or on-farm adaptation of the new technology will

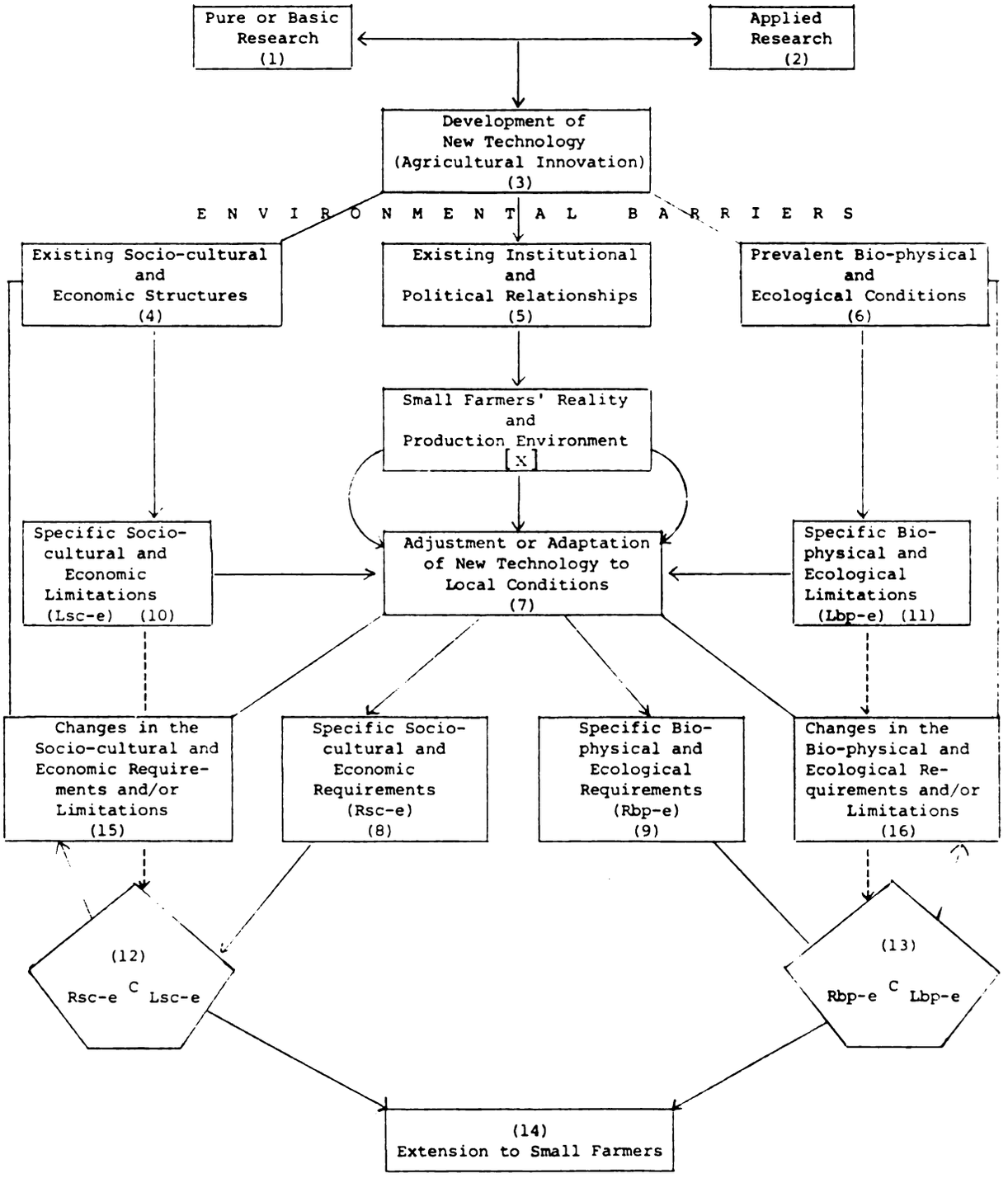


Figure IV-2. Bridging the Requirements--Limitations Gap by Constraint Reduction

SOURCE: Adapted from Swanberg (1980).

determine the full set of resource requirements (Points #8, 9) which the agricultural innovation presents to the small farmers. Thereafter, an in-depth analysis of the small farmers' production environment will clearly reveal the structural and resource limitations (Points #10, 11) that they confront, thereby militating against their beneficial use of the new technology. Therefore, an inventory and careful study of the production resources available to these small producers, as well as the nature of the institutions serving them, must be carried out at this stage. After a thorough identification of the full set of resource requirements and production limitations, a test for closure (Points #12, 13) can then be carried out. This is clearly the stage for "bridging the gap" between the new demands imposed by the improved technology and the production constraints facing the small farmers.

Swanberg (1980:4) has reported that a test for closure can be carried out in the following manner:

> . . . if the set of requirements (Rsc-e and Rbp-e) fall within the set of limitations (Lsc-e and Lbp-e), the new package of activities can be passed on to the delivery (extension) system (Point #14). If the requirements are greater than the limitations, a constraint arises, and an adjustment must be made.

Swanberg (1980) has further noted that the presence of a production constraint is implicated when the new technology is not "adopted" by small farmers. At this juncture, it is suggested that an analysis of the adoption rate patterns among the target population may serve to uncover the

"binding constraint." Furthermore, Swanberg (1980:4) cited two recommendations advanced by Zandstra et al. (1979) regarding how constraint reduction can be effectively accomplished:

1. The "submissive" approach to technology development--which advocates changes (Points #15, 16) through the reduction of the levels of resource requirements demanded by the improved technology (perhaps, through further research efforts and refinements). The primary objective here is to ensure that resource requirements fall completely within, or "harmonize" with, the environmental limitations, so that no constraints arise.
2. The "interventionist" strategy--which advocates changes (Points #15, 16) through the development of: "buffer institutions to expand the farmers' resources, their limitations, so that a given level of incremental requirements will fall within the expanded limitations." Swanberg (1980:5) further observed that "if such adjustments can be made, no constraints will be encountered, and the improved technologies can then be classified as 'appropriate' and passed over to the delivery system for introduction to the farmers."

Strengths and Shortcomings of Swanberg's Model

At the conceptual level, it must be admitted that Swanberg's model appears to have provided a broad-based organizational framework--a framework upon which various disciplinary studies addressing the multi-dimensional production problems facing small farmers can be designed. This model may be especially useful, for example, in agronomic studies dealing specifically with the development and diffusion of an improved seed variety among an identified target population. The "requirements-limitations gap" model can be effectively utilized by a single researcher whose study conditions may necessitate that an identified agronomic (or cultivation) problem facing small producers be handled by him/her single-handedly or in isolation from other researchers. But, in contrast, the farming systems research (FSR) approach, which takes a holistic view of the complex production problems confronting small producers, stresses the need for multi-disciplinary research focused on all facets of those complex on-farm problems. It is further suggested that it is on the basis of these multi-disciplinary on-farm studies that appropriate technologies for small holders can be developed.

In addition, while the Swanberg model implicitly recognizes the key roles played by small farmers with respect to staple food production in the developing countries, the FSR approach expressly recognizes this

factor as a major rationale for the increased research attention to the needs and production problems confronting small farmers. More importantly, however, the FSR approach recognizes the vital need to "tap" the wealth of knowledge and experience accumulated by small-scale, traditional farmers through generations of practical farming. Thus, unlike the Swanberg's approach, farming systems research practitioners strongly advocate a "participatory approach" to the design and development of appropriate technologies for the identified target population. Through active citizen involvement, it is ensured that new technologies will inevitably "build upon" the target population's knowledge and experience. This may constitute one way of ensuring that the new technologies are appropriate.

The Farming Systems Research (FSR) Approach

As discussed in Chapter 2, among the dominant characteristics of the new conceptualization of national development include the emphasis on the provision of "basic human needs" as well as the concern for "growth with equity and distribution." Both characteristics clearly recognize the urgent need to channel development resources and programs toward a definite target population--the poor and underprivileged in the developing countries--most especially the small farmers who constitute the largely neglected rural

poor majority. The increasing concern for the welfare of these poor masses has, therefore, precipitated the design of new development strategies aimed at enhancing the income-earning opportunities of this segment of the population. But rather than taking a "welfare approach," the new development strategies, among other things, aim at "providing small farmers with relevant and improved technology to meet their needs" (Norman, 1980:1). This is regarded as one of the crucial ways of helping to increase the income-earning opportunities of the small producers. It is, therefore, in association with the quest for an appropriate means of providing relevant production technologies to the small farmers that the farming systems research (FSR) approach has emerged (Norman, 1980).

Origins of Farming Systems Research

There is an ever increasing recognition by several scholars (Jodha, 1978; Navarro, 1977) that many traditional agricultural production practices, which have been used for many generations by small farmers in the developing countries, are "sound and should be preserved" (Norman, 1980:2). On the basis of this realization, Whyte (1981: 38) has also reported that scholars have, therefore, begun to abandon the "myth of the passive peasant," through the obvious recognition of the following fact:

> . . . that 20 to 40 years or more of experience in farming in a given area has given the farmer an intimate practical knowledge of behavior of plants and animals in that area under varying conditions, and that furthermore the agricultural scientist needs to gain access to the information and ideas of the small farmer if he (or she) is to be able to make any useful contribution to that farmer and his (or her) farm.

Therefore, the need for researchers to not only analyze the totality of the small farm production environment, but, more importantly, to comprehend it before exploring various ways to improve upon it, cannot be overemphasized. This is the thrust of the farming systems research approach.

Another immediate origin of the farming systems research is the increasing realization by scholars and researchers that previous agricultural development strategies have not only failed to improve the likelihood of small farmers; they have often led to an unequal distribution of benefits. For instance, Whyte (1981) has observed that both the "trickle-down" strategy of technology development and dissemination, as well as the "transfer of technology" approach to technology generation, have all erroneously assumed that the benefits of research and development will ultimately reach the small farmers, whose needs and problems have never been recognized. In addition, Norman (1980:2) has cited studies by some scholars

(Khan, 1978: Poleman and Freebairn, 1973) to indicate the following findings:

> Despite claims that Green Revolution technologies were intrinsically neutral to scale, for instance, many small farmers and the landless found it difficult to gain access to land and the technological packages.

Therefore, the farming systems research approach has evolved as one means of ensuring that improved technologies are specifically designed to meet the production needs or address the field problems faced by small farmers.

The farming systems research also appears to have originated from the realization by scholars and researchers that the "wealth of knowledge" which has been gained by small farmers is not merely based on the "accumulation of experience, handed down from generation to generation" (Whyte, 1981:38). In order to support the view that traditional farmers also engage in, and often carry out, their own indigenous experimentation, Whyte (1981:38) cited the following findings by Howes and Chambers (1979) about a local (traditional) farmer in Nigeria:

> . . . a scientist believed he had made a breakthrough when he found a way of breeding yams from seed, propagation normally being vegetative. A farmer was casually encountered, however, who had not only himself succeeded in doing this, but had also discovered that whereas the first generation tubers were abnormally small, the second and subsequent generations were of normal size. The scientist reportedly exclaimed, "Thank God these farmers don't write scientific papers."

On the basis of the above, Whyte (1981:35) has drawn the following conclusions:

> The stereotyped view of the tradition-bound passive peasant contrasted with the rational agricultural scientist falls apart as we see small farmers making choices based upon observation and experimentation while agricultural scientists often seek to impose upon them the "traditional" style of farming characteristic of the Iowa corn belt.

Therefore, it is this continuing realization of the "peasant rationality," along with the other reasons discussed above, that has contributed to the emergence of the "grass-roots" or "bottom-up" farming systems research approach to the design and development of small farmer technology. The full meaning of this new research approach, as well as its essential characteristics, will now be explored.

Objectives and Characteristis of the Farming Systems Research Approach

A system has been generally conceptualized as any set of interrelated and interacting elements or components. On this basis, a farming system is viewed as consisting of a complex interaction of a number of interdependent components (Norman, 1980). In the world of small farmers, both the farm production enterprises and household decisions are often intimately connected. Therefore, Norman (1980:2) has proposed the following conceptualization of a typical small-scale farming system:

> . . . a specific farming system arises from the decisions taken by a small farmer or farming family with respect to allocating different quantities and qualities of land, labor, capital, and management to crop, livestock, and off-farm enterprises in a manner which, given the knowledge the household posses, will maximize the attainment of the family goals(s).

Okigbo (1981:45) also viewed farming systems research as essentially involving:

> . . . studies of systems components and development of principles, materials, techniques and practices, some of which may be of general application, but others are location-specific.

Furthermore, in a description of the tasks of the International Institute of Tropical Agriculture (IITA) in Nigeria, Okigbo (1981:41-45) has reported that their farming systems research program is aimed at accomplishing the following:

> . . . gives priority to development of appropriate technologies involving mechanical, chemical and biological resource manipulations that are within the means of the small farmer to own, use, and repair or even hire . . . farm-level studies of existing farming systems are aimed at understanding the farmer's overall environment, farm enterprise, and constraints to increased productivity, all of which facilitate determining priorities and strategies.

It is, therefore, evident that the primary objective of the farming systems research approach is to study and analyze the entire production environment (including the resources, constraints and limitations) in an attempt to devise the means to enhance its overall efficiency. Norman (1980:5) also viewed this research approach as a developing technology that is aimed at:

> . . . increasing productivity in a way that is useful and acceptable to the farming family, given its goal(s), resources, and constraints.

Shaner et al. (1982:4) have summarized the objectives of, as well as the developmental activities that are

carried out under, farming systems research as being:

> . . . (small) farmer-based, problem solving, comprehensive, interdisciplinary, complementary, iterative, dynamic, and responsible to society.

Accordingly, they content that the approach can be characterized as:

1. farmer-based -- because FSR & D (farming systems research and development) teams pay attention to farmers' conditions and integrate farmers into the research and development process;
2. problem solving -- in that FSR & D teams seek researchable problems and opportunities to guide research and to identify ways for making local services and national policies more attuned to the farmers' needs;
3. comprehensive -- in that FSR & D teams consider the whole farming activity (consumption as well as production) to learn how to improve the farmers' output and welfare, to identify the flexibilities for change in the environment, and to evaluate the results in terms of both farmers' and society's interests;
4. interdisciplinary -- in that researchers and extension staff with different disciplinary backgrounds work with farmers in identifying problems and opportunities, searching for solutions, and implementing the results;

5. complementary -- because it offers a means for using the outputs of other research and development organizations and for giving direction to others' work;
6. iterative -- in that FSR & D teams use the results from research to improve their understanding of the system and to design subsequent research and implementation approaches;
7. dynamic -- in that oftentimes FSR & D teams introduce relatively modest changes in the farmers' conditions first and the favorable results encourage more significant changes later; and
8. responsible to society -- in that FSR & D teams keep long-run interests of the general public in mind, as well as the farming groups immediately affected (Shaner, et al, 1982:4).

