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CHARACTERISTICS OF THE MILK PRODUCTION SUBSECTOR AND
SUPPLY RESPONSE OF DAIRY PRODUCERS
TO
GOVERNMENT POLICIES AND MARKET CONDITIONS
IN COLOMBIA, SOUTH AMERICA

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I. INTRODUCTION

During the last decade there has been increasing concern in Colombia with respect to the inability of the dairy production industry to respond in the short run to the internal demand for milk, with greater volumes and improved quality of the product. This situation has become evident by the low level of consumption of milk estimated to be 73.4 liter of milk/person/year by the National Institute of Welfare, far below the normal requirement estimated to be 143 liter/P./year. This situation seems to be aggravated by the trend in the population growth in already populated consumption centers, the low purchasing power of the low income groups and slow increment in milk production. However, and in spite of, the government effort to close the gap between supply and demand through different types of price policies, supply lags behind the increasing demand and has forced the government of Colombia to import powdered milk to satisfy the internal demand, especially in the urban area.

In Colombia most of the milk is produced by specialized enterprises, mainly located in cold areas of the country and close to the consumption centers. These areas of production are the ones where productivity gains can be made to meet the increasing demand. However, this potential can be diminished due to low market incentives, inadequate government policies or other reason that need to be investigated.

These reasons and the present government policies to reach deprived target groups indicate the need to undertake a comprehensive analysis of the production and first handlers of milk, in the areas of Boyaca and

Cundinamarca, which explains the reason for the low level of performances of the production part of the dairy subsector. It is important however to indicate that an increase in supply occurs at the end of the year due to the effect of the rainy season. However a decrease in demand evolves by the same period due to the school vacation period. This trend in demand and supply leads to a milk surplus with lower prices during the same period (Fig. 1).

II. THE DAIRY SUBSECTOR: TOWARD A VIABLE RESEARCH FRAMEWORK.

From a methodological point of view the development of an effective research for understanding agricultural development requires some sort of paradigm which helps to indicate how the system operates under a given set of conditions and how it will respond to new alternatives.

In order to deal effectively with this set of factors and conditions affecting a given subsector Rossmiller (7) consider that "in all countries a complex set of vertical and horizontal linkages are necessary prerequisite for agricultural sector development". The comprehension of these linkages are central in the development of an analytical capacity, which provides the decision maker with an understanding of the likely consequences of alternative courses of action. He argues that much of the analysis itself, must include knowledge from a variety of disciplines. These include the technical level and relationships within agriculture, the economic situation and structure, the state of human change, the institutional environment and the political process and its constraints.

Harrison (2) when looking at the coordination and linkages in a marketing analysis takes a system orientation. The system orientation emphasizes "interdependences of related activities and it is concerned with the coordination of economic activities as a system. The production of farm inputs, farm production and food distribution are viewed as a system because they are interdependent. He observes that increases in productivity in one part of the system may greatly improve the potential for the whole system. Similarly failure at any functional level may cause stagnation in the entire system".

The term subsector came in use in 1968 by Shaffer (9), being elaborated and somewhat modified later. A subsector was defined as "the vertical set of activities in the production and distribution of a closely related set of commodities. Its also a meaningful grouping of economic activities, related vertically and horizontally by market relationships. It differs from the industry as a unit of study, in the sense that a subsector includes both vertical and horizontal relationships, whereas in an industry the production units are related horizontally (9); a subsector, therefore, may include several industries.

French (1), found that subsector studies mean different things to different people. For Shaffer (10) the "scope of any particular subsector study will be circumscribed by the limit of the available resources". He contends that, the main objective of the subsector study is "to provide a conceptual frame work for organizing existing knowledge about the subsector and to specify the nature and important of the missing information". He argues that the more important questions concerning economic organization are those involving the "coordination of sequential activities by which goods and services are produced and distributed". In this respect he raised several important questions relevant to the economic research and the endeavor of the present study.

1. Does prices uncertainty associated with seasonal and annual price variation add unnecessary cost? If so, what changes will reduce price variations?
2. Are the economic of scale and the size of the firms or production

- units in the system adequate?. If production units are larger or smaller than necessary, what are the motives for it?, and which are the economic optimum?.
3. Are there barriers to technological progress? Is the adoption of new techniques restricted by labor practices, monopoly control regulatory practices, price level, etc.

For Shaffer the (9) concept of subsector is closely related to his perception of a system; by a system orientation he simply means "the analysis of a problem in the context of a broader system; an analysis which takes into account feedbacks, sequences and externalities".

Therefore the uniqueness of the subsector studies is not in the methodology but in the scope and comprehensiveness of the research. It is more a departure in research organization than a departure from traditional approaches of agricultural economics research". This consideration is especially relevant for the present study in the sense that it attempts to determine the flow of consequences from the dynamic on-going conditions or from the effect of induced modifications on the conduct of the subsystem.

An appropriate subsector has been defined by Purcell as; "A set of two or more interrelated parts of the total system which exhibit the important characteristics of the total system. Such characteristics include price discovery processes, product information flows, separate manager centers". Once an appropriate subsystem is identified, he argues that attention can be directed to the development of a methodology which can both isolate and

evaluate the important economic relationships.

The definition of a subsector in Colombia could be too broad to be fully exposed in the present research although it is felt that it is necessary to delineate a subsector which is broad enough to be relevant and to specify it in such a way that independent research project like the present can be operational and comprehensive.

The dairy subsector of Colombia shall include the dairy producer, the major suppliers of inputs to the producers (feed industry, dairy manufacturing equipment, drugs), the processing, distribution, retailing of milk and the different by products. It's clear that the boundaries of the dairy subsector need to be established quite arbitrarily to make any research manageable. The dairy subsector is furthermore influenced by the number and type of regulations including minimum and intervention prices, location, price differential, maximum selling prices, import-export actions, sanitary regulations, and the number of agencies trying to control the subsector.

However, subsector study is definitely too broad to become manageable to a single researcher and would be a source of frustration. A more viable research orientation, still consistent with the subsector approach, could be the division of the subsector into subparts which would be manageable for the researcher, and would allow the identification of the more critical variables affecting dairy production performance. Dealing with this part of this industry, attention will be given to the vertical and horizontal relationships affecting the dairy farms in the area under study.

Therefore the orientation of the present study is toward the development of an understanding of the interdependences and behavioral actions of the dairy production enterprise, and its linkages not often obvious with traditional analysis.

For the purpose of the present study, milk production and its immediate linkages will include the farm production units and their relation with the exogenous factors such as market conditions, government policies and other relevant constraints affecting the farmers decision to expand milk production.

A. PROBLEM STATEMENT.

There is special concern within the country with respect to the inability of the dairy production industry, regardless of the government policies, to respond with greater volumes and improved quality of milk in the short and long run to an increasing demand for milk.

