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MICH. STATE UNIV.
AGR. ECON. DEPT.
REFERENCE ROOM

THE CORN SUBSECTOR IN COLOMBIA: GEOGRAPHIC DISTRIBUTION
OF PRODUCTION, TRENDS IN PRODUCTION AND CONSUMPTION,
ORGANIZATION AND PRICE MOVEMENTS

By

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CHAPTER I

INTRODUCTION

This paper has been motivated by the author's family involvement in grain marketing and his personal interests in returning to Colombia to engage in agribusiness activities. This paper and the M.S. program at Michigan State University have provided an opportunity to improve the author's understanding of the economic organization and functioning of the agricultural sector and especially the corn subsector. The paper may also provide the basis for identifying problems for future study and for developing the author's analytical skills.

This introductory chapter includes an overview of the corn subsector, an outline of objectives, the framework for analysis, a listing of the source of data and an explanation of the methods used in fitting trend lines to time series data.

An Overview of the Corn Subsector

In Colombia corn is a major cereal crop that is used largely for direct human consumption rather than for animal feed.^{1/} Although corn has lost relative importance among cereals used for direct human consumption, it represented 45 percent of cultivated cereal area in 1980^{2/}

^{1/} Bennett, G., Agricultural Production and Trade of Colombia, USDA - Economic Research Service, 1973.

^{2/} Colombia Today, Vol. 16, No. 9, Colombia Information Center, 1981.

and is still the most important cereal in terms of area utilized for crop production.^{3/} Rice is the leading cereal in volume of consumption and production and is second to corn in area harvested.^{4/}

The apparent total consumption of corn increased 1.6 percent per annum while the per capita consumption decreased .95 percent per annum during the period 1967 to 1980.^{5/} Per capita production of corn decreased 2.1 percent per annum during the same period.^{6/}

Like any agricultural activity, the production of corn involves risk and uncertainty revolving around both exogenous and endogenous variables.^{7/} The most relevant endogenous variables that affect the performance of the corn subsector of the economy are oligopsony market structures, insufficient price information, ineffective government policies and dualism in market channel organization. These problems have resulted in relatively poor vertical coordination among the different stages of this subsector. The consequences of poor coordination are: low yields, high costs of production, under-utilized plant capacity at the processing stage and inadequate import management strategizing. Valderrama^{8/} points out that in some years, even though

^{3/} Ibid.

^{4/} Ibid.

^{5/} Colombia Estadística, DANE, 1981; Demographic Yearbook, United Nations, 1979; Environmental Fund, Washington, 1980.

^{6/} Ibid.

^{7/} Marion, B., "Vertical Coordination and Exchange Arrangements: Concepts and Hypothesis," in Coordination and Exchange in Agricultural Subsectors, Monograph No. 2, NC-117, 1976.

^{8/} Valderrama Ch., "La Política de Importación de Alimentos en Colombia," in La Política Agrícola en Colombia, Universidad de los Andes - CEDE.

the domestic production of corn was sufficient, the government decided to import low-priced corn.

Some exogenous variables that affect corn production are weather, foreign supply, population growth, income increases and changes in food preferences. Colombia does not enjoy a comparative advantage in corn production. Internal prices of corn are generally higher than world prices. This encourages the government to take advantage of imports to increase corn availability to consumers at the risk of lowering self-sufficiency in food production.^{9/} The decrease in per capita consumption has been associated with rural to urban migration and increases in per capita income.

The per capita real national income increased approximately 3.97 percent per annum during the period of 1970 to 1979.^{10/} The increase in per capita national income has resulted in reduced relative demand for low prestige foods such as corn and higher demand for marketing services such as processing, transportation and retailing.

Objectives

The overall objective of this paper is to describe and analyze selected aspects of the Colombian corn subsector in order to provide information for evaluating alternative forms of market organization and operation that could lead to improved subsector performance. The overall objective involves four specific sub-objectives:

^{9/} The Colombian government interest in food self-sufficiency is pointed out in: Attache Report No. Co-1001, FAS-USDA, January 1981, p. 25.

^{10/} Colombia Estadística, op. cit., p. 205.

- (1) To describe the geographic distribution of corn production and the trends in production, consumption and imports.
- (2) To describe the organizational structure of the corn subsector.
- (3) To analyze price movements and demand relationships in the corn subsector.
- (4) To identify problems for future research.

