1974

Planning for more labor intensive and more productive agriculture in Colombia

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Planning for more labor intensive and more productive agriculture in Colombia

by

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A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major: Economics

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

For the Major Department

Signature was redacted for privacy.

For the Graduate College

Iowa State University
Ames, Iowa

1974

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FOREWORD

This dissertation originated from the work done by the author in 1971 as a member of a research team in the Policy Advisory Bureau of the Food and Agriculture Organization, Rome, Italy. Subsequently, research was funded by an AID-211/d grant to Iowa State University. All views, interpretations, recommendations, and conclusions expressed in this dissertation are those of the author and not necessarily those of FAO, Iowa State University or the Agency for International Development.

I. INTRODUCTION AND STATEMENTS OF OBJECTIVES

The introductory chapter has a dual purpose: a) to provide some perspective and, therefore, to describe, in broad outlines, approaches to and experience in development planning, including problem areas; b) to state, in the above context, the objective, nature and scope of the dissertation.

A. Economic Development and Employment

Economic development is a complex process which cuts across many areas of human endeavor. Its basic aim can be broadly defined as the improvement of individual living conditions and the attainment of certain minimum per capita levels of consumption of basic necessities in an environment of human dignity. For this to be possible at least two conditions must be satisfied: a) increased availability of goods and services, and b) greater equality in consumption, education, health and opportunities. To attain the former, there must be sufficient growth of output, to attain the latter, there is a definite need for improved incomes of the poor so that a more equal distribution of output can be effected. Put it in this way, it is clear that economic development is not just production. It is the upward movement of the entire social structure encompassing levels of living, attitudes and institutions. For economic development to take place production as well as distribution activities of an economy must function satisfactorily.

Economic development provides a continuous challenge. As incomes rise and the basic material necessities are satisfied, others, higher in the hierarchy of human needs, become dominant requiring structural

diversification and technological innovations. Technological advance, while increasing productivity, has the tendency to decrease the labor content of output and to affect the distributional function. In a free enterprise or a mixed economy, with private ownership and means of production, this is likely to produce conditions under which concentration of wealth and economic power will thrive. This tendency toward concentration is intensified by the scarcity of entrepreneurs with both organizing ability and financial resources.

Concentration of wealth and economic power give rise to monopolistic production and enterprises. These develop strong and effective political influence and split the economy by dualism: the existence side by side of a technically and institutionally advanced and well organized modern high-income subsector and a backward low-income traditional subsector. The dualistic structure of income distribution becomes associated with social structure and political power. After a time it becomes very difficult or impossible to change the nature of the economy towards one of greater distributional equality: any attempt to bring about such changes is bound to run up against economically and politically powerful groups whose interests are in the maintenance of the status quo. The close and powerful links which develop between private vested interests and the government are a strong and serious obstacle to economic development in its wider, social sense of meaning and constitute one of the most difficult areas in development planning.

Recognition that economic development involves more than production, and that increased production by itself will not improve the redistribution of incomes has led to new planning approaches in which an improvement in the distributive function is sought by the generation of productive and rewarding employment. Impetus for action has been provided by the alarming increase in unemployment and underemployment and the widening extent of poverty, despite relatively good or satisfactory output performance, including the growth of manufacturing. The importance of employment in the development process is quite obvious. Both the output and distribution aspects of development are most directly connected with employment. Employment channels the input of labor into the production process and generates output. Employment also provides the channel through which an individual derives benefits from his participation in the functioning of the economy. For a large number of individuals without capital, employment provides the only means to claim a share in national output and derive an income. Employment thus establishes the basic circular flow of resources and constitutes potential to expand this flow into a dynamic and self-sustained process. The success of development planning therefore hinges on the institution of a number of egalitarian reforms, which stimulate employment and weaken the rigid structure of dualism. Such reforms have been implemented and aided growth in the richer economically developed countries. They are all the more necessary in the poor developing countries where people are undernourished, in poor health, whose housing is substandard and sanitation even worse. Employment generation in these countries is in fact, a sine qua non for economic and social progress.

This realization is reflected in increased preoccupation with the generation of employment at national and international levels. National development plans have given progressively more attention to employment objectives, especially plans prepared in the early 1970's in which specific employment targets and policy measures to promote employment have been explicitly incorporated (1). At the international level a growing amount of theoretical research, country case studies, field missions and other employment oriented activities indicate similar concern. Such major institutions as the International Labor Office (ILO) and the Food and Agriculture Organization (FAO) of the United Nations (UN), the Development Center of the Organization for Economic Cooperation and Development (OECD), the World Bank Group lending organizations and others have become progressively more involved with problems of employment. In recognition of the challenge, the UN has designated its Second Development Decade, extending over the 70's, the decade of employment. During this decade the creation of productive and rewarding employment opportunities for the rapidly growing populations of the developing countries has been set as a major goal.

Among the literature on the problem of employment, the publications of the FAO and ILO provide a very valuable source of information and knowledge mainly because of the wide international involvement of these organizations, of their close contact with planning authorities in the developing countries and because of the work of highly qualified and dedicated experts or teams of experts. Recent findings of their research and recommendations have been summarized, analyzed and evaluated in (2)

and (3). There are detailed references to individual case studies and other supporting documents.

B. Employment Role of Agriculture

Because most developing countries are still agricultural and are expected to remain so until the development process has expanded non-agricultural activities, agriculture becomes the most important sector in the generation of employment. The traditional employment role of agriculture was seen as that of releasing agricultural labor by means of increased agricultural productivity for the nonagricultural sectors of the economy. Today, while it is still recognized that the eventual solution of the employment problem of the developing countries will be in the development of manufacturing and other nonagricultural sectors, it is realized that this can be accomplished only over a long period of time, involving perhaps several generations, and that, therefore, agriculture must play the principal role in employment generation in the short run. The strategic importance of agriculture stems from the following:

(1) Population and labor force are growing rapidly and cannot be checked in the next generation or so.

(2) It has become increasingly clear, that even under the most optimistic projections the labor absorbtive capacity of nonagricultural sectors will not be able to cope with rapid population increases and the consequent rural-urban migration. That is, productive employment outside agriculture cannot be increased at a rate which could absorb increments to the urban labor force.

(3) Expansion of manufacturing output and employment requires wide and growing internal demand which is potentially available in traditional agriculture. Unless this demand is stimulated, there cannot be a solid basis for the expansion of manufacturing and services.

(4) International experience indicates, that the generation of employment is most successful if agricultural and industrial development goes forward in a process of balanced or concurrent growth (4).

(5) The technology of agriculture and the product mix it represents is quite flexible and varies widely over the world. This flexibility makes agriculture particularly suitable for the implementation of technologies that are labor intensive and capital saving, in line with the relative factor endowment of most developing areas.

(6) There is a wide scope for institutional and other reforms in agriculture which increase employment, agricultural productivity and output. Institutional measures such as land reform, the strengthening of the rights and privileges of tenants vis-a-vis landlords, colonization, cooperatives, etc. can be of particular significance.

(7) Finally, the sector of agriculture is of great importance in view of present world food shortages, which may preclude the importation of foodstuffs from abroad.

C. Approaches to Employment Planning and Problem Areas

With the recognition of agriculture as the key to overall economic development, including nutritional improvement, employment potential of agriculture has become the subject of renewed interest and research. In line with this, research and technical assistance to developing countries have been largely directed to assess feasible agricultural employment and output alternatives under different technological and demand conditions and to estimate the impact of these alternatives on the development targets of the economy.

Employment generation in agriculture is attempted in the following three major ways: a) to stimulate demand and obtain more employment from increased production in response to higher demand, b) to change the input structure and obtain more employment from a given level of production, and c) to bring nonagricultural employment to rural areas. These approaches are interdependent, in fact they constitute an integrated policy. Their separation is desirable from an analytical point of view.

Figure 1 is drawn to illustrate, grosso modo, the underlying logic. A number of key variables are identified, including employment. These are connected by means of a line diagram into a closed loop. The assumed cause-effect relationship is as follows: income distribution determines demand, demand determines output, the production of output generates employment, which in turn affects the distribution of income and closes the loop. The planning problem is to design and apply appropriate measures to stimulate interaction and expansion of the whole system.

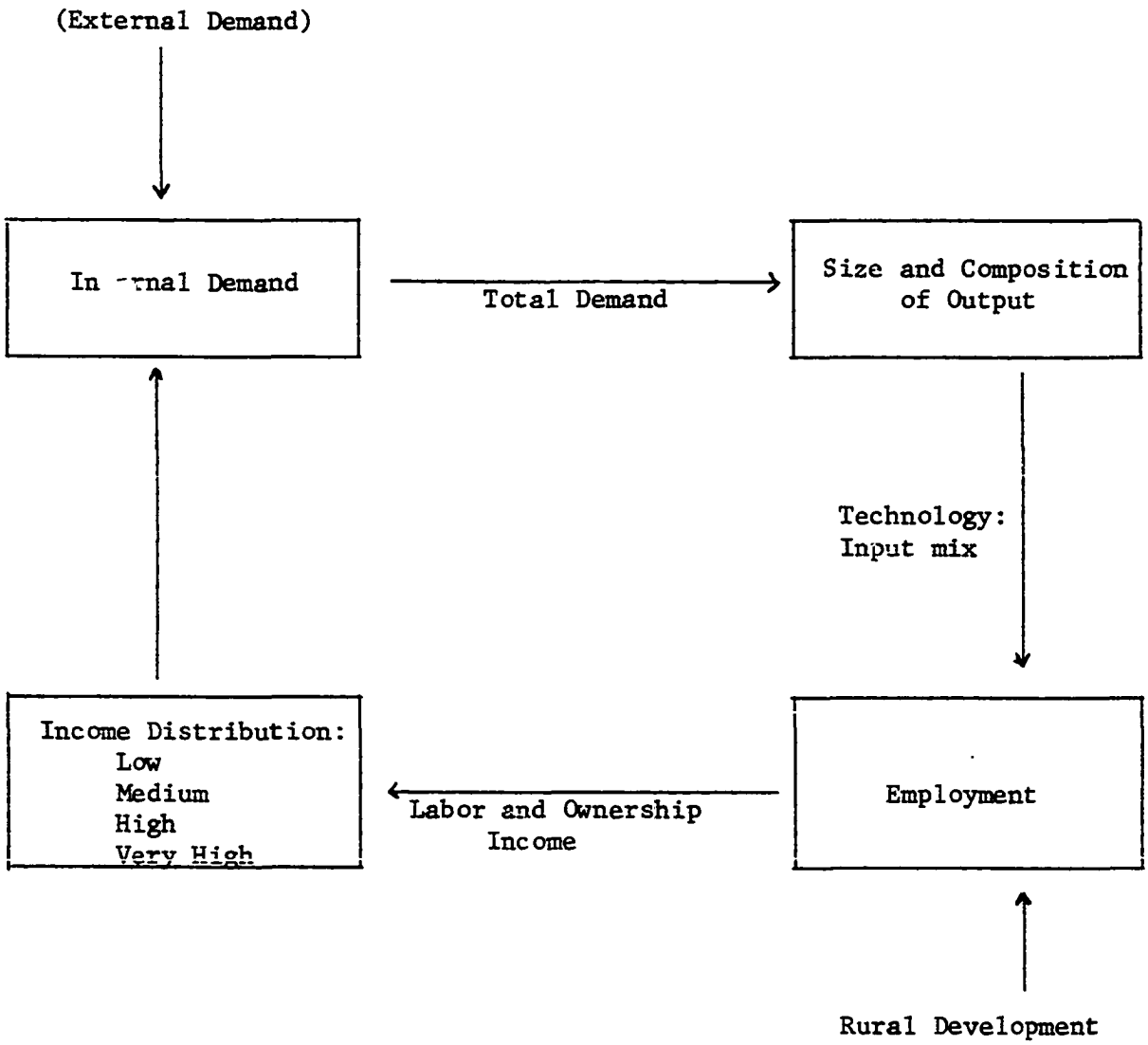


Figure 1. Cause-effect relationship in agricultural development plans

In terms of employment, the need is to know how employment affects the growth of the system and is affected by it.

(a) On the demand side distinction has to be made between internal and external demand. Internally, income is spent in different amounts and for different products by different income classes. Therefore, a change in the distribution of income becomes an important instrument to affect the composition as well as the amount of demand, hence employment. In instances where the distribution of income is split by dualism and is highly concentrated in the upper income classes, as in the case of Central America (4), it is fairly obvious that economic development and the generation of employment is handicapped by lack of internal demand. It is therefore necessary to design policy measures which influence the distributive forces in the economy towards greater equality. The need, in particular, is to increase and sustain at higher levels individual earnings in the traditional subsector and thus activate the large potential market which it represents.

Changes in income distribution could be effected by transfer payments. However, in real life the coverage of fiscal systems in developing countries is extremely limited and difficult to expand. Once the production has been so organized as to leave fairly large numbers of people unemployed, it becomes impossible to redistribute incomes to those who are not participating in the production. Therefore, the answer lies in more fundamental changes, in changes that affect the structure of ownership and social mobility, and lead to fuller participation in the process of production.

The external component of demand may be quite important, but it is largely determined exogenously and is therefore mostly outside the influence of domestic policy. However, the government can see to it that benefits from international trade are reinvested productively and reach down to the lower income groups, including the small farmer, and increase their incomes. With regard to external demand, international measures of trade liberization in agricultural products can be of substantial help to developing countries. The possible employment generating effects of international trade have been the subject of different studies on the basis of which the FAO is currently proposing an international trade adjustment (for details see (5)).

(b) The amount of labor required for a given level of production depends on the composition of that product - the product mix-, and on the technology - the input mix-, used to obtain it. The product mix, as indicated, depends primarily on the pattern of demand and can be influenced by government policies only to a limited extent. The input mix, however, has a somewhat wider scope for policy action because of the flexibility of agricultural technology. The problem is to modernize the predominantly traditional subsector and improve its productivity without greatly reducing, perhaps even increasing, its capacity for labor absorption, while, at the same time, arresting the spread of the labor displacing mechanization in the modern or technified subsector. In other words, a new input-output pattern is needed, an intermediate technology both labor using and yield increasing.

An intermediate technology of this nature has been successfully adopted by many small farmers using better seeds and advanced cultivation practices in a number of developing countries. However, certain fiscal and related measures are required: the government must adjust relative factor prices, including the rate of exchange, provide for adequate credit, marketing and extension services, invest in rural infrastructure, public works projects, and so on.

Again, more or less radical structural changes may be necessary. International experience indicates that whether the agricultural structure is unimodal or bimodal (dualistic) has a major influence on agricultural employment. With a unimodal structure it is possible to apply labor intensive technology to the whole of agricultural sector. Where the agriculture is strongly bimodal it is difficult or impossible to avoid most benefits from technological change going to the large farmers in the modern subsector for reason already mentioned. (For more on this see (3)).

(c) Finally, while employment generation in agricultural activities is of major concern and importance, there is a need to view the problem in a wider, more comprehensive and integrated context which includes the possibility of nonagricultural employment generation in rural areas. Here the research and development planning must be concerned with the development of various processing and manufacturing activities and the development of towns in rural areas, with the necessary infrastructure, with public works programs, education and other activities.

Research and planning efforts along these lines continue and lead to improved and more realistic formulation of development plans. However, there is as yet little sign of any greater success with the employment problem in economies characterized by dualism, mostly because the distributive aspects of development here touch upon the very sensitive area of private ownership and control. A change in the attitudes of the ruling elite must take place, a recognition that political stability, economic progress and the welfare of the nation can obtain only when social development accompanies economic growth, when productive effort, not mere ownership of property determines opportunities for advancement. In most developing countries this is already happening. There is no lack of suggestions and planning for egalitarian reforms - in employment, education, land and elsewhere. These efforts, however, can not carry very far if they do not elicit adequate response and pressure from below, from the large number of people in the traditional subsector. The pressure, in many instances, is not yet forthcoming. As a result of the past, people in traditional agriculture are still largely demoralized, divided and ineffectual. They do not have much faith in the political process and are unable or unwilling to generate a popular movement. The result is a vicious circle of deeply imbedded attitudes and vested interests. These tend to maintain the existing social and economic power structure, which in turn yields an environment unfavorable to change. One of the most difficult and challenging problems is, therefore, the problem of how to break this circle and how to weld together into a strong, independent and indissoluble society the two important productive sources -

traditional and modern production, sources which are presently separated by inequalities in ownership.

D. The Purpose and Scope of the Dissertation

The purpose of the dissertation is to present and discuss a methodology cast in a consistency framework within which the employment capacity of agriculture can be investigated, then to apply it to the agricultural sector of Colombia. The basic assertion is that agricultural production and employment can achieve rapid growth if an effective demand is stimulated by suitable agricultural policies eliciting technological and institutional change which brings about greater equality in the distribution of income.

Along the lines of planning efforts discussed above, the methodology approaches the problem of unemployment in the following areas and ways:

a) It is designed to capture the employment potential of agriculture. At the same time, overall economic consistency is ensured by the use of an economy-wide macro model which situates the sector of agriculture in the economy as a whole.

b) Income redistribution targets are incorporated as an essential part of the model. This permits an examination of the implications of a change in demand on output and employment as well as policy measures required to generate and sustain proposed changes in the distribution.

c) On the production side, distinction is made between three different agricultural technologies for major crops. In this way employment and other effects can be assessed and planned for by a change in the technological mix towards greater labor intensity.

d) Because of technological differentiation the methodology is particularly suitable for application to agriculture split by dualism, that is, to agriculture characterized by high concentration of incomes and ownership of property. This is presently the case in many developing countries, including Colombia.

e) Detailed input-output structure is specified for each technology. This makes the methodology effective at the micro level, reaching down to the subsistence farmer, and enables the policy maker to assess and plan for required changes at the farm level.

The dissertation is organized in the following way. Chapter II describes the structure and functioning of the Colombian economy and indicates why the proposed methodology can be of particular use for the planning of the Colombian agriculture. Chapter III presents and discusses the methodology in considerable detail. Chapter IV applies it to the Colombian agriculture and indicates agriculture's possible employment generating capacity. Chapter V evaluates the results, indicates weaknesses and problem areas, suggests improvements, and concludes the dissertation.

II. THE NATURE AND THE FUNCTIONING OF THE COLOMBIAN ECONOMY

The basic requirements for planning in a developing economy are no different from those in any type of economy. The essential components are an assessment of the resources available, an understanding of the forces, economic and political, controlling their utilization, a determination of the most effective resource combination for the generation of economic growth, and a policy to influence resource utilization and employment towards development goals. The success of economic development is usually judged by the rapidity and ease with which economic resources can be transferred from agriculture, especially from traditional agriculture, into productive industrial activities and by the extent and diversification in output and employment thus achieved. The most obvious results of development appear in the growth of modern manufacturing and in the decline of traditional activities.

The purpose of the present chapter is to trace the course of economic development in Colombia in this context, to observe the growth and transformation of the economy, the evolution of institutional, structural and other impediments, and to survey a number of planning strategies proposed to change the pattern of development towards fuller utilization of resources. The chapter is organized as follows: 1) retrospect into early development and the beginnings of industrialization, 2) analysis of the nature and functioning of modern Colombian economy, 3) obstacles to development and employment and 4) approaches to development planning.

A. Early Development and Some Lessons

The area of Colombia is well placed geographically. It is in the tropics and due to the advantage of bordering both the Pacific and the Atlantic Oceans, its products can be easily placed on the major world markets in the temperate zones, namely North America, Western Europe and Japan.

In the 19th century Colombia was fully integrated in world production and trade as a producer of primary products. Early economic development in Colombia, as elsewhere in Latin America, was conditioned by a periphery-metropolis relationship of production and trade, supported by the philosophy of laissez-faire. During this period emphasis was mostly on export agriculture and the extraction of mineral wealth by private enterprise with little or no government control and interference. For some time the policy of the government continued to be one of strict social code based on class distinction. Land ownership in particular was regarded as a means of accumulation of wealth rather than a trusteeship under which the land is to be developed, improved and passed on to succeeding generations. Such policy gave rise to a small but powerful ruling class of landowners, merchants and foreign investors. The consequence for agriculture was the development of a latifundia-minifundia complex which separated and cut off the bulk of the agricultural population from the mainsprings of change, from the improvement of incomes and opportunity for advancement. The interests of the landowners were sufficiently served by the availability of land, the supply of cheap labor and the existence of profitable external markets. Most investment was shaped accordingly and was directed into infrastructure (ports, roads,

communication, etc.) to service exports. If productive investment was undertaken, it was mostly limited to capacity expansion (e.g., acquisition of more land) to increase the volume of exports rather than diversification to include new economic activities. There was, therefore, no conscious policy to move the economy towards greater distributive equality, greater autarky and industrialization.

The country's agricultural nature is evident from the distribution of output and employment presented in Figure 2. It can be seen that until about 1920's the weight of agriculture in output and employment continued to grow and that of industry remained stationary or declined. Manufacturing was mostly confined to the traditional handicraft (artisan) sector producing cotton textiles, leather, silver and other goods. At the time of the 1870 census, as reported in (6), only about one percent of the country's labor force was classified as employed in modern factory type manufacturing using advanced machinery and power. The bulk of manufactured goods was imported while exports consisted almost entirely of primary products such as tobacco, oil, coffee, precious stones and others.

Figure 3 depicts the export performance. Two periods can be distinguished: the first based mainly on tobacco and extending roughly to the beginning of the 1900's, the second, involving coffee and continuing well into the 1950's. It is noteworthy that only during the expansion of the production of coffee the structure of Colombia's economy became more diversified and more sizeable investment in manufacturing took place. The reasons for this change and the different

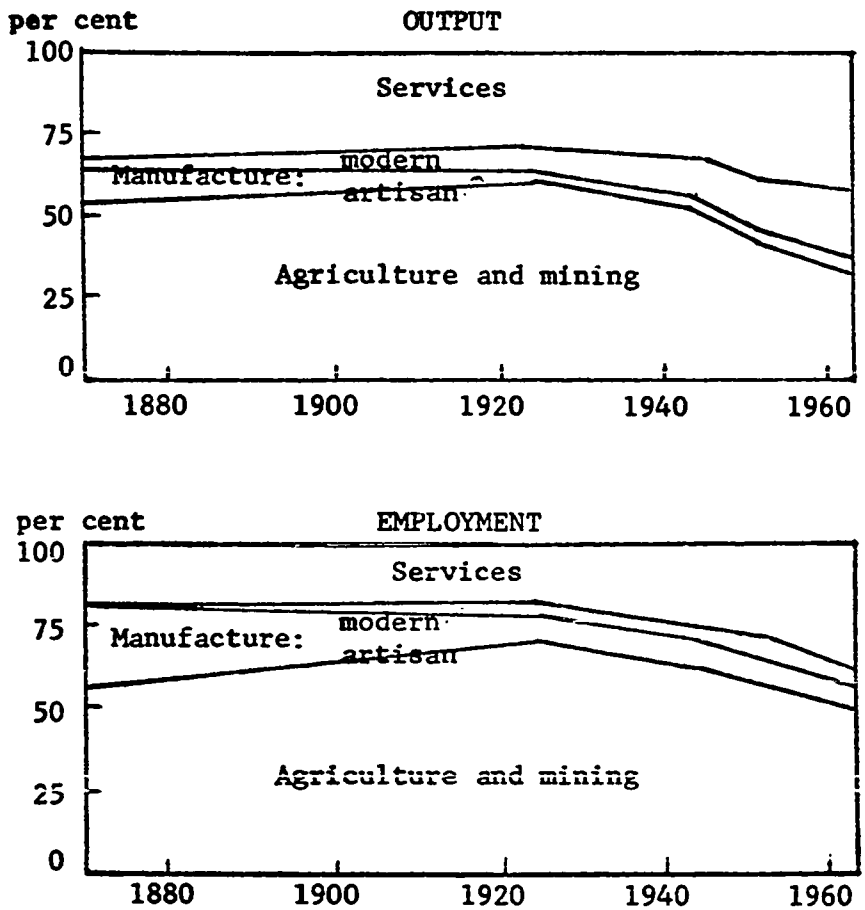


Figure 2. Distribution of output and employment by major sectors of the economy, 1870-1964 (6)

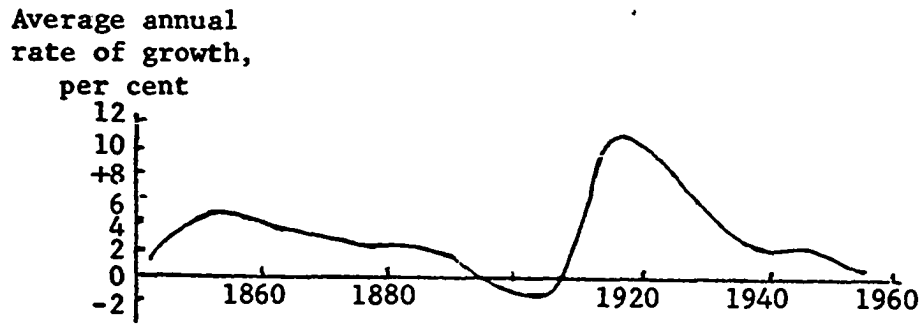


Figure 3. Rates of expansion of exports, 1834-1960 (6)

growth impact of the two major export crops are of considerable importance. Although statistical data are scarce, the basic causes affecting sectoral diversification in spite of the prevalence of laissez-faire are easily established.