In Colombia most of the milk is produced by dairy farmers, with specialized enterprises of different sizes; even-though there is not a clear specification about the economic and technological optimum under the present government policies and market conditions. The contribution of these farms is estimated to be nearly 80 percent of the total output being produced on farms mainly located in the cool weather areas and near the consumption centers; these areas of production are estimated as the ones where productivity gains can be made, given their factor endowments. However, this potential to increase productivity can be affected by market conditions, crop competition, agricultural policies and institutions.

For the area under study (Boyaca and Cundinamarca) a drop in consumption only happens around the end of the year due to school vacation. This and the seasonal effect due to the rainy cycle generates an increase in milk supplies, during the same period which lead to lower prices and have a negative income effect on the producers. At the other extreme, lower production levels are reached during the dry season (April) which usually leads to higher retail prices (Fig. 1).

Taking into consideration the population trend and demand analysis (7) indicates a shortage in supply, in the short and long run despite the production gains made in recent years, estimated to be about 2.8 percent/year. (Tabla 1). As can be expected Colombia has reached the point where it has become necessary to import powdered milk to satisfy the internal demand, especially in the low urban area (4), where consumption studies have indicated that Colombians have an annual consumption of 73.2 liters of milk/person which is far below the minimum requirements established by (ICBF) (Instituto Colombiano de Bienestar Familiar).

This situation combined with the present nutritional policies of the government, to reach deprived target groups, indicates the need to undertake the present study of the dairy subsector with focus on the production side and market linkages.

Also, the fact that most of the previous studies (5, 6) of the dairy subsector have been on the demand side, seems to indicate the need for a study of the dairy production structure and producer response under different sets of government policies. It is expected that the analysis of the internal and external conditions faced by the dairy farms, hopefully

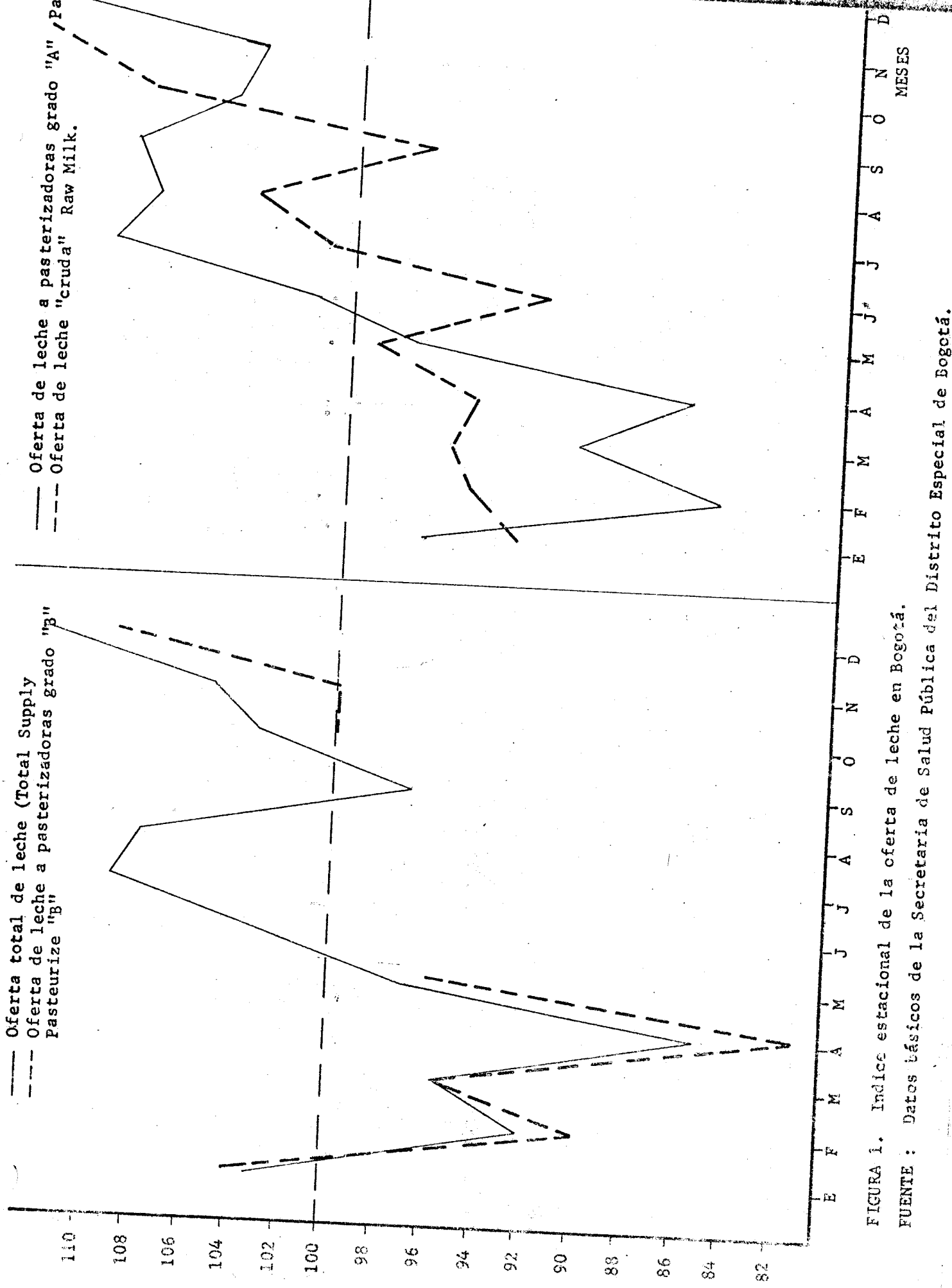


FIGURA 1. Índice estacional de la oferta de leche en Bogotá.
 FUENTE: Datos básicos de la Secretaría de Salud Pública del Distrito Especial de Bogotá.

TABLE 1. Colombia : Dairy Herd (1974)

(Area, Cattle Numbers, Production, Yields, and Credit)

Type of Cattle	Area (has.)	CATTLE NUMBERS				PRODUCTION			YIELDS				Credit (C\$)	
		Cows	Milked Cows	Total (Head.)	Total (A.U.) ^{3/}	Head Ha.	Milk Total ton.	Dressed Beef (tons)	Milk /Cow (kg.)		Milk/ha.			
									VPI/	VH2/	VPI/	VH2/		
Selecto	194.108	127.745	92.178	257.788	221.955	1.14	243.080.1	8.283.0	7.22	2.637	1.902	3.006	2.168	
Mestizo	1.570.908	767.470	460.482	1.740.689	1.498.734	.95	672.303.7	73.195.4	4.00	1.480	875	1.387	831	
"Criollo"	1.188.786	511.640	255.820	1.089.829	938.342	.79	186.748.6	43.573.2	2.00	729	364	576	287	
Carne		1.408.337	1.408.337				925.277.4		1.80	657				
TOTAL	2.953.802	2.841.436	2.216.817	3.088.306	2.659.031	0.90	2.027.409.8	125.051.7	2.50	0.914			822	421.480.000

1/ Cows Milked

2/ All Cows

3/ A.U. Animal Unit.