The Modus Operandi of Farming Systems Research

As shown in Figure IV-3, farming systems research is aimed at analyzing the two main elements of the small farmer's environment, namely: the technical and human elements. According to Norman (1980:3), the technical element is characterized by the following:

> . . . the types and physical potential of livestock and crop enterprises, and includes physical and biological factors that have been modified to some extent by man--often through technology development.

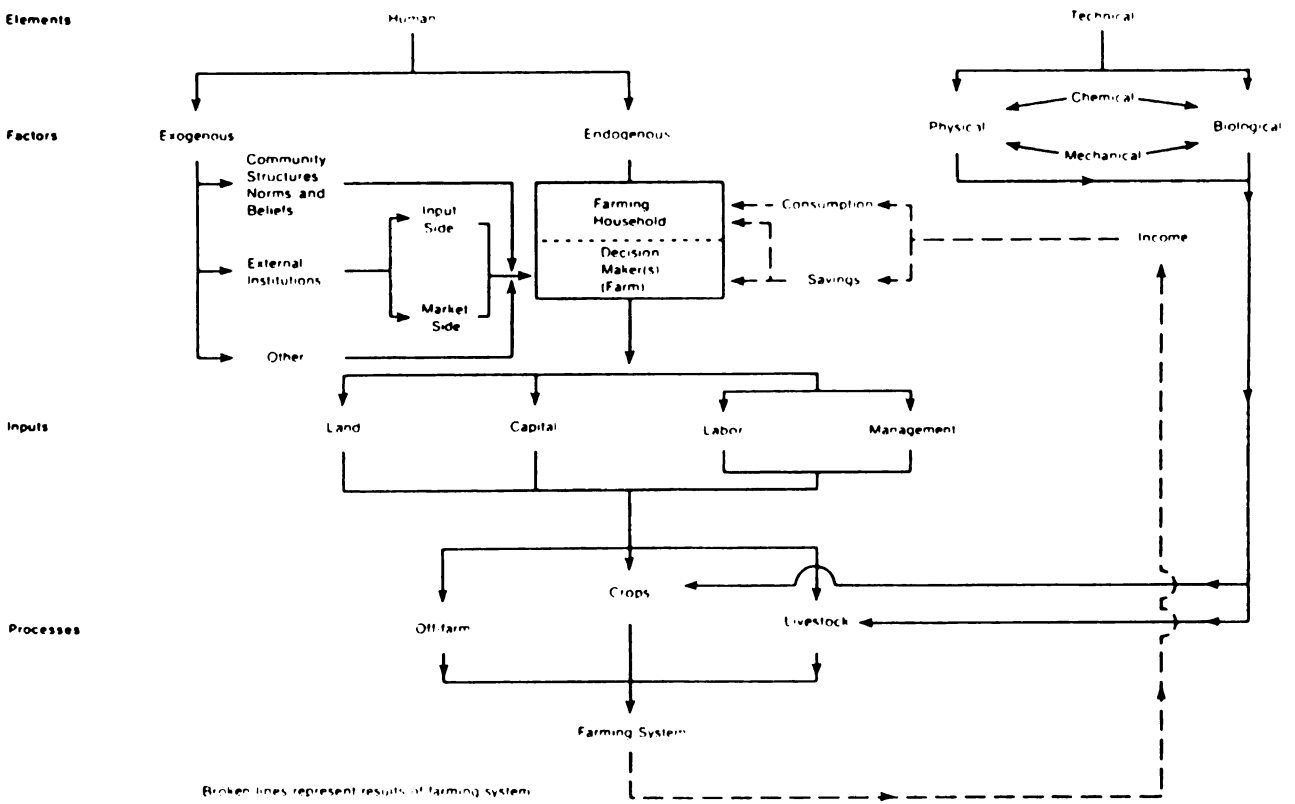


Figure IV-3. Schematic Representation of Some Determinants of the Farming System

SOURCE: Norman (1980).

The human element, on the other hand, is characterized by the exogenous and the endogenous factors (see Figure IV-3). Despite the fact that the exogenous factors (or the socio-cultural and institutional structures) appear to lie largely outside the control of the individual farmer; nonetheless, several scholars (Norman, 1980; Swanberg, 1980) have recognized their significant impacts on the day-to-day activities of the small farmers. In contrast, Norman (1980:3) reported that the endogenous factors differ from the exogenous ones in the following respects:

> Unlike the exogenous factors, the endogenous factors are controlled by the farmer himself who ultimately decides on the farming system that will emerge, given the constraints imposed by the technical elements and exogenous factors.

In view of the foregoing, it is quite evident that the farming systems research strategy clearly:

> . . . recognizes and focuses on the interdependencies and interrelationships between the technical and human elements in the farming systems (Norman, 1980:5).

For the first time in the history of agricultural research and development for the developing nations, the small farmers and their farm families appear to have been clearly identified and recognized as the key figures in a new research strategy. The classical "vertical" or "top-down" approach to technology development tended to concentrate on the modification of only the "technical elements to fit crops or animals and to ignore the human element" (Norman, 1980). But Norman (1980:5) has cited studies by

VanSchilfgaarde (1977) to confirm that farming systems research approach remarkably:

> . . . increases the potential for fitting the animal or crop to the environment rather than vice-versa.

In other words, because the major concern of farming systems researchers is the exploration of ways for improving the welfare of small farmers and their families, research efforts are, therefore, concentrated on the design of appropriate technologies that are suitable to this target population for fulfilling their production objectives.

Types of Farming Systems Research

Two basic types of farming systems programs that have been identified are, namely: the "upstream" and the "downstream" farming systems programs (Technical Advisory Committee, 1978). Norman (1980:5) then defined these two farming systems programs in the following manner:

> Upstream FSR uses research from experiment stations to find prototype solutions to the major constraints on agricultural improvement in a relatively large region or area . . . (and)
> Downstream farming systems research is a farm-level research approach whereby farmers and a multi-disciplinary research team work together to diagnose, design, modify and improve farming systems in a local area (see Figure IV-4).

It is quite evident from the above definitions that the downstream FSR is of particular relevance to small farmers in that it clearly recognizes the significant role that the farmers' knowledge, derived from accumulated

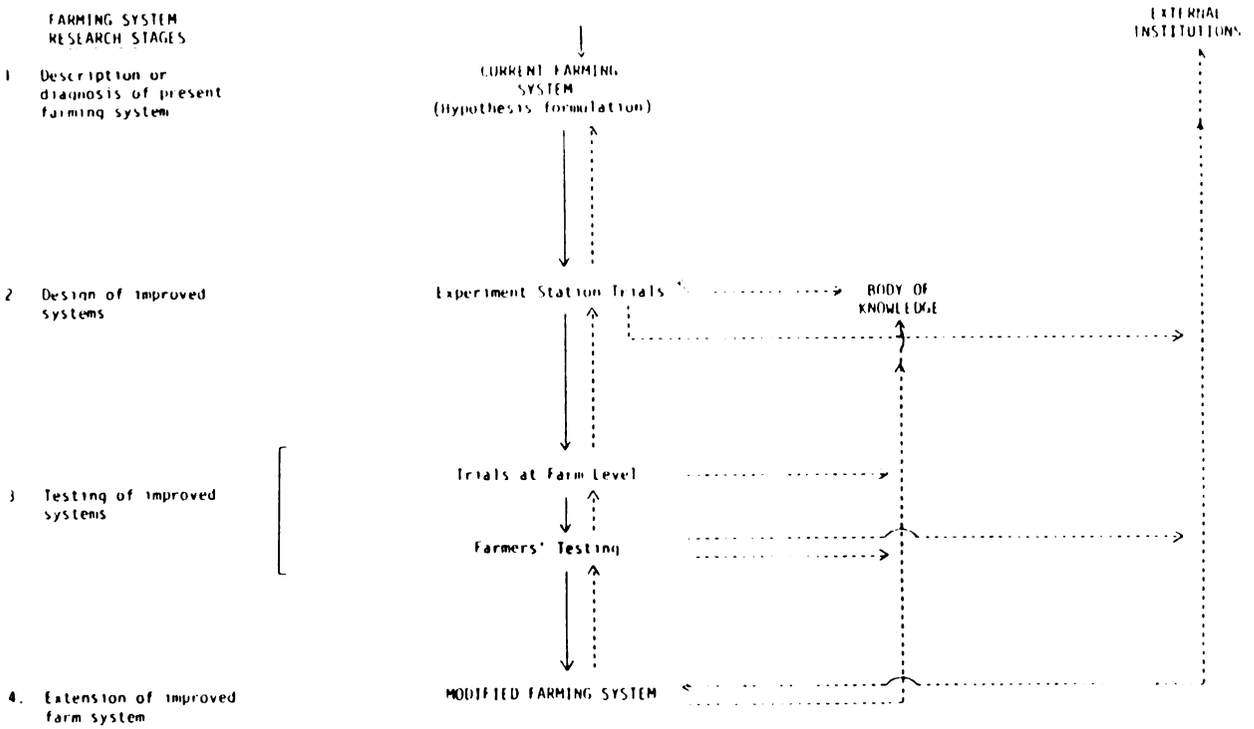


Figure IV-4. Schematic Framework for Farming Systems Research at the Farm Level--Downstream Farming Systems Research

SOURCE: Norman (1980).

experience and indigenous experimentation,will play in the process of improving their existing farming system (Norman, 1980; Whyte, 1981). Furthermore, Norman (1980) has observed that the active involvement of small farmers in this research process is one way of ensuring that the product of these efforts (viz: appropriate technologies) will definitely address their farm-level needs and production problems.

As clearly shown in Figure IV-4, the schematic framework of the downstream FSR depicts the four successive research stages that must be carried out through the collaborative efforts of small farmers and the multi-disciplinary research team. Norman (1980:6) has described these four research stages in the following way:

> The descriptive (diagnostic) stage identifies the constraints and flexibility in the current farming systems. Based on interviews with farmers, this information is used to design, test, and extend programs for improving farming systems. These programs are then assessed by applying evaluation criteria derived from farmer interviews.

In the final analysis, a new and improved farming system, which combines the best of the currently used system with the findings of the downstream research process, often emerges as the end product (Norman 1980, Harwood and Price, 1976). Hence, as Norman (1980) has observed, the relevant changes that may result as the product of this "grass roots" farming systems research will often involve "small adjustments" rather than complete or incompatible and complex changes in the system.

It is, therefore, pertinent to observe that the

usefulness of both the "requirements-limitations gap" model and the farming systems research approach as effective tools for designing appropriate technologies for small farmers cannot be overemphasized. More importantly, both strategies are oriented toward the provision of appropriate solutions to the practical agricultural production problems as they affect the small-scale farmers.

Some Empirical Results of Farming Systems Research

Sole versus mixed cropping

The traditional practice of growing crops in mixtures has been described as a "primitive" production technique and, as such, is not compatible with "modern" agriculture. Hence, mixed cropping was not considered worthy of serious research endeavor; Third World researchers and extension workers encouraged local farmers to plant improved crop varieties in sole stands. But farmers, who have traditionally grown crops in mixtures of two or more crops together, on the same field, have been reluctant to comply with the technical advice of researchers to adopt sole cropping. The rationale for the reluctance of these farmers to plant improved crop varieties in sole stands was provided through farming systems research studies in northern Nigeria.

Norman (1980) cited the results of a farming systems research study by Norman, et al. (1979) to provide empirical support for mixed cropping (see Table IV-2).

TABLE IV-2

COMPARISON OF SOLE AND MIXED CROPS GROWN BY FARMERS IN THREE AREAS OF NORTHERN NIGERIA (1966-68)

Variable Specification	Sokoto Area		Zaria Area		Bauchi Area		
Location	13°01'N	5°15'E	11°11'N	7°38'E	10°17'N	9°49'E	
Annual Rainfall (mm)	752		1,115		1,102		
Days in Growing Season	150		190		180		
Percent Cultivated Area Devoted to Sole Crops	9.1		23.0		46.1		
Sole or Crop Mixture	Sole	Mixture	Sole	Mixture	Sole	Mixture	Avg. % change from sole to crop mixtures
Labor (manhours/ha):							
Annual	425.8	485.6	362.3	586.4	564.9	597.5	27.2
Labor peak period	232.8	237.9	122.3	157.9	247.3	247.3	10.5
Yield (kg/ha):							
Millet	736.4	686.0	--	366.5	727.4	393.4	-26.4
Sorghum	652.3	122.2	785.7	644.5	839.5	728.6	-37.5
Groundnuts	429.3	188.3	587.3	412.5	392.3	217.5	-43.5
Cowpeas	--	56.0	--	132.3	--	51.6	--
Value of production: (N)/ha	31.65	40.8	37.96	61.36	29.50	33.73	34.9
Annual man-hour	0.06	0.12	0.13	0.11	0.08	0.08	28.2
Man-hour put in during peak period	0.13	0.32	0.35	0.42	0.24	0.25	56.8
Net return (N/ha):							
Labor not valued	30.74	38.94	36.79	59.48	30.74	35.76	34.9
Costing hired labor	28.27	36.13	33.41	54.02	28.64	31.18	32.8
All labor costed	17.96	24.36	18.31	29.60	14.80	18.68	41.2

SOURCE: Norman (1980).

The results clearly indicate that the level of profitability or net return per hectare from mixed cropping amply demonstrate the superiority of crop mixtures over sole crops. According to Norman (1980:12), the net return per hectare from crop mixtures:

> . . . ranged from 32 percent to 41 percent higher, depending on how labor was costed.

Also realizing that in many areas of northern Nigeria seasonal labor shortage has been reported as a major constraint on expanding farm output, it is significant to note that the return from crops grown in mixtures per annual man-hour "was 28 percent higher than from growing crops in sole stands" (Norman, 1980:12). In other words, mixed cropping was found useful in helping to alleviate the seasonal labor bottleneck problem. Furthermore, Norman (1980) reported that growing crops in mixtures have been found to provide a more dependable return to local farmers in an unpredictable production environment where the pursuit of risk aversion strategies is almost inevitable.

Therefore, empirical results obtained through farming systems research have clearly demonstrated that mixed cropping in traditional northern Nigerian farming systems is compatible with the technical and human elements (Norman, 1980). Thus, growing crops in mixtures has been found to be a rational strategy for small farmers confronted with labor constraint and high risk associated with uncertain weather. It is therefore not surprising

that researchers in Nigeria and other developing nations have now recognized the need to develop improved technologies based on mixed cropping for raising productivity levels on small farms. According to Norman (1980), the FSR approach can provide the means for the application of the sum total of knowledge about agriculture, including the practices of traditional farming, in the development of relevant and improved (appropriate) technologies for small farmers.

Traditional versus improved cotton technology

The potential advantages of the use of the FSR approach for the development of improved technologies for small farmers have been demonstrated with the case of small-scale cotton growers in northern Nigeria. Norman (1980) has reported that an ex post farming systems research revealed that local farmers in northern Nigeria rejected an improved cotton technology package in which researchers in the experiment station merely emphasized higher yields and overlooked the "human element" of small farmers. The improved cotton technology package required these small farmers to not only plant earlier and in sole stands, but also to apply fertilizer and a water-based insecticide.