Framework of Analysis

The food and fiber sector of the economy includes a very broad set of activities. To provide a manageable unit for analysis, Shaffer and other authors have proposed a subsector approach for looking at single agricultural commodities, in this instance, corn. ✓

The relevant economic functions within the corn subsector include both vertical and horizontal activities. The vertical activities include the various stages from production to consumption. The horizontal activities include the activities at one stage. For example, at the transformation stage is an industry, processing corn for human consumption. An industry is "...a group of sellers of close substitute outputs who supply a common group of buyers."^{11/}

This paper uses a descriptive research methodology. Description is accomplished by using a modified industrial organization paradigm. This framework is based upon the concept that a set of basic subsector conditions, such as production trends and consumption characteristics, influence the subsector organization of marketing channels, agents and

^{11/} Bain, J., Industrial Organization, John Wiley, 1968, p. 124.

functions and facilities. Subsector organization influences subsector conduct which determines subsector performance. Subsector performance, in turn, creates pressures for changes in market structure and the feedback loop is completed.

Subsector conduct includes the actions that competitors use to coordinate market behavior. Conduct includes: type of exchange mechanisms used; method of predicting future supply, demand and prices; information communicated; quality specification; and efforts to influence inter-stage cooperation and conflict.

Performance dimensions include: stability of output, prices and profits; accuracy, adequacy and equity of information distributed; extent to which supply offerings match demand preferences in relation to quantity, quality, timing and location; technical and operational efficiency at each stage and linking stages, transaction costs; subsector adaptability and etc.^{12/}

Vertical coordination is "...the general term that includes all the ways of harmonizing the vertical stages of production and marketing."^{13/} Marion^{14/} states that vertical coordination can be achieved through market coordination and/or administered coordination.

^{12/} Marion, B., Application of the Structure, Conduct and Performance Paradigm to Subsector Analysis, 1976.

^{13/} Riley, H. and K. Harrison, "Vertical Coordination of Food Systems Serving Large Urban Centers in Latin America," Staff Paper No. 73-24, FAO Conference on the Development of Food Marketing Systems for Large Urban Areas in Latin America, Buenos Aires, Argentina, May 8-17, 1973.

^{14/} Marion, B., op. cit., Monograph No. 2, NC-117, 1976, p. 179.

Silva^{15/} has pointed out three major changes: population growth, migration and urban per capita income increases, which have affected the Colombian food market system. The food market system is "...the collection of product channels, middlemen and business activities involved in the physical and economic transfer of food from producers to consumers."^{16/} As part of this Colombian food market system, the corn subsector is affected by these three major changes. It seems that the major impact has been on vertical coordination and effectiveness of the pricing system.

A pricing system is "...a comprehensive concept consisting of all the transactional relationships involved in the determination of prices. The transactional relationships are: rules, regulations, rights, customs, standard operating procedures, taxes, subsidies and transactions."^{17/} Pricing mechanisms are subsets of a price system.^{18/} Tomek^{19/} has stated that "...pricing mechanisms involve the physical and institutional arrangements for discovering prices and other terms of trade." In the prediction process, the study of alternative pricing mechanisms is important because these alternative pricing mechanisms might improve the corn subsector pricing performance and corn subsector vertical coordination.

^{15/} Silva, A., "Evaluation of Food Market Reform: Corabastos-Bogota," Ph.D. Dissertation, Department of Agricultural Economics, Michigan State University, 1976, p. 1.

^{16/} Kohls, R. and J. Uhis, Marketing of Agricultural Products, MacMillan Publishing Co., Inc., 1980, p. 591.

^{17/} Shaffer, D., "Pricing Mechanisms--Some Questions of Policy: An Overview from an Institutional Perspective," paper presented at an OECD Seminar, Paris, July 1, 1980, p. 1.

^{18/} Ibid.

^{19/} Tomek, W., "Growth and Development of Alternative Pricing Mechanisms in Agriculture," draft chapter in Future Frontiers in Agricultural Marketing Research, p. 1.

Sources of Data

This research is based upon secondary data from prior studies and available data from the Colombian Ministry of Agriculture, the Colombian National Department of Statistics (DANE), the United States Department of Agriculture and the United Nations. A review of official data sources on Colombian agriculture showed that there has not been an agricultural census since 1971.