Source : Minag

will help to reveal the more critical variables and options on the production side which may be useful for policy decisions.

PRELIMINARY REVIEW OF THE MILK PRODUCTION-FIRST HANDLER
ARRANGEMENTS AND GOVERNMENT POLICIES

The purpose of this section, which will be mostly descriptive, is to characterize recent level and trends in production processing and consumption in the Colombian dairy subsector, and to describe part of the role of the government in the subsector.

B. TREND IN PRODUCTION, PROCESSING AND CONSUMPTION.

1. The dairy production industry in Colombia.

Dairy Population: Total cattle population of Colombia in 1974 was estimated to be 22,210,000 of which 3,088,306 adult head (14 percent of the total herd) were considered as dairy animals. The average of milk per cow/day is 2.5 kg. and it fluctuates by about 30 percent above and below this amount according to the seasons. Cows of dairy type yield an average amount of 7.22 kg. of milk per cow/day, while the beef type animals yield only 1.7 kg. (6). (Table I, II y II (a)).

Given the different categories of the dairy herd, inventories are subdivided into "selecto" (dairy breeds), "mestizo", (highly crossed with dairy breeds) and "criollo-bajo mestizaje" (slightly crossed with dairy breeds and beef cattle). According to those (6) sources, 4.3 percent of milk cows belong to dairy breeds, 21.1 percent are highly crossed with dairy breeds, and 63 percent are beef breeds.

Total milk production of the country amounts to 2,027,410 tons of which 12.0 percent were produced by the "selecto" cows, 33.2 percent by the "mestizo" cows, 9.2 percent by the "criollo-bajo mestizaje" cows and 45.6 percent by the beef cattle cows.

The dairy herd utilizes 2,953,802 has. of pastures which give a carrying capacity of 0.92 head por hectarea. The carrying of pastures for the different types of cattle is: 1.14 head/ha. for the "selecto" cattle, 0.95 for the "mestizo", 0.79 for the "criollo-bajo mestizaje", and 0.99 for the beef cattle. What these different carrying capacities could indicate is that "selecto" cattle are on better pasture and/or probably are better managed than other breeds.

Location of dairy farms: Dairy farms are located near the consumption centers; location of milk producers depends mainly on the availability of dependable markets, which in turn are somewhat related to the road network and soil quality to a great extent. Most of the milk producers are distributed in the cold and temperate zones of the country; out of the dairy herd, 40.5 percent is in the cold zone, 39.8 percent in the temperate zone, and 19.7 percent in the warm zone.

Cold Zone: Sabana de Bogotá, High plateaus of Boyacá, Antioquia, and Nariffo, Sotaquirá, Sibundoy, Roncescalles (Tol.), Barragán (Valle and Puracé (Cauca).

Temperate Zone: Comprises mainly the coffee areas, those areas are in the Department of Valle, Antioquia, Quindío, Caldas, Risaralda, South

Huila, the two Santanderes, Cundinamarca, Boyacá and the Popayán plateau.

Warm Zone: The Atlantic Coast and the Valleys of the Cauca and Magdalena Rivers. The most representative areas in this group are: Valle, Santanderes, Atlántico, Bolívar, Sucre, Magdalena, Cesar and Córdoba; to a lesser degree, could be cited Caquetá (Florencia), Putumayo (Mocoa, Puerto Asís), and Meta (Villavicencio).

In general, farms in the cold areas are better off as far as the quality of the factor endowment (soil and temperature) than those in the temperate or warm areas. It is in this area where semi-intensive farms are located, many of which are relatively well organized and have potential for further increase in their productivity. The most popular breed in this area is Holstein, though Normandy, Red Poll, Brown, Swiss, and Ayrshire are also important, especially among medium and small dairymen.

Farms in the temperate zone do not appear to have the conditions as suitable as those on the Cold Zone and in fact, their productivity is lower. However, due to the fact that in the temperate zone there are several consumption centers, farmers have crossed some of the dairy breeds, like Holstein, Brown Swiss, and Ayrshire, with native zebu to produce milk to satisfy the increasing demand. The predominant breeds in this area are probably the "Blanco-Orejinegro" (BON) and the Harton.

Farms in the Warm zone have mostly cattle and their crosses with the native breeds (costeño con cuernos, romosinuano); some farmers have introduced Holstein and Brown Swiss with variable results.

Collection and transportation of milk from farms is generally very deficient. In most areas dairy farms are atomistically distributed, unorganized, do not have adequate roads, handling is poor and they lack cooling facilities. Where roads are not available milk is transported to market by donkey or horseback. Ordinarily the continuous exposure to the sun and shaking led to the spoiling of the milk. Usually, farm to market transportation is done in non-insulated trucks and only a small percentage of them belong to the pasteurizing plants (6). It is not unusual that warm milk be transported in non-refrigerated trucks for up to 100 kilometers. Most of the milk transported from small farms is done by few private truckers who usually work with very low volumes per individual farm.

2. Milk Processing and Pasteurization.

Colombia has 43 milk processing plants dedicated to pasteurization and production of powdered milk, cheese, butter, acid milk, condensed milk, sweets, caseins, etc. The estimation of the plant's potential capacity is controversial. In 1974, it was estimated to be 2.2 millones bottles per day (6). While some estimations say that only 52 per cent of their potential capacity is utilized, others say that the unused capacity estimations are not realistic since the plants lack part of the equipment and facilities, as well as the organization necessary to process additional milk volumes; besides, most equipment is very old and there is not capital available for renewal. The average number of liters per day processed by all plants drops during the dry season by 20 to 25 per cent.

Pasteurized milk is about 22 per cent of the total production, and

it is sold only in the 13 main Colombian cities. (Table IIIa). Other industrial uses of milk represent 25 per cent of milk produced and are classified as follows:

PROCESSED/MILK, 1975
(Tons of milk equivalent)

<u>PRODUCTS</u>	<u>AMOUNT</u>	<u>PER CENT</u>
Butter	267,080	40.0
Cheese	252,498	38.0
Powderded milk	90,747	14.0
Acid milk	2,970	0.5
A ndonsed milk	12,891	2.0
Sweets, caseins, etc.	<u>35,692</u>	<u>5.0</u>
TOTAL	<u>651,878</u>	<u>100.0</u>

SOURCE: Ministry of Agriculture.

In most large cities exist regulations classifying milk into two different grades (A and B). However in practice, the difference is not very clear, and the enforcement very limited. Grade A milk is supposed to have about 3 to 3.3 per cent of fact content, while milk grade B has a very low fact content, (about the same as skimmed milk). In neither case is there a very good control over fat content; so in reality, the fat content can be almost anything from normal to below normal.