However, Norman (1980) cited studies by Beeden, et al. (1976) to establish the reasons why virtually no farmers adopted the improved cotton recommendations in their entirety--in spite of the fact that the net return

per hectare of improved cotton was considerably higher than the returns from traditional cotton. Research results indicate that the average labor inputs required for growing improved cotton "were 59 percent higher than those for producing traditional cotton" (Norman, 1980:15). It was also established that the return per man-hour during the seasonal labor bottleneck was 13 percent less for improved cotton than for the traditional cotton. More importantly, Norman (1980) observed that, because the improved-cotton had to be planted earlier than traditional cotton, a labor conflict arose and the local farmer had to choose between weeding his food crops or planting the improved cotton.

It is important to recognize that the technical researchers simply compared the traditional and improved cotton varieties in the experiment station for yield differences. On the other hand, the local farmers carefully analyzed the requirements for growing improved cotton as part of their total farming system (Norman, 1980). According to Norman (1980), the ex post farming systems research revealed that the local farmers did not compare improved cotton technology with the traditional cotton technology in terms of the yield differences. Rather, they compared the improved cotton technology with the labor requirements for their food crops. Therefore, the results obtained through the FSR approach suggested that one good reason for rejecting improved cotton was the incompatibility of the new technology with endogenous factors, such as family labor

bottlenecks and labor availability for food production (Norman, 1980). Other reasons suggested for non-adoption included the difficulty of transporting water required for spraying and the lack of relevant production inputs such as fertilizer.

Problems and Future Needs for the Implementation of Farming Systems Research

Shaner et al. (1982) have observed that farming systems research and development activities strongly emphasize working with small farmers in their own fields. But, historically, most agricultural research programs have been conducted almost exclusively at the experiment stations, although sometimes supplemented by researcher-managed trials at the farmers' level. Norman (1980) also noted that research programs in agricultural institutes have traditionally been organized along disciplinary lines. Even more recently, commodity-based research programs have been advocated in several developing countries. But farming systems research includes the advancement of a more holistic approach to seeking solutions to the complex problems confronting small farmers.

Therefore, according to Shaner et al. (1982), researchers currently working at regional or national agricultural experiment stations, and who are interested in the implementation of FSR, may require some reorientation. Shaner et al. (1982:7) suggested that this reorientation may include:

> . . . research methodology as applied to field conditions and methods for working with the whole farm family--male and female, young and old. Where appropriate, females may need to be added to the research and extension staff.

As clearly illustrated in Figure IV-4, the farming systems research approach advocates an active interaction of the researchers with the farmers, the extension workers, and the government agencies which influence the external institutions (Norman, 1980).

Norman (1980:20) has identified two other practical problems that may frustrate the holistic approach to the solution of agricultural production problems as advocated in FSR. These are:

1. The farming system approach requires the integration of livestock and crop production. Research on livestock and crops, however, is often undertaken by different institutions, making integration virtually impossible.
2. A similar problem exists for social scientists (e.g., agricultural economists and sociologists) who are often located in academic institutions which are separate from government agricultural research institutes (Norman, 1980).

But it can be asserted that these problems seem to have been solved at the international level where such organizations as the International Institute of Tropical Agriculture (IITA) and other related bodies have set up definite FSR units and programs. At the national levels,

Shaner et al (1982:6-7) have suggested that farming systems research and development activities can be implemented through:

> . . . a semi-autonomous government corporation that has more flexibility in operations, budgeting, and personnel management than ministerial research and development organizations . . . (or) a ministry of agriculture if the ministry is responsible for research and extension. A country can apply FSR & D to the activities of an experiment station in which one or more teams trained in FSR & D methods work closely with experiment station staff.

Future Needs of Farming Systems Research

Norman (1980) has observed that much of FSR is currently being conducted by researchers who have been trained in, or originated from, the developed countries. Consequently, their training has usually not only been discipline oriented, but also culturally limited. Hence, according to Norman (1980:21), it may be difficult for such scholars to readily appreciate and understand the importance of:

> . . . local wisdom and values, the complexities of a farmer-household system, the role of non-economic variables, and the potentially significant role to be played by rural sociologists or anthropologists.

A call has therefore been made for a "new breed" of researcher's who can work effectively with small farm families and in interdisciplinary research teams. A call has also been made for the placement of due emphasis on the building of lasting local institutional capabilities

through teaching and training of Third World scholars in farming systems research.

Norman (1980) has also suggested the need for planning and policy makers in the Third World to realize that FSR can be time consuming. In other words, a considerable time lag usually exists from the time a small farm development problem is recognized to the discovery of a relevant solution and its subsequent adoption by the target population. It has also been pointed out that FSR approach is now being advocated in places where applied research, especially as it relates to the solution of the needs and production problems facing small holders, has not been done in the past. Therefore, it is obvious that farming systems research in the Third World will take time before it can produce significant results. According to Norman (1980), if these facts are not clearly recognized, problems may arise in the maintenance of continuity of the research process through adequate funding.

However, Norman (1980) has suggested that the time between recommended solutions and farm adoption may be shortened if the link between FSR and agricultural extension education can be strengthened. It is pertinent to note that this observation is in total agreement with the recommendation made elsewhere in this study with regard to the Nigerian situation. A call has been made for the establishment of a direct link between the activities of

the agricultural researchers in the Nigerian universities/ agricultural experiment stations and the extension education activities of the Ministries of Agriculture.

Integration of Small Farm Development Research Strategies ("Upstream" and "Downstream" FSR and Swanberg's "Requirement-Limitations Gap" Model)

This section of the study would not be complete without exploring the possible integration of the identified strategies for developing improved technologies for small farmers. This is one way of ensuring that the strategies will neither be viewed in isolation from each other, nor be seen as either opposing to, or directly substitutable for, each other. Rather, it is believed that the products of each research approach can be used beneficially to augment the value of the others. In other words, the identified strategies for the design of appropriate technologies for raising productivity levels on small farms should be seen as complementary to each other. Thus, they may, at best, be viewed as dissimilar approaches aimed at accomplishing the same goal--the improvement of the welfare and livelihood of small holders.

Shaner et al. (1982:37) establish the basic differences between "upstream" and "downstream" FSR in the following manner:

> "Upstream" reserch is characterized as being partly basic, broadly general, and supportive; whereas, "downstream" research is characterized

> as being site specific, primarily adaptive, and useful without long delay for target groups of farmers.

Gilbert el al.(1980) further noted that, in contrast to "downstream" FSR programs which are aimed at developing practices or innovations specifically tailored to a definite local situation, "upstream" FSR programs deal mainly with how to overcome major constraints common to a wide range of farming systems extending across one or more geographical areas. In this sense, "upstream" FSR approach is regarded as essentially contributing to the "body of knowledge." Seen in this light, it has therefore been suggested that prototype solutions produced from "upstream" FSR programs can be particularly useful to "downstream" FSR researchers in that those solutions can be further adapted through "downstream" FSR to site-specific situations or local conditions (Gilbert et al., 1980). This contention is equally true and applicable to the Swanberg's model in that innovations produced by the "upstream" FSR programs can be utilized for adaptation to the small farmers' reality or production environment. Therefore, the pool of knowledge generated from "upstream" FSR programs can be fed to the other research strategies so that more appropriate solutions to the production constraints facing small producers in a definite production environment can be discerned. In a reciprocal manner, as argued by Gilbert et al. (1980), "upstream" farming

system researchers should ultimately rely on feedback from "downstream" programs to sharpen their own research priorities and objectives.

Gilbert et al. (1980) have observed that "downstream" FSR programs begin with a basic understanding of the existing farming systems and an identification of the key production constraints. The knowledge and information generated from the study of the prevailing farming systems and the production limitations confronting the target population will be particularly useful for the application of Swanberg's model. By matching the relevant production limitations confronting small holders in this production environment with the requirements of the new technology or available innovation, it becomes relatively less difficult to determine whether or not the new technology is appropriate for the specific target population. Unlike Swanberg's approach, "downstream" farming systems research does not always seek to significantly alleviate the identified key constraints confronting small producers. But, according to Gilbert et al. (1980), "downstream" FSR programs are aimed at the identification of areas of flexibility in the specific farming system through an accommodation of available innovations to the reality of the existing constraints. In this sense, it is quite similar to the "requirements-limitations gap" model as advanced by Swanberg (1980). It is pertinent to note that both research strategies not only depend primarily on, but also

seek for new ways and means of, utilizing existing research results and innovations for the benefit of small farmers. This is accomplished through testing, adaptation and incorporation directly--or with relatively minor modifications--into the prevalent farming systems (Gilbert, et al., 1980).

In sum, Gilbert et al.(1980) have strongly contended that a farming systems research and development approach should basically strive for a suitable blend of "upstream" and "downstream" programs--as determined by the availability of innovations and research results that can be easily integrated into existing farming systems. According to them (as cited by Shaner et al., 1982):

> Where the pool of technologies is large, "downstream" programs can be effective in identifying and adapting the most promising approaches. (And so can be Swanberg's approach). Conversely, where basic or more general research is needed, an "upstream" approach may provide an appropriate mode for organizing research to cut across traditional disciplinary and commodity lines. At the minimum, a two-way flow of information is needed from farm level to research institution and back again in the form of appropriate technologies.

It is, therefore, not logical to make a "blanket recommendation" for the developing countries. Rather, it can be suggested that each country determine the right blend of research types to encourage based on the magnitude of basic research information or new production technologies already available. But it must be pointed out that available evidence seems to suggest a dearth of appropriate technologies for small holders in most Third World countries. The implication here is for an emphasis on

"downstream" FSR programs in these countries. This is one way of providing the much needed appropriate technologies for enhancing productivity levels on the small farms.

Toward the Development of Appropriate Technologies for the Small-scale Farms: A Typology of Improved Technologies for Small Farmers

It has been observed that most improved technologies for agricultural development often require an increased use of certain production resources in order to be maximally effective. For instance, some of the high-yielding cereal grain varieties that have emerged out of the plant breeding breakthroughs of the Green Revolution technology often require an increased application of certain production inputs, such as fertilizers, pesticides, and irrigation. But, when small farmers are limited in their access of these resources (often due to multiple country-specific reasons), a production constraint is said to have arisen. It follows then, according to Swanberg (1980), that it is only when an improved technology faces no such production constraints that such a technology can be properly labelled as "appropriate"--especially for small farmers.

Therefore, any effective strategy for improving the precarious production conditions facing the small producers should not only include a thorough consideration of the increased resource requirements associated with the profitable use of an improved technology, but

should also take into consideration the corresponding production limitations facing the small farmers. In other words, Swanberg (1980) has suggested that critical attention must be paid to an analysis of the technical input requirements and the bio-physical input combinations. This analysis will range from the study of the interactions between such factors as seed varieties and soil fertility levels, response of crops to pesticides and other protection chemicals, to the performance of specific crops under varying levels of soil nutrients and moisture regimes. In addition, the effects of various chemicals on the ecological balance and subsequent environmental implications of their use and/or misuse must be carefully analyzed. Of equal significance, is the analysis of the existing socio-cultural and economic conditions facing the small farmers. Among the important variables that must be carefully studied include: farm labor profiles, liquid asset levels, farm size, market incentives, and factor-product levels, as well as the prevalent mores, values, and beliefs of the target population (Swanberg, 1980). Swanberg (1980) has also suggested that the organizations or institutions charged with the responsibility of facilitating the use of the farmer's own or borrowed resources must be critically analyzed. These include: credit, input supply, and marketing institutions, as well as the agricultural processing, storage and transportation systems. In addition, the small farmers' perceptions of their real

production problems and needs, including their risk-bearing potentials, must be ascertained and evaluated. In the final analysis, Swanberg (1980) has suggested that harmony must be attained and established between the resource requirements for the successful implementation of a new technology and the corresponding production limitations facing the small producers. Only after such a balance has been established (through the bridging of requirements-limitations gap) can the proposed improved technology be rightly described as "appropriate" for the small farmers. This is the basis for the development of a typology of improved technologies for enhancing production on small farms.

A Typology of Improved Agricultural Technologies

In order to precisely determine when any new agricultural technology should be described as "appropriate" for small farmers, a typology of improved technologies has been established. Historically, the economic dimensions of new technologies for small-scale farmers, such as their low-cost and labor intensive characteristics, have been over-emphasized as the basis for the design and even subsequent transfer of improved agricultural technologies. Thus, for example, a low-cost and labor intensive technology that has been specifically designed for an identified target population (say, the small holders of a rural community in a temperate environment) would be assumed to be equally effective in, and therefore, directly

transferable to, a fairly similar target audience (say, the rural small holders of Nigeria). But this notion is no longer tenable. Available evidence clearly indicates that the assumptions are too simplistic; there are other relevant factors that must be carefully considered in any attempt to determine the "appropriateness" of a new technology or innovation among an identified target population. Apart from the socio-economic variables, Swanberg (1980) has suggested the need to consider other relevant socio-cultural, biophysical and ecological variables in a given production environment in any efforts to determine the "appropriateness" of a new technology for a target population in that environment.

Therefore, Swanberg (1980) has advanced a four-category typology. According to him, improved agricultural technologies generally fall into any one of the four categories--only one of which leads directly to the development of "appropriate" technologies. Figure IV-5 clearly illustrates the conditions and specific variables which determine the four types of improved technologies and their status with respect to "appropriateness." The insights gained from a framework for resource development policy, as detailed by Barlowe (1976), provides the basis for developing the specified variables in the conceptual framework shown in Figure IV-5. Barlowe (1976) has highlighted the essential importance of physical and biological, economic, and institutional considerations as factors

that affect the successful development and use of a natural resource, as well as the operation of policies that deal with the management of that resource.

Type 1 technologies

As shown in Figure IV-5, Type 1 technologies, which fall into the "appropriate" class, refer to the condition in which the bio-physical and ecological factors, as well as the socio-cultural and economic requirements of the improved technologies, are in conformity with the existing production limitations facing the small farmers. In other words, the resource requirements for the successful implementation of the new technologies are in harmony with the production constraints facing the small producers.