Annual time series data used in the analysis of quantities produced, imported and consumed are based on a July to June crop year. The period of time for these analyses is 22 years, from 1960 to 1981. The main source of annual data was unofficial computer printouts from the International Economic Division of the USDA.

The annual average prices at the producer, wholesaler and retailer level are also for the July to June crop year. This data is for the 11 years from 1970 through 1980. The main source of annual data was the monthly statistical bulletin of DANE.

Methods of Analysis

Simple linear regressions were used to estimate trends in areas harvested of corn, rice, sorghum and cotton, and the trend in real price of corn meal and unmilled white corn and the producer selling price of corn, wheat flour and rice. The parameters of each equation were calculated using a program for a straight-line linear model for bivariate data. This program was run on a Texas Instrument Model 59 programable calculator. In addition to the value of the trend parameters, the program also calculated the value of the correlation coefficient. The coefficient of determination (R-squared) was obtained by squaring the

correlation coefficient. A t-statistic value was calculated for each equation to test the null hypothesis that the correlation coefficient is equal to zero. The formula used to calculate the t values was:

$$t = [(V \cdot R\text{-squared}) / (1 - R\text{-squared})]^{**1/2}$$

where:

V = degree of freedom = n-2;

n = the number of observations.

The statistical values for each equation are presented in Appendix II.

Organization of the Paper

Chapter II describes the geographic distribution of corn production and the trends in production, consumption and imports. Chapter III describes the organization within the corn subsector by looking at the marketing channels, agents and functions, storage facilities, the commodity exchange, credit, quality standards, and market information. Chapter IV presents an analysis of price movements in the corn subsector. This is carried out by looking at price movements and price spreads at the producer, wholesaler and retailer level; the comparison for producer selling prices and support prices; the comparison of producer selling prices and the world price; and the comparison at the retail level of corn meal, rice and wheat flour prices. Chapter V presents a general summary and questions for further study. Finally, an appendix presents estimations of product price elasticity and corn production and consumption by 1983.

CHAPTER II

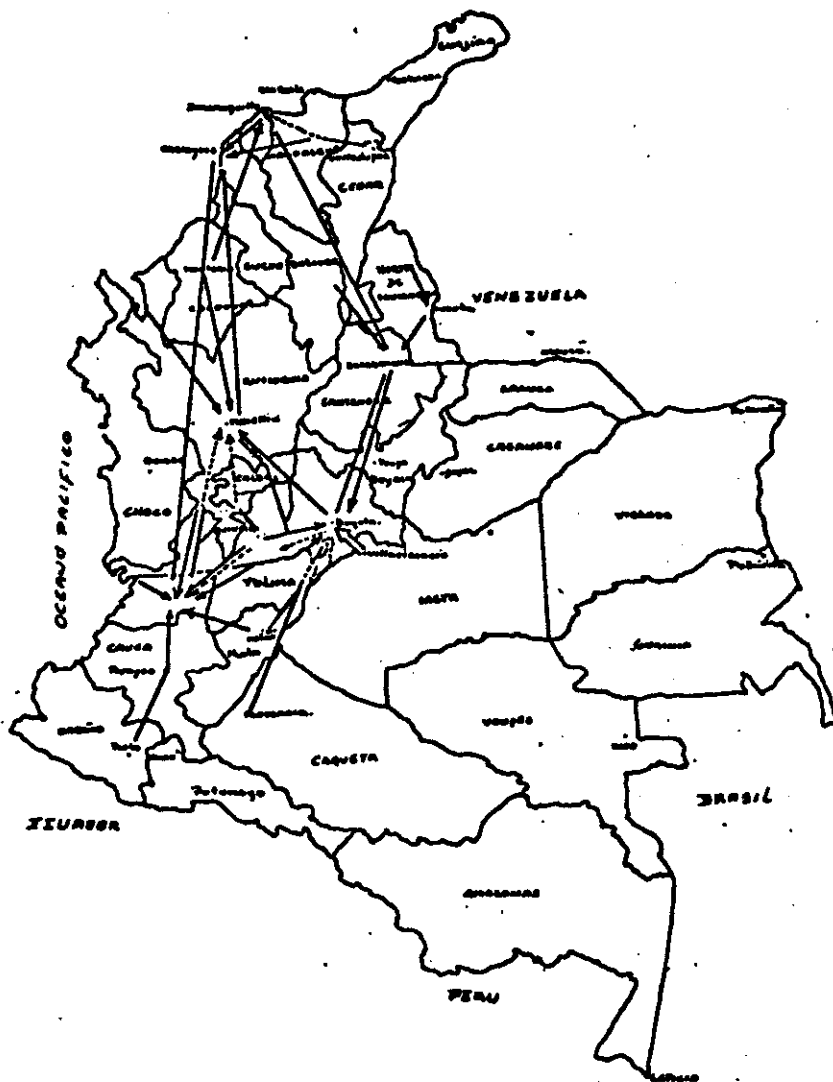
GEOGRAPHIC DISTRIBUTION OF CORN PRODUCTION AND TRENDS IN PRODUCTION, CONSUMPTION AND IMPORTS