3. Marketing Channels.

Milk Procurement.

With respect to supply of milk for processors, there is a wide variation as to suppliers, depending on the type of processor. According to the Universidad Javeriana- ICA study, milk procurement by processors takes place in the following way:

- a) Pasteurizing plants. (This includes 9 plants). Grade A plants buy 89 per cent on the milk directly from the dairymen and produce the rest in farms of their own. On the other hand, grade B plants do not own farms and buy most of the milk from large wholesalers (71 per cent); the rest is bought from dairymen (29 per cent).

Grade B plants (This includes 6 plants for the area) have a larger numbers of suppliers than grade A plants. Suppliers for the grade B milk deliver smaller volumes than those for the grade A plants (6).

- b) Cooling plants. Grade A cooling plants are suppliers of raw milk in the same way as are Grade A pasteurizing plants: 84 per cent of the milk comes directly from the dairymen, and the rest is produced in farms of their own. Grade B plants buy a smaller portion from the dairymen (53 per cent) and depend largely on large wholesalers.

Cooling plants for Grade A milk (raw milk) also tend to be larger and to have larger numbers of suppliers than Grade B plants. Grade B plants depend on small suppliers (ave: 4 milk cans) Chile Grade A plants depend on larger suppliers (ave: 25 milk cans).

- c. **Milk product Factories:** These factories buy most of the milk directly from the dairymen (89 per cent); the rest comes from large wholesalers (6 per cent) and cooling plants (5 per cent). Suppliers are rather small, and on the average they sell only 90 bottles per day.

Milk Distribution.

Distribution of the product from the processors also shows large variations:

- a) **Pasteurizing plants.** Grade A plants sell most of the milk by distributing it to private homes (80 per cent); the rest is sold to large wholesalers, factories, supermarkets, and institutions. On the other hand, grade B pasturizing plants sell most of the milk to general retail stores (91 per cent) and the rest wholesalers.
- b) **Cooling plants.** Grade A plants sell a large portion of the raw milk to private homes (51 per cent) and to pasteurizing plants (37 per cent); the rest is sold to large wholesalers and institutions. Grade B plants sell most raw milk to specialized retail stores (82 per cent) and the rest to large wholesalers, factories, and institutions.
- c) **Milk product factories.** These factories sell most of the products to institutions (69 per cent) and to large wholesalers (27 per cent); the rest is sold to homes and non-milk factories.

4. Consumer Demand for milk in Colombia.

In many developing countries like Colombia, milk is a basic food product that enjoys a rather unique role in that it is usually an important source

for improving the existing diet deficiencies. It is especially important as a source of protein. But on the other hand, it needs special treatment since it is highly perishable and serves as an excellent medium for transmission of contagious diseases such as tuberculosis and undulant fever. Food supply is of major importance in the development of any country and dairy products form a substantial part of this supply.

In Colombia, demand for milk seems to outstrip supply as shown by Tables II and II(a) attached. At present the concern for the consumer in Colombia is that of milk availability, quality and price. These factors may be affected by the range of prices that consumers are prepared to pay in Colombia mainly due to income differences. Since most of the lower quality pasteurized milk is sold in small stores of low income neighborhoods, some retailers take advantage of the scarcity periods to charge high prices or require that the consumers buy other things, especially bread.

This situation in Colombia reflects a common phenomenon of the milk distribution in most LDCs where perhaps more than any other livestock industry, serious problems of pricing and marketing policy exist in the dairy subsector, and these have a direct bearing on its future growth.

5. Government Policies Toward the Dairy Industry:

Analysis of government policies is essential for diagnosis of and prescription for potential improvements in the Colombian dairy industry. No attempt is made, however, at this point to specify and analyze all different policies used by the Colombian government. For present purposes and until more information is available, the following will serve as

illustrative of the situation.

Under the Colombian situation, government intervention has included enforcement of sanitation standards, labor legislation, price control, subsidy programs and export and temporary import policies to meet seasonal variations.

One of the more recent and highly controversial instruments was decree No. 142 of 1972, which imposed a tax on the basis of presumed agricultural productivity. It was assumed that this new legislation would be able to stimulate milk production. In order to complement this government action, law 5 of 1973 makes specific provisions through the Agriculture Finance Fund to facilitate credit oriented to expand milk production. In this respect the 1973 results indicate 27 per cent reduction, from the previous year, in the slaughtering of dairy heifers, which means that an expansion on total supply could be expected in the near future, due to an expected increase in the dairy herd.

In regard to price intervention and regulation of the supply of milk, the government in the past has been engaged in a bilateral agreement with the producers and processors with respect to the pricing of milk and distribution of milk to low income groups by using a combination of subsidy programs to protect low income groups and to import powdered milk to stabilize supply variations. In regard to the farmer, the government buys milk at the agreed-upon price (adjusted every year) and sells to the target groups below market price. This program, however, suffers several serious limitations, especially at the implementation stage.

The most recent government policy which may have implication in the total milk supply was the elimination of the export subsidy program (CAT) for some commodities among which milk, represented in processed products, is about 8 per cent of the total production. The assumption is that the CAT tends to divert milk supply out of the country.

In some areas the G.O.C.* has established milk proces at the farm and plant level. The effect of this is that where distances affect plant profits, plant owners do not collect the milk , especially during the dry period, and the job is taken over by individual truckers who usually pay prices below those established by the G.O.C.

