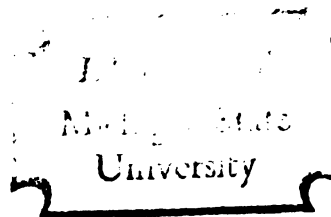


IMPROVING THE ORGANIZATION OF
FRUIT AND VEGETABLE PRODUCTION -
ASSEMBLY SYSTEMS IN THE
COFFEE ZONE OF COLOMBIA:
A CASE STUDY IN THE LA MESA REGION

Thesis for the Degree of Ph. D.
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This is to certify that the

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ABSTRACT

IMPROVING THE ORGANIZATION OF FRUIT AND VEGETABLE PRODUCTION-ASSEMBLY SYSTEMS IN THE COFFEE ZONE OF COLOMBIA: A CASE STUDY IN THE LA MESA REGION

By

J. Pablo Torrealba

A substantial proportion of the Central Coffee Zone of Colombia, which is an important part of the national economy, is composed of small owner-operated farms, a great number of which have underemployment and low incomes. These conditions are stimulating migratory streams to the large urban centers which already have relatively high unemployment rates. As a means of generating higher incomes and employment in these highly populated regions, the Diversification Program of the Coffee Growers' Federation is directing considerable efforts towards promoting the expansion of labor intensive fruit and vegetable output. The poorly organized production-assembly systems in most of the Coffee Zone constitutes a crucial limitation to fruit and vegetable output expansion.

The main objectives of this study were to analyze the production-assembly system for fruit and vegetables and evaluate the economic feasibility of a proposed improvement

strategy that would allow output expansions and greater marketing efficiency. The research focused upon a selected region of the Coffee Zone, La Mesa, for its seemingly high potential to expand this kind of output. Basic information on the production-assembly system was obtained from special farmer and assembler surveys, and from other available secondary information from the institutions working in this region. Prices were collected in rural markets in the region and analyzed in relation to prices in the Bogota wholesale market. Pilot marketing projects were observed in other regions within the Coffee Zone to obtain data and information on improved product handling and assembly methods.

The major findings and conclusions obtained were the following:

1. The production structure for these perishable products at the farm level is characterized by a very small scale, which acts as a deterrent to technical improvements and yields a very heterogeneous product supply. Rural assemblers, which typically handle rather small volumes, face substantial risks in operating with these heterogeneous and unstable supplies. Furthermore, they must face considerable risks and uncertainty in selling at the Bogota wholesale market.

Rural markets are also characterized by logistics of assembly which are quite costly. Moreover, the low degree

of coordination throughout the marketing channels has prevented better pricing efficiency and improvements in product handling and packaging methods, which are actually causing high product losses.

2. A strategy based on the establishment of product assembly centers would be the main element for introducing the necessary changes to improve the operation of production-assembly systems. The product assembly centers are facilities that purchase, assemble, prepare, sort and pack fruits and vegetables for later sale. These facilities would use improved methods for performing these physical functions and the marketing exchange functions. It is expected that such improved methods would diffuse throughout the fruit and vegetable marketing system.

A synthetic cost analysis determined that the lower cost alternative way of implementing the strategy, in terms of the number, size and location of product assembly centers, is to establish one large facility in the wholesale center of Bogota.

3. Public benefits derived from this strategy would exceed costs by a substantial amount as shown by a benefit-cost analysis. However, the private returns to this activity would be much less. It is quite doubtful that any private enterprise would undertake this venture. Public support seems justified in order to realize desired social objectives.

4. The longer run effects of this strategy would enable further improvements in the production and urban distribution stages of the marketing system for fruits and vegetables. Some of the most important effects would be the greater availability of lower cost, higher quality fruits and vegetables for consumers in urban markets, larger and more stable markets for farmers, which in turn would stimulate output expansions and the adoption of improved techniques. Over a longer period, export markets might be developed.

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GLOSSARY

Some of the terms, units and institutions commonly referred to in this dissertation are defined or explained below to facilitate the exposition.

- Campesino: Farm worker, small farmer or peasant.
- CORABASTOS: Corporacion de Abastos de Bogota (Supplies Corporation of Bogota). A semi-public agency which is in charge of the promotion of improvements in the Bogota urban food distribution system. The efforts of this Corporation include several programs as PAN, CABSAs and others.
- DANE: Departamento Administrativo Nacional de Estadística (National Department of Statistics) compiles periodic data on most of the areas of development. It is in charge of conducting the national census.
- Hectare: (Usually abbreviated as ha.) A unit of surface measurement, equivalent of 10,000 square meters or 2.47 acres.
- Kilometer: (Abbreviated as km.) A unit of distance, equivalent to 1,000 meters or 0.6 miles.
- Kilogram: A unit of weight equivalent to 2.2 pounds (abbreviated as kg.).
- Municipio: An administrative unit or subdivision of the largest administrative unit (department or Departamento).
- Minifundio: A small farm or very small farm generally is defined as those small or very small farms that cannot provide an adequate income level to the operator and his family, implying subsistence or under subsistence income level.

- Peso: Monetary unit of Colombia equivalent to 0.0477 U.S. dollars at the official exchange rate of January, 1972.
- Parcela: A sampling unit used by DANE in the 1970 Census of Agriculture, defined as a continuous area of land having only one form of tenancy and located in one vereda, corregimiento or place.
- PAC: Product Assembly Center, a facility to assemble, purchase, prepare, sort, pack and ship fruit and vegetable products.
- Plaza: An open place that serves as a regular market on a permanent basis or on a certain day. It can have both retailing and wholesaling trade.
- PAN: Programa de Abaratamiento Nutricional (Lower-Cost Nutritional Program) is one of the programs advanced by CORABASTOS, which pursues the technical improvement in retail stores and to promote better wholesaler-retailer coordination as a means of lowering retailers' procurement costs and keeping food prices down in Bogota.
- Ton: A unit of weight equivalent to 1,000 kilograms or 2200 pounds.
- Tienda: A small retail neighborhood store which generally does not operate on a self-service basis.
- Vereda: The smallest administrative unit in Colombia, usually a small locality that ranges from a few hectares to several hundred hectares in the region of the study. Several veredas form a corregimiento, and several corregimientos form a municipio.

CHAPTER I

GENERAL PROBLEM

The Agricultural Sector

The agricultural sector of Colombia is playing an important role in the economic development of the country. This sector presently contributes approximately one-third of the gross national product, generates 78 percent of the total foreign exchange and employs 45 percent of the total labor force in the country.¹ This degree of participation in the global economic activity indicates that the role played by this sector in the process of economic development is of critical importance.

The production of the agricultural sector grew at an average annual rate of 3.3 percent between the years 1950-1968.² This growth rate was approximately equal to the population growth rate of the country, thus available per capita production has been virtually static in the last two

¹Oficina de Planeamiento del Sector Agropecuario, Programas Agrícolas para 1972 (Bogotá: Ministerio de Agricultura, January, 1972), pp. 2-3.

²Ibid.

decades. Meanwhile, the gross national product in Colombia grew between 1950 and 1967 at an average annual rate of 4.7 percent which resulted in an average annual per capita growth rate of 1.5 percent.³ More recently (1966-1969) the growth rate of the agricultural sector has increased reaching an annual rate of 5.4 percent.⁴ The gross national product achieved a similar rate of growth during this period.⁵

The Duality of the Sector

Two sub-sectors, having different economic opportunities and growth rates, can be distinguished within the agricultural sector of Colombia. A traditional sub-sector, located primarily in the mountainous area, is typically composed of small farms with low levels of utilization of modern agricultural inputs. On the other hand, a modern sub-sector, generally located in the valleys, is composed of farms which tend to be larger and use modern inputs.⁶

³Jay Atkinson, Agricultural Productivity in Colombia, Foreign Economic Report No. 66 (Washington, D.C.: U.S. Department of Agriculture, Economic Research Service, 1970), p. 5.

⁴Ministerio de Agricultura, El Prestamo Sectorial Agropecuario 1972 (Bogota: Departamento Nacional de Planeacion, 1971), p. 3.

⁵Socio-Economic Progress in Latin America, Ninth Annual Report of the Social Progress Trust Fund, March, 1970 (Washington, D.C.: Inter-American Development Bank, 1970), p. 266.

⁶This division into these sub-sectors has been presented by Jay Atkinson, op. cit., pp. 84-93.

These two sub-sectors have performed differently. While the modern sub-sector has achieved an important growth, the traditional sub-sector has not been able to increase its production--nor possibly its income--in the same proportion.

This disparity in the growth of the two sub-sectors is due to a number of reasons which will be briefly summarized.

In the first place, the existing land tenure patterns cause a concentration of agricultural incomes and also result in an inadequate combination of productive resources (land and labor) which possibly restricts aggregate production. There is a great abundance of labor and very little land in the small farms while the opposite happens in the large farms.⁷ This and other negative effects in the economic and social structure have caused land tenure to be considered as one of the principal problems faced in the rural development in Colombia.⁸

External factors to the agricultural production unit have also operated in a preferential manner supporting the growth of the modern sub-sector. The principal factors have

⁷Peter Dorner and Herman Felstenhausen, "Agrarian Reform and Employment: The Colombian Case," International Labour Review, 102 (September, 1970).

⁸The studies in this respect are many. Some of the recent ones are: International Labour Office, Towards Full Employment (Geneva: ILO, 1970), Chapter 5; and "La Reforma Agraria," Boletín Mensual de Estadística, Departamento Administrativo Nacional de Estadísticas, 234 (January, 1971), 57-127.

been institutional credit, available technology and technical assistance, price policy and the markets for the different agricultural products. In these aspects, the traditional sub-sector has been confronted with greater obstacles than the modern sub-sector, causing a relative deterioration which widens the income gap between these sub-sectors.

The credit distribution of some institutions acting in the agricultural sector has favored larger producers in the modern sector. Thus, more than half of the institutionalized credit of the sector is granted to less than 10 percent of the beneficiaries.⁹ Atkinson, in his analysis of the agriculture in Colombia, states that credit has not been a crucial obstacle for commercial agriculture but the traditional sub-sector instead has been virtually eliminated from the institutional sources of subsidized credit.¹⁰

Agricultural research has given a much greater emphasis to the agriculture of large farms.¹¹ The modern sub-sector has benefited in a greater degree from

⁹Dorner and Felstenhausen, op. cit., p. 232; also see figures on the relative concentration of credit in DANE, "La Reforma Agraria," op. cit., p. 112; and ILO, op. cit., p. 89.

¹⁰Atkinson, op. cit., p. 12; see also Juan F. Gaviria, Francisco J. Gomez and Hugo Lopez, Contribucion al Estudio del Desempleo en Colombia (Bogota: DANE, 1971), pp. 57-58, 73-76.

¹¹Dorner and Felstenhausen, op. cit., pp. 236-237.

technological advances directly applicable to the crops produced by this sub-sector.¹² In this respect, a document published by the Ministry of Agriculture states that "a good part of the traditional producers in minifundio or colonization areas have not had access to modern technologies that are of a vital importance to the improvement of their productivity."¹³ There is a lack of specific research results for the crops of the traditional sub-sector such as plantain, yucca and other crops.¹⁴ Furthermore, in the case of crops produced by both sub-sectors (potatoes, corn, wheat, tobacco), the yields per unit of land, in general, increase in direct relationship to the size of the farm.¹⁵ This possibly reflects differences in the type of natural resources and available credit, but perhaps also a different degree of technical assistance since a great part of the technology could be applied on small farms.¹⁶

The traditional sub-sector is also confronted by more difficult obstacles in the marketing process and, in general, it has also received less attention from the official institutions operating in agriculture. In fact,

¹²Otto Morales, quoted in DANE, "La Reforma Agraria," op. cit.

¹³OPSA, Programas Agrícolas, op. cit., pp. 5-6.

¹⁴Atkinson, op. cit., p. 89.

¹⁵Ibid., pp. 24-26.

¹⁶ILO, op. cit., p. 86.

the small farms of the traditional sub-sector depend to a larger extent on perishable products¹⁷ while the modern sub-sector has oriented its production more towards grains, sugar, cotton and oilseeds. It is evident that the farmers' problems of marketing these perishable products are much more complicated than the marketing of the products of the modern farms, apart from presenting greater price instability. A large part of the support prices existing in Colombia (corn, sorghum, soybean, rice, wheat, barley, sesame and anise) correspond to crops produced in the modern sub-sector.¹⁸ Similarly, the activities of the marketing agencies have possibly benefited the farmers in the modern sub-sector to a greater extent,¹⁹ both by this price support policy as well as by the kind of investments in marketing infrastructure and other services rendered.

The case of coffee farms, which is the main focus of this study, deserves special consideration regarding the argument presented above. The coffee sector, which is an important part of the agriculture of Colombia, shows some

¹⁷The agrarian census of 1959 shows, for example, that the farms with less than five hectares represented 51 percent, 70 percent and 65 percent of the total producers of plantain, tomato and banana, respectively.

¹⁸Coffee prices are an exception of considerable magnitude to the argument presented here. Coffee production is mainly a small farm activity which has had support prices.

¹⁹ILO, op. cit., p. 83.

characteristics which make it different from other commodity sectors. To a large extent it is composed of small farms which utilize a rather primitive technology. This fits the case of the traditional sub-sector. However, coffee farmers have had a relatively privileged position regarding the availability of credit, research, and extension, although the distribution of these services might have primarily reached larger farms. If this commodity sector has had such a distribution of supporting services, it could well fit the previously mentioned duality of modern and traditional sub-sectors. The only exceptional feature which could make it part of the modern sector is the fact that for years it has had highly organized markets with fixed minimum prices.

All these disparities in the available resources and the way in which technical assistance and other programs affect the different sub-sectors have fostered or conditioned a dual structure in the agriculture of Colombia. The gap in production and income has been increasing.²⁰

The disparity in the growth of the income per person in these sub-sectors represents a serious situation since it tends to increase the concentration that exists in the

²⁰Atkinson, op. cit., p. 88; and ILO, op. cit., p. 69.

income generated in the sector.²¹ This general situation also represents a lack of a full use of the productive resources so that the potential contribution of the traditional sub-sector to increase agricultural production is constrained.

Unemployment and Migration

Part of this limited use of resources is reflected in the form of open or disguised unemployment in the agricultural sector. There are no reliable estimates of the magnitude of these forms of rural unemployment,²² but given the rate of productivity increases (2 percent)²³ in the light of the existing rates of demographic growth (3.2 percent) and agricultural output growth (3.3 percent), it is likely that underemployment or migration might have increased.

The underemployment of human resources in the rural areas has stimulated a greater migration towards the cities

²¹For example, 90 percent of the people in agriculture in Colombia only receive 46 percent of the income of the sector. See: Albert Berry and Alfonso Padilla, "La Distribucion de Ingresos Provenientes de la Agricultura en Colombia--1960," Boletin Mensual de Estadistica, DANE (January, 1971).

²²Except for calculations made by DANE in the 1964 census, which shows 18.2 percent of underemployment in the agricultural labor force as quoted in ILO, op. cit., p. 355.

²³Atkinson, op. cit., p. 16.

with the consequent difficulties brought about by a disproportionate growth of the main urban centers. This has brought about an annual growth in the urban labor force in the order of 4.4 percent which the current economic growth of the cities has been unable to absorb productively. As a consequence, high rates of open and disguised unemployment resulted. According to the estimations of the International Labour Office, in 1967 the total of these forms of unemployment represented approximately 25 percent of the urban labor force with a long run increasing trend.²⁴

The government of Colombia has identified these important problems, and the concern is reflected in the stated general policy objectives of the agricultural sector:

1. The exercise of an agricultural policy of a social type that modifies the living conditions of the Colombian [campesino] farmer, through a redistribution of productive resources and incomes, and through the increase in employment in the agricultural sector.
2. Increased production and improvement of agricultural productivity. These are basic requirements to satisfactorily meet the present consumption of essential commodities and industrial raw materials, and also of import substitution and the strengthening of exports.
3. The improvement of marketing and urban supply system, as a means of adequately directing agricultural production, of combating increases in cost of living in the main popular consumption

²⁴ ILO, op. cit., p. 19.

items, and to prevent the deterioration in producers' and consumers' incomes.²⁵

Urban Food Demand

The disproportionate growth of the urban centers has brought about a sharp increase in the urban demand for food which exerts great pressure on the existing marketing channels both in the primary stages in rural areas as well as in those of urban distribution. In fact, if the urban population grows at an annual rate of 7 percent and if the per capita income increases annually 1.5 percent,²⁶ then the total demand for food in urban areas would have an annual growth of almost 8 percent.²⁷ It must be pointed out that this annual growth figure can be even larger for some specific food products with a higher income elasticity, such as of fruits, vegetables, meat and other products.²⁸

²⁵OPSA, Programas Agrícolas, op. cit., p. 6. Similar objectives had been previously stated, see DNP, Plan de Desarrollo Económico y Social 1970-1973 (Bogotá: República de Colombia, 1970).

²⁶Average annual growth rate of income per person registered in the period 1950-1967. See Atkinson, op. cit., pp. 4-5.

²⁷This estimate is based on the equation $\Delta\% \text{ Demand} = \Delta\% \text{ Population} + (\Delta\% \text{ Income per Capita}) \times (\text{Income Elasticity})$ and assuming an aggregate income elasticity for food demand of 0.5.

²⁸Estimates of income elasticity of demand are given in Harold Riley, Kelly Harrison et al., Market Coordination in the Development of the Cauca Valley Region--Colombia (East Lansing, Michigan: Michigan State University, 1970), p. 34; Centro de Investigaciones para el Desarrollo, Estudio

If this remarkable increase in the demand for food products is not accompanied by a parallel growth in the supply of agricultural products, which requires a matching expansion in the marketing channels, inflationary pressures are created in the economy. The price level of food products has a very important role in the distribution of real income since the lower the level of income in a certain population stratum, the greater is the percentage of its total income spent on the purchase of food.²⁹ This is why the measures that tend to increase the final food supply (especially staple food) to consumers are relatively more beneficial to the lower income strata of the urban population.

The Food Marketing System

The food marketing system is a vital part of the process of rural development and of the economic growth of the industrial urban centers. As such, it is one of the elements which have operated in the important problems previously mentioned.

An efficient food marketing system, on one hand, tends to increase and stabilize the income of agricultural

de Consumidores y Distribucion Urbana de Viveres de Bogota Consumidores (Bogota: Universidad Nacional de Colombia, 1971), pp. 51-52; and FAO and ECLA estimates are quoted in ILO, op. cit., p. 383.

²⁹Figures documenting this economic rule can be seen for the case of Colombia in Riley, Harrison et al., op. cit., pp. 30-33; and CID, op. cit., p. 46.

producers. Besides, this efficiency implies a reduction of the marketing and distribution costs from the producers to consumers. This tends to result in a reduction of the food prices and represents an increase in the real income of consumers. This increase in income will be reflected in a greater effective demand for foods and other consumer goods. In turn, this tends to increase the employment opportunities and the income of the agricultural producers through the expansion of production as a response to this increase in effective food demand. The increase of agricultural income, in turn, increases the rural demand for consumption goods of industrial origin and the demand for modern agricultural inputs. This increase in the demand will tend to increase the opportunities to expand production, employment and income in the industrial sector; this expansion, in turn, tends to increase once more the demand for food, and so this dynamic cycle keeps going on, obtaining successive employment, production and income increases which are the essential variables of economic development.³⁰

It is important to point out that these kinds of economic growth processes fundamentally depend on and are stimulated by efficient marketing systems for food, consumer

³⁰This conceptualization of the role of the marketing system in the process of economic development has been presented in detail in Riley, Harrison et al., op. cit., pp. 3-6.

goods and inputs in rural and urban areas. This conceptualization clearly shows the relationship of the marketing system and the generation of income in rural areas which affects the employment opportunities and the migration to cities. However, the improvement of the marketing system must be understood as a component of a larger set of development plans and programs. Thus, the type of program for the improvement of marketing and the means for its implementation must be conditioned to the general objectives of development; that is, there must be priorities reflecting these objectives in the plans for the improvement of marketing.

This view takes on great importance if we consider that an efficient marketing system can (hypothetically) operate in such a way that it widens the gap between the incomes of the two sub-sectors of agriculture. In this sense, improvements in the marketing system, just as for example credit and technical assistance programs, may produce undesirable effects on the distribution of income and the generation of employment in spite of the fact that its contribution to increase production and income may be very positive. Therefore, the orientation of the plans for improvement in the marketing system and the means used must be subjected to these general objectives of development.

This consideration does not necessarily imply that the choice between the trade-offs among objectives (economic efficiency vs. employment or income distribution) will be the same for all the areas of agricultural development; but these trade-offs need to be considered in the overall planning and program implementation. The important point is to consider the programs and means of implementation in light of the overall objectives for sectorial development. Furthermore, it should be kept in mind that in most situations, a solution or program can only be of a "second best" type.³¹

Marketing in Rural Development

The stated policy objectives of the Colombian Government for the agricultural sector clearly indicate a deep concern for income redistribution and increasing employment, aiming to improve the living conditions of the low income farmers (campesino). This indicates that in the area of rural development, high priorities should be given to marketing improvement programs which mainly tend to raise the level of income and employment of the campesino.

³¹The contention in the theorem of the second best is that when analyzing a part of the economic system, no conclusions regarding general economic welfare can be derived since the impact of that part of the economic system on the rest of it is not known. See R. G. Lipsey and Kelvin Lancaster, "The General Theorem of the Second Best," Review of Economic Studies, 24 (1956-57), 11-32.

It is possible to argue that the improvement of the marketing system cannot discriminate in the benefits it renders to the different participants in the market since an efficient system is partly characterized by the absence of discrimination between buyers and sellers. The same can be said of the generation of employment. Nevertheless, there are ample possibilities in the means of introducing an improvement to favor the most needy strata of the population.³² In the case of agriculture in Colombia, the characteristics of land tenure in the different areas and the type of production originating on smaller farms present a setting that makes possible the conception of plans to improve marketing that would principally benefit the traditional sector. This can be obtained through plans oriented towards: (1) agricultural areas in which small farms are predominant and (2) marketing channels of specific agricultural products on which the traditional sub-sector is greatly dependent.

This concept on the improvement of the marketing channels that serve a specific agricultural region must be considered as a fundamental component of the efforts for

³²An example would be the case of differential margins in retail stores with the purpose of offering lower prices for essential foodstuffs. See Charles Slater, Harold Riley et al., Market Processes in the Recife Area of Northeast Brazil (East Lansing, Michigan: Michigan State University, 1966), Chapter 6.

rural development programs. The investments in these programs, the social aid activities and community development are largely dependent on the emphasis given to a set of farm assistance measures in which marketing plays a critical part.

This notion of designing marketing plans oriented to specific agricultural areas has been incorporated to the rural development programs that Colombian institutions are carrying out. INCORA, the land reform and settlement agency has fomented the creation of farm marketing cooperatives as an important part of their efforts in rural development. Recently, the Colombian Agricultural Institute (ICA), which has been in charge of research and extension, has established six rural development projects in regions in which low incomes and small farms are predominant. ICA's strategy also considers the marketing functions (of products, input procurement and consumer goods) as one of the basic factors for success in increasing production and incomes, and also for the diffusion of technology.³³

³³Oficina de Coordinacion Nacional de Proyectos Especificos de Desarrollo Rural Regional, "Informacion Basica de los Proyectos de Desarrollo Rural: Oriente Antioqueño, Oriente de Cundinamarca, Garcia Rovira, Norte Caucano y Region de Ariari" (Bogota: ICA, 1971, mimeo.).

Similar concepts have been developed by many agencies and scholars in rural development, for example see International Labour Office, op. cit., p. 84.

The rural marketing system plays an important role in the adoption and exploitation of new agricultural technologies and in the development of rural communities. It has been recently stated that the promising technological advances of the green revolution have increased productivity but due to marketing problems they have not always represented higher income.³⁴ For these reasons, the marketing of agricultural products must be seen as closely interrelated to the rest of the elements of rural development (credit, technical assistance, etc.) and the key to the strategy is to provide all the elements in an opportune and coordinated way to the benefit of the farmer.³⁵

Specific Problem

A large part of the mountainous area of Central Colombia is composed of small coffee farms. Many of these farms can be categorized in what was earlier described as the traditional sub-sector; low incomes and a certain degree of underemployment are not uncommon in these farms and a part of the migrant stream comes from them.

³⁴Guillermo Grajales, "La Comercializacion de Productos Agricolas en America Latina," Desarrollo Rural de las Americas, III, No. 2 (May-August, 1971), 77-84.

³⁵Similar concepts have been expressed by Eduardo Alvarez, "A Summary of What We Have Learned About Increasing Productivity Among Small Land Holders" in Strategies for Increasing Agricultural Production in Small Holdings, ed. by Delbert T. Myren, Proceedings of an International Conference, Puebla, Mexico (Mexico City, Mexico: CIMMYT, 1970), pp. 69-72.

These conditions have led to a search for new economic opportunities to expand production that would increase incomes and employment. The main efforts in this respect have been initiated by the National Federation of Coffee Growers of Colombia (Federacion Nacional de Cafeteros de Colombia), through the operation of specific programs aiming towards expanding the production of crops different from coffee in the coffee region, since the demand for coffee has constraints in the internal and external markets. The Coffee Diversification and Development Program of this Federation has conducted technical, economic and social studies to identify the regions and economic opportunities that could be advanced for diversifying the coffee zone. Most of these new opportunities are based on expanding the production of fruits and vegetables; these studies indicate that these products can compete very favorably with coffee in terms of incomes and employment generation.³⁶

The Diversification Program has implemented a credit program to foment the production of those enterprises that are deemed as good technical and economic production alternatives. After several years of operation at a regional level within the coffee zone, the Program has been extended to the national level. At this point a Marketing department

³⁶Programa de Desarrollo y Diversificacion de Zonas Cafeteras, Proyectos de Diversificacion Agropecuaria para la Zona Cafetera Central de Colombia (Bogota: Federacion Nacional de Cafeteros de Colombia, 1972).

was formed in this Program in recognition of the serious problems that must be faced in the marketing of these perishable products.

A review of studies (which is summarized below) and the experiences of local technicians reveals that probably one of the main constraints for expanding the production of fruits and vegetables in the coffee region has been the ineffective operation of the existing rural markets. There have been few incentives to foster increased farm production of these products nor to increase the productivity in marketing operations. The output of these products has been unstable in terms of qualities and quantities, and the possibilities offered by the growth of the urban markets have not been fully exploited.

The basic question that has been addressed by this dissertation is as follows: What possible changes in the production-assembly systems for fruits and vegetables could foster productivity improvements in farming and assembly operations, increase the output of these commodities and also result in a more stable supply of better quality products for the urban markets?

A preliminary diagnosis of the existing problems in the processes of production and assembly of fruits and

vegetables based on previous studies³⁷ suggests the following conditions that serve as constraints to improved performance:

Concerning rural assemblers:

1. Oligopolistic structures prevail in these rural markets in which low prices for the farmers are common, these market structures do not create incentives for the adoption of modern marketing techniques.
2. The supply of products in these rural assembly markets is small and very diversified. Consequently, the intermediaries' operations generally are small

³⁷These research questions are based on the analysis of several studies: Alvaro Silva et al., Producción y Distribución de Frutas y Hortalizas en la Zona de Influencia de Cali, Technical Report No. 15 (Cali, Colombia: PIMUR, 1969); Aldo Patruno et al., "Centros de Producción y Acopio del Area de Abastecimiento mas Próxima a Bogotá," Report No. 1: Municipio de Anolaima, Report No. 2: Municipio de La Mesa (Bogota, Colombia: CORABASTOS, 1971); Lazaro Montes, "La Comercialización del Tomate en Bogota y sus Fuentes de Abastecimiento: (Unpublished Research Thesis, Universidad La Gran Colombia, Facultad de Ciencias Económicas, Bogotá, 1966); Instituto Colombiano Agropecuario, Problemas de Mercadeo y Producción del Campesino, Technical Bulletin No. 10 (Bogota: Departamento de Economía Agrícola, 1971); Peter de Balogh, Mercadeo de Frutas y Hortalizas (Bogotá: Instituto Latino Americano de Mercadeo Agrícola, 1969); Informe Final Sobre el Desarrollo Experimental de Sistemas de Empaques para el Transporte de Frutas (Bogotá: IIT, 1966); CEDE, "Estudio del Mercadeo de las Principales Frutas Cítricas en la Ciudad de Bogotá," Monografía No. 11 (Bogotá: Universidad de los Andes, 1961); and "Estudio Sobre la Producción, Comercialización y Perdidas del Tomate" (Bogotá: IIT, 1961).

and non-specialized. This results in high operational costs for the flow of these products towards the urban wholesale markets.

3. The inadequate techniques used by the intermediaries are largely the result of the operating procedures of wholesalers in urban centers.

Concerning farmers:

1. The geographical dispersion of the farms, the lack of good roads and the small volumes of fruits and vegetables produced by the average farm will necessarily bring about high marketing costs in the assembly stage.
2. The marginal character of the production of fruits in coffee agriculture--frequently almost of a subsistence type--does not favor the adoption of modern techniques in the production and marketing of these products. Therefore, production tends to be of a low quality and consequently has low prices.
3. The lack of supporting services to the marketing of fruits and vegetables (such as storage facilities, information services, quality standards, transportation, credit and others) make an increased modernization of production and marketing quite difficult. In addition, this situation does not contribute to improve the bargaining power of the farmer.

4. The prices in these markets fluctuate widely, introducing great risks for the farmers and assemblers. Not only are marketing costs affected but this also prevents prices from being an effective guide to orient production in its different characteristics.
5. The low prices received at harvest time are primarily a reflection of the demand and supply relationship in the main urban centers.

Objectives

This research has three main objectives:

1. Analyze the marketing processes in the rural fruit and vegetable production-assembly system in a representative area of the coffee region of Colombia to identify the major barriers for improved market performance. This implies analyzing the relationships among the market participants within the system and also, some relationships of this system with the larger fruit and vegetable sub-sector.
2. Identify and evaluate a strategy for changing the rural production-assembly system so that an improved performance would be attained. This implies an economic analysis of the strategy and a set of recommendations for implementing it.

3. Develop simple, operational procedures for analyzing the economic aspects involved in the implementation of the strategy, so that it may be applied to other areas.

Orientation of the Study

The principal focus of this study is directed towards an individual and aggregate microeconomic analysis of the different participants of the production-assembly system in a selected rural area. This is the key for identifying alternative arrangements in the system which can improve its performance. Another dimension of the study will involve the analysis of the relationships of the production-assembly system with the markets it potentially faces.

This research will provide information which is intended to be useful in some of the decisions of the Diversification Program of the Coffee Growers Federation, which is carrying out considerable efforts to expand the production of fruits and vegetables in the coffee region. One of the lines of action of this vast program is the analysis of rural markets and the feasibility of establishing assembly centers throughout the coffee region as a means of improving the marketing position of the farmer and fostering increased production. Part of this line of action has been the operation of a pilot project of an

assembly center for fruits and vegetables in Manizales, in the heart of the coffee zone of Colombia. The tentative plans of the Diversification Program are to establish a vast network of assembly centers throughout the central coffee region, which would possibly be financed by a multimillion dollar loan of an international development bank. This research was carried out in close collaboration with the technicians of the Marketing Department of the Diversification Program.

The research should also contribute to the planning activities of CORABASTOS, an agency in charge of analyzing the urban food distribution system of Bogota, and of introducing necessary changes to improve the efficiency of this system. Some of the lines of action which are closely related to this research include activities oriented to the rural marketing stage in the Bogota foodshed; the promotion of voluntary retailer chains and improvements in a wholesaling-retailing coordination; and the establishment and direction of a new modern central wholesale market which was inaugurated in July 1972. All the changes that are taking place in the Bogota food distribution system emphasize the need for carrying out programs that simultaneously improve the performance of rural assembly markets, so that successive improvements may be fostered without facing bottlenecks that could hamper the results of these programs.

Methodology

The rural area selected for this research is composed of the municipios of Anolaima, Tena, La Mesa and Anapoima in the department of Cundinamarca. This area has been selected for the following reasons:

1. Its importance in the supply of fruits and vegetables to the city of Bogota.
2. The existing natural resource potential would permit a substantial expansion of production of fruits and vegetables.
3. This area is typical in many of the aspects of the organization of marketing and production of the vast coffee region in Central Colombia.
4. Some basic information on farms and assembly markets in this region was readily available.
5. Several agricultural institutions were working in the region to improve the marketing of these products.

The research methods required several forms of data collection for the different sub-parts of the study. The first step was to resort to published secondary information available in agricultural and food marketing institutions, universities and libraries. In this stage, personal interviews were held with officials in these institutions.

Several trips were made to the region of La Mesa to make a reconnaissance and establish contacts with the regional offices of agricultural agencies. A great deal of informal knowledge was obtained in this way which was necessary to further design the data collection process.

Assemblers in six rural markets were interviewed with a structured questionnaire. Twenty assemblers agreed to be interviewed (about 30 percent of the population) but only 15 interviews that were reliable and complete were utilized in the quantitative analysis. All but one of these interviews were personally conducted by the author. These interviews also had the purpose of promoting the future opening of CORABASTOS' new central wholesale market facilities in Bogota, which was offering rental space for wholesalers and assemblers. This promotion, which was of great interest to assemblers, turned out to be very useful for getting the interviews made in an environment in which obtaining information has traditionally been very difficult.

Price information on the major fruit and vegetable products was gathered in six rural markets in the region at varying intervals during a period of eight months to conduct intermarket price analyses. This period covers peak production periods and seasons of product scarcity. This information was obtained by technicians of an agricultural agency with local offices, and occasionally by the author. The

IDEMA daily bulletin on Bogota's wholesale prices was used as the main reference for urban prices.

A farm survey with a structured questionnaire dealing with farm production, marketing and some farmer perceptions of changes in the system was completed for 63 farmers (about 1 percent of the population). A two-stage sampling procedure was utilized with stratification of the farm population according to geographic characteristics. Details of the sampling plan are given in Appendix A.

Farm interviews made by CORABASTOS in this region in 1970 were available. These interviews (n = 93) had information that could be incorporated in some of the analyses carried out in this research; these data were incorporated in some parts of this study.

Information on the urban wholesaling and retailing was obtained by numerous informal personal interviews with traditional middlemen and in modern supermarkets.

Several organizations with innovative marketing operations were analyzed in detail, and cost-income data were obtained. These organizations include farmer cooperatives marketing fruits and vegetables in La Mesa, Las Mercedes and Manizales; and some marketing operations of "special" retailers (including supermarkets) and wholesalers.

The information gathered was partly processed by computer in Bogota, Colombia, and in East Lansing, Michigan.

The quantitative methods used in Chapter V are based on synthetic cost analysis; Chapter IV includes some multiple regressions; Chapter VI develops a benefit-cost analysis. The rest of the analysis was based on simple budgeting.

A Chapter Brief

Chapter II presents a conceptualization of a production-assembly system conceived within the broader marketing system. It identifies in detail the main aspects that determine its performance in a dynamic setting. This chapter provides a framework for the diagnostic analysis conducted in the two next chapters.

Chapter III is a descriptive analysis of the main characteristics of the production process of fruits and vegetables. The production patterns observed are explained, some of the opportunities to improve productivity are described, and the principal limitations for expanding the production of fruits and vegetables are identified.

Chapter IV offers an analysis of the operation and performance of rural assembly markets of fruits and vegetables in this coffee region. This analysis determines the most limiting barriers to improved market performance.

Chapter V is a detailed exposition of the strategy for improving the operation of rural assembly markets, which is based on the establishment of product assembly centers. The analysis considers in detail the costs of alternative

ways of implementing the strategy, and the final part of the chapter looks from the private standpoint at the economic feasibility of this strategy.

Chapter VI is an economic evaluation of the product assembly center strategy from the social standpoint. It considers the externalities involved, some of which are handled in a quantitative manner. The analysis of this chapter is conducted within the framework of benefit cost analysis.

The final chapter offers the main conclusions of the study and some recommendations for implementing the proposed strategy in the region of La Mesa and for analyzing the feasibility of the strategy in a wider geographical region.

CHAPTER II

A CONCEPTUAL FRAMEWORK

A conceptual model of the role of the agricultural marketing system in economic development will be defined in this chapter. Based on it, a detailed conceptualization of the rural production and assembly system will be offered to clearly show the functioning of its coordinating mechanisms. This will facilitate identification of the most important aspects in the central problem of this research.

The Marketing System and Economic Development

The marketing system consists of the complex set of institutions and physical installations (infrastructure) which relate human beings to things in the exchange of goods and services.¹ This wide definition of marketing indicates that this is the system coordinating the economic activities of production, distribution and consumption of economic goods. This implies that in a marketing system there are

¹A. Schmid and J. D. Shaffer, "Marketing in Social Perspective" in Agricultural Market Analysis, ed. by Vernon Sorenson (East Lansing, Michigan: Michigan State University, 1964), p. 16.

exchange relationships expressed in the transfer of property rights of goods and services; and also physical relationships (transforming production). An important element in a marketing system is the institutional organization in which these exchange operations take place.

This conception visualizes the marketing system as a part of the system of social relations in a human group. Thus, it must be understood that the exchange activities and functions of this system are conditioned by the social norms, attitudes and values which are generally expressed in the formal and informal exchange rules regulating the economic activity.² This is a particularly appropriate conception for the study of marketing systems in developing countries. It places emphasis on aspects of the social organization matrix which can provide both a more realistic vision of the possibilities of change and a careful selection of the theories applicable to each situation.

The role of the agricultural marketing system in economic development has been emphasized by a series of authors. Some of these opinions will be briefly summarized.

²The detailed exposition of this conception has been presented in Harold Riley et al., Market Coordination in the Development of the Cauca Valley Region--Colombia, Research Report No. 5 (East Lansing, Michigan: Michigan State University, 1970), pp. 3-4; Bonnen, Eicher and Schmid, "Marketing in Economic Development" in Agricultural Market Analysis, op. cit.

One of these views, based on extensive research, is that of the Latin American Market Planning Center of Michigan State University. The agricultural marketing system is seen as a coordinating element in the economic activities related to the food sector which promotes an increase in the efficiency and a reduction of the costs implied by the satisfaction of the urban demand for food. In the long run, this results in lower prices for food in the urban sector which expands the effective demand for food. This, in turn, results in greater income in the agricultural sector which can then demand a larger quantity of modern production inputs and consumption goods of industrial-urban origin. This expands the urban economic activity and allows an increase in the income and demand for food. This cycle of increases in income, production and consumption becomes dynamic due to the continual coordination and adjustments of the rural and urban markets, thus permitting a constant improvement in the key variables of economic development.³

A recent FAO study indicates that the primitive marketing methods are incompatible with a sustained general economic growth and with agricultural development in

³This model of the role of the marketing system has been presented by Slater, Riley et al., Market Processes in the Recife Area of Northeast Brazil, op. cit., pp. 12-15.

particular. Marketing modernization permits, on one hand, the satisfaction of the needs of the growing urban population to expand exports and foment processing industries; and, on the other hand, it permits an expansion of agricultural production through better marketing channels for products and inputs.⁴

The marketing system must be seen as a set of activities with a positive role in stimulating new productive activities in agriculture and in food industries. This may require a greater allocation of resources to these activities. This modern vision is very different from the traditional views which consider marketing as the simple movement of goods from producer to consumer, with a minimum expense of resources.⁵

Abbott, an author of long standing in agricultural marketing in FAO, has stressed in numerous publications the importance of marketing in economic development indicating that marketing has been a largely forgotten aspect in the national development plans of underdeveloped countries. Thus, the frequent need to stimulate and regulate these economies through the markets to achieve success in these

⁴FAO, Marketing a Dynamic Force in Agricultural Development, World Food Problem Series No. 20 (Rome: FAO, 1970), p. 10.

⁵C. D. Vincent, "Marketing and Economic Development" in Agricultural Producers and Their Markets, ed. by T. K. Warley (Oxford: Basil Blackwell, 1967), pp. 75-81.

plans is often disregarded.⁶ This author has also indicated the need to approach marketing programs in a coordinated way given the close interrelationships among the different stages of marketing.⁷

Collins and Holton have emphasized the need for public policy to provide the means to transform marketing systems since several kinds of barriers may be impeding autonomous change from within the system.⁸

There is consensus among some researchers and politicians on the importance of marketing systems in economic development, and to some extent, on the coordinating role of marketing in the rural and urban sectors, and also in the interactions among them. Expressions of this concern are the numerous marketing policies and programs in agricultural marketing being carried throughout Latin America, as

⁶J. C. Abbott, "Marketing Issues in Development Planning" in Markets and Marketing in Developing Economics, ed. by Moyer and Hollander (Homewood, Ill.: Irwin, 1968), pp. 87-116.

⁷J. C. Abbott, "The Role of Marketing in the Development of Backward Agricultural Economies," Journal of Farm Economics, 44 (May, 1962), 349-362.

⁸Norman R. Collins and Richard H. Holton, "Programming Changes in Planned Economic Development" in Agriculture in Economic Development, ed. by Carl Eicher and Lawrence Witt (New York: McGraw-Hill, 1964).

well as the support of international agencies for research and education training in this area.⁹

Counter-arguments to the notions expressed above were stated long ago. Bauer and Yamey questioned the validity of marketing reforms in promoting economic growth. Their argument was based in a supposed underestimation of farmers' responsiveness and price knowledge, and an exaggeration of the dangers of local buying monopolies. They also argue that the system automatically eliminates the unnecessary middlemen through the workings of the price mechanism. What they failed to explain is that if the system is in a low level of productivity and income equilibrium, how could it rapidly evolve out of that situation, and whether this evolution could come from within the marketing system.¹⁰

This brief description of the most prominent views of marketing serves as a basis for the conceptualization of the rural production-assembly system which is the main interest of this study.

⁹FAO, Políticas Gubernamentales de Mercadeo en America Latina (Rome: 1967); and FAO, Teaching in Agricultural Marketing at University Level, Report on the FAO Ad Hoc Expert Consultation on Teaching Agricultural Marketing held in Rome, December, 1971 (Rome: 1972).

¹⁰P. T. Bauer and B. S. Yamey, "The Economics of Marketing Reform," Journal of Political Economy, 62 (June, 1954), 210-225.

The Rural Production and Assembly System

To conceptualize a production and assembly system, it is necessary to clarify the meaning of "system." "A system is a set of objects together with relationships between the objects and between their attributes."¹¹ Other definitions have been offered regarding marketing systems: "A system is simply a set of interrelated and interdependent activities. The economy as a whole can be usefully viewed as a system of coordinated sequences of physical transformations";¹² and "a system is any set of interacting variables."¹³ A system must also be identified by its limits; that is, what objects or entities (or elements) it contains. In determining the limits, we will also be determining the system's environment. The system's environment is "the set of all objects, a change in whose attributes affects the system, and also of those objects whose attributes are changed by the behavior of the system."¹⁴ For

¹¹McMillan and Gonzalez, Systems Analysis (Homewood, Ill.: Irwin, 1965), p. 1.

¹²J. D. Shaffer, "Designing Agricultural Marketing Systems in Developing Countries," Staff Paper No. 72-3 (East Lansing, Michigan: Department of Agricultural Economics, Michigan State University, 1972).

¹³G. Fisk, Marketing Systems, An Introductory Analysis (New York: Harper and Row, 1967), p. 12.

¹⁴McMillan and Gonzalez, op. cit., p. 2.

practical reasons, it is necessary to reduce the environment, identifying the links or important connections within the system and the rest of the socioeconomic system.¹⁵

These observations on systems analysis indicate that for this particular case it is necessary to:

1. Identify the components of the system indicating their attributes.
2. Establish the way in which these components are interrelated.
3. Identify the limits of the system and establish the main connections with the rest of the socioeconomic system.
4. Define the units of measurement of the internal relationships of the system and the relationships of the system with its environment.