1. The impact of tobacco

Tobacco cultivation in Columbia began as an operation of government monopoly. Free production was permitted later, but the technique of production was so fixed by previous development that large plantation type units continued to be the rule. While the ownership unit was large, the actual production unit was small and based on a share-cropping arrangement, since it was known that successful cultivation requires great care from seedlings through regular weeding, topping, selective leaf harvesting and the long process of curing. In the organization of production and marketing there were considerable economies of scale which effectively precluded the smaller landholders from participation in the production for foreign trade. Therefore, as tobacco exports expanded, so did the size of tobacco plantations with the result that the limited area of alluvial lands best suited for the production of the tobacco leaf became concentrated in the hands of relatively few large landowners. The scarcity of land and the policy of laissez-faire were important factors in the consequent increase of monopoly power of the plantation owners. This was manifest in declining rural wages and increasing rents - a change in the distributive function towards greater income inequality favoring the owners of the land. Evidence in (6) indicates that landlords were not only able to obtain higher regular rents, but that they were also in the position to extract

substantial profits from the differential between the price paid to tenants for tobacco and the price obtained on the world market, a differential seldom less than 100 percent. In addition to low and stagnating incomes, the sharecropper also became isolated from the contact with market forces and consequently from the opportunities to move into additional processive activities associated with the final product. Such development set the stage for agricultural dualism splitting incomes, distorting incentives and isolating low income rural population from the benefits of international trade.

It must be noted that as a result of the concentration of incomes in the higher income classes, economic dualism also pervaded artisan activities. Traditional handicrafts at that time constituted an important source of additional incomes to low income families in rural as well as urban areas. Handicrafts were practiced not only by the head of the household, but also largely by women and children, especially the manufacturing of cotton textiles. Here there existed competition between the influential class of merchants, the principal proponents of free trade, and the numerically large but unorganized, poor class of artisans.

The spending pattern of the consumers in the higher income classes favored manufactured imports. The availability of such imports and the continuation of free trade policies under which imports were admitted freely or at low tarrif rates narrowed the market share of artisans quite drastically. It has been estimated that mostly due to increased textile imports from England, the value of domestically produced and marketed handicrafts in Colombia declined from $20.0 million in 1850 to $7.8 million in 1895 (6). Since alternative employment and income

opportunities were not readily available, the consequence was further reduction of incomes at the lower end and their augmentation at the upper end of the income distribution scale,favoring the class of merchants.

Under these circumstances internal demand for manufactured products of domestic origin could not be stimulated. In fact, it continued to decline as the gains from international trade were redistributed not so much on the basis of actual contribution to the production but rather in line with the growing concentration of land and political power.

2. The impact of coffee

More sizeable investment in manufacturing appeared only after World War I. Although there was some change in the free trade policies towards greater control and economic planning, notably the establishment of higher tarrif in 1905, the initial force behind the growth of manufacturing and consequent structural changes in the direction of more developed economy was due to the emergence of coffee as Colombia's major export crop.

The period of coffee expansion began already in the 1890's and was extremely rapid in the decade of 1905-14 as the capacity of the Antioquia region, particularly well suited for cafe suave - Colombia's mild coffee, in which the country excelled, began to be more fully utilized. Further growth occurred in the 1920's largely in the rich Quindio region from which exports moved through the Pacific port of Buenaventura. A visible result of the changing economic structure was the first large-scale textile mill, employing some 300 people which began production in 1906

in Medellin. Various other light consumer goods industries also emerged and by 1918 industrial employment in Medellin was estimated at 6,000 (6). It was clearly not by accident that these developments, which formed the first industrial nucleus in Colombia, occurred in Antioquia, the principal coffee producing area.

Important differences in production took place. In contrast to tobacco, coffee cultivation in Colombia did not involve economies of scale. This was due mostly to the fact that ecologically best suited coffee areas were found on intermediate or steep slopes which did not lend themselves to large production and marketing units. Moreover, the cultivation of coffee fitted extraordinarily well in the production cycle and capacity of the small subsistence farmer possessing only a few hectares of land, and operating in frontier areas. Here the typical sequence of activities was as follows: an initial slash-and-burn corn planting, an intermediate period of interplanting with additional crops such as beans, manioc, plantains, bananas and coffee, then more dependence on coffee alone.

As a result, coffee production in Colombia developed and continued to be a smallholder operation. A large share of coffee exports originated from small family type farm units in contrast to large coffee fincas in Brazil and Central America. The wide extent of the smallholder participation in the production of coffee is revealed by the first coffee census in 1932. According to the findings of this census, quoted in (6), of the 150,000 coffee farms surveyed, more than 50 percent were found to be under 10 hectares. Similarly, according to the United Nations estimates in

(7), in the mid 1950's only less than 7 percent of Colombia's total coffee production originated on farms larger than 50 hectares. The smallholder characteristic is evident in Figure 4 which compares by means of Lorenz curves coffee farm and land distribution in Colombia and El Salvador. The much larger weight of smaller coffee farms in Colombia is quite apparent.

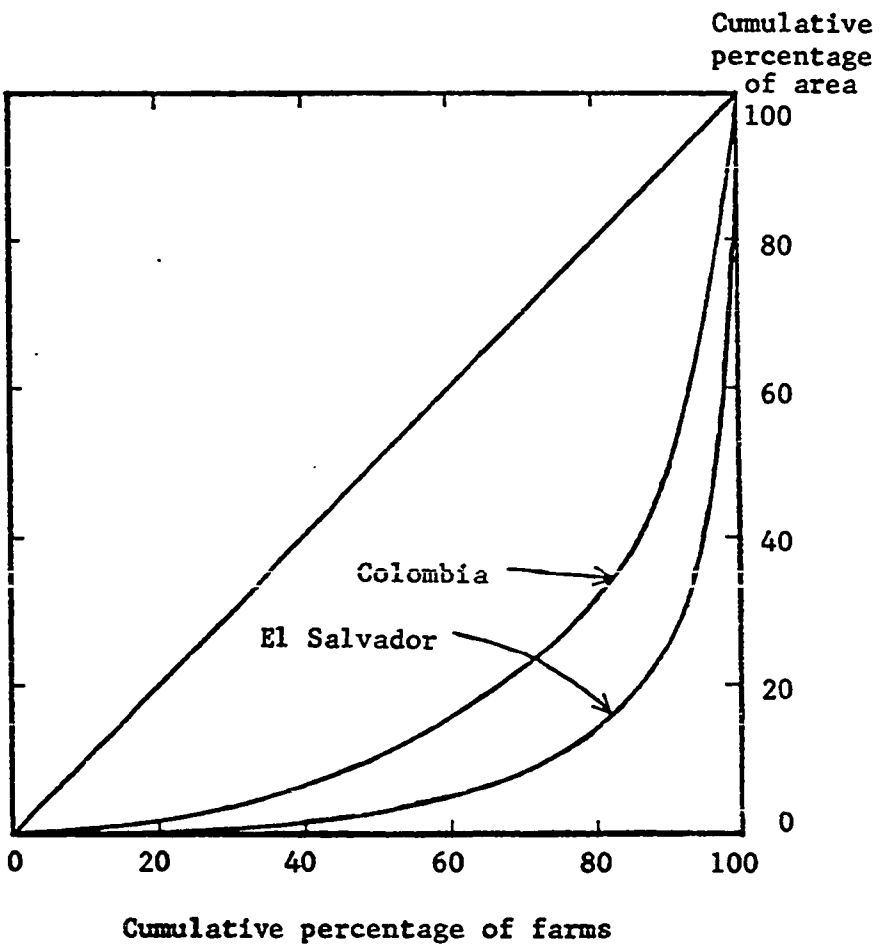


Figure 4. Lorenz curve comparing coffee farm and land distribution in Colombia and El Salvador, 1950's (6)

3. Lessons from early experience

The different growth impacts of the two export crops makes it possible, within limits, to identify and understand forces which shaped Colombia's economic structure and brought about impediments to economic diversification and development. At the same time it is also possible to observe the development potential of agriculture and see how this potential can be released. The early experience, therefore, suggests what basic strategy, or elements of such strategy, are appropriate in generating employment, improving the distributive function and bringing about development with fuller participation and use of resources. The following are some lessons and observations in this respect.

a) If an economy is wide open to international trade and if there is no effective government control of the accumulation of property and wealth, the process of development leads to a dualistic structure within which the export sector becomes divorced from the rest of the economy. While the process generates growth, the gains from it are largely consumed in the form of imports within the export sector itself. This elicits little if any growth linkages without consequent diversification of production. Such development took place during the tobacco period, a period characterized by small sharecropping production units and large ownership units. It led to the generation of highly unequal, low-wage, high-rent income distribution limiting internal demand, distorting incentives and preventing social mobility. As a result, manufacturing was not stimulated and sizeable nonagricultural employment did not develop.

b) Technological change in agriculture can bring about a change in the distribution of incomes which widen internal demand and stimulate diversification. The production of coffee is a case in point. Coffee production in Colombia expanded under different technological conditions which brought greater numbers of subsistence rural families in direct contact with the market economy. It is important to note that this process took place while laissez-faire was still dominant. The possibility to include coffee in the production unit of the subsistence farmer in combination with freely available frontier land made a surplus in cash incomes available after the satisfaction of the family's requirements for food for the first time. It has been estimated that between 1870 and 1930 a fifth to a quarter of Colombia's rural population, amounting to some 5 million by 1932, was brought into market economy by coffee. This had a powerful, expansionary effect which contributed to the widening of the industrial basis as indicated in Figure 2.

c) Forward and backward linkages emerging from a particular industry can be of great significance in stimulating economic expansion. In the tobacco period no noticeable pressures and inducements for diversification were evident. In the coffee period, however, there emerged important supplementary activities promoting urban employment and the expansion of infrastructure. In the city of Medellin, for example, by 1922 over 40 percent of the urban labor force was employed in coffee processing plants providing almost twice as many jobs as in the manufacturing of textiles which was dominant in employment before (6).

The spread of coffee cultivation also stimulated the development and widening of the road and railroad network opening up and integrating remote and isolated rural areas. No such development took place in the tobacco period because the production of tobacco was mostly limited to alluvial lands in tierra caliente and could be, therefore, serviced by steam navigation in the rivers. The spread and multiplication of coffee growth areas in the highlands necessitated inland transportation. The effect was not only to expand economic frontiers at home but also to improve Colombia's competitive situation on the world coffee market as well. It has been calculated that due to the spread of the railroad network, transport costs of coffee within a decade fell from 20 percent to 5 percent of the delivered price (6).

d) An important factor in the development process is the human element the quality of which can be improved and strengthened by measures leading to and enabling participation and exposition to decision making in the production process. With the emergence of more numerous individual and independent production units and their direct involvement in the market economy during the coffee period, there began a change in individual attitudes and personal qualities. Unlike the case of tobacco when management and entrepreneurial functions remained in the hands of a few, the production of coffee spread the possibility and need to exercise and develop these qualities more widely as individual producers became involved in money transactions. The strength of the management and entrepreneurial activities was demonstrated by a number of important innovations such as the phased interplanting of coffee with subsistence

crops thus avoiding the risk of narrow specialization, the use of banana and platano trees for shade, the picking of individual beans as opposed to crude stripping of the branch, and the development of small machines to remove the outer hull from the bean before transportation to urban markets.

Although coffee provided an important primum mobile in the growth of manufacturing and other nonagricultural activities and conditioned attitudes towards development, it failed to break the rigid structure of dualism embedded in the concentration of property and political power. Figure 2 indicates that only about 3 percent of Colombia's labor force was employed in modern factory-type manufacturing producing about 7.5 percent of the GNP by the mid 1920's. The importance of the coffee experience, however, lies not so much in the actual diversification achieved, but rather in the demonstration that technological change in agriculture can generate conditions under which growth may spread throughout the economy. Coffee production expanded participation, improved the distribution of incomes, widened internal demand, shifted it away from imports and towards domestic products, conditioned attitudes and generated growth linkages. Such change may come about as a consequence of natural conditions as in the case of coffee. But it can also be planned and supported by government action providing the necessary institutional setting.

There is another important realization emerging from the early experience. It is that economic backwardness in Colombia is not so much the result of an outright absence or scarcity of productive resources-- these are latent and conditionally available-- but that there is only the

need for strong catalytic agent to call forth and enlist for development purposes resources and abilities that are hidden, scattered or badly utilized. The expansion in the cultivation of the slow-yielding coffee in frontier areas is a good example. It indicates that if technological and institutional conditions are right and there is a quid pro quo for individual effort, capital and skill formation in agriculture can be remarkably responsive to improved income expectations.

B. Modern Development and Present Economic Structure

In Colombia the period between 1880 and 1930 can be considered as a period of preindustrial transition. During this time, most notably during the coffee period, subsistence agriculture became more market oriented with greater division of labor and a more extensive network of trade. An important development was the slow emergence of the country's industrial basis. As indicated, the beginnings of industrialization was not the result of a deliberate economic policy - laissez faire continued to prevail - but rather the consequence of natural forces activated by technological change in the production of coffee. It was only after the transitory period, marking the advent of modern development, when international events led to the adoption of a development policy aimed at the promotion of manufacturing industries by active government policy.

The growth of the extent of state intervention in economic matters was brought about by continuous upheavals in international relations triggered by World War I. While it was hoped that the pattern of international trade and specialization could be restored, the effort of reconstruction collapsed during the great depression in the 1930's.

Between 1929-32 world industrial production fell by 31 percent, the value of world trade declined by 65 percent and the price of coffee, of particular importance to Colombia, fell by more than 70 percent (8). After World War II the extraordinary economic and military power of the United States, the rise of world importance of the USSR and the impoverishment of western Europe were facts of decisive importance marking the end of an era during which western Europe had dominated world politics and economy. The system of world trade based on metropolitan-periphery subordination and laissez-faire was irreversibly wrecked. The loss of European markets and the changed world situation revealed the danger inherent in the narrow dependence on primary exports for foreign exchange. During the war and during the depression Colombia's export earnings declined to critically low levels and caused serious and acutely felt shortages of previously imported consumer goods. Rapid industrialization by import substitution to diversify the production capacity of the economy appeared a reasonable solution.

1. Industrialization by import substitution

In simple terms industrialization by import substitutions refers to the take-over of an existing domestic market from foreign producers by prohibiting or impeding imports and by promoting industrial investment in various ways. The actual process usually begins with the import of intermediate and capital goods which are then combined with labor to produce the finished product. At a later stage the process may be completed by extending it "from the top downwards" to include the production of formerly imported intermediate and capital goods.

In Colombia, as well as in most other developing countries, industrialization came to be regarded not only as an integral part of the wider process of development, but also as a necessary precondition for sustaining it. On the basis of development experience of developed countries it was expected that if sizeable investment was directed into manufacturing, the overall productivity of labor and capital in the economy would be appreciably higher than otherwise and would rapidly increase the growth of output. Furthermore, it was hoped that emphasis on domestic manufacturing would generate conditions for self-sustained progress: a) employment opportunities would expand and per capita incomes grow, stimulating internal demand and changing it towards domestic products; b) the growth of manufacturing would tend to progressively improve economic and social environment and facilitate further expansion.

The policy of import substitution was adopted with the following major objectives in mind: a) to decrease the dependence on imports and achieve higher self-sufficiency in manufactured goods, particularly consumer goods; b) to widen the country's industrial basis and provide higher and increasing employment and income opportunities outside agriculture, and c) to diversify exports by raising the contribution of manufacturing in the earning of foreign exchange.

The process began to be shaped by extensive controls over imports and exchange transactions with the setting up of the Exchange Control Board in 1931. Import substitution was vigorously promoted in the following two decades by measures such as protective tariffs, exchange controls, special preferences for domestic and foreign firms importing capital goods for new industries, preferential import exchange rates for

industrial raw materials and intermediate inputs, cheap loans for selected industries, government support of infrastructure, etc. (for details of protective arrangements consult (9) and (10)).

2. Structural changes

The policy of import substitution brought about visible structural changes and relocation of labor. According to the Currie Mission (11), between 1939-48 the value of industrial production, in constant prices, increased by 143 percent or at about 9.3 percent per year on the average. At the same time employment in manufacturing industries increased by 46 percent from 100 thousand to 146 thousand full time workers. Changes of similar magnitude were also observable in transport, commerce and other sectors.

Sectoral distribution of Colombia's labor force and changes that took place between 1951 and 1970 are illustrated in Table 1. A notable characteristic is the importance of agriculture despite the rapid rate at which agriculture's share in total labor force has been declining. Thus in the period of nearly 20 years prior to 1970, during which the total labor force was growing at a rate between 2.4 and 3.3 percent a year, agriculture's share in the total declined from nearly 54 percent to about 37 percent. Nevertheless, agriculture still continues to accommodate more of the total labor force than any other sector. It is evident that agriculture's declining weight in total labor force has been associated with a rapidly diminishing growth rate of agricultural labor force, which shows a decline from 1.4 percent per year in 1951-64 to slightly a negative -0.8 percent per year in 1964-70. The latter means that the agricultural labor

force may have stabilized, or is beginning to decline in absolute numbers, a fact which may mark an important turning point, provided the trend persists. It can be calculated that if this trend continues through 1985, agricultural labor force will decline to slightly over 2 million, while the urban labor force will double from 4 million in 1970 to 8 million in 1985.

It is clear, however, that while agriculture has been, to some extent, relieved of the pressure generated by rapid population growth, the problem of employment has merely shifted to sectors outside agriculture. Table 1 shows, for example, that the growth rate of labor force in the three most important nonagricultural sectors, manufacturing, commerce plus finances, and services, have doubled or more than doubled to 6.9, 14.0 and 6.8 percent per year, respectively, between 1951-64 and 1964-70. Since it is known that employment in these sectors has grown at a much slower rate, e.g., at 2.0 percent per year in manufacturing between 1965-70, unemployment here, and in nonagriculture in general, has been increasing at a faster rate than in agriculture.

Underlying the changes in the composition of Colombia's labor force is a complex rural-urban migration pattern. Colombia has approximately one hundred towns with over 100,000 inhabitants, some thirty of which have more than 300,000 inhabitants. The pattern of migration indicates that in most cases rural migrants move to villages and small towns, while the residents of these move on to larger towns. This means that smaller towns, which are very important in the strategy of rural development, are loosing much of their more dynamic entrepreneurs while gaining migrants with

TABLE 1. Sectoral distribution of labor force in numbers, percent per year changes[a]

Sectors	1951		1964		1970		1951-1964	1964-1970
	Total	%	Total	%	Total	%	%	%
1. Agriculture (includes fishing and hunting)	2,023,281	53.9	2,427,059	47.3	2,312,262	37.1	1.4	- 0.8
2. Mining	61,223	1.6	81,279	1.6	32,374	0.5	2.2	-16.6
3. Manufacturing	460,907	12.3	655,961	12.8	978,073	15.7	2.8	6.9
4. Electricity, gas and water	10,472	0.3	13,276	0.3	33,619	0.5	1.8	16.8
5. Construction	132,922	3.5	220,705	4.3	267,087	4.3	4.0	3.2
6. Commerce, hotels and finances	203,774	5.4	440,520	8.6	968,112	15.6	6.1	14.0
7. Transport and communications	130,083	3.5	191,817	3.7	262,729	4.2	3.0	5.4
8. Services	598,093	15.9	925,946	18.0	1,371,544	22.1	3.4	6.8
9. Other activities	134,854	3.6	177,562	3.4	-	-	2.1	-
TOTAL	3,755,609	100.0	5,134,125	100.0	6,225,800	100.0	2.4	3.3

[a]Source (12).

few skills. The flow of migrants has been increasingly unidirectional and growing in numbers. In 1938 only 31 percent of total population was in urban areas, while in 1964 over 52 percent resided in cities with population over 100,000. By 1985 nearly 73 percent of the estimated population of 33 million is expected to have left the rural sector. In recent years the largest four cities in Colombia have been growing by nearly 7 percent a year, approximately twice as fast as the growth of total population.

Sectoral distribution of output between 1950 and 1967 is presented in Table 2. Again the importance of agriculture is quite outstanding. In terms of annual percentage growth rates, obtained from (13), the output of agriculture has grown at a somewhat uneven and fluctuating rate: at about 2.8 percent per year in the periods 1950-55 and 1960-67, and at about 4.4 percent per year in 1955-60. In comparison with corresponding periods in Table 1, it is quite striking that agricultural output has grown at a considerably faster rate than the agricultural labor force.

TABLE 2. Sectoral distribution of GNP (percentages)[a]

Sector	1950	1955	1960	1967
Agriculture	40.0	35.5	34.6	30.9
Minerals	3.8	3.6	4.1	3.5
Manufacturing	13.9	15.1	16.7	17.6
Construction	2.8	3.9	3.2	3.7
Commerce	12.8	13.6	12.7	12.9
Transportation	5.3	6.9	6.1	6.3
Services	8.0	7.5	7.6	7.3
Other	13.4	13.9	15.0	17.8
Total	100.0	100.0	100.0	100.0

[a]Source: (12).

The share of manufacturing in total output has increased to nearly 18 percent. Its rate of growth has been relatively stable at about 7.0 percent, while that of the GNP has increased from about 5.0 percent in the 50's to about 7.0 percent at the beginning of the 70's. This indicates that the initial growth stimulating effect of the manufacturing sector has gradually subsided and that the share of manufacturing in total output is not increasing, but remaining rather constant. At the same time it is also interesting to note that while between 1950 and 1967 the share of manufacturing in total output did show an increase from roughly 14 to 18 percent, the share of manufacturing in total labor force in the same period remained virtually constant, indicating increasing capital intensity.

Another striking feature is the relatively large and growing accommodation of the labor force in the service sector accompanied by a decline of the service sector's share in the GNP. Thus while the share of the service sector in total employment increased from nearly 16 percent in 1951 to over 22 percent in 1970, the share of the service sector in the GNP declined from 8.0 percent in 1950 to 7.3 percent in 1973. This indicates that labor productivity and incomes in this sector declined and shows that the service sector has acted as a residual absorbing large numbers of rural rural-urban migrants.

3. Extent of underutilization of resources

In spite of or rather because of industrialization efforts and the economic diversification thus achieved, underutilization of land, human and capital resources is quite extensive. The following characterizes the present situation in Colombia.

a. Land Colombia is richly endowed with agricultural land suitable for crops and livestock and there exists a range of altitudes that offer a variation in climate and, therefore, a favorable environment for diversified agricultural output. However, according to 1960 census, as reported in (12), land under permanent and seasonal crops amounted to only 3.5 million hectares out of approximately 12.3 million hectares suitable for crops. Similarly, only about 14.2 million hectares were being used (mostly in a very extensive manner) for beef and dairy production - a small fraction of the potential grazing land, especially when the use of the seemingly unlimited expanse of the empty Llanos (some 25 million hectares of tropical lowlands in eastern Colombia) is considered. Colombia is also relatively rich in forests and mineral deposits most of which are still only marginally exploited.

b. Labor In spite of the relatively rich natural resource endowment there is widespread poverty and underutilization of human resource resulting from lack of productive employment opportunities in present day Colombia. Economic dualism is clearly visible both in the country-side and urban areas. A relatively small segment of the population constitutes the modern, high income sector which generates growth and also absorbs most of its benefits. The majority of people, however, are in the traditional, low income sector which is bypassed by economic progress. Here incomes are stagnating, often at the threshhold of subsistence. Colombia's Department of National Planning has estimated that in the past decade nearly 75 percent of the total labor force was in the traditional sector, mostly in rural areas (13). Underutilization of human resources

has been recognized as the most serious obstacle to economic development in Colombia. Much has been done in recent years to assess the size and nature of the problem so that development strategies could be devised for sustained growth and a more equal sharing of benefits. Following are some samples of recent findings which indicate the extent of poverty and underutilization of labor.

1) A thorough analysis concerning labor in Colombia has been undertaken by the International Labor Office (ILO) in 1970 (14). According to this study unemployment in the urban sector in 1962 was estimated at about 17 percent of the urban labor force, or at half a million people out of a urban labor force of some three million. It was also found that among those employed, about one third received less than three quarters of the minimum wage of 11.20 pesos per day and therefore could be considered underemployed, since underemployment can also be defined in terms of incomes below a certain minimum.

The situation in rural areas was approximated with the help of information contained in Table 3. Using the minimum wage approach and setting the minimum wage at 1,100 pesos per annum, ILO concluded that about one sixth of those tabulated received incomes below the minimum and were, therefore, underemployed. Taking both sectors together and allowing for both unemployment and underemployment, ILO estimated that in 1970 only 5 million man-years were used compared to an estimated labor capacity of 6.5 million man-years, which indicates an unemployment of about 23 percent. USAID Mission to Colombia, considering agriculture alone, found the rate of unemployment for 1968 to be much higher. According to its

calculations 450 million work days were required to produce the total output of the agricultural sector for that year. On the basis of a 280 day year, it was estimated that 750 million work days were available which meant that un- and underemployment together amounted to 40 percent of the agricultural labor force (15).

TABLE 3. Income distribution of the occupied labor force in agriculture, 1960 (percentages)[a]

Annual income[b] (Thousand pesos)	Percentage of those occupied in agriculture	Cumulative percentage of those occupied in agriculture	Cumulative percentage of incomes
0 - 1	9	9	2
1 - 1.5	33	42	13
1.5 - 2	22	64	23
2 - 3	12	76	30
3 - 5	10	86	41
5 - 10	9	95	57
Over 10	5	100	100

[a]Source: (14).