Swanberg (1980) illustrated the above condition by referring to the development of most new high-yielding and disease resistant seed varieties (such as the IR8 rice hybrid in the Philippines, the Guantiva and Purace potato varieties in Colombia, and the Katumani maize composite in Kenya) as common examples of this type of improved technologies. The rationale for this classification is based on the finding that the cultivation of these improved seed varieties has resulted in increased crop yields without demanding substantial increases in resource requirements. With respect to the Purace potato variety, for example, Swanberg (1980:5) has observed:

> . . . in Colombia, fertilizer and pesticide requirements for the Purace potato variety

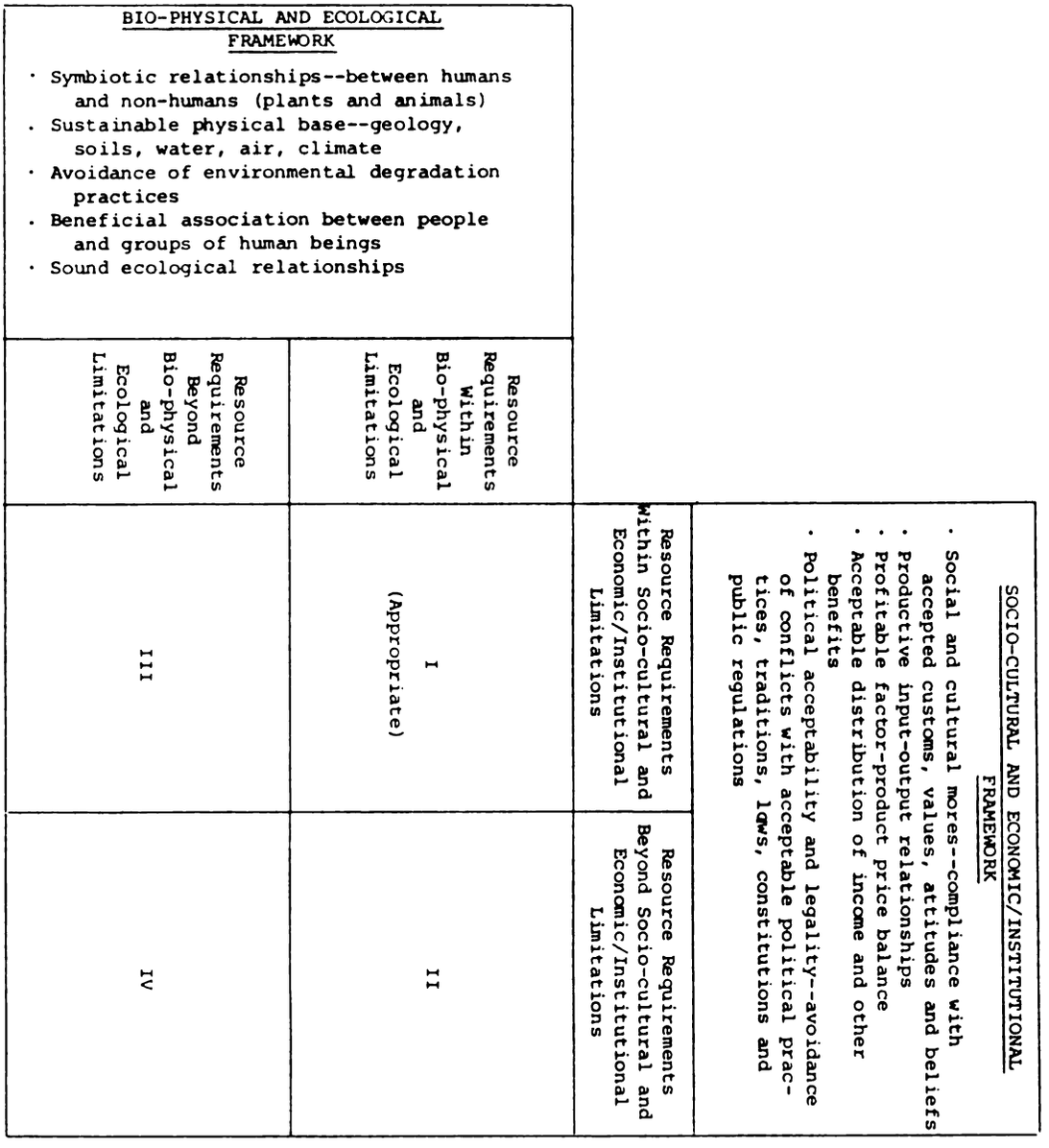


Figure IV-5. A Typology of Improved Technologies According to a Two-Fold Framework for Appropriate Resource Development

SOURCE: Adapted from Swanberg (1980) and Barlowe (1976).

> actually declined with respect to the levels applied by the farmers prior to the introduction of the new seed.

Swanberg (1980:5) also reported that the Katumani maize has been introduced in Kenya "with or without increasing fertilizer levels." Furthermore, this variety:

> . . . serves to reduce the risk of crop failure in low rainfall seasons because the Katumani maize, being an early maturing variety, avoids the effects of drought.

It is also pertinent to cite the reasons advanced by Swanson (1975:20) to undergird his argument that genetic breakthroughs (such as the development of improved seed varieties and better breeds of livestock), may be viewed as a "technological solution" that is particularly appropriate for the developing countries of the tropics and subtropics:

1. Genetic solutions involve little economic cost to the farmer beyond the purchase of the initial seed or stock. Therefore, the cost of adoption has not only been described as minimal, but is also not a regular, annual production cost. In this sense, it appears to be of immense economic importance to small farmers who have very limited availability of, or access to, capital.
2. From the farmer's standpoint, it has been established that genetic solutions to limiting production factors are simple or uncomplicated

for adoption. Except in a few cases, they do not generally require any drastic changes in the local cultural practices. For instance, with the development of cassava varieties that are resistant to the cassava bacterium blight (CBB) disease in Nigeria, farmers are merely expected to substitute the old susceptible planting material (stem cutting) with the new disease-resistant varieties. Therefore, genetic solutions to production problems, such as insect pests and diseases, do not necessarily require an extensive educational input (as would be the case with pesticides, for example), to be successfully utilized by small farmers.

3. Genetic solutions do not require substantial investments in industrial capacity and the necessary supply or delivery system to make inputs (such as pesticides) available to farmers when needed. In addition to these direct capital costs, the tasks of organizing an efficient and reliable delivery system for capital inputs that can reach millions of small farmers at the right time may become quite onerous.
4. Genetic solutions tend to eliminate the potential ecological costs often associated with

chemical solutions to farm problems. They also, for instance, eliminate the serious health hazards that may be associated with improper handling of dangerous pesticides by illiterate small farmers.

5. Finally, genetic solutions can give widespread control of specific limiting factors across large geographical areas and, if properly maintained by an effective research and monitoring system, can do so with little risk of genetic vulnerability.

Type II technologies

As indicated in Figure IV-5, Type II technologies refer to those new technologies that are constrained by the prevalent socio-cultural and economic, as well as institutional limitations.

Swanberg (1980) illustrated a type II technology constraint by citing the rejection of the Purace potato variety in some parts of Colombia. Here was the case of an improved potato variety that "outperformed" the Guantiva variety at the same level of inputs. But the "size of this potato is much larger than that preferred by the homemakers in Bogota and it has a disagreeable taste and texture" (Swanberg, 1980:7). Therefore, although the cultivation of Purace variety gives rise to higher yields than the Guantiva, farmers refrained from growing it. Similarly,

it has been found that farmers living in the semi-arid regions of Kenya have preferred to grow maize (instead of sorghum which has higher drought-resistant qualities than maize) as their major subsistence grain crop. On investigation, however, it was found that their refusal to grow sorghum primarily emanates from the "milling, texture and taste problems of the improved varieties" (Swanberg, 1980:7).

Swanberg's observation are consistent with the views of Zaltman and Duncan (1977:14): "compatibility" or the "goodness of fit" that an innovation has with the situation in which it is to be used is an important determinant of the rate of adoption of that innovation. It, therefore, follows that an agricultural innovation should be made as consistent as possible with such factors as: group values and beliefs, existing technologies, literacy levels, and past history of change within that target group or organization (Zaltman and Duncan, 1977).

In the light of the above, it becomes clear that it is essential to establish "harmony" between the requirements of an improved technology and the existing socio-cultural and economic conditions of the small farmer's environment. Until this is accomplished, it may be unsound to label that new technology or agricultural innovation as "appropriate" for the small farmers.

Type III technologies

The type III technologies are those that are limited in their utilization by small farmers in light of the existence of bio-physical and ecological constraints (see Figure IV-5). For example, when a new technology (or more specifically, an agricultural innovation) requires an ample supply of moisture to be maximally effective, but the small farmers happen to be located in an arid or semi-arid region where there is neither sufficient rainfall nor irrigation facilities, then a production constraint arises. Consequently, the adoption of this technology is limited by the existing, but rather unfavorable, environmental condition.

Studies sponsored by the International Rice Research Institute (IRRI) in Asia have confirmed that small farmers without access to irrigation or supplemental water supply in their production environment did not reap much benefits from the "Green Revolution" technology. Where these "small farmers were cultivating irrigated land, they tended to adopt the new technology about as rapidly as the larger farmers and to reap substantial benefits" (Whyte, 1981:VII).

It is also pertinent to state that with the increasing realization of the immense need to maintain an ecological balance between humans and nature, certain agricultural practices, whose implementation will cause irreversible damage to the environment, are now being rejected. In this regard, Lodwick and Morrison (1980:49) have observed

that a major criticism levelled against the large-scale, "hard" technology is that:

> hard technology wastes, depletes, and denigrates natural resources, creating dangerous environmental pollution.

In constrast, however, it has been suggested that the sparing use of indigenous natural resources (especially non-renewable ones), through the development and use of appropriate technologies will reduce the "potential of conflicts over scarcities and preserves environmental quality" (Morrison, 1978b).

It is, therefore, essential that new technologies be designed to conform with the requirements of the bio-physical and ecological framework (as outlined in Figure IV-5). Furthermore, for improved technologies to become "appropriate," and subsequently acceptable to small farmers, their characteristics should also be in concert with the dictates of the socio-cultural and economic framework (see Figure IV-5).

Type IV technologies

Improved technologies that are neither suited to the prevalent socio-cultural and economic/institutional conditions or the small farmer's reality, nor to the existing bio-physical and ecological limitations of the environment in which these small farmers operate, are referred to as the Type IV technologies.

Swanberg (1980:7) illustrated a type IV technology

by citing research findings in Caqueza, Colombia that showed that, through the use of trickle irrigation, vine-ripe tomatoes can be grown in relay sequence with maize at the end of the rainy season. But, aside from the need to provide the supplemental water through irrigation (which tends to eliminate the bio-physical constraint), Swanberg (1980:7) has observed that the socio-economic requirements for such an endeavor are awesome:

> . . . in terms of building the head water reservoir; developing the water distribution system and establishing a water pricing technique, managing the supply, delivery and risks involved with high fertilizer and pesticide use; and finally, ensuring the presence of an adequate market and marketing services.

It can therefore be argued that, as a result of the tremendous amount of resources that need to be expended in efforts to harmonize the requirements of Type IV technologies with corresponding environmental production limitations, it may be quite unprofitable to undertake such ventures. In other words, it is advisable to refrain from the development of Type IV technologies--technologies that are neither suited to the existing socio-economic and institutional conditions of the target population, nor to the prevailing bio-physical and ecological limitations of the environment in which they are to be utilized.

Implications of the Typology of Improved Agricultural Technologies

In the light of the foregoing, it is evident that for the improved technologies that fall mostly under types

II and III to be effectively and profitably utilized, resource requirements for their successful adoption and implementation by the target population (viz., small-scale farmers) must be carefully identified. Thereafter, these resource requirements have to be matched against the production limitations that face small farmers within the "exogenous" and "endogenous" contexts. In other words, it is of fundamental importance that the totality of the "small farmers' reality" be carefully studied and analyzed in order to establish the constraints that will militate against their successful adoption and implementation of improved technologies or agricultural innovations. Herein lies the relevance and emphasis on "downstream" FSR as well as the Swanberg's model.

Swanberg (1980:8) has suggested that, within a given farming system, the major farm resources that must be critically studied include:

Land - its amount and quality;

Labor - its availability and composition;

Fixed assets - in terms of tools, equipment, structures, livestock, and land;

Liquid assets - such as crops in store, cash deposits, or collectible debts; and

Farm inputs - in terms of seeds, fertilizers, or dusts and sprays on hand.

In order to determine the proper set of environmental limitations that may confront small farmers, other factors that must be analyzed include: local climate, soil types,

agro-ecological zones, as well as the nature of service institutions (Swanberg, 1980). Insights must be gained into institutionalized environmental conditions such as land tenure and rent or share-cropping system. Swanberg (1980:9) also reported that trends and patterns are required for such indicators as:

> . . . wage rates, by activity and season; prices, for commodities and inputs; rents, for different kinds of land-types; interest rates and nominal and imputed opportunity costs, for formal and informal credit; and land values, for cropland and grassland.

The complicated nature of the above list underscores the need for an interdisciplinary approach to the identification of the needs, concerns and production problems facing small farmers, as well as to the design and development of appropriate technologies for enhancing productivity levels on their small farms. This is the thrust of "downstream" farming systems research approach.

CHAPTER V

TOWARD AN UNDERSTANDING OF THE PROCESS AND MODELS OF AGRICULTURAL GROWTH AND DEVELOPMENT IN THE THIRD WORLD: IMPORTANT LESSONS AND POLICY IMPLICATIONS FOR NIGERIA

An Overview of the Process of National Growth and Agricultural Development in the Developing Countries

Should developing countries continue to provide cheap agricultural raw materials to the industrialized economies? And, at the same time, should they be major consumers of expensive value-added industrial goods from these countries? Recently, these questions have been widely debated.

Amin (1974) has dealt with these questions by advancing a four-sector model of development that illustrates the fundamental difference beween a "self-centered system" and a "peripheral system." As indicated in Figure V-1, Amin (1974:10) has asserted that sectors 2 and 4 represent the essential features of an advanced economy (a self-centered system), while sectors 1 and 3 represent those of a developing economy (a peripheral and dependent system). The unmistakable inference here is that the peripheral economy appears to have emanated as a result of the demands imposed on it from outside, i.e., as the

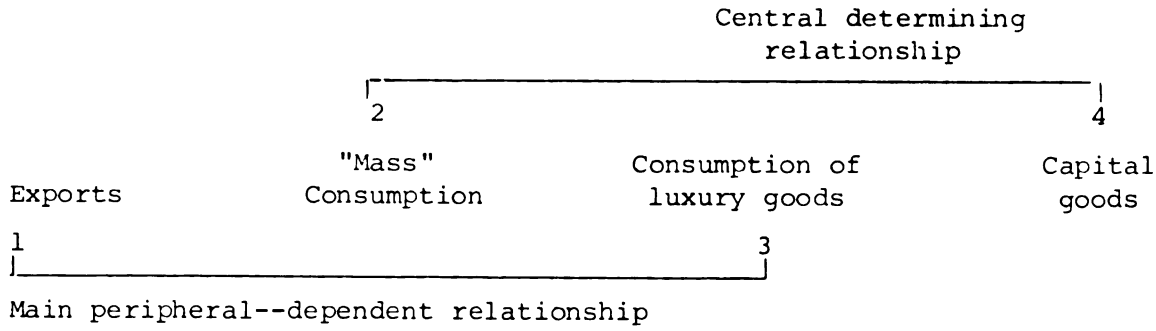


Figure V-1. A Four-Sector Model of Development

SOURCE: Amin (1974).

supplier of primary products. Igbozurike (1976:32) has further inferred that the consumption pattern, which emerges from this development style, was essentially "consumer-oriented and generated by the import-substitution industrialization." It was a development style that adequately catered to the interests of the few rich, but completely ignored the welfare of the majority of the population. In other words, it was a clear situation of growth without development. While the gross national product, as well as per capita incomes, may show rising trends, levels of poverty, unemployment and income disparities have often worsened (Clower, et al.,1966). The net result is a polarization of the few rich and the many poor; the majority of the populace being "left out" of this style of development. In this sense, Igbozurike (1976:32) asserted that underdevelopment and poverty cannot be regarded as

the original state of Third World countries. Rather, they constitute the product of the structural dependence and incorporation of their economies into the world capitalist system.