A rural production and assembly system represents all the activities which directly or indirectly affect these processes in a rural area.

This representation of the system is quite ample and the number of elements which could be included is large; thus the system's components and the functions that are of primary interest in this study will be specified next.

¹⁵Harold Riley et al., Food Marketing in the Economic Development of Puerto Rico, Research Report No. 4 (East Lansing, Michigan: Michigan State University, 1970), p. 227.

The components of the system of rural production and assembly of fruits and vegetables are all those units of decision which participate in the exchange, the physical transformation and distribution of these products in a rural area. This would include farmers, transporters, rural assemblers, rural wholesalers and rural markets. These components are characterized by their interdependent behavior; that is, the change in its attributes affects some of the components of the system and the rest of the system affects all these attributes.¹⁶

There are also other components which may affect the system through a change in its attributes but the changes in the system do not significantly affect the attributes of these components.¹⁷ Among these components are some which are susceptible to modification (controllable) such as credit institutions, physical installations, transportation, rural marketing rules, extension, etc. Other elements are not susceptible to modification (uncontrollable) and constitute the system's environment which is considered as given; for example, weather conditions, or in the short term, the rural road network, the demand for fruits and vegetables, the practices of the urban distribution system, etc.

¹⁶This is a concept similar to that of endogenous variable.

¹⁷This is another concept similar to that of exogenous variable.

For the purposes of this study other components will also be considered as belonging to this system (see Figure 1).

1. Public and private institutions involved in agricultural marketing including those of extension, credit, marketing, input procurement, transportation, etc.
2. Physical facilities (assembly centers, warehouses, processing operations, etc.).

This identification of the components of the system determines its limits. In this way, what is outside of the limits of the system will constitute the environment, which, for the purpose of this study, is considered as given (unless it is expressly stated by assumptions that specify certain changes). Nevertheless, it is necessary to identify the main links or connections of the system with its environment and the global social-economic system in the context of rural urban development. This research considers that the most important links of this system are the wholesale market of Bogota and the aggregate urban demand and its growth.

The attributes of the components of the system are given by:

1. The resources possessed by each component.
2. The internal organization of these resources in each decision unit.
3. The functions performed in production and marketing.

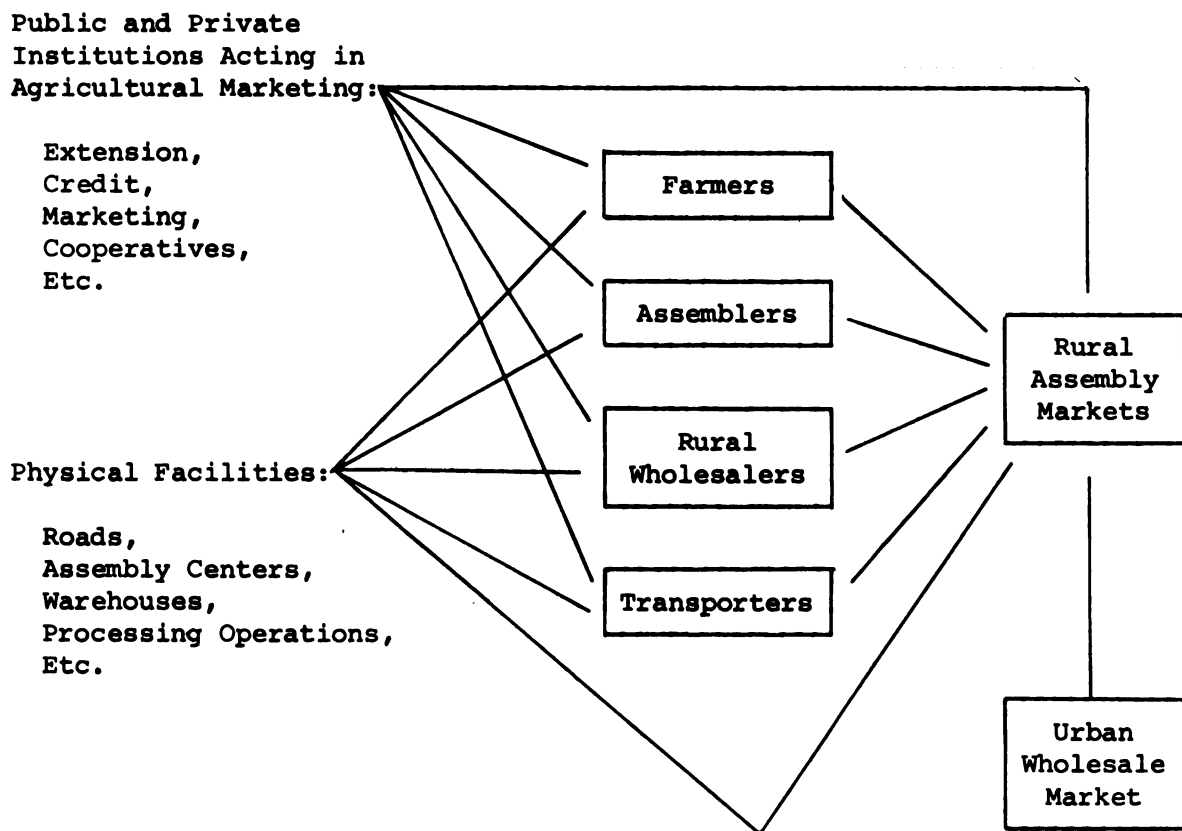


Figure 1. Components of the Rural Production and Assembly System.

An essential part of the attributes of each component is given by the functions of exchange and transformation and physical distribution which include the concept of marketing systems previously defined. It is also important to identify customs, attitudes and social habits which also constitute attributes that condition the behavior and relationships of the components of the system.¹⁸

The description of the attributes of these components will be done in detail in the next chapters.

It is necessary to describe the conceptual framework in which an economic analysis of the functions of the production assembly system can be made.

The system has a diversity of functions which are carried out by the different components. As was previously mentioned, these functions are of two types:

- Exchange (of property, information, etc.).
- Transformation and physical distribution.

These functions of transformation and physical distribution represent the production of these goods and all the added services and/or transformation given to the product in its flow towards the final consumer (sorting, packaging, storing, processing, transporting, etc.).

¹⁸This is derived from the idea previously stated that the marketing system includes aspects of the social organization matrix.

Theoretically, in a rural production assembly system any component of it can carry out any (or all) of these functions, and in the way it wishes to do so. This has been graphically represented indicating the different marketing channels on which the products could flow from farmer to consumer (see Figure 2).

This figure clearly indicates that the functions carried out by each component are intimately related to the functions of other components. These relationships among the activities of different components are complementary in some channels, but also many functions could be of a repetitive nature; for example, sorting a product three or four times before it reaches the final consumer. It could also happen that certain functions are never carried out; for example, the product is never sorted or stored in any stage of a given marketing channel. It is then possible to ask how to determine: Which functions must be carried out? Which components of the system should carry them out? How should these functions be carried out? In synthesis, the question could be posed: What are the coordinating mechanisms in the rural marketing system?

Any component of the system will carry out certain functions whenever each and every one of the following necessary conditions are met (see Figure 3):

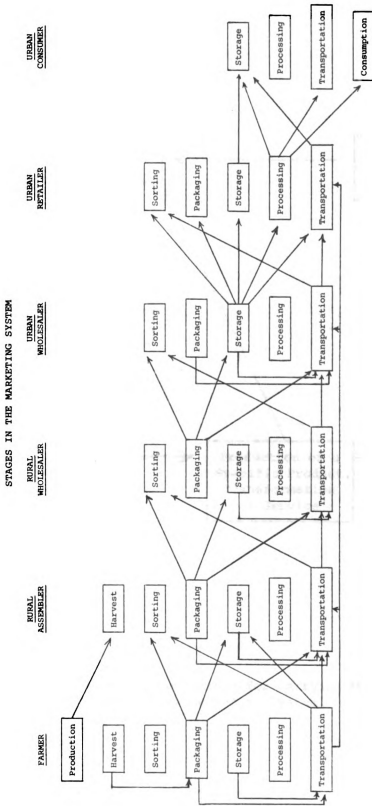


Figure 2. Transformation and Physical Distribution Functions and Channels in a Marketing System.

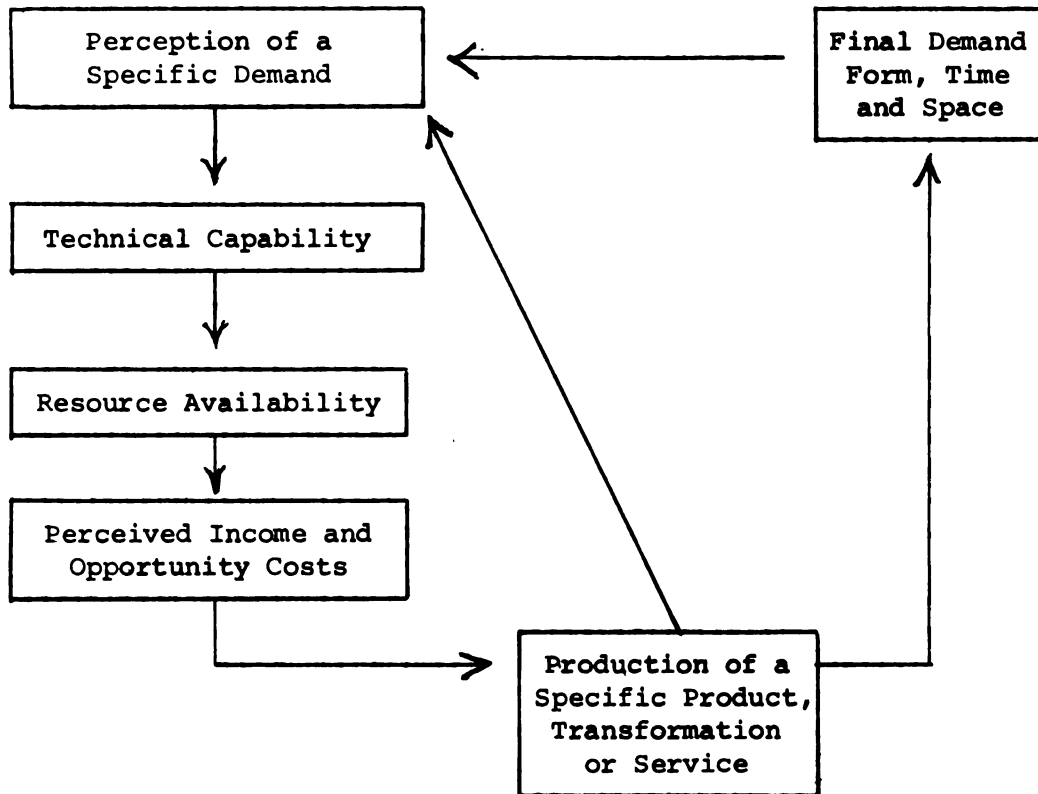


Figure 3. Necessary Conditions for Carrying Out a Specific Function in a Marketing System.

1. A given need or demand (derived) for a certain transformation or service in a later stage of the marketing channel is perceived with certainty and reflected in a specific buyer.
2. The technical capability or know-how to perform this transformation or service is available.
3. The natural and human resources needed to efficiently carry out this activity are also available.
4. The perceived increased earnings generated by this new activity are greater than the perceived opportunity cost of the resources used.

In this line of reasoning, the existing marketing channels and the services and transformation carried out by each component are the result of the way in which these necessary conditions are met. It should be emphasized that each and all of these necessary conditions should be met for a certain function to be performed.

This leads up to a basic principle in marketing: In a given situation in which the information system, the technical capability, the private and public resource availability, the market structure and the individual risks are given, it is possible to eliminate intermediaries but it is not possible to eliminate the functions of service or transformation of the product that these intermediaries carry out.

This principle reflects the viewpoint of a firm or individual component of the system that confronts a set of given conditions and which will carry out new services or transformations or modify its functions only if these necessary conditions are met. The last of these conditions implies that this component can carry out the service of transformation in a more efficient way--in the economic sense--than any other component of the system. This means that the resources possessed by the components of the system and their organization have competitive and complementary relationships.

These resources are organized to produce certain goods and services depending upon the specific conditions given by the markets of products, of inputs and of productive resources. Thus, imperfections in these markets cause inefficient allocation of resources by the different components. This is conducive to a lack of coordination, restraints in production and also to the duplicity of functions in the system.

Based on these considerations, an analysis of the market coordination mechanisms will be offered next. Market coordination has been defined as "the process in an exchange system whereby producers, distributors and consumers interact to exchange relevant market information,

establish conditions of exchange and accomplish physical and legal transfer of economic goods." ¹⁹

This definition has implications for:

- the information system.
- the risk and uncertainty confronted in establishing the conditions of exchange and in achieving the transfer of goods itself.
- the conditions of exchange (or price structure).

The information system plays an important role in communicating the demands or needs of the different components in the different stages of the marketing channel. These needs must be reflected in price information, considered as a formal system, and also in the informal system of interpersonal communication.

The information system is also necessary in the communication of new technologies required to satisfy these demands in an efficient manner. Finally, this system also has an important role in communicating the availability of internal and external resources to the decision unit or component of the system. This includes the availability of public services and infrastructure and also the markets

¹⁹Kelly Harrison, "Agricultural Market Coordination in the Economic Development of Puerto Rico" (unpublished Ph.D. dissertation, Michigan State University, 1966).



of the productive resources needed (credit, labor, transportation, inputs, etc.).

This brief discussion shows how the information system influences the four necessary conditions stated above. If any of these pieces of information are not transmitted or are communicated imperfectly, the possible functions of the system will not be carried out or will be carried out without the necessary coordination and, therefore, with lesser efficiency.

The price structure is another of the important elements in the coordinating mechanism. The price system must faithfully reflect the situation of the market at its different levels. This implies that prices must represent the existing demand in all its dimensions: form (or quality), time and space.

A well organized market is characterized by its capacity to clearly reflect the different demands in these three dimensions.²⁰ This allows the distribution of this available supply in the short run among consumers according to their "degree of desire" for the product; and in the long

²⁰The term "different demands" must be understood as a grouping of the similar demands of many individuals in such a way that it is economically feasible to group them in the distribution and satisfy them in the production. It is possible to conceive demands that cannot be satisfied due to the fact that their low volume is not compatible with scale diseconomies which may appear in production. This can happen, for example, in an "excessive classification" of a product.

run it allows the allocation of resources to satisfy these different demands.

The market structure also determines in part the price structure. Non-competitive market structures do not reflect the demands confronted back to the primary producers but on the contrary, usually these demands are distorted to obtain additional benefits. This distortion is in turn reflected in an inefficient allocation of resources.

In a market with a structure that has a desirable level of competition, prices should reflect both the "value of a need" and the cost of the marginal producers that satisfy these demands for services or economic goods.

Prices serve as guides for specific producers creating incentives to produce. A market operating in this way obtains a certain allocation of resources and production in diverse forms, time and space. The prices of these different products must have close relationships among qualities, time within the year and buying and selling prices. These relationships are an exact and efficient guide for coordinating the market only in a theoretical situation where a static world exists. In the short run, due to unpredictable factors, these relationships fluctuate as a rule.

Uncertainty and risks affect the components of the system in all its stages; they also affect the coordination of the market in a negative way. This means that it

counterbalances the coordinating mechanisms that were mentioned above.

These elements are seen in various ways acting in a system such as the one described. This study will consider the risks existing in each of the four necessary conditions stated earlier; that is to say, risks in the perception of demand, in the adoption and adaptation of technology, in obtaining resources and in perceiving market prices and opportunity costs.

The main effects of risks as a negative factor in market coordination are to increase unit costs, restrict production and consumption.²¹ For this reason, any scheme for improving market coordination demands a careful analysis of the means that might potentially reduce risks.

In a production assembly system of fruits and vegetables, the different risks have different degrees of potential control due to their nature. It is important then to identify those risks that could be more controllable with the purpose of analyzing what mechanisms could effectively act in the complete (or partial) elimination

²¹The hypothesis that the elimination of risks brings with it a greater production, an increase in resource productivity and an increased adoption of new technologies has been sustained by many. See, for example: Slater and Riley, op. cit., p. 15; Harrison, op. cit.; and J. C. Abbott, "The Development of Marketing Institutions" in Southworth and Johnston, Agricultural Development and Economic Growth (Ithaca, N.Y.: Cornell University Press, 19), p. 365.

of a specific risk. In the system under consideration, those risks that arise due to the relations among components are more controllable as opposed to those risks that are due to the relationships with the elements defined as outside the system (uncontrollable elements) which are less susceptible of decreasing.

A great number of improvements in market coordination come about in response to reorganizations, investments and provisions of services and innovations which do not evolve spontaneously from the system. This is due mainly to the fact that these activities which stimulate improvements represent great externalities, great risks or great indivisibilities for the typical firm or decision unit. Consequently, they will not be carried out, even acting upon the four necessary conditions mentioned above, since the benefits that accrue to these activities will be spread all over the system, or the risks or resource requirements are well beyond a firm's capability.

This indicates that the forms of association of the components of the system--horizontally and/or vertically--could have a great potential to increase the rural market coordination since an association of several components is capable of confronting in a better way indivisibilities, great risks and internalizing externalities.

Operational Application

This brief discussion of the production assembly system has pointed out the main variables of interest in this study. A great part of these variables refer to mechanisms of market coordination emphasizing their dynamic aspects. This implies an analysis of the existing components of the system, their economic results, the organization of the internal resources and the availability of external resources, with the purpose of identifying the main obstacles to achieve a greater coordination and a more efficient market operation.

The operational approach of this research will be of a clinical type which is characterized by the special emphasis placed upon the definition of the problem or diagnosis of the situation which may not be the same as that of the people and institutions involved in it, but might be an independent one. In this sense, this approach differs from others such as, for example, the engineering approach which takes the definition of a problem as given with certainty by the client or those involved.²² The diagnosis is followed by an identification of the alternatives that could potentially solve the problem. Later on these alternatives are

²²J. D. Shaffer, "Some Conceptual Problems in Research on Market Regulations" in Federal, State and Local Laws and Regulations Affecting Marketing (NCR-20), Regional Research Bulletin No. 168, North Dakota State University, 1965, p. 10.

projected, trying to detect what the possible results would be and finally these results are evaluated based on certain criteria, all of which is used to propose solutions to the problem identified.

These criteria (or measures of market performance) are based on the general objectives of development identified by the political and social activity of those interested--institutions and persons in the social system in question. These objectives are specifically expressed in stating the policy objectives for the agricultural sector of Colombia. They are:

1. Increase the level of income and employment.
2. Increase the production and resource productivity.
3. Achieve a more equitable distribution of income and productive resources.²³

These objectives dictate the specific criteria of evaluation of the production assembly system under study. These specific criteria can be stated in the following way:

1. Increase the level of employment and income in the system under consideration. Since there are many components in the system and potential changes could generate greater income and employment for only some components, other qualifications to the criterion

²³Departamento Nacional de Planeación, Plan de Desarrollo Económico y Social 1970-73, República de Colombia, 1970.

should be included to answer: increases of income for whom? for what resources? with what distribution of income?

2. Increase the production of goods and services originated in this system, increasing also the productivity of the resources. This criterion implies a sub-criterion that the relative prices of goods and services originated in the system do not change substantially. Another sub-criterion implied is that there must be a modernization in the organization and the technology in the system.
3. Generate an income distribution in the system that implies a dynamic process in favor of a lesser income concentration and also a lesser concentration of the productive resources.

These criteria are not independent nor exclusive but frequently are related in a competitive way; that is, the greater the achievements relative to one criterion, the lesser the achievements related to another criterion. This circumstance makes the process of evaluation extremely difficult and demands a determination of priorities. In this case, the priorities are not given by the stated objectives of development of the sector which have given rise to our criteria. For this reason, some kind of balance should be achieved among the different criteria.

CHAPTER III

FARM PRODUCTION AND MARKETING OF
FRUITS AND VEGETABLES

This chapter describes and analyzes the present processes of farm production and marketing of fruits and vegetables in the region of La Mesa. The potential income and employment effects of expanding the output of these products is also considered. The chapter concludes with an analysis of the possible limitations to the expansion of fruit and vegetable production.

The primary source of information for the farm data presented in this chapter was a farm survey especially conducted for this research (n = 63). The details of the sampling procedures used in this survey are shown in Appendix A. In some of the variables analyzed, a previous farm survey (1970) done by CORABASTOS in this same region was incorporated to the primary data obtained. Several published and unpublished documents of some institutions were made available; these documents are identified in the corresponding footnotes in the text.

General Description of the Area

The area selected for this study is composed of the municipalities of Anolaima, La Mesa, Tena and Anapoima, in the department of Cundinamarca (see Figure 4).

The geography of this area shows a topography with great contrasts. Altitudes above sea level within this area range from 500 to 3000 meters. This affects a wide variety of climatic conditions; average temperature in the main towns (cabeceras municipales) are 22°C and 23°C in Anolaima and La Mesa, respectively, and in Anapoima it reaches 27°C. These climatic conditions are appropriate for the production of a great variety of fruits and vegetables of cold, temperate and tropical requirements. The altitudes needed for different products are shown below in Table III.1.

Table III.1. Altitude Requirements for Some Crops in the Coffee Region

Product	Altitude Above Sea Level (meters)
Coffee	1250-1750
Tropical fruits (avocado, pineapple, citrus fruits, etc.)	0-1600
Plantains, bananas	0-1750
Yucca	0-1800
Cane	100-1600
Vegetables	1600-2000
Cold climate fruits (<u>anon</u> , <u>lulo</u> , etc.)	1600-2500

Source: Unpublished working documents of Programa de Desarrollo y Diversificación de Zonas Cafeteras, Technical Department, Bogota, 1971.

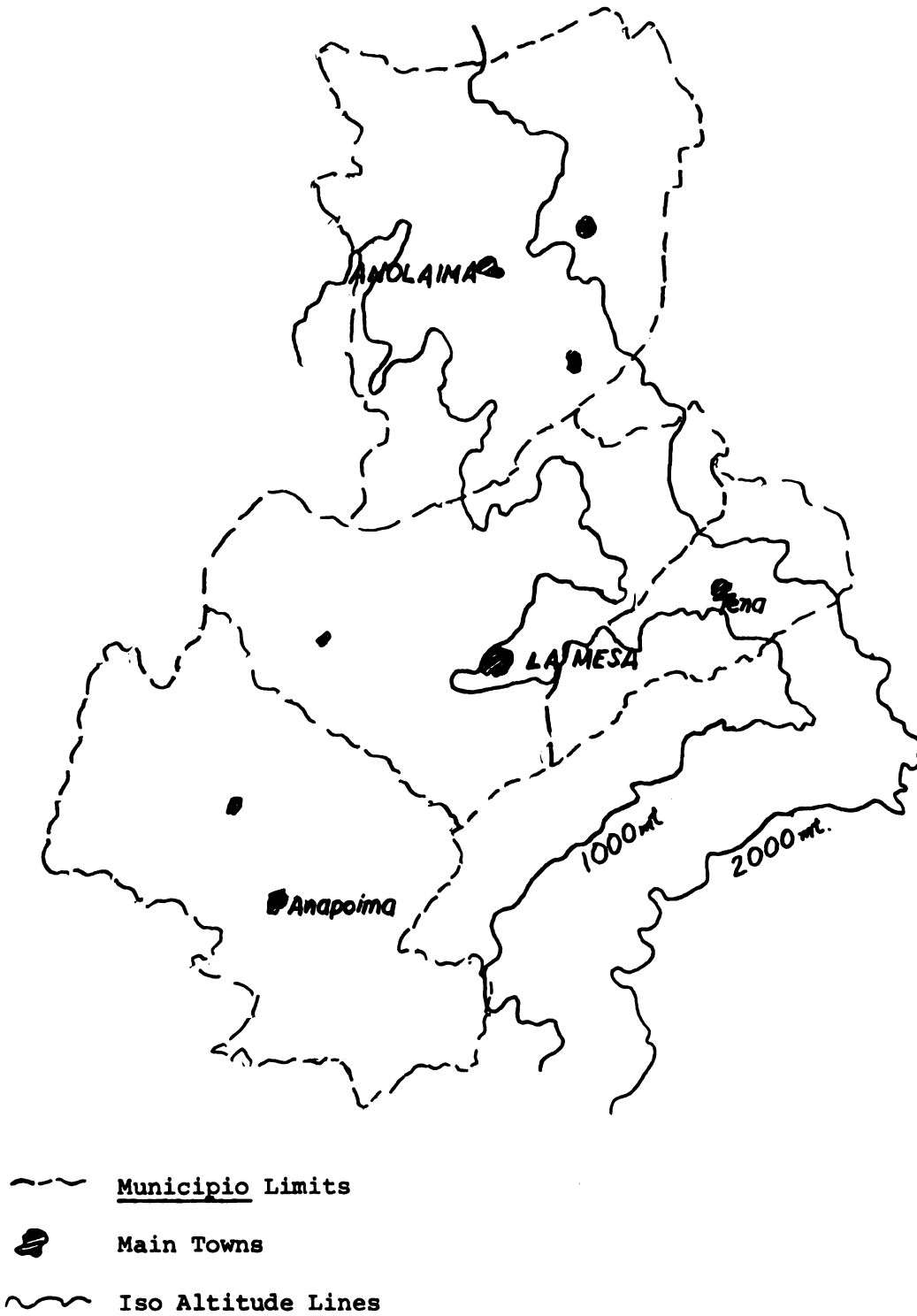


Figure 4. Map of the Region of La Mesa.
 (Source: Mapa de Cundinamarca, Instituto Geográfico Agustín Codazzi, Bogotá, 1965.)

Given these geographic conditions that greatly influence the production possibilities, this study will consider three strata or sub-regions:¹

1. Below Coffee Zone Stratum or Sub-Region
2. Coffee Zone Stratum or Sub-Region
3. Above Coffee Zone Stratum or Sub-Region.

These strata are defined by the altitude of the coffee producing region. The coffee region is technically limited to the altitudes between 1250 and 1750 meters above sea level, although in practice coffee is grown above and below these limits.² For this reason, this study will consider that the coffee zone stratum is composed of the farms located between the altitudes of 1200 and 1800 meters. The strata below and above the coffee zone are composed of those farms located outside these same altitude limits. This stratification will be referred to in what follows in this chapter.

This region is mainly a coffee producing area, since a great proportion of its land is located within the

¹This stratification was also considered in the sampling methods (see Appendix A, Sampling Procedures).

²The Coffee Census of 1970 showed that 61.8 percent of the coffee growing farms in Colombia were located between the altitudes of 1200 and 1800 meters above sea level. These farms produce a very high percentage of the total coffee production. See *Federacion Nacional de Cafeteros de Colombia, Economia Cafetera*, Vol. 2 (Bogota: Division de Investigaciones Economicas, November, 1971), p. 14.

altitudes most suited to coffee production, between 1250 and 1750 meters above sea level. The Coffee Census of 1970 shows that 53.9 percent of the area is composed of farms that grow coffee. This figure is 63.1 percent if the municipio of Anapoima is excluded, which only has 17.4 percent of its area in farms that grow coffee³ (see Figure 4).

The area of the study seems to have topographic and climatic conditions that are similar to those that prevail in other areas of the Coffee Zone in Central Colombia, which likewise show a variety of climatic conditions within relatively small geographic areas. In this sense, the area chosen for this study is representative of the Coffee Zone.

In other aspects this area is not representative of the larger Coffee Zone, particularly regarding distance to a large urban market. This area has a privileged position, since it is located only 70 kms. from Bogota, the largest consumption market in Colombia. This is a feature of vital importance in the marketing of highly perishable products, such as fruits and vegetables.

Proximity to market has been one factor in the development of this area as an important source of fruits

³Federacion Nacional de Cafeteros de Colombia, Censo Cafetero, Presentaciones Preliminares. Anexo No. 3 (Bogota: Division de Investigaciones Economicas, 1971).

and vegetables for Bogota. Table III-2 shows the percentages of selected fruit and vegetable products in the Bogota wholesale market that arrive from the La Mesa region. These are average figures based on product inflow in two different weeks in two years. At certain times the relative importance of some products is much larger, for example, the mango shipments of this region reach 74 percent of the total supplies of Bogota, during the month of April, according to the checkpoint study carried out by CORABASTOS.

All the roads within the La Mesa region are unpaved. These roads link the main towns and some important production points. This road network is connected at three points to one of the main paved highways going to Bogota.

Land Resources

The region includes 35052 hectares of land according to the latest Census of Agriculture of 1970.⁴ About 30 percent of this land is in permanent crops (mainly coffee), 12.6 percent is in annual crops, 48.3 percent is pasture land and 7 percent is in other uses (see Table III.3).

The figures in Table III.3 show that the municipios of La Mesa and Tena have a higher proportion of their area in coffee (permanent crops) than Anolaima and Anapoima.

⁴Departamento Administrativo Nacional de Estadística (DANE), Censo Agropecuario 1970-71, Datos Preliminares, Bogota, April, 1971.

Table III.2. Relative Importance of the La Mesa Region as a Supplier of Selected Fruits and Vegetables in the Bogota Market

Product	Percentage of Bogota's Supply Arriving From La Mesa
<u>Guayaba</u>	53.6
<u>Maracuya</u>	49.1
<u>Mora</u>	45.3
Papaya	43.8
<u>Pepino</u>	41.4
Mangoes	38.6
Tangerines	33.8
Oranges	16.9
Bananas	15.6
Squash	10.2
Tomatoes	10.0

Source: Computations from data published by CORABASTOS, "Movimiento de Productos Alimenticios en la Ciudad de Bogota," Informe No. 1 Entrada de Productos, Bogota, October, 1970; and unpublished results of the 1971 checkpoint study also made by CORABASTOS. These estimates only give a rough idea, since fruits and vegetables show a great seasonality of production, which is different for the diverse regions. The basic data was obtained through checkpoint observations of product inflow in two weeks; one in May, 1970 and the other in April, 1971.

Table III.3. Total Land and Land Use by Municipio in the La Mesa Region

<u>Municipio</u>	Total Surface	Perm. Crops	Annual Crops	Fallow Land	Pastures	Other
	(hectares)					
Anolaima	13446	3656	1783	404	6282	1321
	100%	27.2%	13.3%	3.0%	46.7%	9.8%
La Mesa	9840	3376	1093	115	4683	573
	100%	34.3%	11.1%	1.2%	47.6%	5.8%
Tena	4691	1788	430	64	2193	216
	100%	38.1%	9.2%	1.4%	46.7%	4.6%
Anapoima	7075	1568	1113	281	3766	347
	100%	22.2%	15.7%	4.0%	53.2%	4.9%
TOTAL	35052	10406	4419	864	16924	2457
	100%	29.6%	12.6%	2.5%	48.3%	7.0%

Source: DANE, Censo Agropecuario 1970-71, Datos Preliminares, Bogota, April, 1971.

La Mesa and Tena also show a slightly higher percentage of land devoted to crops, 45.2 percent and 47.3 percent, respectively, than Anolaima, 40.5 percent and Anapoima, 42.2 percent. All the municipios show about the same proportion of land devoted to pastures. As a general rule, land is used much more intensively in the coffee zone stratum than in the other strata, above and below the coffee zone.

The typical farm in this area is a small, owner-operated enterprise, primarily utilizing family labor (except during the peak labor requirement season). The

average farm size for the area as a whole is 5.79 ha.,⁵ although the average farm size by municipio had a range from 4.19 ha. in Anolaima to 8.2 ha. in Anapoima.

The distribution of farm size is highly skewed, showing a great number of small farms, a few middle-sized farms, and very few large ones (see Table III.4). About 46.1 percent of the farms have less than 2 ha., the median farm size is of about 2.2 ha., and 89.9 percent of the farms are under 10 ha. As a general rule, farms in the coffee zone stratum tend to be smaller than in the strata above and below it. If La Mesa and Tena are grouped, the municipios with the highest proportion of coffee zone land, about 61.4 percent of the farms are under 3 ha., and only 9.5 percent of the farms are over 10 ha.

Many of the farms in this region can be categorized as minifundio, or farms that have such a small size that the income generated cannot support the operator and his family (income figures will be shown on a later section of this chapter).

Owner operation is by far the most common form of land tenure; 89.2 percent of the farms interviewed had this form of tenure, 7.7 percent of the farms were rented, and only 3.1 percent had sharecropping or partnership arrangements. The 1970 Coffee Census showed that over 97 percent

⁵The abbreviation ha. stands for hectare, a unit of area which is equivalent to 2.47 acres. This unit will be used throughout this study.

Table III.4. Distribution of Farms by Size, Municipio and for the La Mesa Region, 1970

Farm Size (ha.)	<u>Municipio</u>											
	ANAPOIMA		ANOLAIMA		LA MESA		TENA		LA MESA REGION			
% of Total Farms	Cumulative %	% of Total Farms	Cumulative %	% of Total Farms	Cumulative %	% of Total Farms	Cumulative %	% of Total Farms	Cumulative %	% of Total Farms	Cumulative %	% of Total Farms
Less than 1	17.9	30.5	28.2	30.3	28.2	30.3	28.2	30.3	28.2	30.3	28.2	30.3
1<2	14.7	18.0	48.5	18.4	46.6	19.7	50.0	17.9	46.1	17.9	46.1	17.9
2<3	10.7	13.7	62.2	12.2	58.8	13.3	63.3	12.9	59.0	12.9	59.0	12.9
3<4	8.4	10.0	72.2	9.9	68.7	9.0	72.3	9.6	68.6	9.6	68.6	9.6
4<5	6.4	7.3	79.5	5.9	74.6	7.5	79.8	6.8	75.4	6.8	75.4	6.8
5<10	21.0	13.8	93.3	14.0	88.6	11.5	91.3	14.5	89.9	14.5	89.9	14.5
10<20	14.0	4.5	97.8	5.9	94.5	5.8	97.1	6.3	96.2	6.3	96.2	6.3
20<30	3.5	1.3		1.5		0.7		1.6		1.6		1.6
30<40	0.5	0.4		1.3		0.8		0.7		0.7		0.7
40<50	0.6			0.6		0.1		0.3		0.3		0.3
50<100	1.2	0.3		1.1		0.8		0.7		0.7		0.7
100<200	0.5			0.9		0.3		0.3		0.3		0.3
200<500	0.5	0.2	100.0	0.2	100.0	0.1	100.0	0.2	100.0	0.2	100.0	0.2
500<1000						0.1	100.0	0.0	100.0	0.0	100.0	0.0

Source: Computations based on DANE, unpublished preliminary tabulations of the 1970 Agricultural Census (to be revised), Bogota, 1971.

of the farms in the whole coffee zone of Colombia are operated by their owners, and less than 2.5 percent of the farms are rented.

The productivity of land is much higher in the smaller farms than in the large ones, gross income per hectare had an average of \$7,216. pesos⁶ on the small farms in the coffee stratum, while the four largest farms only had an average of \$4,551. This can be explained by the greater proportion of land devoted to pastures on the larger farms. If the land in all the farms in the region had a similar potential productivity, these numbers would be indicating a relative degree of land underutilization on the larger farms.

Production Patterns

The production patterns in the three climatic strata are quite different; the coffee zone stratum farms obviously show a high percentage of their gross income originating in coffee production (63.8 percent), while the rest of the crops--including fruits and vegetables--have a lesser importance. The opposite is the case for the strata below and above the coffee zone, where fruits and vegetables are the most important crops in generating gross income (see Table III.5).

⁶The symbol for pesos (\$) is the same as the dollar sign. In this study it will be used to indicate pesos, unless stated otherwise.

Table III.5. Composition of Gross Farm Income for the Three Climatic Strata by Types of Crops and Animal Production (% of Gross Income)

Stratum	Coffee	Fruits and Vegetables	Other Crops	Flowers	Animal Products
Below coffee zone	28.6	44.5	13.3	--	13.6
Coffee zone	63.8	29.7	2.2	--	4.3
Above coffee zone	3.0	57.9	13.4	14.9	10.8

Source: Computations from farm interviews.

In the region of La Mesa, coffee is generally grown under the shade of other trees, some of which are fruit trees. In this traditional technology of coffee production, some tropical fruits are a joint product of coffee, and in this sense they are complementary. Vegetables, instead, are competitive products with coffee, since they compete for land, the resource that perhaps is most limiting in the majority of the farms in this region.

The stratum below the coffee zone has a lower proportion of its hectares in coffee, and a greater number of tropical fruit trees and land in pasture. Production of most vegetables in this area is not possible due to climatic conditions (with the exception of a few crops such as tomatoes).

The stratum above the coffee zone presents the opposite situation. It has a greater production of

vegetables and much lower output of fruits (only a few kinds can be grown in those climatic conditions). In addition, it has almost no coffee, and a considerable amount of pastures.

These production combinations in the different sub-regions or strata are reflected in the percentage of farms growing each crop (see Table III.6). There are almost no farms without some fruit production in the strata below and in the coffee zone. In the stratum above coffee zone there are no farms without vegetable production, and very few of them grow fruit at all, except very small quantities of some cold climate fruits such as mora, granadilla, peaches and curuba.

The most important fruits and vegetables grown in the area (in terms of the percentage of farms that grow a crop) are citrus, bananas, mangoes, guayaba, avocado, tomatoes, and mora. Besides these products, there is an impressive variety of fruits and vegetables of all kinds grown in the region, as Table III.6 shows.

At the farm level the production of fruits and vegetables is organized on a very small scale. Farms are very small, and there is almost no specialization of production to speak of in fruits and vegetables. On the average, farms in the stratum below the coffee zone grew 6.4 different kinds of products, in the coffee zone 6.0, and above the coffee zone there were 6.9 different products per farm.

Table III.6. Percentage of Farms Growing Different Crops, by Stratum and for the Whole La Mesa Region

Product	Below Coffee Zone	Coffee Zone	Above Coffee Zone	Region
<u>Coffee</u>	85.3	97.8	16.7	87.7
<u>Pasture</u>	64.7	54.3	91.7	60.1
<u>Fruits</u>				
Oranges	73.5	95.6	16.7	83.3
Bananas	85.3	66.3	33.3	68.1
Mangoes	26.5	25.0	--	23.2
Guayaba	14.7	34.8	--	26.8
Tangerines	32.4	47.8	--	39.9
Lemons	8.8	5.4	--	5.8
Avocados	14.7	26.1	8.3	21.0
Pineapple	8.8	2.2	--	3.6
Limes	5.9	8.7	--	7.2
Mora	2.9	2.2	58.3	7.2
Apples	--	2.2	--	1.4
Grapes	--	2.2	--	1.4
Guanabana	--	2.2	--	1.4
Cidro	--	1.1	--	0.7
Papaya	--	2.2	--	1.4
Mamey	2.9	1.1	--	1.4
Maracuya	2.9	1.1	--	1.4
Curuba	--	--	8.3	0.7
Granadilla	--	--	16.7	1.4
Peaches	--	1.1	33.3	3.6
Plums	--	1.1	--	0.7
Chirimoya	--	1.1	--	0.7
Pears	--	1.1	--	0.7
Nisparo	--	1.1	--	0.7
<u>Vegetables</u>				
Tomatoes	29.4	6.5	8.3	12.3
Onions	--	2.2	--	1.4
Green Beans	--	3.3	16.7	3.6
Pulse (haba)	2.9	2.2	25.0	4.3
Peas	--	1.1	33.3	3.6
Cucumber	--	1.1	16.7	2.2
Cabbage	--	--	25.0	2.2
Carrots	--	--	25.0	2.2
Coriander	--	--	41.7	3.6
<u>Flowers</u>	2.9	3.3	58.3	8.0
<u>Other Crops</u>				
Cane	29.4	13.0	8.3	16.7
Corn	23.5	2.2	25.0	9.4
Yucca	8.8	3.3	--	4.3
Arracacha	--	4.3	--	2.9
Potatoes	--	--	25.0	2.2
Beans	--	--	25.0	2.2
Cacao	--	1.1	--	0.7
Corn-Yucca	2.9	--	--	0.7
Fique	--	1.1	--	0.7

Source: Farm interviews conducted for this study (1972) and CORABASTOS' farm interviews conducted during 1970.

Considering that the average farm size is 5.79 ha., and that in most cases (below and in the coffee zone strata) a large percentage of the farms are covered with coffee, the average production of a single fruit or vegetable crop is very small. Moreover, since these products are produced over a range of time, the production per unit of time (week or month) is even smaller.

This lack of specialization at the farm level to a large extent is due to the considerable price and yield variability exhibited by most of the fruits and vegetables. Furthermore, there are other important risks involved such as those affecting pre-harvest product quality, and selling in the traditional markets. In addition, specialization requires a technical know-how which is almost non-existent among most farmers. Hence, farmers diversify production in an attempt to reduce aggregate risks and to stabilize incomes.

The production of fruits and vegetables is thinly distributed in a geographic sense. This has important implications for the assembly process. The production density, which can be expressed as the volume produced per unit of area in a region or sub-region, illustrates this notion. The municipio of Anolaima which has the highest production of fruits and vegetables, shows quite low production densities for any single crop (see Table III.7).

Table III.7. Production Densities for Selected Products in the Municipio of Anolaima^g

Products	Existing Production Density (tons/100 ha.)	Expected Yield per Commercial Hectare (tons)	Hectares of Commercial Production with Output Equal to 100 Hectares of Existing Production ^h
Oranges	48.32	18.75 ^{a,b}	2.60
Bananas	25.60	7.0 ^{c,d,e}	3.70
Mangoes	0.64	47.0 ^c	0.01
Tomatoes	9.34	14.8 ^{c,f}	0.63
Avocados	1.00	15.0 ^a	0.07

Sources: Farm interviews and yield estimates of several agencies, including:

^aFondo de Desarrollo y Diversificación de Zonas Cafeteras, Programa de Desarrollo Regional y de Sustitución de Café Marginal para los Departamentos de Caldas, Quindío y Risaralda (Manizales: Federación Nacional de Cafeteros de Colombia, September, 1968).

^bPrograma de Desarrollo y Diversificación de Zonas Cafeteras (unpublished working documents on yields and costs per hectare, Bogotá, July, 1972).

^cINCORA. Costs and Returns per Hectare in the Cundinamarca No. 1 Project (unpublished working documents, La Mesa, August, 1971).

^dCaja de Crédito Agrario Industrial y Minero, Manual de Costos (Bogotá: Talleres Gráficos de la Caja, 1967).

^eCaja de Crédito Agrario Industrial y Minero, "Costos del Primer Semestre 1972, Pequeños Agricultores" (unpublished working document, Bogotá, July, 1972).

^fCaja de Crédito Agrario Industrial y Minero, "Producción Comercialización de Hortalizas en Cundinamarca, Zona Oriental y Sabana de Bogotá," Depto de Investigaciones Económicas, Bogotá, 1971.

^gThe area considered is only part of this municipio, the areas with no production were not considered in the computations for this table.

^hThese figures represent the average output of 100 ha. in the region expressed in terms of the number of commercial hectares that would have the same (expected) production.

This table shows the production densities of some of the major fruit and vegetable products in terms of the yearly output of 100 ha. For illustrative purposes, this production has been expressed in terms of the number of commercial hectares that would product the same output based upon expected commercial yields. Thus, it can be shown that production of 100 ha. of oranges in this municipio would be equivalent to the output of 2.6 ha. in commercial orchards.

These comparisons serve to illustrate that as a general rule production is quite sparsely distributed. The marketing implications are even more significant when it is considered that out of this total production, a significant percentage is used for farm consumption. This is especially true for bananas, in which case 54.8 percent of the production was consumed on the farms (according to the farm survey).

This low density of production makes the task of assembling production a costly one. In Chapter V this problem will be treated in further detail, analyzing quantitatively the relationship between density and unit assembly costs. Despite this low concentration of production, there are a few cases where the production of a certain product on the individual farms is small, but the aggregate production of the whole vereda is of a significant volume.