[b]"Income" refers only to incomes from agriculture (though subsequent research shows that it makes little difference when other rural incomes are covered). Income in kind is included.

2) The extent of poverty and dualism becomes evident in Urrutia's recent study concerning the distribution of incomes of rural and urban populations in 1964 (16). Figures from this study are presented in Table 4. They reveal that incomes in Colombia are distributed very unevenly and

that the situation is worse in the rural sector, in which the upper ten percent of the population receive more than half of the total rural income. It is also apparent that the absolute level of rural incomes is only half the level of urban incomes.

Projecting 1964 per capita rural income to 1970 (on the basis of the growth of value added in agriculture) an income of only $175 per rural inhabitant is obtained as contrasted to about $300 per capita for the total population. Poverty in rural areas is clearly quite extensive.

TABLE 4. Colombia: Decile distribution of urban and rural incomes in 1964[a]

Decile	Rural Population		Urban Population	
	% of total income	Average annual income per person occupied (Pesos)	% of total income	Average annual income per person occupied (Pesos)
1	1.4	880	0.9	1,140
2	3.1	1,940	3.3	4,200
3	3.6	2,260	4.3	5,470
4	3.9	2,450	5.0	6,360
5	4.5	2,820	5.5	6,000
6	5.5	3,450	7.0	8,910
7	6.0	3,760	8.0	10,180
8	8.0	5,020	11.0	14,000
9	13.0	8,160	14.5	18,450
10	51.0	32,000	40.5	51,530
Total	100.0	6,274	100.0	12,724

[a]Source: (16).

3) Rural poverty and change in its extent has been the subject of a detailed investigation by the Colombian Institute of Agrarian Reform (INCORA) in 1970 (17). In defining the concept of poverty INCORA adopted a minimum income of $700 pesos per family as a poverty benchmark for 1970. It was calculated that in 1962 (deflating 1970 income to 1962 price level) there were 802,000 families with incomes below the poverty benchmark. Of this total, 85,000 families were landless, 633,000 owned less than 5 hectares of land and had incomes of less than 80 percent of the benchmark income, 34,000 were families with 5 to 10 hectares of land with incomes less than 60 percent of the benchmark, and 50,000 were tenant and sharecropper families working plots of less than 15 hectares.

In 1970 the total number of families below the poverty line was estimated to have increased by nearly 17 percent to 935,000. The number of landless families more than doubled and amounted to 190,000. Families with less than 5 hectares of land and earning less than 80 percent of the benchmark income increased to 658,000, families with 5 to 10 hectares and incomes less than 60 percent of the benchmark increased to 37,000 and only the number of tenant farmers and sharecroppers with less than 15 hectares of land remained as before at about 50,000.

This indicates a rapidly worsening situation, particularly with respect to the group of landless families. There is strong reason to believe that the distribution of rural incomes has tended toward greater inequality in spite of the rise in per capita value added which, for the agricultural sector as a whole, increased by 150 to 175 percent during the 1930-70 period.

It must be noted that figures concerning the extent of poverty, the size of un- and underemployment, etc., differ quite substantially. Such variations reflect both differences in survey techniques and coverage and the conceptual difficulties of measurement and comparison. For example, it is very difficult to measure and directly compare unemployment in rural and urban areas because, in rural areas, the family and community structure clouds the distinction between those employed and unemployed. Also seasonal agricultural unemployment has no comparable parallel in urban areas. For these and other reasons the interpretation of the absolute level of unemployment and underemployment may be quite different. However, all studies agree that poverty is widespread and serious, that underemployment cuts deeply into the labor force, and that, if present trends continue, underutilization of labor and the distribution of income will become worse.

c. Capital The extent of capital misallocation and waste is revealed in a study by the Department of National Planning which discloses that it is possible in most industries to duplicate present output without additional investment in fixed capital (13). In other words, about 50 percent of the capital in manufacturing industries is in fact idle. This greatly explains why the growth of manufacturing output has resulted in a disappointingly low rate of employment creation, and why the service sector in accommodating the majority of migrants from rural areas has fulfilled essentially the same function as the low income subsistence agricultural subsector.

4. Size of the employment problem

One of the most serious and challenging problems in present day Colombia is the problem of employment. Its dimensions become clearer when the trends in the growth of the labor force and employment are investigated together. Table 5 is intended for that purpose and summarizes Colombia's experience between 1951-70. It can be seen, that over the entire period the growth of employment opportunities has lagged behind the growth of the total labor force. While in the latter part of the 60's there appeared a slight improvement in the labor absorptive capacity of the economy, there was also an increase in the growth of the total labor force. Consequently, the growth of output not only failed to reduce the existing backlog of unemployment, it also failed to absorb significant and increasing shares of the increments to the labor force.

TABLE 5. Estimated changes in the supply of labor and in employment, 1951-70 (annual average rates of growth in percentages)[a]

	1951-1965 (Rough estimates)	1965-1970 (Very rough estimates)
Growth of population	3.1	3.3
Growth of adult population (10-64)	2.9	3.6
plus or minus effects of changes in over-all participation rate	-0.4	-0.4
equals growth of total active labor force	2.5	3.2
Total expansion in employment (man-years)	2.1	2.3

[a]Source: (14).

The government of Colombia has initiated a vigorous family planning program in order to ease the problem of employment. But even if present attempts to control the population succeed it will be at least 15 years before there is a marked effect on the growth of the labor force. Hence it is reasonable, using 1970 as a base, to project present trends to 1985 for a numerical evaluation of the employment problem at that time.

Assuming that employment continues to grow at 2.3 percent per year and applying this rate to the 5 million jobs which were estimated to exist in 1970, the number of jobs in 1985 will total 7 million. The growth of the labor force which has been accelerating, is expected to proceed at 3.5 percent per year during the 70's. At this rate Colombia's labor force of 6.5 million in 1970 will have increased to nearly 11 million by 1985. On this basis, there will be 4 million persons unemployed in 1985, or more than one third of the 1985 labor force.

5. Realization of import substitution objectives

Industrialization in Colombia was initiated to stimulate economic development by achieving higher self-sufficiency in consumer goods and lower dependence on imports, by sectoral diversification and higher employment opportunities and by raising the level of manufactured exports. Judged in terms of economic diversification and output growth this policy was fairly successful. By 1970, however, Colombia was faced with problems which could not be successfully resolved by this development strategy. Growing unemployment, inequalities of income, uncontrolled urbanization and unfavorable balance of payments were some of the symptons which

indicated that the policy of import substitution was failing and that a new policy response and strategy was needed to confront the problems.

In terms of achieving self-sufficiency in consumer goods the record appears to be quite good. Near self-sufficiency in some basic products such as beverages, tobacco, a number of building materials including lumber, bricks and tiles, and in a number of important fuels, namely coal, refined petroleum and electricity was reached already by 1947. By 1955 domestic consumption requirements were satisfied in processed foods, footwear, clothing and furniture. As of the 1960's Colombian consumer goods industry had the capacity to meet almost all of the domestic demands.

However, while Colombia now produces a large quantity of consumer goods, satisfying most of its domestic demand, it is also necessary to import for their production much larger and increasing quantities of intermediate and capital goods. In 1956, for example, 12 percent of imports were composed of consumer goods, 35 percent of intermediate goods. In 1964, while imports of consumer goods declined to 6 percent, imports of intermediate goods increased to 46 percent. Although it is clear that the import of consumer goods has been reduced drastically, there is no evidence that the overall dependency on imports has been reduced. In 1970 imports still amounted to about 17 percent of the GNP. It appears, therefore, that while the form of import dependency has been changed, the dependency itself has not been noticeably affected. The change in the form of dependency, however, has certain implications. Whereas formerly a decline in the import capacity meant a reduction in the availability of consumer goods, now it directly affects the output and

employment of the modern industrial subsector. For this reason the economy may now be even more vulnerable and dependent on foreign sources of supply than before.

In terms of employment the results, as already discussed, have been most disappointing. Mostly because of capital intensive bias, labor absorbtive capacity of modern manufacturing has been very limited. In combination with the declining growth rate of output and the rapidly swelling rural-urban migration lack of adequate employment opportunities has caused a serious deterioration in the urban employment situation. In the period 1962-64, for example, employment in modern manufacturing expanded at only about 1.5 percent per year, while urban population was growing at about 7.0 percent a year. Sample surveys in Colombia's major cities conducted in the mid-1960's indicate the following unemployment rates: 9.0 to 16.0 percent in Bogota, 10.0 to 12.0 percent in Medellin, 12.0-13.0 percent in Cali and 16.0 percent in Barranquilla (18). According to ILO, urban unemployment in 1967 was at about 14.0 percent of the urban labor force, while underemployment (persons working less than 32 hours per week) amounted to about 12 percent of the urban labor force. In total, the underutilization of labor in the urban sector was placed at about a quarter of the labor force (14).

Thus the policy of import substitution did not resolve but rather contributed to the twin problems of unemployment and the unplanned growth of urban areas. Moreover, it is also clear that this policy did not induce favorable changes in the distributive function. On the contrary, many of the policy measures designed to spur industrialization through such mechanisms as high tariffs, multiple exchange rates, import

licensing and tax incentives for certain types of manufacturing also induced widening income disparities between upper level businessmen and unionized workers on the one hand, and the bulk of the population on the other. Table 6 indicates the resulting income distributions in the two largest industrial centers of Bogota and Cali in 1965.

Until the beginning of the 70's, the contribution of manufacturing industries to export earnings remained relatively small and without a tendency to expand. Most enterprises were small, and protected by high tariffs. There were no incentives to increase efficiency and to bring down the cost of production to international levels. In fact, it was more profitable to produce at high cost for the protected domestic market than to specialize and seek international outlets.

Perhaps the most damaging aspect of import substitution policy was the realization that it was not leading to autonomous development and greater autarky. Under this policy the process of economic growth was accompanied by increasing foreign indebtedness. Colombia's foreign debt increased by $220 million between 1950 and 1961; it rose by $560 million between 1961 and 1965 and by an additional $735 million between 1965 and 1970. By the end of 1971, Colombia was burdened with a public foreign debt of over two billion dollars. It was estimated that if these trends were to continue, in 1973 the debt service would arrive at a figure of 18 percent of exported goods and services, which would seriously inhibit Colombia's capacity to import the capital and intermediate goods it needs to promote its domestic industrialization program (19).

TABLE 6. Size distribution of individual income in Bogota and Cali, 1965 (employed workers only)[a]

Population	BOGOTA		CALI	
	Income		Income	
Decile	Percentage of total	Cumulative percentage	Percentage of total	Cumulative percentage
1	0.8	0.8	0.9	0.9
2	1.7	2.5	1.3	2.2
3	3.0	5.5	2.3	4.5
4	4.6	10.1	3.0	7.5
5	4.7	14.8	4.6	12.1
6	6.5	21.3	5.2	17.3
7	8.0	29.3	6.7	24.0
8	11.0	40.3	8.5	32.5
9	16.3	56.6	12.7	45.2
10	43.4	100.0	54.8	100.0

[a]Source: Adapted from (19).

C. Impediments to Growth and Employment

It was shown that while there has been a relatively satisfactory growth of output accompanied by structural change towards greater industrialization, underutilization of labor and the distribution of incomes have actually worsened. It is, therefore, reasonable to conclude that Colombia's underdevelopment rests on the failure of the economy to generage sufficient employment.

The basic factors responsible for this failure are not too difficult to find and are discussed next. However, it must be realized that these factors can not be fully isolated because of their complete and intimate interdependence.

1. Unequal distribution of the ownership of land

There is little doubt that the nature of land ownership constitutes one of the principal obstacles to economic development and employment generation not only in rural areas but also outside agriculture. Land ownership in Colombia like the distribution of incomes, is highly concentrated. Two recent studies attest to this. a) According to ILO findings for 1960 quoted in (14), nearly 45 percent of cultivable and pasture land was in the hands of only 1.2 percent of the population with average holdings around 700 hectares. In contrast, 65 percent of the population owned 5.5 percent of land with average holding size of less than 2 hectares and with 25 percent of them owning holdings of 0.5 hectares. b) More recent figures, which take into account the results of the agrarian reform of the past decade, are quoted in (13) by the Department of National Planning. These cover the size distribution of

nearly 1.4 million farms with a total area of 23.5 million hectares. The picture is not much different. About 70 percent of all farms have an area of less than 5 hectares, and occupy only 5.6 percent of total farm area. Furthermore, 32.5 percent of all farms are smaller than 1 hectare. On the other end of the scale, holdings of more than 50 hectares represent only 5.9 percent of the total number of farms, but occupy 72.3 percent of total farm area. Farms of more than 300 hectares (0.8 percent of total farms) cover 40.7 percent of the total within which holdings of more than 1,000 hectares (0.2 percent of total farms) control 22 percent of total area.

These findings clearly indicate that economic dualism in agriculture, despite the impact of coffee, is still very strong and continues to distort the distributive function. Since the largest part of the agricultural population is confined to a small fraction of total arable land, increases in rural population can only lead to two alternatives: further fragmentation of land, thus depressing incomes and widening the extent of poverty, or outmigration to urban areas in search for new employment opportunities which are not adequate.

Employment opportunities on large farms in the modern subsector are quite limited because of capital intensive production techniques. Farm mechanization in Colombia appears quite extensive. According to FAO information, quoted in (20), there is one tractor for roughly every 150 hectares of land, close to the level found in labor-scarce, land-rich economies of Australia and the USSR, where agricultural production is an extensive operation. The pattern of mechanization is clearly linked to

the uneven distribution of farm sizes: farms bigger than 50 hectares have 66 percent of total tractors.

The large land owner in the modern subsector is excluded from any adverse effects of poverty since the product of his land is sold in external markets and the gains from trade are at his disposal at favorable terms as will be indicated below. Poverty in the traditional subsector may even be beneficial to the land owner in the modern subsector by providing large supplies in cheap labor. Existing institutes which provide employment, education, justice, housing, health and other public services, are largely shaped along the lines of dualism and reflect the concentration of power. They, therefore, do not adequately respond to the needs of the poor who own little or no land at all, but continue to favor the rich.

2. Distorted factor prices and inefficient industries

Another principal obstacle to full employment is the strong capital-intensive bias inherent in Colombia's relative price system. Colombia is clearly a labor-abundant, capital-scarce economy. Colombia's manufacturing industries, however, appear to be highly capital-intensive contrary to the country's relative factor endowment. In comparison with the average found in the United States, for example, capital intensity, measured by capital labor ratio, is found to be particularly high in the three largest Colombian manufacturing activities, namely, tobacco products, beverages and petroleum products. Similarly, textile products enterprises, major contributors to manufacturing exports, show a capital intensity only slightly below the U.S. average (19). Capital intensive and labor displacing techniques are also found in agriculture. This

largely explains why in a labor surplus economy such as Colombia, labor saving is made economically rational.

Existing distortion of factor prices in Colombia is a direct consequence of industrialization by import substitution policies. During this period the prices of capital, credit and foreign exchange have been artificially lowered below their equilibrium and, therefore, distorted in relation to labor. It has been estimated that despite relative capital scarcity, the rate of interest during most of import substitution period was kept at the same level or below that prevailing in industrialized capital abundant countries (19). Similar evidence is found in the Currie Report which states that "although Colombia's national capital market is little developed, funds are readily available at cheap cost and that the development of industries is mainly limited by the smallness of the internal market" (11).

There is also clear indication that the rate of exchange was kept artificially low. The overvaluation of the domestic currency encouraged further a degree of capital intensity inconsistent with fuller utilization of labor. At the same time, Colombia's exports were discouraged, exposing the economy to foreign exchange difficulties.

In addition, along with the development of manufacturing, there came into being wage legislation and labor union organizations. These were effectively extended to the modern subsector in which the real wages began to increase. It has been estimated that between 1951-63 real incomes in modern manufacturing increased at roughly 4.5 percent a year, while real income in traditional manufacturing remained stationary or

declined. Since capital was relatively cheap and available, and since the pressure on wages in modern manufacturing persisted there were additional incentives to substitute capital for labor.

It makes a great difference to the economic development of a country depending upon international trade whether or not its industries are efficient and capable of changing with the world. The difficulty arises when the change abroad is of a negative character - a change in taste away from the country's exports, a discovery of competitive sources of supply, a technological change which replaces the natural product previously exported or reduced the demand for it. Capacity to transform its capacity to react to change by adapting the structure of production and foreign trade to the new situation in an economic manner. In a private enterprise system capacity to transform requires the existence of a price system reflecting actual costs and responses to profit and income differences on the part of entrepreneurs and owners of productive factors. An increment of resources should be invested in export, import-competing, or domestic industry depending upon the relative rates of return in each. If all factors are continuously reallocated so as to equalize returns at the margin, industries with falling prices uncompensated by increases in relative efficiency should lose factors until the decline in production costs arrests the fall in price and factor return. Similarly, there should be a gain of resources for industries with rising prices. For the system to work, it must be possible for profitable industries to grow, attracting new entrepreneurs, new supplies of labor, land and capital. Industries rendered unprofitable by rising costs, declining demand or

increasing competition from more efficient source of supply must readily release their factors of production and lose their attraction to entrepreneurs. There must be occupational, spatial and social mobility to accommodate the shifts of factors required by evolving economic opportunity. These shifts must be at the margin and on a continuous basis.

These conditions did not exist nor were they encouraged. Throughout the period of industrialization Colombia maintained a system of quantitative restrictions on imports. Import restrictions are a form of protection which tends to result in misallocation of scarce resources for investment and production since no administration can expect to be a reasonable substitute for the price mechanism. Furthermore, there is no criterion which could serve as a major guideline for government incentives to improve resource allocation. The government system of quantitative import restrictions makes it difficult to compare costs of domestic industrial production with international standards and therefore it is impossible to isolate those industries and products in which the country has a comparative advantage and which would benefit the economy most. Because of this no serious attempts were and could not be made to concentrate on the promotion of activities having a potential advantage in international trade. Rather a nonselective, across-the-board emphasis on industry was stressed, a drive towards national self-sufficiency without too much thought to fit production techniques to the relative factor endowment. Such policies, in the words of the Currie Mission,

> increased the cost and complexity of foreign trade, have weakened competition, have caused certain distortions in business policies, and have encouraged high markups and permitted excessive profits on both legitimate and illegitimate imports. They have frequently been used to promote economic self-sufficiency without much regard

> for the relative costs of domestic and foreign production. Their complexity and discretionary character have tended to discourage foreign investment and to distort the pattern of domestic investment (11).

Moreover, the government being anxious to secure benefits of domestic competition (since protectionist policies suspend foreign competition) encouraged too many firms to enter. According to (21) in 1967 there were slightly over 1,000 factory establishments in Colombia employing 50 or more persons. These constituted about 10 percent of all manufacturing establishments at that time. Half of them employed more than 100 workers. At the other end, there were over 8,000 establishments, about 78 percent of the total, employing less than 20 persons each.

As a result most industrial enterprises remained small, capital intensive, high-cost and inward looking. They were not in the position to adapt to external changes nor could they initiate factor substitution in production in line with relative domestic resource endowment.

3. Population growth

The characteristics of demographic trends in Colombia have been high fertility rates, rapid decline in infant mortality, high and increasing population growth rates, and a growing proportion of young people. Accelerating growth rates are reflected in the following: it took 33 years, between 1905 and 1938, for the population to double the first time in this century, but only 26 years, between 1938-1964, for this to happen the second time. It is estimated that the population will double again by 1986, in only 22 years. In the same time period, i.e., since the

beginning of the twentieth century, world population has been doubling, on the average, every 42 years, that of Latin America, every 26 years.

While Colombia is relatively rich in land and natural resources and there is even underutilized and idle capital resources, rapidly doubling population is clearly a serious factor responsible for continued underdevelopment, the extensive poverty and the difficulties of generating productive employment for the increments to the labor force. Although the government is channeling additional resources in administration, education, housing and other services to break the circle of low productivity and low incomes, rapidly rising numbers to whom these services are applied make it very difficult to increase their quality and efficiency. As a result, dualism continues and the number of the poor increases.

4. Other obstacles

There are also a number of other reasons which explain the lack of productive employment opportunities in Colombia. These, however, seem to exist mostly as a consequence of those already mentioned, and are, therefore, discussed in less detail.

a. Internal demand It was emphasized that mostly as a consequence of the unequal distribution of land, incomes in the traditional subsector, especially in rural areas, are very low and stagnating. Under such circumstances effective demand, i.e., demand supported by the purchasing power is also very low and stagnating. Moreover, given the relatively high income elasticity of demand for food at low income levels, increases in incomes are spent mostly on food. Hence, the

growth of output and employment in manufacturing is seriously limited by lack of adequate and vigorously increasing internal demand, the principal incentive of production.

While the initial process of import substitution brought about quite substantial industrial diversification, it appears to have been a once-for-all expansion with little subsequent reinvestment. This is not only because of insufficient and stagnating internal demand, but also because initial import substitution was difficult to be extended further "from the top downwards" to the domestic replacement of intermediate inputs, and finally, because import-replacement industry can not yet successfully compete in export markets.

b. High yielding varieties and rural institutions Yields of major food crops, although rising quite rapidly in recent years, are still relatively low and lagging behind those of most other countries. According to FAO data for 1970 (22), Colombia's corn yields amounted to 12.5 thousand kilograms per hectare (kg/ha) as contrasted to 45.0 thousand kg/ha in the USA, 35.9 thousand kg/ha in Chile and 32.2 thousand kg/ha in Japan. The wheat yields in Colombia registered 9.4 thousand kg/ha, behind Mexico with 28.4 thousand kg/ha, Japan with 20.7 thousand kg/ha and Chile with 16.9 thousand kg/ha. Only in terms of paddy rice, Colombia's yields of 29.7 thousand kg/ha ranked somewhat more favorably as compared to 28.6 thousand kg/ha in Mexico, 31.3 thousand kg/ha in Chile and 56.4 thousand kg/ha in Japan.

Relatively low yields reflect the limited spread of high yielding varieties, with the exception of paddy rice for which nearly 85 percent of total area was found under improved varieties. Also the use of

fertilizers, pesticides and insecticides is still quite low. Thus, in 1968 only 22 percent of total area under the 12 major crops received fertilizers and only about 1.3 percent of all farms used insecticides and pesticides (13).

The last decade, however, has seen a wider adoption of high yielding varieties and other modern inputs as a result of vigorous agricultural research and dissemination of knowledge, originating mostly in the agricultural research station at Palmira, operated by the Colombian Institute of Agriculture (ICA), and in the International Center of Tropical Agriculture (CIAT) in the Cauca valley. However, extension efforts to acquaint farmers with new methods and seeds resulting from research still do not reach too far beyond the more progressive, better educated and more well-to-do farmers. Most of the small farmers are ignorant of the new technology and those who have heard about it generally are distrustful of it.

Some 60 extension units, a number far too small for the needs of the country, exist over the country, each usually staffed with an agronomist, an animal scientist or veterinarian and a home economist, plus five or six agricultural technicians who live in the immediate area. The spread of extension work to more satisfactory levels is hampered by financial and skill constraints. In Colombia as in most developing countries, the great majority of extension workers and researchers do not originate from rural areas but come from towns or cities and are professionally qualified on the basis of academic and theoretical education in a college and/or university. Hence, they lack first hand experience of actual farm operations and of farm people, which leads to difficulties in communication, to suspicion and sometimes hostility on the part of poorly educated farmers.

Farm credit, which is needed to adopt the new technology is available only in very limited amounts and on a selective basis. To be eligible for a loan from the agricultural credit bank a farmer must present a farm plan worked out by an ICA licensed agronomist or livestock specialist, for whose services he must pay a fee. The farmer then is advanced part of his loan and receives the balance only after an inspection in mid-season shows that he is following the plan. Smaller farmers who cannot afford the services of a professional planner may qualify for the remittance of the fee, but although the intent of the credit policy is to help them, the prevalent power structure of dualism is such that farm credit goes mostly to the bigger farmers. It has been estimated that roughly only about one-third of small farmers with farms of 20 hectares or less received institutional credit in 1970. When the definition of the small farmer is set at a lower limit, the coverage of institutional credit is much smaller which indicates that there is a large and urgent need of improving credit availability to the small farmer.

c. Education and skill levels Most of the people in the traditional subsector are illiterate, only a few of them having had as much as two or three years of schooling. The situation is especially serious in rural areas, as reflected in the following figures for 1970. Out of every 100 students attending primary schools 64 were in the urban areas and 36 in the rural areas. Of urban children 48 percent of those initially enrolled completed the third grade, and 38 percent the fifth grade. But in rural areas only 10 percent were able to obtain three years of primary education and only 3 percent completed the fifth grade (13).

Primary education is suffering from a shortage of funds, schools, and instructors. The very low level of basic education is a serious impediment to economic progress. Lack of knowledge strengthens the acceptance of the status quo and weakens the prospects of change in response to economic stimulae. Investment in human capital has been a major source of growth in advanced countries, but in Colombia the small amount of investment in basic education has done little to extend the capacity of the people to meet the challenge of development. Equally serious is the deficiency in secondary education, especially in technical skills. Some of the most critical manpower shortages are for managers, administrators, scientists, engineers, agronomists, economists, accountants and technical personnel.