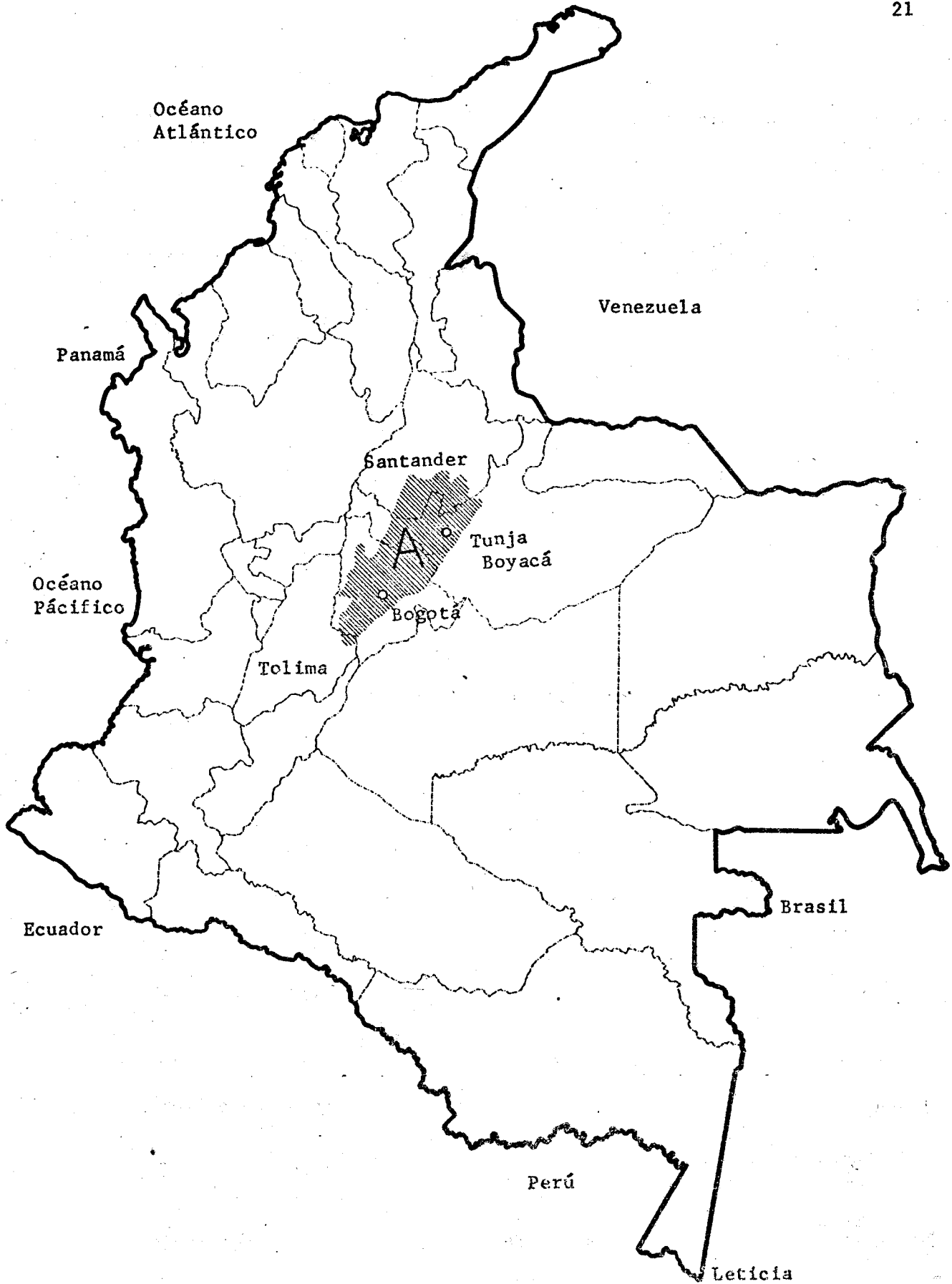
III. Characteristics of the area under Study:

There is no doubt that the areas of Bogotá and Boyacá offer special conditions and comparative advantages for the production of milk in comparison to other areas of the country.

Cundinamarca and Boyacá are basically one region geographically speaking. The climate for the whole region is cool and the temperature range form 14°C- 15°C. The topography of the area under study is flat and surrounded by mountains.

The soil however, has a great deal of variation and can be characterized by its high fertility for the production of high quality roughage crops. In general the regions have a good road network that serves a population of about four million people of which nearly 90 per cent are urban and 10

* Government of Colombia.



A : Area of Study.

per cent are rural. In 1970 it was estimated by DANE that in the Cundinamarca region there were close to 70,000 rural properties in the rural areas with 36,765 production units. For the Boyaca area the estimation was 50,524 rural properties with 36,765 production units. The range of sizes for these units go from less than 3 has. to units with more than 2,000 has. The greater number of units, however was found in the smaller range. Out of these and for the whole area 25,370 (75 per cent) were small dairy farmers with 1-5 has.

From the production point of view one of the greater dilemmas for the dairy farmers is the high cost of the land and competition from other crops. Sandino (8) has indicated these as the major constraints in the improvement and adoption of new technology within the region. These factors, he considered, have been critical in the displacement of the dairy production units out of the boundaries of the large consumer centers to less fertile soil, with lower productivity levels and higher procurement cost.

These factors, the competition of other crops in the tropical areas for dairy production, and the demography trend (to a continuous growth), tend to indicate a serious shortage in the supply of milk, in the short and long run and the difficulties the industry and the government may face to meet the nutritional objectives. X

IV. The Conceptual Framework: The diagram on Fig. 2 is an attempt to provide an overview of the production components and their interrelationships as a first approximation to develop a more comprehensive theoretical and realistic framework. Performance as measured by previously mentioned criteria will depend upon the effect of the