Gross Income

For the sample as a whole, gross income per farm averaged \$33,668 (pesos) (or U.S. \$1606.30).⁷ The average per farm varied among stratum, with \$53,654 (pesos) for the coffee zone (although it was only \$31,118 if the extreme case of one vereda with very large farms was discarded, \$23,767 for the stratum below the coffee zone, and \$23,583 for the stratum above the coffee zone. In the coffee stratum, gross income per unit of land is considerably higher than in the two other strata, so that the smaller coffee farms realize higher gross farm income than the larger sized farms in the other strata. The gross income per ha. was \$7025 in the coffee zone, \$6260 in the stratum above the coffee zone and \$3930 in the stratum below the coffee zone.

In the coffee zone, fruits and coffee not only are complementary in production technology but there is a financial complementary too. Coffee is by far the largest income generator. This income is received once or twice a year at harvest times (April, May and June, and in favorable production years there is a second and smaller harvest in October and November). Meanwhile, the income generated by fruits is spread over a six-month period, and in some cases over longer periods, depending on the particular product

⁷At the official exchange rate (in January 1972) of 20.96 pesos per dollar or 0.0477 dollars per peso.

combinations. For example, banana production is evenly distributed throughout the year. The different income flows generated have made coffee income the source for major farm and living expenses, such as home improvement, investments, etc., while fruit income is generally used for common living expenses, such as purchased food. This was clearly reflected in the survey when farmers were asked for the reasons why they were planning to expand fruit production, in many cases the answer was "to buy food" ("para el mercado").

The complementarity of fruit and coffee production has other economic rationale. Fruit production is extremely variable from year to year and prices are even more variable, making fruit production a very risky enterprise. Coffee production is also variable, but is more stable than fruit production, and it has had support prices for a long time. This makes coffee one of the most stable enterprises out of all those possible in the coffee zone. Hence, coffee provides a stable income base, to which fruit production, with its greater risks, is added.

Net Income

Net incomes were computed for the farms in the sample, based on the gross incomes derived from direct information of the interviews, and also based on secondary information on costs of production. The sources of this secondary

information were several important agricultural agencies, the local office of INCORA (land reform agency) in La Mesa, the Diversification Program of the National Coffee Growers' Federation, and the main agricultural credit institution, Caja Agraria, with local offices in the La Mesa region. These sources of information are the same as those listed in Table III.7.

It was impossible to get data on costs of flowers and a few vegetables which were grown in eight of the ten farms interviewed in the stratum above the coffee zone. Therefore, net incomes could not be computed for these farms. For this reason, all the farms in this stratum were not considered in the analysis of net income. Four farms in the other two strata had to be eliminated due to weaknesses in the information to compute net income.

In the two lower strata net income per farm averaged \$16,795 (U.S. \$801).⁸ Both strata had similar averages; in the coffee zone it reached \$17,437 and in the stratum below the coffee zone was \$14,814. A similar effect as in the case of gross income can be observed; net income per hectare is much higher in the coffee zone stratum (\$5745) than in the stratum below the coffee zone (\$3225), this is partly

⁸An extreme observation was discarded to compute this average, if included the average net income per farm for all the sample would be \$27,769 (U.S. \$1325).

compensated by the difference in farm size in these strata making income per farm not too different between these strata.

The distribution of this income is skewed, as shown in Table III.8. Thirty-eight percent of the farms had net incomes below \$9,000 (U.S. \$429), and the median is at an income level of about \$14,000. The top 4 percent had a net income per farm of \$287,487 (U.S. \$13,716).

Table III.8. Distribution of Net Income Per Farm

Income Levels (\$)	Frequencies	
	Number	Percent
0- 9,000	19	38
9,001-21,000	13	26
21,001-30,000	10	20
30,001-40,000	2	4
40,001-50,000	4	8
50,001 and over	<u>2</u>	<u>4</u>
TOTAL	50	100

Source: Computations from farm survey.

This distribution of net incomes indicates that a certain proportion of the farmers obtain income levels only sufficient for subsistence and the small investments needed to maintain coffee production. It is extremely difficult to

accurately determine the minimum level of subsistence, but a close approximation is probably given by the prevailing wage rate. This is an annual income of about \$7500 (determined on the basis of 300 work days per year). Thirty percent of the sampled farms had incomes below this figure; and 22 percent were below the \$6000 a year level.

The low income level has been reported as an explanation to the lack of innovations in traditional agriculture. The essence of this contention is that the farmer is not willing to accept alternatives which might result in outcomes falling below a minimum income level, called the focus-loss, which in the case of traditional peasants is close to the minimum subsistence level. The new alternatives naturally are judged by the farmer's subjective expectations.⁹ This line of reasoning describes well the situation of some farmers in the region of La Mesa, regarding new production and physical handling techniques, as well as their resistance to produce crops with great price uncertainty (such as many fruits and vegetables).

⁹A comprehensive discussion of this topic is provided by David L. Peacock, "The Adoption of New Agricultural Practices in Northeast Brazil: An Examination of Farmer Decision-Making" (unpublished Ph.D. dissertation, Michigan State University, East Lansing, 1972). See also, Clifton R. Wharton, Jr., "Risk, Uncertainty and the Subsistence Farmer: Technological Innovation and Resistance to Change in the Context of Survival" (paper presented at the Joint Session American Economic and Association for Comparative Economics, Chicago, Illinois, December 28, 1968), pp. 1-5.

Technology

The technology used in fruit production is generally very primitive. For example, fruit trees are generally grown from seed instead of a grafted small tree, which means that production starts about three years after planting. Consequently, the variety or quality of the fruit cannot be known until the tree starts producing. Fruit production under these conditions is almost a gift of nature, since the trees receive very little care, and practically the only work being done is the harvest of the fruit. Even the harvest is not done effectively since all sorts of fruit are picked without much consideration for its quality. Fertilizer was used on fruit trees on only an 8.6 percent of the farms in the case of oranges, 4.8 percent in bananas (the main fruit crop), and 9.0 percent in avocados. The highest use of pesticides was in the cases of oranges, with 4.3 percent of the farmers, and mangoes with 5 percent (see Table III.9).

This situation reflects the fruit production technology in the coffee zone, where fruits are not considered important and modern production technologies are simply not well known or utilized. For this reason, farmers probably do not fully comprehend the potential income from fruit if produced under modern techniques. The small scale of production of any single fruit crop acts as a barrier for the diffusion of technical innovations. From the standpoint

Table III.9. Percentage of Farms Using Modern Inputs in the La Mesa Region, by Specific Products

Crop	Input Use			
	No Modern Inputs (%)	Fertilizers (%)	Pesticides (%)	Fertilizers and Pesticides (%)
Coffee	68.8	25.0	--	6.3
Oranges	89.1	4.3	4.3	4.3
Banana	95.2	2.4	--	2.4
Mango	95.0	--	5.0	--
<u>Guayaba</u>	96.0	--	--	4.0
Tangerine	90.5	4.8	--	4.8
Avocado	90.9	4.5	--	4.5
<u>Mora</u>	83.3	--	--	16.7
<u>Curuba</u>	--	--	--	100.0
<u>Granadilla</u>	--	--	--	100.0
Peaches	50.0	--	--	50.0
Tomato	15.4	--	15.4	69.3
Peas	50.0	--	--	50.0
Green Beans	--	--	33.3	66.7
<u>Haba</u>	75.0	--	--	25.0
Cabbage	--	--	--	100.0
Carrots	66.7	--	--	33.3
Colander	20.0	--	--	80.0
Cane	91.7	8.3	--	--
Corn	88.9	--	--	11.1
Pasture	100.0	--	--	--
Flowers	--	--	--	100.0

Source: Farm survey.

of the farmer, who in most cases is quite traditional, a new technical practice involves additional work and risk, and the subjective expectations of payoff may be too low to induce adoption.

Small scale farming can only explain in part the existing low technological levels. In the case of coffee, the crop which produces most of the farm income in this region, production techniques are more advanced, but still only 31.9 percent of the farms used fertilizers and only 6.4 percent of them used pesticides. A few large farms had planted part of their coffee area with the new sun exposed variety, caturra. This kind of coffee which is planted with a high density of trees per hectare, requires considerable amounts of fertilizer and pesticides. The coffee yields obtained are several times higher than those obtained with the traditional shade grown variety.

Some efforts have been devoted in the past to extension and education programs with farmers related to coffee production. In the case of fruits and vegetables almost no extension programs have been available in this region. The farm survey indicates that only 26 percent of the farms had previously received at least one visit from an extensionist or technician. Eight percent of the farms received a visit at least once a month, and all these cases were large or very large farms. Another 5 percent of the farms received one visit a year, and 1.6 percent of them

had received one visit in the past (50 percent of the farms receiving visits could not specify the frequency of these visits).

The purpose of these visits in most cases (85 percent) was for technical assistance in coffee production, but in 8 percent of the cases it was for vegetables, and 7 percent for other crops. These visits in many cases were linked to a credit program, where the visit had the main purpose of checking the financial position of the borrower.

Vegetable production represents a different situation. Technology is much more advanced as measured by most standards. For example, fertilizers and pesticides are commonly used; in the case of no individual crop was it less than 25 percent, and in some vegetables, fertilizers and pesticides were used on 75 percent of the farms (see Table III.9).

This situation is quite different since farms producing vegetables (mainly in the stratum above the coffee zone) depend almost as much on this kind of production as coffee farms depend on coffee; therefore the payoff to new technical practices are substantially higher than in the case of fruits. Production risks probably are reduced by using modern technology (particularly by the use of pesticides), and in some cases it is not possible to economically produce at all without these modern inputs (e.g., flowers, tomatoes).

This situation of significantly different technological levels in producing fruits and vegetables among strata can be explained. In the stratum above the coffee zone where most of the farms grow vegetables, the stability of income that coffee provides is absent, for the most part, and the use of modern inputs could be helping to stabilize income. Since farms in this stratum tend to be of a larger size, a single fruit or vegetable crop tends to have a larger area, raising the payoff to new technology. Farm size could also affect the use of pesticides. In the coffee zone stratum, farms are so small that pests cannot be effectively controlled without concerted action on contiguous farms. Thus, pest control by individual farms would have a higher cost than in the region above coffee zone, where farms are more isolated and crops separated by pasture lands.

A comparison of actual yields and technically possible (realistic) yields can give a rough idea of the changes that could be achieved with greater adoption of new technologies (see Table III.10).

The average yields obtained are much lower than those judged feasible by local technicians, this comparison understates the additional income gains from new techniques since better product quality generally means higher prices.

Table III.10. Comparison of Actual and Technically Feasible Yields for Selected Fruit and Vegetable Products in the La Mesa Region

Product	Unit	Actual Yields ^a (kg.)	Feasible Yield Commercial Orchards (kg.)
Bananas	Tree	21	35 ^c
Oranges	Tree	68	120 ^c
Mangoes	Tree	61	192 ^b
Tangerines	Tree	38	120 ^c
Tomatoes	Hectare	7969	18,000 ^b
Cabbage	Hectare	6563	30,000 ^c

Sources: Farm survey and the technical studies listed below.

^a Average yields obtained from the sampled farms.

^b INCORA's estimate of attainable yields in the region, internal working documents, Cundinamarca project, No. 1, 1971.

^c National Coffee Growers' Federation, Diversification Program, Working Documents 1972. These yields are attainable using the latest production techniques.

Production Expansion

The expansion of production in the region has been mainly oriented to the same type of agricultural production as described before. The farmer interviews indicated that there seems to be no major changes actually evolving in the production patterns as a whole. Table III.11 shows the changes in production that have taken place in the last two years and the farmers' plans for increasing production, these figures are expressed by crop and climatic stratum.

Among strata some differences appear. In the stratum below the coffee zone, one-third of the farmers plan to expand coffee. Increasing banana, citrus, and tomato production is planned by a significant proportion of the farmers, while only a few of them plan to expand the production of other fruit and vegetable products. The coffee stratum farmers show intentions of increasing production which are roughly proportional to the existing combination of crops. Thirty-eight percent of the farmers plan to expand coffee production and about half as many have plans to increase bananas and oranges. The changes in production in this stratum in the past two years shows an expansion of coffee and oranges, and a slight decrease in banana production. Farmers' plans also indicated that there are a few innovative producers who are considering the expansion of non-traditional fruit products (not produced in this region) such as grapes, apples, chirimoya, peaches,

Table III.11. Changes in Production and Plans for Increasing Production, by Crop and Climate Stratum^a
(Percentages of the number of sampled farms in each stratum and in the total survey)

Product	STRATUM I			STRATUM II			STRATUM III			TOTAL
	Change in Production		Expansion Plan	Change in Production		Expansion Plan	Change in Production		Expansion Plan	Expansion Plan
	+	-		+	-		+	-		
Coffee	30.0	....	33.3	41.1	26.4	38.8	....	10.0	....	34.0
Oranges	30.0	....	16.6	17.6	5.8	20.0	10.0	....	....	17.4
Bananas	40.0	10.0	40.0	11.7	20.5	20.0	....	....	....	22.7
Mongoes	10.0	...	3.3	2.9	....	3.3	....	....	....	3.0
Avocados	30.0	....	6.6	....	....	....	5.5	....	....	1.5
Guayaba	....	....	3.3	....	5.8	....	....	3.7	....	0.7
Tangerines	....	....	3.3	....	....	2.2	....	....	....	2.2
Fruits						4.4				3.0
Mora	....	....	3.3	2.9	....	6.6	20.0	....	33.3	8.3
Grapes	....	....	....	2.9	....	3.3	....	....	....	2.2
Apples	....	....	....	....	....	2.2	....	....	....	1.5
Papaya	....	....	3.3	....	....	1.1	....	....	....	0.7
Limes	....	....	3.3	....	....	1.1	....	....	....	1.5
Cidro	....	....	....	....	....	1.1	....	....	....	0.7
Lemons	....	....	....	....	....	1.1	....	....	....	0.7
Chirimoya	....	....	....	....	....	1.1	....	....	....	0.7
Peaches	....	....	....	....	....	1.1	....	....	....	0.7
Flowers	....	....	3.3	....	....	5.5	30.0	....	16.7	6.0
Vegetables								10.0		
Tomatoes	10.0	....	16.6	....	....	4.4	1.8	....	....	6.8
(Haba) Pulse	10.0	....	....	2.9	....	....	10.0	10.0	....	....
Cucumbers	....	....	3.3	....	....	1.1	10.0	....	8.3	2.2
Green Beans	....	....	3.3	5.8	....	4.4	....	....	....	3.7
Onions	....	....	3.3	....	....	1.1	....	....	....	1.5
Beans	....	....	....	....	....	2.2	....	....	....	1.5
Arracacha	....	....	....	....	....	1.1	....	....	....	0.7
Potatoes	....	....	....	....	....	....	....	10.0	....	....
Wheat	....	....	....	....	....	....	....	....	8.3	0.7
Corn	....	20.0	3.3	....	....	1.1	....	10.0	....	1.5
Cane	....	....	13.3	....	2.9	2.2	....	....	....	4.5
Peas	....	....	....	2.9	....	....	10.0	....	....	....
Yucca	....	....	....	....	....	1.1	....	....	....	0.7
Pasture	....	....	3.3	....	....	5.5	30.0	....	16.7	6.0

Sources: The columns "Change in Production" are based on the interviews made in this study. The columns "Expansion Plans" are based on both the interviews made in this study and the interviews made by CORABASTOS in 1970. Therefore, the percentages were computed on a different basis for the two kinds of columns.

^aThe signs (+) and (-) under the column headings "Change in Production" denote increases and decreases in production.

cidro; and also flowers which generally are not produced in this stratum.

The stratum above the coffee zone reflects the greatest change; some attractive new production opportunities are being considered by many farmers. In this stratum, 33 percent of the farms had plans for expanding mora production and about 17 percent planned to produce flowers. The change in this stratum makes the production of the whole area more diversified in terms of number of products, although there seems to be no major impact on the total volume of production in the region.

The changes in production of particular crops deserve some attention. There is almost no production expansion or plans to increase production of such traditional crops as arracacha, yucca, potatoes, corn and wheat. Pasture and animal production seem to be excluded from most farmers' expansion plans (except in the stratum below the coffee zone).

On the whole, the area appears to be moving to a more intensive production where coffee, fruits and vegetables are the main components of production increases, while some traditional crops and pastures are being reduced. This would be consistent with what would be expected; since the growth in demand for fruits and vegetables is much higher than for traditional coffee zone products (other

than coffee), such as panela, and corn.¹⁰ Because of its proximity to Bogota this region would be "sensing" this demand growth despite the deficiencies of the existing market channels.

An important factor in the production expansion have been the activities of some institutions and a few innovative farmers who have been experimenting with new fruit products which are promising production alternatives. INCORA, the land reform agency, has been testing several fruit crops and different varieties in this area. Private farmers are starting to produce some new fruits such as apples, grapes, and chirimoya in response to INCORA's extension activities.

INCORA's activities were initiated several years ago. Tree nurseries were established; this was followed by experimentation and attempts to convince farmers to use these new fruit varieties. Many of these products have been tested with the aim of initiating export activities. Further development of INCORA's activities has recently resulted in a Fruit Promotion Program for the region of Tequendama, supported also by Caja Agraria (the major agricultural credit agency), the Colombian Agricultural

¹⁰See H. Riley, K. Harrison et al., Market Coordination in Colombia, op. cit., p. 34; CID, Distribucion de Viveres en Bogota, op. cit., pp. 51-55; and ILO, Towards Full Employment, op. cit., p. 383, show estimates obtained by FAO and ECLA.

Institute of Research ICA, and the Tequendama cooperative. This program contemplates assistance to farmers in all stages from planning orchards to the cooperative sale of products.

Some of the concrete results of INCORA's have been the planting of more than 73 ha. of mangoes (some small proportion of which is exportable varieties), and an additional 32 ha. in a variety of other fruits. This new activity has promoted the formation of compact orchards (not disperse plantings), which in an extreme case consists of 8.4 ha. in a single orchard of mangoes. This has obvious advantages in producing and marketing these fruits, both in terms of costs and quality of the product.

The expansion of production of fruits and vegetables ranks high in generating income and employment per hectare with respect to other production opportunities. The figures in Table III.12 clearly illustrate that the yearly man-work days required and net income generated are greater than in traditional crops such as coffee, cane, yucca and livestock enterprises.

These characteristics of fruit and vegetable crops make their expansion a highly desirable alternative in the development of the region since low incomes and underemployment exist in a significant number of farms. For illustrative purposes, yearly underemployment was computed for some of the farms interviewed. For these farms the available

Table III.12. Net Income and Labor Requirements per Hectare for Selected Production Alternatives in the Coffee Zone

Crops	Yearly Net Income per Hectare (\$)	Yearly Man-Day Requirements per Hectare
Coffee (marginal) ^a	-170	42
Coffee (average traditional) ^b	622	90
Tomatoes ^c	17,996	830
Cabbage ^d	5,132	444
Green Beans ^d	12,000	540
Onions ^c	30,961	520
Peas ^d	6,702	525
Citrus ^e	4,815	51
Pineapple (<u>perolera</u>) ^f	12,109	472
Pineapple (<u>coyena</u>) ^f	10,608	306
Plantains ^e	5,760	122
Dairy cows ^f	3,240	47
Cattle raising ^f	912	26
Cattle fattening ^f	1,073	21
Yucca	2,813	115
Cane (panels) ^f	2,033	122

Source: Programa de Desarrollo, Proyecto de Diversificación, op. cit., pp. 27-30.

^aMarginal coffee refers to the coffee plantations in non-optimal coffee zone or very old and unproductive coffee stands; its yield is about 50 percent of the national average.

^bAverage coffee refers to coffee plantation with a yield close to the national average.

^cTwo crops a year are considered.

^dThree crops a year are considered.

^eThe year that these crops reach full production was considered.

^fThe net incomes shown are those averaged over the complete production cycle of a few years.

labor supply exceeded labor requirements by approximately 40 percent (computed on a yearly basis and assuming 252 effective work-days per man per year). This 40 percent estimate is perhaps a slight overestimation since labor requirements for essential operations such as, for example, trips to purchase food, were not considered. Another study in a similar coffee region has reported that demand for labor is highly seasonal, and it is concentrated in the ten to twelve weeks of coffee harvesting. During the rest of the year, labor requirements in coffee plantations decrease from 70 percent to 85 percent from the peak levels of the harvest season. The seasonally unemployed work force migrates to other regions or remains inactive in the region.¹¹

The expansion of fruit and vegetable production in the coffee region should be viewed in relation to the technological changes that are taking place in coffee production. The major change that is occurring in coffee production is the replacement of the traditional shade grown coffee varieties with the sun grown variety caturra which has a much greater plant density per hectare and requires considerable amounts of fertilizers and pesticides. Yields

¹¹Hugo Valdes, "Obstaculos enel Desarrollo Agropecuario de una Zona Cafetera," Boletin Cenicafe, 15, No. 4, (1964), 167-194, cited by Programme de Desarrollo, Proyecto de Diversificacion, op. cit., p. 139.

per hectare are increased several times with this new variety. One of the possible effects of this change is that it could concentrate the production of coffee on fewer farms or fewer hectares, depending upon the ability of small coffee growers to switch to this new variety. Another possible effect that could be expected is the reduction in labor requirements in coffee production under this new technology; data to support this contention are not available, nor is data available to make a comparison between technologies. But in some other countries similar changes in coffee production technology have reduced the labor requirements per unit of output; in Puerto Rico, for example, changes have reduced the work force in coffee production and far greater reductions are expected in the coming years.¹²

If the change in technology in the coffee farms tends to either concentrate the production or reduce the labor requirements, a greater sense of urgency is needed in looking for alternative production opportunities that

¹²In Puerto Rico the introduction of sun grown coffee varieties and the use of harvesting nets reduced the labor force about 40 percent in six years; if all the coffee is grown under this new technology, the labor force would be reduced to about 20 percent of its actual level. This analysis is presented by J. D. Shaffer, "Observations on Food and Agricultural Policy in Puerto Rico Within the Context of a Planning Strategy for Economic Development," Final Report to the Governor's Advisory Committee on the Development of Governmental Programs, Commonwealth of Puerto Rico (unpublished report, East Lansing, December, 1970).

would employ displaced labor and utilize land that would be shifted out of coffee. A detailed analysis of these possible effects could well show that the expansion of fruit and vegetable production is one of the better alternatives for utilizing released land and labor resources. The technical potential and the social and economic desirability of promoting an increase in the output of these products seems warranted by the considerations above. However, there are some factors that could be serious limitations to an expansion of fruit and vegetable output in this region.

Limitations to Expand Production

The main limitations to expanded fruit and vegetable production in the La Mesa region seem to be (1) possible demand constraints in the Bogota market, (2) a possible constraint in labor availability at the fruit harvesting season, (3) deficiencies in the marketing channels serving this rural area, and (4) a lack of supporting services.

Demand Constraints

The expansion of production of fruits and vegetables should be promoted with great concern for the effective demand, since demand for many of these items is probably narrow. The consequences of market saturation are reflected in low prices to farmers. In the case of fruit trees, there is no possibility of capital or land reallocation to other

enterprises, since an orchard is a fixed asset for many years.

The case of the expansion of mango production serves to illustrate the point. The estimated production of the 73.5 ha. of mango trees planted in the last two years is 1102.5 tons per year (assuming a yield 50 percent below the feasible yield shown in Table III.10). This production represents, on the average, 47 percent of the total inflow of mangoes to the Bogota market.¹³ This would represent a substantial increase in the supplies for this market; although some of this production would probably be diverted to other large urban markets such as Cali and Medellin. Effective demand could conceivably be expanded with measures such as promotion, improved quality, better distribution, and having the retail shelves permanently well supplied. But an expansion of the effective demand for this product would probably mean a decrease in the demand for other fruit products, since the cross elasticity of demand among fruits may be quite high.

Further mango production expansions should only be promoted after a careful analysis in view of the possibility

¹³The CORABASTOS' check point studies indicate that the mangoes entering the Bogota market per week range from 37.7 tons to 180.8 tons. Considering the mango harvest in La Mesa extends for about 21 weeks (in two yearly harvests), the average weekly production of the expanded tree plantations would be 51.5 tons. This represents a 137 percent increase and is 28 percent of the weekly mango supply in Bogota.

of decreasing prices to uneconomical levels. Mango prices at the farm level have been extremely low during the peak harvest period, about 5 to 6 pesos (about 24 U.S. cents) per box of 20 kilos. Consequently, about 7 percent of the production of the region was not harvested in 1970-71.

The size of the Bogota market is probably not a severe limiting constraint on fruit and vegetable output expansions in the La Mesa region, at least in the short run. However, if a substantial fruit and vegetable program is to be promoted in this region, it would be wise to analyze the demand constraints on a product by product basis. It has already been noted that significant production expansions of certain products (as in the case of mangoes) could affect the Bogota market and the prices received by farmers in the La Mesa region.

If the expansion of fruit and vegetable production is seen from a wider viewpoint, considering the entire coffee zone, the size of the internal market is a serious constraint that should be carefully studied. Overproduction of these highly perishable products could imply income and capital losses of importance as well as a redistribution of income that could negatively affect the smaller farmers.

Labor Availability

Despite the high yearly underemployment mentioned earlier, labor availability is relatively scarce at coffee

harvesting time. This could be a limiting factor to the expansion of fruits and vegetables since most of these products are ready to be picked at about the same time as coffee. Figure 5 shows the harvest season for selected products. The months of April, May and June are those of greatest labor requirements in the region. In this period 76 percent of the citrus fruit, 90 percent of quayaba, 53 percent of avocado and 99 percent of the coffee are harvested. Mango has a different season and bananas are available for harvesting evenly throughout the year. The figure also shows that peak harvest requirements for coffee, quayaba and citrus are in a two month period, May and June; this is the time in which labor could be a constraint for fruit expansion.

The fact that a significant proportion of the fruits are not harvested seems to give some support to the contention that labor scarcity might be an actual constraint in some farms. Under the existing production conditions of small crop size, the additional labor required would be quite low, and the cost of mobilizing labor might be relatively high in terms of the time needed by the employer. The potential wages involved for the possible employee might be too low since what is involved is a short work period, hence, the cost of mobilizing for him is also high, especially in terms of the job stability. The consequence of all this is that additional labor might not be hired, even

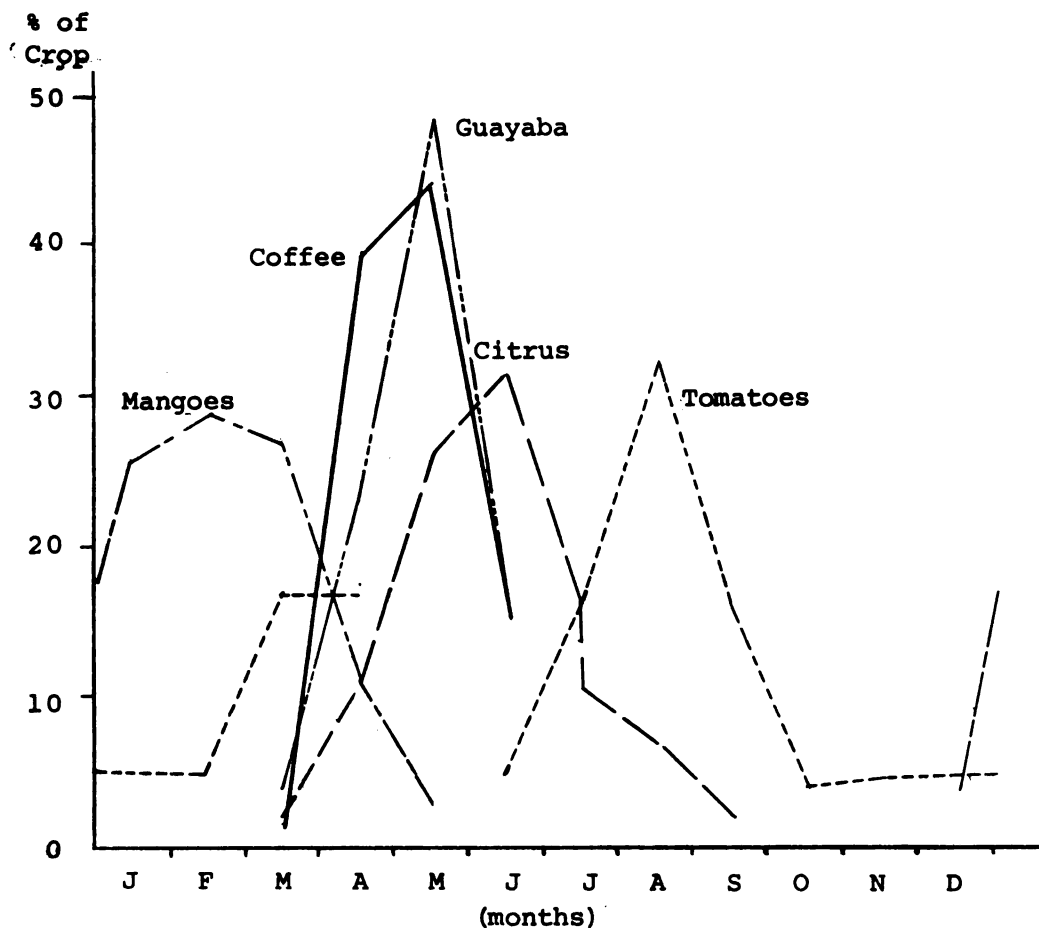


Figure 5. Harvest Season for Coffee and Some Fruit and Vegetable Products in the Region of La Mesa. (The harvest considered is the main harvest of fruits and coffee.) (Source: Farmer interviews of this study and CORABASTOS.)

if its productivity is higher than the prevailing wage rate (disregarding the cost of mobilizing labor). In this case, the size of the fruit crop offers relatively low additional income, and therefore, the product is not harvested.

In a situation of commercial fruit production, labor productivity could be higher since in a commercial orchard the harvesting operation is easier than in the case of dispersed trees that exist in most coffee farms. The relative importance of the crop is greater so that the cost of mobilizing labor can well be afforded. Commercial operations are an entirely different case, and additional labor would probably be hired to harvest all of the crop.

Labor is scarce in the months of April, May and June, but probably not to the point of being an absolute constraint to fruit expansion; several indications give support to this contention.

Over one-third of the farmers interviewed had plans to expand coffee production, which is by far the most demanding crop in terms of labor at harvest time. Thirty percent of the farmers in the stratum below the coffee zone and 41 percent of the farmers in the coffee zone had increased coffee production in the past three years. All this indicates that a significant proportion of the farmers have not had such a severe labor constraint, and the intentions of others imply that they do not see labor (or other factors) as an absolute constraint.

The case of vegetable production gives additional support to the explanation previously presented that the cost of mobilizing labor and the size of a single crop might explain why products are not harvested. All the vegetables produced are harvested, while at about the same time nearby coffee farms do not harvest some of their fruit crop. Generally, vegetable production is a larger scale, more specialized enterprise than fruit production on coffee farms. Hence, these farms can better afford to cover the costs of mobilizing labor since the relative income at stake would be much larger.

Supporting Services

The actual level of supporting services would be a constraint for an expanded production of fruits and vegetables. Credit is required for fostering a commercial type of fruit plantations since it involves a long term investment, with risks, which would be a deterrent for most of the small farmers. INCORA has provided credit for these needs, the Coffee Diversification Program has also made available credit for this specific objective in other regions of the coffee zone. Shorter term credit is also needed for vegetable production, especially if an improvement in production techniques is sought.

Another possible constraint for expanding fruit production could be the availability of grafted trees of

improved varieties. INCORA has tree nurseries, but these would not be enough for supporting a considerable change in the plantings of fruit trees. Extension and technical assistance programs would also need to be expanded from their actual level of operation. Other resources needed for expanding production such as fertilizers and pesticides and improved seeds could probably be supplied by the existing input distribution stores located in the region. The INCORA sponsored cooperative, the Coffee Growers Federation and Caja Agraria have small farm supply stores in all the major towns that have been providing these kind of inputs. These operations could supply larger quantities of these inputs as soon as the demand for them was detected.

The possible limitations to fruit and vegetable expansion caused by deficiencies in the existing marketing channels are discussed in the following section and in the next chapter.

Farmers' Marketing Costs

The structure of production of fruits and vegetables at the farm level described above, generates small volumes of fruit within local market areas, and if a single product is considered, the concentration of production is even less. It must be noted that the means of transportation and roads are primitive and relatively scarce. The farmers' unit marketing costs are high in this system due to several

factors: (1) harvesting costs are probably higher if production is sparsely distributed throughout the farm; (2) transportation costs are also high due to the lack of roads which force most farmers to move their products on mules; and (3) marketing costs also involve the time spent by the farmer in going into the market, searching for a buyer and returning to his farm. This cost is almost invariable regardless of volume, therefore some economies of size are present.

Transportation

A major problem in transporting the products to the marketplace is the lack of roads that can be used by trucks. About 45 percent of the area (with 39 percent of the farms) of the municipios of Anolaima, La Mesa and Tena does not have a "close or near" access to a road.¹⁴ This does not mean that the remaining 61 percent of the farms can move their products in trucks. Transportation from farm to roadside is a problem even for those farms "close" to the roads. Transportation on animals is extremely expensive, for two reasons:

¹⁴These figures were obtained by considering the land of those veredas in which there is no road going through it nor very close to its limits (about 0.5 kilometers from its limits). This gives a rough idea of the possibility that farmers have of using motor vehicles.

1. Rates for mule transport are very high, in part due to the low degree of utilization (they are used one or two days a week), which in turn is the result of the low concentration of production.
2. The time spent in transit by the farmer from farm to market and back to the farm is considerable. This figure is even more impressive if time spent per unit of production is considered (since individual volumes transported are very low).

The average costs of transportation to market and the farmer's opportunity cost of the time spent in transit and selling is \$3.02 per box of 20 kg.¹⁵ Mule transportation costs are equivalent to a cost of \$25.89 per ton per kilometer for the average distance to market of 3.5 kilometers. This is quite costly compared to other forms of transportation such as buses, serving routes between towns in this region, or a few small trucks; some farmers located at relatively long distances (6 kilometers or more) frequently use these other forms of transportation.

¹⁵Mule transportation costs were computed on the basis of customary rental charges obtained from the farmer interviews. These costs are not proportional to distance, although they are increasing function of distance: $Y_1 = 1.351 + 0.074x$ and $Y_2 = 2.775 + 0.151x$, where Y_1 and Y_2 are the rates in pesos per box and bulto, respectively, and x is distance in km. Transit and selling time were computed at an imputed opportunity cost of \$25 per day, the on-going wage rate in the region.

The opportunity cost of transit and selling time is also quite high, almost as costly as transportation itself. This is explained by the low volumes (11 boxes or about 200 kg.) sold on the average by each farmer on a market day. The opportunity cost averaged \$1.42 per box.

The opportunity cost of the time spent by the farmer in marketing the products might be in some cases an over-estimation since all the time in transit and in selling were imputed to this activity. At times, the trip to the market and back to the farm has additional functions such as, purchasing food and farm supplies and socializing. However, given the difficulties in estimating the time and importance of these functions, they were disregarded in computing opportunity costs.

These two components of the marketing costs, transportation and the opportunity costs, represent about 55 percent of the farmers' total marketing costs.

Harvesting

The labor used in harvesting and packing the fruits and vegetables was considered as another component of total marketing cost.¹⁶ For the most important fruit and vegetable

¹⁶The cost of bags, boxes and other containers is generally not borne by the producer. Thirteen percent of the farmers interviewed had to bear the cost of packing containers at times; 87 percent of them were always given back similar containers by the product buyers.

products this cost represents about 45 percent of the farmer's marketing costs. For individual products, it ranged from 40 percent to 51 percent.

It should be recalled that the farmers' marketing costs only cover the harvesting and physical movement of the product from the tree to the local marketplace, which in most cases, is only about 3.5 km. away. A revealing comparison can be found in the fact that the additional marketing costs incurred in moving the product from these rural marketplaces to Bogota (storing, handling, and losses) amount to about 120 percent of the farmers' marketing costs, and in some cases the middleman's costs are even lower. It should also be remembered that physical losses of the product in the transportation from farm to marketplace, which is a real cost, have not been considered (although they are reflected in the prices received by farmers).

Marketing costs for the farmer are so high that at certain times of peak production periods for a crop, when prices are lowest, these costs are higher than the prices paid in rural markets. Consequently, products on some farms are not harvested at all.

In extreme cases such as mangoes and guayaba, the farmers marketing costs account for 80 percent of the lowest prices paid at the peak production period (see Table III-13). For citrus products marketing costs are about 55 percent of the lowest harvest time prices to farmers.

Table III.13. Farmer's Marketing Costs and Lowest Prices Paid for the Most Important Fruit Products

Products	Total Farmer's Marketing Costs ^a (pesos)	Lowest Price Paid to Farmer ^a (pesos)	Farmer's Marketing Costs as % of Minimum Price
Bananas ^b	9.61	21.00	45.76
Oranges ^b	12.59	23.27	54.11
Tangerines ^c	5.80	10.00	58.00
Mangoes ^c	5.13	6.66	77.03
Guayaba ^c	5.24	6.47	80.99
Avocados ^c	5.88	15.00	39.20
Tomatoes ^c	5.53	18.26	30.28

Source: Computations based on the farmer interviews.

^aCosts and prices refer to averages of all the interviews in the sample.

^bIn pesos per bulto of approximately 62 kg.

^cIn pesos per box of approximately 18 kg.

Based on the previous cost computations, the frontier of economical harvesting of products with respect to distance and volumes sold in each market day was determined. Transportation and transit and selling time costs were determined for varying distances to market and volumes sold in each market day. These costs were compared to the lowest prices paid to farmers (average of all the farms interviewed) less the harvesting costs. This comparison indicates at what volume-distance combinations it is

uneconomical to harvest the different products during the peak production season. Figure 6 shows these breakeven volume-distance combinations for different products. These computations are used later in this thesis (Chapter VI) to determine what could be the amount of unharvested products resulting from a different assembly system which involves lower farmer marketing costs. It must be noted that to a large extent these figures of breakeven combinations are the result of imputing an opportunity cost to the farmer's transit time, which is a fixed cost component for any volume of product transported from a given distance to the market.

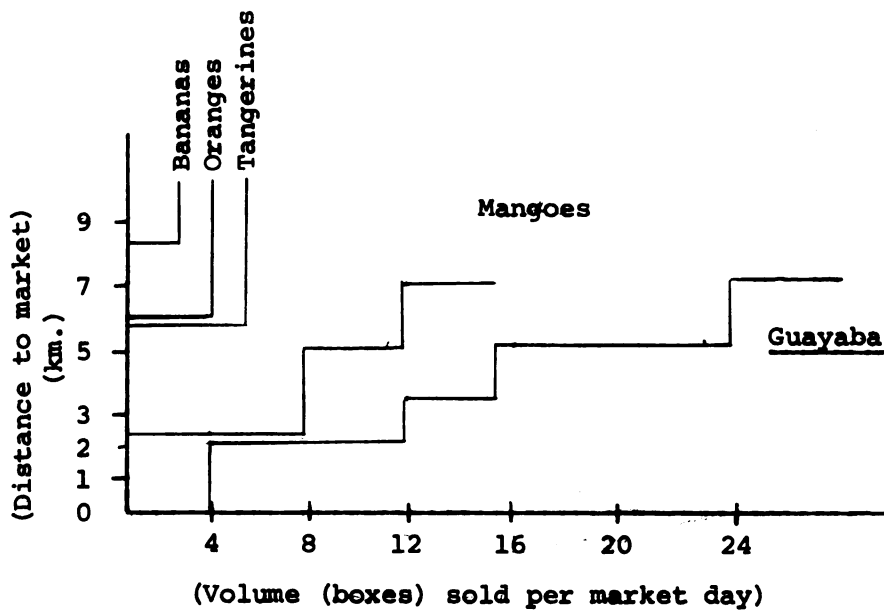


Figure 6. Volume-Distance Breakeven Combinations Over Which Harvesting Products Is Uneconomical.
(Source: Farm interviews.)

The area above each line in Figure 6 shows the combinations in which harvesting each product is uneconomical. The case of mangoes and quayaba are the most limiting ones. This figure partly explains the different proportions of unharvested products found in the farm interviews: 0.9 percent in the case of bananas, 16.5 percent in oranges, 8.7 percent in tangerines, 7.1 percent in mangoes, 1.5 percent in avocados, and 17.1 percent in quayaba. These numbers are an average of all the farms interviewed; individual cases showed wide variations from the averages. The "relatively low" proportion of unharvested mangoes is due to the fact that their harvest comes in a different season than that of all the other products, and therefore, the opportunity cost of labor could be lower than that imputed.

The situation regarding farmer's marketing costs can be summarized by saying that the low volumes sold by each farmer, which are the result of a lack of specialization in fruits and vegetables, yields high costs, up to the point that a significant proportion of some fruit products are not being harvested. Furthermore, these low volumes result in an uncertain aggregate supply of uneven quality which creates serious difficulties and risks for any middleman or organization working at this stage of the marketing process. This is one of the most fundamental reasons for the lack of vertical coordination in the rural stages of the marketing channels of fruits and vegetables.

Chapter IV will describe these problems of vertical coordination as a part of the general analysis of rural assembly markets.

CHAPTER IV

RURAL ASSEMBLY MARKETS

This chapter contains a description and analysis of the rural assembly markets in the La Mesa region. It considers the market participants, the main forces determining the relative positions of intermediaries and farmers, their ways of operating and the results obtained in these rural markets. For the purpose of organizing the analysis, this chapter follows a structure-conduct-performance approach.¹

The definition of what constitutes a market is the following: "a closely interrelated group of sellers and buyers."² This definition is sufficiently flexible, but in operationalizing this concept there is a need to concretely define the meaning of "closely interrelated." In the case of the area under study it was observed that in general there was a great stability of farmers and assemblers with respect to the place where they conducted their operations of buying and selling. This indicates that the conditions

¹This approach has been presented by Joe Bain, Industrial Organization (New York: Wiley, 1959).

²Ibid., p. 7.

for the existence of a market are being met in these assembly places. These places where the production is assembled in a defined space and time will be referred to as rural assembly markets.

Geography of the Markets in the Area

The size of the assembly markets and their area of influence are fundamentally defined by the cost of transportation existing in the rural areas. Another factor that determines the area of influence of a market is the distance that a farmer can travel in one day to and from a market, making allowance for the time necessary to sell, socialize and transact other business in the market center. This has been an important factor that historically has shaped the area served by traditional markets. In the La Mesa region transportation from the farms to the assembly markets is generally by mule.

Typically, the primary assembly markets have a radius of attraction of approximately five kilometers, as can be observed in Figure 7. This represents an area of 7850 ha. The primary assembly markets are located in the principal towns in the region. As in the case of most traditional societies these markets not only serve as a place of exchange, but also they have important social and political functions. Secondary assembly markets have developed in minor villages along a road and near areas of higher production density.