Of particular handicap is the low level of knowledge and skills in the sector of agriculture. In order to modernize and to accept new equipment, seeds, insecticides etc., the quality of labor needs to be improved first as an input in its own right. As was pointed out earlier, land is not a limiting factor of production per se, it can be made available on a more equal basis, but agricultural transformation may not succeed without higher levels of knowledge and skills.

Finally, the success of population control policy clearly requires new knowledge of birth control and a change of traditional beliefs and social institutions that have sustained fertility at a high level. Evidence in a number of countries (e.g., India, Korea) where regional planning projects have been quite successful, tends to indicate that literate and more educated populations are more responsive to population control policies.

d. Inflation Import substitution policies in Colombia have been accompanied by relatively strong inflationary pressures. It seems to be quite impossible to ascertain quantitatively to what extent inflation as such has obstructed the growth of output and employment. Qualitative impacts are somewhat easier to describe. Since Colombia has displayed a strong propensity to maintain fixed exchange rates, inflation has introduced a progressive tendency toward exchange rate overvaluation, balance of payments difficulties and, hence, has been a cause of increasing protectionism and capital intensive bias in production. All this, as explained earlier, has helped to divert resources away from export industries toward high cost import substituting industries and has resulted in the loss of economic efficiency. Distortions caused by increasing prices appear to be quite influential in farm mechanization, for example. It has been estimated that as a result of inflation farmers purchasing farm machinery, mostly tractors, have been paying back only about 85 to 90 percent of the initial loan (20).

D. Employment Planning and Specific Employment Generating Strategies

Colombia was the first developing country to be studied by the World Bank in 1949; the first Latin American country to use Economic Commission for Latin America's (ECLA) programming approach to development planning in the late 1950's; the first Latin American country to present a development plan before the alliance for Progress in 1961; and the first Latin American nation to have its foreign aid coordinated through a consulting group of World Bank lenders. However, it is only since the constitutional

reform of 1968 that economic planning has assumed broader and more comprehensive perspectives, has acquired authority and has been based on a more realistic assessment of the existing situation (13).

Early development plans emphasized high GNP growth rates assuming that high rates of growth would lead to full employment and more equal distribution of income. By the end of the 60's it was abundantly clear that in the Colombian setting of dualism and unequal ownership of land, there does not exist a complementary relationship of any consequence between GNP growth and employment and that, therefore, major structural changes must be planned and brought about with explicit employment and income redistribution objectives in mind.

The case of Colombia has received much attention. Several strategies for action have been suggested, three of which are described below. The fourth is treated in considerable detail in the rest of the chapters.

1. ILO full employment strategy

This strategy, described in (14), is essentially based on the realization that trends in the rural-urban migration will continue, that the urban component of the population will increase and that, therefore, major emphasis on structural change must be in nonagriculture. The strategy sets 1985 as a target year by which 95 percent of the total labor force becomes fully employed. The task involves the creation of 5 million new jobs in a time span of 15 years. Of this the nonagricultural sector is required to absorb 85 percent.

The strategy is that of selective industrialization and more modern agriculture, and is based on planned changes in the labor absorptive capacities of various sectors, changes which have to be enforced to attain the desired objective of full employment. To illustrate the details the nonagricultural sector is broken down in three subsectors: alpha, beta and gamma. The alpha subsector comprises mining, manufacturing, public utilities and transport and is defined as relatively capital and skill intensive. The beta subsector which consists of construction, handicraft, commerce and personal services is relatively labor intensive, and the gamma subsector, embracing banking and other services, is skill intensive.

The basic aspects of the strategy are illustrated in Table 7. The rate of growth of labor productivity in agriculture is required to increase, implying a shift from traditional low-yielding production to more efficient modern methods making wide use of high yielding plant varieties, the application of fertilizers, insecticides, irrigation and some mechanization. The nonagricultural sector, in contrast, is required to shift to much more labor intensive production in order to absorb the bulk of the unemployed. This is indicated by falling productivity growth rates in all of the three composite subsectors.

The implementation of the ILO Strategy clearly involves drastic changes and a major dislocation of vested interests both in agriculture and nonagriculture. The growth of agricultural output is planned to increase from 3.4 percent per year in 1964-70 to 5.4 percent per year in 1970-85. The underlying growth in agricultural productivity is not possible under existing land fragmentation because the greatest majority of farms are so small that they can not hope to adopt modern inputs and

thus improve their incomes and purchasing power. The latter are needed to enlarge the domestic market which in turn is called for as part of the program of industrial growth and overall development. ILO strategy, therefore, appears feasible only under a major land reform which gives to the majority of rural people the opportunity to participate in domestic and export markets from family size farms or communal enterprises.

Since the bulk of productive employment is to be generated in non-agriculture a major effort is required to speed up its structural change and increase the growth of output to nearly 9.0 percent per year, by more than 50 percent in comparison to 1964-70. In order to achieve the employment objective the productivity growth of labor must decline to 1.8 percent per year from 2.5 percent per year in the last part of the 60's. For this to take place a basic change in the production techniques and in the output mix is required. Such change must include the elimination of the existing capital intensive bias, a readjustment of factor prices to reflect the abundancy of labor, a downward adjustment in the exchange rate, a change in the protective tariff system, the loss of special preferences for domestic and foreign firms importing capital goods, the redirection of industrial credit to labor-intensive, small-scale industries, including handicraft, catering to the demand of the rural population, etc.

The task of this dimension will impose a challenge of unprecedented magnitude on Colombia's administrative and managerial capacity to identify measures and techniques which would fit development needs best, then to change the present structure accordingly. The challenge will also exert

TABLE 7. Colombia: Growth rates of employment, labor productivity and value added by sector: Estimates for 1964-70 and hypothetical strategy for 1970-85 (annual cumulative growth rates in percentages)[a]

	Employment		Labor Productivity		Value Added	
	1964-1970	1970-1985	1964-1970	1970-1985	1964-1970	1970-1985
Sector:						
Agriculture[b]	1.4	1.8	2.0	3.5	3.4	5.4
Nonagriculture	3.2	7.0	2.5	1.8	5.7	8.9
of which:						
Capital-intensive and skill-intensive[c]	2.5	6.9	4.0	2.9	6.6	9.1
Not capital-intensive nor skill-intensive[d]	3.6	6.9	1.4	1.5	5.1	8.5
Skill-intensive[e]	3.3	8.3	1.8	1.0	5.1	9.3
All Sectors	2.3	4.8	2.9	3.2	5.2	8.1

[a]Source: (14).

[b]Agriculture, livestock, forestry and fishing.

[c]Mining, modern manufacturing, public services and transportation.

[d]Construction, artisanal production, trade and personal services.

[e]Financial and government services.

a heavy pressure on the country's educational system which will be required to sharply increase the quality and quantity of skilled manpower to ensure a successful implementation of the full-employment strategy.

2. Consistency check within an input-output framework

The central idea of economic planning is to describe the economy in such a way that the effects of an initial change in any part (sector) of it can be traced to all other parts (sectors) qualitatively and quantitatively. This is possible in an input-output framework, which ensures internal consistency of any projections within such framework. For example, given the inter-industry matrix of coefficients one can calculate if an expected increase in the final demand can be sustained with present technology, i.e., present input structure, including labor.

An attempt to check the feasibility within an input-output framework of full employment in Colombia by 1985 has been recently made (for details see (23). There are two major conclusions which result from the study. First, an agreement with other findings that if the present productive and technological structure is not basically altered, future prospects are for a rapidly worsening employment and income distribution situation, mainly because of the balance of payments constraint which will make it impossible for the GNP to increase at 8 percent per year as postulated by the ILO. Second, a drastic structural change, such as proposed in the ILO strategy (described above) may not be feasible on the grounds of consistency. The results of the input-output study are compared to those of the ILO proposed strategy in Table 8. ILO's target growth rate of GDP of 8 percent is substantially higher than the growth rates ranging between

TABLE 8. Colombia: Comparisons of results obtained in consistency study under Alternatives I and II with ILO Full Employment Strategy, 1966-1980 (compound annual growth rates 1966-1980)[a]

Sectors	Growth Rates of Value Added r_{v_i} Value Added			Growth Rates of Employment r_{e_i} Employment			Growth Rates of Labor Productivity r_{p_i} Labor Productivity		
	Alt.I	Alt.II	ILO	Alt.I	Alt.II	ILO	Alt.I	Alt.II	ILO
Agriculture	3.8	4.6	5.4	1.8	2.2	1.8	2.0	2.4	3.5
Alpha[b]	6.1	7.0	9.1	2.8	3.4	6.9	3.3	3.6	2.9
Beta[c]	5.3	6.3	8.5	3.9	4.4	6.9	1.4	1.9	1.5
Gamma[d]	5.7	6.3	9.3	3.8	4.0	8.3	1.9	2.3	1.0
GDP	5.2	6.1	8.1	2.8	3.3	4.8	2.4	2.8	3.2

[a]Source: (23).

[b]Alpha sectors are the capital and skill-intensive sectors: mining, manufacturing, utilities, and transportation.

[c]Beta sectors are neither capital nor skill-intensive, i.e., construction, craft industry, commerce and personal services.

[d]Gamma sectors are skill-intensive, i.e., finance, government services and other services.

5.2 and 6.1 percent which were found possible in the input-output study. Substantial differences also appear in the sectoral growth rates of labor productivity. As a consequence, the rate of employment generation which results from the ILO strategy appears very high, 4.8 percent annually, in comparison to 2.8-3.3 percent in this study. Finally, the sectoral growth rates of value added in the ILO alternative do not appear to be internally consistent from the demand side. A growth rate of agricultural value added of 5.4 percent seems very high given likely values of the income elasticity of demand for food in Colombia and the export prospects.

3. Multiple strategy approach - Las Cuatro Estrategias

As a result of the recent reexamination of social and economic realities in Colombia, Colombia's Department of National Planning is now evaluating a strategy which involves simultaneous action on four fronts (13). Concentration of determinate action is proposed in the following areas: urban construction, agriculture, exports and income distribution. The first three concern productive activities and are expected to contribute significantly to increased productivity, output and employment. The third is a corrective action, planned to redistribute incomes toward a greater equality by direct government intervention where the economic process is judged unable to do this on its own accord.

Emphasis on construction (residential, public, commercial) stems from the realization that economic development in Colombia today is inseparable from urban development. The strategic importance of the sector of construction to serve as an inducement mechanism for sustained

growth is due to the following. a) Housing is badly needed, there is a large but presently dormant demand for it. b) Construction is quite labor intensive requiring large numbers of unskilled labor. Furthermore, there exist strong and wide-spread backward linkages with other manufacturing sectors, with services and agriculture. Hence the direct and indirect labor requirements associated with an increase in the final demand for housing is expected to be quite substantial and will greatly stimulate productive activities throughout the economy (quantitative estimates of linkages can be found in (12)). c) High labor component and linkages will mean that an increase in construction investment will have an immediate increase in incomes and consumption, thus stimulating and widening the presently limited domestic market and spreading the growth to the rest of the economy. d) The import content of construction is very low, hence no undue pressure on the balance of payment can be expected. e) Public construction will increase badly needed facilities for education.

The strategy concerning agriculture aims toward more productive, more modern technology avoiding undue labor displacement by mechanization. However, specific emphasis is placed on more extensive redistribution of land to achieve greater equality. The Planning Department makes it quite clear that productivity in latifundia is quite low, even lower than in minifundia and that a well-planned redistribution of land can significantly contribute not only to higher productivity and output, but also to rising incomes and consumption for a large segment of the rural population.

Increase in exports is considered sine qua non to sustain the growth of manufacturing industries, including construction and also to cope with growing payments on foreign debt. Exports are expected to provide significant additional employment of their own in manufacturing as well as in agriculture. The measures which are suggested to stimulate exports and make them more competitive in world markets are along the lines already discussed.

While the three measures just described are designed to increase output, the fourth concerns itself with a more equal distribution of the gains from growth. The generation of additional employment, as envisioned by the strategy, will by itself improve the existing distribution, especially if the employed come from the ranks of un- and underemployed. However, there is a definite need to mobilize additional funds for administrative and social services, which are badly needed, especially funds for education. For this reason the income distribution aspect of the strategy proposes a progressive income tax, carefully designed not to lessen incentives. In this way the fruits from economic growth may be directed where the need is greatest for the benefit of all.

III. THEORETICAL FRAMEWORK TO ANALYZE THE DEVELOPMENT POTENTIAL OF AGRICULTURE

A. Development Perspectives

The structure and functioning of the Colombian economy provide the following perspectives on development.

1) The basic constraint on development and employment is both on the supply and demand sides. While there exists idle industrial capacity and agricultural land, there is also lack of modern inputs, incentives and appropriate technologies. The functioning of the economy has been dualistic leaving the bulk of the population, about 75 percent, with little or no effective purchasing power. Economic dualism reflected in unequal distribution of income, high and growing unemployment and underemployment, has been responsible for low and stagnating internal demand which in turn has limited the expansion of output and the growth of manufacturing in particular.

2) Industrialization by import substitution has led to the growth and diversification of the economy. The measures used to promote industrial development, however, have imparted capital intensive bias, and caused relatively inefficient, inward looking enterprises to develop without a favorable impact on employment and on the distribution of incomes. Given the size of the rural-urban migration and the extent of urban unemployment, it is quite clear that even if corrective policy measures are applied to eliminate existing distortions, manufacturing and allied industries will not be in the position to cope with the employment problem in the foreseeable future.

3) Agriculture is still dominant in terms of employment and output. In addition, agriculture provides about 75 percent of total export earnings, 95 percent of domestic food supply and 50 percent of the primary materials used by industries. The importance of agriculture, however, lies in the dormant growth potential of its vast subsistence subsector. So far this potential has been neglected. Most investment, managerial skills, research and marketing have been concentrated on the modern export sector. There has been slowness in establishing necessary rural institutions such as farmer's cooperatives, credit and marketing facilities, agricultural extension, etc. to help the subsistence farmer. The early coffee experience indicates that the development potential of agriculture is considerable. If physical capital is short, skill formation and organization can replace it in the short run. There is, therefore, ample room for greater labor intensity, higher productivity and incomes, supported by appropriate technology and policy measures.

The above indicates that in the Colombian context an overall development strategy must place primary emphasis on agriculture. Such realization is evident in the latest Colombia's development plan, Las Cuatros Estrategias. In this plan one of the major goals, as indicated, calls for technological change and modernization of agriculture so that productivity and incomes in its traditional subsector can be significantly enhanced. The intent is to stimulate internal demand and at the same time to decrease the flow of rural migrants who are either being pushed off the land by extensive mechanization and concentration of land ownership or are being pulled to the city by the apparent possibility of better life.

In Colombia, agricultural production takes place in two distinctive subsectors: (1) using labor-intensive, traditional ways of cultivation, accomplished with simple hand and animal methods, and (2) using fully mechanized, capital intensive methods. If agriculture is to take advantage of its growth potential, a mixed or intermediate technology will have to be planned (to the extent that it does not presently exist) and become dominant. The last two decades have seen the successful spread of high yielding varieties along with modern agricultural inputs which have increased output per area quite substantially and improved incomes in the small farm sector. The new technology has also proven more labor intensive, therefore, there is a considerable scope for the generation of employment on larger farms if excessive mechanization is avoided, on new land or by means of land redistribution.

Economic progress in Colombia, therefore, depends on the choice and enforcement of appropriate agricultural technology. A new input-output pattern is needed, not for a once-and-all effect, but for a sustained expansion of agricultural productivity and output and for an improved distribution of incomes. The logical move is to adopt a technology or a mix of technologies which on the average are both labor using and yield increasing. The task is to raise labor productivity and to distribute benefits from it more widely and evenly so that the dominant agricultural sector can make a significant contribution to finance the expansion of manufacturing by providing investable surplus and by generating increasing demand for manufactured products.

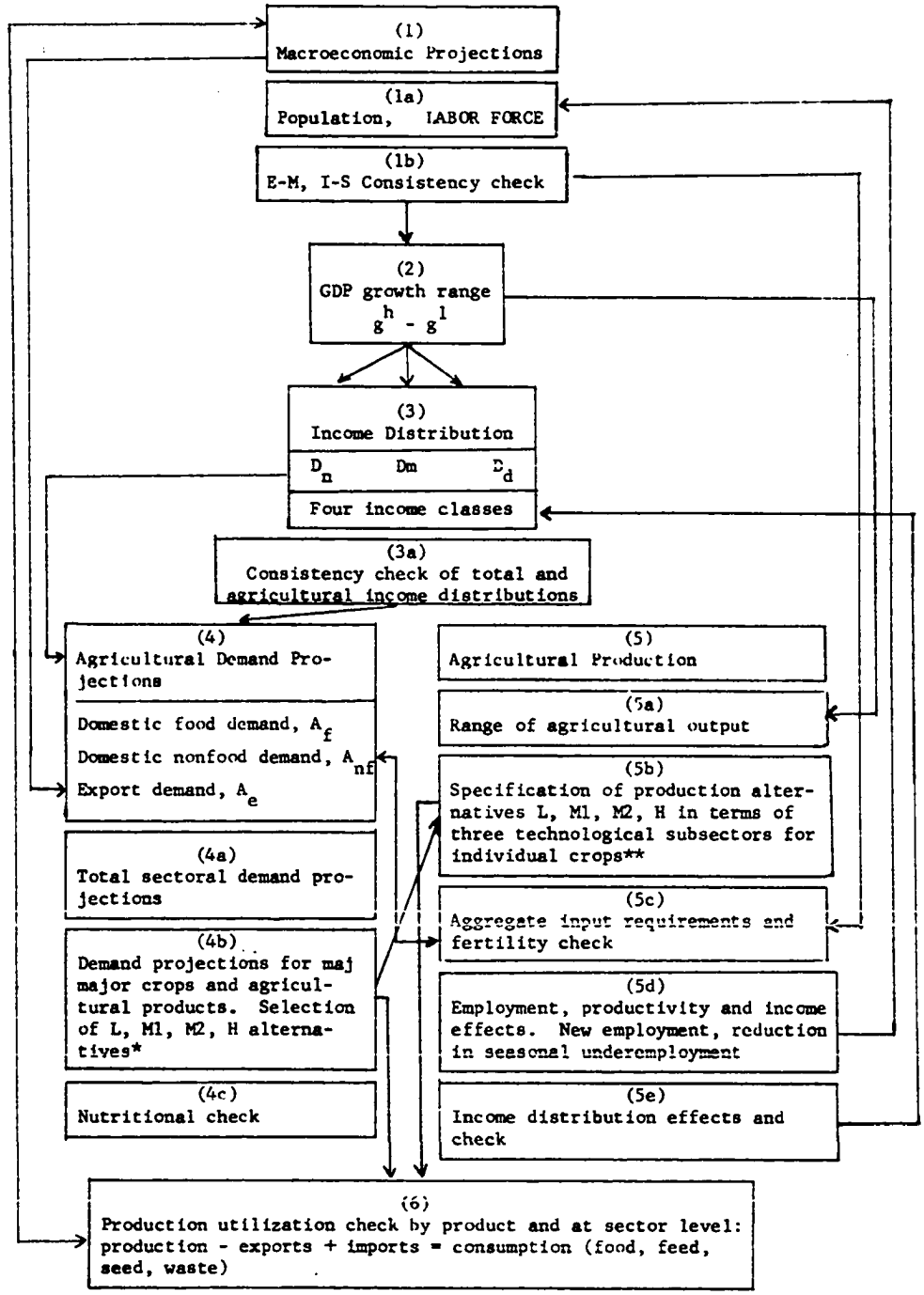
In order to ensure rigor and overall planning consistency there is need for an analytical framework within which possible agricultural development alternatives in terms of output, employment and income distribution can be evaluated. Such framework is presented and discussed in this chapter. Its building blocks were partially developed in the course of Central American wide pilot study in Guatemala in 1971, by the UN-GAFICA team in which the author participated. The formal framework was developed later in the year at FAO's headquarters in Rome, Italy by Professor Erik Thorbecke (24). The present author was then a member of the Policy Advisory Bureau at FAO headquarters and participated in the application of the methodology to the Colombian economy. The presentation here is a synthesis and evaluation of the above planning experience.

B. Logic of the Consistency Framework

Economic planning process can be divided into several stages. Each stage may be thought of as part of the total, standing in a hierarchy of mutually consistent models of increasing order of complexity or detail. In such a framework any concrete problem may be treated in an efficient way at any form of dissagregation by any one or more models according to the nature of the problem.

The present framework is schematically represented in Figure 5. Connecting arrows indicate relationships between individual parts. The following major stages are involved.

1) Economy wide model to obtain macroeconomic and demographic projections for the target year 1980.



*See Table 9.

**See Table 10.

Figure 5. Consistency framework (24)

2) Selection, on the above basis, of a range in the GDP growth.

3) Specification and introduction of income-redistribution targets.

4) Agriculture demand projections consistent with income redistribution targets and export prospects.

5) Specification of production (supply) plans stated in three technological subsectors or levels.

6) Estimation of employment and income distribution effects of the above production plans. Central to this stage is a consistency check between income distribution targets specified at the outset and actual income distribution resulting from the proposed production plan. This check consists of an iterative procedure until convergence is achieved and feasible production alternatives are obtained.

7) Production utilization check.

C. Economy Wide Macroeconomic Estimates

In order to delimit the capabilities of the economy for the purpose of more disaggregated analysis, it is essential that the movement of such economic aggregates as GDP, savings, imports, exports and the impact of economic policy instruments such as tax rates, government consumption, government investment on economic variables included in the system can be traced and estimated at the end of a period with the highest degree of certainty. For this reason a macroeconomic model is needed to capture the first stage in the hierarchy of planning and to ensure that the analysis in agriculture can be carried out consistently and down to the micro level of individual crops.

1. GDP and population growth range

The starting point of the methodology is the determination of the overall growth rates of the economy. In Colombia as well as in other export led countries, changes in external conditions, particularly in the terms of trade are major determinants of the rate of growth of aggregate output. Although export behavior may be difficult to estimate, mostly because the demand for exports is largely determined outside the system, it is essential that at this stage such estimates are obtained, preferably on the product basis. To allow for variations, three alternative export behavior possibilities need to be considered: pessimistic, A_e^{pes}, medium, A_e^{med}, and optimistic, A_e^{opt}. On this basis the macro model can then determine the likely range of GDP growth in the planning period. This range is fixed by a high or optimistic growth rate, g^h, and a low or pessimistic growth rate g^l. By definition, these rates constitute an objective and not a result of the development possibilities of each sector of the economy. Furthermore, the methodology considers that these growth rates can be obtained independently of changes in income distribution structure.

The second important macro variable is that of population growth, p. Although population projections are usually considered independent and exogenous of the economic system in question, certain aspects such as the participation rate and the trends in the rural-urban migration are clearly related to the process and stage of development and can be incorporated at this stage of analysis. Here population and labor force projections have to differentiate between agriculture and nonagriculture.

It is possible of course, to specify a range for the population growth rates as well, but since the quality and coverage of demographic variables are quite good in Colombia, and since the planning horizon does not exceed 10 years, only one growth rate is specified.

2. Income distribution objectives

While population growth in combination with accelerated external demand for agricultural products may raise demand and income in agriculture, it is fairly obvious that these factors per se would not be strong enough to induce changes to an extent commensurate with the need to eliminate poverty and foster sustained development. Therefore, the methodology introduces specific income distribution goals for the economy as a whole and for the sector of agriculture in particular. Income redistribution is introduced as a factor having the dual role of a) stimulating demand for agricultural products by increasing at a rate faster than the national average the purchasing power of the low income consumers who have a higher marginal propensity to spend on agricultural products than the high income groups of the population, and b) using the agricultural income generated from the concomitant increases in agricultural production to meet, to the extent possible, the income redistribution targets within the agricultural sector itself to the benefit of the poorer strata of the agricultural population.

If the existing income distribution is known, another income distribution can be specified as a target. For example, taking 1970 as basis, the following changes may be postulated for the target year 1980.

Population		Income			
		1970		1980	
Class	Percent	Percent	$ Per Capita	Percent	$ Per Capita
Low	50	13	74	24	248
Medium	30	26	264	32	551
High	15	30	568	27	931
Very High	5	31	1,760	17	1,760
Total (percent)	100	100		100	
Average ($)			289		517

Here while the average income nearly doubles from $289 in 1970 to $517 in 1980, the per capita income of the lowest 50 percent of income earners more than triples, but that of the highest 5 percent of income earners remains the same. The end situation is clearly a much different economy, an economy with greater distributive equality, with considerably larger internal market and with different composition of final demand.

The above example involves very drastic and dynamic changes which may not be feasible in the light of conditions under which output is produced. To triple the income in the lowest income strata means that there must be significant productivity increases, and that large additional land and capital resources might be drawn into production. Consequently, the three alternatives are provided, namely no change (D_n), moderate change (D_m) and drastic change (D_d). In the first instance income distribution remains unaltered, that is, the base year distribution by income class would be maintained. In the second instance, income undergoes moderate redistribution, i.e., the increased

income generated during the period is roughly distributed towards the economically weak groups. In the last instance income distribution undergoes a drastic change - not only the increase in income but also part of the income already generated is redistributed.