Geographic Distribution

Corn production is widely dispersed throughout Colombia (Figure 2.1); however, primary cultivated areas are concentrated in a few states such as Antioquia, Cundinamarca, Meta, Caqueta and Narino. These states are also the largest producers (Table 2.1). On the other hand, the best yields are in Valle del Cauca, Cundinamarca, Viejo Caldas, Tolima and Cordoba.

There are two reasons for the fact that the highest yields are not necessarily obtained in those states which have the largest percentages of area devoted to corn. First, corn is not well adapted to all climatic zones (Table 2.2). This is reflected in the fact that in the coldest areas the production cycle is from 290 to 320 days, resulting in only one harvest per year. This explains the lower yields in these areas in comparison with yields from lower altitudes and warmer climatic zones where shorter production cycles (115 to 170 days) permit two harvests per year. In the states with the largest areas devoted to corn, it is produced in the entire range of altitudes and climatic conditions; thus, yield figures are an average for this entire range. Second, in states such as Valle del Cauca and Tolima yields are high because of favorable altitude and climatic conditions, corn must compete with other crops

Figure 2.1
 Geographic Pattern of Corn Shipments from Producing
 Areas to Major Consuming Centers



Source: Alvarado, et. al., Ponencia sobre Mercadeo y Productividad Agrícola en Colombia, May 1978, p. 169.

Table 2.1
Distribution of Corn Production, Area and Yield by
Departamentos (States) 1980

<u>States</u>	<u>Production</u> (Per cent)	<u>Area</u> (Per cent)	<u>Yield</u> (Ton/Ha.)
Antioquia	11.84	14.9	1.19
Atlantico	.76	1.2	.9
Bolivar	4.46	4.96	1.25
Boyaca	2.55	2.86	1.24
Cauca	3.95	3.56	1.54
Cesar	3.55	3.25	1.51
Cordoba	6.42	5.69	1.57
Cundinamarca	18.98	13.99	1.88
Guajira	.48	.65	1.04
Huila	1.38	1.3	1.43
Magdalena	4.0	3.98	1.41
Meta	9.38	10.09	1.29
Narino	6.27	6.26	1.39
Norte de Santander	2.58	2.4	1.49
Santander	3.22	3.7	1.19
Sucre	1.76	2.1	1.16
Tolima	2.22	1.87	1.65
Valle del Cauca	4.1	2.6	2.19
Uraba	3.27	4.15	1.09
Caqueta	5.27	7.32	1.00
Viejo Caldas	1.67	1.30	1.77
Others	1.89	1.87	.92
Total	100	100	

Source : The percentage were calculated by the author using
data from:
Ministry of Agriculture, Cifras del Sector Agropecuario
1980, November 1981, p. 58.

Table 2.2
Distribution of Corn Area by Climatological Zones

Climatic Zones	Altitude (Meters)	Mean Temperature $^{\circ}\text{C}$	Production Cycle (Days)	Percent of Area
Hot	0 - 600	27	95 - 170	22.7
Warm	600 - 1200	24	145	7
Warm - Cool	1200 - 1800	20	155 - 160	52.7
Cool	1800 - 2200	17	250	8.8
Cold	2200 - 2800	13	290 - 320	8.8
				100.0

Source : Ministry of Agriculture, Estudio del Caso del Cultivo del Maiz, February 1980, P.35. This data refers to the agricultural census in 1970-71.

such as sorghum and cotton in Valle del Cauca and rice in Tolima.^{1/}

The wide geographical distribution of corn production in Colombia reflects its importance as a subsistence crop for small farmers in mountainous areas. The expanding urban market has stimulated the development of large scale, modern farm production units which tend to be in areas best adapted to mechanized production, i.e., large river valleys and interior plains and coastal plains in areas in which the transportation infrastructure is well developed.