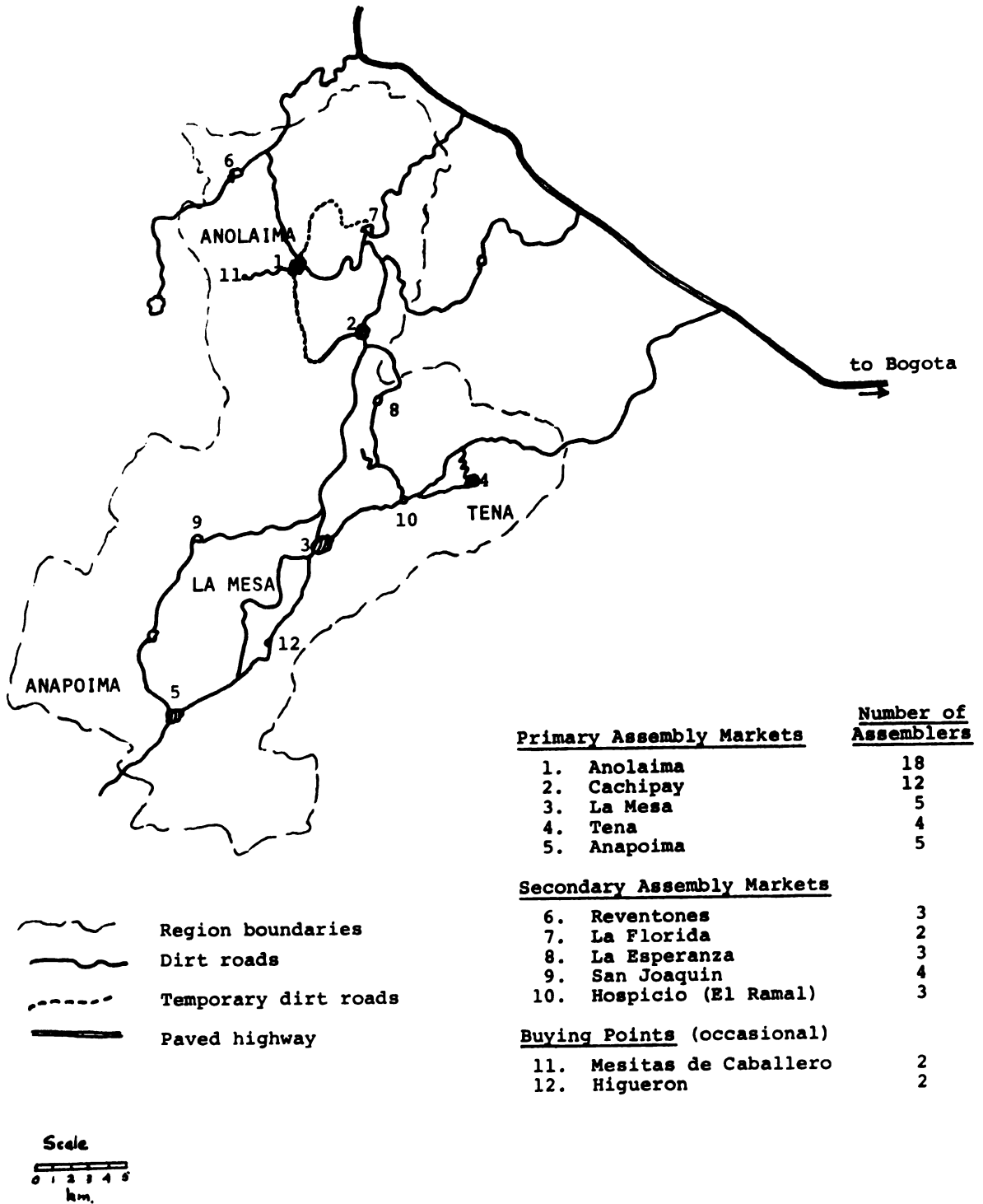


Figure 7. Assembly Markets in the Area of La Mesa.

Anolaima is the municipio with the greatest production and the largest number of assembly markets, four. An average of about 800 farms are served by each market or an extension equivalent of 3350 ha. Table IV-1 reflects the diverse production density of the area, showing the lesser density in the municipio of Tena.

The assembly markets have adapted to the production density variations. As the production of fruits and vegetables has been growing in the last few years in response to the demand in Bogota, new secondary assembly markets have been formed, such as La Esperanza and possibly Hospicio. This natural adaptation is based on transportation economies which may be quite significant.

Another kind of adaptation relates to the seasonal variations of production. Temporary buying points operate along the roads during the harvest time of seasonal products (mangoes, oranges, guayaba, etc.). These buying points are established in areas with a high production density and are located relatively far from the nearest assembly market. For example, Mesitas de Caballero (point 10 in Figure 7) is a seasonal buying point. Another expression of this seasonal adaptation is the variation in the number of assemblers that attend these markets in harvest times. It is also common to find that during peak harvest time that the market days increase from two days a week to three or even four.

Table IV.1. Fruit and Vegetable Assembly Markets and Assemblers by Municipio and Relationships of Markets and Assemblers to Farms and Area

<u>Municipio</u>	Number of Markets ^a	Number of Assemblers	Hectares per Market	Hectares per Assembler	Number of Farms per Market	Number of Farms per Assembler
Anolaima	4	35	3350	383	800	91
La Mesa	4	15	2728	727	367	98
Tena	1	4	4473	1118	953	238
Anapoima	<u>2</u>	<u>7</u>	<u>4742</u>	<u>677</u>	<u>579</u>	<u>165</u>
TOTAL AREA	11	61	3479	627	616	111

Sources: Assembler Survey and Preliminary Data of the 1970-71 Census, DANE, Censo Agropecuario 1970-71, Datos Preliminares, Bogota, 1971.

^a Primary and secondary assembly markets are considered.

Structure of the Rural Assembly Markets

The structure of a market refers to the organizational characteristics that it possesses which determine the relationships between buyers and sellers, among sellers, among buyers and between these and potential buyers. These characteristics may exert a strategic influence in the nature of the competition and price formation in the market.³

The structure of markets has been identified as an important element in a causality relationship that links structure with market performance. This causality relationship considers that market structure affects conduct, or the patterns of behavior that the market participants develop in adapting to the market itself. In turn, conduct affects the performance of the market.

The importance of this relationship of causality--structure-conduct-performance--lies not only in the scientific interest which allows a better organization of the analysis of markets, but also, in reasons of market policy. If specific relationships are known to exist between structure and performance, it is possible to design market rules or policies attempting to assure a market structure which would foster a desired performance.

The interrelationships between structure and performance have been well analyzed in developed economies and

³Ibid., p. 7.

several generalizations have emerged.⁴ These generalizations have been challenged by many economists since it allows, and has fostered, performance implications out of structural analyses which are unwarranted.⁵

In the case of developing countries the relationships of structure to performance have had some attention, especially in reference to perfect competition. It has been mentioned that the classical pattern of perfect competition exists in many primitive markets and, in general, these markets show an efficient operation from the standpoint of static economic analysis. This implies a low productivity-low income equilibrium.⁶ The performance attained has been

⁴There are many studies of this nature. For example, see: ibid, and applications to food marketing such as the Technical Reports of the National Commission on Food Marketing on Organization and Competition in the Food Industries; and OECD, Food Marketing and Economic Growth (Paris: OECD, 1970).

⁵For example, see: S. K. Seaver, "Implications of Food Commission Findings," Proceedings of Market Structure Workshop (Michigan: North Central Regional Extension Market Committee, 1966); and R. Bressler, "Market Structure and Performance: The Conceptual Framework," Proceedings of Market Structure Workshop, ibid.

⁶C. Slater, H. Riley et al., Market Processes in the Recife Area of Northeast Brazil, Research Report No. 2 (East Lansing, Michigan: Latin American Studies Center, Michigan State University, 1969); J. Mellor, "Elements of a Food Marketing Policy for Low Income Countries," in The Marketing Challenge: Distributing Increased Production in Developing Nations, Foreign Economic Development Report No. 7 (Washington, D.C.: FEDS-USDA in cooperation with USAID, 1970), pp. 11-15; and Kelly M. Harrison, "Agricultural Market Coordination in the Economic Development of Puerto Rico" (unpublished Ph.D. dissertation, Michigan State University, 1966), pp. 54-59.

judged far from desirable in the dynamic aspects of introducing new technology and institutional changes which lead to increases in productivity.

Apart from the attention given to the perfect competition model, not much has been documented on the relationships of structure-conduct-performance that prevail in developing countries. Therefore, research on marketing in economic development still has as an important question the identification of the critical variables that must be included in the analysis of structure.

In this study the structure-conduct-performance framework has been used as a means of organizing the diagnostic part of the rural market analysis. The main variables of market structure to be considered are: (1) degree of concentration of buyers, (2) seller concentration, (3) degree of product differentiation and (4) the conditions for market entry.

Producers

The assembly markets are characterized by having a low degree of seller concentration; that is, a great number of farmers go to these markets and individually offer very small quantities. In fact, more than a hundred farmers are usually present in the primary assembly markets. This figure ranges from approximately 300 in the case of Anolaima, the biggest market, to 100 in Tena.

The individual volumes of sale are small with an average sales transaction per farmer of 243 kg. at an approximate value of \$292.50. These reduced sales are due to the small importance of the production of fruits and vegetables in the total production of most of the farms, and to the small size of farms, as was documented in the previous chapter. This low concentration of the supply in the assembly markets and the perishable nature of these products contributes to a weak bargaining position for the producer, who individually faces the assembler. Moreover, the typical producer has very deficient knowledge of the price levels in the wholesale market of Bogota.

In this production-assembly system the largest marketing channel is by far that one that goes through the rural middlemen (assemblers, truckers and wholesalers). This channel moves about 90 percent of the La Mesa region's fruits and vegetables to the Bogota wholesale market, and occasionally to other cities (see Figure 8).

The marketing functions performed by farmers can be characterized as risky and lacking basic techniques to protect and preserve the products sold. A major factor explaining these characteristics is the prevailing instability in producer-assembler relationships. The farmer survey revealed that only 15 percent of the farmers generally sell to the same assembler, while the rest of them do not have any kind of stable selling relationship. This

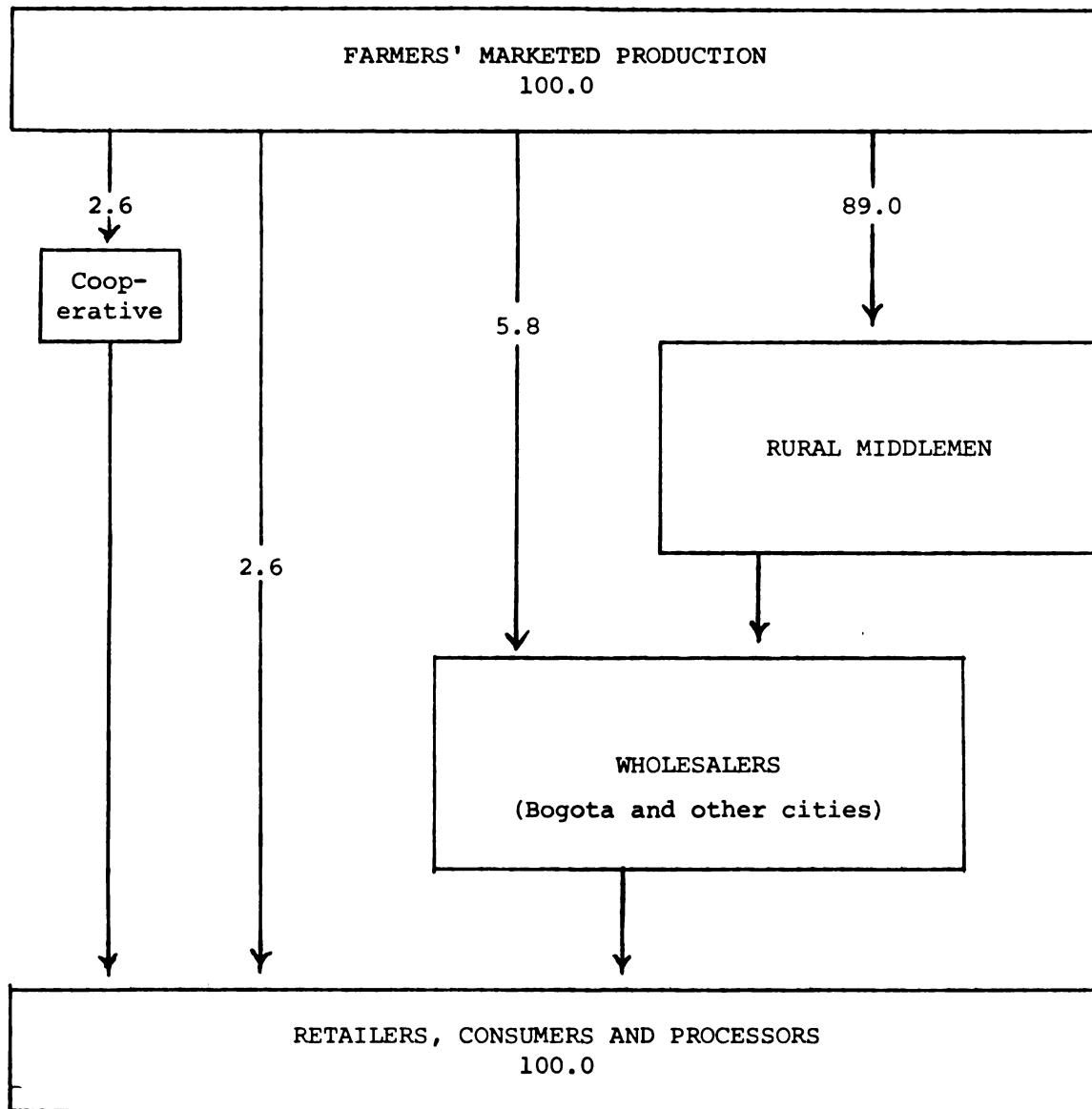


Figure 8. Marketing Channels of Fruits and Vegetables in the La Mesa Region (computed on the basis of number of farmers selling in each channel, regardless of their individual volumes). (Sources: Farm interviews and CORABASTOS' interviews.)

lack of stability represents a serious market uncertainty for both assemblers and producers.

Another kind of risk refers to price instability. Prices commonly fluctuate and the price information available to farmers is rather limited. Eighty percent of the farmers indicated that they had little or no market price information before actually coming to the market. When asked to make a prediction for the next market day, only 3.3 percent of the farmers could advance an estimate. If price information on the Bogota wholesale market was readily available to farmers (e.g., through radio broadcasts) more direct marketing channels might be established. Some farmers would consider selling directly in the Bogota wholesale market when their volumes of harvested products would justify it, and more farmers would be willing to sell their products at the farmgate or roadside, with considerable savings in transportation costs and transit time.

The fruit and vegetable supply in a market day is very diverse as far as volumes and qualities are concerned. Therefore, as a general rule, assemblers do not specialize in certain products, but operate with a variety of products of different importance according to the composition of the supply at a given moment. This diversification of the assemblers is also a response to the seasonal character of the production of most fruits.

Assemblers

The assemblers in these markets perform different functions. All of them perform directly the functions of buying, transportation to Bogota and the sale in the wholesale market. This naturally implies the functions of obtaining information about the wholesale market and assuming the risks of price fluctuation. Besides these functions, the assemblers may perform one or more of the functions described in Figure 9.

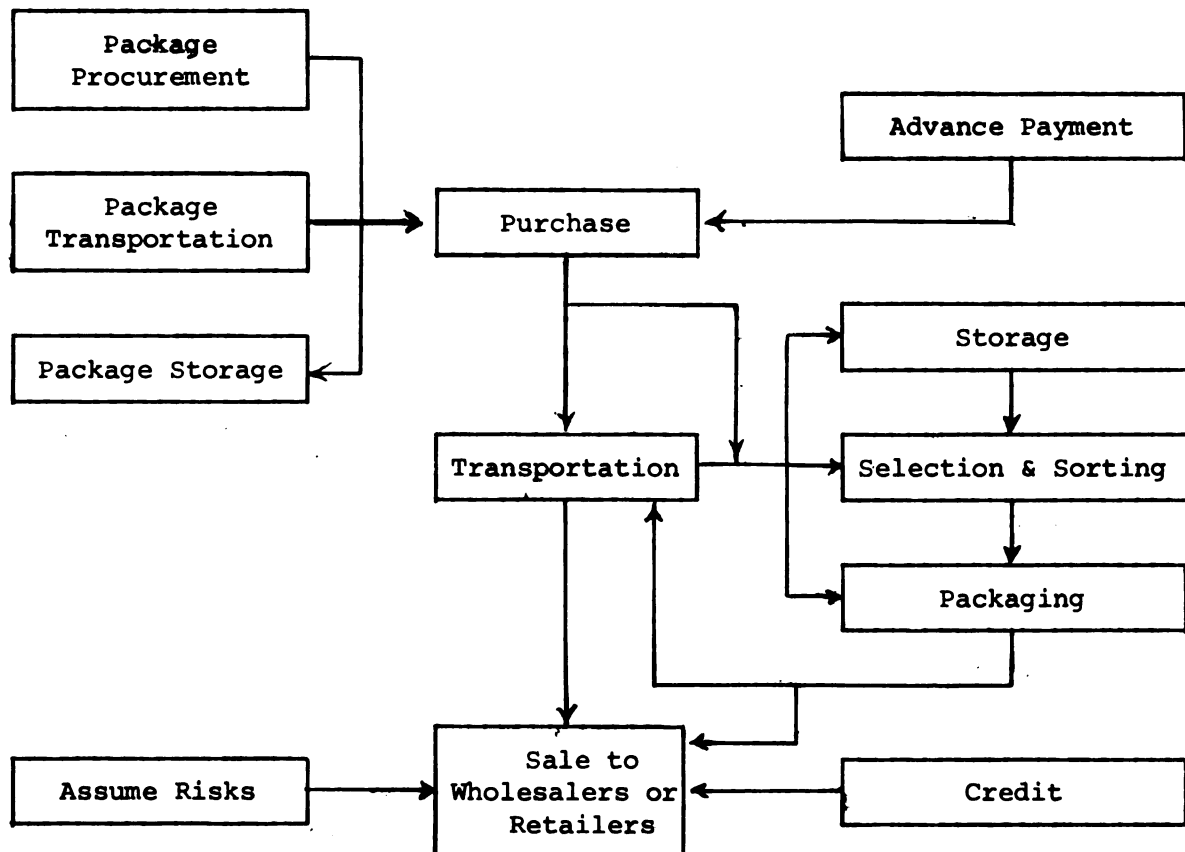


Figure 9. Functions of the Rural Assemblers.

Assemblers can be categorized in two types which, to a large extent, are defined by the installations they may possess. These may include: storage space in the rural area, their own truck and/or a sales stall in the wholesale market of Bogota. Based upon these characteristics, two types of assemblers have been defined as follows:

1. One group is represented by those assemblers who control (or possess) storage space in a rural market and a stall in the wholesale market of Bogota, and, also, those assemblers who control (or possess) storage space or a wholesale stall in Bogota; and also possess a truck.
2. The other group is then defined as those assemblers who do not have these installations or those who only possess a transportation vehicle or storage space in the rural market.

These two types of assemblers may be distinguished in relation to their volume of business. Those in Group 1 had purchases which averaged \$14,789.64 per week or 11,720 kg. while those in Group 2 had average sales of 8425 kg. valued at \$9142.60. This means that, as a rule, those in Group 1 handle a volume that is 35.5 percent larger than those in Group 2. The assemblers in Group 1 represent about 50 percent of the total sample. This proportion might be slightly lower for the total population since there are some

assemblers that do not operate in every market or operate with very small volumes; these assemblers are hard to identify in a visit to the market. Assemblers in Group 1 handle approximately 60 to 70 percent of the product movement. It must be noted that within Group 1 there are important differences in the volume handled by each assembler.

The number of assemblers per market, shown in Figure 7, gives an idea of the absolute concentration of buyers. From these figures it would seem that concentration is high. It must be realized though, that the volumes in each market are not large, therefore, in most cases buyer concentration cannot be lower in a market defined in these terms. A more relevant notion of concentration could be based on a wider geographic area than a single marketplace. Furthermore, the notion of concentration is not so relevant in this kind of market since there are no significant barriers to market entry at any scale of operation. It should also be mentioned that concentration by itself does not indicate or imply any performance result with certainty in any kind of market.

These groups of assemblers are also differentiated in the functions and services performed. In Group 1, 72 percent of the assemblers perform some operation (storage, ripening, packing or sorting) on one or more of the products handled, and only 30 percent at times sorts at least one

product; in Group 2, these figures are 50 percent and 16 percent, respectively.

Concerning the granting of credit to the buyers in the wholesale market of Bogota, approximately 30 percent of both groups of assemblers give credit at least occasionally.

The mobility of the assemblers of both groups is different. The members of Group 1 on the average buy in 2.1 different assembly markets while those in Group 2 only do so in 1.4 assembly markets. Obviously, this is due to the greater percentage of truck owners in Group 1.

The assemblers of Group 1 also have a better vertical coordination than Group 2. This is due to the greater flexibility made possible by having storage space in the rural markets and a wholesale stall in the Bogota market. In Group 1, 45 percent of the assemblers have some stable clients in the wholesale market, while in Group 2, this figure is only 28 percent.

There are no significant barriers to enter into the market as a buyer or seller; an assembler can operate with little capital, \$3000 or less. The only necessary condition for entering the market as an assembler is to be permanently well informed of the prices in the wholesale market in Bogota. In practice this implies that the job of an assembler is almost inevitably a full-time job since prompt and reliable price information in the rural areas is not easily obtained.

The characteristics of the rural markets described up to this point indicate that their structure cannot be categorized into the classical perfect competition model since: (1) the number of buyers in most of these markets is not high; (2) price information presents deficiencies and it is difficult to obtain; and (3) market participants do not exclusively act under economic motivation, but also are subject to several restrictions of a non-economic nature. Relationships of social or political dependence, friendship, and other kinds of attitudes which have been analyzed by Everett Rogers, do not foster behavioral patterns based only on economic rationale.⁷

Conduct in the Assembly Markets

Market conduct is the behavior pattern that the assemblers show in adapting to the markets in which they buy and sell. These conduct aspects refer mainly to: (1) price formation mechanisms, (2) volumes and products handled, (3) buying and selling operations and (4) the mechanisms of interaction, mutual adaptation and coordination among the competing members in a market.⁸

⁷Everett M. Rogers in association with Lynne Svenning, Modernization Among Peasants: The Impact of Communication (New York: Holt, Rinehart & Winston, 1969).

⁸This notion of market conduct is based on considerations made by Bain, Industrial Organization, op. cit., pp. 9-11.

Price Formation

The interviews with the assemblers indicated that there are several bases upon which prices to be paid on a certain day are determined. Some of these bases reflect a conduct which is not very competitive and consequent with the existing market structure. Sixty percent of the assemblers consider the prices of the previous day on the wholesale market of Bogota as the main base on which to determine buying prices on a certain day; 20 percent of them consider that the base should be the quantity of product that reaches the assembly market; 20 percent indicated several other reasons, such as prices paid by the rest of the assemblers in the market, the individual position and information possessed by a given farmer trying to sell his products while others did not mention any single main base over which prices were determined.

As it was previously mentioned, an important characteristic concerning price formation in assembly markets is the lack of bargaining power on the part of farmers. An assembler on a given market day buys from many farmers--from 15 to 30, on the average of about 19. It is possible therefore not to buy the products offered by an individual farmer, and without much difficulty buy from another farmer among the many that attend the assembly market. At times of relative scarcity of supplies the farmers' bargaining position might be increased substantially.

It seems reasonable to conclude that the forces acting in the price formation mechanism are: (1) the prices in the Bogota wholesale market, (2) the degree of competition existing among assemblers and (3) the total supply of specific products offered in a given market day in the assembly market.

This case of rural assembly markets fits well in what Fellner calls cases of "scarcity" of buyers or sellers.⁹ Fellner states that a determinate equilibrium solution (as in the case of perfect competition or monopoly) does not exist. Nevertheless, there are certain utility and cost functions that determine the limits among which there are no net profits. Between these limits there is a range of indeterminacy in which a market result is achieved through bargaining procedures.

This structure originates a conduct based upon bargaining which may be in an explicit manner, as a market agreement solution with collusive behavior, or in an implicit way or quasi-bargaining, in which the behavior of the market participants is directed to "test" the reactions of the rest of the participants to changes in price policies and volumes bought.

⁹William Fellner, "Competition Among the Few" in Werner Sichel (ed.), Industrial Organization on Public Policy (Boston: Houghton Mifflin Co., 1967), pp. 36-47.

The result of this bargaining process may depend upon: (1) the greater capacity of some to inflict losses on others and bear losses for a given period of time; (2) the capacity to learn that all of them may benefit with a philosophy of "live and let live" or (3) the presence of certain leaders who are recognized as such by the rest of the market participants who follow them.

It is possible that the type of result obtained in these assembly markets is of the type in which all learn that in the long run, it is better to "live and let live."¹⁰ That is to say, it is possible that all of them have a certain notion of the effects of their actions upon the rest of the participants and at the same time they have an idea of the possible type of retaliatory action taken by others and its effect on his own business.

Competition would then develop within these limits of "relative respect for the business of other participants."

¹⁰ Similar types of market behavior have been described in other cases in Latin America. For example, see: John K. Galbraith and Richard Holton, Marketing Efficiency in Puerto Rico (Cambridge, Mass.: Harvard University Press, 1955); William Glade and John G. Udell, "The Marketing Behavior of Peruvian Firms: Obstacles and Contributions to Economic Development" in R. Moyer and S. Hollander (eds.), Markets and Marketing in Developing Economies (Homewood, Ill.: Irwin, 1968), pp. 153-169; Sherwood George Walters, "Marketing in Brazil Tested According to Recent Economic Theory" (unpublished Ph.D. dissertation, New York University, 1960); and Harper P. Boyd, Richard M. Clewett and Ralph L. Westfall, "The Marketing Structure of Venezuela," The Journal of Marketing, 22 (April, 1958), 391-397.

There are some facts and answers in the interviews that confirm in part this notion:

1. The number of assemblers that go to a certain market is relatively constant according to the volumes offered in the market. For example, on Sundays, which is the biggest market day in terms of products offered, the number of assemblers is substantially greater than that seen on market days during the week. In the same way, when there is a seasonal crop of a given fruit and the supply is abundant, the number of assemblers also increases in a more or less proportional way.
2. Some assemblers expressed that if they wanted to they could buy substantially bigger quantities of product than those they actually handled but this would imply that they would have to pay higher prices.
3. None of the assemblers interviewed stated that they were buying greater quantities than in the past two years. The majority of them answered that the quantities handled depended upon the production conditions in the region. This means that there might be limited competition to attain a greater volume of operation. It seems that over time all tend to adapt to the existing supply, avoiding extreme degrees of competition.

4. Of those interviewed, 72 percent stated that when assemblers from other regions or from "outside" attended the market, prices tended to rise. This might indicate that assemblers who do not know the "rules" or implicit agreements in the assembly markets and operate exclusively on the basis of selling price expectations and costs might unbalance the supply and demand on this day, causing increases in prices and greater competition among all.
5. It must be emphasized that in doing the interviews it was observed that most of the assemblers knew the way of operation of the rest of them and many of them seemed to be friends. This might give some confirmation to the contention that implicit negotiations or collusive agreements could exist among them.
6. Finally, it was possible to indirectly verify through informal conversations that explicit agreements existed among assemblers. Assemblers of a given market were asked about the operating procedures in an adjacent market; some of them answered that their own market was very competitive but that agreements were commonly established among assemblers in the adjacent market.

This evidence confirms the earlier statement that interdependent behavior exists in these markets, and it also supports the possibility of implicit or explicit agreements. On the basis of the evidence presented, it seems reasonable to categorize these markets in the oligopsonistic type, that is, markets in which there is more than one buyer, but the number of buyers is not so large that the actions of an individual buyer does not affect the rest of them.¹¹

The existence of some kind of market agreement does not necessarily imply that assemblers are able to capture abnormal profits. The ease of market entry, mentioned earlier, is felt at times when assemblers from "outside" occasionally participate in these markets; this probably places a limit on agreements and profits (evidence shown later in this chapter confirms also that profits do not seem to be abnormal). Agreements can be a market conduct mechanism to prevent cut-throat competition and losses, and also to obtain more stability in the business.

The informal evidence presented does not imply that agreements are always respected. On the contrary, it is quite likely that they are binding to a certain limit. The fact that assemblers revealed that the volume of supplies arriving at a market on a given day was one of the bases to

¹¹This is the definition of oligopoly in C. E. Ferguson, Microeconomic Theory (Homewood, Ill.: Irwin, 1969).

determine the prices to be paid, indicates that competition exists in the market.

The economic theory of the firm would also support the contention that behavior in the market would be characterized by competition to get at least a certain minimum volume of products. Assemblers with a permanent clientele to supply in the Bogota wholesale market, and those assemblers who have their own truck, warehouse or market stall (which imply certain fixed costs) would operate attempting to reach a minimum volume to cover these fixed costs and to maintain the clientele.

Calculations were made to determine the zero profit point in terms of volume handled. These were made with two alternatives--one considered the opportunity cost of the labor of the assembler¹² and the other considered the fixed costs effectively paid. The cost and price data showed that, on the average, the minimum volume at which all operating costs (including the opportunity cost of labor) are covered is 5603 kg., that is, 52 percent of the volume handled at the time of making the interviews. This minimum volume of operation is only 2788 kg., or 26 percent of the volume handled at that time, if opportunity costs are disregarded.

¹²This opportunity cost was imputed at a rate of \$3000 per month. This is the approximate salary for an equivalent position. In the case of the assemblers who also carried out other activities, the imputed cost was only \$2000.

These calculations assume price levels in buying and selling similar to those existing at the time of making the interviews. This would be a motivating force to break market agreements at times of product scarcity. In a case of extreme scarcity of supplies, and therefore, of aggressive competition, the purchasing prices in the assembly markets could increase up to the point where the price spread obtained does not cover fixed costs. In theory, the extreme case in a short run situation is a price level that covers only variable costs. This line of reasoning leads to hypothesize that agreements in these markets would tend to be broken at times of product scarcity and more intense competition would increase prices and decrease absolute margins.

A price analysis was conducted to study the margins and their variation among seasons of product scarcity and abundance. This analysis consists in verifying the relationships between price spreads and the absolute price level in the Bogota wholesale market. The kind of behavior hypothesized above would show constant or decreasing price spreads as a function of Bogota's prices. Constant or lower absolute margins when prices are high indicate a greater degree of competition, since at times of higher prices supplies are relatively more scarce, therefore, volume handled per assembler tends to be smaller, making total and net revenue lower than at times of product abundance.

Price information was gathered in several markets in the region at sporadic times during an eight-month period, January through August, 1972. Prices on the Bogota wholesale market were obtained from the daily bulletins of IDEMA (Institute of Agricultural Marketing). Later, when the new wholesale market was inaugurated, this information was obtained from the market information department of CABSA (the organization that runs the new wholesale market).

Price spreads between the rural markets and the wholesale market of Bogota were related to the wholesale price level for some of the main products by using a simple regression:

$$P_b - P_r = \text{Price spread} = S$$

$$S = f(P_b)$$

where: P_b is the wholesale price in the Bogota market.

P_r is the rural market price.

Simple, quadratic and cubic functions were tested. The results of the simple functions are given below, since they showed a similar goodness of fit as the other functions and their interpretation is much simpler. These simple functions had the following form:

$$S = \beta_0 + \beta_1 P_b$$

The results obtained are shown in Table IV.2.

Table IV.2. Estimates of the Functions Relating Price Spreads with Wholesale Prices

Products	n	β_0	β_1	Level of Significance of β_1	R ²
Oranges	37	-5.43	0.34	.06	0.10
Avocados	14	7.25	-0.016	.94	0.005
<u>Guayaba</u>	19	6.73	0.10	.60	0.02
Tomatoes (<u>chonto</u>)	25	27.93	-0.112	.52	0.02
Tomatoes (<u>milano</u>)	10	-8.88	0.39	.57	0.04

The results obtained indicate that only in the case of oranges price spreads tend to increase as prices increase in the wholesale market. In the rest of the products, the functions show β_1 coefficients that are not significantly different from zero at the 10 percent level. A more general conclusion is that price spreads have a very weak relationship with the price level in the Bogota market, this is clearly implied by the low R² obtained in all cases. The conclusion of these equations is that in most cases margins are constant with respect to the wholesale prices, and price spreads tend to vary due to reasons other than the variation in wholesale prices.

Other functions using this price information were used to analyze the relationships among price levels between the Bogota wholesale market and the rural markets. These

functions had the rural market price on a given day and market as a dependent variable; the independent variables were the Bogota wholesale prices in the two previous days and dummy variables that represented specific rural markets (to account for product quality variations and transportation costs). The functions had the following form:

$$P_r = a + \beta_1 P_{b_1} + \beta_2 P_{b_2} + D_1 + D_2 + \dots + D_n$$

where: P_r is the rural market price on day t

P_{b_1} is the Bogota wholesale price on day $t-1$

P_{b_2} is the Bogota wholesale price on day $t-2$

D_n are the different rural markets considered (excepting the base market); $n=1, \dots, 4$.

The R^2 obtained are presented below to show the degree of association between these independent variables and the rural market price (see Table IV-3). These R^2 are not too high. It must be mentioned that the wholesale price information available quoted the average price for a product that has a great variation in its quality, the same was true of the rural market prices obtained; the lack of greater specificity in the kind of product accounts in part for some unexplained variation in the functions, and therefore, a lower R^2 .

Table IV.3. Multiple Correlation Coefficients Showing the Degree of Association Between Rural Prices in Different Markets and Wholesale Prices in Bogota for Selected Products (1972)

Products	R^2	Level of Significance of the Analysis of Variance of the β_1
Oranges	0.46	0.001
Tomatoes (<u>chonto</u>)	0.76	0.0005
Bananas	0.59	0.001
<u>Guayaba</u>	0.66	0.08

The price analysis on the whole gives evidence which permits to conclude that in the markets of this region the level of competition makes margins fairly constant, and that the rural prices follow the variations of the Bogota wholesale prices with fair closeness.

There are other forms of competition apart from prices. Some of these take the form of payment in advance for the product, the assembly of products along points in the roadside close to the farms and several social expressions. Apparently these forms of competition are more frequently seen in those markets with a lesser number of assemblers where it is more difficult to break a price agreement since it is easier for assemblers to influence individual producers.¹³

¹³For example, in Tena, the smallest market, the assemblers usually advance cash on future product deliveries.

Operations of Assemblers

In what follows, some aspects of the operations of the assemblers which are of interest for the analysis of market conduct will be discussed.

Buying operations are characterized by unstable buyer-seller relationships despite the fact that assemblers consistently buy at the same places. About 72 percent of the assemblers have some farmers that permanently sell to them although in general the numbers are very few in relation to the total number of farmers from which a given assembler buys.¹⁴

In general, assemblers operate through fixed buying points. Only 23.5 percent of them also buy in other markets within the region. This is compatible with the notion that if market agreements do exist, assemblers must participate permanently in the market to benefit from such agreements. The lack of ownership of transportation equipment also limits the mobility of some assemblers.

Handling operations such as sorting, storing and packing are very rudimentary. The greatest part of the products handled by the assemblers are sold on next day in the wholesale market of Bogota in the same form in which it

¹⁴An estimate of the percentage of stable clients over the total of sellers was obtained in a few cases which indicates 20 percent in the larger assembly markets and 50 percent in Tena, a market of merely four assemblers.

is purchased from farmers. The purchase of products is done with little inspection so that prices paid have little relationship with differences in product quality. This has a great impact upon product quality since the farmer has little incentive to improve the quality of the product.

There are some exceptions to this way of operating for products that require special handling. In the case of bananas, 39 percent of the assemblers store and ripen and occasionally they make some selection of this product. Papaya is another product that generally is selected according to size. Tomatoes and mangoes could be bought with the appearance of having been sorted, since the boxes allow a limited inspection on the top, but on the inside any kind of product is found.

Only 55.5 percent of the assemblers occasionally perform some work (sorting, packaging, ripening) to certain products. This seems a paradox since 86.6 percent of the assemblers showed a positive reaction to product sorting as a better way of selling and of improving business. The main problems confronted by assemblers in selling classified or sorted products are: (1) Given the buyer (and seller) instability, it is difficult to assure the qualities of the products bought and, on the other hand, it is difficult to convince the buyer of the quality of this product. (2) It is difficult to sell the lower quality products. (3) A considerable part of the buyers in the wholesale market of

Bogota are retailers who have as their only business buying and selling in plazas very small volumes of fruits or vegetables. These buyers are not too interested in buying sorted products which would imply relatively higher purchasing prices, and also since one of their functions is sorting the products for resale. (4) Given the lack of a stable clientele to which the assembler can sell his product, he has an opportunity to sell sorted products to only a few wholesalers with whom he may hold a permanent commercial relationship.

This consideration indicates that the physical handling given to a product in the rural markets is to a great extent a natural response to the structure and behavior of the wholesale market of fruits and vegetables in Bogota. An analogous argument can be made in relation to the rest (non-physical functions) of the operating procedures in the rural markets. This has an important implication for the introduction of changes in the system. The success of such attempts is largely conditioned to the efforts and capacity to deal in this urban wholesale market. This is another example of the interdependence of the components of a system.

The predominant characteristic of the selling operations is the price and buyer instability. About 53 percent of the assemblers stated that they had some permanent buyers in the wholesale market, but apparently these

buyers represent a very low proportion of the total sales of assemblers.¹⁵ These permanent buyers normally make orders ahead of time to the assemblers concerning the products needed. About 64 percent of the assemblers reacted favorably to the possibility of establishing selling contracts in Bogota while the rest of them did not accept the idea, thinking it was not feasible or for other reasons.

In asking for the main difficulties that assemblers encountered in selling their products in Bogota, 14 percent did not have any problem, 57 percent occasionally had difficulties in finding buyers and 36 percent occasionally had difficulties in finding unloading and parking space (see Table IV.4).

The average time that assemblers incur in selling their product in Bogota is 1.37 days for those assemblers who have a stand in the wholesale market and only one day (eight hours) for those that do not have a stand.

Apparently the assemblers individually are not expanding the volume of operation. Only 7 percent of them stated that they were buying a greater volume than in the previous two years; and what is more surprising, 59 percent of them do not consider expansion of the volume of operation

¹⁵Due to reluctance of those interviewed in a very few cases (n = 3) it was possible to quantify the percentage of permanent clients over the total buyers. On the average this figure was 35 percent.

Table IV.4. Main Difficulties Confronted by Assemblers
in Selling the Wholesale Market of Bogota^a

Difficulty	Percentage
Finding buyer, occasionally	57
Finding unloading space, occasionally . . .	36
Insecurity	14
Excess of traffic	7
Excessive price fluctuations	7
No problem	14

Source: Assembler interviews.

^aAll of these assemblers sell permanently in the wholesale market of Bogota and 93 percent of them sell in the sector of Plaza España.

as a means of improving the business. This is quite understandable in a short run view of their business since an attempt to buy more products, say one more truckload per week, could well increase prices in the rural market. Assemblers generally are traditional people with a predominant view on the short run that does not lead to a high volume-low margin philosophy.

The greatest problems perceived by assemblers in trying to expand their businesses are: increasing the degree of competition in the assembly market, a lack of managerial capacity and the selling risks in the wholesale market of Bogota (see Table IV.5).

Table IV.5. Main Difficulties Confronted by Assemblers
in the Expansion of the Volume of Operation

Difficulty	Percentage
Increase in the degree of competition (and prices) in the assembly market	42
Work and time demanded by business	33
Instability of buyers	17
No problem	8

Source: Assembler interviews.

Performance in the Assembly Markets

Performance refers to the final consequences flowing from the system to all its participants through the operation of the market. The object of analyzing performance is to evaluate the results to determine if they are acceptable. At an operational level this means seeing if these results are compatible with the general objectives of social and economic development.

The aspects that guide the evaluation of performance can be grouped in three major dimensions:¹⁶ (1) economic efficiency, (2) progressiveness, and (3) distribution or equity.

¹⁶These dimensions have been proposed in detail in H. Riley, K. Harrison et al., Market Coordination in Colombia, op. cit., pp. 6-8.

It is necessary to specify the approach under which this evaluation is undertaken. The results obtained from the operation of these assembly markets are the product of the free interaction of the social and economic forces. In this way, it is not possible to point out "responsibility or blame" (and there is no sense in doing it) for the results since each of the participants acts in a way such as to maximize the economic benefits obtained from his participation subject to certain legal, social and cultural restrictions.

The fact as to whether or not the combined results are acceptable will be due to the composition and interaction of the existing socioeconomic forces.

The task is to analyze the situation to see how possible changes could modify the interaction of these forces so that the results obtained by these new arrangements could be considered an improved performance. This approach is not very normative, but rather pragmatic. This approach considers that there are no given absolute norms of magnitude to evaluate performance, but that performance can only be judged in comparison with that which could be attainable under certain changes or new alternative arrangements. Nevertheless, at some point normative judgments need to be made in comparing alternatives.

Economic Efficiency Aspects

The main aspects in this dimension of performance refer to the analysis of the economic results and pricing efficiency.

The economic results of assemblers' operations were obtained from direct interviews made. It should be noted that there are several limitations to the data generated in this way:

1. It only represents the level and product composition of the operations that assemblers had at that time of the year (March). This is a time of average volumes of production; but the situation of assemblers could be very different in times of peak harvest.
2. This type of interview generally produces data of doubtful reliability, especially regarding volume of operation and prices paid. Therefore, several checks had to be made in the crucial answers obtained--volume of operation on that day and selling and buying prices. It was possible to make these checks in most of the cases since more than one assembler was interviewed on a given day in a market, thus allowing a comparison of buying and expected selling prices. Furthermore, some farmers were asked about prices received on that market day; also price information on selling prices (to

retailers) on the next day in the Bogota wholesale market was considered. The information on costs is much more reliable since transportation rates per truckload, bag (bulto) or box are very well established; wages and salaries do not show significant variations.

An unsuccessful attempt was made to measure the physical losses and price losses realized by assemblers.¹⁷ This is an important omission since price and product losses can be quite high in handling highly perishable products such as fruits and vegetables. The physical losses to a great extent have not been omitted since the prices on the wholesale market of Bogota should have an implicit component for an expected amount of deteriorated product.¹⁸

3. The margins and costs per unit of volume for different products are different. Since all the assemblers

¹⁷Physical losses on bananas were obtained from three assemblers. This is the only product that they store for a few days; the rest of the products are sold the next day and the product deterioration is simply passed on to the wholesaler or retailer that purchases the packaged product. These losses on bananas were incorporated in the calculations.

¹⁸This must exist as a judgment made by retailers and wholesalers which through time and experience could be quite accurate.

handle several products (from four or five to ten products), cost and income calculations were made for this combination as an aggregate. Unit costs and income figures were later derived from these combined calculations. In this sense costs may vary substantially from one season to another depending on the relative importance of different products handled.

4. Finally, extreme values of costs or prices that were judged to be of dubious reliability were adjusted to the next closest value obtained for the same market on the same day. For this reason, several interviews were discarded. It is possible that some variation could have been eliminated in this way.

Costs were grouped in three main categories: (1) variable costs, (2) fixed costs and (3) product purchases.

The variable costs include transportation (if the assembler did not own a truck), packages (boxes and bags), handling costs (if the assembler did not have permanently hired personnel) and product losses (for bananas only).

Fixed costs include the rent (or imputed rent) paid on storage space in the rural market and on a wholesale stall in Bogota, permanently employed personnel, transportation costs (if a truck was owned), interest on working

capital (computed at an annual rate of 16 percent per annum) and an imputed value for the assembler's opportunity cost.¹⁹

The cost of product purchases were the sum of the values of the products bought. All these calculations were standardized on a weekly basis to consider the variability that these figures could have in different production seasons.

Based on the selling and buying prices revealed by the assembler survey, assemblers were operating at this point in time and with the combination of products existing on a gross margin of 25 percent of sales. This margin is composed of 6.9 percent of real profits, 4.9 percent of imputed costs (of operating capital and the assemblers work) and 13.2 percent of variable and fixed costs (see Table 6).

These net profits generate a total income for the assemblers--including their imputed rents--averaging \$8014 (or U.S. \$382) per month per assembler. From this total figure, \$2828 represents imputed opportunity costs and

¹⁹The opportunity cost of assemblers time was imputed at a rate of \$3000 per month for those operating full-time in this business; those with other occupations were only imputed \$2000 per month. Obviously, this is not the real opportunity cost; their net profits would also be a part of it. This procedure was used to present figures with more clarity.

Bank rates are slightly higher, about 18 percent, but part of these banking rates are a compensation to the inflation rate which has been about 8 to 10 percent in the past years. It is quite likely that the operating capital of assemblers is not affected by inflation given the very high turnover it has in this kind of operation.