Igbozurike (1976) has also argued that, in the light of available historical evidence, it appears preposterous to suggest that poverty is a condition that arose from the traditional subsistence nature of African agriculture. Several scholars (Crowder, 1966; Rodney, 1974) have maintained that historical studies clearly indicate that traditional subsistence agriculture was far from being backward, and that, especially before the colonial intervention, Africans enjoyed the material comfort that resulted largely from settled farming. Igbozurike (1976:26) contended that poverty may have existed in several developing countries, as elsewhere, but not to the extent experienced by the large majority after the incorporation of the African economies into the capitalist system. Rodney (1974:149) asserted that with the incorporation of the traditional African system into capitalist system, poverty assumed tragic proportions; its vicious circle resulted from the "trend within capitalism to concentrate or polarize wealth and poverty at opposite extremes." In citing studies by Kingué (1975), Igbozurike (1976:26) has contended that three types of poverty may be found in contemporary Africa:

1. Intrinsic poverty -- refers to basic poverty that is characterized by the absence or insufficiency of significant possibilities of enrichment. It has been suggested that for a large number of African countries, this kind of poverty may be ruled out;
2. Induced poverty -- describes the kind of poverty that results "from an iniquitous economic order, from the exploitation of ignorance or weakness, although the possibilities of enrichment and fair distribution exist." It is evident that this is the fate of most African economies--resulting largely from colonial exploitation and their incorporation into the world capitalist system; and
3. Emergency poverty -- brought about by more or less temporary circumstances, such as natural disasters. For instance, the Sahelian countries of Africa have suffered immensely from the effects of drought and desertification.

However, with regard to Nigeria, it has been suggested that aside from her agricultural potentials, the country's mineral oil wealth is more than enough to offset any possibilities of the existence of intrinsic poverty or dangers arising from emergency poverty. It has also been contended that poverty, as may exist in contemporary

Nigeria, cannot be regarded as the product of the structure of the country's traditional peasant or small-scale agriculture (Igbozurike, 1976). Rather, it has largely arisen from previous agricultural development strategies that tended to ignore the importance of small-scale agriculture in national development.

As will be evident from a review of the process of agricultural development in Nigeria, the historical models of agro-economic development appeared to equate growth and development in agriculture with the promotion of large-scale farming and its subsequent commercialization. Also evident was the primary emphasis on export or cash-crop production and the consequent neglect for food crop production. Furthermore, the early models of agricultural development not only ignored the need for the promotion of indigenous technical skills and agricultural research, but also failed to accord any recognition to the traditional knowledge and experience of Nigerian small holders.

The Process and Models of Agricultural Growth and Development in Nigeria

Igbozurike (1976:13) has argued that Nigeria's agricultural development problems can only be logically studied within the framework of a critical analysis of the overall process of development and underdevelopment of the country. In this sense, it is contended that the country's

agricultural development problems seem to derive basically from:

> . . . the colonial 'false start' in her economic growth and development, from the intended and unintended structural distortions inherent in her history and in the interaction with the contemporary world economic and political systems. (Igbozurike, 1976:13).

This perspective is an obvious departure from the widely held stereotypical notion that Nigeria's agricultural development problems stem mostly "from traditionalism, from resistance to change and innovation, and from the use of traditional techniques and tools..." (Igbozurike, 1976: 13). However, Igbozurike (1976) contended that even though some of those notions may have some relevance, they are not based on empirical findings about the Nigerian traditional farmer. Rather, they are mostly based on Western-biased extrapolations and misrepresentations from anthropological work of "questionable validity, or at least lack validity as a basis for extrapolation" (Igbozurike, 1976).

In order to provide a historical basis for evaluating the agricultural development problems facing Nigeria, Igbozurike (1976:28) has identified three coherent historical models that characterize the evolution of the country's agricultural economy. These are:

1. The Commercialization/Monetization model;
2. The Industrialization model; and
3. The Agro-industrial model.

The Commercialization/Monetization Model

This model is a representation of the process of agricultural growth and development. It is characterized by the transition from a fairly closed subsistence and self-reliant (small scale) agriculture to an open, monetized agriculture, which emphasizes the promotion of primary production mainly for the export market. According to Igbozurike (1976), this model dates back to the era of colonialism when trade in tropical agricultural products was encouraged (as a substitute for the slave trade) and it also depicts the marginal integration of the developing economies into the industrial capital system. He defended this notion by contending that the commercialization of the traditional African agriculture was motivated by a desire to keep African nations as a major market for European industrial products, as well as a provider of the needed raw materials for those industries.

It is evident from the above that there was no attempt to encourage the development of indigenous Nigerian skills or expertise in farming. Those who embraced the commercialization model were concerned about the development of a consumer market and agricultural raw materials for export. Besides, nothing was done to promote food crop production. Limited attention was given to agricultural research and technology development for enhancing productivity. Even when research was done, it was limited to the development of new technology for

fostering the production of cash or export crops such as cocoa, oil palm, and groundnuts. Helleiner (1966a:12) contends that:

> . . . beyond offering the peasant farmers a vent for their potential surplus production, the foreigner (colonial regime) did next to nothing to alter the technological backwardness of the economy . . . (because) the relative switch from food to export cropping was not a switch from backward to modern agriculture.

Oluwasanmi (1966:11) also maintained that:

> In Nigeria as in other African territories the course of economic development was dictated by the logic of colonial expansion in tropical Africa. Before these territories could be transformed into effective markets for European industrial goods it was necessary first to modify the subsistence structure of their economies by creating new economic relationships based on money. In Nigeria, this task was achieved in part by persuasion, in part by taxation, in part by the creation of new wants and in part by a sedulous appeal to the instincts of acquisition latent in all men.

Eicher (1967) has also observed that, from the beginning of the colonial period and until the 1930s, the colonial policy with respect to agricultural growth was based on exploiting Africa's natural resources and unskilled labor. Even when a shift was made from a natural resource base to a science-based strategy of agricultural research and development, the primary emphasis was on export crop production. According to Eicher and Baker (1982:114), the colonial governments invested few (if any) resources in food crop research because it was assumed that surplus land would automatically be brought under cultivation by subsistence farmers in line with population growth.

In light of the above, it can therefore be argued that contemporary agricultural policies in Nigeria based strictly on the commercialization model are bound to be counter-productive, especially with respect to food crop production. Here was a model that did not consider the welfare and livelihood of the populace.

At a period when food import bills are soaring in the country and the majority of the rural population are small holders who produce the bulk of the food needs of the country, it is only reasonable that research to enhance productivity in this sector has to be encouraged. Thus, the basic premise of this study is that appropriate national development mandates the concentration of efforts on the development of small farms. One means of accomplishing this task is through the design of appropriate technologies that will enhance productivity on the small-scale farms.

As will be seen from a review of the two other historical models of the evolution of Nigeria's agricultural economy, past agricultural policies in the country have failed to specifically address the needs and production problems facing the small holders in Nigeria. This is not an indictment of previous public policies pertaining to agricultural production. Rather it is an attempt to expressly state the need for focusing on the development of small farms--as opposed to a desire to phase them out in preference to large-scale commercialized agriculture.

The Industrialization Model

This model represents the initial efforts of indigenous power elites (during the first decade of the country's independence) to transform "Nigeria from an agricultural into an industrial economy typical of Europe and America" (Igbozurike, 1976:29). According to Igbozurike (1976:29), the industrialization model may be likened to a "modernization" model which is aimed at:

> . . . reflecting an ambitious but somewhat unsuccessful nationalist over-reaction to what was rightly considered a colonial design to keep Nigeria as a source of primary products for European industries and as a market for finished consumer goods.

It is also likened to the "transformation approach" which, according to Eicher and Baker (1982:49), has been aimed at bringing "rapid development," as well as providing immense employment opportunities for the growing number of school leavers. Within the context of this model, agriculture became equated with underdevelopment and traditionalism, while large-scale industries stood for development and modernization. In other words, massive industrialization was regarded as the "engine" for achieving national development. According to Igbozurike (1976), national development programs were ill-conceived and poorly executed, sometimes with little or no feasibility studies. This invariably suggests that a "top-down" approach to program design and planning, as well as implementation, was the rule rather than the exception during this period.

Centralized management was the vogue and local or grass-roots participation was anathematized. Thus, there was a blatant disregard for needs assessment studies as one basis for the determination of community felt needs/ problems for program planning or policy making. Igbozurike (1976:29) even reported that:

> In many cases, narrow political motives guided the siting of projects and industrial plants as was the case with the Nigerian Iron and Steel Industry . . . Earnings from peasant agriculture, which was virtually left to take care of itself, was ploughed into questionable industrial ventures.

Oluwasanmi (1966:208) also asserted that the "craze" for massive industrialization resulted in the:

> . . . building of industries that bear little or no relation to the existing economic advantages and growth capacities as determined by demand for industrial products and the existence of raw materials . . . Giant dam projects, iron and steel complexes, skyscrapers, and national airlines have become modern symbols of development. Investment in farm implements, pesticides, fertilizers, land resettlement, and in the extension service is often regarded, for the reason that it is agricultural, as a continuation of colonial forms of development even though the returns . . . may be higher than the returns on investment in dams, iron and steel, skyscrapers and airlines.

Even though there were few investments in agriculture during this period (notably the promotion of large-scale plantation-type agriculture and farm settlements), Igbozurike (1976:30) observed that peasant productivity was merely stimulated in order to satisfy the increased need for foreign exchange to finance government giant industrial ventures. In other words, there was an

emphasis on export crop production and, again, the limited agricultural research and development activities were concentrated in this area.

As with the commercialization model, the industrialization approach did not recognize the need to direct some attention to the production needs and problems of small holders engaged in food crop production. In order to raise the much needed foreign exchange and also transfer any rural surplus to the urban sector, the Nigerian governments continued to enforce repressive "marketing board taxes" on the cash or export crops, such as cocoa, cotton, groundnuts and oil palm. As previously mentioned, Johnson (1968) has reported that, by the early 1960, the marketing board taxes on export crops, such as oil palm and rubber, had reduced the rate of return on plantations to almost zero. Eicher and Baker (1982:57) also cited studies by Olayide, et al. (1974), which studied the effects of marketing board pricing policies on the Nigerian economy, and concluded that depressed producer prices had reduced the growth and development of the agricultural economy. The elimination of licensed agricultural produce buying agents and a centralized fixing of producer prices was, therefore, strongly recommended.

A fairly conspicuous characteristic of the evolution of the Nigerian agricultural economy (as depicted in the commercialization and industrialization models) is the nearly complete neglect of small-scale farms with regard

to food crop production. Consequently, Nigeria has witnessed, since the early 1970s, a marked decline in food production per capita and a heavy dependence on food imports. Eicher and Baker (1982:64) have reported that Nigeria imported 1.4 million tons of basic staples in 1977; this figure is projected to increase by 1985. The value of Nigeria's food imports in 1981 was recorded as $1.3 billion and Eicher and Baker (1982:64) observed that the "prognosis is bleak."

But it is the contention of this study that immediate and long-term investments in agricultural research and development are needed. Thus, R&D should be aimed specifically at the design and infusion of appropriate production technologies for fostering food production within the small holder farming system. Incentives must also be provided in this area through the initiation of specific programs that deal with all facets of small farmer's environment or reality as discussed in Chapter IV. The new paradigms of national development also call for the provision of basic human needs in terms of pipe-borne (clean) water, education--including agricultural extension--roads, transportation, shelter, food and profitable employment, etc. These basic infrastructures are especially needed in the rural areas of Nigeria so as to help stem the rural-urban exodus and assist in attracting qualified Nigerians to work in the agricultural sector. However, as will be seen from a review of the third model for characterizing the evolution of the

Nigerian agricultural economy, it appears as if the governments are making good progress in this direction.

The Agro-Industrial Model

Igbozurike (1976) has observed that the agro-industrial approach came into existence as a result of a loss of faith in the performance of the pure industrialization strategy. The large-scale industrial ventures have failed to operate at the anticipated capacities, thereby failing to provide meaningful employment opportunities to the growing number of school leavers. Even the farm settlements or large-scale plantation-type agricultural systems became "more of economic disasters than absorbers of school leavers" (Igbozurike, 1976:30). Consequently, it dawned on the Nigerian policy makers that:

> Instead of treating agriculture and industry as mutually exclusive sectors in the process of economic growth, envisaging a stage at which (small scale) agriculture will be phased out in developmental importance while giant industries dominate our economic scene, an awareness arose of the need for a harmonization of agricultural and industrial progress (Igbozurike, 1976:30).

However, instead of designing effective policies for the promotion of small-scale farming, emphasis was placed on the promotion of large-scale river basin development ventures in several parts of Nigeria. Eleven river basin development authorities were established in the country by the Federal Government of Nigeria Decree No. 25 of 1976 (River Basin Development Authorities Decree 1976) and part of their specified mandate include:

> . . . to construct and maintain dams, dykes, polders, wells, bore-holes, irrigation and drainage systems . . . to develop irrigation schemes for the production of crops and livestock and to lease the irrigated land to farmers or recognized associations in the Authority's area of authority . . . (Anambra-Imo River Basin Development Authority "News Bulletin," 1978).

But, it is strongly contended that most of the mandates of the River Basin Authorities still fall short of specific recommendations designed to directly address the production problems and needs facing the small producers. Current policies and agricultural programs appear to be too broad and unspecific, i.e., directed broadly to the two prevalent farming systems (small and large-scale farmers alike), with the result that the small farmers (lacking the economic and political clout) are often left out of the agricultural development process. What is urgently needed is a set of programs, policies and institutions that specifically address the felt needs and production problems facing small holders in Nigeria.

Evaluative studies by Olayide, et al. (1974) have found widespread inefficiencies on such existing institutions as the Nigerian marketing boards. Idachaba (1973) also found that marketing boards in Nigeria substantially dampened producer incentives and restricted output and employment generation in agriculture. It has, therefore, been strongly recommended that alternative structures, such as producer and marketing cooperatives, be promoted especially within the small holder farming system.