Production Trends

Area

Law 135 of 1961, The Reforma Agraria (Agricultural Reform) helped in the expansion of agricultural land.^{2/} This can be noted by a review of data from the two most recent agricultural census figures. The agricultural census of 1960 indicated that 27,337 thousand hectares were utilized and the census of 1970-71 showed that the land utilized increased to 30,993 thousand hectares.^{3/} However, corn did not benefit from this expansion due to the difficult economic situation of the 1960s (a deficit in the balance of payments because of the low price of coffee

^{1/}Alvarado, R., et. al., "Ponencia sobre Mercadeo y Productividad Agricola en Colombia," paper presented at I Seminar on Agricultural Yield, Neiva-Colombia, May 1978.

^{2/}Kalmanovitz, S., "La Agricultura en Colombia, 1950-1972," special edition of numbers 276, 277 and 278, Boletin Mensual de Estadistica, DANE, p. 90.

^{3/}Colombia Estadistica, DANE, 1981, p. 87.

and a small increase in total demand for coffee).^{4/} Pressure was put on the government to implement a political strategy of import substitution for some industrial products. This resulted in an increased domestic demand for raw materials such as sorghum, cotton, soybeans, etc., for industry and the intensification of the use of modern technology in the production of these crops.^{5/} This process began in 1931 with Law 57 which created the Rural Bank and was reinforced by Law 26 in 1959 which created the Agricultural Financial Fund.^{6/}

During the 1960s, import substitution was complemented by an export promotion policy for industrial and non-traditional agricultural products in an effort to reduce the dependency on coffee exports.^{7/} In the 1970s the government policy changed to a more open economy because of the more favorable balance of payments resulting from higher coffee prices. In 1975 the cold weather in Brazil resulted in a small export crop and this particularly increased world coffee prices. During this period, the inflation rate was high because of the increase in foreign currency and low production. Two policies were implemented. One policy was to increase imports and another policy was to increase credit to agriculture in order to expand production. Credit for corn,

^{4/} Caballero, C., 20 Anos de Economia Colombiana, El Tiempo, March 1, 1982.

^{5/} Kalmanovitz, S., op. cit., Boletín Mensual de Estadística, DANE, p. 86.

^{6/} La Economia Colombiana, 1950-1975, Vol. IX, No. 3, Revista de Planeación y Desarrollo, Departamento Nacional de Planeación, 1977, p. 164.

^{7/} Ibid., p. 150.

however, increased only in current terms; it decreased in constant terms (see Chapter III).^{8/}

Corn area harvested had a tendency to decrease 9.7 thousand hectares per year during the period 1960-1981. However, rice, cotton and sorghum, crops that compete with corn for the best land available, showed a tendency to increase 7.9, 6.6 and 12.0 thousand hectares, respectively, per year (Figure 2.2 and Table 2.3). The increases in corn area harvested in 1963-1965 and 1973-1975 were the result of the government's promotion of corn production. The campaigns were called "Operation Maiz"^{9/} and "Programa de Fomento de la Produccion de Maiz,"^{10/} respectively.

Yield

Corn is grown with various combinations of technologies. These technologies can be grouped into two categories: traditional and modern. The principal characteristics of those technologies are presented in Chapter III.

Corn yields were lower than rice and sorghum yields during the period 1960-1981 (Table 2.3). Corn yields also showed a great deal of variation during 1960-1981, ranging from 1 ton per hectare to 1.43 tons per hectare. It is important to point out that corn yields during 1973-1981 were higher than those of the first years of the time period

^{8/} Boletín Mensual de Estadística, No. 273, April 1974, p. 85.

^{9/} Adams, et. al., Public Law 480 and Colombia's Economic Development, Department of Agricultural Economics, Michigan State University and Departamento de Economía y Ciencias Sociales Facultad de Agronomía E Instituto Forestal Universidad Nacional de Colombia, 1964, p. 212.