Table IV.6. Economic Results of the Assemblers in the Region of La Mesa

Income and Cost Category	Value per Kilogram Sold ^a	Percentage Over the Value of Sales
Sales	\$1.637	100.0
Purchases	1.228	75.0
Other costs	0.217	13.2
Net profits	\$0.192	11.8
Imputed rent (opportunity costs)	0.079	4.9
"Real" profit	\$0.113	6.9

Source: Assembler survey. Simple averages based upon 15 usable interviews.

^aComputed over the average weekly volume of 10,622.2 kg.

\$5186 represents real profits. It must be noted that there is a wide variation in the distribution of incomes and profits; assemblers' incomes from this business range from \$4966 to \$20,404 per month.

Table IV.7 indicates that the most important costs for the assembler are the purchase costs of the product which represent 81.5 percent of the total costs. Variable costs represent an additional 11.8 percent. The remaining 6.7 percent are fixed costs of which only 1.8 percent are actual cash costs and 4.9 percent are opportunity costs.

Table IV.7. Average Unit Costs of Assembler Operations

Cost Category	Cost per Kilogram	Percentage of Total Cost
Variable costs	\$0.189	11.8
Fixed costs	0.028	1.8
Subtotal	\$0.217	13.6
Opportunity costs	\$0.079	4.9
Costs of the product	1.302	81.5
Total costs	\$1.598	100.0

Source: Assembler interviews.

A function relating volume of operation to unit costs was estimated without positive results.²⁰ This is understandable since the sample size is relatively small. Furthermore, the proportion of the different products handled by the assemblers in different markets is diverse, and unit costs vary for different products.

The profits do not seem excessively high given the risky nature of the business. Sharp daily price fluctuations are not infrequent. The uncertainty of finding a buyer is associated with risks of price declines and/or product deterioration, and also the possibility of affording bad debts. These factors of risk and uncertainty, and the

²⁰By means of a simple regression in which y = total cost per kg. and x = sales (in pesos), a coefficient $b = 0.000003$ was obtained, not significantly different from zero.

economic consequences that they have in the profit accounts of assemblers have not been considered in a quantitative way, for the difficulties of obtaining this kind of information. This would indicate that these profit figures could be somewhat overestimated. The evaluation of profits must take into consideration that the greater the risk implicit in a certain activity, the greater (expected) profits should be to induce an individual to undertake this business activity. Under these circumstances it is reasonable to expect that this activity carried out by assemblers would show real profits.

Assemblers' net returns are high in relation to the net incomes of the farmers in the La Mesa region. The average net income per farm was \$16,795 in two of the strata of the farm survey as reported in Chapter III. This is only a small fraction of the net incomes received by assemblers. It must be realized that this comparison involves returns to several factors which might be very different in the case of assemblers and farmers. However, a more appropriate comparison would be to consider the assemblers' profits in relation to those obtained by business units in other stages of the marketing process for the same products. Such a comparison indicates that assemblers' profits are not higher than those of wholesalers

or retailers in major urban centers but in some cases are lower.²¹

The fact that assemblers' profits do not appear to be abnormally high does not indicate that performance regarding economic efficiency is adequate. Many factors have been identified in this and the previous chapter indicating that costs are high due to the risks inherent to the operation of the production assembly system. Furthermore, the flow of incentives has been such that no significant structural changes allowing cost reductions in farm production or marketing seem to be occurring.

Pricing efficiency.--This dimension of performance refers to the capacity of the system to clearly reflect the final demand of consumers to the participants of the market in previous stages: wholesalers, assemblers and farmers. This communication of consumer demand should include aspects of form, time and space of the products. The price is the mechanism that should provide the incentive to producers and other market participants to satisfy this demand.

²¹Gross and net margins are shown in studies done in Bogota and Cali. See: PIMUR, Informe de Distribucion Urbana de Viveres en Cali (Cali, Colombia, 1970), pp. 72-74; PIMUR, Produccion y Distribucion de Frutas y Hortalizas en Zona de Influencia de Cali (Cali, Colombia, 1970); CID, Estudio de Consumidores y Distribucion Urbana de Viveres de Bogota, Mayoristas (Bogota, Colombia, 1971), pp. 79-84; and CID, Estudio de Consumidores y Distribucion Urbana de Bogota, Minoristas (Bogota, Colombia, 1971), pp. 84-86.

This dimension of performance is probably one of the most limiting in the present production assembly system since the aspects of form of the product are not adequately transmitted to producers, and possibly, not even to assemblers. As it was mentioned earlier, product sorting is more of an exceptional procedure among farmers and assemblers rather than a common way of operating due to the very low degree of vertical coordination.

The absence of sorting and grading systems is possibly a vicious circle. Retailers buying in the wholesale market of Bogota ordinarily do not demand sorted or classified products since it does not exist, and since any one individual retailer is insignificant for the business of a wholesaler, wholesalers might not react to their specific demands. On the other hand, wholesalers may not sort products since they do not have stable relations with retail buyers and have difficulties in obtaining higher prices for the top quality products. This suggests that even if there were potential gains from classifying or sorting products (as was the opinion of most assemblers), there are greater risks which middlemen are unwilling to undertake. Furthermore, there are no official classification and grading standards to use as a guide in sorting products.

The economic consequences of these considerations are important. On the one hand, there is no clear incentive

to farmers to improve product quality. This limits their possibilities of increasing their income and technifying the production of fruits and vegetables. This also influences the lack of care in the handling of products, both by farmer and assembler, since generally the product is sold without a careful inspection. The results of handling operations under these conditions are high physical losses and deterioration of the products with the consequent reduction of their final value. Obviously, this increases the marketing costs and is reflected in high prices at a later stage of the marketing channel.

This situation might contribute to high costs of arranging transactions and causing excessive purchasing time for wholesalers and retailers. This may be a serious barrier to the development of larger size, low cost, full line retail outlets. Furthermore, the lack of an efficient pricing system is a deterrent to an expansion of consumption in domestic markets; and possibly it could be a serious constraint to the long run development of an exporting capability for fruits and vegetables.

The flow of price information from urban markets to rural areas through timely and reliable communication channels is almost non-existent. Among urban markets, there is a price information system but it may lack relevance to market operations due to its lack of timeliness. These characteristics are probably producing a lower spatial

pricing efficiency than what could be possible if effective price information was available to all market participants.

Pricing efficiency in a time dimension also presents problems that stem from the low degree of market coordination and lack of price information. Supplies of fruits and vegetables arriving on consecutive market days at a given market may vary substantially both in volume and quality, thus producing wide price fluctuations. This characteristic increases market risks for all participants.

Progressiveness

Progressiveness is the capacity of the system to generate and adopt new techniques or arrangements that allow reductions in unit costs of production and distribution, or increases in productivity; decreasing risks; developing new products or forms of products and rendering new services which allow a better satisfaction of the final demand of consumers.

The performance of the production-assembly system in this aspect shows a lack of dynamism. As mentioned earlier, the functioning of the system is based on very elemental practices in harvest, handling, packaging, classification, etc. which originates high product losses.

The barriers to technical innovations are, on the one hand, the structure of the wholesale market which is composed of businesses that handle relatively small volumes.

This makes the innovation or adoption of new techniques difficult due to the fact that the benefits from using new techniques, when handling small volumes, would not be great. The risks implicit in the adoption of a new technique could be great relative to what small enterprises are willing and financially able to undertake, thus inhibiting change even when the techniques are readily available.

The cost of developing a new product handling technique or service could also be very high for a single wholesaler, especially due to the costs needed for the introduction and acceptance in the market (including their risk or rejection). The benefits that could be derived from introducing a technique might be distributed to many market participants that could rapidly adopt the technique. In this way private profitability could be very low although social profitability could be very high. This is a typical case of market externality.

All these factors were reflected in the attitudes of the assemblers interviewed. Sixty-four percent of the assemblers were not interested in using new boxes that reduce the deterioration of the products. The main reason for their negative answer was the preoccupation that they might not be accepted by buyers or sellers. Only 21 percent of the assemblers had a favorable attitude towards this change in packaging. The assemblers interviewed were asked about the possibility of forming a cooperative of assemblers

that could enable them to achieve lower costs and higher sales; only 64 percent of them were interested in operating through a cooperative association.

The environment in which the assemblers operate, with low volumes and great risks, makes them rather traditional in their views. This was demonstrated when asked for opinions concerning what should be done to make a significant improvement in the marketing of fruits and vegetables in assembly regions as well as in Bogota. Only 14 percent of the assemblers suggested improvements of roads and taking measures to increase production; 36 percent had the opinion that the system was functioning well and did not need any improvement; and 50 percent of them had no answer to this question.

This lack of dynamism can also be clearly seen if studies of ten years ago are considered. These indicate that the operating procedures of assemblers today are essentially the same as in that time;²² meanwhile in this ten year period, incomes per capita have increased substantially and urban demand has probably doubled in volume.

²²See for example: IIT, "Estudio Sobre la Produccion, Comercializacion y Perididas del Tomate que Llega a Bogota" (Bogota, December 1961); or CEDE, "Estudio de Mercadeo de las Principales Frutas Citricas en la Ciudad de Bogota," Monografia No. 11, by Alfonso Suarez Fajardo (Bogota: Universidad de los Andes, September, 1961).

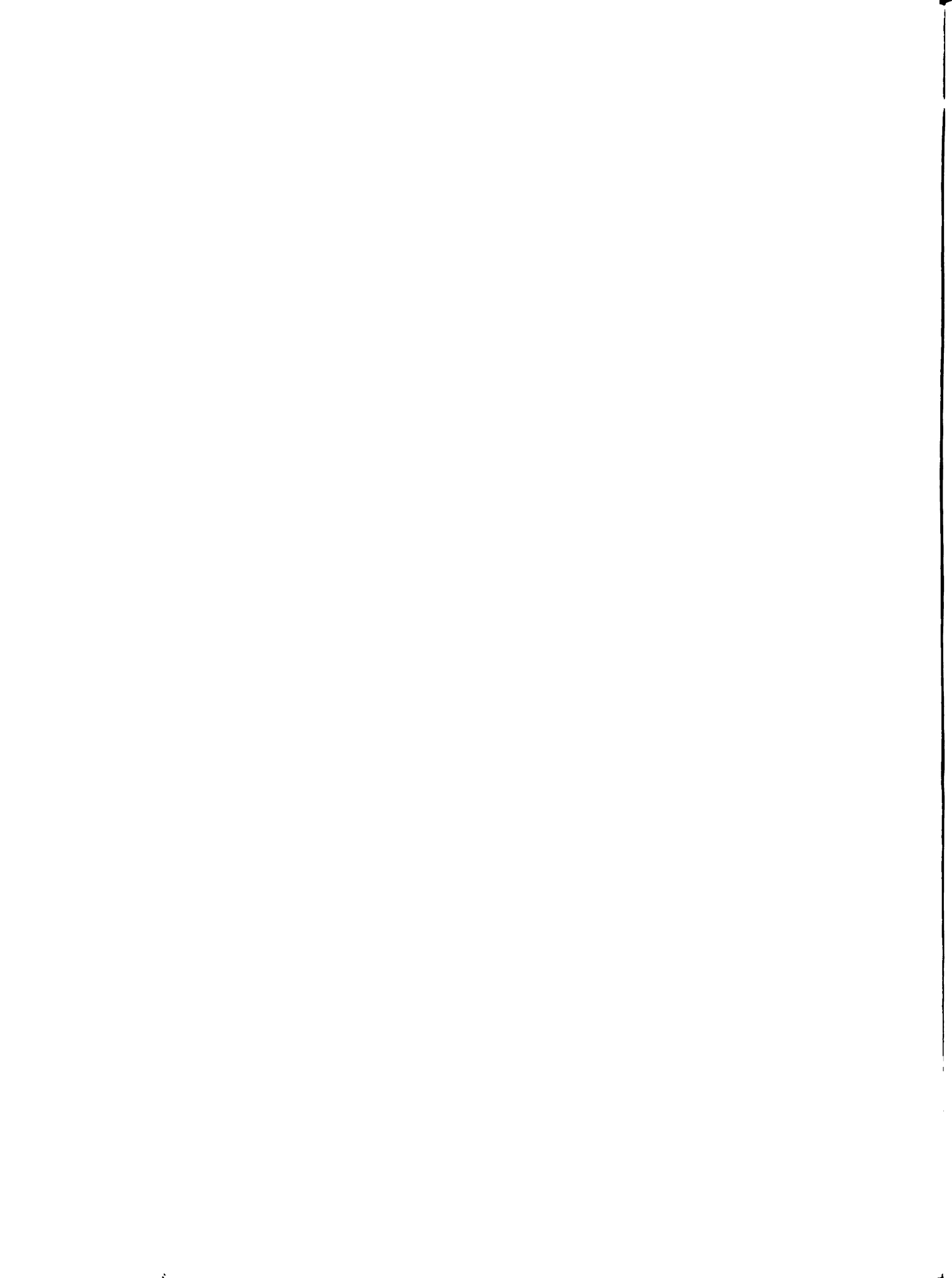
The lack of progressiveness of this system is also reflected in the absence of significant structural changes in production that can potentially decrease costs (or increase productivity). The previous chapter indicated that there was a very slow trend to increased farm specialization in fruits and vegetables. The same is probably true of the whole coffee zone. Regional specialization in these crops is still not very significant.

Income Distribution Considerations

The relative distribution of the income generated by the effective demand for a specific product among the different market participants is a matter of increasing social concern. The economic analysis showed that, on the average, farmers receive 75 percent of the prices paid in the Bogota wholesale market and assemblers receive the remaining 25 percent, of which, only 6.9 percent are real profits. Incomes of assemblers are also higher than those of the average farmer. This is a static view of the distribution aspects. Within this view, market reforms are commonly undertaken primarily to "restore back to the producer" the excessive profits of middlemen. In the case at hand, the profits of assemblers represent about 9.2 percent of the prices paid to farmers in the rural markets, therefore this is the maximum additional income that, in theory (in a riskless situation), could be restored to farmers if the objective was to eliminate the middlemen's "excess profits."

As in the case of the two other dimensions of performance, the distributional issues should be viewed in a dynamic context. In this view, the major concern should focus on changes in the system that allow market participants to obtain a distribution more in accordance with the socially accepted objectives. In this case, this implies strengthening the farmers' capabilities--individually and collectively--to improve their incomes.²³ This means implementing changes mentioned before (price information system, fomenting changes in the structure of production, aid in improving their bargaining position, diffusion of new techniques, etc.). These changes could induce cost reductions in the short or medium run, but who will benefit from improvements in production and assembly? In the short run, the income position of innovators will be improved (farmers and/or assemblers) provided that an acceptable level of competition prevails in the next stage of the optional marketing channels to which a given market participant is confronted. As the innovation or change is adopted by all the participants in a given stage, competition will erode the additional income benefits obtained before, through a reduction in prices and/or margins.

²³This is the practical result when the farm sector has lower incomes than either middlemen or urban consumers. This is not to say that farmers should be the only ones to benefit from any improvement in performance.



Ultimately, in the long run, consumers benefit from any change or innovation. Farmers and middlemen would benefit only from real productivity increases (which involves physical productivity and prices that the market changes through time).²⁴

These considerations indicate that if the actual shares of farmers, assemblers and consumers in the distribution of incomes flowing from the market are compared to those that could flow from alternative market arrangements, the relative distribution to farmers might not change, or even could be lower. It is impossible to know what relative position would be attained. The important point is that an efficient marketing system allows, and moreover fosters, improvements in productivity which ultimately determine individual incomes. The presence of competition is a vital part of the process of distributing the benefits realized from productivity gains.

In the case under study, incomes and productivity are low, and the economic opportunities for their improvement in the longer run are clearly not being fully exploited. Therefore, performance in this dimension could probably be improved.

²⁴This line of reasoning can be extended to link with the conceptual model on the role of marketing in economic development, described in Chapter I.

The diagnostic picture of the rural-production assembly system presented in the last two chapters has permitted the identification of the most limiting problems to attain on improved performance in this system. The next chapter takes these limiting aspects into consideration to propose and evaluate possible changes for improving the performance of the system.

CHAPTER V

IMPROVEMENT OF THE PRODUCTION ASSEMBLY SYSTEM THROUGH THE FORMATION OF ASSEMBLY CENTERS

This chapter identifies a general strategy to improve the performance of the production-assembly system in the La Mesa region through the establishment of product assembly centers. The economic aspects of alternative means of implementing this general strategy are also examined. The first part of the chapter presents a summary diagnosis of the problems confronted in the production-assembly system and elaborates the characteristics of a proposed strategy for resolving these problems. In the last sections of this chapter the costs of alternative ways of implementing this strategy are analyzed. This analysis identifies the lower cost alternative and evaluates its economic feasibility.

A Summary of the Main Limitations

The opportunity to expand the production of fruits and vegetables in the coffee region of Colombia is seen as a means of increasing incomes and employment. As mentioned before, the natural resources are well suited for such

production.¹ The preceding chapters indicated that there are several limitations in marketing and in the structure of farm production of these perishable products. These problems are a barrier for increasing production and distributing it efficiently to the urban markets.

A major problem in the production of fruits and vegetables is that the importance of a single product is quite small in relation to the total income of most farms. This gives rise to two main consequences: (1) it increases marketing costs, (2) it serves as a deterrent to the modernization of the production techniques and improvements in product quality. At the aggregate market level, it produces an unstable supply in terms of quantities, qualities and kinds of products. The aggregate production has a low density which has prevented the formation of marketing channels serving the farmers at or near the farms. Therefore, farmers must incur high marketing costs in selling in rural assembly centers.

¹The Coffee Diversification Program of the National Coffee Growers Federation has analyzed from the technical and economic viewpoints the opportunities for expanding different enterprises (other than coffee) in the coffee growing region. Their conclusions and programs rely heavily on the expansion of fruit and vegetable production which offers a similar income level and employment requirement that coffee does. See: Programa de Desarrollo y Diversificación de Zonas Cafeteras, Proyecto de Diversificación Agropecuaria para la Zona Cafetera Central de Colombia (Bogota, Colombia: Federación Nacional de Cafeteros de Colombia, June, 1972), pp. 13 ff.

These problems in production indicate that a strategy must aim toward the reduction of farmers' marketing risks so as to stimulate greater specialization and larger output per farm. This indicates also that the strategy must be conceived and organized to serve a great number of small farmers.

The operations of assemblers were characterized as having high risks both in buying and selling perishable products. The lack of vertical coordination and the poor physical handling of products cause high product losses.

The analysis of assembly markets clearly indicated that most of their operating procedures are greatly influenced by market conditions in the urban wholesale centers.

The problems outlined above should be understood within the context of an interrelated system so that a strategy may be designed that will foster improved vertical coordination. Emphasis must be placed upon the relationships between the urban wholesale markets and the rural assembly operations. With this central idea in mind, a proposal for establishing product assembly centers as a means to contribute to the solutions of these problems is described below.

Product Assembly Centers

The idea of product assembly centers (PAC)² has been proposed in several previous studies of fruit and vegetable marketing.³ In these studies PACs have generally been conceived as physical facilities located in rural areas where commercial volumes of perishable products are purchased from farmers. The products would then be classified, sorted and packaged for shipment to more distant wholesale markets or resale within the local market.

The Marketing Department of the Coffee Diversification Program has been actively working to establish assembly centers for fruits and vegetables in the coffee region. The initial plans of this department were to create a network of assembly centers throughout the coffee region. The basic conception of the operation of these centers was much in line with the notions outlined above. The main purpose of these centers would be to assist farmers in marketing these perishable products. In this way, the Coffee Federation would be contributing to the overall

²For convenience, this will be referred to from here on as PACs.

³See for example, ILMA, Produccion y Mercadeo del Platano y el Banano con Referencia Especial a las Zonas Cafeteras de Colombia (Bogota, Colombia, April, 1968); ILMA, Bases de un Sistema de Clasificacion y Empaque del Tomate para el Mercado Interno y para la Exportacion (Bogota, Colombia, 1969); ILMA, Estudio de Viabilidad para Establecer Centros de Acopio de Platano en la Zona Sur del Lago Maracaibo, Venezuela (Bogota, Colombia, November, 1968).

objectives of rural development and of diversifying agricultural production in the coffee region.

These activities have resulted in the direct operation, by the Marketing Department of two assembly centers that function as pilot projects. One is located in Manizales, in the center of the coffee zone, and another is operating in Cartago, in the northern part of the department of Valle. These assembly centers have served as experimental pilot projects where the problems of implementation and the possibilities of success are being analyzed in a practical way. The assembly center in Manizales has operated for more than a year. Both projects have been operating in association with local coffee grower cooperatives.

These pilot projects are now being seen as a component of the larger production-distribution system for fruits and vegetables. As such they are complementary to other marketing services and supporting actions to which they must closely coordinate. A practical example of this perceived linkage within the larger marketing system is the realization that these PAC should have selling space in the new central wholesale facilities in Bogota and in other cities. Also, the potential complementary of this assembly program with urban marketing programs, such as the PAN (Programa de Abaratamiento Nutricional) program in Bogota has been recognized. The PAN program is being organized by CORABASTOS to

promote the development of larger, full line wholesalers that might supply retailers at a lower cost. It also aims to improve the operating efficiency of retailers (especially small retailers). Furthermore, the assembly centers are also being viewed as a part of the efforts to plan production at the national level, and this is especially needed in the case of fruits and vegetables where overproduction can lead to disastrous price declines and financial losses to producers.

A program fomenting the formation of assembly centers must also be seen as an opportunity to introduce dynamic changes both in the rural and urban wholesale markets.

Operational Objectives for PAC

A set of operational objectives for a PAC program are tentatively proposed on the basis of the problem situation that has been presented in Chapters I through IV of this thesis. These objectives will serve as a guide to an economic analysis of alternative ways of implementing a PAC program. The specific objectives are as follows:

1. To create viable and competitive market outlets to the farmers of the region, thus providing greater security of sale. The PACs would provide an alternative market and would tend to foster a more competitive environment in the rural markets.

2. To efficiently transmit the urban demands for fruits and vegetables to farmers. This implies that product classification, pricing procedures and information flows would reflect actual consumer demands to producers, thus providing incentives for improvements in product quality. An effective implementation of this objective would tend to influence the operation of the participants of parallel marketing channels, contributing to a more rational organization of the production-distribution process.

3. To serve as a means of stimulating technical improvements. The PAC program could identify specific problems in the physical functions of marketing, communicating such information to research institutions, and in turn, testing and acting as a diffusion agent for new technical improvements. In this sense also, the effects of PAC would not only be on the farmers which it serves directly, but also on the participation of parallel market channels.

4. To serve as a promoter of coordinated efforts aimed at improving the longer-run performance of the production-assembly system. In collaboration with other agencies the PAC program could increase the effectiveness of credit, technical assistance and extension agencies in promoting:

- a. Concentration of production through a greater farm and regional specialization.
- b. Adoption of new technologies in production and marketing.
- c. Planned coordination of production among regions.
- d. The development of export opportunities for fresh and processed fruits and vegetables.
- e. The development of basic supporting services in marketing (price information, use of grades and standards, etc.).

Obviously, these changes will not come about by the sole action of PACs, but PACs can be effective as a contributing agent. In essence, the PAC program would be a strategy to actively promote improved coordination in a part of the marketing system; searching for new ways of performing the physical and exchange functions, and in so doing, to diffuse them throughout the system. It should be primarily understood as an element of change in the system and not as a complete substitute for the system.

The basic means of action of PACs would be:

1. To purchase products on a quality basis.
2. To prepare products for transporting and selling in the wholesale markets.
3. To transport and sell products of determined qualities under the most favorable conditions.

Given the strategy defined above, the focus of attention turns next to the economic feasibility of different ways of implementing this strategy.

Economic Analysis of Production
Assembly Center Alternatives

This section identifies different alternative means to implement a PAC program in the La Mesa region, and analyzes the costs involved in each of these alternatives. The analytical problem of implementation considered in this section can be stated as follows: what is the least cost of assembling, processing⁴ and distributing (or shipping) a given volume of production scattered through a region. This involves decisions regarding:

1. What is the most economical means of assembling the product by truck routes (or buying points along the roads) or buying in facilities (PAC buildings) located in the different rural markets?
2. How many PACs should there be?
3. Where should they be located?
4. What capacity should each have?
5. What technologies should they use?

⁴The internal operations of PAC (receiving, weighing, sorting, treatment, packaging and storage of products) will be referred to as "processing," although it only involves very simple operations.

The decisions are many; this makes the problem of finding "a best" solution a difficult one. Similar problems have been encountered before and the literature has a number of works dealing with them. The methodology used in this part of the thesis is based to a great extent on these earlier publications, particularly on the works of Stollsteimer, Smith and Black.⁵

Production in the Region

The estimated total annual marketed production of fruits and vegetables in the region of La Mesa was 20,033 metric tons in 1970-71.⁶ This production is mainly located in the municipios of Anolaima and La Mesa. The main

⁵Some of the published works dealing with similar problems are the following: John F. Stollsteimer, "A Working Model for Plant Numbers and Location," Journal of Farm Economics, 45 (August, 1963), 631-645; B. C. French and D. G. Gillette, Cost of Assembling and Packing Apples as Related to Scale of Operation (East Lansing, Michigan: Agricultural Experiment Station, Michigan State University, August, 1959), Technical Bulletin 272; B. C. French, "Some Considerations in Estimating Assembly Cost Functions for Agricultural Processing Operations," Journal of Farm Economics, 42 (November, 1960), 767-778; L. D. Smith, "Economic Aspects of Slaughterhouse Size and Location," The Farm Economist, 10 (1964); R. Bressler and Richard King, Markets, Prices and Interregional Trade (New York: Wiley, 1970), Chapter 8; E. L. Olson, "Location Theory as Applied to Milk Processing Plants," Journal of Farm Economics, 41 (1959), 1546-1559; and G. Black, "Synthetic Method of Cost Analysis in Agricultural Marketing Firms," Journal of Farm Economics, 37 (May, 1955), 270-279.

⁶A metric ton is a measure of weight that is equal to 1000 kilograms or about 2200 pounds. This unit of weight will be used and it will be referred to as tons.

products in this diversified aggregate production are, in decreasing order of importance: bananas, citrus products, mangoes, tomatoes, maracuya, guayaba, papaya and cucumbers (see Table V.1).

This total annual production shows a marked seasonality pattern, especially in the production of fruits; typically the months of March, October and November have low volumes of production while the months of May, June and July show production levels well above the average month. This seasonal variation is graphically shown in Figure 10.

As shown in Chapter III, farm consumption and unharvested production add up to significant proportions of total production of fruits and vegetables. Part of this unharvested production might be sold if the marketing costs could be lowered and/or the prices paid to farmers could be increased.

Marketing Goals of PACs

The PAC strategy outlined earlier must be reflected in a specific operational goal expressed as the percentage of the production in the region which PACs will handle. This is a necessary starting point in the analysis of the costs of different alternatives of implementation, i.e., the number, size and location of PACs. This way of viewing the problem eliminates an important dimension of the implementation of the strategy since the percentage of the volume to be handled is fixed a priori.

Table V.1. Marketed Production of Fruits and Vegetables in the La Mesa Region, By Municipio and Kind of Product (in tons per year)

Product	<u>Municipio</u>				Total
	Anolaima	La Mesa	Tena	Anapoima	
Bananas	3,500	1,700	128	340	5,668
Oranges	2,175	1,000	780	250	4,205
Mangoes	50	650	920	800	2,420
Tomatoes	1,138	226	33	480	1,877
Maracuya	127	85		1,204	1,416
Guayaba	313	175	472		960
Papaya	123	186		325	634
Cucumbers	491	18			509
Cabbage	390				390
Green Beans	292	57			349
Tangerines	107	90	13	48	258
Berries (<u>Mora</u>)	250				250
Potatoes	244				244
Carrots	176	25			201
Avocados	55	43	38		136
Pulses	132				132
Green Peas	107				107
Lemons	62	12	8	15	97
Pineapples	25		9		34
Sweet Corn	32				32
Squash	26				26
Onions	7				7
Peppers	3				3
Other minor vegetables	47				47
Total	9,883	4,287	2,401	3,462	20,033

Sources: Farm interviews of this study, CORABASTOS' farm interviews (1970), and CORABASTOS checkpoint studies of the inflow of food products into Bogota, 1970 and 1971.

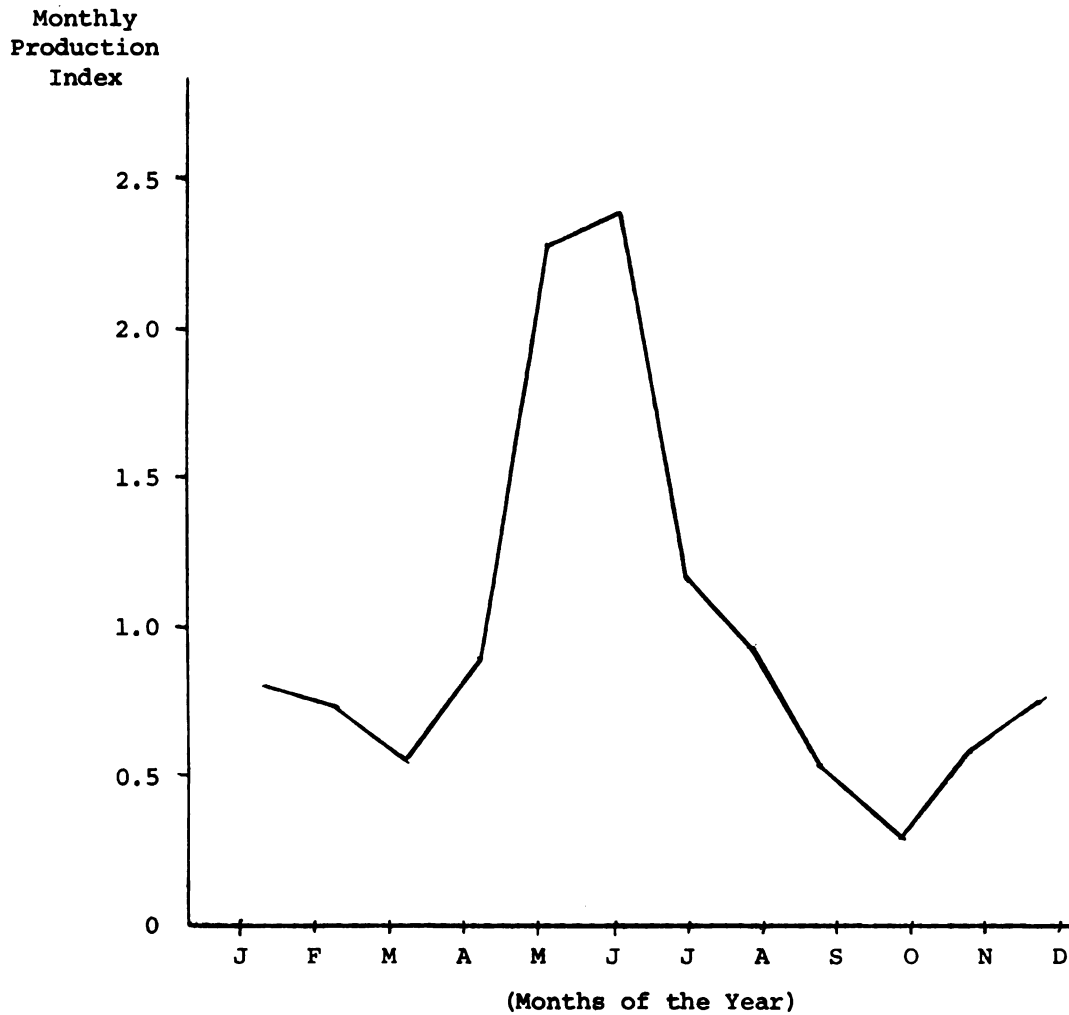


Figure 10. Aggregate Monthly Marketed Production of Fruits and Vegetables in the Region of La Mesa. (Monthly production has been expressed in terms of the yearly production per average month; i.e., the average month is equal to 1.0.) (Sources: Farm survey and CORABASTOS checkpoint studies of inflow of food products to Bogota.)

The following guidelines can be advanced for the determination of this volume target:

1. The primary objective of the strategy is to introduce in the system an element of change and not to eliminate the economic units actually participating in these markets. This implies handling a percentage which is high enough so that it can affect rural markets, and also, have a demonstration effect in the Bogota wholesale market.
2. The volume percentage to be handled should not be high since possible changes in the marketing system, such as, for example, improved roads, adoption of grading standards and price information, could decrease the need for the kind of services provided by PACs. Underutilized capacity would imply higher unit costs.
3. From a viewpoint of product quality, PACs would probably not be able to easily handle a complete range of products or all qualities of major products. Traditional assemblers could handle minor products and lower product qualities. They might have a comparative advantage in doing so.
4. The potential competition that traditional assemblers would impose on PACs' growth represents a constraint on aiming at a very high percentage target, especially if this activity is to be

economically feasible. The sluggish growth observed in the few farmer cooperatives operating in this line of business in the coffee zone, tends to support this notion.

5. The target percentage should include some minimum restriction so as to insure a relatively even distribution of services throughout the region.

Over time the monitoring of a PAC program activity could provide some empirical data that could permit a more definitive approach to the selection of the program's market share target. Answers to the following questions should be sought for this purpose: (1) What is the impact on rural markets (in terms of prices, costs and diffusion of innovations) of handling different percentages of the production of a region? (2) What is the degree of diffusion of techniques in urban wholesale markets when handling different volumes? (3) What are the costs of handling different percentage volumes through PAC in a given region? And the inverse question: What are the costs of handling a given volume as a function of different size of PAC's area of attraction?

From the research standpoint it is hard to get the necessary information to find answers to these questions; actually, it is unavailable. In this study it has been assumed that a target volume of 20 percent of the marketed

production of the La Mesa region will adequately satisfy the guidelines stated above and accomplish the program goals. The Coffee Diversification Program is beginning the operation of the PAC pilot projects with a similar marketing goal.

It must be understood that this target goal is not an optimal one regarding the questions stated above, but it is a figure based upon judgment. Therefore, this figure cannot be generalized to another region when dealing with a similar problem. The density of production plays an important role in the determination of this goal, and the existing market structure should also be considered carefully.

In determining this goal there is a fundamental question on the objectives and conception of a PAC program. If PAC is seen as a private venture that would aim to maximize profits, obviously, the solution would be to search for ways of lowering costs. One of the ways of lowering costs is to handle a high percentage of the production, which implies a reduced geographical area of attraction and lower assembly costs. This would probably imply a reduced impact on the rural markets and on the possible benefits accruing to other farmers. Instead, if PAC is basically seen as an element of change in the rural production-assembly system, the importance of the impact

on the rural market and the secondary benefits have a great priority.

Product Assembly Methods

PAC has two basic alternative methods of assembling products. One is to use the actual system of product assembly. This means that farmers would bring their products to the rural markets, transporting them mostly on mules, or in local buses and small trucks. PAC would then buy products in facilities in these rural markets at specified hours and days of the week. Another possibility of assembling products is to use trucks on determined routes along which farmers would assemble the products at specified buying points; products could also be purchased in the rural markets.

The decision on which method is most desirable is a matter of costing out assembly costs for both alternatives.

Mule transportation has well established rental prices in the different points of the region. This allows the estimation of a cost function for this kind of assembly. There is an additional cost besides transportation: the opportunity cost of the time and effort spent by the farmer in going to the market, selling his product and returning to the farm. Both components of assembly costs are to a great extent a function of the farm-to-market distance.

The following cost function was estimated for this kind of assembly:

$$C_1 = 69.4 + 19.549x$$

where C_1 is the cost of assembly per metric ton and x is the number of kilometers from farm to market (one-way trip).⁷

The average farm (of those interviewed) is located at 3.45 kilometers away from the nearest rural market, so the average cost of product assembly for farmers is \$136.84 per ton.⁸

The cost of product assembly in trucks operating in routes would involve two main components: the truck operation and the time spent by farmers in carrying the products to buying points along the roads. The farmers' costs of moving their products to the buying points along truck routes is \$82.10 per ton, assuming that these buying points are located at a distance of two kilometers from each other.

⁷This function was estimated from the basic data gathered in the farmer interviews. The cost function for mule transportation (per ton) is $C_1' = 56.90 + 3.109x$ which shows that to a large extent this is a cost with relatively minor variation as a function of distance. The cost function for the farmers' time in transporting and selling was calculated by imputing an opportunity cost of \$25 per day, or 3.125 per hour, which is the prevailing wage rate in the region. This function is $C_1'' = 12.5 + 16.44x$ per ton. It shows that this is a highly variable cost in relation to distance traveled.

⁸This figure does not consider the cost of transporting in local buses or trucks, since only a small percentage of farmers use this kind of transportation means.

The costs involved in assembling products in truck routes were calculated by using an assembly cost function. This function was constructed on the basis of the synthetic cost method. The details of the calculation and the data sources of these costs are shown in Appendix B. These costs are expressed in the following function:

$$C_2^1 = 54.055 + 1.944x$$

where C_2^1 is the cost of these operations per ton and x is the one-way distance of a given route (kilometers).⁹

The total costs of assembling products from farms to the assembly center is given by the sum of the farmers' costs of transporting products to the buying points along truck routes, and the truck routing assembly costs. These farmers' costs are invariably given a certain road network and a set of assembly points. In these costs it was assumed that buying points were located every two kilometers along the roads. This aggregate assembly cost function would be:

$$C_2 = 136.155 + 1.944x$$

⁹These costs were assumed to be linear although it is possible that they might not be linear; but in any case, with the assumptions used, a good approximation is obtained. Similar assumptions have been used in other studies; see: French, "Assembly Cost Functions," op. cit., p. 770. Furthermore, these costs only represent a minor component of unit costs of PAC, so that possible differences of approximation due to this assumption have almost no effect in total unit costs.

where C_2 is the cost per ton in pesos.

These costs could be reduced in the long run (by using truck drivers who can also perform the functions of a buying agent) as shown in Appendix B. In this case the cost function would be:

$$C_3 = 124.288 + 1.608x$$

where C_3 is the cost per ton in pesos.

A comparison of the cost functions of both assembly methods shows that the costs of mule assembly are lower up to a distance of about three kilometers; for greater farm-to-market distances, the costs of truck routes are lower (see Figure 11).

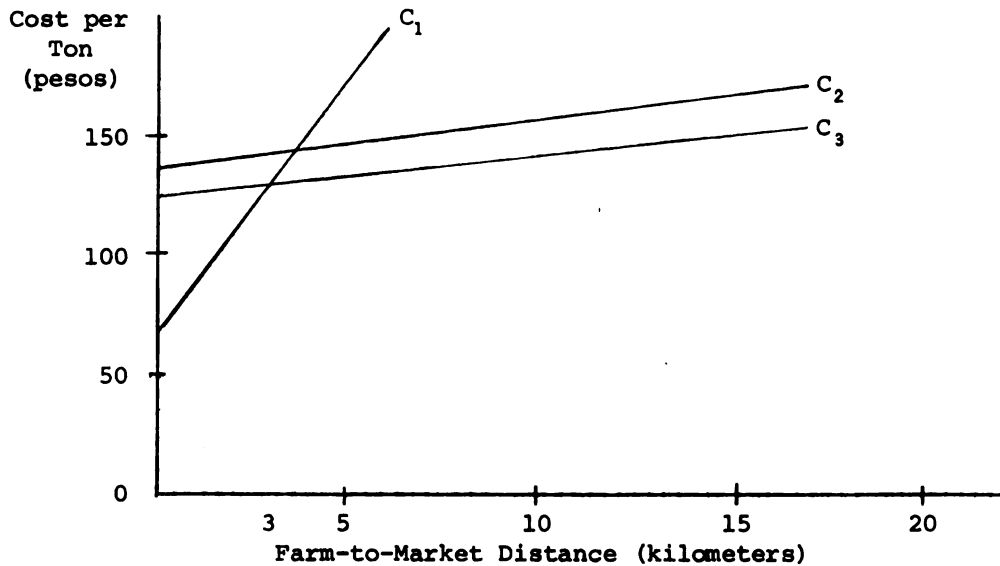


Figure 11. Cost Functions for Mule and Truck Routing Assembly Methods.

The potential savings to be achieved by truck routing results from a lower utilization of farmers' time and mules. If the opportunity cost of labor is different from the rate assumed, the cost function (C_1) would be different and the critical distance to decide on truck routing would change. Obviously, the greater the opportunity costs of labor, of capital invested in mules and of the land used to keep mules, the lesser will be the distance at which trucking is the least costly alternative method of assembly. The opposite is also true.

The opportunity costs of labor could have been slightly overestimated for certain times of the year since a flat number was applied year around. It must also be acknowledged that the time spent in transit to the market, and the time spent in the market, not only serve the purpose of selling products but also of purchasing food and farm supplies and of socializing or conducting other business. These activities, different from selling products, should also account for part of the opportunity costs, therefore, the costs imputed to the marketing functions of farmers might have been slightly overestimated.

This analysis of assembly costs indicates that the best method of assembly is a combination of the two types considered: traditional mule transportation and truck routing. In any case, the existing roads force the use of

mules to move the products to the roads under any assembly method. Truck routing would not be economical for distances of less than three kilometers, unless the production density in a specific sub-area is very high.¹⁰ The direct purchase of products in PAC facilities in the rural markets would capture some of the supplies arriving to the markets on mules from nearby areas, where trucking is more costly than mule transportation.

Another consideration that should be made in deciding on the method of assembly is to analyze what are the costs of damaged product in both means of transportation. If mule transportation has greater costs in damaged product (which is likely), the distance at which truck routing is less costly will be even smaller.¹¹

Pricing in PAC.--This assembly cost analysis gives the basis for establishing a pricing system according to the location of product purchase. If product purchases are not going to be subsidized in any way, producers should be paid a basic price for sales at the assembly centers in the rural markets. This price would have to be decreasing in the same

¹⁰This cannot be taken as an absolute rule, but costing out particular routes is the appropriate step in working out an operational plan.

¹¹No available data was found (nor could be obtained) on these aspects of transportation so the possible cost differentials are ignored in this research.

amount that assembly costs (for PAC) increase as the farm-to-market distance increases.

This brings up the need to keep in mind that in the case of the La Mesa region, assembly costs do not define by themselves alone what the area of attraction of a PAC could be. In this region all the markets lie approximately on some iso-price line in relation to Bogota, therefore, although truck routing assembly costs increase slightly as distance increases, the area of attraction is soon constrained by the close presence of another market which has approximately the same price levels as the market where a PAC might be located. This situation indicates that as the area of attraction of a given PAC increases to include several markets, the difficulties of facing the price competition with the traditional assemblers would increase.¹²

Costs of Operation of PAC

Operating costs of PACs have three main functional components: assembly, processing and distribution or shipping costs.¹³ Each of these costs vary according to the location and size of a given PAC. Given certain locations, the decision on the number of PACs to serve a region affects

¹²Unless the net margins of assemblers in the traditional channel were very high.

¹³Distribution or shipping costs involve those costs associated with the operations of truck loading, transportation to the Bogota wholesale market (or other point in Bogota) and unloading.

the size (or capacity) of the PAC in different locations; and the three components of costs may vary substantially for different sizes of PACs.

Theoretically this would involve a simultaneous solution to all these variables.¹⁴ However, given the problem at hand, a simplified method was utilized for several reasons listed below.

1. There are few potential location possibilities since location, for practical reasons, needs to be associated with the villages or towns in the region.
2. The distribution costs are practically the same from the different potential PAC locations.
3. The exact location of production points (or route buying points) and the volumes to be obtained in each point are unknown (in two municipios); only total production by municipios and of some sub-parts of them are known.
4. Last, but not least, an implicit objective in this part of the research was to develop a workable method so that it could be utilized by local institutions (Coffee Diversification Program and CORABASTOS) interested in the same kind of problem

¹⁴A comprehensive treatment to this problem is given by Stollsteimer, op. cit. The method utilized to find a solution in that paper essentially involved a two step minimization process: first for assembly costs and then for processing and distribution costs, considering the multiple combinations of location and size.

in many different regions. This requires a simple method focusing on the main relationships involved, since the information deficiencies mentioned above will also have to be faced by these institutions.