Furthermore, Eicher and Baker (1982:52) have maintained that available evidence amply suggests that most large-scale farming and land-settlement schemes (as may be envisaged in the agro-industrial model) have been failures throughout Africa over the past 50 years. The big challenge facing the Nigerian governments (planners and policy makers) is to be able to learn from the bad experiences of past agricultural development strategies based on the development of large-scale farming.

Research evidence also suggests that the role of governments should shift from centralized planning, financing and management of agricultural production to the provision of agronomic research and effective extension service, disease control, and a minimum of infrastructure (Eicher and Baker, 1982:52). It has equally been suggested that government policy should help the Nigerian small holders build their own houses and clear their own farmland in order to reduce the capital cost per household. Apart from giving these rural poor families a major relief, it is obvious that this strategy is in keeping with the provisions of the new paradigms of national development, as detailed in Chapter II. Recognizing that the roots of widespread poverty in Nigeria are basically to be found in the rural small-scale farming system, it is strongly advocated that research efforts be focused on the design and development of appropriate production technologies for enhancing productivity in this

sector. The strategies for the accomplishment of this task were extensively reviewed in Chapter IV.

But, nevertheless, it is also necessary to review conceptual frameworks useful for analyzing problems usually encountered during the process of developing the small farm sector. Case studies of successful small farm development programs will now be discussed. The primary emphasis will be placed on useful experiences that have been gained in the execution of such programs. It is believed that, on these bases, recommendations can be made for planning and policy making in the area of Nigerian small farm development.

Toward an Understanding of the Nigerian Small Farmer Situation

Identifying the Nigerian Small Farmer

There is no doubt that Nigeria has realized substantial increases in income and economic growth mainly through the revenues accruing from the exploitation of her oil wealth in the past decade. But, despite the undisputed increase in national income, it can be asserted that the apparent upsurge in economic growth and prosperity has barely resulted in appropriate national development. Large segments of the population, particularly the large majority of rural small-scale farmers, have neither participated in producing the additional output nor directly benefited from the rapid economic growth that has

resulted from the increases in oil revenue. General access to meaningful socio-political and economic involvements has been largely denied to this neglected majority of Nigerian citizens.

The authors of the Nigerian Third National Development Plan (1975-80) reported that about 70 percent of the country's population live in the rural areas. Of this figure, it is estimated that approximately 44 percent constitute the rural labor force, whose primary source of employment is in the agricultural sector--mostly small-scale farming. It has also been reported that the majority of Nigerian peasant farmers practice their agricultural production activities on scattered small holdings varying from less than 1.5 hectares in parts of the Eastern states to over 2.0 hectares in the Northern states. The national average of about 1.2 hectares of land is reported for a Nigerian small holder.

It, therefore, appears that planners and policy makers are fully aware of the extent and composition of peasant small holdings in Nigeria. Consequently, this study proposes the design of development programs and agricultural policies that are specifically targeted toward the solution of the production problems and felt needs of this relatively homogeneous group of the rural poor. This view is widely shared by several scholars (Adams and Coward, 1972; Norman, 1980) who contend that the design and implementation of development programs that

would enable small farm operators to become major participants in economic, political, and social systems is an urgent task facing most developing nations in the next decade.

Adams and Coward (1972:5) have also reported that a "small farmer" can be identified in any given locality in the following ways:

1. A small farmer can be recognized in terms of the absolute smallness of his/her farm, i.e., where a cultivator has access to only a modest amount of land. Based on this reasoning, it has already been established that the average small farm size in Nigeria is about 1.2 hectares;
2. A small farm may also be identified in a relative sense, i.e., where the farms in a given locality are generally smaller in comparison with other farm units in the general area; and
3. The third method of identifying a small farm tends to focus less on the size of the farm per se, and more on the level of market interaction by the small farm operator. In other words, those farms which are heavily subsistence in nature, i.e., buying and selling only a minor portion of their farm inputs and outputs, are also considered to be small farms.

In the final analysis, Adams and Coward (1972:6) believe that a farm should be considered small if:

> . . . its occupants had very limited access to political power, productive services, productive assets and/or income streams in the society.

This is the fate of the large majority of small farm operators mostly residing in the rural areas of Nigeria. It is now widely recognized that the needs of all rural poor (farm and non-farm operators alike) are very pressing. It is also true that, in most cases, the available resources for effectively dealing with the problems of poverty and mass deprivation--especially in the rural sector--are often quite limited.

But it can be strongly argued that small holders are already involved in the production process; their managerial skills and expertise have been accumulated through years of practical farming experience. Their case and problems appear to be generally more tractable than those of the other classes of rural poor. Adams and Coward (1972) have observed that stimulating output is usually a less difficult task than initiating production. That is why this study advocates the advancement of specific agricultural policies that will promote the design and development of appropriate production technologies for enhancing productivity in the small farms. One of the ways of achieving this is through the establishment of a direct link between the Colleges of Agriculture in the Nigerian universities and the Ministries of Agriculture

and Natural Resources. It is further recommended that the mandate for most faculty appointments in the College of Agriculture and related fields include a definite requirement for an active involvement in grass-roots research and extension of appropriate production technologies to the small-farm operators in the rural areas. Consequently, most university agricultural research priorities would be tailored to the needs of small producers. It might also be anticipated that research results would not merely be "tucked away" in university book shelves and faculty files--awaiting publication in foreign journals. Rather, it is to be expected that the research results will be adequately interpreted and transmitted to the small producers through the extension service system of the Ministries of Agriculture. This approach may be likened to the U.S. "Land Grant" philosophy, and the associated Cooperative Extension Service System.

Therefore, this study proposes a direct linkage between the country's agricultural research centers (including the universities and the agricultural experiment nations) and the Ministries of Agriculture. It is envisaged that through this process, action research and education, geared to the concerns needs and problems of the Nigerian masses, will evolve. It is further hoped that the available resources will be channeled to the development of Nigerian rural communities that have been neglected for a long time.

Having identified the Nigerian small farmers and

some approaches for reaching them, it is necessary to review the major conceptual frameworks for analyzing the problems encountered in the process of developing their small farms. In this way, it will be possible to describe the strategies that have been used to analyze and solve agricultural production problems relevant to small producers in Nigeria. Then, based on lessons drawn from successful analysis and solution of small farm development problems in other parts of the world, recommendations will be made for planning and policy making in Nigeria.

Conceptual Frameworks for Analyzing Nigerian Small Farm Development Problems

Among the several difficulties faced by Western development scholars in the post-independence era in Nigeria was their inability to classify the country as either a land or labor-surplus economy. This difficulty arose as a result of the great diversity of the country's ecological zones and population densities (Helleiner, 1966b). While most Northern sections of Nigeria are not as densely populated as comparative areas in the Southern parts, the "Northern Grain Economy" is characteristically based on cereals, sorghum and millets as well as on such cash crops as groundnuts and cotton. The Southern sections of the country, on the other hand, are generally very densely populated and its tropical rain forest belt is characterized as the "Southern Root Economy," which is based on such subsistence crops as yams, cassava, maize and rice in some

areas, as well as on such cash crops oil palm, cocoa and rubber. The "Middle Belt" of the country represents the transition zone between the rain forest belt of the south and the savannah of the north. Here the population densities are quite variable and obht grain and root crops are produced.

In the same vein, it can also be argued that the immense variability in the rural systems in Nigeria makes it difficult to classify the entire country as constituting either a unimodal or bimodal agricultural sector. Some areas exhibit patterns of a pure unimodal agricultural system, while other areas are conspicuously bimodal in character.

Because this phenomenon is not unique to Nigeria, there has emerged a consensus among scholars that rural systems in various developing countries, and regions within countries, lie somewhere along a continuum (Adams and Coward, 1972). At one end of the continuum, lies the bimodal agricultural sector and, at the other end of the continuum (where relatively homogeneous sizes of farms exist), is the unimodal agricultural sector. In this regard, it is widely believed that most rural areas in Nigeria are still inhabited by a large majority of small farm operators who cultivate scattered holdings ranging from 1.5 to over 2.0 hectares. This is the basis for the new emphasis on the need to initiate agricultural development policies and programs that are specifically directed toward raising the production levels in the small farms.

Previous development programs have been directed at the overall improvement of the agricultural sector with the result that the few privileged large producers have benefitted more from such programs because of their political and economic clout. In other words, the peculiar needs and problems of small producers have been largely ignored in the planning and implementation of previous agricultural development programs in Nigeria.

But, because small holders constitute a definite component of the overall socio-economic and political system within any nation-state, Gotsch (1971a) has argued that their small farm development problems should not be analyzed in isolation. Rather, the needs and production problems facing small farm operators have to be studied in the context of the prevailing socio-economic and political processes. In other words, a systems approach for relating small-farm development problems to the overall national development issues has been proposed. According to Gotsch (1971a), it then follows that the initial variables, which have to be used for describing the system, are:

1. a specification of the nature of the available production technology, with particular reference to its scale effects;
2. the distribution of land holdings by size;
3. the distribution of income and power; and
4. the distribution of institutional services.

It is contended that these variables are key for

understanding rural poverty (Adams and Coward, 1972). For instance, it has been argued that if technologies with significant scale effects are introduced into a socio-economic setting that is characterized by a highly skewed distribution of land holdings, their effects will be to further skew the distribution of income and power. This situation will, in turn, result in further inequity in the distribution of income as well as land holdings. In this sense, Gotsch (1972b:326) has argued that the adverse distributive effects of technological change in the agricultural sector must be attributed primarily to the socio-economic and institutional context in which it occurs. Herein lies the importance of treating such factors as institutions, income levels, and capital (land holdings) as critical variables in any meaningful description of the agricultural development process. It is also in connection with the effects of these factors (that is, the interaction of the aforementioned variables) that Ladejinsky (1969:15-19) has argued:

> It is not . . . the new technology which is the primary cause of the accentuated imbalances in the countryside. It is not the fault of the new technology that the credit service does not serve those for whom it was originally intended; that the extension services are not living up to expectations; that the panchayats are political rather than development bodies; that security of tenure is a luxury of the few; that rents are exorbitant; that for the greater part tenurial legislation is deliberately miscarried . . .

It is, therefore, evident that predicting the outcomes of

technological change at the small farm operator's level requires a thorough understanding of the four variables advanced by Gotsch (1971a). In other words, it is strongly argued that the basic characteristics of any new agricultural technology on the target population (viz., small holders in Nigeria) should be directly related to the nature of the existing socio-economic and institutional structures that service the agricultural sector.

Relevant Small Farm Development Policy for Nigeria

The necessity for designing agricultural policies relevant for small-farm operators in those sections of the country that exhibit a bimodal agricultural structure has already been stressed. This is one way of ensuring that the position of the small holders will be made more viable in terms of improving their accessibility to the necessary institutional services, such as credit and extension education. This proposition calls for an examination of the totality of the socio-economic, political and institutional environment in which small farmers operate as a means to determine the root causes of their development problems. It is not enough to design and develop appropriate production technologies for enhancing agricultural production per se. Increasing evidence suggests that merely doing that has resulted in further inequity in the distribution of incomes. According to Gotsch (1972b:327) the key policy questions

should be:

1. Why should planners and policy makers dwell on the outcome of events (symptoms such as the non-utilization or unprofitable use of a new production technology by small holders) rather than on the root causes of such problems?
2. If there are undesirable distributive effects associated with the introduction of a new production technology, what explains the failure of planners and policy makers to develop institutional and political instruments for mitigating, if not eliminating, such negative effects on the small holders?
3. Why should agricultural policies with adverse distributive effects be continued long after their cumulative impact on the small holders are well understood by policy makers?

According to Gotsch (1972b:327), to stop short of asking these pertinent questions as well as the refusal to seek appropriate answers to such questions, has:

> . . . tended to produce policy advice to developing countries that is at best politically naive and, at worst, the basis for developing strategies that may be socially disastrous in the long run.

It is, therefore, evident that the characteristics of the socio-economic and institutional structures within which growth (or the technological improvement of

the small holders) is to take place are critical in determining the ultimate effect on the welfare of this class of rural poor. This is the basis for the inclusion of such factors as relevant variables in a meaningful analysis of the agricultural development process as it affects the small farmers.

Even though a large percentage of the rural areas in Nigeria approximates a unimodal agricultural system, there is still a need for an on-going investigation of the ways in which any new agricultural innovation and the existing institutions that service the agricultural sector interact through time. This is one way of determining the short-term and long-run (cumulative) effects of that technology on the welfare of small producers. On the basis of such determination, corrective measures through policy changes can be made where existing ones militate against the profitable use of the new technology by small farmers.

Adams and Coward (1972) have also suggested the importance of understanding Gotsch's framework as the basis for developing appropriate agricultural policies that benefit small producers. Considerable insights and important lessons can be learned from reviewing various "intervention strategies" that have been used for reaching the small farmers. Relevant case studies based on the application of the identified intervention techniques will now be discussed in order to specify their

shortcomings and, hence, draw useful lessons for planning and policy making in Nigeria.

Typology of Approaches for Solving Small Farm Development Problems

Available evidence suggests that there is now a general recognition that small-farm operators face a complex set of problems within any specified location where they operate. Based on this realization, Adams and Coward (1972) have observed that, only in a few exceptional cases, have these innumerable production problems confronting small producers been resolved through a single development technique. In other words, it is argued that most simple problems facing small farmers have already been solved. Therefore, small producers cannot be substantially assisted by a simple development strategy that is less complex than the multitude of problems and needs confronting them. Simplistic solutions may resolve a problem in one area, but create or amplify problems in other areas. For instance, there is a customary simplistic equation of mechanical technology with labor-saving (or capital-using) change and bio-chemical technology with capital-saving (or labor-using) change. But Gotsch (1972b:328) contended that this is often a matter of expositional simplicity rather than a description of the real world because:

> For example, herbicides and weedicides are among the most labor-saving innovations that have been introduced into agriculture, while the tube well

> and other mechanical devices for providing supplementary water are intensely labor using. Even tractors, which in temperate climates are almost invariably labor-saving, can become labor-using where the environment of the tropics makes double and triple cropping possible.

While a case for the appropriateness of any technology has not been made here, Gotsch (1972b) has only stressed the need for a detailed analysis of the production process--the farming system--at the level of the producer unit. This is one way of ensuring that the analysis of an innovation's effects on an identified target population is put on, at least, sound technical grounds. Socio-economic, political and institutional considerations, as they influence the societal benefits accruing from the use of the innovation, are yet another matter that must also be carefully studied. It has also been suggested that, as a result of the multitude of problems facing small producers, a coordinated, multi-activity approach is generally required to deal effectively with the small-farm development problems (Adams and Coward, 1972).

However, Adams and Coward (1972) have cited studies by Mosher (1971) who clearly identified three major approaches that have been used to address small farm development problems. These are:

1. the Integrated Approach;
2. the Non-integrated or Partial Approach; and
3. the Filter-down Approach.