^{10/} Programa de Fomento de la Produccion de Maiz, 1972-1975, Colombian Ministry of Agriculture, December 1971.

Figure 2.2
Trends in Corn, Rice, Cotton, and Sorghum Area (1960-1981)

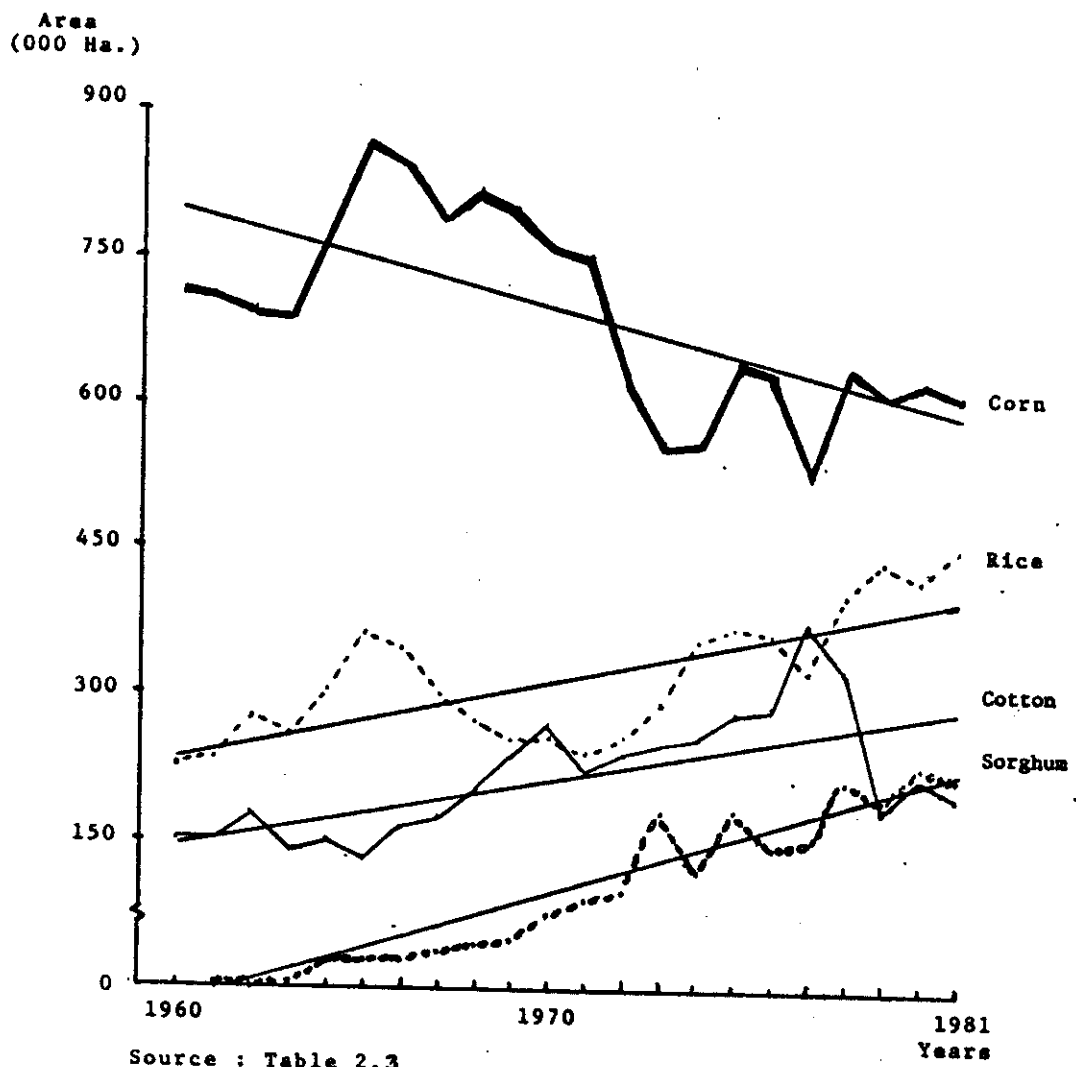


Table 2.3
Trends in Corn, Rice, Cotton and Sorghum Production, Area and Yield (1960-1981)