ECONOMIC FACTORS DETERMINING MILK PRODUCTION

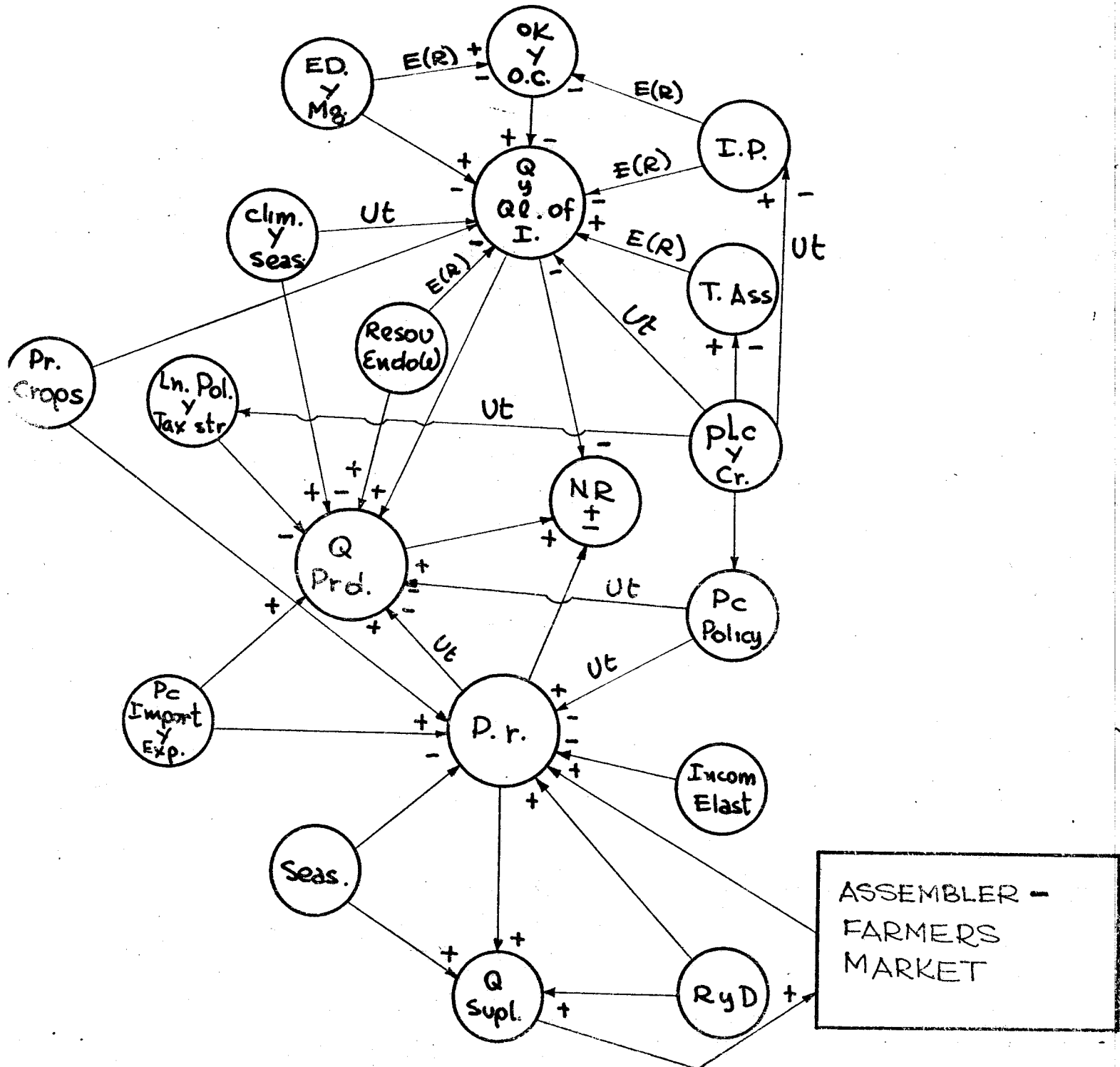


FIGURA 2.

independent variables on output levels. The degree of innovation, its quality, an level of inputs committed to production will depend on price signal, market uncertainty, and relative profitability of crop investment alternatives.

Performance of the dairy production could also depend on the behavioral characteristics exhibited by some of the variables and linkages included in the model under a variable set of conditions (location, size of the farm, government policies, others).

For the type of farms that are considered in this proposal, the assumptions are that whatever their size and degree of sophistication, farmers will commit resources (Q.L.) to production based on their expectation of net return to investment, the opportunity cost of capital, and good market information. This means that they (when farming is the main source on income) implicitly take into consideration the cost and revenues related to a given activity, the conditions of the market, uncertainty when making decisions on whether to invest in milk production or alternative enterprises.

It is assumed that dairy farmers make their decisions in this respect by looking at their experiences on earnings of years past. The value of their decision, will also depend on the degree of participation in the enterprise. However, they may actually be making their calculations of net return by formulating an expected price based on market information over a certain period and mainly in regard to government policies, seasonal variations, structure of the market, and crop competition.

Whenever factors or product prices change in either direction, a feedback effect can be expected on total output (Qprd). This condition could induce adjustment on innovations over a certain period and it is assumed to have a great effect on the decisions to invest-disinvest at the farm level.

1. O.K. : Owned capital
- O.C. : Opportunity cost
2. I.P. : Input prices
3. T. Asst : Technical assistance
4. Q. & Qlty. I : Quantity and quality of inputs
5. ED & mg : Education and management
6. Clim & Seas : Climate and Season
7. Res. Endow : Resource endowment
8. Q. prd : Quantity produced
9. Plc & Cr : Government policies and availability of credit
10. Ln Pol & Tax structure: Land policy and taxes
11. N.R. : Net Revenue
12. Pr : Price received by the farmer
13. R & D : Road quality and Distance
14. Q.S. : Quantity supply
15. L.E. of D.M. : Income elasticity of demand for milk
16. Seas : Season
17. Pc Import & export : Price of Import and Exported milk.
18. UT. : Uncertainty
19. Pc. P. : Price policy

20. E (R) : Expected Revenue
21. Pr. Crops : Price of other crops.

Therefore, production tends to have a great variation, in addition to the seasonal variations, due to farm expectation and participation rationality. Thus the hypothesis is that adjustments to the farm output depend to a certain extent on the opportunity cost of capital (own capital), and participation rationality; but is also depends on the profit expectations and cost functions.

Some other factors (variables) relevant to the behavioral and supply response analysis, which may affect total output could include managerial capacity and involvement in the enterprise, and quality of the inputs used.

Technical assistance to the farmers can help to reduce seasonal variations and the difference between expected production and actual production, by giving to the farmers more control upon the natural elements affecting their production, assuming they depend on the enterprise for making their living. The decision to use these factors on the farm, however, will depend on the condition of the farm and the alternatives offered to the farmers over a certain period of time.

If many of the resources can be considered fixed to the farm, farmers can be forced to sell or go out of business if $MUP \times < P_{xi}$. This assumption seems to indicate that dairy farmers maximize their fixed resources; however the decision to remain or to leave the enterprise will depend on the impact of some critical variables over a certain period, on their MUP_{xi} . When desinvestment in the short run is difficult for the farmers, variation in the total supply to a given consumption center can be due to the structure

of the market faced by the producers and the new possibilities open to them somewhere else. Therefore milk suppliers could tend to use different channels of distribution or divert the supply to other consumption points or processing terminals, mainly as a response to government policies, market structure or price variation on regions outside of the traditional consumption center (assuming farmers have good market information). Therefore the quantity supply by farmers may well depend on those factors but it also could depend on external demand or processors demand elasticities, as they change over a period of a year. Overall, total output could be less than the optimum mainly due to the lack of a formal organization for bargaining, which may help to smooth milk production and supply to the traditional consumption points.

V. RESEARCH OBJECTIVES:

The scope of the present study will necessarily be limited by the available resources and the nature of the subsector. It is believed that the development of a more adequate knowledge of the dairy subsector requires an accumulative effort over time. Therefore the main objective of this research effort will be to develop or provide a conceptual framework for organizing existing knowledge in regard to the dairy production subsystem and show importance of the missing information, for policy decisions.

Therefore the general objective is to provide a descriptive, diagnostic, predictive and prescriptive information which lead the study to:

- 1) To describe the most important characteristics of the production subsystem;

- 2) To diagnose some of the shortcomings of the present subsystem, to identify problems of the participants, unexploited opportunities, and barriers to improved performances;
- 3) To estimate future economic configurations of some significant variables , and
- 4) To prescribe possible changes leading to improved performance.

MORE SPECIFICALLY AND BASED ON THE CHARACTERISTICS OF THE PROBLEM THE OBJECTIVES OF THE PRESENT STUDY WILL BE ORIENTED TO :

- 1) Identify the internal constraints of the dairy subsystem to achieve higher production level.
- 2) Estimate the cost function for each representative dairy size farm and identify the more critical variables affecting their cost production functions.
- 3) Evaluate how the structure of the market, the institutional programs and the government policies affect the behavior and performance of each size farm.
- 4) Evaluate the implications on supply responses by dairy farmers to the above factors.