It is important to note that the implications for the performance of the economy of the above changes can be fully assessed only if the income distribution data is relatively good. If, for instance, the actual income distribution for the base year, is more unequal than indicated, the change to the target distribution D_m or D_d would be that much harder or even impossible to achieve. In the case of Colombia six principal estimates of income distribution patterns are presently available in (25). Two of these, Berry and Urrutia, are estimates of income distribution in the agricultural sector, while the remaining four, Taylor, Musgrave, CEPAL and DANA 1970 are economy wide estimates.

In the presence of a large traditional subsector, it is essential to check the consistency of the base year income distribution with other available information; e.g., by computing the value of the subsistence diet which together with the number of subsistence farmers might provide enough information to approximate the average income going to the lower income class in agriculture.

In the consistency framework which is economy wide, but within which agriculture is selected for detailed analysis care must be taken that the estimate of income distribution in the agricultural sector is consistent with that in the economy as a whole. A test of the required consistency between the economy wide and agricultural sector income distributions is

provided in (26). Serious difficulties in comparing two or more income distribution estimates may arise if the methodology used and/or the years of estimation differ.

D. Analysis on the Demand Side

1. Aggregate projections

Once the macroeconomic variables have been obtained and income redistribution targets specified, demand for agricultural products under the three income redistribution alternatives can be estimated. Agricultural demand constitutes an important part of the growth dynamics and determines in large part the extent to which output and employment goals can be achieved. Although demand in itself cannot create productivity increases it can encourage them and provide a favorable environment for producers to take decisions that result in development.

To improve the quality of projections, total agricultural demand, A, is considered in a disaggregated fashion. Distinction is made between three basic components: export demand, A_e, domestic food demand, A_f, and domestic nonfood demand, A_{nf}. Thus:

$$A = A_e + A_f + A_{nf} \tag{1}$$

A_e, the export demand, is projected, as indicated, on the basis of pessimistic medium and optimistic assumptions. Given the base year quantity, A_e , and the rate under which exports are expected to expand, e.g., A_e^{pes}, under pessimistic conditions, total export demand at the end of t years is

$$A_e = A_{eb}\left[1 + a_e^{pes}\right]^t \tag{2}$$

A_f is determined internally and depends on the population growth rate, p, on the rate of growth of per capita GDP, g_p, and on the income elasticity of food demand, ϵ_f. The relationship is as follows:

$$a_f = p + \epsilon_f g_p \tag{3}$$

where A_f is the rate of growth of food demand. The domestic food demand in year t is then determined by:

$$A_f = A_{fb} \left[1 + a_f\right]^t \tag{4}$$

where A_{fb} is the base year quantity.

A_{nf}, the nonfood demand, may be computed in a similar way, namely by first estimating the rate of growth of nonfood demand,

$$a_{nf} = p + \epsilon_{nf} g_p \tag{5}$$

and then applying this to the base year quantity as before. The situation here is somewhat more complicated since nonfood demand is in general a derived demand which depends on the demand for final product and of the technological input-output relations of production. Discussion of estimation procedures for the nonfood demand is found in (26).

The combination of GDP growth alternatives (two), export alternatives (three) and income redistribution targets (three) leads to eighteen permutations of total agricultural demand. Although each of these may be selected for further analysis, only four, including the combinations resulting in the lowest and the highest demand levels, are needed to describe the demand potential. Presented in Table 9 these are:

(a) Alternative Low: it represents a combination of domestic demand resulting from the projection on the basis of the low economic growth

variant with unchanged income distribution and the medium export alternative.

(b) Alternative Medium 1: it represents a combination of domestic demand resulting from the projections on the basis of the high economic growth variant with unchanged income distribution and the medium export alternative.

(c) Alternative Medium 2: it represents a combination of the domestic demand resulting from the projections on the basis of the high economic growth variant with moderate income redistribution and the optimistic export alternative.

(d) Alternative High: it represents a combination of the domestic demand resulting from the projections on the basis of the high economic growth variant with drastic income redistribution and the optimistic export variant.

TABLE 9. Definition of selected alternatives of projected total demand

Projected Total demand alternative	Combination of	Projected Domestic Demand related to:		Projected Export demand alternatives
		Economic Growth variant	Income Redistribution hypothesis	
Low (L)		low (l)	no change (n)	pessimistic (pes)
Medium 1 (M1)		high (h)	no change (n)	medium (med)
Medium 2 (M2)		high (h)	moderate change (m)	optimistic (opt)
High (H)		high (h)	drastic change (d)	optimistic (opt)

These alternatives represent, in ascending order, combination of more and more favorable demand conditions. Furthermore, they provide for direct comparison of the influence on domestic demand of an acceleration of economic growth (comparison between alternatives Medium 1 and Low) and of the income redistribution (comparison between alternatives High, Medium 2, and Medium 1).

Letting b stand for the base year and t for the target year and using symbols already defined, the four selected demand projections can be stated in mathematical terms as follows:

$$L = A_{fb}\left[1 + p + \epsilon_f^n g_p^l\right]^t + A_{nfb}\left[1 + p + \epsilon_{nf}^n g_p^l\right]^t + A_{eb}\left[1 + a_e^{pes}\right]^t \quad (6a)$$

$$M1 = A_{fb}\left[1 + p + \epsilon_f^n g_p^h\right]^t + A_{nfb}\left[1 + p + \epsilon_{nf}^n g_p^h\right]^t + A_{eb}\left[1 + a_e^{med}\right]^t \quad (6b)$$

$$M2 = A_{fb}\left[1 + p + \epsilon_f^m g_p^h\right]^t + A_{nfb}\left[1 + p + \epsilon_{nf}^m g_p^h\right]^t + A_{eb}\left[1 + a_e^{opt}\right]^t \quad (6c)$$

$$H = A_{fb}\left[1 + p + \epsilon_f^d g_p^h\right]^t + A_{nfb}\left[1 + p + \epsilon_f^d g_p^h\right]^t + A_{eb}\left[1 + a_e^{opt}\right]^t \quad (6d)$$

Here the first term on the right hand side refers to the component of food demand, the second to the component of nonfood demand and the third to the component of export demand.

It is, of course, clear that the growth rates of total agricultural demand, a^i, i = L, M1, M2, H, can be obtained from

$$A_t^i = A_b\,(1 + a^i)^t \quad (7)$$

2. Individual projections

So far the demand projections have been presented in aggregate terms, i.e., on the basis of the sum of the total consumption of agricultural commodities by the four population strata. It is essential, however, to complement the sectoral projections discussed above with more disaggregated commodity projections. In most countries it is possible to obtain quite reliable estimates of elasticity coefficients for individual products (crops). In fact, in a number of countries the aggregate elasticity coefficients corresponding to different income distribution alternatives (ϵ_f^i and ϵ_{nf}^i where i = n, m, d) can only be obtained through the aggregation (consolidation) of elasticity coefficients for individual commodities. In general, it may be sufficient to take six to ten products and subject them to a detailed analysis to obtain the bulk of agricultural demand and to carry out simple extrapolation for the remaining products.

The estimation of demand on individual commodity bases is similar to that presented at the sector level. As before, distinction is made between food, nonfood and export demands. While the export component of the demand is obtained in the usual fashion, the food and nonfood components require the estimation of specific demand functions for each commodity in which the per capita consumption is functionally related to per capita income. There are four different demand functions which are currently used by the FAO for this purpose: the double logarithmic function, the semi logarithmic function, the inverse logarithmic function and the double inverse logarithmic function. The mathematical

specification of these functions as well as their graphical representation are placed in the Appendix and are presented in Tables A1, A2, A3, and A4.

It is important to note that the coefficients of elasticity ϵ^n, ϵ^m and ϵ^d attached to the income redistribution targets D_n, D_m and D_d are aggregates of four separate income elasticities of demand, since, it must be recalled, each of the income redistribution variant is defined in terms of four income classes. Because each of these classes has a distinct and different average per capita income, the elasticity coefficient for each class is also different. As a rule, the elasticity coefficient for the lowest income class has the highest numerical value, indicating that increments in income of the poor are almost completely spent on food. For the highest income class the elasticity coefficient for food demand is usually very low, since additional incomes are spent largely on nonfood, mostly luxury items.

Given the demand function for a particular commodity j, total domestic demand for that commodity, Q_j, can be computed as a sum of the demands of the four income classes. Once Q_j is known, it is possible to obtain the value for the aggregate income elasticity of demand coefficient ϵ_j. A simple method is provided in (27).

For each commodity j there are four major projection alternatives as indicated in Table 9. To obtain corresponding projections at the sector level it is necessary to aggregate individual projections over the commodity range j. The aggregation requires a set of domestic and export

prices. The value of agricultural demand at sector level in year t is calculated as follows:

$$V_t^i = \sum_j p_{ej} E_{jt} + \sum_j p_j Q_{jt} \qquad (8)$$

where

V is the total value of agricultural demand in the target year t,

i is the L, M1, M2, H,

p_{ej} is the export price of commodity j,

E_{jt} is the projected export volume of commodity j in year t,

p_j is the domestic producer price of commodity j, and

Q_{jt} is the projected volume of domestic demand of commodity j in year t.

The growth rate of demand V^i, (i = L, M1, M2, H), can then be calculated from:

$$V_t^i = V_b (1 + v^i)^t \qquad (9)$$

where V_b is the base year value of demand.

This concludes the major analytical steps on the demand side. Before turning to the supply side it is desirable to subject the results of the demand projections, aggregated at the sector level, to a nutritional test to ensure that basic minimum standards are met. The nutritional state of the population is perhaps one of the most fitting of measures of development, particularly in low income countries where the weight of the traditional subsector is quite large. For this reason the daily intake of protein and calories required for adequate health must be introduced so that the various demand projections can be checked for consistency on this account.

E. Analysis on the Supply Side

The process of economic growth is fundamentally one of changes on the supply side which increase the productive capacity of the economy. Demand itself cannot generate such changes, although it can encourage them by providing a favorable environment of incentives for producers to take the right kind of decisions. Supply analysis affects the design, organization and requirements of the production process and, therefore, constitute the essence of agricultural development.

The technological production levels are determined by the necessary quantity of each of the factors of production per production unit. The choice of the technological mix, therefore, determines the utilization of inputs. In a labor abundant, capital scarce economy the appropriate technology should be one which increases the labor-capital ratio. This will tend to maximize employment and improve the distribution of incomes. The latter can be further enhanced if technological aspects are combined with changes in property structure and labor remunerative aspects.

These considerations show the necessity of designing, classifying and ordering agricultural production alternatives to meet employment and income redistribution objectives. More specifically, taking the demand alternatives discussed in the previous section, the task is to estimate the type and quantities of inputs to be used to achieve production objectives for each product.

1. Sector-wide projections

As an initial step, the supply capacity and input requirements of agriculture should be checked grosso modo at the sector level. One possibility is to take the lower and higher demand variants (L, H) and check the feasibility of achieving these on the basis of a) agricultural GDP trend projections, and b) the past and expected future elasticity of agricultural output with respect to total GDP.

In the latter case, estimates of elasticity coefficients can be obtained from international cross sectional studies, covering a large sample of developing or developed countries, or from countries which are in the same development stage. Using the approach suggested by Chenery in (28), the coefficient of elasticity, b_1, is obtained from

$$V_{si} = k\, r_i^{b_1}\, P_i^{b_2} \qquad (10)$$

where V_{si} is the value of per capita agricultural output of country i, r_i is the level of per capita GDP in country i, P_i is the population of country i and b_2 is the elasticity of agricultural output to population.

Next it is necessary to estimate input requirements for the low and high demand variants. In most developing countries the rate of growth of inputs into agriculture is higher than that of output because of the tendency to adopt more efficient techniques of production. Consequently, The ratio of agricultural GDP (value added) to agricultural output tends to fall over time. A realistic range for the elasticity of agricultural value added to output might be of the order of .8 to 1.0.

Finally, the growth rate of value added can be compared to the likely growth rate of the agricultural labor force to obtain the implied growth rate of labor productivity. This can be done with the help of

$$\frac{1 + g_a}{1 + b_a} = 1 + \pi_a \qquad (11)$$

where

g_a is the growth rate of agricultural GDP (value added)

b_a is the growth rate of agricultural labor force, and

π_a is the growth rate of agricultural labor productivity.

In turn, an estimate of the implied labor productivity (π_a) in agriculture permits one to check grosso modo some of the distributional implications for agriculture and the feasibility of achieving a desired overall income distribution alternative.

In summary, the most that can be expected from supply projections undertaken at the sector level is that they provide very rough checks of the feasibility of satisfying the projected agricultural demand, and the given changes in the overall income distribution. Alternatively, these supply proposals may serve a general guideline for the magnitude of growth in agricultural production which has to be achieved.

2. Production alternatives at the commodity level

a. Specification of technological subsectors for individual crops

One of the features of agricultural production is that there exists a considerable variety in the production of cultivation to a given output (crop). For example, rice may be broadcast or planted in straight rows; the seedlings may be transplanted or not; the farmer may use chemical

weedkillers, weed by hand or not weed at all; he may prepare the soil with a hoe, animal force or with a tractor; the fields may be irrigated, or reliance may be placed on rainfall or flooding; the harvesting may be with a combine, with a sickle or a knife. The same applies to all other crops. They can be cultivated in traditional ways with little or no application of the results of modern agricultural science, without the use of fertilizers, high quality seeds, plant protection and modern machinery. Or the production can proceed along the lines of modern, highly mechanized commercial practices. In between there are a number of possibilities which combine the traditional and modern methods of production.

A production technology is defined in terms of the input structure. For a number of crops, where the crop is grown in two or three technically or regionally different subsectors, it is possible to specify and quantify separate input structure for each technology (technological level) of production. In these instances the whole process of agricultural production can be described in great detail with considerations for the share of each technology in the total and the implications of the changes in these shares with respect to employment, intermediate inputs and output and with respect to income distribution.

The methodology, therefore, describes the supply side at individual crop level in terms of three technological subsectors: traditional (T), intermediate (IM), and modern (M). For each of the major crops j the input-output information is collected and quantified as indicated in Table 10. To simplify the various inputs such as irrigated and

TABLE 10. Target year input-output structure of crop j produced in three technological subsectors where i = L, M1, M2, H

Technological subsector	Land		Intermediate inputs			Capital	Labor	Output
	irrigated	nonirrigated	fertilizers	insecticides	others			
T^i	←		I^T_{jk}		→			Qs^T_j
IM^i	←		I^{IM}_{jk}		→			Qs^{IM}_j
M^i	←		I^M_{jk}		→			Qs^M_j
Total or average	←		I^i_{jk}		→			Qs^i_j

nonirrigated land, fertilizers, insecticides, labor, etc. are lumped together and designated by I. In the actual production plans which appear in Chapter IV, individual input coefficients are estimated for each input category. Total output and inputs are summed together in the bottom line.

This information is collected first for the base year. Then taking the four demand alternatives specified in section D.2 as production goals, likely changes in the input structure of the technological subsectors are investigated and their feasibility determined. An important assumption here is that production alternatives are relevant to their relative demand projections because grosso modo, the same overall economic factors influence both of them. This assumption is reflected in the combination of domestic demand with export demand alternatives within the total demand alternatives and the consideration that demand acts as a ceiling for production. Hence, for the target year, t, four supply alternatives, or production plans, for each crop j have been postulated, namely Qs_j^i, Qs_j^i, Qs_j^i and Qs_j^i, where i = L, M1, M2, H and refer to the Low, Medium 1, Medium 2 and High production alternatives, respectively.

In deriving these estimates the following considerations must be taken into account: How much of additional production should come from the extention of harvested area versus increases in yields? Where should new land be developed or how could the intensity of land use be increased? What yield increasing measures should be emphasized and how should they be combined? For the individual crops the basic procedure to adopt is:

a) To examine past trends in production, area and yield and identify reasons for observed behavior.

b) If past trends appear to be sufficient for reaching desired targets, it is important to examine whether area and yield components are feasible. For example, an observed short run expansion in cultivable area, if postulated over the planning period, may exceed the availability of arable land.

c) If past trends appear to be insufficient, a preliminary area figure should be postulated in the light of information on land development opportunities and costs and then a check should be made of the increase in yields to meet demand. If the resultant yield level appears feasible from technical and economic points of view, changes in the input level should be identified which would be required to reach the postulated output.

b. Value added at crop level The agricultural value added at the level of individual crops for each of the four supply alternatives can be obtained by deducting the costs of inputs from the value of output. Table 10 provides the physical input requirements as well as the corresponding output. Applying prices consistent with those on the demand side, the value added is:

$$Y^i_{jt} = V^i_{sjt} - \Sigma p_k I^i_{jk} \qquad (12)$$

where

Y^i_{jt} is value added of commodity j in t

p_k is the price of input k

I^i_{jk} is total input requirements to produce j

i is the four supply alternatives T, M1, M2, H

c. Sector wide aggregation and estimation of agricultural GDP growth Having estimated the likely input-output structure under the L, M1, M2 and H growth alternatives for individual crops it is necessary to aggregate the results at the sector level. Total production can be obtained from

$$Vs_t^i = \sum_j p_j \, Qs_{jt}^i \qquad (13)$$

where

Vs_t is the value of agricultural production in target year t,

p_j is the price of product j,

Qs_{jt} is the supply projection of product j in year t, and

i is L, M1, M2, and H.

Then the growth rate of agricultural output a_s^i, can be calculated from

$$Vs_t^i = (1 + a_s^i)^t \, Vs_b \qquad (14)$$

where

Vs_b is the value of agricultural output in the base year.

The value added at the sector level is the sum of individual values across j. In algebraic terms

$$Ys_t^i = \sum_j Y_{jt}^i \qquad (15)$$

where i is as before.

The corresponding growth rates of agricultural value added, y_s^i can be calculated from

$$Ys_t^i = (1 + y_s^i)^t \; Ys_b^i \qquad (16)$$

where

Ys_b^i is the value added in base year,

i = T, M1, M2, H.

F. Feasibility Check

The methodology at this stage yields a number of production alternatives and growth rates to be matched with corresponding projections on the demand side. Even while working on the estimates for individual products, some total limiting resource factors, such as land, investment capital, infrastructural development, etc. must be kept in mind. However, it is only at the aggregate level stage that these can be quantitatively tested.

The quantity and value of various supply projections must be compared both cropwise and in aggregate with the quantity and value obtained on the demand side. Where the supply capacity of the production plan falls below demand, the extent to which deficiencies can be alleviated through imports must be considered. Those alternatives which can be satisfied only through relatively large imports should be carefully checked out from the standpoint of balance-of-payments. It is important to aggregate the total sectoral import demand and compare it to the total projected value of imports available from the macro model. In general, a large increase in the proportion of agricultural imports to total

imports would not be feasible because of balance-of-payments constraint. Consequently, only supply plans which can reasonably satisfy domestic demand through domestic production and imports should be considered feasible.

Similarly, judgment must be passed as to the size of excess supply which can be tolerated without harmful effects on the prices of commodities involved. If large excess supply imbalances are allowed to exist, there will be a decline in prices leading to a situation which is inconsistent with the assumption of the maintenance of stable prices.

Equally important is to check the feasibility of inputs required by each of the supply alternatives. It is obvious that the aggregate input requirements must not exceed domestic supply and import capacity. Where inputs such as fertilizers, farm machinery, improved seeds, etc. are imported, a rough check must be made to test the foreign exchange expenditures involved and the implication for the balance of payments equilibrium.

In a surplus labor economy such as Colombia, labor will not in general be a constraint on production. However, seasonal bottlenecks are possible since for any composition of output labor requirement pattern varies from month to month. It is, therefore, important to evaluate for each of the supply alternatives peak monthly labor requirements and check these with available labor supply. A check on land area by crops underlying a given supply alternative must also be included since the area of land can not exceed the cultivable and potentially

available area. For other public inputs such as the provision of extension services, agricultural credit, irrigation assistance, etc., it is important to ensure that total expenditures do not significantly exceed budget allocations for agriculture.

A feasibility check along these lines will help to eliminate supply alternatives which are not economically feasible. Those that remain can be examined for employment and income distribution implications.

G. Employment and Income Distribution

In view of the smaller labor requirement per hectare for the modern technological subsector, increasing its share in total production would entail sacrificing the possibilities of increasing employment or opting for reducing yields in order to permit greater increase in employment through the expansion of area of the traditional subsector. Hence, the importance of the third intermediate technological subsector in which a level of yield per unit area would be achieved roughly similar to that of the modern subsector, but with greater labor intensity.

The basic approach of the methodology is, therefore, centered on quantifying and exploring employment and income effects that would be produced by technological change that, on the average, is more labor intensive and more productive. The differences between the three technological subsectors are not due exclusively to whether there is more or less mechanization of production activities, although it obviously constitutes one of the central elements in view of its effect on labor

requirements per hectare. In many cases, increased mechanization, when properly planned, goes hand in hand with the widespread use of modern inputs such as improved seeds, fertilizers, etc. which increase not only the use of labor but also yields per unit area.

Distinction has to be made between labor requirements per unit of output and unit of land because these may change in opposite directions with technological change. Thus, if, for example, the production technology in the traditional subsector is replaced by the technology prevailing in the intermediate subsector, labor requirements per unit of area will increase because of the use of intermediate inputs such as fertilizer, insecticides, irrigation, which are complementary with labor. Labor intensity per unit of land may also be increased through the use of selective mechanization eliminating seasonal labor bottlenecks and permitting, among others, multiple cropping. But while labor requirements per unit area are increasing, labor requirements per unit of output are decreasing as a result of yield increases. Thus, in an aggregate sense, total employment will increase only if the relative increase in total production is greater than the relative decline in labor requirements per unit of output.

As a first step total labor requirements for, or the labor absorbtive capacity of, the selected supply alternatives must be calculated. This involves aggregation over crops and technological subsectors. Since the individual production plans specify labor input in terms of man-days, these should be converted into man-years. Conversion rates differ ranging from 200 man-days to 250 man-days per man-year.

Having obtained total labor requirements for the target year t, LF_t, and knowing the base year, b, requirement, LF_b, increments in the employment capacity as well as the growth rate of employment, e, for each supply alternative can be calculated. The latter can be obtained from:

$$LF_t^i = (1 + e)^t LF_b \qquad (17)$$

$$i = T, M1, M2, H.$$

Since the corresponding growth rates of agricultural value added, y_s^i, were already calculated, the rate of growth of labor productivity, π, based on individual production plans, can be obtained from:

$$1 + \pi = \frac{1 + y_s}{1 + c} \qquad (18)$$

indicates the annual rate at which productivity in agriculture increases. Assuming that productivity increases elicit known increases in per capita income of the four income classes, it is then possible to calculate sectoral income distribution implications of a given production alternative. In particular, it is possible to ascertain whether a selected supply alternative is sufficiently productive and whether productivity affects the traditional sector in a manner to generate and sustain that distribution of income which was postulated as a target on the demand side.

H. Reiteration for Convergence and Consistency

The methodology postulates independent analytical approach from two sides - from that of demand and supply. Such approach ensures that general equilibrium is maintained. In comparing the magnitudes projected or specified as targets on the demand side with corresponding results on the supply side, the size and nature of various imbalances become apparent. Hence, it is possible to reject unfeasible variants or to consider readjustments until the differences are reconciled or become insignificant.

Projections on the demand side can be readjusted mainly be selecting alternatives with different income redistribution targets and/or different GDP growth rates. Adjustments on the supply side can be effected mainly by changing the technological mix , that is, the relative weights of the three technologies during the planning period. Thus, for example, if a given production plan falls short of output and income distribution targets specified on the demand side, new production plan with changed technological conditions can be substituted which comes closer to the desired objectives. If, however, it must be concluded that the conditions under which production is likely to take place can not be greatly influenced, then the targets on the demand side must be lowered. Such iterations may be repeated until desired convergence is achieved.

There is also the possibility to make adjustments, in the final product mix . Taking into account the limitations imposed on the demand side, emphasis could be placed on more labor intensive crops such as vegetables, oilseeds, etc. which could be expanded under a policy of

economic diversification and could help to raise the employment capacity of agriculture.

Each production plan contains either implicitly or explicitly a number of policy implications which may question the feasibility of its implementation under the specific conditions of Colombian agriculture. Thus, for example, the high production alternative H, which aims at a drastic redistribution of income, may be possible only if an agrarian reform is carried out. For this reason, the reiteration for convergence and the selection of consistent alternatives should be more than a mathematical exercise; it should be policy oriented and provide, in the above case, for example, quantitative estimates of the probable goals of an agrarian reform to attain the objectives of income redistribution in the agricultural sector.

As a result of the consecutive steps described, the methodology provides consistency throughout the analysis. First, the macro model ensures a realistic range for GDP growth alternatives and situates the sector of agriculture in the total economy. Second, given the income redistribution and nutrition targets, agricultural demand is obtained in the above context. Third, following the procedure on the supply side, feasible production alternatives can be selected to match the demand. Fourth, from these the labor content as well as input requirements can be ascertained which may prevail if supporting agricultural policies are implemented. The planner and the policy maker is thus in the position to analyze the factors which govern the trend of employment in agriculture and to determine the role which this sector can actually play in solving the employment and income distribution problems.