The Integrated Approach

This strategy refers to the simultaneous provision of a number of related services to small-farm operators residing in a specified geographic area. According to Adams and Coward (1972), the basic philosophy for the promotion of an integrated approach is the increasing recognition that small holders face a complex set of problems that must be addressed before productivity levels can be substantially increased. It is, therefore, reasoned that to deal effectively with the complicated set of problems facing small producers, then an almost equally complex set of policy instruments must be simultaneously initiated by planners and policy makers. It has also been suggested that the integrated approach is based on the assumption that a critical minimum effort is quite necessary for exerting a noticeable impact on an identified target population within a relatively short time (Eicher and Baker, 1982). This is probably the reason for the apparent concentration of projects based on this approach in a limited geographic area. Most developing countries have often experienced difficulties in planning and coordination, as well as in replication, of integrated developmental programs.

According to Hunter (1978), an integrated approach refers to a method of action, and not to a subject of action. The implication of this distinction has been reflected in the immense difficulty experienced by planners and policy makers who opt to treat "Integrated Rural

Development," for instance, as a subject for which a ministry is appropriate. Even the creation or establishment of a separate ministry--as distinguished from the Ministry of Agriculture, for example--is often not adequate. Rather, Hunter (1978:98) has strongly suggested the need for a close coordination of policy and action at all levels. Integration can only be achieved first, and foremost, at the top (cabinet and secretariat levels). It must then be reflected through effective coordination at each lower level (state, province, district and sub-district).

However, a common characteristic of the integrated approach to small farm development has been the introduction of a package of techniques or innovations in a specific geographic location. Common examples or case studies of projects, whose execution have been based on an integrated strategy, include the Comilla Project in Bangladesh (as reported by Stevens, 1971) and the Puebla Project in Mexico (as reported by Myren, 1971; Biggs, 1974). A brief review of the projects will provide useful insights and lessons for planning and policy making in Nigeria.

The Comilla Project. This project, begun in 1959, was principally aimed at stimulating organizational activities and creating a cadre of developers (from amongst the target population) who could help supply more profitable factors of production to other farmers (Adams and Coward, 1972). Stevens (1971) also observed that heavy emphasis

was placed on the development of local organizations that would tie farmers into wider service organizations. In other words, major attention was directed toward the building of service organizations from the "ground up"--a grass-roots development strategy. In order to help create the new service institutions, the "bottom-up" strategy necessitated the development of local leadership and initiative. Adams and Coward (1972:10) remarked that:

> In essence, the Comilla Project concentrated on the creation of new organizations and institutional relationships intended to increase the availability of institutional services (e.g., the public works project to improve the available infrastructure and the "model farmer" to improve the dissemination of information).

In keeping with the multi-activity nature of the integrated approach, the Comilla Project stressed the following six major activities:

> agricultural cooperative development, training centers, irrigation improvement, women and family planning training, rural education programs, and public works activities (Adams and Coward, 1972:10).

It was also reported that major efforts were aimed at testing and adapting available technologies to the existing socio-cultural and economic environment. In other words, it can be inferred that there was a recognition of the need to ensure that the available technologies were made appropriate for the target population. According to Adams and Coward (1972), the activities emphasized in the Comilla program included tractor plowing, use of low-lift pumps

and tube wells, testing of seed varieties and cultural practices. In conclusion, Adams and Coward (1972:110) cited studies by Stevens (1971) to confirm that:

> Overall . . . the Comilla approach had been quite successful in integrating local training and development activities with higher levels of administration, and . . . (remarkably) a cadre of development-oriented people had been trained by the program. In addition . . . (a) problem solving approach had been infused into the system.

However, one of the major criticisms levelled against the Comilla Project is that relatively little emphasis was placed on the design and generation of new profitable technologies. It can also be inferred that the project staff did not seem to emphasize the role of indigenous knowledge systems and their invaluable inputs into research and understanding of the existing farming systems. Therefore, the project can be criticized for its apparent lack of interest in farming systems research.

But the above limitation, notwithstanding, Adams and Coward (1972:11) have observed that discussions surrounding the Comilla case often raise a critical question for planning and policy making, viz.:

> Why has Comilla been highly successful in evolving an institutional infrastructure which serviced small farmers when many SFD (Small Farm Development) programs flounder on this step?

Part of the answer can be provided by the fact that the Comilla Project was located in a region where almost all farms were small in an absolute sense--the land holdings averaged only 1.46 acres each (Adams

and Coward, 1972). As a result, the services of public institutions in this region were not monopolized by a large landowner class. Thus, based on Gotsch's contextual perspective (unimodal versus bimodal agricultural sectors), Adams and Coward (1972) observed that it is often easier to develop institutions to service small farmers in a relatively homogeneous small-farmer environment than in a bimodal society. It is, therefore, evident that irrespective of the contextual setting, if policies and development programs are not tailored to the needs of small holders located in a socio-economic environment, the viability of the target population cannot be enhanced. In other words, in order to ensure that the benefits of technological improvements accrue to all groups/classes within any nation-state, institutions need to be created or re-structured to address the needs of that society's less privileged members. For example, as observed by Adams and Coward (1972:11), another major contributing factor to the success of the Comilla project in building an effective institutional infrastructure that serviced small farmers has been:

> The patience shown by the Comilla staff in identifying local leadership which created service institutions from the bottom up . . . (and) the viable set of economic functions which the cooperatives were asked to perform. Provision of credit and mobilization of savings were two important activities of the cooperatives. Less emphasis was placed on marketing activities in which the cooperative may not have had as much comparative advantage as in handling financial assets.

However, with regard to the Nigerian situation, several scholars (Idachaba, 1973; Olayide, et al. 1974; Abalu and D'Silva, 1980) have linked Nigeria's present food crisis and agricultural development problems to repressive marketing board policies. These policies substantially dampened producer incentives and restricted output and employment generation in agriculture. Eicher and Baker (1982:54) cited studies by Olayide, et al. (1974) who recommended the initiation of alternative structures, such as producer and marketing cooperatives, to take over the roles of the grossly inefficient Nigerian marketing boards.

Because it has already been established that small holders produce the bulk of the food needs of Nigeria, the above recommendation appears to be in agreement with the insights gained from the review of the Comilla Project. In other words, there is need to promote the development of local (small-farmer based) institutions that focus on the provision of adequate incentives (such as appropriate production technologies, credit and marketing services) to small farmers. However, detailed analysis of the existing socio-economic and political conditions in which small farmers operate is necessary to determine the areas in which small farmer-based institutions possess comparative advantage over existing institutions.

The Puebla Project. This project was launched in 1967 in the State of Puebla, Mexico by the International Maize and Wheat Improvement Center (CIMMYT). Like the Comilla Project, the Puebla project area is located in a relatively homogeneous small farmer area. But Adams and Coward (1972) have also observed that this project area fits into a national system that is predominantly bimodal in its distribution of services, income/power, and land ownership. Consequently, past development programs and public investments in the agricultural sector have mostly benefitted the large farm operators. Biggs (1974) also noted that previous agricultural development policies and programs merely focused on the stimulation of higher levels of production and output in the entire sector. It was assumed that accelerated agricultural growth, and the resulting increase in aggregate production, would benefit the entire population. As a result, there were no special attempts to initiate programs and policies specifically oriented toward the improvement of the welfare of the poor small-scale farmers.

However, the Puebla project was initiated with the expressed objectives of providing new production technologies well suited to the needs of maize farmers and an appropriate extension strategy for conveying the new technologies to small producers in that area (Biggs, 1974). In other words, the project objectives specifically stressed the provision of a package of integrated

production services to small holders. According to Adams and Coward (1972), the initial focus of the program was on increasing corn yields and training technicians to work in small farm development activities. Unlike the Comilla Project, heavy emphasis was placed on the identification of production problems--in soil, seed, disease, and cultivation practices. Thus, there was a major effort to promote in-depth research aimed at the provision of appropriate solutions to the identified production problems. This research generated new and improved technologies for the target population.

Several scholars (Myren, 1971; Biggs, 1974) have observed that the corn production problems faced by small farmers in the Puebla Project area were highly complicated. It was reported that farmers carried on their production activities in a high risk environment--involving problems of hail, frost, drought, pests and soil. For example, the heterogeneity of soils types within a relatively small area necessitated the recommendation of several dozen fertilizer formulations (Adams and Coward, 1972). Rainfall distribution was also reported to be highly variable within the region and the available improved corn varieties did not prove to be much better than the indigenous or native varieties. Therefore, there was the necessity to invest in farm-level research in order to develop new varieties and better cultivation practices.

The investment in research appeared to yield

immense benefits in the Puebla Project area. According to Adams and Coward (1972:4):

> Corn yields in the area have increased by 50 percent . . . Farm sales and net farm income have also increased. Most of the improvement . . . is due to better use of fertilizer, use of optimum plant densities, and weed control and pest control . . . The project has also been highly succesful in integrating research, extension, and developmental training activities.

However, several criticisms have been leveled against the International Maize and Wheat Improvement Center (CIMMYT) staff that initiated the Puebla Project. Adams and Coward (1972) lamented the inability of the project staff to integrate their activities into the fabric of regular governmental services. For instance, it was reported that the research and extension functions executed under the Puebla programs still lie largely outside regular governmental channels. In addition, it was observed that credit institutions and banks must still "be prodded to lend to small farmers" (Adams and Coward, 1972:14). Even more importantly, the formation of local (small farmer-based) organizations, which could have been charged with the responsibility of articulating local farmers' opinions, needs and concerns, was not promoted. In addition, even where they existed, the organizations were not tied to higher levels of the service system or institutional structure.

Nevertheless, several important insights can be gained from the execution of Puebla Project:

1. The necessity for the integration of agricultural research and extension education programs has been amply demonstrated as a sure means of enhancing agricultural production even on small-scale, peasant farms.

As clearly observed by Biggs (1974:152) in the Puebla situation:

> Rather than conducting agronomic experiments in the isolation of an experiment station, the farmers' plots were used in performing the research for developing new production recommendations. In this way, experimental results were obtained under precisely the same environmental conditions confronting the cultivator, thus, shortening the feedback loop to the researcher.

This strategy also appears to be thrust of the Farming Systems Research (FSR) approach that has already been recommended as a means of reaching, as well as addressing, the needs and production problems of small holders in Nigeria. It is also in agreement with an earlier recommendation of this study, viz., the necessity for establishing direct linkage between, and/or coordination of, the activities associated with the Nigerian Colleges of Agriculture/Agricultural Research Stations and the Ministries of Agriculture.

2. The Puebla Project also demonstrated the need for, and the effectiveness of , using an interdisciplinary team to accomplish the complex functions of research, extension, evaluation and coordination of activities with both public and private institutions (Biggs, 1974:152). It is pertinent to state that the Farming Systems Research (FSR) is in favor of this strategy for dealing with the complex needs and production problems facing small holders.

3. The importance of providing a lasting institutional capability necessitates the need for establishing local (small holder-based) organizations. These organizations can also become an effective bargaining "voice" for small holders--a condition

necessary for their viability especially in a bimodal agricultural sector.

The Non-integrated or Partial Approach

Unlike the Integrated Approach, this approach tends to promote a small number of services or activities that are considered crucial for overcoming small farm development problems. It is an approach that has gained popularity in those nation-states where budgetary constraints, or an inadequate recognition of the relevance of promoting increased production on small farms, have forced planners to initiate few programs aimed directly at enhancing productivity on the small farms.

Adams and Coward (1972) have reported that the basic philosophy for the promotion of partial or non-integrated approach is the assertion that only a few critical factors militate against small farmer development. As already indicated, they also observed that, in some situations, developing nations may resort to a partial approach because of limited financial or administrative resources. It is also argued that a partial approach may be justified as a preliminary stage for more comprehensive small farm development activities (Adams and Coward, 1972). Common examples of a partial approach include the initiation of credit programs and cooperative development efforts. The promotion of community development activities in some countries (such as Community Actions Program in Colombia, as reported by Edel [1971], and the Ujamaa/villagization

program in Tanzania, as reported by [Seidman, 1971]) has also been cited as an example of a partial or non-integrated approach.

Although this study favors the promotion of an integrated approach to the solution of the complex small farm development problems in Nigeria, it is, nevertheless, pertinent to review a specific project whose implementation is based on a partial approach. In this way, the major strengths and weaknesses of the approach will be highlighted. The supervised agricultural credit program in Southern Brazil, as reported by Erven and Rask (1971), has been described as an example of a partial approach. This approach will now be reviewed.

The Ibiruba Pilot Project in Southern Brazil. This pilot agricultural development program had as its primary objective the provision of more easily available credit to small farmers in the project area. In describing the project location, Erven and Rask (1971) observed that structurally, this area is moderately bimodal--with large land holdings predominating amidst a large number of small to medium-sized units. Consequently, it was observed that small holders were not the primary beneficiaries of significant portions of the institutional agricultural credits that were previously made available. Therefore, the project initiators not only stressed the need, but also encouraged banks to lend to small farmers. They also encouraged the small holders to borrow. The programs designed for

these small producers included some technical assistance (such as soil testing) with the use of credit (Adams and Coward, 1972).

With the provision of specific funds by the Central Bank to the private banks for this purpose, several of the banks in the project area were, therefore, constrained to make additional loans to small farmers. According to Adams and Coward (1972:18):

> Within a year (from late 1966) these banks made over 1,500 loans to small farmers, more than a five-fold increase over their previous level of lending to this group.

The small farmers' willingness to borrow and their excellent repayment record were described as good indicators of the partial success of this program--and invariably of the non-integrated approach. However, despite the spectacular increase in the effective demand for credit and the continued availability of funds, Adams and Coward (1972:18) observed that the supporting agencies (especially the extension service and the banks) were soon noticed to be quite unenthusiastic about continuing the program past the initial year.

In an evaluative report, Adams and Coward (1972:18) observed that the major factors that contributed to the termination of the program included:

1. With the low administered interest rates on agricultural credit in Brazil, private banks did not have sufficient financial incentive to prompt them to lend to agriculture; and
2. the production problems faced by the small farmer were more complex than originally thought.

In addition, Adams and Coward (1972) observed that even though some farmers profitably utilized the additional credit, the overall impact of the program in terms of raising productivity levels on small farms as a result of the use of additional credit was not substantial. Adams and Coward (1972:18) contended that:

> Appropriate technology was not available, the extension knowledge base was too thin, and participating agencies did not see enough production increase to develop support for further efforts.

The policy implications of the above observations appear to be quite obvious. It calls for the need to further stress the importance of realizing the enormity and complicated nature of the needs, problems and concerns facing small holders in any production environment. Partial approaches are hardly ever adequate to meet these needs or provide adequate solutions to their production problems and concerns. Rather, there is need to examine the totality of the small farmers' environment to determine the precise nature and magnitude of factors (socio-cultural, economic, political and institutional) that militate against their adoption and utilization of improved technologies for fostering production. Until appropriate solutions to their production problems and needs are found, productivity levels on their small farms can hardly be enhanced. Herein lies the relevance of the already proposed Farming Systems Research (FSR) approach and the "Requirements-Limitations Gap" strategy for studying

the small farmers' reality and, subsequently, developing appropriate technologies for their small farms.