After the area of interest has been defined and its basic data (production, distances, etc.) has been obtained, the basic procedures utilized in this research to analyze costs involve the following steps:

1. Determine the potential locational points of PAC.
2. Develop a reasonable combination of number and location of PACs (not necessarily all the combinations possible) or PAC alternatives.
3. Determine the volume of operation that each PAC would have in each of the alternatives chosen.
4. Determine the processing and distribution costs of each size of PAC.
5. Determine the assembly costs as a function of PAC size, given the density of production.
6. Determine the total operating costs of each PAC size.
7. Determine the total costs of each alternative of PAC number-location.

The basic modification of this procedure in relation to Stollsteimer's is that it assumes a constant density of production throughout the region, so that assembly costs may be analyzed in relation to PAC size. This is a necessary

assumption for the available data¹⁵ and it does not produce very different results than an actual computation of each PAC assembly cost in relation to production points. The limitations of this assumption will be discussed in the section where assembly costs are presented.

The method used apparently does not distinguish the concepts of PAC size with PAC location, which are very different. In view of the assumption mentioned above and the fact that almost all locations have a similar distance to Bogota (which affects shipping costs), both concepts have been handled almost as if they were the same.

Potential Locations of PACs

The potential locations of PACs, for practical reasons, are constrained only to villages or towns in the region and preferably to those in which a primary rural market is operating. This means that the potential locations are: (1) Anolaima, (2) Cachipay, (3) La Mesa, (4) Tena and (5) Anapoima (see Figure 7, page 110).

Based on these locational possibilities and the knowledge of the region and its roads and distances, three

¹⁵The Stollsteimer's model instead requires a detailed knowledge of the exact location of volumes of production and the distances to the different potential PAC locations, i.e., a transportation cost matrix for assembly. The possibility of getting this kind of data on most regions in the coffee growing area of Colombia are very remote or null. Therefore, a workable method should attempt to deal with the commonly available data.

alternatives of PAC number-location were developed. These are:

- Alternative 1: Establish five PACs, one in each of the locational possibilities.
- Alternative 2: Establish three PACs, in La Mesa, Anolaima and Tena.
- Alternative 3: Establish one PAC located in the central wholesale market of Bogota.

Processing and Shipping Costs

Given these number-location alternatives, the volume to be assembled, or size of each PAC, can be calculated from production data of the sub-parts of the municipios. The need to determine the size is forced by the underlying question of whether there are any economies of size in PAC operation.

The maximum weekly volumes to be handled in each of the PACs considered in the three alternatives are given in Table V.2.

The maximum weekly volume was determined on the basis of 20 percent of the total production sold in the peak production period (May-June). This is the relevant figure to determine the necessary capacity of the PAC installation, and not a figure based on a yearly average of weekly volumes, due to the following reasons:

Table V.2. Maximum Weekly Volume in Each Possible PAC Under the Three Number-Location Alternatives (volumes expressed in tons per week)

Location	Alternative		
	1	2	3
Anolaima	53	90	--
La Mesa	20.8	56.1	--
Cachipay	47	--	--
Tena	22	22	--
Anapoima	25.3	--	--
Bogota	--	--	168.1
Total	168.1	168.1	168.1

1. If one of the objectives of PAC is to affect the rural markets, it should be most actively operating in peak production season.
2. The competition in the Bogota wholesale market at this time of the year demands greater product quality, therefore, this is also the time when the services of product preparation in PACs are most needed.
3. It would be very difficult, if not impossible, to operate with a highly variable percentage of farmers throughout the year, which it would be necessary to do if an average weekly volume is used to plan the PAC capacity. It would be difficult to operate

buying from some farmers at the time of low production (when the competition to purchase products in the rural market is most active), and to refuse to operate with them at the time of peak production, when the farmers have a harder problem in selling their products.

Planning the capacity of PACs at a 20 percent of the maximum yearly marketed volume implies having a certain unused capacity for a certain period during the year, if PACs are to operate with a constant percentage of the marketed volume. The possibility of handling varying percentages of the marketed production as it relates to operating costs will be discussed in a later section.

A more stable weekly volume of operation could be obtained in a longer run, when permanent working relations have been well established with farmers. It would be possible then to transfer, at times of peak production, some of the product preparation functions of PAC to some selected farmers.

The maximum weekly volumes, determined in Table V.2, for the different locations in the three number-location alternatives, can be categorized into four sizes or types of PAC. These types have been labeled A, B, C and D for the sake of simplicity in making reference to each. These types of PAC would have the following weekly capacities:

<u>Type of PAC</u>	<u>Weekly Capacity</u> (metric tons per week)
A	170
B	90
C	55
D	23

The estimation of the processing and shipping costs of these PAC were based on the synthetic method developed by R. G. Bressler.¹⁶ This technique basically consists in determining costs by building blocks; "the building blocks are the various operations performed upon raw materials in the process of converting them into finished goods. These operations are discrete acts of production and can be analyzed separately."¹⁷

This technique was the most appropriate to use in the research situation confronted since there are very few cases of PAC, or of some kind of large scale organized sorting operation in the coffee growing region of Colombia. This circumstance does not allow the use of statistical analysis for determining costs.

The main limitations of this technique are that it must make arbitrary allocation of overhead costs (but all techniques also must do so); managerial differences are ignored; and also, it may not be possible to detect all the

¹⁶Black, op. cit., p. 273.

¹⁷Ibid., p. 270.

problems of coordination of the different operations or blocks. Despite these limitations, it "permits more accurate research determination of the economies of scale curve than is possible by any other method."¹⁸

The input-output requirements, factor prices and other details of the computations, as well as the sources of information used for this synthetic cost construction, are shown in Appendix C.

The main parts of the cost computations are presented in the following sub-sections. The first sub-section shows the fixed and variable costs of processing. The shipping and fixed costs of assembly are added to the processing costs to analyze the size economies that could exist in the operation of PACs. Variable costs of assembly are analyzed next, considering their relations with size of PAC and production density. These variable costs of assembly are added to the rest of the costs previously determined, allowing a comparison of the total costs involved in each PAC, and the aggregate costs of each number-location alternative defined.

Fixed costs and investments.--The different capacities determined for the types of PAC defined were expressed in terms of daily capacities. For this purpose it was assumed that the effective length of a work week was

¹⁸Ibid., p. 277.

5.5 days. This reflects the impossibility of achieving a stable volume and a continuous flow of product throughout the week, due to multiple technical and administrative problems. The resulting daily maximum capacities for the types of PAC would be the following:

<u>Type of PAC</u>	<u>Weekly Volume (tons)</u>	<u>Daily Volume (tons)</u>
A	170	30.9
B	90	16.4
C	55	10.0
D	23	4.2

These maximum daily capacities were utilized to determine the total space requirements and the necessary investments for each type of PAC, based on the unit requirements determined and the prevailing factor prices. The investment costs of the different types of PAC are summarized in Table V.3.

The depreciation and interest costs resulting from these investments are shown in Table V.4, which summarizes the total monthly and weekly fixed costs that have been estimated for each of the PAC types. Table V.5 shows the overhead costs, including personnel costs which are not associated with a specific function that can be categorized as a variable cost; other expenses are also included (energy, communications, administrative expenses, etc.).

Table V.3. Investments Required by the Different Types of Product Assembly Centers

Investment	Unit Cost	Type of Product Assembly Center											
		Type A		Type B		Type C		Type D					
		Units	\$ (000)	Units	\$ (000)	Units	\$ (000)	Units	\$ (000)				
BUILDINGS													
Total space ^a	\$750/sq. mt.	--	--	216	162.00	133	99.75	102	76.50				
Land ^b	\$120/sq. mt.	--	--	326	39.12	183	21.96	127	15.24				
Subtotal		--	--		201.12		121.71		91.74				
EQUIPMENT													
Selection tables	\$2,400	--	--	--	--	--	--	2	4.80				
Conveyor belts	\$20,000	3	60.00	2	40.00	1	20.00	--	--				
Scales (two kinds)	17.40	5	87.00	3	10.70	2	6.70	1	4.00				
Carts	\$900	4	3.60	3	2.70	2	1.80	1	0.90				
Office equipment	60.00				10.70		10.70		10.70				
Other			15.50		9.30		5.85		4.35				
Subtotal			156.50		73.40		45.05		24.75				
TOTAL INVESTMENT COSTS FOR ASSEMBLY CENTER			156.50		274.52		166.76		116.49				

Sources: Unit requirements were determined from several sources listed in Appendix C. Unit prices are based on internal working documents of the Marketing Department of the Diversification Program of the Coffee Growers Federation and special inquiries carried on for this study.

^aThe cost of construction for this kind of building was estimated at \$750 per square meter by the Department of Architecture and Engineering of the Coffee Growers Federation.

^bThe land value in these rural towns is about \$120 per square meter although it is extremely variable depending on the precise location in town and the availability of water, light, paved street, etc. This cost could run up to about \$250 per square meter.

Table V.4. Monthly and Weekly Fixed Costs by Type of PAC

Cost Item	Type of Product Assembly Center			
	A	B	C	D
	(pesos)			
Building				
Depreciation ^a	--	675	416	319
Rental ^b	7,400	--	--	--
Equipment				
Depreciation ^c	1,630	765	469	258
Maintenance	1,800	250	200	100
Overhead ^d				
Personnel ^e	26,425	6,040	4,530	3,775
Other expenses	5,500	900	700	400
Interest charges ^f				
Building & equipment	534	785	483	338
Land	--	261	146	102
Monthly fixed costs	43,289	9,676	6,944	5,292
Weekly fixed costs	10,408	2,258	1,620	1,235

^a Monthly depreciation of buildings was calculated by assuming a linear depreciation over a 20-year period.

^b Rental of space at the new central wholesale market facility of CABSAs, computed at the on-going rates.

^c Depreciation of equipment was computed in a linear form over an 8-year period.

^d Overhead expenses are detailed in Table V.5.

^e The details of these costs are shown in Table V.5.

^f Interest charges were computed at a rate of 8 percent; apparently it is a low rate compared to banking rates. It should be remembered that most of those banking rates have a component to compensate inflation which is not considered here since real values are taken into account. These interest charges are computed over 50 percent of the investment in buildings and equipment since linear depreciation is being used. Interest charges are computed over 100 percent of the investment in land; probably most of the expected increase in land value in these small towns would be just inflation with little or no increase in real value.

Table V.5. Overhead Expenses in Each Type of Product Assembly Center
(in pesos per month)

Overhead Item	Type of PAC				Coordinating Office in La Mesa Region ^a
	A	B	C	D	
Personnel					
Manager	10,570	6,040	4,530	3,775	9,815
Warehouse Assistant	3,775	--	--	--	--
Sales Assistant	6,040	--	--	--	--
Secretary	3,020	--	--	--	2,265
Accountant (half-time)	3,020	--	--	--	3,020
Other expenses	5,500	900	700	400	3,550
Total	31,925	6,940	5,230	4,175	18,650

^aThese costs are only associated with those alternatives of number-location of PAC which have PACs located in the rural area. In the computations, these costs were allocated among the PACs for each number-location alternative considered; this allocation was done on the basis of the volume of operation of each PAC.

Variable costs.--The variable costs considered at this point include the following: processing, shipping and the unit assembly costs that are invariable with respect to the distance traveled in the truck routing operation.

The processing costs include two different techniques: a manual sorting operation that is performed in simple sorting tables, and a semi-mechanized sorting operation that uses a conveyor belt to move the products through a team of workers. The labor costs of these two techniques were computed on a unit basis (per metric ton). Processing costs also include the operating capital costs, i.e., the interest charges on the necessary funds to purchase products, and to keep a stock of containers. These interest charges were also computed at a rate of 8 percent per annum.

The shipping costs include the operations of truck loading, transportation to Bogota, and unloading the products. These costs were determined on a basis of the assembly cost function developed in Appendix B. This appendix also shows the computations of the shipping costs.

The assembly costs included in this section are all those unit costs that are invariable with respect to distance traveled in the assembly operation, such as loading and unloading costs, and the costs implied by the time spent in purchasing and product inspection activities. The costs excluded at this point are the variable costs of the truck (per kilometer) and the personnel and of the truck costs

implied by the time spent in transit to the assembly route and back to the assembly center. The details of these costs are presented in Appendix B.

The variable costs outlined above are presented in Table V.6 on a unit basis (per metric ton).

Table V.6. Variable Unit Costs with Different PAC Location and Technique (in pesos per ton)

Variable Costs	Semi-Mechanized		Manual ^a
	In Region	In Bogota	
Labor	28.86	28.86	75.52
Operating capital	4.74	4.74	4.74
Assembly	54.06	54.06	54.06
Shipping	117.21	97.14	117.21
Total	204.87	184.80	251.53

Source: See Appendices B and C.

^aThe only option for this technique is in rural locations.

^bAn average distance of different locations was used for this presentation of costs.

It must be noted that unit variable costs change with respect to the sorting technique used and with respect to location. The sorting techniques have different unit labor requirements, with a considerable difference which makes the semi-mechanized process a lower cost one. The

difference in variable costs between the Bogota and the rural locations of PAC stems from the fact that the rural locations of PAC imply an additional operation: unloading and loading the products in the rural area. These variable unit costs clearly show that the location in Bogota using semi-mechanized sorting has significantly lower costs than the same process in the rural area. The manual sorting technique, which is only performed in the smallest type of PAC considered, yields significantly higher costs. These differences have a major impact on the comparison of overall unit costs. This is shown in the following paragraphs.

Table V.7 shows the fixed and variable unit costs presented so far. These costs are expressed for the different types of PAC. The total costs presented in this table do not include the assembly costs that are variable with respect to distance of assembly, which have not been presented (the next section analyzes them). The fixed unit costs presented in Table V.7 are those attained at the maximum volume of operation, which means that they are the lowest total unit costs.

Total unit costs in PAC Types B and C (90 and 55 tons per week, respectively) show slightly lower costs in PAC Type B. Type A of PAC has a meaningful difference with Type B and Type C, while Type D has a very significant cost disadvantage with all the other types of PAC.

Table V.7. Unit Costs by Type of PAC at the Maximum Volume of Operation^a
(pesos per ton)

Unit Costs	Type of PAC			
	A	B	C	D
Fixed ^b	61.21	51.46	55.61	80.04
Variable	184.80	204.87	204.87	251.53
Total	246.01	256.33	260.68	331.57

Source: Appendix C.

^aVariable unit costs of assembly are not included.

^bFixed unit costs are calculated at the maximum weekly volume of operation.

The explanation of these differences in the minimum costs attainable can be summed up in four main reasons as listed below:

1. There are differences due to technology of sorting and grading. PAC Type D has a completely manual operation while all the other types have a semi-mechanized, lower cost technique that uses conveyor belts and manual sorting and packing.
2. PAC Type A has its location in Bogota, which means that the assembly and shipping operations become one continuous process. This means that there are lower costs since the operations of unloading and loading the product at the PAC in the rural area do not need to be performed.

3. The location of Bogota of PAC Type A has significantly higher costs of building, since in this case the building space must be rented from CABSA, the administrative unit that runs the new central wholesale market. The services implied by this building, in contrast to those in the rural areas, are quite different too.
4. The management and administration costs of operating several assembly centers in the rural area are much higher than those of operating one large PAC, as Type A.

All these differences in technology, location and processes in the PAC types makes it difficult to speak of economies of size. Bearing these limitations in mind, it seems that beyond the capacity of 55 tons per week (PAC Type C) there are no economies of size of significance for this particular type of process defined.¹⁹

PAC size, production density and assembly costs.--

The size of a PAC and the existing production density determines the variable assembly costs. Given a certain production density in a region, as the size of a PAC increases,

¹⁹It is possible to conceive that economies of larger size could exist for similar operations, but given the quality produced and demanded and the volumes of production found in most regions, larger size PACs do not seem to be feasible under these conditions.

the area of attraction will need to be larger and products will have to be hauled greater distances, implying increasing unit costs of assembly. For a given size of a PAC, greater production densities will imply lower assembly costs.

The assembly costs referred to in this sub-section are only those unit assembly costs that vary with distance, and not those that are constant at any location.

This relationship of size of a PAC to assembly costs considering production densities has been determined empirically for the La Mesa region. The relationship was analyzed on the basis of a model which is largely based on a previous work of L. D. Smith²⁰ (see Appendix D).

Table V.8 shows the unit assembly costs in relation to size of PAC considering the average production density in all the municipios, and expressed in terms of an average season of production. The fact that only 20 percent of the marketed production is to be channeled through PAC was also accounted for.

The costs shown in Table V.8 increase at a decreasing rate as volume of operation increases since hauling distances increase. These costs show substantial change; for example in the case of a volume of operation of 200 tons per week the variable unit costs of assembly would be

²⁰Smith, op. cit.

Table V.8. Variable Unit Costs of Assembly as a Function of PAC Size, in the La Mesa Region

Volume of Operation (tons per week)	Variable Unit Costs (\$ per ton)	Volume of Operation (tons per week)	Variable Unit Costs (\$ per ton)
5	3.88	55	12.92
10	5.48	60	13.43
15	6.72	70	14.51
20	7.75	80	15.51
23	8.32	90	16.45
30	9.50	100	17.34
40	10.97	170	22.61
50	12.26	200	24.51

Source: Appendix D.

2.9 times higher than in the case of the smallest size of PAC, with 23 tons.

The model developed to measure these costs can also be used to analyze the change in assembly costs resulting from changes in production density. Figure 12 shows the unit costs of assembly for three different production density situations, the average, minimum and maximum densities observed in the region. It also includes the unit costs of assembly for the case of the average production density under the assumption that 100 percent of the production of the area is channeled through PAC.

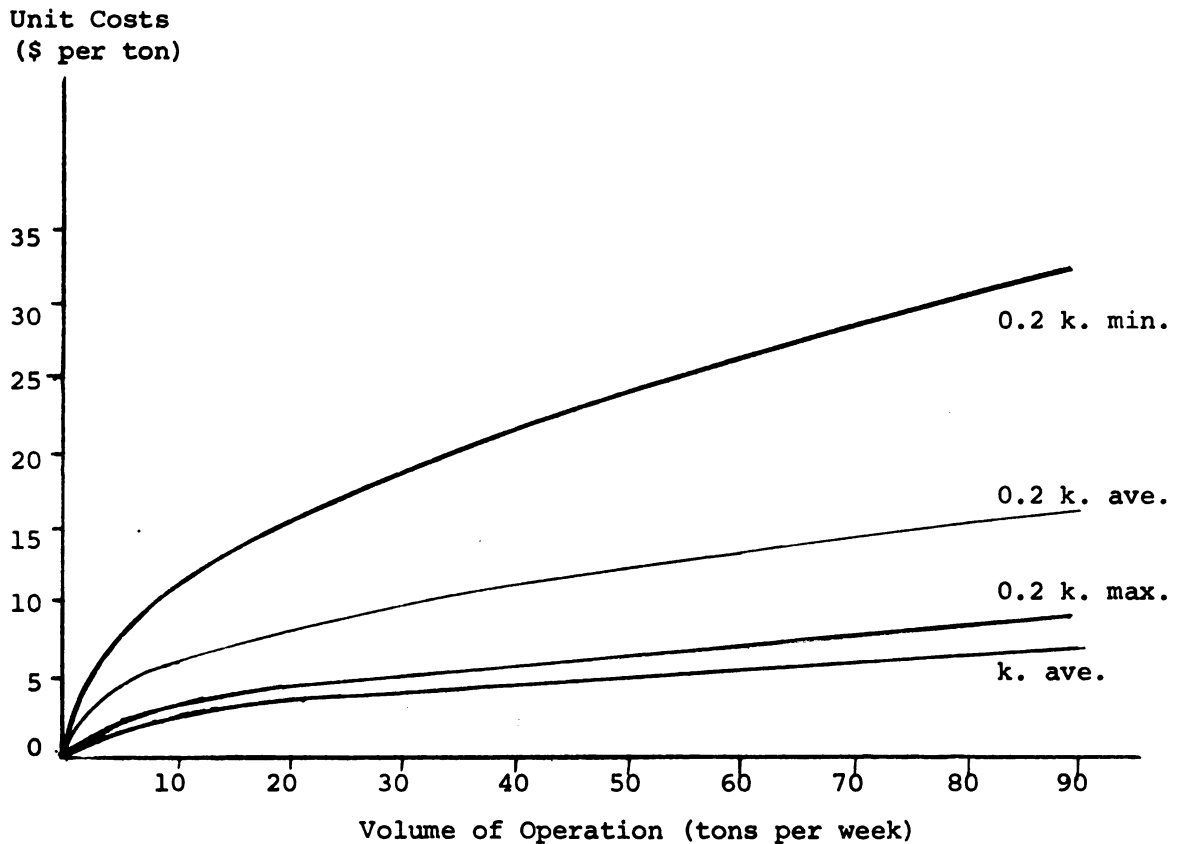


Figure 12. Unit Assembly Costs for Different Volumes of Operation in Three Production Densities. (Source: Appendix D.)

The cost functions in Figure 12 show that as the production density decreases, unit assembly costs increase at an increasing rate, and the inverse is also true. The comparison of both functions for the average production density (handling 20 and 100 percent of the production of the area) shows that unit assembly costs do not decrease in a proportional way as the percentage of the production

handled increases. This result sheds some light on the question stated earlier in this chapter concerning the possible effects on costs when a different assumption was used regarding the market share to be handled by the PAC program. The results indicate that costs tend to decrease at a decreasing rate when this percentage increases. This supports the guideline stated earlier that it is desirable to plan to handle a market percentage share which is not too high.

These functions have shown cost differences among different situations, but as the next section demonstrates, these differences have a small incidence on total costs. Therefore, although assembly costs increase as size of PAC increases, this increase does not materially affect the cost advantages that were determined earlier for the larger size PAC. The incidence of these costs in total unit costs is clearly seen in Figure 14, page 293.

Total unit costs.--Total unit costs can be obtained by aggregating the costs presented so far, the assembly, processing and shipping unit costs (Table V.7) and the unit costs of assembly that vary with respect to hauling distance (Table V.8). These total unit costs are presented in Table V.9. This table shows that costs in each type of assembly center have substantial variations according to the actual volume of product handled. The costs of operation at the

Table V.9. Total Unit Costs at Different Volumes of Operation for the Four Types of PAC (in pesos per ton).

Volume of Operation (tons per week)	Type of PAC			
	A	B	C	D
10	1283.3	673.5	517.4	441.1
15	891.4	520.3	416.2	380.9
23	650.1	414.5	346.6	339.7
40	457.8	331.6	292.6	--
55	386.8	302.0	273.6	--
70	346.3	285.5	--	--
80	327.7	278.2	--	--
90	313.2	272.8	--	--
140	271.9	--	--	--
170	258.8	--	--	--
Costs at the average volume of operation ^a	334.4	328.8	340.9	439.3

Sources: Appendices C and D.

^aIn the case of PAC Types C and D, the average volume of operation shown here is a composite average since these PACs have more than one locational possibility; and some locations have different patterns of seasonality in production.

annual average volume per week are from 20 to 29 percent higher (depending on the type of PAC) than the costs at maximum volume of operation.²¹

A comparison of the total costs shows decreasing minimum and average costs as size increases. An exception to this are the average costs between PAC Type A and B, which is due to the fact that PAC Type B has only one possibility of location, Anolaima, where production has the least seasonal variation within a year so that the average volume is relatively higher than in PAC Type A.

Selection of the Best Number-Location PAC Alternative

The best number-location alternative of PAC, from an economic standpoint, would be the one that has the lowest total costs of handling the volume set as a target, 20 percent, or 3965 tons per year.

Of the three alternatives designed, the alternative with one PAC located in Bogota has the lowest cost; and the most costly alternative is the one that has five PACs. Figure 13 shows these total aggregate yearly costs for the

²¹This could have implications for the seasonal pricing policy used in PAC. It would be conceivable to raise prices paid to farmers at times of product scarcity, increase volume and lower operating costs. In times of scarcity competition is stronger and the prices received by farmers are quite high, so that the increment in prices paid would not represent a very high percentage of the on-going prices. Earlier considerations indicate that it would be difficult to operate with some farmers only at the time of product scarcity.

Total Yearly
Costs
(\$)

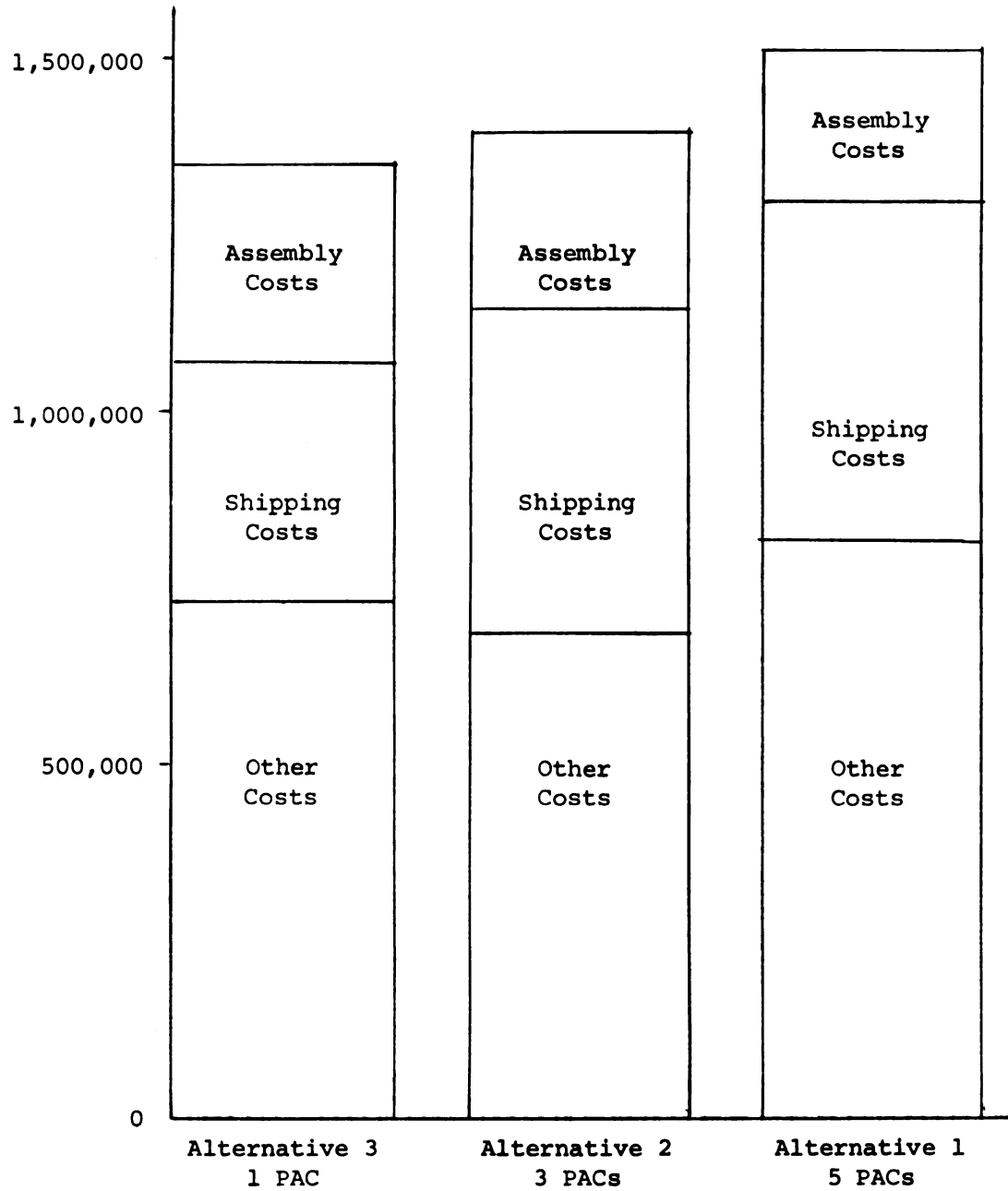


Figure 13. Assembly, Shipping and Total Yearly Aggregate Costs of the Three Number-Location Alternatives of Product Assembly Centers.

three alternatives, their processing, assembly and shipping costs.

Figure 13 shows that as the number of PACs increase, assembly and shipping costs tend to decrease (an exception is Alternative 1 where the shipping process has fewer operations and therefore lower costs). As the number of PACs increase, processing costs increase at a faster rate than the decrease in assembly costs, resulting in higher total costs.

The higher costs of a greater number of PACs are due to an implicit increase in PAC Type D, which were shown to have considerably higher costs.

Economic Feasibility of PAC

This section evaluates the short run economic feasibility of the PAC product assembly center from a private enterprise viewpoint. This evaluation was done by comparing the unit costs that have been determined for the lower cost PAC alternative with the price spreads observed in the traditional marketing channel.

This comparison involves a determination of the level of prices that PAC could obtain in selling in the wholesale market, and those prices that PAC could competitively pay to farmers. This is a difficult task since at both ends there are product quality and service differences which are hard to evaluate.

The first part of this section shows the margins in the traditional channel, analyzing what could be the selling price level of PAC. The probable price spread that PAC would have to confront is compared with the unit cost to determine the feasibility of this kind of operation in the short run. The PAC could have numerous secondary benefits, and in the longer run it could obtain different prices, these external and longer run effects are considered in detail in Chapter VI.

Margins in the Traditional Channel

Price spreads were determined for each major product, based on the same data used in the price analysis shown in Chapter IV. An aggregate figure was obtained for the most important products by weighing each price spread by the relative importance of each major product in the region of La Mesa. Price spreads for most products may vary throughout the year, so this aggregate figure is also an average over the different production seasons.²²

The weighted average price spread per ton is \$434.69, as shown in Table V.10. This figure represents the difference between wholesalers' selling prices (in the Bogota wholesale market) and assemblers' buying prices.

²²It must be recalled that this price information extends for an 8 month period in which peak production and product scarcity are included.

Table V.10. Price Spreads for the Main Products in the Region of La Mesa in Relation to the Bogota Wholesale Market

Products	Price Spread per Ton	Tons Marketed in the Region per Year	Weight Factors
Bananas	223.00	5668	.441
Oranges	415.83	4205	.327
Tomatoes	1122.95	1877	.146
<u>Guayaba</u>	439.50	960	.075
Avocados	314.50	136	.011
Weighted price spread per ton		\$434.69	

Economic Feasibility

This average price spread is not the relevant figure with which to compare the PAC's costs, since PAC would probably not be able to sell in the short run at the price levels that wholesalers sell. At least in the short run, it is hard to conceive that PACs would be able to develop a commercial capability so as to sell great volumes of products (as those considered) directly to retailers.

The implementation of PAC in the lower cost alternative facilitates wholesaling functions since it has been considered that space in the Bogota wholesale market is rented. In this alternative it would be possible to wholesale part of the volume handled. Nevertheless, in the short run PAC would probably depend on other wholesalers as a

market outlet for part of the volumes. In the long run it could develop these wholesaling capacities to a fuller extent. It must be noted that in a fragmented and relatively unorganized market, as the Bogota wholesale market, the wholesaling operations are difficult and quite risky.

The question of the short run private economic feasibility of the lower cost alternative PAC largely depends on the selling prices that may be attained in the Bogota wholesale market. Unfortunately, there is no way of predicting with accuracy the possible market outcome of this program, since to a great extent it depends on the commercial and managerial talent involved in dealing in this complicated market. For these reasons, two possible market outcomes were considered in analyzing the economic feasibility. One considers the worst possible market outcome, that is, the selling prices obtained in the wholesale market are the purchase prices regularly paid by wholesalers. This implies that the PAC is not able to capture any part of the wholesaling margin. The other alternative considers that the PAC's selling price level is an intermediate price between the wholesalers' buying and selling prices; this implies that the PAC is able to obtain 50 percent of the wholesalers' gross margin.

Information on wholesalers' buying prices is not available and it is extremely difficult to obtain. Therefore, secondary information on wholesalers' gross margin

was utilized to determine the relevant price spread to which PAC costs should be compared.²³ On this basis, the weighted average of the wholesalers' gross margin is \$207.11 per ton, and the relevant average weighted price spread for PAC, under the alternative of obtaining the regular wholesaler purchase price level, would be \$227.58 per ton.

It must be recalled that the total unit costs of the lower cost PAC alternative is \$334.12 per ton. Therefore, under the pessimistic market outcome considered, the PAC program would not be economically feasible. However, under the second alternative market outcome, the relevant price spread would be \$331.13; this spread almost covers the costs of PAC, indicating that a similar or better outcome would make PAC a feasible activity. If the wholesalers' price level is attained in the short run (which would be highly questionable) PAC would be covering its costs and obtaining a profit of \$100.57 per ton.

These considerations on the short run feasibility are based on the simple cost-margin comparisons shown, and cannot be generalized to the long run feasibility of PAC. Chapter VI analyzes this long run problem in a benefit-cost analysis framework.

²³CID, Estudio de Consumidores y Distribucion Urbane de Viveres de Bogota, op. cit., p. 83.

The cost-margin comparison presented has not considered that the PAC operation would involve important product quality and service differences in relation to the traditional marketing channels. Some of these would directly affect the PAC operation in its internal profitability, while others would affect other participants of the marketing system. These differences are briefly discussed next.

Regarding wholesalers in Bogota, PAC would offer better quality products with a longer shelf life. This is an obvious advantage to wholesalers. PAC could also eventually establish some sort of vertical coordination with some wholesalers, thus reducing transaction costs and risks, and eventually sales expansion through such arrangements.

These benefits obtained by wholesalers could be replicated at subsequent stages of the marketing channel, so that retailers and consumers would also indirectly receive benefits from the PAC marketing scheme.

It must be noted that it is quite likely that these benefits would not be recognized in the short run by wholesalers and retailers. Credibility has to be built up first, which may not be easy in the initial stages. Some kind of product identification could aid in this effort (creating a brand name). Once recognition of PAC products is widespread, benefits will occur to those directly involved in handling these products. When this happens, it will be possible for

the PAC to start obtaining better selling prices, and conceivably these price levels could equal or exceed those that other wholesalers obtain.

Regarding farmers, PAC has some advantages and disadvantages compared to the traditional marketing channel. On one hand it purchases products at buying points near farms thus allowing some reduction in marketing costs. But it also demands greater product quality, at the very least a pre-sorting of unsaleable products; the traditional channel instead, buys any kind of products. Eventually, better quality products would receive better prices in the PAC marketing scheme. Additional benefits could be passed on to farmers in the form of prices as a result of the use of improved product packaging and handling.

In conclusion, in the short run the economic feasibility of PAC shows probable losses. Furthermore, there are several other costs of starting this kind of project (mainly technical assistance and training) which have not been considered in this part of the research (the next chapter takes them into account). In a longer run, as better product quality and services are developed and product recognition is gained, in the market, higher prices will probably be obtained. This, in turn, will foster product quality improvements at the farm level, all of which will create an expanded demand for these PAC products. If the price level reaches that of the wholesalers' selling prices,

PAC would be a sound economic venture. Furthermore, some cost reductions are possible in the long run. These will be considered in the next chapter.

A compromise solution that could achieve economic soundness in the short and long run may be one in which small volumes are handled initially, implying low overhead costs, and at the same time developing technical and managerial capabilities. Selling smaller volumes could allow obtaining somewhat higher prices than those considered before since it would be a matter of identifying and supplying only the reduced higher quality demand in the market. Perhaps this strategy could be economically feasible in the short run. From there on, volumes and capabilities would gradually increase, but some kind of support is needed to stimulate this growth.

In this, as well as in the rest of the PAC alternatives considered, the crucial point seems to be in developing the managerial and commercial capabilities, one can hardly overemphasize this point.

CHAPTER VI

A BENEFIT-COST ANALYSIS OF THE PRODUCT ASSEMBLY CENTER STRATEGY

This chapter presents a social benefit-cost analysis of the product assembly center strategy described earlier as a means for reorganizing rural assembly markets.¹ Consideration is given to the internal and external benefits and costs of the PAC operation. Some of the most important primary and secondary social benefits and costs are considered in a quantitative way, others are only accounted for in a qualitative manner. This type of analysis provides a basis for a rational economic decision (from the standpoint of society) concerning this PAC project. Some of the externalities involved in this marketing improvement project are also examined.

¹This framework is commonly utilized in economic evaluations and it has been discussed in detail by many authors. For example, see: Ian M. D. Little and James Mirrlees, Manual of Industrial Project Analysis in Developing Countries, Vol. II, Social Cost Benefit Analysis (Paris: OECD Development Centre, 1969), pp. 1-37; J. Price Gittinger, Economic Analysis of Agricultural Projects (Baltimore: John Hopkins University Press, 1972); and A. R. Prest and R. Turvey, "Cost-Benefit Analysis: A Survey," Economic Journal, December, 1965).

Identification of Benefits

The benefits stemming from any economic investment or dynamic change directly affect some parts of an economic system which in turn affect the rest of the system through a complex set of economic interrelationships. These indirect effects will depend on the magnitude of the direct effects, and also, on the degree of the interrelationships among the components of the system that initially receive the economic impacts and those components that are affected in an indirect way. For practical reasons this poses a need to restrict an economic evaluation to that part of the economic system which is most affected.

In this study the economic effects will be restricted to the rural production-assembly system described in Chapter II. According to this system delineation, the main components or participants of the system would be: farmers, assemblers, truckers and wholesalers in the Bogota market.

This excludes important economic decision units, such as retailers and consumers. The effects on these units might be more important than the one on the market participants to be considered, but the perspective of this research, the limitations in the secondary information available, and time, do not allow the inclusion of the effects on retailers and consumers, at least in a quantitative way. From the

economic standpoint this exclusion is important, but some of the benefits at these stages (retailing and consumer purchasing) will be indirectly considered since they are reflected back, in part, to the wholesaling and assembly levels through the price mechanism.

Changes in Farmers' Marketing Costs

The PAC operations would purchase products at collection points along truck assembly routes. This would reduce the farmers' marketing costs, as shown in the previous chapter, mainly by reducing their transportation costs and transit time to market. This has two main effects on the farmers' economic position. It reduces their costs and/or increases their labor availability for other activities. Most of this increase in labor availability would materialize in the fruit and coffee harvesting season, a time in which labor is scarce. Therefore, this labor would represent additional income for farmers, since it could be used in a productive way in the region.

This reduction in costs would make economically feasible the harvesting of a greater proportion of fruit production. (It should be recalled that in some farms relatively high proportions of fruits are not harvested, as shown in Chapter III.) In practice, this means that on those individual farms located at greater distances, or with lower volumes of production (where the additional costs of

harvesting and marketing fruits are higher than the additional revenue to be obtained from sales), fruits will be harvested at peak production periods (or at the lowest prices).

Truck collection points could be established every three kilometers along the roads. In this case the distance traveled by the average farmer on a truck-road would be only 0.75 kilometers, which is a substantial reduction from the actual situation.

The changes in distances to be traveled under this new arrangement, as compared to the actual situation, were determined considering the joint distribution of farm to road and road to market distances (obtained from the farm survey). The resulting differences in distances traveled and transit time were costed out on the basis of the actual rates of the means of transportation (mules or trucks or buses), and the opportunity cost of labor. These computations used the information presented in Chapter III. This results in cost reductions for the farmer which on the average amount to \$41.52 per ton (this figure is a weighted average for the distribution of farm location).

Changes in Harvested Production

As mentioned above, these reductions in marketing costs would increase the proportion of harvested fruits. The basis for determining the expected changes in harvested

production are the cost-price relationships shown before (see Chapter III, pp. 103-104). These relationships show at what combinations of farm-to-market distance and volume of products sold in each market day, it would be uneconomical to harvest different fruit products, at the time of lowest prices. The distances to be traveled from farm to pick-up points under the truck routing arrangement were introduced into these cost-price relationships. The analysis showed that, on a cost-price basis, under this arrangement only 3 percent of the farmers growing guayaba could not profitably harvest it, and 0.6 percent in the case of mangoes. The rest of the fruit products would be economically harvested, even at the lowest price level.

This cost comparison disregards the possible labor constraint that some individual farms could still have. Other reasons could also limit a drastic increase in harvested production. For example, the cost of mobilizing labor for short-time periods, or simply, a lack of economic motivation of some farmers to increase net income by a small amount at the expense of a few additional hours of work after a full day's work (this implies an economic equilibrium according to the farmer's preferences). These factors that could explain a certain amount of unharvested fruit production are impossible to quantify. The assumption made in this study is that farmers are completely rational economic beings and that the opportunity cost of labor has been

measured exactly. Therefore, cost-price relationships would explain all the unharvested production.

The benefits of increased harvested production stemming from the new assembly arrangement were measured as the difference between the actual percentage of unharvested products and what the cost-price analysis indicated that would not be economically harvested. This added production was valued at the minimum rural market price less the farmers' marketing costs.

It should be recalled that since the assembly center's goal is to handle only 20 percent of the marketings of fruits and vegetables in the region, these benefits would likewise apply to 20 percent of the farms. The yearly benefits from expected changes in harvested production would be relatively small since the differences of prices and costs are low at peak production season. These yearly benefits amount to 32,752 pesos.

Primary Benefits and Selling Prices

Most of the direct benefits arise from the sale of products in the Bogota wholesale market. All of the revenues from sales of these products can be considered an economic benefit to society since the resources used by those actually buying products from farmers and selling them in the Bogota wholesale market (assemblers and truckers) are not "job specific" or immobile. In fact, most

of their resources consist of operating capital, trucks, labor (personal and hired), management and commercial skills. All of these resources are highly mobile, so that the operation of PAC would represent only a transfer of some of the assemblers' resources to other productive economic activities with similar productivity to the one they actually have (or their opportunity cost).

Furthermore, as it was indicated in Chapter V, there are additional economic benefits stemming from the added services and product quality improvements that PAC would attain. The discussion will turn next to an analysis of these additional economic benefits.

The operation of PAC would result in improved product quality through the use of better harvesting, packaging and handling methods. This improvement would generate higher prices. It must be emphasized, though, that these higher prices are dependent on the recognition that can be gained for these products in the marketing channels. Recognition of a product in a market is a slow process, especially in a fragmented market such as the wholesale market of Bogota.

On the other hand, adoption of better harvesting, packaging and handling techniques is also a gradual process which involves even greater difficulties. Individual market participants are reluctant to use different packaging due to the possibility of not having acceptance at other stages

of the marketing channels. This was clearly detected in the assembler and farmer surveys carried out for this study; it has also been reported as a major constraint in other studies done in Colombia.² Generally the problem faced is to get recognition in the latter stages of a marketing channel, or getting a high degree of vertical coordination. In this situation product quality can be recognized and different packaging can be accepted. An additional difficulty in introducing improved packaging (which must be reusable for cost reasons), is to get the reusable containers back to the marketing agents that have adopted the new packaging technique. As the number of adopters or the vertical coordination increases this would be a lesser problem.

Research in packaging technology for fruits indicates that there are substantial physical product losses that can be reduced. The Institute of Technology Research has done research in this area. This work has produced improved boxes and packaging techniques which experimentally reduced fruit damage to very small percentages (see Table VI.1), but have not been adopted.

²Ruben Cruz, Produccion, Distribucion y Uso de Empaques para Productos Agropecuarios en la Zona de Influencia de Cali, Technical Report No. 2 (Cali, Colombia: PIMUR, 1969), pp. 80-82.