IV. INVESTIGATION INTO THE LABOR ABSORBTIVE CAPACITY OF THE COLOMBIAN AGRICULTURE

In Chapter II the nature and functioning of the Colombian economy was examined in some detail. It was shown that attempts to bypass agriculture by rapid industrialization were failing mostly because of the capital intensive nature of modern enterprises which did not provide the opportunity for sizeable employment generation. The neglect of agriculture resulted in continuously low internal demand retarding the growth in both agriculture and manufacturing. In addition, failure to develop a viable inflow of export earnings from manufacturing or to check rising imports of food and agricultural products tended to aggravate foreign exchange shortages and cut into the supply of imported development capital. These circumstances underlined the importance of agriculture as an essential underpinning for accelerated development and showed the need and possibility to transform Colombia's agriculture into a driving force for economic growth.

Under the Colombian circumstances the best strategy for raising levels of living appears to be in technological and structural changes which increase agricultural output and labor inputs. In this chapter it is attempted to estimate quantitatively the extent to which this change can take place on the supply side in response to increases in demand, and to explore the implications for greater labor intensity and agricultural productivity between 1970 and 1980.

To associate increases in agricultural productivity with increases in employment may seem paradoxical, since the low levels of productivity

which characterize the traditional subsector in agriculture are partly the result of more people being on the land than are really needed, even at low levels of technology. However, the analysis of the Colombian economy indicated that this objective is in fact quite feasible.

In the first place, it was found that existing yields, compared internationally, were on the average quite low. Therefore, there is substantial room for the introduction of yield increasing techniques based on inputs complementary with labor. Secondly, one of the conclusions of Chapter II was that low productivity in Colombia was not the result of lack of productive resources and abilities. These were hidden, scattered or badly utilized and require only a catalytic agent, such as extended private ownership of land or other incentives, to draw additional labor into production. Thirdly, as labor requirements vary from one crop to another, higher labor intensity can be obtained by a possible change in the final output mix. Fourthly, yield increasing and labor using technology may be also extended to new agricultural land.

A. Specification of Production Alternatives

The basic information for the planning period is presented in Tables A.2 through A.12 which are placed in the Appendix. There are nine major crops which are listed separately: wheat, rice, maize, barley, pulses, coffee, cotton, potatoes and sugar. These comprised about 76 percent of the total area under crops in 1970. The remaining crops which

comprise millet, sorghum, cassava, yams, other starches, plantains, groundnuts, vegetables, bananas, citrus, other fruits, cocoa, coconuts, soybeans, sesame seeds, palm oil, sisal and tobacco are lumped together under the heading of Other Crops in Table A.12.

Taking 1980 demand estimates as given - these were provided by the FAO Production Team - four production alternatives or production plans: Low (L), Medium 1 (M1), Medium 2 (M2), and High (H) were postulated for each crop to match the corresponding four alternatives on the demand side. In each case three technological subsectors were distinguished: Traditional (T), Intermediate (IM), and Mechanized (M). This was done on the basis of the extent to which the crops were or were expected to be produced in each of the above subsectors.

1. General considerations and decision rules

The specification of production alternatives for 1980 involved careful consideration and evaluation of a number of factors providing the physical basis for more intensive and more productive agriculture. Among these the following were of particular importance.

a. Area expansion versus intensification For each of the crops available land and water resources were estimated, taking into consideration historical trends and future limitations. In general, increase in arable area was based mainly at the expense of grasslands and to a lesser extent of forest. However, initial estimates indicated that while the eventual potential cultivated area is large with respect to the area cultivated at present, it is more economical to make more intensive use of those parts of the country that are already opened up. This would

mean more intensive use of land already in farms, considering subdivision of underutilized existing large holdings which would increase the number of farm owners. Recalling the incentives and growth potential released through similar development in the early coffee period, such policy may be most effective. Massive expansion into the less accessible areas was seen to be appropriate at a later stage of the development after the necessary accumulation of capital resources to establish communication and transportation network and to meet the heavy costs of settlement.

b. Irrigation The expansion of irrigated area and investment in flood control and drainage was considered critical to faster growth of food and livestock feed production, since it provides the key to the wider use of high yielding crops and multiple cropping. In preparing the production plans particular stress was, therefore, laid on estimating the possibility to provide new and to improve the existing irrigation systems which would allow farmers to make full use of modern agricultural technology. In many instances it was found that simple, nonexpensive improvements to existing systems were possible to provide the farmer with more effective means of water control.

c. Modern inputs Experience has shown that high levels of irrigated production depend not merely on efficient irrigation and drainage systems, but on the whole range of complementary inputs including high-yielding varieties and selected breeds of livestock, fertilizers, pesticides, etc. Even in nonirrigated areas some or all of these inputs are likely to be essential to productivity increases, since their substitutability by labor becomes progressively less as production grows

more intensive. At the higher level of productivity there is an important positive interaction between labor and modern inputs. In other words, as agriculture becomes more productive, it also becomes more labor intensive.

The relationships between increases in yields and modern inputs, as well as the associated labor intensity, was estimated for each of the crops and incorporated as input-output coefficients in the various production plans. Emphasis was also placed on assuring adequate supplies of seed, fertilizer, pesticides and machinery as a "package" rather than isolated inputs for areas designated for high-yielding varieties and intensive cropping in order to exploit the complementarity of inputs as fully as possible.

d. Mechanization In the specification of labor requirements for production alternatives careful attention was also given to the effects of mechanization. In the intensification of agriculture mechanization assumes particular significance because of the more precise cultural requirements of the high yielding varieties, the importance of timely sowing, the elimination of fallow in rainfed areas, and the narrower time gap between crops in more frequent rotations. It was realized that increased mechanization is not necessarily in conflict with developing more labor intensive agriculture, since although it generally saves labor for the operation involved, it also can be concentrated on tasks which could not be done effectively by other means, or which would raise yields or facilitate more intensive land use. Labor released from one operation through mechanization would be utilized for other operations for which it

was better suited within the agricultural sector as a whole - for weeding, more frequent crop protection, pruning, more careful irrigation, improved marketing of produce and integration of crops with livestock enterprises. By these means mechanization would actually tend to increase overall labor requirements. In addition, mechanization would also provide work outside farming for machinery maintenance and spare parts services, for rural workshops of manufactured parts, tools and the simpler kinds of implements, and eventually for domestic manufacturing of farm machinery.

In the case of tractors, which appear as inputs in the production plans, their requirements were determined at the level of individual crops on the basis of an estimate of the pattern of exploitation that the expansion of cultivation could assume, as well as taking into account that a modest intensification of tractor use on already harvested areas will occur.

e. Labor The effects of the above discussed factors on the labor requirements were determined on the basis of following considerations:

1) For each crop and within each one of the three technological subsectors labor requirements were increased pari-passu with increases in harvested area, i.e., the elasticity of employment to area increases was assumed equal to unity;

2) Labor requirements per unit area were increased for each crop with increases of yields. The elasticities used for determining the increase in man-days per hectare requirements ranged between 0.2 and 0.5 depending upon crops and other circumstances.

3) Within each subsector the average labor requirements per hectare were assumed to decline with the increase of the share of less labor intensive crops in the total.

4) For the aggregate of the production of the ten crops the labor requirements were affected by the change in the shares of the three subsectors in total area.

Additional decision rules affecting the specification of the input-output structure of the four 1980 production alternatives are indicated at the bottom of individual production tables. While efforts were made to base the estimates of the coefficients on actual observations and results provided by research institutes, their size, in some instances, was estimated purely on an ad hoc basis as informed judgment. It is, therefore, inevitable that quantitative data will have to be revised in the light of new information. Nevertheless, some rough criteria was laid down, which indicate the orders of magnitude according to which production and employment in agriculture will evolve, if the specific production plans are implemented.

2. Technological subsectors

The specification of three technological subsectors expands and enriches the analysis of employment in agriculture. It also requires subsectoral delimitation of the proportion of area under cultivation as well as distinction in input requirements and yields for each of the crops in each of the production alternatives. In the Colombian situation of agricultural dualism reliable data for the intermediate technological subsector was difficult to find and necessitated the adoption of various

criteria on the bases of which subsectoral specification was possible. As a result, the three technological subsectors in each growth alternative have the following general characteristics.

In the traditional subsector, T, production continues without little or no benefits from the progress in agricultural science. Seedbed preparation, planting, crop care and harvesting is mostly accomplished with the simplest hand and animal methods, except for rice, wheat and maize where a number of tractors for tillage are being introduced. The introduction of tractors in this subsector was motivated by the fact that, given their total number, the tractor density in the fully technified sector would be otherwise unrealistically high, and that, therefore, a good proportion of tractors could be used in an extensive fashion elsewhere. Nevertheless, overall productivity in the traditional sector remains low, some slight increases result from improved farm implements, mechanization and learning by doing. This subsector, in general, is supposed to encompass the very small farmers (minifundistas) possessing less than adequate quantity of land to support a family.

In the intermediate subsector, IM, the use of improved seeds, commercial fertilizer, plant protection and irrigation is significantly expanded. Primary and secondary tillage, planting, crop care and harvesting is partly mechanized for most of the crops. For this reason sugar production in the Cauca Valley where land preparation and transport is planned to be fully mechanized, whole cane cutting is not, and cotton production in Valledopor region, where land preparation and pest control are mechanized, but harvesting is not, were included in this subsector.

The same was also done with the area of potatoes and barley in which the use of improved seed and fertilizers was expected to be extensive, while mechanization remained limited.

Labor coefficients take into account the use of high yielding varieties, the possibility of multiple cropping, crop rotation, irrigation and other effects of mechanization. The owners of family size farms and those of multi-family farms of medium size were considered as most likely candidates to adopt and benefit from this technology.

In the mechanized subsector, M, modern inputs are combined with more extensive use of mechanization which occurs on large individual or multi-family farms and plantations. The high degree of mechanization, a basic characteristic of this technological subsector, is reflected in labor coefficients which are, on the average, smaller than those in the other two subsectors.

Decisions on the technological breakdown were also influenced by some peculiarities in the composition of final product. In the production of sugar, for example, subsectors T and IM were assigned to subsistence oriented "panela" (raw sugar) production, (in the IM subsector improved cultivation methods including the use of fertilizers and better varieties were considered), while subsector M represented exclusively sugar for factory production.

The extent to which intermediate technology was to replace traditional subsector was assumed to be influenced by a number of institutional factors, such as the evolution of extension services, marketing facilities for inputs and products, credit and others.

3. Production alternatives

The prospects for increasing production of each of the major crops were stated in terms of four production alternatives, L, M1, M2 and H, discussed before. These were postulated to indicate the extent to which production could respond to the pull of successively stronger demand stimuli incorporated in the demand analysis. It must be emphasized that future production levels presented in the plans should be understood as valid in the context of the given demand structure only.

The low production alternative, L, which responds to low GDP growth with no change in the distribution of incomes and a pessimistic export outlook, extrapolates past trends and maintains roughly the same share of traditional technology in the total. Some slight changes were assumed to take place between IM and M technological subsectors. In general, increases in output were based mostly on area expansion in harmony with past trends. The use of high yielding varieties, fertilizers, plant protection and land under irrigation was limited. Consequently, no significant overall yield increases are evident, in some instances even a diminishing trend is indicated, as in the case of wheat.

The high production alternative, H, responds to the high GDP growth variant with a drastic change in income redistribution and an optimistic export outlook.

The future production level of this alternative was planned to be achieved by intensifying agriculture and putting emphasis on the expansion of the IM technological subsector while taking full advantage of the labor augmenting effects of mechanization. The increase in output is, therefore,

the result of higher productivity rather than that of area expansion while the overall average labor coefficients are maintained at a high level.

The two intermediate production alternatives, M1 and M2, were postulated to reach future demand levels under intermediate conditions. In both instances a high GDP growth variant was assumed. In the case of M1 there was no change in income distribution and a medium outlook for exports was assumed. In the M2 case moderate income distribution with optimistic exports were postulated. Productivity increases for the two intermediate alternatives were planned both on the bases of area, expansion and yield increases. For this reason the weights of T and IM subsectors were expanded, in different proportions for different crops, while that of T subsector was generally diminished.

In instances where two of the production alternatives were found close together these were considered identical and appear as such in the production tables, e.g. for some crops L and M1 and M2 and H alternatives are listed as the same.

B. Employment Generation in Agriculture

1. Major crops

Given the input-output dissaggregation in the production tables, sector wide effects of the 1980 production alternatives on employment and inputs can be calculated and compared. The calculations require aggregation of physical labor and input requirements per crops and technological levels, and their conversion in value terms for which a set of prices is required. In each of the alternatives a valuation was performed

product by product. A comparison of the total valuation with that of the base year produced the growth rate of the value of production.

The basic information arising from these calculations is presented below. Table 11 describes in summary the size of output and man-day requirements for the base year and for each of the production plans, changes in output, man-day requirements and labor productivity from the base year situation to 1980 are also given in annual percentage terms.

TABLE 11. Summary output and labor requirements, their corresponding growth rates and the resulting growth of labor productivity, 1970 - 1980

	Output		Labor Requirements		Labor Productivity
Production	$1,000	Annual % growth	Man-days 1,000	Annual % growth	Annual % growth
1970	8,477	--	263,445	--	--
1980 L	11,158	2.8	331,612	2.4	0.4
M1	11,366	3.0	329,227	2.2	0.8
M2	12,754	4.2	351,817	2.9	1.3
H	12,902	4.3	355,124	3.0	1.3

Table 12 indicates required amounts and corresponding growth rates of a number of inputs such as agricultural land, irrigated and nonirrigated, fertilizers, improved seeds and tractors.

It is important to note that M2 and H production alternatives, while being more productive, are, at the same time, also more labor intensive. When M2 and H alternatives obtain, the growth of man-day requirements proceed at 2.9 and 3.0 percent per annum respectively, accompanied by

TABLE 12. Summary input requirements and growth rates, 1970-1980

Production Plans	Total Area		Fertilizers		Tractors		Irrigated land		Area under improved seed	
	ha/1000	Annual % growth	MT/1000	Annual % growth	No./1000	Annual % growth	ha/1000	Annual % growth	ha/1000	Annual % growth
1970	3,812	--	130.9	--	22.0	--	499	--	934	--
1980 L	4,737	2.2	218.7	5.3	28.3	2.5	716	3.7	1,226	2.7
M1	4,651	2.0	237.4	6.1	--	--	730	3.9	1,371	3.9
M2	4,997	2.8	279.2	7.9	--	--	808	4.9	1,523	5.0
H	5,099	2.9	285.4	8.1	32.1	4.2	813	5.0	1,596	5.5

labor productivity growth of 1.3 percent per annum. These growth rates are considerably higher than those that result from L and M1 alternatives. However, as expected, higher productivity is associated with higher absorbtion of intermediate inputs. Thus for example, in order to implement the H growth alternative, fertilizer input will have to grow at 8.1 percent per year, the number of tractors at 4.2 percent per year, irrigated land area at 5.0 percent per year and the use of improved seeds at 5.5 percent per year. These rates are significantly higher than the corresponding growth rates associated with L and M1 alternatives.

2. Livestock sector, forestry and fishing

Attempt was also made to complement the results obtained from major crops with estimates of the livestock sector's role in agricultural employment generation.

In the livestock sector as in the sector of major crops, three production techniques were identified; extensive, medium and intensive. These correspond roughly to subsectors T, IM and M in the crop sector. The main inputs for the livestock sector which were quantified comprised permanent pasture area, fertilizer use of grasslands and feed. Distinction between the three techniques was based on the availability and use of machinery, improved feeds, veterinary services, shelter, management, etc. In the case of dairying, for example, extensive production technique meant milking by hand, no application of cash inputs and a scale of operation which could be large but was essentially primitive. The small operator for whom livestock production is an integral part of the general farming practice was included in this subsector.

Intensive technique, in contrast, was assumed to involve modern, large scale operations using mechanical equipment for milking, modern pasture management with improved water supply, and fencing. This subsector, in general, was identified with commercialized forms of production. Medium technique was defined as a mixture of the previous two. The weight of this subsector in the total was assumed to increase as improved farming practices were projected to 1980.

Production tables, showing the breakdown of technological subsectors were prepared for dairy, beef, swine, sheep plus goat, and poultry operations in terms of the number of animals in each and in terms of man-day requirements per animal. This information was gathered for 1970, the base year, and was projected for 1980. Only one production alternative was postulated on the basis of projected animal population and expected labor coefficients. In the livestock sector, man-day requirements were assumed to decline as modern practices were substituted for traditional, small-scale methods, emphasizing the fact that commercialized forms of livestock production have relatively low labor intensity.

The total impact of the livestock sector on employment resulted in the creation of nearly 23 million additional man-days by 1980 corresponding to an annual growth rate of 1.8 percent. Most of the growth of employment opportunities was generated through the increase of dairy and beef production. In the case of dairying the relative share of medium and intensive techniques of production were increased on commercialized farms. Since in the livestock sector labor requirements are more evenly spread out over the whole year, with little seasonal

fluctuations, employment increases were assumed to result mostly in full-time jobs. For the beef industry and the remaining activities of the sector, extensive and medium production techniques were postulated to retain or slightly increase their relative shares which meant a better labor distribution both seasonally and for the members of the family providing additional income.

It is important to recognize that within the medium sector or within small animal enterprises a large share of the increase in labor requirements will be forthcoming from family members otherwise idle or from work carried out beyond the day's work in the field. The importance of the livestock sector of Colombia, in terms of employment creation may be also in its potential to create new industries if meat processing, packing, feed manufacturing and other related secondary activities are done within the country. In addition to providing new jobs, this will displace imports, create and increase exports and earn foreign exchange.

From international experience, employment potential of forestry, especially in the case of man-made forests whether established for soil and water conservation or for production appears quite substantial. More so if forestry gives rise to domestic forest products industries such as the production of mechanical pulp, chemical pulp and newsprint. Logging operations bring with it increased job opportunities in road building, maintenance, transportation, etc. and their advantage may be that they offer job opportunities in otherwise seasonally slack periods. Employment opportunities created by forestry is of special importance to settlers in virgin areas since they provide a flow of badly needed income

in the early stages of land clearing and preparation, before returns are available from crop or livestock products.

Considerable employment potential may also exist in Colombia's fishing industry. At the time of investigation, however, no information was available to estimate quantitatively labor absorbtion potential of forestry and fishing.

3. Total effects and problems of seasonal variations

If the 1980 H production alternative is successfully implemented, nearly 91.7 million additional man-days will be generated at the end of the decade. To this has to be added nearly 23 million man-days originating in the livestock sector. Thus a total of about 114.7 million man-days can be generated which represents a growth rate of about 3.5 percent per year.

In Chapter III, Section B.4 the size of Colombia's employment problem was discussed in some detail. The basic conclusion was, that if existing trends continue, there will be roughly 4 million persons unemployed by 1985, or more than one third of the Colombia's 1985 labor force. Similarly, in Section D.1, on the basis of ILO's estimates, about 5 million jobs would have to be created by 1985 in order to reach a level of unemployment of 5 percent of the labor force.

If the high growth alternative is implemented, which assures employment expansion in agriculture at 3.5 percent a year, it can be calculated that the contribution of agriculture toward full employment can be quite considerable and will generate roughly 2.2 million jobs. Furthermore, recalling that the high growth alternative redistributes income

drastically, the end situation will be an economy with higher purchasing power in the hands of low income people which will stimulate growth of manufacturing and overall employment.

A difficult and important question is to determine how this sizeable increase in labor requirement effects the seasonal nature of agricultural employment. The total yearly requirement was calculated on the basis of technical coefficients for labor input per unit area and on data concerning the cultivated area for each product. However, appreciable differences in the demand for labor exist on monthly and regional basis. There are periods of the year in which underemployment is much higher while in certain months the local agricultural population is insufficient to furnish the work required. In Colombia, for example, the latter is true during the cotton and tobacco harvests. The peaks and troughs in the demand for agricultural labor occur at different times for different crops, and while the total demand for labor shows less seasonal variations for the country as a whole, regional variations are quite pronounced and lead to temporary migration of labor from one area to another.

Therefore, it is important to supplement the average annual labor requirements by more detailed input-output coefficients on a seasonal basis. Thereby the magnitude of seasonal underemployment can be estimated and a strategy designed which would reduce the aggregate level of seasonal underemployment by an appropriate combination of technological change (e.g., adopting high-yielding varieties and multiple cropping), changes in the output mix, and the promotion of rural nonfarm activities

capable of absorbing labor in a way which complements the seasonal labor demand for labor in agriculture.

The results of an attempt to analyze the effects of the high growth alternative on seasonal variations in agricultural employment are presented graphically in Figures 6 and 7. The seasonal labor requirements vary from month to month and are represented by a kinked curve. Figure 6 presents the situation in 1970, Figure 7 the situation in 1980 which is expected to obtain when the high growth alternative H is implemented. Labor utilization is expressed as an index of required over available labor.

According to seasonal estimates, employment situation in agriculture could be improved considerably. Employment could be raised to over 90 percent in January, April, June and July with full employment in December and labor shortage in October. It is clear, however, that full employment throughout the year is impossible because while the above improvements can be achieved, employment is only about 66 percent in August. Some smoothing out of the seasonal pattern of employment may be achieved by further adjusting the crop mix or seasonal cropping patterns. In general, however, it appears that seasonality and labor intensity do not follow each other in any consistent way. Those commodities which have the lowest labor input per unit of output, e.g. livestock, are also those having the lowest fluctuations in seasonal labor requirements.