VI. RESEARCHABLE HYPOTHESES:

According to French (1), most researchable issues pertaining to the subsector involve the question of: "How various measures of system performance are affected by instruments of change". This section tries to list 4 hypo -

theses which will be tested, and to relate them to the relevant performance criteria (mainly economic efficiency, progressiveness, and participant rationality).

In analyzing the areas of potential cost saving on each size of farm at least two separate facets of efficiency become evident:

1. The suboptimal utilization of available factors and suboptimal use of potential new resources within the farm. This condition exists primarily in the absence of a competitive environment, or with a lack of incentives or condition to increase their use.
2. The inefficient allocation of resources within the different farms sizes due to market conditions, institutional constraints or government policies. This kind of inefficiency can be evident through maladjustments in the structure and concentration of the firms.

In regard to the first facet of efficiency, it is assumed that the ownership composition and land pricing behaviors are factors hampering the efficiency of the dairy subsystem. Although the production has been increased during the last twenty years and the present arrangement can be considered an improvement with respect to the 1950 production levels, the present levels of performance cannot be considered acceptable by the present technological possibilities. The four hypotheses which are considered important to test are;

- 1) Hypothesis 1. Most of the dairy producers within the area are independent in their relations with the market channels and lack of a formal organization to guide their production decision and enhance

their bargaining power at the market place (exchange efficiency, participation rationality).

- 2) Hypothesis 2. It is generally argued that the lack of technical innovation in the dairy production subpart, which leads to low production level, are due to land ownership composition, low price incentives, low profitability, and market conditions (Progressiveness);
- 3) Hypothesis 3. The present level of production does not seem to coincide with the least cost patterns (Economic Efficiency);
- 4) Hypothesis 4. Some government policies like price fixing at the farm level, subsidy programs and market condition (like number of buyers and lack of marketing alternatives) tend to discourage dairy production investment (level of profit).

VII. PERFORMANCE CRITERIA FOR EVALUATING MILK PRODUCTION SUBPART OF THE DAIRY SUBSECTOR IN COLOMBIA.

The starting fundamental assumption is that the Colombian society wants from the dairy subsector an abundant and high quality product at a fair price. Good performance, of course, is a multidimensional attribute embodying at least the following goals; economic and production efficiency, progressiveness, participant rationality, adequate level of profit, and absence of externalities, among others.

Shaffer (10) considered as an important dimension of performance "to create incentives (rewards to increase productivity). He also considered that certainty of the market is related to the willingness to invest in

technology leading to increased productivity".

The comprehensiveness and the practicality of these dimensions suggest that the dairy production subpart and the dairy subsector can be examined in relation to those criteriams.

In regard to the efficiency criteria Shaffer considered that the policies designed to influence the market structure and conduct of the participants involve change in the property rights. For him the property rights (their distributions) prescribe the means of access and control of the assets of the community. The conditions of entry in the market and the possibilities of increased productivity are also significantly related to the property rights.

Some of the more widely used dimensions of performance, and the subject of the present study, will be discussed at this point.

- 1) Efficiency: From the firm point of view decision as to what to produce, how much and how to produce should be efficient both in the use of available and potential resources. Production will be efficient when maximum output is obtained with minimum resource input. In this regard good static framework for measuring cost and analyzing the production efficiency is now available (French).

With respect to the production efficiency of the dairy subsector, methods of solving programming problems requires the determination of optimum level of production for each technological strata. In this sense firm studies are becoming a means to an end rather than a end in themselves as the interest shifts to systems rather than the firm.

Furthermore, efficient transfer of goods from producers to consumers is essential for the maximization of satisfaction and resource use. Survey of exchange and pricing efficiency can be made to measure exchange efficiency. The various means of exchange can be examined with the higher standards being obtained in one subsector or in the other subsectors.

Among the standard procedures used in this regard: price formation and pairing of buyers and sellers should not be unreasonably costly; prices should be high enough to avoid excess of demand and low enough to avoid undesirable stock accumulation.

- 2) Progressiveness. The operation of the producers in the subsector should be progressive, taking advantage of innovations for both increasing output for unit of input and making available to consumers superior new products (Scherer). Even though the ideal level of progressiveness is undetermined, some unquantified criterias could be used to assess the progressiveness of the sector to the available opportunities. The progressiveness could be measured in terms of investment, and innovation should not be suppressed.
- 3) Participant Rationality: Participants should have the opportunity to be well-informed and should exercise freedom of choice rationally in their own interest, except when private interests are in conflict with the social welfare (10).

Aids to participant rationality from the point of view of the information may include; common terminology, standard weights and measures, and price posting.

- 4) Level of profit. Profit must provide an adequate indication of relative investment opportunities in different firms and industries, within the subsector.

The evaluation of profit at the farm level offers practical difficulties from the standpoint of obtaining reliable figures and compiling them, so that they are in the more useful form. The evaluation of the elements for the profit calculations can change over time due to market adjustments either in the factor or output side. These conditions may prevent uniformity and therefore offer substantial problems. However some of these difficulties have to be overcome, especially when dealing with welfare losses or excessive profit (Harberger and Scherer).

VIII.METHODOLOGY:

Data collection and analysis.

The focus of the study will be concentrated on the Cundinamarca and Boyacá regions, which are some of the largest milk producer areas of the country, besides being fairly homogeneous in many aspects. Some other factors which have been influential in the selection of the region are accessibility to the consumer center, adequate net road, lower cost of data gathering and probable better information sources in regard to the variables under consideration.

Considering the scope of the proposal and the lack of aggregate information on this matter, the approach to the problem should include a qualitative part of which the main objective is to identify institutional problems and describe activities external to the farm and not very easy to capture by quantitative means. This portion of the study should include dairy farmers supply response to those economic and institutional variables included in this proposal, such as uncertainty, dairy farm organization, government, regulations, market structure, market information, contracts, etc. The second portion of the study related to the internal conditions and the quantifications of the critical technical variables determining dairy farmers supply responses. In this portion of the study production functions and cost functions will be determined by using cross section data. Milk production responses will be made by using time series data from predetermined farms, mainly ICA projects.

Given the data constraints faced by the present study it seems unreal

istic to attempt to develop an optimization model. Instead, efforts will be made to develop or use a predictive model based on aggregate data for farm types based on actual production levels, farm sizes and number of cows. In this regard, however, Swanson considers that factors such as size of farms, equity position and tenure status may be more important in determining supply responses than present production levels. This consideration may affect the classification of the farms for the purpose of sampling; therefore the analysis of these factors will be included in the study.

With respect to the objectives stated in the study the methodology includes the conduction of personal interviews on a sample of farmers determined at random and drawn from clusters of milk production areas.

The first step in the selection of the random sample will be the characterization of the milk production clusters by total volume produced, size of the area, number of farmers in the area and classification of the farmers by size. The selection of the clusters to be studied will be determined by the highest production levels.

In regard to the derivation of the cost functions and due to the difficulties in obtaining reliable information from the farmers, indirect data from input suppliers will be appropriate to consider, mainly local or regional.