Table VI.1. Percentages of Damaged Fruit Handled in Traditional and Improved Packaging, by Type of Product

Fruit	Percentage of Damaged Fruit (physical measurements)	
	Traditional Packaging	Improved Packaging
Ripe Mangoes	30	4
Oranges	38	0
Tomatoes	20	3
Papaya	23	0
Avocados	26	0
Pineapples	45	4

Source: IIT Research reported by Daniel Diaz Delgado, "Desarrollo Experimental de Empaques para el Transporte de Frutas," Tecnologia, No. 42, July-August, 1966, pp. 15-23.

The reduction in damaged fruit obtained by the use of improved packaging overestimates the economic result of their adoption, since most of the damaged fruit is sold at lower prices. Nevertheless, this research provides some basis to predict possible economic changes stemming from improved packaging.

Other studies have measured the physical and economic loss represented by damaged product at the different stages of the marketing process of fruits and vegetables.³

³Alvaro Silva et al., Estudio de Frutas y Hortalizas, op. cit.; Montes, op. cit.; CEDE, op. cit.; and Ruben Cruz, op. cit.

These studies show varying results that can be summarized as follows: platano economic losses up to the wholesale level amount to 7.5 percent; tomato physical losses up to the wholesale level range from 8 to 22 percent, while the PIMUR study shows an 8 percent loss in value. Economic losses in the case of oranges are about 16.5 percent. In the case of vegetables such as onions and cabbage, losses in value are only about 4 percent.

These results clearly indicate that substantial economies are possible by reducing damaged products. A great part of these losses could be reduced through the use of improved packaging; other losses due to selling problems (market fluctuations, market saturation or others) would still persist.

Another basis for product improvement would be technical advice and extension given to farmers on improved harvesting methods and the timely harvesting for obtaining the best product quality and longer shelf life.

The product assembly center would attain a more stable volume and product quality which would be an obvious risk reduction for its clientele, a valuable additional service in comparison to the operation of the traditional assemblers or wholesalers.

All these probable effects of the PAC would make it possible to obtain relatively higher selling prices. It is impossible to accurately predict the price

level to be attained. The basic assumption made is that within two years of operation, the selling prices obtained by PAC will be the same as those actually obtained by existing wholesalers. This means that the improvement in handling and packaging would have been completely adopted in this period of time, and also, a certain degree of product recognition would have been gained in the market. This basic assumption was specified considering that selling prices would have a gradual increase from the imitation of the PAC activities, at which time selling prices would be equal to the wholesalers selling price minus their conventional margins.

Since the probable market outcome cannot be predicted accurately, other assumptions were made. A more conservative assumption was also used. It considered that only 50 percent of the volume would be sold at the wholesale price level and the remaining 50 percent would be sold at an intermediate level between the wholesalers' buying and selling prices.

In addition, two other assumptions considering more optimistic results were also used. The first of these considers that within a year of operation PAC will be able to sell its products at the wholesalers' selling price level. The other assumption accounts for the same basic situation, but in addition PAC is able to capture price bonuses of 10 percent above the wholesalers selling price

level. This price level is attained at the third year of operation and runs through the eighth year, affecting 50 percent of the volume handled by PAC.

These assumptions should give some basis for analyzing the sensitivity of the project to this variable which is considered crucial.

Secondary Effects in Rural Markets

The competition imposed by PAC in this rural area would affect the operations and prices of the traditional channels serving it. Competition would probably tend to force existing assemblers to reduce their costs and/or handle larger volumes of products. It would also tend to diffuse the improved handling and packaging methods, since assemblers would be confronted with farmers that have some knowledge of these practices and, at the other end, with wholesalers who have handled or have seen the acceptance of products with improved packaging.

These expected effects would gradually tend to reduce costs for assemblers and the competition imposed by PAC would tend to force assemblers to pass on to farmers part of these cost reductions in the form of higher prices (in those rural markets in which PAC operates). Again, the magnitude of these effects is impossible to predict exactly. This study has assumed that non-participating farmers (or farmers not served directly by PAC) would receive price

increases equivalent to 25 percent of those obtained by the farmers served by PAC, with a one-year lag. This would be a gradual increase up to the third year in which all of these secondary benefits would have been obtained.

Other benefits in rural areas.--The operation of PAC would probably also have other dynamic effects in a longer run in the rural area which it serves. The cost and benefit figures to be presented show that PAC would be able to slightly increase the prices paid to farmers, if operated on a non-profit basis, after the initial period (about two years). It would also reduce the farmers' market risks. This would obviously tend to stimulate greater production which would increase producers' net incomes and employment. A similar effect can be expected from the differential prices offered for product qualities. Farmers will tend to increase the quality of products sold with the consequent increase in income and greater employment that this may demand.

Another possible effect of the lower risk situation that PAC would offer to farmers is to stimulate an increase in the scale of operation of single fruit or vegetable product at the farm level. An increase in the scale of operation of a single crop, or an increased farm specialization, allows for decreased marketing costs (transportation, harvesting, transaction, transit time to market) and possibly in production costs as well.

Secondary Effects in Urban Markets

The secondary benefits considered here refer to the probable dynamic effects that would be induced by the continuing operation of PAC. Many of these expected dynamic effects on the urban market participants (wholesalers, retailers and consumers) are based on the demonstration effect and the diffusion of innovations. Therefore, the time involved and degree of accomplishment of these effects largely depends on the actual implementation of the project and the future commitment it might have to act as an innovating institution on a traditional marketing environment. For these reasons, it is extremely difficult to attempt to quantify these changes or effects, and at least, very questionable assumptions would need to be used with the data available. Therefore, this study has only considered them in a qualitative way, showing the trends that would exist in the market organization. This is regrettable, but it is a common shortcoming in most studies, as the literature on secondary effects indicates:

Dynamic secondary effects prove extremely difficult to analyze given the existing state of economic development theory. Thus, the attempts which have been made to analyze scale effects and dynamic secondary effects have been of a largely theoretical nature and have little operational significance.⁴

⁴Gittinger, op. cit., p. 25.

Nevertheless, it must be emphasized that the secondary benefits in this case could probably be the greatest ones of all those considered.

The starting point for these effects is PAC's output: a relatively dependable supply of sorted fruit and vegetable products in the wholesale market of Bogota as compared with the less stable quantities and qualities of products now offered by traditional assemblers. This greater stability allows greater vertical coordination, as previously mentioned.

In the wholesaling stage of the urban markets, it is quite likely that once PAC products have gained market recognition, other wholesalers in the Bogota market will show an imitative behavior, adopting similar practices. This adoption implies that innovative wholesalers would also attain a higher degree of coordination and use improved methods of product handling and packaging. This would tend to reduce their costs and improve the services they can render. These changes in wholesaling would (or at least would tend to) probably be the result of changes in the demand requirements imposed by these innovative wholesalers to their suppliers. These changes in demand requirements would be a force to change the operations in the rural production-assembly systems of other areas in the Bogota foodshed.

The impact in the wholesale market would branch out in many directions. This is another important reason that could emphasize the advantage of locating PAC in the urban wholesale market rather than in a rural area; in this case, the "change effects" of a given limited amount of resources would have a greater economic impact.

The benefits of these secondary dynamic changes would probably be quite substantial.

Retailers would undoubtedly benefit from the availability of sorted, and better packaged products with a longer shelf life. This would tend to have two main effects in their operations. The first effect would be a reduction in the frequency of trips to the wholesale market to purchase these perishables, which is a substantial cost given the low volumes of products generally bought by the tienda (small neighborhood store) operators. This also implies an increase in the volume of perishables bought per trip to the wholesale market, decreasing their unit procurement costs. A second effect would be a probable increase in the volume of sales of perishables. The sale of sorted products at differential prices would be expected to expand aggregate consumer demand for a product. Improved quality of perishable products offered in tiendas could also stimulate a change in consumer shopping patterns from public markets (plazas), which serve a high proportion of the urban demand for perishables, to tiendas. This change would

increase the volume of operation of tiendas, which would be a very beneficial effect, since it has been documented that one of the main problems in retailing is very small volume of operation of these units.⁵

An expansion of effective demand for these perishable products could be expected from regularly carrying them in stores, since the actual situation commonly shows irregularity in their availability in tiendas. Over time, the regularity of these supplies would tend to increase the proportion of perishables in the consumer's basket.

Both of these effects on retailing perishables in tiendas would tend to decrease costs of procurement and increase sales, and given the level of competition in the great numbers of existing tiendas, some of these cost savings would tend to be passed on to consumers in the form of lower prices or increased services. This, in turn, expands effective demand for these products.

Consumers would benefit from having a wider variety of products and possibly lower prices or greater services (as hypothesized above). Shopping time would be reduced since tiendas (which would capture a greater percentage of the demand for perishables) are widely distributed throughout the city of Bogota; while plazas (which would suffer a reduction of sales of perishables) are fewer and sparsely

⁵H. Riley, Market Coordination, op. cit., Chapter 2.

distributed in the city, therefore the consumers' shopping distances would be shorter.

All these probable effects might be made possible by the PAC program and the diffusion of its effects, through imitative behavior, in the wholesale market of Bogota. This is not the same as claiming that these effects would be the necessary outcome of the existence of PAC. Obviously, too many other factors (which lie outside the main thrust of this thesis) come into consideration when relatively remote stages (from the assembly) of the marketing system are considered. Therefore, the impact of PAC would be a necessary but not sufficient condition for attaining these effects. This qualitative analysis only had the aim of showing trends; but this is the aim of economic analysis in a dynamic system where a multiplicity of non-economic factors are part of the real situation confronted.

The PAC project should be closely related to other marketing programs, so that the hypothesized effects would materialize to a greater degree. As it was earlier described in Chapter I, there are specific programs aiming to improve the urban marketing system in Bogota. These programs include the establishment and operation of a new central wholesale market facility in Bogota (CABSA). This CABSA market will facilitate changes in the operations of wholesalers, both in the physical and exchange functions; the PAC program could well contribute with its diffusion

and demonstration effect. CORABASTOS' programs are designed to improve the operating efficiency of the Bogota retailers. through the formation of full-line wholesalers that operate at a large scale with lower margins. This type of program would help retailers in their actual costly procurement activities. The PAC project could well contribute as a supplier in these procurement activities.

The description of the possible changes induced in the marketing system should be seen as the outcome of all these related programs. It should be obvious that each of these programs is a necessary part, and deficiencies in any of them could seriously hamper the potential success of all. This emphasizes the need to view the PAC project operating in close coordination with these other programs.

In the short run, these secondary benefits to consumers and retailers would be reflected back through the marketing channel in the form of increased prices. Part of these benefits have been accounted for, since higher selling prices for PAC products were projected, as described earlier in this chapter.

It must be noted that as these changes diffuse throughout the urban marketing system, the initial additional price gain of PAC products would tend to be eroded by competition since other (or many) wholesalers would be offering similar products and/or services. Under this

consideration, the additional long-run price benefits outlined for PAC could be an overestimation.

In the final analysis, if a reasonable degree of competition prevails in all the stages of the marketing channels, the benefits of this market reform would tend to be passed on to consumers.

Costs of Implementation

The costs of implementing this market reform change can be classified into operating costs, investment costs and technical assistance and research costs.

The operating costs considered are those analyzed in detail in the previous chapter. These have been modified to the requirements of benefit cost analysis: the depreciation and interest charges used in the previous presentation have been subtracted.

Assembly costs can be reduced in the longer run through the experience and training of truck drivers to perform also the functions of purchasing agents. This cost reduction was incorporated as a gradual change to be fully reached at the second year of operation.

The product purchasing costs considered in the analysis were based on the actual level of prices paid to farmers in the rural assembly markets in the region.

The investment costs used were those determined in the previous chapter (see Table V.2, page 191). The

reoccurring investments, such as trucks, were timed according to the expected life of the equipment utilized, as determined in Chapter V.

Finally, the necessary technical assistance and applied research inputs and costs to start a PAC project were estimated on the basis of the experience obtained from the Manizales PAC pilot project of the Coffee Diversification Program. These costs include the services of two marketing technicians for a period of 10 months; two extension agents to work with farmers during two years; and two research persons to apply the available research results on the proper packaging and product handling techniques, working for two months, plus the associated transportation costs of this personnel. These costs do not include resources or efforts especially for the diffusion and change of the system, except for the necessary changes with those market participants operating directly with PAC. This is consistent with the inclusion of benefits, since the secondary benefits have not been included in a quantitative manner in the analysis.

It must be noted that these costs only include those necessary to directly initiate the PAC operation; it does not include the resources needed in the planning phase of this project, nor the resources that might be needed for maintaining necessary research efforts or coordination with complementary programs. To some extent the costs could be

underestimated, since the resources might be needed for a longer period than the one proposed.

The interest rate used for discounting benefits and costs was 0.08 (8 percent). Other rates (0.06 and 0.10) were also tested to analyze the project's sensitivity to capital cost. The time horizon considered was 20 years.

The actual yearly figures of costs and benefits used are shown in Tables VI.3 and VI.4.

Indicators of Economic Evaluation

The economic indicators used for this evaluation were the benefit cost ratio and the internal rate of return. These indicators were obtained through the use of a computer program available at the Michigan State University Computer Center (Program Ben Cost, No. 00000427).

It must be recalled that four basic alternatives of projected outcomes were analyzed. The first one (Alternative 1) projects a gradual increase in the selling price level to reach the wholesalers' price level within two years. The second alternative (Alternative 2) outcome projects that the wholesalers' selling price level is attained within one year of operation. A third alternative (Alternative 3) market outcome considered projects that 50 percent of the volume handled would be sold at the wholesalers' selling price level within two years, while the remaining 50 percent would only be sold at an intermediate level between the

wholesalers' buying and selling prices. Another alternative (Alternative 4) projects a more optimistic outcome: the wholesalers' selling price level would be reached within a year, and the prices of 50 percent of the volume sold would increase 10 percent above this level between the third and the eighth year. This alternative assumes that product recognition is gained at the third year, while imitative behavior and competition in the wholesale market only allows PAC products to keep this advantage for the following five years, later one, the price premium is eroded.

The cost components of all these alternative outcomes are the same since the functions involved are essentially the same. The alternatives with a brighter outlook would imply a greater wholesaling and/or commercial capacity, which could represent higher costs in the form of human commercial talent. Given that this would only involve higher salaries for one or two persons (without much impact on total costs), the costs were not changed for the different alternatives.

In addition to computing these outcomes in a social cost benefit analysis framework, a benefit cost analysis from the private standpoint was also computed considering the internal benefits in PAC (sale of products and salvage values) and the same set of cost components. The PAC project's initiation technical assistance and extension costs would also have to be afforded in the case of a

private or a non-profit operation of PAC. The comparison of the private and social cost benefit analyses should illustrate some of the externality problems involved in this kind of marketing improvement program. This has important implications in planning the implementation and the institutional arrangements for this program.

The results of these alternative projected outcomes are shown in Table VI.2.

Table VI.2. Economic Indicators of Alternative Outcomes Realized by the PAC Program in the La Mesa Region

Market Outcomes	Benefit Cost Ratio ^a	Internal Rate of Return	Net Present Value (pesos)
Alternative 1	1.24	0.65	11,506,968
6 percent	1.23		13,836,214
10 percent	1.21		9,664,090
private	1.04	0.21	2,316,316
Alternative 2	1.23	0.72	12,201,792
private	1.06	0.26	3,011,138
Alternative 3	1.16	0.50	8,354,306
Alternative 4	1.25	0.77	13,197,368
private	1.08	0.33	4,243,949

^aThe interest rate used was 8 percent, unless otherwise indicated.

Social Standpoint

These economic indicators show that in all the cases of projected outcomes, the benefit-cost ratio is greater than one which means that the net contribution of this project to society is greater than the cost of the resources that society must dedicate to this project.

The sensitivity of the benefit-cost ratio to interest rate is quite low. In outcome 1, two other interest rates were used, resulting in slight variations of the ratio. The sensitivity regarding alternative market outcomes (selling prices) is significant; the results show differences among the outcomes considered. This variation found in the ratios shows that the market outcome is a crucial aspect in the success of this project. Therefore, the price level should be one of the variables that needs to be looked at permanently in monitoring the project after its initiation.

This sensitivity to market outcome also indicates that one of the most important resources in this kind of activity would be the commercial capability to deal in the wholesale market.

The internal rates of return are quite high. Outcome 1 has an internal rate of 0.65, in outcome 2 this indicator is 0.72, outcome 3 shows a figure of 0.50 and outcome 4 shows 0.77. The internal rates of return show the expected earning power of the resources utilized. The

prevailing commercial interest rates in Colombia are about 0.18 or slightly higher. Therefore, social investment in this economic venture seems highly desirable since the economic yield would be about three times higher than the opportunity cost, as measured by commercial interest rates.

The total net present value per year of outcome 1 (with a rate of 0.08), expressed per farmer attended by PAC, amounts to about 5 percent of the actual average net income per farm in the region. It must be recalled that some of the benefits considered would accrue to farmers not attended by PAC, therefore the increase in net farm income for the region would be less than 5 percent. This figure of increase in net income only considers the quantifiable benefits, which it must be emphasized again, are probably smaller than the secondary dynamic effects.

Private Standpoint

The private cost benefit analysis, or financial analysis, shows a benefit cost ratio of 1.04 (Alternative 1), which indicates that the discounted internal benefits and costs are roughly equal. The internal rate of return in this case is 0.21, which is approximately equal to the prevailing commercial interest rates in the country. These indicators show that from a private standpoint the PAC would only be an economic activity with results close to breakeven. Certainly it would not be an attractive

opportunity for private business, given these indicators and the risks inherent in this kind of activity. Furthermore, the payback period for this private activity would be seven years. This leads to the conclusion that no private institution would undertake this activity, the economic incentives are clearly too low. If the most optimistic outcome is considered, the benefit-cost ratio increases slightly, and the internal rate of return improves considerably. The payback period in this case would be at the third year of operation. This optimistic market outcome perhaps could be high enough to induce private activity into this line of business, but on the other hand, it could still be questionable in light of the great risks involved. It might be worth mentioning that a relatively large supermarket chain which has innovated in almost every sense in the food marketing system of Bogota, has stayed away from having a controlled procurement system in the rural assembly markets.

This case of establishing product assembly centers illustrates a common situation in marketing improvement programs. The benefits of improving the operation of open competitive markets are diffused to many participants, and the great number of economic units involved precludes any of them from capturing (or internalizing) enough benefits to induce significant improvements or changes, even in particular marketing channels. The externalities involved in this case are several times greater than the internal

net present value: Table VI.3 shows a net present value of \$11,506,968 for the social cost benefit analysis, while from the private standpoint, the same situation shows a NPV of only \$2,316,316.

The conclusion reached above confirms earlier generalizations or statements which explained the marketing systems of developing countries as having low productivity and a low static equilibrium. Greater productivity in these systems will often not be attained from changes coming from within the system; the necessary introduction of new technology and institutional reforms must come from stimulating forces outside the system.⁶

Table IV.3 shows the yearly benefits categorized according to the way benefits were identified in an earlier section of this chapter. The principal benefits are those from the sales of products which reflect a gradual growth in volume handled that is assumed to reach the program volume target at the end of the second year of operation. The growth in sales also reflects the assumption that prices received for products in Bogota would reach the level realized by other wholesalers at the end of the second year of operation. These benefits correspond to the Alternative outcome number 1, which is judged by the author as the most realistic outcome of all those considered.

⁶Slater and Riley, Market Processes in Recife, op. cit., pp. 1-11; and Collins and Holton, op. cit.

Table VI.3. Yearly Benefits of the Product Assembly Center Project for the Region of La Mesa

Year	Production in Farmers' Marketing Costs (\$)	Changes in Harvested Production (\$)	Sales ^a (\$)	Changes in Prices to Non-Participating Farmers (\$)	Salvage Values ^b (\$)	Total Yearly Benefits (\$)
1	82,148	16,372	1,290,744	----	----	1,389,267
2	164,295	32,752	4,176,985	213,995	----	4,588,027
3	164,295	32,752	5,711,285	625,035	----	6,533,367
4	164,295	32,752	5,711,285	826,788	----	6,735,120
5	164,295	32,752	5,711,285	826,788	----	6,735,120
6	164,295	32,752	5,711,285	826,788	200,000	6,935,120
7	164,295	32,752	5,711,285	826,788	200,000	6,935,120
8	164,295	32,752	5,711,285	826,788	----	6,735,120
9	164,295	32,752	5,711,285	826,788	----	6,735,120
10	164,295	32,752	5,711,285	826,788	----	6,735,120
11	164,295	32,752	5,711,285	826,788	200,000	6,935,120
12	164,295	32,752	5,711,285	826,788	200,000	6,935,120
13	164,295	32,752	5,711,285	826,788	----	6,735,120
14	164,295	32,752	5,711,285	826,788	----	6,735,120
15	164,295	32,752	5,711,285	826,788	----	6,735,120
16	164,295	32,752	5,711,285	826,788	200,000	6,935,120
17	164,295	32,752	5,711,285	826,788	200,000	6,935,120
18	164,295	32,752	5,711,285	826,788	----	6,735,120
19	164,295	32,752	5,711,285	826,788	----	6,735,120
20	164,295	32,752	5,711,285	826,788	592,000	7,327,120

^aThe benefits shown are those of alternative outcome number 1, i.e., at the end of the second year, the wholesaler's selling price level is attained. These and the salvage values are the only benefits that are internalized in the PAC operation.

^bSalvage values represent those of trucks in the years they are replaced.

The benefits accruing to the farmers in the same rural market area who do not directly operate with PAC are expected to be quite substantial. It must be noted that the increase considered in the rural market prices is small, but it affects a much larger volume of production, or number of farmers, than those that operate directly with PAC, hence the benefits are high.

The anticipated benefits from changes in harvested production and the reduction in marketing costs are a relatively small portion of the total program benefits. One of the reasons for this is the fact that the increase in harvested products was assumed to materialize at the peak production period, which is the time when the net value of these products for the farmer is lowest, i.e., prices are only slightly greater than farm costs.

Table IV.4 presents the yearly costs by category, in the same order that they were analyzed in detail in Chapter V. Variable costs include the assembly, processing and shipping costs. The overhead costs also are those presented in Chapter V. The costs referred to are those shown for the lower cost PAC implementation alternative of Chapter V (considering one PAC located in Bogota and truck assembly routes). The product purchase costs are increasing for the first three years reflecting the assumption made that volumes handled in PAC grow in a steady fashion to reach full capacity at the second year of operation.

Table VI.4. Yearly Costs of the Implementation of the Product Assembly Center Project in the Region of La Mesa

Year	Variable Costs (\$)	Overhead (\$)	Product Purchases (\$)	Technical Assistance and Extension (\$)	Investments (\$)	Total Yearly Costs (\$)
1	160,077	449,100	1,033,208	406,840	676,050	2,725,275
2	426,857	493,500	3,100,670	126,840	---	4,667,867
3	498,068	493,500	4,133,878	---	---	5,125,446
4	498,068	493,500	4,133,878	---	---	5,125,446
5	498,068	493,500	4,133,878	---	---	5,125,446
6	498,068	493,500	4,133,878	---	520,000	5,645,446
7	498,068	493,500	4,133,878	---	520,000	5,645,446
8	498,068	493,500	4,133,878	---	96,050	5,221,496
9	498,068	493,500	4,133,878	---	---	5,125,446
10	498,068	493,500	4,133,878	---	60,000	5,185,446
11	498,068	493,500	4,133,878	---	520,000	5,645,446
12	498,068	493,500	4,133,878	---	520,000	5,645,446
13	498,068	493,500	4,133,878	---	---	5,125,446
14	498,068	493,500	4,133,878	---	---	5,125,446
15	498,068	493,500	4,133,878	---	---	5,125,446
16	498,068	493,500	4,133,878	---	616,050	5,741,496
17	498,068	493,500	4,133,878	---	520,000	5,645,446
18	498,068	493,500	4,133,878	---	---	5,125,446
19	498,068	493,500	4,133,878	---	---	5,125,446
20	498,068	493,500	4,133,878	---	---	5,125,446

These costs are the most significant ones. They were computed at the weighted average of prices actually paid in the region. Therefore, the profitability of the private benefit cost analysis includes the potential price increases that PAC could pay to farmers.

The investment costs are those determined in Chapter V, plus the investments in trucks, which were treated in a different manner in the previous chapter. Investment costs show a reoccurring pattern which is the replacement of trucks and equipment according to the estimated life span shown in Chapter V. The technical assistance and research costs are those outlined in a previous section in this chapter; these include marketing technicians and managerial assistance needed during project initiation, as well as extension personnel who would aid in improving the farmers, handling and packaging procedures.

Other Effects

The indicators of social contribution shown above are silent with respect to other key dimensions of economic development, mainly the impacts on income distribution and employment generation.

The initial impact of the PAC operation would tend to have two main effects on income distribution. First, it would redistribute income from some assemblers to farmers, since a proportion of assemblers would be displaced from the

rural market or would face a decrease in their volumes of operation. Secondly, the stage of product recognition in the wholesale market and of higher selling prices would allow increases in farmers' incomes.

As imitative behavior and diffusion of technology in marketing operations evolves in the rural and wholesale markets, the initial price premiums received for PAC products would eventually be eroded by competition. The effect of competition at the wholesale and retail level would tend to pass on to consumers these productivity gains in the form of lower prices or added services. This implies a transfer of income from farmers and middlemen to consumers. Lower prices stimulate a greater effective demand for these products, which probably restores back to farmers part of the income transfers (depending on the demand elasticity).

Employment in rural areas would be expanded through the added harvested production, and more importantly, through the increased production that would be stimulated by this lower risk situation that PAC represents. Some small negative employment effect can be expected in the assemblers' activities, but this would very likely be more than offset by the increased employment on farms. On the whole, employment expansion can be expected with the consequent beneficial effects on the serious migration problems outlined early in this thesis.

In the rural areas the greatest benefit of PAC would probably be to stimulate increased farm specialization in fruits and vegetables. The reduction of farmers' selling risks would tend to increase the specialization in some farms. This allows for greater productivity increases and cost reductions. Assembly and transportation costs would be reduced, and there could also be some size economies in production, given the actual small volume of a given crop in a farm. More importantly, increased farm and regional specialization would make it easier for agricultural agencies to deliver their services, such as: granting credit and supervising it, extension and technical assistance, identification of research problems in production technology, diffusion of market information, and collection of crop forecasting information. Finally, it could also have a beneficial effect on the input marketing system of the region in question.

All of these effects would tend to facilitate longer run productivity increases and stimulate increased production. Output expansion in this region could reach significant levels, not only to serve the Bogota market, but also to other markets in the country, food processing activities and export markets as well.

The distribution of benefits among farmers would greatly depend on the actual implementation of the project. It would be expected that if no special commitment is given

in terms of extension, technical assistance and credit to small farmers, most of the opportunities and benefits would be captured by the more innovative farmers. This type of farmer is usually found in a higher proportion in the upper strata of the income and farm size distribution. But it must be kept in mind that a very large proportion of the farms in this coffee region are of relatively small size, as shown in Chapter III. The probable outcome would be that these middle and small size farms would take advantage of these income and employment opportunities. However, the farm survey in this study indicated that production changes and planting intentions have been most sluggish in the very small and very large farms; the response to PAC in these farms would probably be similar.

It would also be expected that farmers located near roads or pick-up points in truck routes would benefit most from the program. These farmers are the most likely candidates for expanding output of the more perishable fruits and vegetables, that are severely damaged in mule transportation. Therefore, the construction and improvement of roads is an activity that will have an important influence in the distribution of program benefits among farmers.

CHAPTER VII

SUMMARY AND CONCLUSIONS

The Diversification Program of the National Coffee Growers' Federation is directing considerable effort toward promoting the expansion of fruit and vegetable output in the Central Coffee Zone of Colombia. These efforts are part of a more general program to diversify agricultural production in the Coffee Zone to improve the income of the large number of small farmers who populate this mountainous area.

These activities of the Coffee Growers' Federation are reinforced by national social and economic development policies which give a high priority to the creation of employment opportunities and the improvement of income distribution patterns. The national development strategy attempts to stimulate rural development programs in an effort to slow rural migration and as a means of achieving a better geographical balance in economic growth. Thus, the expansion of labor intensive fruit and vegetable production and processing activities in highly populated, small farm areas of Central Colombia is seen as a highly desirable program activity.

It has been alleged that the poorly organized production-distribution system for perishable products constitutes one of the main limitations to the expansion of output of fruits and vegetables in the Central Coffee growing region.

The main objective of this study was to describe and analyze the existing rural production-assembly systems and to evaluate some of the proposed changes that might improve system performance in terms of broad development goals. The study was focused upon a sub-region of the Coffee Zone. The La Mesa region was selected for study since the potential for expanding output of these perishable products is favored by the proximity of the Bogota market and the existing natural resources. Furthermore, some basic data was available, and agricultural agencies are highly interested in promoting an expanded output of fruits and vegetables in this region.

The analysis and conclusions of this study were intended to provide information which might be of use in the program planning activities of the Coffee Diversification Program, especially concerning the product assembly center (PAC) program activities which are being conducted by its Marketing Department.

In the framework of analysis of this study the production-assembly activities are part of the larger marketing system that serves the Bogota market. In this

approach the interrelationships among the parts of the larger marketing system, mainly between the rural assembly markets and the urban wholesale market, play a critical role.

The main findings and conclusions of the study are summarized below; these are presented in the same order that the thesis was organized. First, farm production aspects are considered; secondly, the findings related to the operation of rural market are presented. Another section includes the findings concerning the proposed changes to reorganize the rural marketing system. A final section of this chapter offers some recommendations for implementation of the proposed strategy in the La Mesa region, and also, for the analysis and implementation of similar projects in other regions within the Coffee Zone.

Production

1. The typical farm in the region of La Mesa is a small, owner-operated enterprise largely devoted to coffee production. In this region, there are very diverse topographic and climatic conditions making possible the production of a great variety of fruits and vegetables. Fruits are commonly grown as a joint product with coffee, while vegetables are mostly grown above and below the optimal climatic coffee growing areas.

2. The predominant characteristic of farm fruit and vegetable production is that a single crop is grown on a very small scale, even in relation to the small size of most farms. Therefore, individual crops, especially in the case of fruit crops, are relatively unimportant in terms of farm income generation. However, since most farms grow several of these products, the total fruit and vegetable income quite often is a significant part of total farm income.

This structure of production at the farm level is one of the factors explaining why production technology remains relatively primitive. This is especially true in the case of most fruit production. Vegetable production tends to be organized on a relatively larger scale than fruits (but still quite small in absolute terms); hence, their importance in generating farm income is greater. Consequently, the technological levels observed in vegetable production are more advanced than in the case of fruits.

3. This leads to the conclusion that the adoption of modern production techniques which are necessary to satisfy the rapidly growing urban markets as well as potential export markets--in terms of quality and quantities--requires that the existing patterns of production be altered so that single crops have a greater relative importance, i.e., greater farm specialization in fruit and vegetable production.

In a historical perspective, it must be realized that this kind of production might have served well the urban demands in the past; but increasingly demanding urban markets cannot depend in the future on this kind of uneven and unstable production. Therefore, if longer run efforts are not undertaken to foment production changes in the Coffee Zone, the price mechanism will probably stimulate new production in other areas. It must be realized that large scale, more mechanized, fruit and vegetable production in the valleys of Colombia is just starting. Hence, if the fruit and vegetable output of coffee zones remains static, larger scale production in other areas may take an increasing share of the fruit and vegetable market. It might be expected that a trend toward large scale production would have negative effects on income distribution and employment in the Coffee Zone. This is an important consideration for policy makers in the agricultural sector due to the great number of farms that could be affected in the longer run if these trends prevail.

The change in production structure in the small Coffee Zone farms can be stimulated only if marketing risks are reduced and appropriate technical assistance is directed toward both farm production and assembly market operations.

4. The adoption of more modern production techniques would have a substantial positive impact on employment and incomes within the region, as shown by available

cost-yield relationships. Commercial production of fruits and vegetables compares favorably to traditional coffee in terms of labor requirements and income generation. This makes commercial fruit and vegetable production a highly desirable opportunity in this region since there appears to be significant underemployment and low levels of income on a high proportion of the farms.

5. The main limitations to expand the marketed output of fruits and vegetables seem to be: (1) the relative scarcity of labor in the coffee harvesting season, when many of the fruit and vegetable crops typically are ready for harvesting; (2) the lack of effective demand in the Bogota market (which is the main market for this region) for absorbing large increases of market offerings of fruit products such as, for example, mangoes; (3) the ineffective operation of rural markets which pose a high degree of risks and uncertainties, as discussed in the following section; and (4) the relative scarcity of supporting services for fruit and vegetable production and marketing, such as technical assistance, extension, credit, availability of improved seeds and grafted trees, etc.

Rural Markets

1. The supply of fruits and vegetables in a given day in the rural markets is characterized by great product diversity and a substantial variation in product quality.

This heterogeneity in the supply is the result of the large numbers of small lots offered by a great number of individual farmers.

2. The unstable and heterogeneous character of the rural assembly market supply makes assemblers' operations quite risky. Assemblers, in attempting to stabilize their businesses, typically must handle a wide variety of products.

3. The rural assembly markets are characterized by having a small number of buyers, which is related to the low volume of products reaching each market. There is an interdependent behavior among the buyers in these markets. Given the scantiness of buyers and their interdependent conduct, these markets typically can be characterized as having an oligopsonistic structure. Within these markets the individual farmer generally has a weak bargaining position, except at times of product scarcity. There are tendencies for buyers to arrange informal arrangements to restrict the range of competition, but the ease of market entry for new buyers, limits the degree to which these agreements may be accomplished.

4. The prices in these rural markets follow the variations of the Bogota wholesale market prices. A statistical analysis showed that for most products absolute price spreads tend to be constant as the level of prices raises and falls with seasonal variations in marketings.

5. The weighted average gross margin of assemblers for a representative group of fruits and vegetables was 25 percent. This margin covers their operations which include transportation to the Bogota market, the buying and selling operations, occasionally granting credit, and a few sorting and storing operations on some of the products handled. If the services performed are considered, these margins seem relatively costly, but substantial efforts in terms of the assembler's time are required to perform the buying and selling functions, and since the volumes handled per assembler are relatively small, assembler incomes are not too high.

Close to 7 percent of the rural assemblers' sales are real profits, although the computations to reach this figure do not include price and product losses that are often incurred. Therefore, this profit estimate is somewhat overestimated. This level of profit does not seem to be excessively high, given the high risks involved in the assembler operations and considering the level of profits obtained by other middlemen (wholesalers) in the same line of business. If profits were excessive, it would be expected that new assemblers would enter these markets, since there are no significant barriers to market entry.

6. The performance of the rural production-assembly is limited in important aspects described below:

- a. Poor vertical coordination and poor pricing efficiency are associated with lack of standard product classifications, and poor communication networks for transmitting market information from the urban wholesale market to rural assembly markets and to farmers.
- b. The logistics of assembly in rural markets has developed in such a way that farmers must transport small volumes over relatively long distances by mules. The low density of production, the scarcity of roads, and the instability in producer-assembler relationships have served as barriers to the formation of a lower cost truck assembly system.
- c. The low degree of vertical coordination between the participants in these traditional marketing channels has acted as a disincentive to improvements in product quality and in the handling and packaging operations, all of which results in a high level of physical product losses in the flow of products from farmers to consumers. The physical functions have been performed in virtually the same way for many years. Thus, the rural marketing system has not been progressive. To some extent, the lack of progressiveness has been a consequence of the small size of the existing firms in these marketing channels. The risks and/or costs involved in introducing

an improved operating practice might be too high for a single firm to afford.

7. The performance results in rural markets to a great extent are the result of the kind of exchange relationships and physical marketing functions that exist in the urban wholesale market. The operations in rural markets can be seen as an extension of those that exist in the wholesale market. This has an important implication for rural marketing improvement programs; such programs can be much more successful if they are coordinated with parallel efforts to improve the wholesale market operations.

Evaluation of Proposed Changes

The situation summarized above indicates that some of the essential characteristics of a strategy to improve the performance of rural assembly markets must emphasize the reduction of farmers' and wholesalers' risks which may be achieved through better vertical coordination arrangements. Such arrangements would permit a better pricing system with the introduction of a product sorting and classification scheme. This strategy must also emphasize the improvement in the physical functions performed in the marketing operations, since there are potential economies that can be realized from better product handling and packaging.

Within this general context, the Diversification Program of the Coffee Growers' Federation has been considering a vast program for establishing product assembly centers (PACs) for fruits and vegetables in selected regions throughout the Central Coffee Zone of Colombia. As part of the initial efforts, two product assembly centers have been operated as pilot projects. The product assembly centers are facilities which would provide a reliable local market outlet for farmers. Products would be sorted and packaged for shipping and later sales. The operation of PACs is expected to increase competition in rural markets, and affect the operation of urban wholesale markets. PACs could be an element of change in the production-distribution system for fruits and vegetables. Improved methods of performing the physical and exchange functions would be implemented. It would be expected that through time these improved methods would diffuse through the system permitting important improvements in performance.

This study examined from an economic standpoint a PAC program in the La Mesa region. An analysis was conducted to identify the lower cost alternative PAC arrangement comparing various numbers, sizes and locations of PACs. The main findings were as follows:

1. An assembly method based on pick-up or purchasing points along predetermined truck routes would reduce farmers' marketing costs and save them considerable time

when compared to present practices of transporting products mostly by mules to rural markets. The existing road network is not adequate to serve farmers in all parts of the region with a truck route assembly method.

2. Four types of product assembly centers of different sizes were analyzed. The largest ones have the lower unit costs of within center handling, while the smallest ones have the lower costs of product assembly, but, since variable assembly costs are a minor component of total costs, the largest PAC capacity (170 metric tons per week) had the lowest total unit costs including all the operations, from product pick-up to sale in Bogota.

3. Three alternative PAC arrangements were analyzed, one considered a large size PAC located in the Bogota wholesale market, another considered the establishment of three medium sized PACs in the main rural markets of the La Mesa region, and the last alternative considered five small PACs also located in rural markets. The alternative considering one large PAC in the Bogota wholesale market had the lowest total costs for handling the total yearly target volumes.

4. The short-run, economic feasibility of this lowest cost PAC alternative largely depends on the ability of the PAC organization to merchandise products in the wholesale market. If PAC products are only sold at prices being paid by existing wholesalers, the PAC's costs would not be covered. However, if PAC could operate a wholesaling

stall in the CABSAs wholesale market in Bogota and sell products at prices equal to those being obtained by other wholesalers, the PAC would be a feasible economic enterprise. Over a longer period of time as PAC gained market recognition for high quality well packed products, there would be an economic opportunity for achieving greater economic gains that could be passed back to farmers.

5. A strategy that might allow PACs to achieve successful economic results in the short and long run would be to initiate operations with small volumes, capturing the narrower demand for higher quality products. This could imply lower overhead costs and possibly price premiums, even in the short run. Gradually, the volume of operation could be increased together with a build-up of managerial and technical capabilities, allowing for a sound economic operation over the longer run.

The preceding points refer only to the economic feasibility from the private enterprise viewpoint. It must be emphasized that the activities of PAC would facilitate and stimulate cost reductions both in farm production and in urban distribution. These potential economic gains have not been taken into consideration in the economic feasibility analysis since they are external to the PAC organization accounts. However, the external economic impacts of PAC operation were included within a framework of social benefit-cost analysis.

6. The benefit-cost analysis included the PAC's internal costs and benefits and some quantifiable external impacts on farmers, assemblers and wholesalers. The social benefits considered quantitatively were: (1) the net value of the reduction in farmers' marketing costs and time that the PAC assembly method would imply; (2) the net value of the expected short-run increase in harvested production of fruits that the PAC operation would stimulate; and (3) the probable impact of the PAC program on the prices paid in the rural markets of the region.

This benefit-cost analysis showed positive economic results. The benefit-cost ratio fluctuated between 1.25 and 1.13 for the different market outcomes considered. The internal rates of return ranged from 0.77 to 0.47. These indicators show that social investment in this activity would be highly desirable since commercial interest rates (which may be taken as a proxy for the social opportunity cost of capital) are slightly higher than 0.18. Financing a PAC program through international development agencies or banks would also be feasible since their rates are much lower, fluctuating around 8 percent.

7. The private benefit-cost analysis, or financial analysis showed relatively unfavorable economic results. The benefit-cost ratio ranged from 1.08 to 1.04 for the different outcomes considered and the internal rate of return fluctuated from 0.2 to 0.33. Furthermore, the

initial years of operation would yield losses, and the payback period would be somewhat lengthy for a private entrepreneur--from three to seven years. These results indicate that probably no private organization would undertake the PAC activity, given the risks involved and the existing alternative investment opportunities.

8. The preceding findings show that the benefits accruing to economic units other than the PAC organization, or externalities, are substantial. The implication of this is that public support of some kind is needed for the PAC organization if it is to be undertaken at all by a non-public organization. The main difficulty for private initiative to undertake a PAC operation is the initial investment cost needed to set up the organization and the probable initial losses. This implies that the public support could take the form of personnel and/or financial assistance in initial stages of the program implementation and planning. This support could also include applied research to identify adequate product handling and packaging methods.

9. In addition to the benefits mentioned above, the PAC operation would enable and stimulate several other changes in different stages of the marketing system. These secondary benefits have not been incorporated to the benefit-cost analysis shown above although they could possibly be more important than the primary benefits.

At the wholesale level, market recognition and the possible price premiums for PAC products would stimulate imitative behavior on other wholesalers. These wholesalers would adopt similar physical handling and exchange operations with the consequent improvement in efficiency and reduction in marketing costs.

Retailers would also benefit from the availability of sorted products with longer shelf life. Their costs would tend to be reduced since they could probably reduce the frequency of procurement trips to the wholesale market, and also, the availability of sorted products in their stores should tend to increase their sales.

Competition at retail level would eventually tend to pass on to consumers the cost reductions obtained in retailing. Consumers would also benefit from a more stable and better assortment of supplies of these perishables in the retail stores. The end result would be an expansion of the effective demand for these products.

10. Other probable effects of PAC relate to the longer run reorganization of production at the farm level. The slightly higher prices that PAC would be able to pay to farmers and the reduction in market risks that it may accomplish, would tend to stimulate increased production of fruits and vegetables. It is quite probable that these effects would also stimulate increased farm specialization in fruits and vegetables, allowing for an improvement in

production and marketing techniques with the consequent cost reductions that this would imply.

11. Increases in farm income and employment would come about not only from the higher prices and lower farm marketing costs stimulated by PACs in the short run, but more importantly, from the longer run increase in production and farm specialization.

12. The effects of the PAC program activity in the La Mesa region would also imply a greater regional specialization. The expected improvements in fruit and vegetable production and expanded output, eventually could not only serve the Bogota fresh market, but also processing activities and export markets as well.

13. The short run impact of the PAC program on the distribution of incomes would tend to favor farmers, transferring income from consumers and assemblers. These transfers would be in the form of higher retail prices and some displaced resources of assemblers. In the long run, most of the additional benefits obtained from higher prices would disappear since it would be expected that the imitative behavior of other wholesalers would erode the initial higher prices. The beneficiaries of most of the improvements in the marketing system would then be the consumers, provided that effective competition prevails at all the stages of the marketing process. In the longer run, the income position of farmers and middlemen will depend on the real

productivity gains obtained, the speed and degree of diffusion of these productivity gains, and the elasticities of demand for these perishable products.

These findings and conclusions should be a contribution to a more comprehensive analysis of the rural production-assembly systems for fruits and vegetables in the entire central Coffee Zone of Colombia. Furthermore, the strategy for improving the performance of the rural marketing system that has been elaborated in some detail, and justified in economic terms, should contribute to the broader development programs within the Colombian agricultural sector.

The implementation of this strategy is a difficult task, especially in its institutional aspects. The basic data obtained for this study and the findings and conclusions elaborated suggest the following recommendations for guiding the efforts within the specific region of the study as well as in a larger program for the entire Coffee Zone.