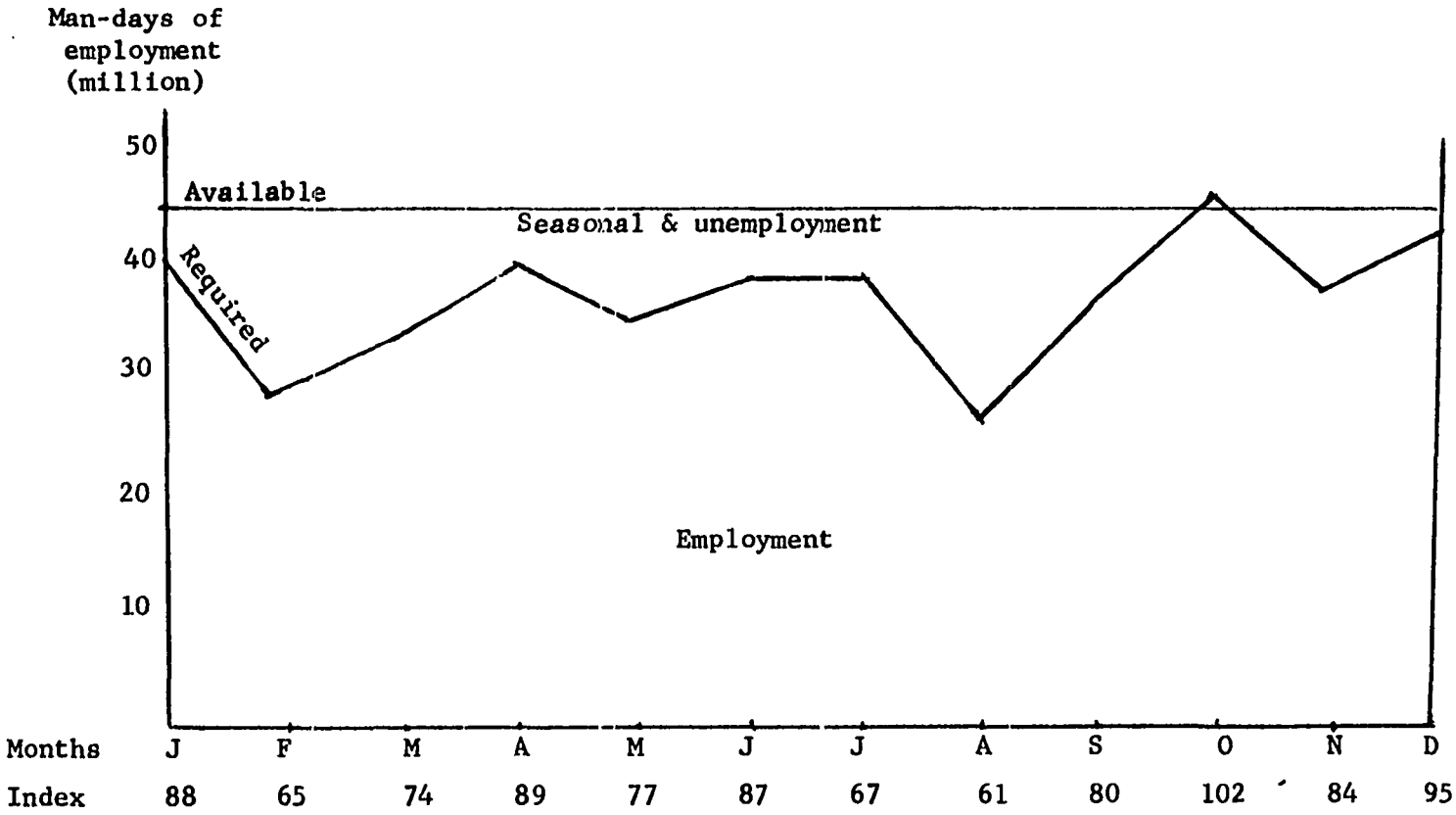


Figure 6. Labor utilization pattern in agriculture, 1970

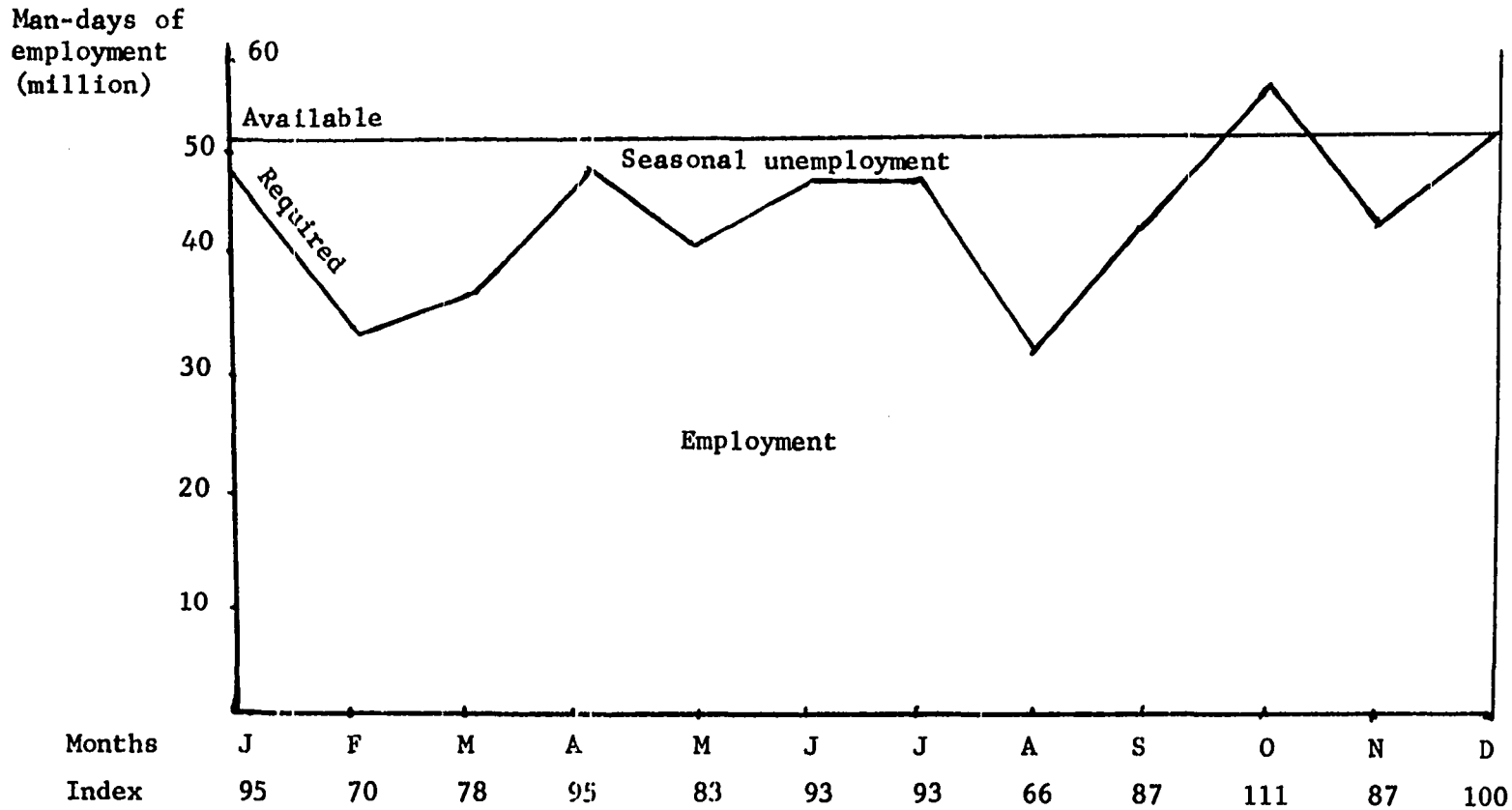


Figure 7. Labor utilization pattern in agriculture, 1980, high alternative

V. EVALUATION OF METHODOLOGY AND CONCLUSION

The purpose of this chapter is to evaluate critically the methodology on the basis of experience in its formulation and application and present conclusions. In many instances advantages on the theoretical side may change into weaknesses or limitations when the applicability of theoretical specifications are tested in the real world situation. Thus, for example, quantitative detail in the production relationships is highly desirable, but may not be available or the estimates may be too unreliable for a useful analysis. The intent is, therefore, to identify major advantages and point out, at the same time, some of the limitations which may detract from the usefulness of the methodology and also to suggest improvements in its future application.

A. Evaluation

1. Applicability to agriculture and consistency

The methodology was designed for the purpose of analyzing agriculture's development potential and its contribution to employment under a number of assumptions concerning the likely behavior of macro variables and aiming at a more equal income distribution.

One of the major advantages of the methodology is that the framework in which the sector of agriculture is analyzed maintains consistency in the sense that the development of agriculture remains a component and final product of a given growth level of the overall economy. The macro part of the methodology which situates the agriculture in the total economy ensures that macro variables at the sector level of agriculture

are within the range of feasibility. Moreover, following the steps outlined in Chapter III, consistency can be maintained also at regional, farm or crop levels of disaggregation. The methodology is therefore well-suited in all instances where the sector of agriculture assumes major importance in economic development or where the development potential of agriculture in terms of employment, productivity and income distribution goals needs to be ascertained. As such, the methodology can complement a number of development plans or strategies in which the role of agriculture is recognized but is not made explicit. Lack of detail and consistency which are missing in those cases may seriously underestimate the role that agriculture can actually play and, therefore, result in misallocation of resources and prolonged underdevelopment. It appears, for example, that proposals in both the ILO full employment strategy as well as in the national Las Cuatros Estrategias plan would acquire added meaning and usefulness if the sector of agriculture was subjected to a more rigorous analysis along the lines of the methodology presented here. The added detail and consistency thus achieved would not only indicate more fully the development potential that agriculture holds, but also provide greater clarification of policy alternatives through the quantification of impacts of feasible development alternatives on production and employment.

2. Incorporation of income distribution targets

In the methodology the growth alternatives for agricultural GDP depend on the specification of future income distribution targets. Besides normal projections of demand for agricultural products in the 1970-1980 decade, the methodology provides quantification and analysis of the effects that might be produced on demand by redistributing income according to three alternatives: no change, medium redistribution and drastic redistribution. This enables one to plan for economic development in its wider social context by specifying and ensuring the achievement of certain minimum consumption levels.

The supply side provides quantification and analysis of the input and productivity requirements to check the feasibility of attaining the initially specified income redistribution targets. By a confrontation of required with attainable productivity requirements (i.e., comparison of demand alternatives with corresponding production plans) the extent to which income transfers from the rest of the economy to agriculture will be needed can be ascertained in the case where attainable distribution falls short of the target distribution. This provides valuable information for the policy maker on the basis of which direct income transfers (e.g. through public investment in agriculture in excess of the tax revenue levied in the sector) or indirect income transfers (e.g., through changes in relative prices in favor of agricultural products) can be planned.

However, while the introduction of income redistribution targets adds to the value of the methodology as a more powerful technique for planning, there are, at present, some unsolved problems in this area

which detract from the usefulness of the methodology and require improvement. The difficulties stem from the following.

As discussed in Chapter III a given income redistribution proposal implies specific increases in per capita income for each of the five different income classes. This should be matched correspondingly on the supply side as a result of technological change and higher productivity. For example, the part of the agricultural population that forms, say, the low income class should increase their per capita income at the rate postulated on the demand side as a target, and so on for the other groups. If it were known how the changes in the technological mix affect each of the income classes, then it would be possible to ascertain also to what extent the required per capita growth rates in each of the income classes are attained. This information is quite important. In the case where the attainable level falls short of the required level the above information enables one to calculate income transfers into or within agriculture to raise the income of the different segments of the agricultural population to the levels postulated by the redistribution hypothesis.

The present framework, however, does not provide this information. While it is possible to calculate productivity and per capita income increases in each of the technological subsector and for a given production alternative as a whole, it is not possible to link these increases to the individual income classes which contain the agricultural population. This arises from the lack of a clear cut relationship between the distribution of the population in the income classes and its

distribution in the technological subsectors. There is some overlapping of unknown dimensions. Thus, for example, while most of the individuals producing in the traditional subsector are also individuals in the low income class, there is evidence that a number of producers in the intermediate sector also fall in the low income category. The situation incomewise is even more complicated with respect to those using intermediate and mechanized technology. There is a considerable number of landless workers and migratory small tenant farmers and farm owners whose average incomes are very low but who are employed within the intermediate or in the mechanized subsectors. These observations indicate if possible serious shortcomings whose elimination would improve the framework considerably. It is essential that better information be generated on target groups of poor such as landless workers and small tenant and farm owners. Particularly data on employment and income - on a sectoral basis, by crop, technology and region would be of utmost importance. In this fashion, more reliable income distribution estimates could be generated from the supply side.

3. The definition of technologies

Experience indicates that high product aggregation not only conceals a wealth of heterogeneity but also distorts the production estimates of the analysis. Product disaggregation is very important to generate and analyze the different technological production alternatives.

One of the important characteristics of the methodology is the detailed breakdown defined in terms of the basic crops and three alternative production technologies which is used to describe agricultural

production in the base year and project it in the future. Such a detailed specification makes it possible to analyze the effects of changes in the composition of output and technologies on development objectives such as income, income distribution and employment. The specification of production in terms of three technological subsectors is necessary in a situation where the sector of agriculture is characterized by economic dualism. In this instance planning for economic development means the transformation of the traditional technology into an intermediate technology with higher productivity, employment and incomes. Determination of an intermediate technological subsector permits an analysis of the various technical options for each crop, and likewise an evaluation of the feasibility of their implementation under the specific conditions of Colombia's agriculture.

To do this effectively, the need is first to know the modern input requirements along with their effects on increases in labor productivity and yields. The quantification of the input-output coefficients corresponding to the three alternatives is sometimes difficult. In reality there exists a continuum of production alternatives of which one end is represented by the truly traditional sector and the other end by fully technified and mechanized operations. By attempting to define subsector criteria some arbitrariness in the definition of input-output coefficients is inescapable as these change from subsector to subsector and from crop to crop.

The specification of technological subsectors used in the study was intended mainly to develop and strengthen the framework for analysis of the development and employment perspectives which the Colombian agriculture appears to present. In fact, production alternatives were meant to represent working hypotheses having the basic purpose of enabling the planner to examine the response of the agricultural sector to demand stimuli on one hand, and the ability of the sector to generate income commensurate with the need to improve the living standards of the poorer strata of agricultural population, on the other. It is fully recognized that the quantitative estimates defining technological subsectors will have to be revised. Thus while the present state of knowledge may impose certain limitations on the usefulness of the methodology on the account of technological detail, these limitations may eventually be removed after additional information becomes available on the basis of which new production estimates can be formulated.

4. Seasonal variations

Agricultural employment has a high seasonal character. In the estimation of the labor absorbtive capacity and income levels in agriculture it is necessary to achieve a level of disaggregation which allows the seasonal impacts to become quite apparent. There is, therefore, a need to complement the methodology by analyzing the employment situation on a monthly or even weekly basis. Thus, labor requirements for each of the crops studied and for each technological alternative should be available seasonally. In particular, it is important to analyze possible seasonal labor shortages which may arise from the

implementation of the alternative production plans because seasonal labor shortages are frequently the basis for labor-substitution mechanization which is to be avoided (except for some type of selective mechanization).

Further study needs also to be made on output-mix combinations at the farm and regional level which would minimize seasonal underemployment. Multiple cropping may also provide significant advantages of smoothing out fluctuations in the seasonal labor demand. There might be cases where selective mechanization might reduce the labor bottleneck at peak time without substituting capital for labor during off-peak periods.

5. Standardized sector wide data files

The methodology provides a set of consistent and conveniently formulated production plans in the form of tables which contain detailed and highly useful sector wide information for easy reference and updating. These tables can be used for a number of specific purposes, e.g. for commodity by commodity cost of production comparisons, for productivity and input requirement analyses, etc. The standardization of information in the above form provides ease of orientation in evaluation of progress and results of ongoing independent research. On this basis reconciliation and improvement of the input-output and other data in the specification of production alternatives and technological subsectors can be obtained. For example, in the application of the methodology to the Colombian economy, considerable strengthening of the reliability of a number of input-output coefficients were achieved through their

comparison with coefficients of similar nature obtained in a comparable but independent study conducted at FAO's Santiago, Chile, Regional office. Since the study followed essentially the same procedure, although differentiating only between two technological subsectors - rudimentary and technified - it was highly useful to compare the level of yields, labor requirements, modern input levels, their variations from crop to crop and from technology to technology and other data. Through the exchange of information in standardized form, clarification of reasons for discrepancies in the input-output structure of a number of production plans was possible which led to considerable improvement in the reliability of initial estimates.

6. Geographical disaggregation

Another area where considerable improvement needs to be made concerns the disaggregation of analyses at regional level. While considerable detail has been specified at crop and technological levels, no distinction has been made, no regional production breakdown was given. Colombian agriculture, as indicated in Chapter II, extends over different terrain and climatic zones. There are significant regional differences in the composition of agricultural output, the seasonality factor and the technology of production. Regional differences appear particularly important with reference to the seasonality of labor demand. For this reason some regional disaggregation is necessary to provide more useful planning for the sector. At the time of the analyses of Colombia's agriculture regional data disaggregation was not available.

7. Technological disaggregation according to farm sizes

It was hypothesized that the pattern of production varies widely between smaller and larger farms so that a disaggregation based on technological levels might also be related to farm size. However, unavailability of reliable data and small coverage and sampling prevented the confirmation of this relationship. Nevertheless, subfamily farms were grouped in the traditional subsector, intermediate size farms in the intermediate subsector and large plantation type farms in the fully technified subsector. Further investigation in this area is certainly needed and would strengthen the criteria for delineation of technological subsectors.

B. Conclusions

The major conclusions arising from the study can be summarized as follows:

a. Economic development in Colombia, in its wider social context as defined at the beginning of this study, is constrained mostly by a very unequal and gradually worsening income distribution. This was demonstrated in Chapter II in terms of the extensive underutilization of labor and prevailing poverty. Using the estimates provided by the ILO effective unemployment in 1970 amounted to about 23 percent of the labor force while the income of about 75 percent of the population was considered below or at the level defined as subsistence. Under these conditions the growth of internal demand was limited, there was limited interaction between agriculture and manufacturing and little basis for economic development to become self-sustained.

b. Upon examining the effects of import substitution and industrialization policies and the resulting structure and functioning of the economy, it was apparent that the labor absorbtive capacity of manufacturing industries in the nearest future will not be able to cope with rapid population increases and rural-urban migration, mainly because of capital intensive production. It could be, therefore, concluded that no significant expansion of employment and a change in the distribution of incomes towards greater equality could be achieved on the basis of further expansion of manufacturing industries. In fact, it was shown, that the growth of manufacturing output could not be expected to absorb the increments to the urban labor force, let alone the already existing large backlog of unemployment.

At the same time, investigation into the labor absorbtive capacity of agriculture indicated a sizeable development potential in terms of productive employment in its large traditional subsector. Based on this potential and on the lessons gained in the past with regard to the growth of coffee production, which benefited the traditional subsector, it can be concluded that the identification of an appropriate technology within agriculture and supported by complementary policy measures constitutes, perhaps, the sine qua non of Colombia's future economic and social development.

c. To release the development potential of agriculture the need is to transform production in the traditional subsector by means of a technology which raises productivity and incomes through the use of yield increasing inputs complementary to labor. The extent to which Colombia's

agriculture can become more productive and labor intensive and the extent to which these changes can contribute to higher incomes and a more equal income distribution was examined in Chapter IV. The basic conclusion was that a significant improvement was indeed possible. Under the high growth alternative (including the livestock sector), the growth of agricultural employment was projected to increase at about 3.5 percent per year in contrast to only a 2.2 percent increase if trend conditions (no change in the structure of agricultural production) were to prevail. The growth rate of output would increase from 2.8 to 4.3 percent a year. As a consequence, the growth rate of labor productivity would increase from 0.4 percent a year under trend conditions to 1.3 percent per year under the high growth alternative. In terms of income distribution the high growth alternative would change the existing situation to a more equal distribution quite drastically, although the exact effects in the four income classes could not be determined.

The high output and employment growth alternative required for its achievement favorable growth of exports as well as a high growth rate of GDP for the economy as a whole. Of course, an impressive output performance in agriculture contributes to high GDP growth. In turn, a high global growth rate of income combined with a more equal income distribution resulting from technological changes in agriculture and changes in the composition of output, alter demand towards agricultural commodities thereby reinforcing the move towards more labor absorbtion and more equal income distribution.

d. Examination of employment, income and output potential of alternative agricultural production plans under technological change is effective only when disaggregation extends to the level of individual crops and technological subsectors. Planning at a high level of disaggregation within a multiple objectives context necessitates a framework such as the one presented and discussed in Chapter III to ensure an overall economic consistency between demand and supply at all levels of disaggregation. The value of the framework also stems from the fact that it captures economic dualism such as exists in Colombia.

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VII. ACKNOWLEDGEMENTS

I wish to express my deepest appreciation and thanks to Professor Erik Thorbecke for his guidance, assistance, and inspiration throughout the course of my graduate studies, and in the preparation of this dissertation. I owe him also very much for the opportunity which enabled me to gain valuable experience in development planning during my work with the Food and Agriculture Organization of the United Nations.

My thankfulness also goes to the members of the FAO GAFICA team in Guatemala and to the members of the Policy Advisory Bureau in Rome with whom I was associated in 1971. Their helpfulness, professional competence and devotion to problems of developing countries were most valuable and gratifying.

I also wish to thank the AID-211/d grant committee at Iowa State University for their support in the preparation of this dissertation.

My special thanks to Betty Ingham for her patience in reading the manuscript and typing the dissertation.

VIII. APPENDIX

A. Projections of Food Demand

Consumption goods are generally classified in three categories:

a) inferior goods - the consumption of which declines both absolutely and relatively to income as income rises (negative elasticity);

b) necessities - the consumption of which declines only relatively as income rises (the value of the elasticities in this case ranges from 0 to 1;

c) luxuries - the consumption of which increases both relatively and absolutely to income as income rises (elasticity higher than 1).

Four functions may be used to estimate income elasticity of demand, e, and to project future demand for goods in the above categories. In general, the value of the elasticity varies inversely with income. Thus the same good can be a luxury good to a consumer in the low income group and an inferior good to another consumer with high income. The same considerations apply over time when real income levels change.

The four functions are: double-log, semi-log, log-inverse (sigmoid) and log-log inverse. Their mathematical forms are given in Table A.1, their graphical representations in Figures A.1 through A.4.

The main characteristics of the four functions can be briefly summarized as follows:

1. double-log: This function implies a constant elasticity over all income ranges, i.e., a constant ratio between the percentage change in per capita consumption (or expenditure) and in income. In the analysis

TABLE A.1. Formulas to express the relationships between per capita consumption, y, and per capita income, x

Functions		Coefficient of elasticity
Original	Transformed	
	1. Double-logarithmic	
$y = e^{a} x^{b}$	$\log y = a + b \log x$	b
	2. Semi-logarithmic	
$e^{y} = e^{a} x^{b}$	$y = a + b \log x$	$\frac{b}{y} = \frac{b}{a + b \log x}$
	3. Log-inverse (sigmoid)	
$y = e^{a \frac{b}{x}}$	$\log y = a - \frac{b}{x}$	$\frac{b}{x}$
	4. Log-log-inverse	
$y = e^{a - \frac{b}{x}} x^{-c}$	$\log y = a - \frac{b}{x} - c \log x$	$\frac{b}{x} - c$

of family budget data the double logarithmic function has the practical advantage that the regression coefficient is equal to the elasticity coefficient. However, as all the data must be transformed into logarithms, there is often a problem where for a particular household the expenditure on or the quantity consumed of a particular commodity equals zero, because there is no logarithm of zero. This function is mainly used to project food demand for "luxury" items, especially in countries where the consumption of these expensive commodities is very low at

present and might remain far below the saturation level during the projected period.

2. semi-log: This function has an income elasticity coefficient which varies inversely with the quantities consumed (or expenditure), and its marginal propensity to consume is inversely proportional to income. This function, like the double-log, does not provide for a saturation level; it is mainly used for "basic necessity" foods.

3. log-inverse (sigmoid): This function has an income elasticity coefficient which varies inversely with income level; when income tends toward infinity, the elasticity tends towards zero and the per capita consumption toward a saturation level, defined by the value of the constant terms. This function may be used to describe a situation where consumption increases rapidly, as income rises, starting from a state of hunger, but then, at higher income levels, reaches a saturation level determined by physiological limits. This function with positive elasticities, can be used to project the demand for those commodities which are being already consumed at high levels, but whose consumption will still increase moderately until saturation is reached. With negative elasticities, consumption will slightly decline towards a minimum level at which it will be stabilized.

4. log-log inverse: This function is used to describe the long-term evolution of per capita demand for staple food (cereals and starchy roots) in a number of countries. Starting from a level of undernutrition, the consumption of these products which supply cheap calories at first grows rapidly so as to eliminate the calories deficiency. Consumption

reaches a maximum followed later by a falling-off due to the progressive substitution of more expensive, higher quality foods for cheaper, low quality foods. In terms of Figure 4.A, the first segment AB of the curve represents the consumption of a "luxury" commodity which increases rapidly with income; segment BC represents the consumption of "necessities", for which the rate of increase in consumption diminishes progressively as income rises; after having reached a maximum the curve begins to decline; segment CD represents the consumption of an inferior good, which diminishes as income rises.

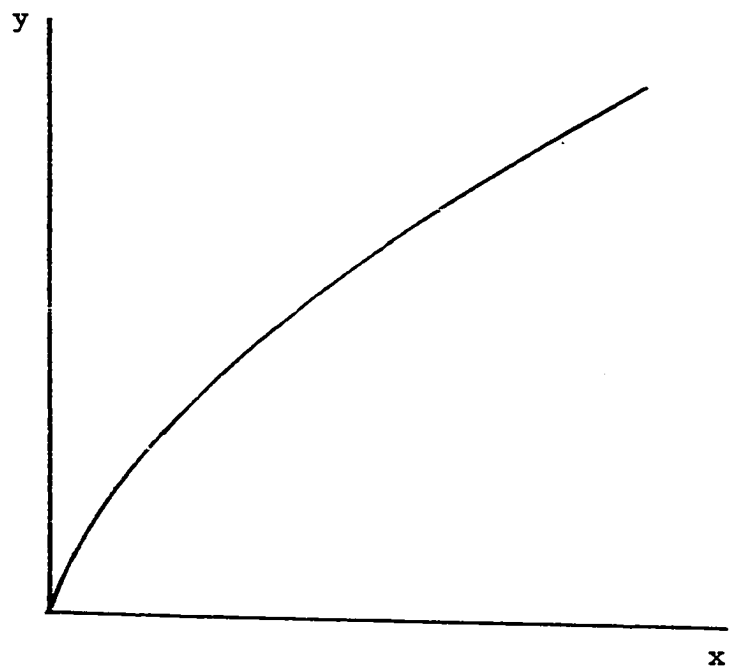


Figure A.1. Double-logarithmic function

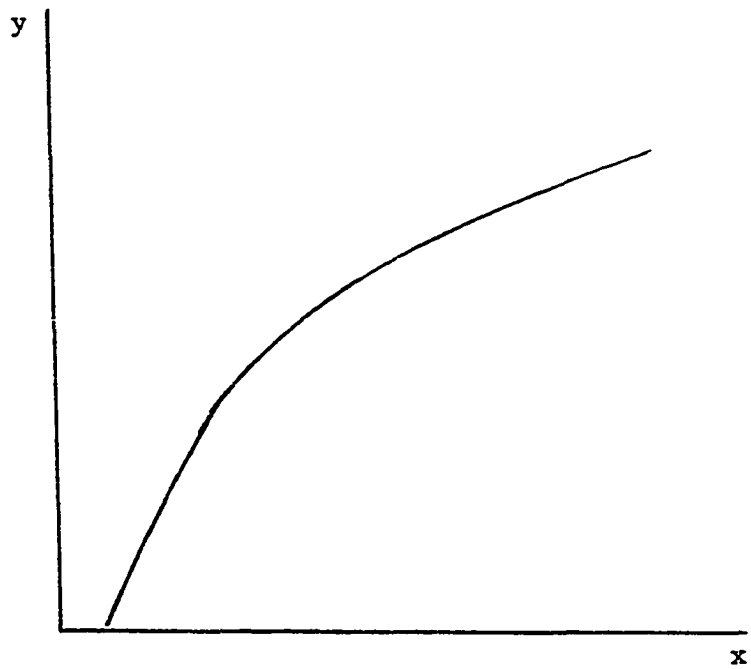


Figure A.2. Semi-logarithmic function

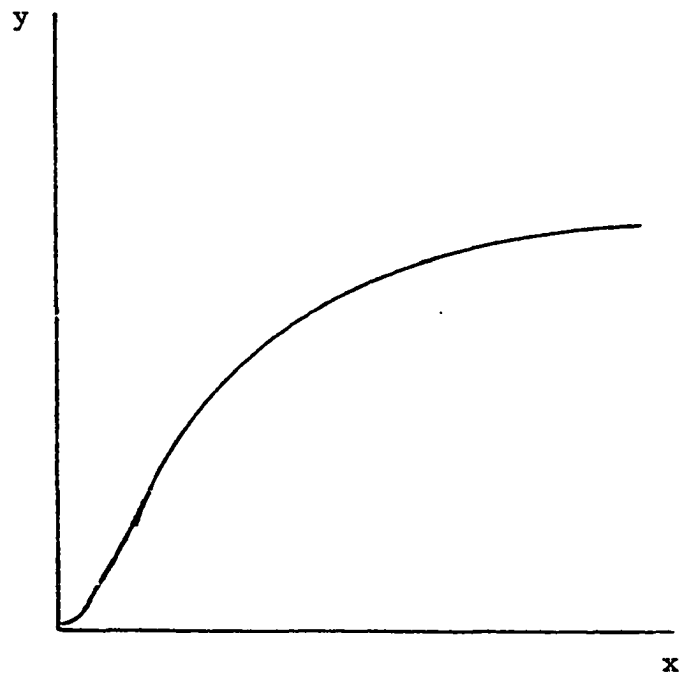
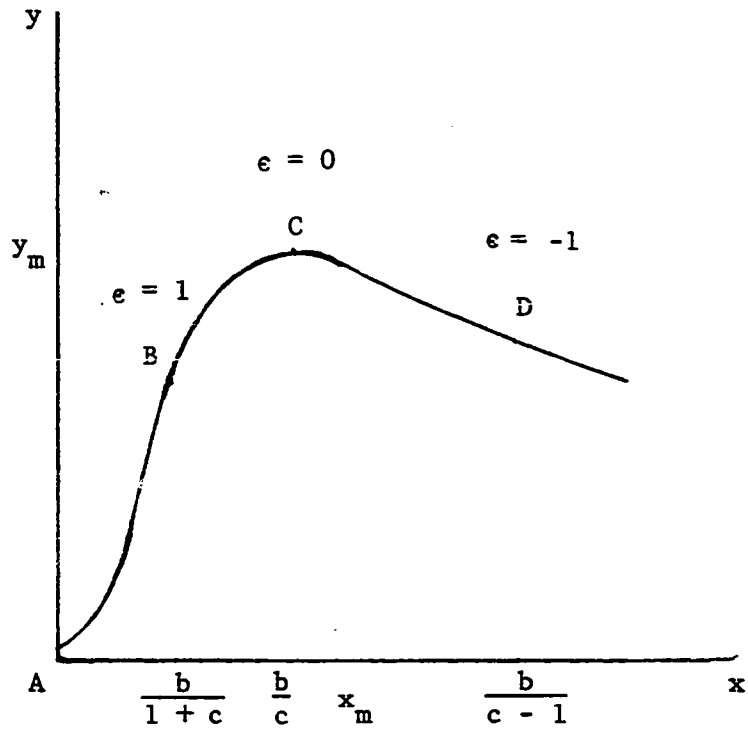


Figure A.3. Log-inverse (sigmoid) function



Note: x_m represents the level of per capita consumption at which the maximum level of consumption, y_m, is reached.