As indicated elsewhere in this study, there is also a need first, to integrate the activities of the Nigerian agricultural research stations with those of the extension components and, then, to design specific service institutions whose programs and duties are tailored to suit the needs of small producers. Even more importantly, is the need to promote the formation of local, grass-roots (small farmer-based) organizations that relate the needs of small holders to the national institutional service systems.

In sum, it is pertinent to state that the integrated and the non-integrated (or partial) approaches are two types of small farm development techniques that provide direct programs for solving identified small farmers' problems. In this way, they differ from the third approach--the "filter down" method.

The Filter-down Approach

This approach is by far the least beneficial to the large poor majority in the developing countries, including Nigeria. But, ironically, it has been the basis for most development programs and policies. It is a development approach that is aimed at the overall stimulation of the national economy through the introduction of various sophisticated and large-scale technologies. The basic philosophy of this approach is that, since the

indigenous power elites in the developing countries were eager to establish their credibility and bring "rapid development" to the populace, programs and policies that would stimulate the overall growth of the national economy were all that mattered. Thus, it was assumed that projects, such as the construction of large-scale irrigation schemes/dams, apart from being highly visible, would result in increase in aggregate production. This, in turn, would benefit the entire population. Adams and Coward (1972:8) have observed that other national agricultural development programs initiated in an attempt to stimulate output include:

> Price support programs, marketing boards, extension efforts, overall credit increases, foreign exchange and trade policies, input pricing policies, research which generates new technology, etc., . . .

But available evidence clearly indicates that programs and policies based on the filter-down approach have been largely "disappointing for the rural poor, especially in bimodal societies" (Adams and Coward, 1972:9). Biggs (1974:151) also observed that the filter-down approach mostly benefits the small minority large-scale, commercial producers whose privileged social position is such that they:

> . . . have (easy) access to information and are already active participants in the exchange economy.

Very seldom have programs or policies based on the filter-down approach helped in any significant way to ameliorate the precarious socio-economic and political positions of

small holders vis-a-vis large commercialized producers. Nor has programs based on this approach adequately addressed equity issues or the prevailing unemployment problems, especially in the rural areas.

Therefore, in the light of the new paradigms of national development, it becomes obvious that the filter-down strategy is no longer tenable. A call is now being made for citizen participation in the design, planning, and implementation of development programs. The populace must now be encouraged to actively participate in change programs that are aimed at improving their lives. There is also a call for the provision of new forms of social power (through the formation of local grass roots organizations) that will create and promote a new, non-income based demand for available institutional services. This is one way of ensuring that such services are no longer monopolized by the few, privileged and already established, large commercialized producers. However, the exact form of such an organization, i.e., whether it is to be a farmers' cooperative, producer units, or credit and saving unions, depends on the unique features and attributes of the target population. Adams and Coward (1972: 23) also reported that additional research is needed on such related issues as:

> . . . identifying how and why successful small farmer organizations emerge. What are the conditions which create a demand for a new form of social organization? What procedures need to be followed to induce such an organization when the demand is present?

Until technological packages are tailored to the specific needs of small holders, and associated institutional services are made easily available to them, productivity enhancement on their small farms may not be readily accomplished.

Additional Future Research Issues

There is a general consensus that many of the key issues related to the process of designing, developing and diffusing appropriate production technologies for raising productivity levels on small farms are now being identified. According to Adams and Coward (1972:19):

> A few success stories are emerging where local farmer organizations have been strengthened, where incomes of small farmers have been increased, and where small farmers are being linked to regional and national service institutions.

But experience and insights gained from the review of small farm development programs around the world amply suggest that small farmers generally face a complex set of problems that have been frequently ignored by planners and policy makers. Therefore, as observed by Adams and Coward (1972), more work is still needed on the refinement of the analytic frameworks for studying small farm development problems and for designing and developing appropriate agricultural innovations. There is need to identify additional essential variables, adjust the critical variables already identified, and further specify the relationships among the variables (Adams and Coward, 1972).

There is no doubt that previous agricultural policies and programs in Nigeria have largely ignored the relevance of promoting increased production from small farms. However, several scholars (Schultz, 1963; Whyte, 1981) have observed that small farmers are generally doing their best in terms of production, given the existing precarious environmental conditions under which they operate. In other words, it is strongly argued that:

> . . . there is only a modest amount of productivity slack in small farms which can be taken up by additional credit, education, application of existing technology and coordination (Adams and Coward, 1972:21).

The implication of this observation is quite obvious. It calls for more research efforts in order to generate new and improved (appropriate) production technologies that will raise productivity levels on small farms. The specific nature of the new production technologies needed by Nigerian small farmers must be determined through grassroots farm-level research. In other words, more detailed information is needed on the precise technological constraints which Nigerian small farmers face. As suggested by Adams and Coward (1972:23), answers to the following related questions must be found through research:

1. What are the differential effects of a new agricultural technology or innovation between small and large farmers? If it is adversely affecting the small holders, what type(s) of institutional reforms are necessary

for amelioration, if not elimination, of such effects?;

2. Can small farmers profitably use additional agricultural credit without using new production technology?; and
3. What types or forms of innovative social organizations will allow Nigerian small farmers to collectively utilize indivisible production technologies which are, or will be, available?

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study can be accurately described as a theoretical treatise. It has essentially involved a comprehensive review, analysis, and synthesis of perspectives from scholars who have carried out studies in areas of: Third World development approaches, appropriate technology, agricultural development strategies, and the development, adaptation and/or transfer of new agricultural production technologies or innovations. Nigeria has been used in this study as a national case in point. Its choice is based on the fact that it can be described as a typical developing country in Sub-Saharan Africa. In other words, Nigeria has provided a non-abstract basis for the application of the ideas and recommendations emanating from this study.

Chapter VI will include a synthesis of the major topics/themes that have been addressed in this study. A review of the key points discussed in previous chapters will be presented in a descriptive summary. The summary of each chapter will be immediately followed by recommendations. Finally, several concluding observations will be made.

Chapter 11 - Toward a New Paradigm for National Development in the Developing Countries: Implications for Agricultural Development

Summary

1. The early model of national development was basically a Western "growth-oriented" development strategy which emphasized massive industrialization and an excessive dependence on large-scale, capital and energy-intensive technologies.
2. The new paradigm of national development is now "people-oriented"--emphasizing the provision of adequate minimum standards of basic human needs for the populace.
3. Instead of centralized management and a "top-down" approach to problem identification, planning and implementation of development programs, a grass-roots or "bottom-up" approach, involving active citizen participation, is now advocated.
4. Economic growth, per se, as measured by GNP and per capita income, has given way to viewing development in terms of the provision of profitable employment, food, water, shelter and other basic needs. Cultural identity and self-reliance in development are also viewed as benchmarks in the national development process.

Recommendations

1. Abundant research evidence supports the need to concentrate on the design and diffusion of small-scale, capital and energy-saving technologies for enhancing productivity, especially on small farms. Small farms not only apply more labor per hectare (i.e., employment generation), but also achieve higher yields per hectare (i.e., increased food production). Therefore, this recommendation is clearly in concert with the new conception of development.
2. Achievement of a reliable food surplus has been described as a fundamental prerequisite for development, and since research evidence indicates that the bulk of staple food production takes place on small farms, it is mandatory that their development become a top priority for planners and policy makers in the '80s.
3. Instead of imposing projects and development programs from "above" (via centralized management and decision-making), it is now strongly advocated that the design, planning and execution of development programs be based on a needs assessment strategy and active public involvement.

Chapter III - The Meaning, Nature and Scope of Appropriate Technology: Implications for the Development of Small-Scale, Peasant Agriculture

Summary

1. Technology generally refers to the native capability of all humans and/or human groups to utilize their intellectual skills, wisdom, and experience for the solution of their practical problems through several methods or techniques. Therefore, technology may be described as a product design, a production process or technique, or even a managerial system for the organization and accomplishment of a production plan.
2. A new technology or innovation can be labelled "appropriate" only through a specific reference to the criteria or objectives (often stated in empirical terms) to be achieved by the identified target population/client system that intends to utilize it.
3. An appropriate technology has to be compatible with the goals, products, processes, cultural values and mores, as well as other relevant environmental realities, of the specified community in which it is to be utilized. In other words, a "goodness of fit" or harmony must be established with the unique socio-

cultural, economic, political/institutional and environmental conditions of the identified geographic boundaries in which it is to be utilized.

4. The agricultural growth and development recorded in Kenya in recent years, strongly attests to the desirability of promoting small-scale agriculture through the design of appropriate technologies as well as the elimination of critical barriers that hinder the adoption and profitable use of such technologies by small holders.

Recommendations

1. Recognizing that poverty is still a predominantly rural phenomenon and, since most rural dwellers are small-scale farmers, it is recommended that raising output and productivity levels in the small farms (through the infusion of appropriate production technologies) is one of the best ways of meeting the basic needs of the rural poor.
2. It is also recommended that it is not enough to design new production technologies for small farm operators, if the relevant socio-cultural, economic, and institutional constraints that hinder their successful adoption

and profitable utilization of such technologies, are not eliminated.

Chapter IV - The Nature and Structure of Nigerian Agriculture: Implications for the Design and Diffusion of Appropriate Technologies for Enhancing Productivity

Summary

1. The agricultural production systems that characterize the Nigerian situation basically consist of:
   a. agricultural enterprise carried out by small holders; and
   b. agriculture conducted on large-scale commercial farms.
2. Evaluative studies clearly indicate that the transformation approach (characterized by the promotion of a wide variety of large-scale, capital and energy-intensive farming and processing technologies) has proven to be a failure in boosting domestic food production in Nigeria.
3. The improvement approach (characterized by the provision of appropriate technologies to small farmers at affordable rates) has proven to be a more effective means of achieving increased food production and appropriate development.
4. Swanberg's "requirement-limitations gap" model

and farming systems research (FSR) approach are among two of the major strategies for the design, development and dissemination of appropriate production technologies for enhancing productivity on small farms.

5. Agricultural researchers and planners/policy-makers must work as a team in ensuring that the resource requirements necessary for the successful adoption of improved production technologies by small holders are in harmony with the limiting socio-cultural, economic, and institutional factors that prevail within the specified production environment. A typology of approaches and the analytic framework for the accomplishment of this objective have been detailed.

Recommendations

1. It is recommended that governments should de-emphasize the promotion of large-scale, capital and energy-intensive food production complexes and, instead, concentrate on the development of small holder improvement programs for the 1980s'. In other words, the various governments in Nigeria (States as well as Federal) must formulate specific policies and initiate effective structures that encourage the

development of small-scale agriculture.

2. The improvement strategy calls for the infusion of appropriate production technologies that may range from improved seed varieties and better breeds of livestock, to the provision of subsidized fertilizer, pesticides, irrigation facilities, and the availability of cheap credit as well as farmer training programs or an active extension education system.
3. Wherever possible, agricultural researchers (most specifically, breeders) should strive to provide genetic solutions to the on-farm production problems confronting small farmers, in view of the several advantages already discussed.
4. It is strongly recommended that an active linkage be established between agricultural researchers in the universities/agricultural experiment stations and the extension education personnel of the ministries of agriculture and natural resources.

Chapter V - Toward an Understanding of the Process and Models of Agricultural Growth and Development in the Third World: Important Lessons and Policy Implications for Nigeria.

Summary

1. Previous models and strategies for agricultural growth and development were mainly

aimed at stimulating the primary production of cash or export crops (such as, oil palm, cocoa and groundnuts) for the "mother country." For instance, the Commercialization model was basically concerned with the development of a consumer market and the generation of agricultural raw materials for the industrialization of the West.

2. Very limited (if any) resources were invested in food crop R & D as the small-scale, peasant agriculture was virtually left to take care of itself.
3. Since small holders constitute a definite component of the overall socio-economic and political system within any nation-state, it is only reasonable that small-farm development problems not be analyzed in isolation. Rather, a systems approach for relating small farm development problems to the overall national development process is imperative.
4. The necessity for a thorough examination of the totality of the socio-economic, political/institutional and environmental conditions in which small farmers operate in order to identify the root causes of their developmental problems is now urged.
5. Three major approaches that have been used

to address small farm development problems are:

1. Integrated Approach
2. Non-integrated or Partial Approach
3. Filter-down Approach.

Recommendations

1. Since several evaluative studies have found widespread inefficiencies on existing institutions, such as the Nigerian produce marketing boards, it is recommended that alternative structures (such as producer and marketing cooperatives) be promoted, especially within the small holder farming system.
2. Since the felt needs and production problems facing small farm operators have been ignored by previous agricultural development programs and policies, it is now recommended that a new set of programs, policies and institutions be specifically designed to address these issues.
3. It is also recommended that grass-roots, small farmer-based organizations be initiated. These organizations should be: a) responsible for the articulation of local farmers' opinions and concerns and; b) tied to higher levels of institutional service/delivery systems. The organizations should serve as a bargaining "voice" for small holders.

4. Apart from the need to establish an active link between agricultural research and extension education, it is also recommended that the mandate for faculty appointment within the Colleges of Agriculture and related fields include a requirement for grass-roots research and extension of appropriate production technologies to small holders in the rural areas.

Conclusions

Although a variety of issues/topics have been covered in this study, it is necessary to appreciate their linkages and interrelationships. For instance, one cannot effectively deal with the issue of national development in the Third World without relating it to the process of agricultural development in those regions--in view of the fact that these societies are fundamentally agrarian in nature. Although its share of the GDP has continued to decline in relatively recent times, agriculture is still regarded as the "back bone" of most Third World economies. Furthermore, it is almost impossible to discuss the process of agricultural development in the Third World without making specific allusions to the roles and relevance of technological improvements for enhancing production in this sector. Technology has been accurately described as the "engine" for development. Lastly, since the bulk of

the staple food needs of the populace are produced by small holders, it was only logical that their production problems and concerns be critically analyzed in this study.

Nevertheless, it is pertinent to reiterate that Sub-Saharan African countries face a variety of national development problems (of which raising the domestic food supplies is only one) that are equally deserving of attention. There is an urgent need to initiate policies and design effective programs aimed at improving health services, housing, water supplies, and roads. But since studies have shown that as much as 70 percent of the population in Sub-Saharan Africa earns its income from agriculture, it is only logical to assert that the recorded decline in productivity and aggregate production in this sector spells major economic disaster for many of the poorest in this region. Consequently, the gap between the rich and the poor has widened. Thus, recognizing the need to stem this dangerous trend, this study has focused on issues related to raising productivity levels on small-scale peasant farms.

In sum, it can be categorically stated that if the Third World governments are genuinely serious about achieving a reliable food surplus in the 80s', then it is imperative that the recommendations listed above be given serious consideration.

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