For the development of the predictive model, technical coefficients could be generated from empirical data or private farms managed by ICA, during the last ten years.

IX. ANALYTICAL PROCEDURES:

The first method which will be used involves a description and discrimination of the existent technological and supply levels of the selected dairy production areas. This portion of the study will include the description of the socioeconomic characteristics of the production units and the type of relations existing with the market.

The second method of analysis will include for each technological and supply level, the derivation of a cost and production function, level of investment, and profitability. The third method includes the construction of a supply response model for each strata as a means to detect the impact of the different government programs.

1. TOTAL COST FUNCTION:

Given j cows for each technological strata, each of which produce Y_k level of output (milk) at a P_x average variable cost/cow the problem is to find a total cost function for each average size farm for both the ICA group of farms and the random sample from the predetermined production clusters.

Therefore the total cost for each strata will be given by

$$TC_t = \sum T_i + \sum_{ij} P_{x_i} X_j + \sum Z_{jk} \quad \text{Where:}$$

T_i = Average rent of land/ha.

P_x = Average variable cost/cow

X_j = Average No of cows/ha.

Z_{jk} = Average fixed cost/ha.

An average profit function will also be determined by investigating the average total sales per strata.

$$\pi = \sum (TR - Tc) \quad \text{Where average Total revenue (ATR) is given by } ATR = \sum \frac{TS}{n}$$

TS = Total sale

n = Number of cows.

2. PRODUCTION FUNCTION:

In order to estimate production function for each farm group, cross section data from a random sample will be taken. For the definition of the production function the weather variable will not be considered relevant. Instead, production levels will be a function of the size of the farm, number of cows, level of investment/cow, and the degree of participation of the owners in the enterprise. Investment/cow includes the average variable cost per lactations to maintain a given level of production. This variable cost includes the average cost of factors used, given their present production patterns. (Technological level).

Thus:

$$Y_i = f(X_1, X_2, X_3, A) \quad \text{Where:}$$

Y_t = Average production level for each type farm strata

X_1 = Average N^2 of cows/farm strata/ha.

X_2 = Average size of the farm

X_3 = Average level of investment/cow/farm strata

A = Dummy variable for degree of participation in the enterprise (participant or absentee).

3. SUPPLY RESPONSE FUNCTION

Changes in the milk supply could depend on the farmers response to government policies, previous prices of the products (Y_{t-1}) and price trend of factors (X_t). The adoption of new technology is assumed to be profit dependent and could be affected by the previous variables. Therefore, to estimate supply response it is important to estimate P_y and P_x i trend.

Thus supply responses will be determined by

$$Y_t = B_0 - B_1 P_{x1} + B_2 P_{yt-1} + E_t \quad \text{Where}$$

P_{x1} = Average price of factor pay by farm on time t

P_{yt-1} = Average prices received by farmers on time t-1.

Changes in milk supply will also be analysed by determining the impact of the government regulation on the overall supply over a given period.

X. APPENDIX

TABLE II

SUPPLY AND DEMAND PROJECTIONS OF MILK 1974-1975 (Tons.)

BY LEVELS OF INCOME 1974-75

S U P P L Y

1.974

D E M A N D

		D E M A N D					S U P P L Y					
		Low Income	Medium Income	High Income	Superior	Total	Low Income	Medium Income	High Income	Superior	Total	Deficit
MILK	892,620	535,572	267,786	89,261	1,785,239	878,137	526,882	263,441	87,814	1,756,274	28,965*	
						1.975						
MILK	938,859	560,315	280,157	93,386	1,867,717	901,798	541,079	270,539	90,180	1,803,596	64,211**	

* 1.62 per cent of the total

** 3.47 per cent of the total.

Source : Colombia Ministry of Agriculture. Cattle Programmes. 1974-75.

TABLE II(a)
MILK PRODUCTION AND CONSUMPTION IN COLOMBIA

	1974 Milk (Tons)	%	1975 Milk (Tons)	%
Production	2,027,410	100.0	2,096,448	100.0
Animal Consumption	92,720	4	100,147	5
Human Consumption	1,756,274	87	1,803,596	86,6
A. Industrial Production	466,231	23	522,188	25
B. Pasteurized Milk	442,180	22	464,290	22
C. Raw Milk	847,863	42	817,118	39

Source : Colombia Ministry of Agriculture, Cattle Programs, 1974-75.

TABLE II(b)
EXPORT VERSUS NATIONAL CONSUMPTION

	Export	1974 Nat'l Cons.	Gross Total Tons.	%	Export	1975 Nat'l Cons.	Gross Total Tons.	%
Butter		232,276	232,276	46.5		267,080	267,080	40.
Cheese	92,906	135,000	227,906	27.	103,998	148,500	252,498	38.
Powdered Milk		85,176	85,176	17.		90,747	90,747	14.
Acid Milk		2,451	2,451	0.5		2,970	2,970	0.5
Concentrated Milk		11,328	11,328	2.0		12,891	12,891	2.0
Case Instances		34,656	34,656	7.0		35,692	35,692	5.5
	92,906	500,887	593,793	100.0	103,998	557,880	661,878	100.0

Source: Colombia Ministry of Agriculture, Cattle Programs, 1974-75.

TABLE II(c)

HUMAN CONSUMPTION OF MILK AND MILK PRODUCTS

	1974 Gross Total Milk (Tons.)	%	1974 Cons. Per capita (Kilos)	1975 Gross Total Milk (Tons.)	%	Cons. Per Capita (Kilos)
Milk available	1,756,274	100.0	73.42	1,803,596	100.0	73.11
Milk products.	466,231	27	19.50	522,188	29.	21.17
Liquid milk	1,290,043	73.	53.96	2,281,408	71.	51.94
Main cities	635,448	36.	75.55	667,221	37.	76.15
1) Pasteurized	442,180	25.	51.57	464,290	26.	51.99
2) Raw milk	193,268	11.	22.98	202,931	11.	23.16
Rest of the country raw milk	654,595	37.	47.75	614,75	34.	38.61

Source : Colombia Ministry of Agriculture, Cattle Programs, 1974-75.

TABLE III(a)

DISTRIBUTION OF HUMAN CONSUMPTION OF LIQUID MILK

	1974		1975		1975		Gross Total (Tons)	%
	13 Main Cities (Tons.)	%	Rest of The country (Tons)	%	13 Main Cities (Tons)	%		
Pasteurized	442,180	69.18	NA	NA	442,180	34.27	464,290	36.
Raw Milk	193,268	30.47	654,595	100.0	847,863	65.73	817,118	63.
Total	635,448	100.0	654,595	100.0	1,290,043	100.00	1,281,408	100.0
%	49.25		50.75		51.16		48.34	100.0

Source : Colombia Ministry of Agriculture, Cattle Programs, 1974-75.

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