Recommendations

1. A strategy for improving the marketing system in rural areas should place considerable emphasis on those dynamic aspects which can stimulate basic changes in the overall fruit and vegetable production-distribution system. This view implies focusing on the search for institutional arrangements which will facilitate improvements in vertical

coordination and market exchange processes. It also implies focusing on the development and diffusion of new technology in farm production and in product handling at the different stages within the marketing channels. Under this view, publicly provided services of marketing support such as market information, grades and standards, applied research and extension are important components stimulating the desired changes in the system. An important part of the benefits identified are the result of the demonstration effect and diffusion of new methods, therefore, a critical element for economic success are the resources committed to this diffusion process.

2. The success of any rural marketing program depends to a great extent on its ability to relate to urban wholesale markets. The PAC program implementation should emphasize the involvement in the wholesale market. Competition in the wholesale market tends to be much stronger than in rural assembly markets, and the commercial skill required to operate in wholesaling is much higher also.

From the viewpoint of diffusing technical innovations in the system as a whole, the greater emphasis on urban wholesale markets also seems justified. Increased efforts for diffusion of improved techniques and exchange relationships will probably have a greater impact on the total marketing system if they are carried out at the wholesale level than if comparable efforts are done only

in rural areas. The reasoning is simple: The imitative behavior of other wholesalers to keep up with competition will rapidly bring about changes reaching back into assembly markets. Wholesalers can exercise a dominant position in the marketing channels for perishables, and their market power in a given channel may be quite significant.

3. Since the wholesale market is so critical for the economic success of a PAC program as well as for the diffusion and change in the fruit and vegetable production-distribution system, it is recommended that the wholesaling operations for the PAC program serving the La Mesa region be located in the CABSAs central wholesale market in Bogota. These wholesaling operations initially should not be too different from the ones of existing traditional wholesalers. Gradually, changes could be introduced. This would probably foster an imitative behavior; drastic initial changes would tend to discourage such behavior. Wholesaling operations would also be a faster way of achieving market recognition for PAC products. This recognition would permit higher selling prices and a higher program profitability, which would, in turn, stimulate a faster imitative behavior from wholesalers with the consequent beneficial changes this brings.

It is recommended that the PAC wholesaling operations be coordinated with the urban marketing improvement programs being conducted in Bogota. The recent initiation



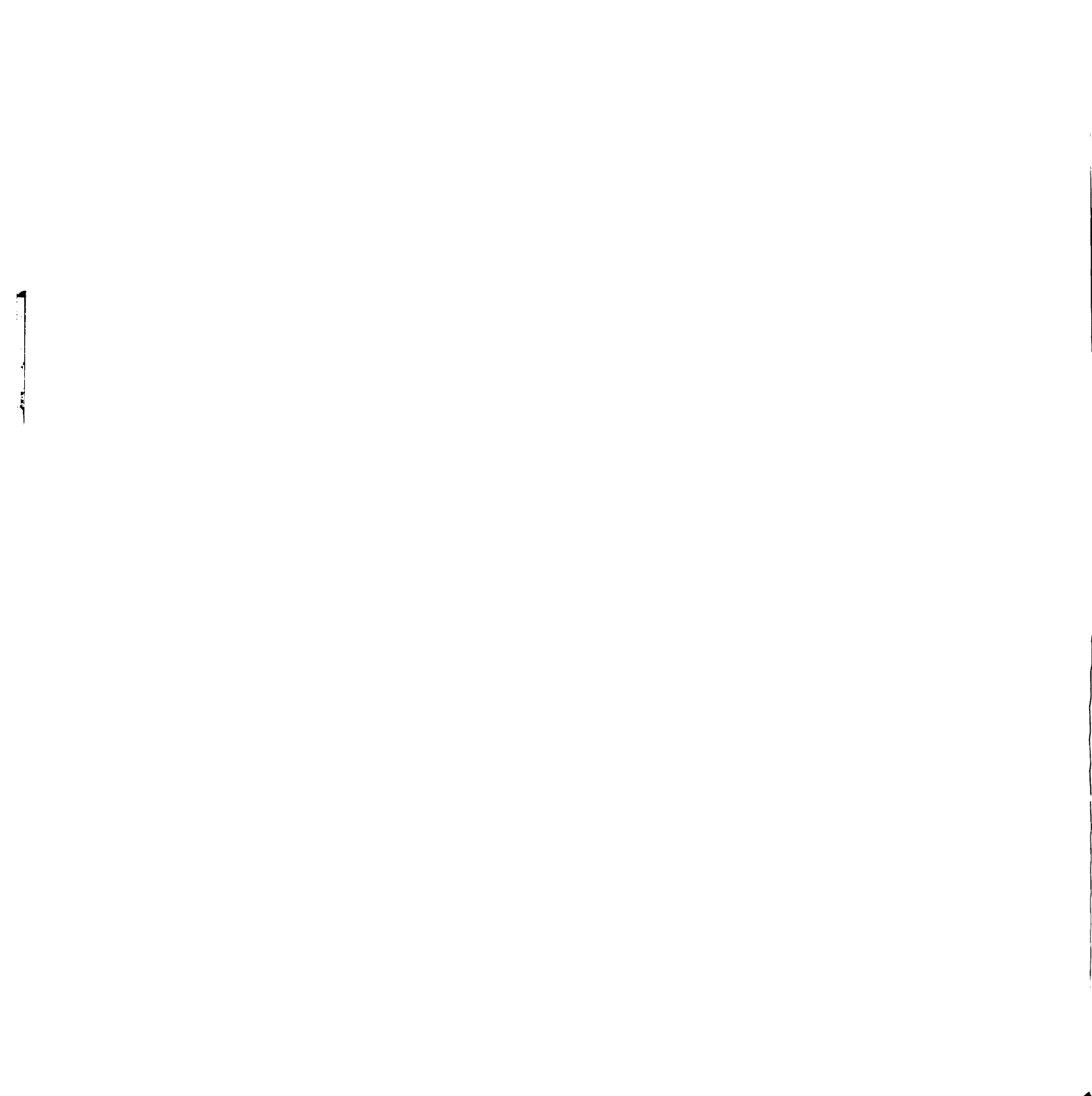
of operations at the new central wholesale market of CABSA provides an adequate basis to operate with innovative wholesale arrangements. Furthermore, CABSA is interested in promoting these kinds of changes in the wholesaling system. Therefore, a natural complementarity exists between the PAC and CABSA programs.

The PAC wholesaling operation should attempt to find better ways of performing the wholesaling functions. One possibility is to design a full-line delivery system for perishable products serving retail stores in Bogota. This alternative could be initially performed on an experimental basis in close coordination with the PAN program. This program groups a considerable number of retail stores with the purpose of promoting changes to facilitate the retail procurement functions.

The considerations above indicate that the locations of a PAC in a wholesale market is preferable to rural locations, apart from the lower costs it implies. Furthermore, a wholesaling operation can attain a greater stability in the volume of operation and a more complete line of fruit and vegetable products than what most rural locations could have, since at times of production scarcity in the La Mesa region products of other regions could be purchased. Both of these characteristics, stability of supplies and having a more complete line of products, would permit a better wholesaling operation.

4. The comments mentioned above concerning the needed emphasis on the urban wholesale markets do not mean that the efforts to obtain effective changes in the rural markets are easy or simple. Changes at both stages are needed. As mentioned earlier, the most fundamental change needed in production is to increase the degree of importance of a single (or few) fruit or vegetable crops at the farm level, i.e., greater farm specialization in these perishable products. This requires several complementary services such as: credit (especially for fruit plantings in small farms), market information and technical assistance. It also requires applied research on new and/or improved varieties and products, on product handling and packaging, on improved production techniques. Supplies of improved seeds and grafted trees, which are relatively scarce in the region, must be arranged. Most of all, farmers need a reliable market outlet for their products which PAC would provide.

The PAC program should coordinate closely with other institutions in this region which are providing some of these services; the various programs of the Coffee Federation, INCORA's extension and fruit research programs, Caja Agraria's credit programs and ICA's research and extension activities could effectively collaborate with the PAC organization.



In attaining the production structure changes, it is also important to commit efforts in the field of cooperative education and development, especially in a small farm region such as La Mesa. This is seen as a future potential means of fostering an active participation of farmers themselves in improving their market position and modernizing their farm operations.

Without changes in the production structure at the farm and regional level, it is hard to visualize the evolution towards the existence of a highly efficient production-distribution system of fruits and vegetables. This observation is to some extent also valid for the larger Coffee Zone, since the production patterns throughout the zone are similar. The region of La Mesa, as well as the Coffee Zone, have great potential for increasing the supply of these products for the internal and the export markets.

5. An important issue is which farmers will capture the increased opportunities for expanding incomes and employment in the rural area--the few large farm-owners existing in the Coffee Zone or the great majority of small and middle-sized farmers?

Generally, low income has been a deterrent to technical change; therefore, expansions of production would probably not come from very small farms. This is especially clear in the case of fruit plantations where long term investments are required. The basis of this argument,

previously shown in this study, is that small farmers have an objective of avoiding risks that would place their financial position below a minimum level of income. In many cases, these production changes would imply such risks; therefore, no major changes could be expected in the stratum of small farms with low incomes, unless special measures are taken. Most of the production increases would probably come about on middle-sized farms and some large farms.

If the objective of stimulating production increases on small farms is undertaken by the agencies of agricultural action, measures specifically directed to small farms would foster the accomplishment of this objective. Such measures could include credit, technical assistance, education programs, cooperative promotion and the action of PAC itself. In this way, the goals of redistribution of income and income opportunities, as well as increased employment and reduced migration, which are stated objectives for the agricultural sector of Colombia, would probably best be accomplished. If the existing social and economic forces are left alone, expansions of production would probably come about from higher income farmers, and in a longer run, negative price effects could be felt by the small farms producing these products with the consequent negative impact on their incomes.

This should not be understood as a call to preserve the relatively inefficient patterns of production but only

as a warning of what the effects would be if the system change is not carefully managed to accomplish its objectives.

6. The institutionalization of PAC poses a problem since the benefit-cost analysis showed that this program would not be an attractive opportunity for private entrepreneurs. Even if it was, the private activity probably would not have the same objectives stated for PAC, especially as it relates to effecting changes in the marketing system. However, the benefit-cost analysis showed that from the social viewpoint, the expected economic effects make this program a desirable one. Public support of the program seems justified.

One possibility would be to stimulate the establishment of PAC within existing base institutions such as farmer cooperatives (i.e., Coffee Federation cooperatives or INCORA sponsored cooperatives). Support of interested agencies, such as the Coffee Diversification Program which is attempting to organize a PAC program, could take the form of human resources for managerial support, financial assistance and technical advising in the initial stages.

The implementation should be gradually done aiming initially to reduce overhead costs and capture the high product quality segment of the consumer market. This would provide a "testing ground" for designing operations, building up management, training personnel and provide specific needs to researchers for improving the physical functions

performed. It must be realized that probably the most crucial aspect in this kind of project lies in the managerial and commercial capability of personnel since most of the problems are basically of an organizational type. Investments in physical facilities should only have a secondary role.

On the basis of this study several recommendations are given for the larger program of the Coffee Diversification Program, which aims to establish PAC in several selected regions of the central Coffee Zone of Colombia:

a. Careful demand studies should be undertaken to identify what products should be promoted since the effective demand for these products might not be easily expanded. In some cases this could be quite limiting for a larger program embracing a wider geographical region. This is especially critical since the demand for these products is probably price inelastic, hence, significant production expansions could have serious negative price effects. This would have detrimental income effects on some farmers, especially in the case of fruit trees which are fixed assets that cannot be replaced in the short run, therefore capital losses might be realized.

The indications obtained from the demand studies should provide a guide for orienting the necessary applied research, extension and credit resources necessary to stimulate production. Economic studies of demand should

precede the efforts of technical assistance to farmers and not inversely.

Another dimension of importance in these demand studies should be the analysis of the different segments of demand in terms of product quality. This seems important in view of the emphasis that PAC program has in product handling. A program as large as the one contemplated by the Coffee Diversification Program could well run into the problem of overemphasizing the probable demand for high quality products. Some notion of the magnitude of this demand is needed, since the expectation of this demand would affect the planning and even the physical facilities and equipment that PACs would have.

b. The identification of product demands and of the opportunities offered should be followed by a careful analysis of the adjustment problems of coffee farms in shifting to a greater specialization in fruit and vegetable production. This analysis should consider crop combinations in view of the different degrees of risks imposed by the different crops. The analysis should also include the possibility of labor constraints at the farm level. Such a detailed analysis should aid in identifying the possible implementation measures that could direct a substantial part of the output expansion and farm specialization opportunities to small farms, where change seems most necessary and most difficult.

Farm production adjustments should be complemented with regional analyses so that the aggregate increased farm specialization results in increased regional specialization. Regional specialization can significantly contribute in the way of building a more efficient production-assembly system capable of supporting processing activities and serving export markets. Credit programs should also be monitored in a coordinated way to accomplish increased regional specialization.

c. The specific results and recommendations for implementing the PAC program in the La Mesa region may not apply equally well in other parts of the Coffee Zone. However, the methodology used is directly applicable to other regions within the central Coffee Zone, in determining the method of assembly, the number, location and size of PACs. A generalization regarding the specific decisions cannot be made since the underlying conditions are different, even within the Coffee Zone.

8. A final issue that must be raised is an important policy question which is part of the larger employment problem faced by the agricultural sector of Colombia. The support and later implementation of PAC will tend to improve the efficiency in the production-assembly systems for fruits and vegetables in the central Coffee Zone, which is the most densely populated region in the country. The effects of PAC would be highly desirable in terms of employment generation.

If increased efforts are not committed to improve the fruit and vegetable production systems in this zone, it would be expected that increased demand (and perhaps prices too) would tend to stimulate fruit and vegetable production on large scale operations in the numerous valleys in central Colombia. Such increases in production could be mechanized to a larger degree, and operate at much lower unit costs than the small coffee farms. This has been the case in some fruits, as grapes, oranges in the Cauca Valley, and vegetables in the Sabana surrounding Bogota. The longer run effect of these shifts in the regional pattern of production and output expansion could tend to lower prices, decreasing or keeping at a standstill the production of these perishables in the Coffee Zone. The result of these changes could be decreased employment (due to more mechanized operations) and unfavorable effects on income distribution.

These changes and effects should be interpreted as a speculative hypothesis, but changes underway in the cases illustrated above indicate that this might be the direction of future changes. Similar effects could be expected from production expansions coming from the Atlantic region of the country, which is largely devoted to export markets, but directing some of its lower cost output to the internal markets. This policy problem on the kind of farming in which output expansion of fruits and vegetables should be

stimulated with publicly financed efforts should be regarded in the agricultural sector decision-making bodies, since it involves a substantial amount of employed resources and is an important efficiency-income distribution trade-off.

APPENDICES

APPENDIX A

POPULATION OF FARMS AND SAMPLING PLAN

The population was defined as all the economic units (farms) included in the municipios of Anolaima, La Mesa, Tena and Anopoima. This population consists of 6778 farms that include an area of 38,270 hectares (94,525 acres), according to the 1970 Agricultural Census.

There is a clear relationship between altitude and climate that affects production possibilities. Therefore, the population was stratified according to altitude in three strata: (1) below coffee zone, included farms located up to 1200 meters above sea level, (2) the coffee zone stratum included farms from 1200 to 1800 meters, this is the optimum altitude range technically recommended to grow coffee; and (3) the stratum above coffee zone which included all the farms above 1800 meters.

Another hypothesized relationship was that farm to market distance affected the marketing process of an individual farm, and its production possibilities. Four strata were established to account for this effect: (1) 0 to 3 kilometers; (2) 3.1 to 5 kilometers; (3) 5.1 to 8 kilometers; and (4) more than 8 kilometers.

A major difficulty confronted was that there was no frame of the population. This led to adopt a two stage sampling process with conglomerates (veredas) as sampling units of the first stage, and farms as the sampling unit of the second stage.

The distribution of the population in the different strata were determined in the following way:

1. A frame of veredas (the first stage sampling unit) was obtained from unpublished data of the National Department of Statistics (DANE) obtained in the 1970-71 Agricultural Census.
2. The veredas were located in an altitude map categorized according to the different strata

defined. For this purpose, DANE's maps were utilized, identifying in them all the markets.

3. Lastly, the number of farms and total hectares in each vereda were also obtained from DANE. This allowed the determination of the total number of farms and hectares in each stratum.

It should be mentioned that the concept number of farms per vereda was not available at the time this research was being done. The Census data instead had the number of parcelas per vereda, a very similar concept to farm. This unit was adopted as a proxy for farm in the sampling procedure of this research.

The distribution of the population in the strata is shown in the following table (Table A.1).

Table A.1. Distribution of the Population of Farms in the Region with Respect to Altitude and Distance to Market (number of veredas and % of total population of farms)

Distance to Market	Altitude			Total
	Below 1200 Meters	1200 to 1800 Meters	Above 1800 Meters	
0 to 3 kilometers	5 4.3%	21 25.6%	1 2.1%	27 32%
3.1 to 5 km.	8 6.1%	11 14.3%	1 0.9%	20 21.3%
5.1 to 8 km.	15 15.4%	14 13.1%	3 4.9%	32 33.4%
More than 8 km.	23 12.1%	1 0.6%	1 0.6%	25 13.3%
Totals	51 37.9%	47 53.6%	6 8.5%	104 100%

This distribution of farms was the basis for allocating in a proportional way the total sample.

Total sample size was 63 farms, or about 1 percent of the population. This seems a relatively small sample size, but there was evidence from previous farm interviews made by CORABASTOS in this region (in 1970), that a great proportion of the farms were strikingly similar in many ways, especially in the coffee zone. Furthermore, time and human resources were limited.

The interviews made by CORABASTOS were categorized into the same strata, and incorporated for some of the variables analyzed. These interviews were 93, so that basic information on 166 farms was available (over 2.2 percent of the population).

Veredas were taken at random from each strata. Three to seven farm interviews were made in each vereda depending upon the number of farms they had; in an exceptional case in a vereda that only had three farms, only one farm was interviewed.

Once the veredas were chosen, the major roads or foot-paths for each vereda were localized in a map, and the approximate area in which to interview each farm was determined, trying to evenly distribute these farms along the roads and/or paths.

In the actual field work it was seen that the maps used were not exact regarding the area of different veredas or the different roads. Also, some previously unknown small market places were found. For these reasons, some of the farms interviewed had to be reclassified.

The final sample had the following distribution: 14 farms (22 percent) in the stratum below coffee zone, 39 (62 percent) in coffee zone and 10 (16 percent) above the coffee zone. Four farms had to be discarded from the sample for most of the analytical purposes, due to deficient or unreliable information.

APPENDIX B

AN ASSEMBLY-COST FUNCTION

A generalized assembly cost function was developed to suit the different operations involved in the assembly process. The method used to construct this function is based on the procedures of synthetic cost analysis.¹ The advantage of having a generalized cost function is that it can be used in different situations, locations or with varying factor prices.

The product assembly process involves several operations which are listed below:

1. Truck transportation.
2. Product inspection and purchase (determining quality and quantity and other functions of purchasing).
3. Loading and unloading the products to and from the truck which also involves arranging the load in the truck.
4. Loading and unloading empty boxes.

These operations generate costs as a function of volume, time, distance and the interrelationships among these variables. Most of these operations have costs with two main components: a constant unit cost and a variable unit cost that is a function of time or distance, or both. These costs have been expressed as linear functions, which is not necessarily true. The cost behavior could have a different functional form, but due to the limitations of time and for the sake of simplicity, the assumption of linear functions are made.

The empirical data to use in the function was obtained by actual measurement of time in these kinds of assembly processes carried out in La Mesa and Manizales.

¹Black, op. cit.

Definition of Variables

CA = Total assembly costs (pesos).

D = One way distance of a trip or route (in kilometers).
D can be disaggregated into:

Df = Constant distance to a given point in a rural road.

Dv = Variable distance in a route; this depends on the volume sold by each farmer, the distance between farms or buying points and truck capacity.

T = Time (hours).

V = Density of production in an area or route. It can be expressed, depending on the case, as:

Va = Average volume sold by a farmer in each buying day in a given route or buying point (ton).

Vb = Volume of product bought per kilometer in a given route.

Vc = Volume bought per square kilometer in a given area divided by kilometers of road in the area.

h = Distance between farms or buying points.

t = Necessary time to purchase products from one farmer. It can be expressed as (hours):

$$t = z + iVa,$$

where z is the constant time spent in each purchase and i is the time in loading (and unloading) the volume bought.

M = Personnel and labor costs in a truck assembling products in a route (pesos per hour).

j = Fixed costs of truck (pesos per hour).

v = Truck variable costs per kilometer. It is an average figure of loaded and unloaded trucks.

p = Percentage of unutilized truck capacity.

b = Speed of truck transportation.

K = Truck capacity

The assembly cost function is:

$$1. \quad CA = T(M + j) + D \cdot v$$

$$2. \quad \text{Defining: } T = D/b + (K/va)t$$

$$3. \quad t = z + iVa$$

$$4. \quad D = 2[Df + (K/Va)h]$$

$$(M + j) = A, \text{ a constant.}$$

$$5. \quad CA = \frac{DA}{b} + \frac{KA}{Va} (z + iVa) + D \cdot v$$

$$6. \quad = D\left(\frac{A}{b} + v\right) + K\left(\frac{Az}{Va} + Ai\right)$$

If we make $\left(\frac{A}{b} + v\right) = B$, a constant,

Substituting 4 into 6.

$$7. \quad CA = 2B\left(Df + \frac{K}{Va}h\right) + K\left(\frac{Az}{Va} + Ai\right)$$

Rearranging, we obtain:

$$8. \quad CA = \frac{K}{Va}(2Bh + A) + KAi + 2Bdf$$

And the unit costs per ton would be:

$$CAU = \frac{1}{Va}(2Bh + Az) + Ai + \frac{2DfB}{K}$$

Considering the utilization of truck capacity:

$$CAU = \frac{1}{Va}(2Bh + Az) + Ai + \frac{2DfB}{K(1-p)}$$

Empirical Determination of Assembly Costs

The value of B, A, Z, i, K and p are empirically observed constants that will be shown next.

$$M = \frac{\$3,020 + \$750}{200} = \$18.84, \text{ labor cost per hour including the purchasing agent and assistant.}$$

j = \$49.58, the determined fixed truck cost per hour. A six metric ton truck was considered (see next section).

v = \$0.954/km. (see next section).

b = 20 km./hour on dirt roads of the region.

Z = 3 minutes by farmer (0.05 hour).

i = 1.08 man-hours per ton. Since the truck has two men loading and unloading, the time of this operation is 0.54 hours per ton.

K = 6 tons.

p = 0.25.

These values determine A and B:

A = \$68.43--Total cost of the truck per hour including the personnel.

B = \$4.375--Total cost of the truck per kilometer on dirt roads in assembly.

$$CAU = \frac{1}{V_a} (8.75h + 3.421) + 36.95 + 1.944Df$$

Taking a value of $V_a = 0.2$ ton of product per farmer,

$$CAU = 43.75h + 54.055 + 1.944Df$$

If $h = 0$; that is, if a truck load is obtained at one buying point, unit assembly costs are:

$$CAU = 54.055 + 1.944Df \text{ (in pesos per ton).}$$

In a longer run, truck drivers with experience and training could also perform the functions of buying agents (product inspection and purchase), thus lowering assembly costs. In such a case, unit assembly costs per ton would be:

$$\text{CAU} = 42.128 + 1.608Df \text{ (in pesos per ton)}$$

Variable and Fixed Costs of Trucks

Truck costs can be disaggregated into fixed costs per unit of time (year, month, day or hour) and variable costs per average kilometer traveled. Calculations to determine these costs are shown next.

Truck: 6 metric ton capacity

Price: \$260,000 pesos

Usable life: five years

Residual Value: \$100,000 pesos

Depreciation: \$160,000 pesos

Average capital invested: \$180,000 pesos

Fixed costs per month:

Driver's salary ²	\$2,775
Truck assistant ²	1,359
Insurances	556
Depreciation	2,666
Taxes	60
Parking, wash, others	100
Interest over invested capital (16%)	<u>2,400</u>
Monthly total	\$9,916

²Includes salary bonuses and 51 percent of social security contributions.

Variable costs per kilometer:

Fuel	\$0.289
Lubricants	0.075
Tires and maintenance	0.450
Repairs	<u>0.150</u>
Total per kilometer	\$0.954

Sources of Information:

1. INTRA (Instituto Nacional de Transporte), "Costos de Operacion de Camiones de Diversa Capacidad" (Operating Costs of Trucks of Different Capacity), Internal Working Document, August, 1972.
2. Departamento de Mercadeo, "Costos de Transporte Contratado y Propio para Acopio y Distribucion de Productos Agricolas Percederos en Centros de Acopio de Cartago," Internal Document, Programa de Desarrollo y Diversificacion de Zonas Cafeteras, July, 1972.
3. Karl Wierer, Economics of Improving Marketing Organization and Facilities to Accelerate Agricultural Development in Land Settlement Projects, ILMA (Bogota, September, 1967), pp. 118, 130, 178, 179. This includes cost data on interviews of 85 truckers.
4. N. Suarez and C. Bonilla, El Sistema de Transporte de los Productos Alimenticios en la Zona de Influencia de Cali, Informe Tecnico No. 8, PIMUR (Cali, Colombia, 1970).
5. Personal interviews with truckers in the La Mesa region.

Transportation Costs to Bogota

The assembly cost function developed earlier can be adopted to obtain the transportation costs to Bogota, included in the shipping or distribution costs.

The different PAC requirements imply two basic methods of product transportation: (1) from the PAC operated in the region and (2) directly to Bogota from the farm or buying point in a truck route. This second process implies fewer operations since products do not have to be unloaded and loaded at a PAC in a rural location.

The cost function for these transportation processes would be:

$$(1) C_d = A_i + \frac{2DfB}{K(1-p)}$$

$$(2) C_d = \frac{2DfB}{K(1-p)}$$

The values of the constants in this function are different from those of the assembly function, and have been determined from the same sources used for the assembly information. The values of the constants for both transportation methods are given below:

	<u>Method 1</u>	<u>Method 2</u>
M	\$15.00	\$18.85
j	\$49.58	\$49.58
A	\$64.58	\$68.43
b	30 km/hour	30 km/hour
v	\$0.954/km	\$0.954/km
B	\$3.106	\$3.235
i	0.54 man-hours	0.54 man-hours
p ³	0.85	0.75
Df	66.3 km	66.3 km
Average Cost per Ton	\$117.21	\$97.14

³The value of Df used is an average of distances from Bogota to the different potential PAC locations. The range is between 54 and 84 km.

APPENDIX C

OPERATING COSTS IN PRODUCT ASSEMBLY CENTERS

The operating cost calculations follow the synthetic cost analysis method. Several sources of information had to be used to construct the building blocks, or operations that constitute an entire process. These sources of information are listed at the end of this Appendix.

The internal operations (called processing) of PAC include several physical functions which were considered in determining these costs. These functions are:

1. Receive products: weighing, inspecting, counting and movement of the product to the reception area.
2. Product preparation and packaging: movement of the product and empty boxes to the sorting tables or conveyor belts, sorting products and packing in boxes.
3. Storing (only in the case of bananas that need a few days for ripening): movement of the product to the storing room, hanging banana bunches.
4. Outflow of product: movement to the dispatch area, weighing and identifying (label or other method) the product. It does not include loading products on trucks, an operation which already has been considered in the transportation component of distributor shipping costs.
5. Other operations: receive, store and outflow of empty boxes.

The determination of the later coefficients involved was based on direct observations of these operations and the use of secondary information.

Fixed Costs and Investments

The different PAC capacities established previously were expressed in terms of daily capacity. For this purpose it was assumed that PAC could only work 5.5 days a week to reflect the impossibility of achieving a stable and continuous product flow throughout the week due to multiple technical and administrative problems.

The resulting daily maximum capacities for the four types of PAC are shown.

<u>Type of PAC</u>	<u>Weekly Volume (tons)</u>	<u>Daily Volume (tons)</u>
A	170	30.9
B	90	16.4
C	55	10.0
D	23	4.2

Space Requirements

1. Banana ripening--3.12 square meters per ton of bananas times the number of days of ripening needed. Since the proportion of bananas in the total volume to be handled is known, the requirements of space would be:

<u>Type of PAC</u>	<u>Space Required for Banana Ripening (square meters)</u>
A	86.70
B	46.05
C	28.08
D	11.85

2. Operating space--This space includes the needs of receipt of product (40 percent of the daily volume), space for feeding empty boxes to sorting units (tables or conveyor belts), for product dispatch (40 percent of the daily volume) and for storing boxes.

Two basic technologies for sorting and packaging units are considered: (1) manual sorting and (2) use of conveyor belts to move the product through a team of workers sorting and packing. The space requirements of both techniques are shown below (in square meters per daily ton handled):

	<u>Manual Technique</u>	<u>Semi-Mechanized Technique</u>
8-hour day	20.0	9.0
10-hour day	18.3	8.3

The minimum volume needed to operate a conveyor belt is approximately ten tons per day. This restricts the use of this technique to the three larger size PACs; the lowest capacity PAC would have manual sorting.

The total space needs for operation in each type of PAC are listed below:

<u>Type of PAC</u>	<u>Operating Space Requirements (sq. meters)</u>	<u>Total Space Requirements¹ (sq. meters)</u>
A	263	370
B	150	216
C	90	133
D	75	102

Total fixed and investment costs are summed up in Tables V.3, V.4 and V.5, pp. 191-193, which show the monthly costs of buildings, equipment, overhead and interest charges on fixed investment for each type of PAC.

Variable Costs

Labor

The labor requirements for these operations in the PAC require approximately 24 man-hours per ton of product handled in the case of the completely manual technique. The semi-mechanized technique using a simple conveyor belt requires about 9 man-hours per ton. These estimates have considered 30 percent of unproductive time due to delays, rests and the difficulty of maintaining a constant flow of product during the whole day.²

¹Includes office space, services and space required for product movements inside PAC.

²Similar studies in California packaging plants make an allowance of 15 percent for these concepts. See: University of California, Technical and Economic Evaluation of New and Conventional Methods of Packing, op. cit.; and French and Gillette, op. cit.

Considering the ongoing wage for women (to sort and pack) is \$18 per day and \$24 per day for an unskilled worker, the total labor cost would be \$75.52 per ton for the manual technique and only \$28.86 for the semi-mechanized technique.³

Operating Capital

Two kinds of needs of operating capital are considered here--for boxes and for product purchases.

Assuming a rotation of one week for boxes (reusable) at a cost of \$6 per box, the interest charge on this capital in boxes comes up to \$0.90 per ton handled.

In the case of product purchases, an average 10-day repayment period is assumed. Considering an average value of \$1,500 per ton for several products, the interest charge on this capital would be \$3.84 per ton of product handled.

It should be noticed that the imputed cost is only the interest charge accruing to the operating capital needed, valued at a rate of 8 percent a year.

Assembly and Distribution

Assembly costs have been shown in detail in Appendix B; in the short run they would be \$54.06 + (1.944 x km) per ton. The distribution or shipping costs to Bogota are \$34.873 + (1.218 x km) per ton for PACs located in the rural area and only \$1.437 x km in the case of a PAC located in Bogota. These costs are also shown in Appendix B.

Variable Unit Costs

The unit variable costs per ton in the two different techniques and locations are presented in Table C.1.

It should be noticed that the variable unit costs of assembly have not been included in this cost presentation since they vary with size of PAC. These costs are analyzed in another section.

³This also includes social security costs.

Table C.1. Variable Unit Costs with Different PAC Location and Technique (in pesos per ton)^a

Variable Costs	Semi-Mechanized		Manual
	In Region	In Bogota	
Labor	28.86	28.86	75.52
Operating Capital	4.74	4.74	4.74
Assembly	54.06	54.06	54.06
Distribution ^b	117.21	97.14	117.21
Total	204.87	184.80	251.53

^aThe only option for this technique is in rural locations.

^bAn average distance of different locations was used for this computation, 67.6 kilometers.

Total Unit Costs

Total unit costs for the different types of PAC are shown in Figure 14. These costs include the fixed and variable unit costs of assembly (presented in Appendix D). These costs consider all components, including interest charges to capital investments, which is an imputed cost at a rate of 8 percent.

Sources of Information

The physical requirements for different operations and input prices were obtained from direct observations, interviews and measurements, and also using secondary sources. These are the following:

Information obtained directly:

1. Operations of a product assembly center in Manizales.
2. Packaging and sorting operations in Paulo VI, a supermarket in Bogota.
3. Operations of a cooperative product assembly center in Las Mercedes.
4. Assembly and sorting operations of the Tequendama cooperative in La Mesa.
5. Packaging and sorting operation in another supermarket in Bogota.

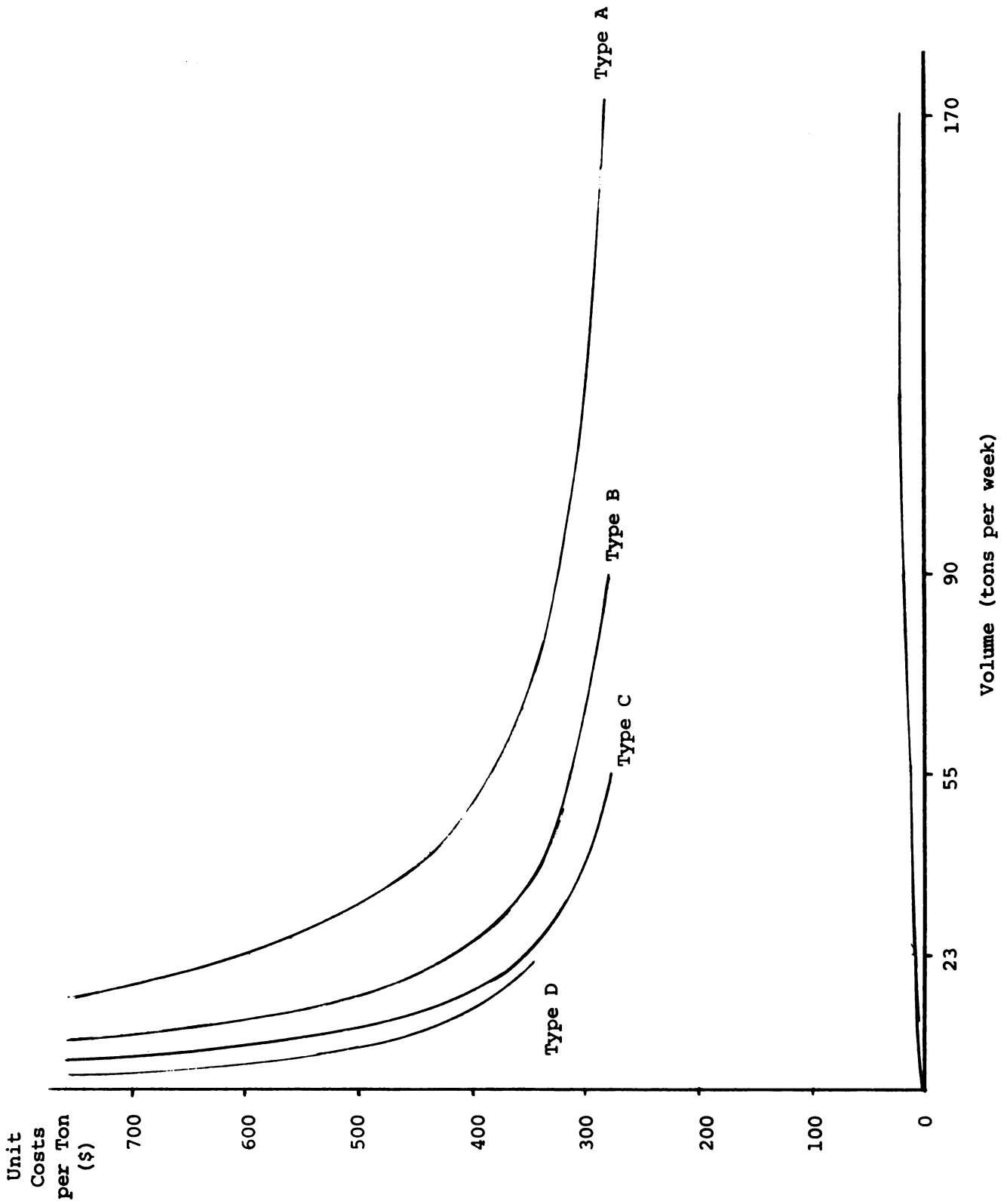


Figure 14. Total Unit Cost in Relation to Volume of Operation for Four Types of PAC Size.

6. Operations of wholesalers and assemblers in La Mesa region and the wholesale market of Bogota.
7. Operations of a very large specialized wholesaler in Bogota with a ripening and packaging plant.

This direct information included, in some cases, the access to the accounting books and other internal records.

Secondary information with directly usable data of similar processes were used for the sake of evaluating the estimates obtained from the previous information:

1. ILMA, Bases para Clasificacion Tomate, op. cit.
2. ILMA, Mercadeo del Platano y Banano, op. cit.
3. ILMA, Centros de Acopio de Platano, op. cit.
4. E. Alvarez et al., "Centro de Acopio, Estudio de Factibilidad," Curso de Preparacion y Evaluacion de Proyectos auspiciado pro BID, Cordiplan (Caracas, February-April, 1970)
5. OECD, Standardization of Fruits and Vegetables, Technical and Economic Aspects (Paris, 1970).
6. University of California, Technical and Economic Evaluation of New and Conventional Methods of Packing Fresh Peaches and Nectarines (Berkeley: Agricultural Experiment Station, Giannini Foundation of Agricultural Economics in cooperation with Marketing Economics Division, ERS-USDA, 1964).
7. U.S. Department of Commerce, The Role of Cooperatives in the Production and Marketing of Fruits and Vegetables in Puerto Rico (San Juan: Economic Development Administration, Commonwealth of Puerto Rico, 1970).
8. B. C. French and D. G. Gillette, Assembling and Packing Apples, op. cit.

APPENDIX D

RELATIONSHIPS OF SIZE OF PRODUCT ASSEMBLY CENTER TO PRODUCTION DENSITY AND ASSEMBLY COSTS

This Appendix uses a model to quantify the relationship between assembly costs and size of PAC, considering the production density in a given area.

Several authors have studied and dealt with these kinds of relationships, producing several models to measure them.¹ The model used here is based on the work of Smith.

This model assumes that the area of attraction of a PAC is circular, and production density is homogeneous throughout the area. In the region of La Mesa the production is not homogeneously distributed throughout, but instead, it has clear points of higher production density. It could be possible that this uneven production (in space and time) tends to compensate in its geographic location and time, so that the actual average assembly costs are not so different from those resulting from using an average figure of production density in the model. Such a simplification has also been judged acceptable in other studies.²

A more refined treatment of the problem is offered in other works.³ These more refined methods consider the computation of a transportation cost matrix from every production point (origin) to every potential PAC location

¹See for example: French and Gillette, Assembling and Packing Apples, op. cit.; French "Assembly Cost Functions," op. cit.; Smith, "Slaughterhouse Location," op. cit.; Stollsteimer, op. cit.; and Bressler and King, Markets, Prices, op. cit.

²French and Gillette, Assembling and Packing Apples, op. cit.; and French, "Assembly Cost Functions," op. cit.

³Bressler and King, op. cit.; Stollsteimer, op. cit.

(destination) in the region. This gives more exact estimates of assembly costs, but unfortunately it requires a great deal of detailed information, which was unavailable for this study.

The Model

Suppose a PAC of a capacity of V tons per week is planned for a certain region. Given an homogeneous distribution of production, the necessary surface to supply this volume would be:

$$V = \pi \cdot R^2 \cdot k$$

where,

V = PAC volume in tons per week.

k = Production density in the area (in weekly tons per square kilometer).

R = Radius of the circle of attraction (in kilometers).

For any desired volume of operation, given a certain density of production, the unit costs of transportation to PAC will be:

$$CU = \frac{2k\pi CR^3}{3V}$$

where C is the transportation cost per ton/kilometer. This function generates increasing costs in relation to V .

Mathematical Demonstration

$$V = k\pi R^2$$

$$\frac{\partial V}{\partial R} = 2k\pi R$$

$$\partial V = 2k\pi R \partial R$$

The number of tons in an outer ring of the attraction circle of internal radius R_1 and external radius R_2 is: $v_2(R_2 - R_1)$

$$\begin{aligned}
&= 2k\pi \int_{R=R_1}^{R=R_2} R \partial R \\
&= 2k\pi \left(\frac{1}{2} R_2^2 - \frac{1}{2} R_1^2 \right) = k\pi (R_2^2 - R_1^2)
\end{aligned}$$

The transportation cost of $\partial V = (\partial V)CR$

$$(\partial V)CR = (2\pi kR \partial R)CR = 2\pi kCR^2 \partial R$$

The transportation cost of all the tons in the circle of attraction will be:

$$\begin{aligned}
2k\pi C \int_{R=0}^{R=R} R^2 \partial R &= 2k\pi C \left(\frac{1}{3} R^3 \right) \\
&= \left(\frac{2}{3} \right) k\pi CR^3
\end{aligned}$$

Therefore, the average transportation cost per ton will be:

$$CU = \frac{2k\pi CR^3}{3V}$$

But, by definition,

$$R^2 = \frac{V}{k\pi} \quad R = \sqrt{\frac{V}{k\pi}}$$

The average transportation cost function can be expressed as:

$$CU = \frac{2k\pi C \left(\sqrt{\frac{V}{k\pi}} \right)^3}{3V}$$

which can be simplified to the following expression for computations:

$$CU_t = \frac{2C}{3(k\pi)^{\frac{1}{2}}} \cdot V^{\frac{1}{2}}$$

Empirical Results

The values of the constants C and k were determined and costs were computed.

The average production density in the region is 0.78 tons per square kilometer per week; this is an average of time and space for the sub-parts of the municipios that were interviewed. The maximum value found in the region was 2.54 for the municipio of Anolaima in the month of June, while the minimum density was only 0.2. It was also considered that only 20 percent of the available production would be channeled through PAC.

Table D.1 shows the unit costs of assembly in relation to PAC volume of operation considering the minimum, average and maximum production density of the area when 20 percent and 100 percent of the production of the area is handled.

Table D.1. Unit Transportation Costs in Relation to Volume of Operation
(in pesos per ton)

Volume of Operation (tons per week)	Production Density (20% of Production)			Production Density (100% of Production)		
	k	k	k	k	k	k
	Min	Average	Max	Min	Average	Max
5	7.66	3.88	2.16	3.42	1.73	0.97
10	10.83	5.48	3.06	4.84	2.45	1.37
15	13.26	6.72	3.75	5.93	3.00	1.68
20	15.32	7.75	4.33	6.85	3.47	1.94
23	16.42	8.32	4.64	7.34	3.71	2.07
30	18.76	9.50	5.30	8.39	4.24	2.37
40	21.67	10.97	6.12	9.68	4.90	2.74
50	24.22	12.26	6.84	10.83	5.48	3.06
55	25.52	12.92	7.21	11.41	5.77	3.23
60	26.53	13.43	7.50	11.86	6.00	3.35
70	28.66	14.51	8.10	12.81	6.48	3.62
80	30.63	15.51	8.66	13.69	6.93	3.87
90	32.50	16.45	9.18	14.52	7.35	4.11
100	34.25	17.34	9.68	15.31	7.75	4.33
170	44.66	22.61	12.62	19.96	10.10	5.65
200	48.43	24.51	13.69	21.65	10.96	6.12

These costs increase moderately as volume of ; operation in a PAC increases, and this increase is much greater with lower production density.

This indicates that production density in an area is a vital factor to consider in identifying areas for PAC operation. Once an area has been identified, the exact location of PAC within the area only moderately affects the assembly costs. Thus, it should be a lower order decision than the identification of areas.

The costs shown in Table D.1 are illustrated graphically for greater clarity. See Figure 11, page 178.

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