Figure A.4. Log-log inverse function

B. Production Plans

The ten production plans, presented in Tables A.2 through A.11, describe for each of the crops four 1980 production alternatives - Low (L), Medium 1 (M1), Medium 2 (M2) and High (H) - together with production in the base year 1970, against which changes during the period can be evaluated. Production information is presented in the form of input-output coefficients which have been estimated at three technological levels - Traditional (T), Intermediate (IM) and Mechanized (M) for each of the production alternatives of a given crop. This information was used to derive employment implications of production increases associated with individual production alternatives as discussed in Chapter III.

TABLE A.2. Production plan - wheat[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970 - Subsectors: T	44		43	--	--	365
IM	8	1.40	11	32	.30	65
M	20	1.55	31	55	1.10	200
Total or average	72	1.18	85	19	1.40	630
1980 Low-Subsectors: T	20	1.00	20	--	--	330
IM	20	1.85	37	74	1.48	--
M	20	2.00	40	88	1.76	200
Total or average	60	1.62	97	54	3.24	530
1980 Medium 1-Subsectors: T						
IM			SAME AS LOW			
M						
Total or average						
1980 Medium 2-Subsectors: T						
IM			SAME AS HIGH			
M						
Total or average						
1980 High-Subsectors: T	10	1.00	10	--	--	330
IM	30	1.70	51	61	1.83	--
M	20	1.80	36	70	1.40	200
Total or average	60	1.62	97	54	3.23	530

[a]Fertilizer accounts for 70 percent of yield increases. The area of wheat is ecologically constrained and competes with barley and potatoes. Recent trends have shown rapid decline in area. Labor elasticity to yield 0.3 for Subsector IM, 0.1 for Subsector M.

Plant protection		Area under improved varieties	Area irrigated	Labor Requirement		
$ ha	mill. $			days/ha	ooo days	days/MT
--	--	10	--	30	1,320	30.7
--	---	90	--	34	272	24.7
--	--	100	55	13	260	8.4
--	--	44	15	26	1,852	21.8
--	--	20	--	30	600	30.0
--	--	100	--	38	760	20.5
--	--	100	45	14	280	7.0
--	--	73	15	27	1,640	16.9
--	--	20	--	30	300	30.0
--	--	100	--	36	1,080	21.2
--	--	100	60	13	260	7.2
--	--	87	20	27	1,640	16.9

TABLE A.3. Production plan - rice[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970 - Subsectors: T	90	1.20	108	--	--	1504
IM	130	3.40	443	119	15.4	2166
M	54	3.70	200	140	7.6	1000
Total or average	274	2.74	751	84	23.0	4670
1980 Low-Subsectors: T	140	1.20	167	--	--	--
IM	234	3.38	791	119	27.8	6230
M	70	3.70	258	140	9.8	1400
Total or average	444	2.74	1216	85	37.6	7630
1980 Medium 1-Subsectors: T	120	1.25	150	--	--	--
IM	235	3.80	892	147	34.5	6230
M	60	3.80	228	147	8.8	1400
Total or average	415	3.06	1270	104	43.3	7630
1980 Medium 2-Subsectors: T	140	1.25	175	--	--	--
IM	240	3.80	913	147	35.3	6500
M	70	3.80	266	147	10.3	1400
Total or average	450	30.10	1354	101	45.6	7900
1980 High-Subsectors: T	140	1.25	175	--	--	--
IM	250	3.80	950	147	36.8	6500
M	70	3.90	275	154	10.8	1400
Total or average	460	3.04	1400	103	47.6	7900

[a]In 1970 the share of M in total area was roughly 20 percent. Irrigated area is expected to rise from 184,000 ha in 1970 to 320,000 ha in 1980 under High alternative, while in the same time period unirrigated area is expected to increase from 90,000 to 140,000 hectares. Irrigation is assumed to add .5 MT to yield per hectare. Subsector M is fully irrigated. Labor elasticity to yield .3. Fertilizer response: 70 percent of yield increase. Low alternative depends mainly on area expansion.

Plant protection		Area under improved varieties	Area irrigated	Labor Requirement		
$ ha	mill. $			days/ha	ooo days	days/MT
--	--	20	--	45	4,050	37.5
--	--	70	100	30	3,900	8.8
--	--	80	100	20	1,080	5.4
--	--	56	67	33	9,030	12.0
--	--	20	--	45	6,300	37.7
--	--	70	100	30	7,020	8.9
--	--	80	100	20	1,400	5.4
--	--	56	68	33	14,720	12.1
--	--	30	--	45	5,400	36.0
--	--	75	100	30	7,050	7.9
--	--	85	100	20	1,200	5.2
--	--	63	71	33	13,650	10.7
--	--	30	--	45	6,300	36.0
--	--	75	100	30	7,200	7.9
--	--	85	100	20	1,400	5.2
--	--	63	69	33	14,900	11.0
--	--	30	--	46	6,440	36.8
--	--	80	100	31	7,750	8.2
--	--	90	100	20	1,400	5.1
--	--	66	70	34	15,590	11.1

TABLE A.4. Production plan - maize[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo Mt	No.
1970 - Subsectors: T	635	.90	575	--	--	1586
IM	100	1.80	180	54	5.4	254
M	130	2.30	299	84	10.9	2600
Total or average	965	1.22	1054	19	16.3	4440
1980 Low-Subsectors: T	898	.95	855	--	--	--
IM	200	2.20	440	78	15.6	2500
M	150	2.60	390	102	15.3	3000
Total or average	1248	1.35	1685	25	30.9	5500
1980 Medium 1-Subsectors: T	762	.95	724	--	--	--
IM	200	2.20	440	78	15.6	2500
M	200	2.60	520	102	20.4	3000
Total or average	1162	1.45	1685	31	36.0	5500
1980 Medium 2-Subsectors: T	778	.95	740	--	--	--
IM	230	2.50	575	96	22.1	4360
M	212	3.00	635	126	26.7	4400
Total or average	1220	1.60	1950	40	48.8	8760
1980 High-Subsectors: T	830	9.50	790	--	--	--
IM	260	2.50	650	95	25.0	4360
M	220	3.00	660	126	27.7	4400
Total or average	1310	1.60	2100	40	52.7	8760

[a]Fertilizer response: 60 percent of yield increases. Labor elasticity to yield .3 for IM subsector, .1 for M subsector. Production goals slightly exceed demand projections to make allowance for replacing some wheat in the diet. Yield increases postulated for subsector T are assumed to be due to slightly improved production practices. M1 alternative: yields and area according to trend (L projection). M2 alternative: yields same as in H, but lower area.

		Area under improved varieties	Area irrigated	Labor requirement		
$ hr	mill. $	% of total area		days/ha	ooo days	days/MT
--	--	--	--	40	25,400	44.2
--	--	--	--	53	5,300	29.4
--	--	25.0	--	28	3,640	12.2
--	--	4.0	--	40	34,340	32.5
--	--	--	--	41	36,818	43.1
--	--	10.0	--	57	11,400	25.9
--	--	25.0	--	28	4,200	10.8
--	--	4.6	--	42	52,418	31.1
--	--	--	--	41	31,242	43.1
--	--	10.0	--	57	11,400	25.9
--	--	25.0	--	28	5,600	10.8
--	--	6.0	--	42	48,242	28.6
--	--	--	--	41	31,898	43.1
--	--	10.0	--	59	13,570	23.6
--	--	30.0	--	29	6.148	9.7
--	--	7.0	--	42	51,616	26.5
--	--	--	--	41	34,030	43.1
--	--	20.0	--	59	15,340	23.6
--	--	30.0	--	29	6,380	9.7
--	--	9.0	--	43	55,750	26.5

TABLE A.5. Production plan - barley[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970 - Subsectors: T	--	--	--	--	--	--
IM	33	1.24	41	30	.99	270
M	22	2.00	44	96	2.11	220
Total or average	55	1.54	85	56	3.10	490
1980 Low-Subsectors: T	--	--	--	--	--	--
IM	35	1.40	49	44	1.54	290
M	22	2.20	48	113	2.49	220
Total or average	57	1.70	97	71	4.03	510
1980 Medium 1-Subsectors: T						
IM			SAME AS LOW			
M						
Total or average						
1980 Medium 2-Subsectors: T						
IM			SAME AS HIGH			
M						
Total or average						
1980 High-Subsectors: T	--	--	--	--	--	--
IM	32	1.60	51	61	1.95	270
M	26	2.60	65	149	3.72	250
Total or average	57	2.04	116	99	5.67	520

[a]Fertilizer response: 70 percent of yield increases. Labor elasticity to yield: .3 in IM, .1 in M subsectors. Yields in IM subsector may be too optimistic.

Plant protection		Area under improved varieties	Area irrigated	Labor requirement		
$ ha	mill. $	% of total area		days/ha	ooo days	days/MT
--	--	--	--	--	--	--
--	--	100	--	30	990	24.1
--	--	100	40	12	264	6.0
--	--	100	16	23	1,254	14.7
--	--	--	--	--	--	--
--	--	100	--	31	1,085	22.1
--	--	100	40	12	264	5.5
--	--	100	15	24	1,349	13.9
--	--	--	--	--	--	--
--	--	100	--	33	1,056	20.7
--	--	100	45	12	300	4.8
--	--	100	20	24	1,356	11.8

TABLE A.6. Production plan - pulses[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970 - Subsectors: T	128	.48	61	--	--	--
IM	27	.67	18	--	--	--
M	27	.81	22	--	--	270
Total or average	182	.55	101	--	--	270
1980 Low-Subsectors: T	163	.48	78	--	--	--
IM	50	.72	36	30.0	1.5	--
M	37	.85	31	30.0	1.1	370
Total or average	250	.58	145	10.4	2.6	370
1980 Medium 1-Subsectors: T						
IM			SAME AS LOW			
M						
Total or average						
1980 Medium 2-Subsectors: T						
IM			SAME AS HIGH			
M						
Total or average						
1980 High-Subsectors: T	160	.50	80	--	--	--
IM	75	.76	57	35.0	2.6	--
M	40	.90	36	35.0	1.4	400
Total or average	275	.63	173	15.0	4.0	400

[a]Labor coefficients based on labor requirements for dry beans. Labor elasticity to yield .3.

Plant protection		Area under improved varieties	Area irrigated	Labor requirement		
$ ha	mill. $	% of total area		days/ha	ooo days	days/MT
--	--	--	--	50	6,400	104.9
--	--	20	20	57	1,539	85.5
--	--	100	100	35	945	42.9
--	--	18	18	49	8,884	88.0
--	--	--	--	50	8,150	104.5
--	--	25	25	58	2,900	80.6
--	--	100	100	35	1,295	41.8
--	--	20	20	49	12,345	85.1
--	--	--	--	51	8,160	102.0
--	--	30	30	59	4,425	77.6
--	--	100	100	36	1,440	40.0
--	--	23	23	51	14,025	81.1

TABLE A.7. Production plan - coffee[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970-Subsectors: T	480	.50	240	--	--	--
IM	240	0.60	146	76	18.2	--
M	88	1.00	88	182	16.0	--
Total or average	808	.59	474	42	34.2	--
1980 Low-Subsectors: T	462	.53	245	--	34.9	--
IM	255	.70	178	137	14.7	--
M	81	1.00	81	181	14.7	
Total or average	798	.63	504	62	49.6	--
1980 Medium 1-Subsectors: T	423	.56	237	--	--	--
IM	290	.72	209	138	40.0	--
M	90	1.05	95	184	16.6	--
Total or average	803	.67	541	70	56.6	--
1980 Medium 2-Subsectors: T						
IM			SAME AS HIGH			
M						
Total or average						
1980 High-Subsectors: T	470	.56	264	--	--	--
IM	300	.72	216	138	41.4	--
M	90	1.05	95	184	16.6	--
Total or average	860	.69	575	67	58.0	--

[a]Base period: About 40 percent of total area is fertilized. Fertilizers assumed to be responsible for about 60 percent of increase in yield in M subsector. Low alternative, IM subsector: 80 percent of yield increase due to fertilizer, 20 percent to improved varieties, better cultivation practices. Labor elasticity to yields .5.

Plant protection		Area under improved varieties	Area irrigated	Labor requirement		
$ ha	mill. $	% of total area		days/ha	ooo days	days/mT
--	--	--	--	83	39,840	166.0
10	2.40	20	--	90	21,600	147.9
30	2.64	89	--	70	6,160	70.0
--	5.04	16	--	84	67,600	142.6
--	--	--	--	84	38,808	158.4
15	3.83	30	--	95	24,225	136.1
30	2.43	80	--	70	5,670	70.0
--	6.26	18	--	86	68,703	136.3
--	--	10	--	85	35,955	151.7
15	4.35	40	--	96	27,840	133.2
31	2.79	90	--	72	6,480	68.2
--	7.14	30	--	88	70,275	129.9
--	--	10	--	85	39,950	151.3
15	4.50	40	--	95	28,500	131.9
31	2.79	90	--	72	6,480	68.2
--	7.29	29	--	87	74,930	130.3

TABLE A.8. Production plan - cotton[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970 - Subsectors: T	15	.80	12	--	--	--
IM	60	1.42	85	43	2.58	250
M	150	1.90	285	106	15.90	3000
Total or average	255	1.70	382	82	18.48	4250
1980 Low-Subsectors: T	15	.80	12	--	--	--
IM	80	1.60	128	67	5.36	1580
M	202	2.10	425	133	26.87	4040
Total or average	297	1.90	565	109	32.23	5620
1980 Medium 1-Subsectors: T						
IM			SAME AS LOW			
M						
Total or average						
1980 Medium 2-Subsectors: T						
IM			SAME AS HIGH			
M						
Total or average						
1980 High-Subsectors: T	15	.80	12	--	--	--
IM	80	1.60	128	67	5.36	1610
M	209	2.23	468	151	31.56	4180
Total or average	304	2.00	608	121	36.92	5790

[a]Differences between subsectors IM and M are mainly in the levels of crop protection and fertilization. It is assumed that all harvest is done by hand, but that in subsectors IM and M tilling is predominantly done by machinery. Production targets are only preliminary ones, because no demand projections were available. Forty percent of yield increases are assumed due to fertilization. Labor coefficients for subsector M are reduced because of the possibility of areal spraying and mechanization of crop care. Labor elasticity to yield .6.

Plant protection		Area under improved varieties	Area irrigated	Labor requirements		
$ ha	mill. $	% of total area		days/ha	ooo days	days/MT
--	--	20	50	113	1,695	141.2
65	--	100	80	113	6,780	79.8
130	--	100	90	97	14,550	51.1
--	--	95	85	102	23,025	60.3
--	--	20	50	113	1,695	141.2
75	--	100	80	121	9,680	75.6
150	--	100	90	103	20,806	49.0
--	--	96	85	108	32,181	57.0
--	--	20	50	113	1,695	141.2
75	--	100	80	121	9,680	75.6
155	--	100	90	107	22,363	47.8
--	--	96	85	111	33,738	55.5

TABLE A.9. Production plan - potatoes[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970 - Subsectors: T	30	9.73	292	--	--	--
IM	30	12.00	360	45	1.35	--
M	30	13.00	390	65	1.95	600
Total or average	90	11.58	1042	37	3.30	600
1980 Low-Subsectors: T	30	9.73	292	--	--	--
IM	52	12.10	629	48	2.50	--
M	35	13.20	462	71	2.49	700
Total or average	117	11.82	1383	43	4.99	700
1980 Medium 1-Subsectors: T						
IM			SAME AS LOW			
M						
Total or average						
1980 Medium 2-Subsectors: T						
IM			SAME AS HIGH			
M						
Total or average						
1980 High-Subsectors: T	30	9.80	294	--	--	--
IM	45	13.25	596	70	3.15	--
M	42	14.16	595	88	3.70	--
Total or average	117	12.69	1485	59	6.85	840

[a]Subsectoral breakdown based on crude estimates. No fertilized base yield 9.75 MT/ha. Yield increases due to fertilizers roughly 60 percent. Employment elasticity to yield .6 because of the high harvest component. M1 projection is based mostly on area expansion, M2 projection on yield expansion.

Plant protection		Area under improved varieties	Area irrigated	Labor requirements		
$ ha	mill. $	% of total area		days/ha	ooo days	days/MT
--	--	--	--	120	3,600	12.3
--	--	--	--	126	3,780	10.5
--	--	80	--	120	3,600	9.2
--	--	27	--	122	10,980	10.5
--	--	--	--	120	3,600	12.3
--	--	--	--	127	6,604	10.5
--	--	80	--	121	4,235	9.2
--	--	24	--	123	14,439	10.4
--	--	--	--	120	3,600	12.2
--	--	--	--	134	6,030	10.1
--	--	80	--	126	5,292	8.9
--	--	29	--	128	14,922	10.0

TABLE A.10. Production plan - sugarcane[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970 - Subsectors: T	218	38.9	8,491	--	--	--
IM	24	45.0	1,080	28	0.67	2,690
M	108	68.6	7,410	137	14.80	1,350
Total or average	350	48.5	16,981	44	15.47	4,040
1980 Low-Subsectors: T	266	40.5	10,776	--	--	--
IM	50	50.0	2,500	61	3.05	3,510
M	115	79.0	9,122	195	22.43	1,440
Total or average	431	51.9	22,398	59	25.48	4,950
1980 Medium 1-Subsectors: T	267	38.9	10,409	--	--	--
IM	50	53.0	2,650	75	3.75	3,510
M	138	72.0	9,956	162	22.36	1,440
Total or average	455	50.6	23,015	57	26.11	4,950
1980 Medium 2-Subsectors: T	230	40.0	9,200	--	--	--
IM	62	57.0	3,544	93	5.77	3,300
M	135	75.0	10,125	176	23.76	1,620
Total or average	427	53.5	22,869	69	29.53	4,920
1980 High-Subsectors: T	230	40.5	9,315	--	--	--
IM	60	53.0	3,204	75	4.50	3,300
M	130	79.0	10,328	195	25.35	1,620
Total or average	420	54.4	22,847	71	29.85	4,920

[a]Fertilizers assumed to be responsible for 60 percent increase in yields.

Plant protection		Area under improved varieties	Area irrigated	Labor requirements		
$ ha	mill. $	% of total area		days/ha	ooo days	days/MT
--	--	--	--	190	41,420	4.9
--	--	30	--	213	5,112	4.7
--	--	80	20	60	6,480	0.9
--	--	27	25	151	53,012	3.1
--	--	--	--	192	51,072	4.7
--	--	30	--	222	11,100	4.4
--	--	90	100	65	7,475	0.8
--	--	27	27	162	69,647	3.1
--	--	--	--	190	50,730	4.9
--	--	40	--	233	11,650	4.4
--	--	85	100	62	8,556	0.9
--	--	30	30	156	70,936	3.1
--	--	--	--	191	43,930	4.8
--	--	50	--	246	15,252	4.3
--	--	90	100	63	8,505	0.8
--	--	36	32	159	67,687	3.0
--	--	10	--	192	44,160	4.7
--	--	50	--	233	13,980	4.4
--	--	95	100	65	8,450	0.8
--	--	42	31	159	66,590	2.9

TABLE A.11. Production plan - other crops[a]

	Area	Yield	Production	Fertilizers	NPK	Tractor units
	ooo ha	MT/ha	ooo MT	Kg/ha	ooo MT	No.
1970 --Subsectors: T	504	2.8	1,412	--	--	--
IM	195	3.4	664	35.0	6.8	850
M	192	5.3	1,018	50.0	9.6	1,760
Total or average	891	3.5	3,094	18.4	16.4	2,610
1980 Low-Subsectors: T	559	2.8	1,565	--	--	--
IM	269	4.0	1,076	53.0	14.2	860
M	207	6.4	1,335	68.0	14.1	1,630
Total or average	1,035	3.8	3,976	27.4	28.3	2,490
1980 Medium 1-Subsectors: T						
IM			SAME AS LOW			
M						
Total or average						
1980 Medium 2-Subsectors: T						
IM			SAME AS HIGH			
M						
Total or average						
1980 High-Subsectors: T	602	2.6	1,562	--	--	--
IM	356	4.2	1,493	59.0	21.0	770
M	271	6.5	1,757	74.0	20.0	1,710
Total or average	1,229	3.9	4,812	33.4	41.0	2,480

[a]Other crops include: millet, sorghum, cassava, yams, other starchy roots, plantains, groundnuts, vegetables, bananas, citrus, other fresh fruits, sesame, cocoa, coconuts, soybeans, palm oil, sisal, tobacco.

Area breakdown, yields and input use were calculated on the basis of individual crops, then aggregated. Fertilizers account for about 60 percent of yield increase. Average labor requirements were calculated on limited information basis covering about 70 percent of area under crops in this table.

Plant protection		Area under improved varieties	Area irrigated	Labor requirements		
$ ha	mill. $	% of total area		days/ha	ooo days	days/MT
--	--	--	--	60	30,200	21.4
15	--	20	5	70	13,650	20.5
60	--	70	10	50	9,610	9.4
--	--	19	3	60	53,460	17.3
--	--	--	--	62	34,596	22.1
--	--	20	5	75	20,114	18.7
--	--	70	10	46	9,460	7.1
--	--	19	3	62	64,170	16.2
--	--	--	--	63	38,170	24.3
--	--	20	10	76	26,944	18.1
--	--	70	15	41	11,084	6.3
--	--	21	6	62	76,198	15.8

C. Cost-Benefit Calculations

Each of the production plans, given prices, can be evaluated in terms of its cost and revenue. Preliminary calculations were attempted to analyze profitability of production in each of the technological subsectors, as well as to determine the cost of transforming traditional technology into intermediate technology. Due to insufficient cost information cost-benefit calculations were not complete.

In the calculation of costs the following figures were used:

Land (rent)	
irrigated	$80/ha
nonirrigated	$20/ha
Fertilizer	$282 per MT of NPK nutrient
Tractors	$9,000 per tractor
Plant protection	no information

Seed — The cost of improved, high yielding seed was assumed to be about 25 percent above the regular seed.

The seed for coffee was estimated at $6 per hectare plus $180 per hectare for initial field investment.

Sugar cane cost figures not available.

Other crops (Table A.11) cost figures not available.

Labor — $1.20 per man-day

The following prices in dollars were used to calculate the revenue from crops (per MT): wheat 113, rice 105, maize 71, barley 87, pulses 220, coffee 405, cotton 223, potatoes 60, sugarcane 4, other crops 113.