Years	Production (000 Tons)			Area Harvested (000 Ha.)			Yield (Ton / Ha.)				
	Corn	Rice	Sorghum Seed	Corn	Rice	Sorghum Seed	Corn	Rice	Cotton Sorghum Seed		
1960	866	450	115	n.a.	715	227	151	1.21	1.98	.76	n.a.
1961	758	474	132	4	711	237	151	1.06	2.0	.87	2.0
1962	754	585	142	8	697	280	176	1.08	2.09	.81	2.0
1963	782	565	126	12	689	260	141	1.13	2.17	.89	2.4
1964	968	600	114	56	772	302	150	1.25	1.99	.76	2.33
1965	871	672	114	70	869	365	134	1.0	1.84	.85	2.33
1966	850	680	125	60	846	350	164	1.0	1.94	.76	2.0
1967	850	662	175	90	790	300	175	1.07	2.21	1.0	2.25
1968	886	786	202	100	818	277	199	1.08	2.84	1.01	2.22
1969	920	689	214	100	800	255	236	1.15	2.70	.91	2.0
1970	862	702	276	165	760	257	267	1.13	2.73	1.03	2.14
1971	750	852	322	200	750	242	219	1.0	3.52	1.47	2.19
1972	625	997	412	224	625	258	242	1.0	3.86	1.70	2.21
1973	722	1151	335	378	555	291	251	1.3	3.96	1.33	2.1
1974	684	1540	420	298	559	354	258	1.22	4.34	1.63	2.5
1975	879	1614	401	456	646	372	281	1.36	4.33	1.43	2.51
1976	766	1560	408	285	631	366	286	1.21	4.27	1.43	1.99
1977	737	1307	480	325	531	324	377	1.38	4.03	1.27	2.10
1978	841	1715	330	461	638	406	328	1.31	4.22	1.01	2.18
1979	881	1932	281	452	612	442	186	1.43	4.37	1.51	2.31
1980	863	1892	205	502	623	420	219	1.38	4.5	.94	2.18
1981	880	1990	165	545	610	452	199	1.3	4.4	.83	2.47

Sources : Corn and Sorghum data come from unofficial USDA computer print out.

The data for the other crops come from:

1960-1969 Salomon Kalmanovitz, *La Agricultura en Colombia 1950-1972*, DANE, Special Report from Boletín Mensual de Estadística Numbers 253-254.

1970-1979 Colombia Kalmanovitz, *La Agricultura en Colombia 1950-1972*, DANE, Special Report from Boletín Mensual de Estadística Numbers 253-254.

1980-1981 Foreign Agricultural Service, USDA, *Attache Report No Co-1001, January 1981*.

Cotton Seed Yield is low but if Cotton Fiber production is add, the yield increased above corn for most of the time (See Kalmanovitz).

n.a. means not available.

studied (Table 2.3). This suggests that modern technology increased its share of production or that some traditional farmers adopted the use of modern inputs.

Production

Corn production varied considerably during 1960-1981; whereas rice and sorghum presented a clearer tendency to production increases during the same time period (Table 2.3).

Most of the decrease in corn production during 1960-72 is explained by the decrease in area harvested. Within this period, however, there were production increases in 1964 and 1969. The increase in 1964 is explained by the increase in area cultivated as a result of government promotion. The explanation for the increase in production in 1969 may be an increase in the use of modern technology during this year or it may be good weather since area harvested declined during this year.

In the period from 1974 to 1981 corn production increased from an average of 781 thousand tons during 1974-75 to an average of 866 thousand tons during 1978-81. This increase in production is explained by the slight increase in area harvested during the period and to some extent by a more intensive use of modern production technology. The decrease in production in 1974 was the result of unfavorable weather. In 1977 the decrease in production was the result of dry weather and a decrease in area harvested. The slight decrease in 1980 was also due to lack of rain.

Producer Responsiveness to Prices

The importance of supply elasticities is pointed out by Tomek and Robinson^{11/} as a useful tool for those responsible for forecasting

^{11/}Tomek, W. and K. Robinson, Agricultural Product Prices, Cornell University Press, 1981, pp. 78-79.

future supplies or making policy decisions. The price elasticity of corn supply at mean values was .2 during the period 1960-1980 (for calculations of this value see Appendix I). This elasticity means that the percentage increase in quantity supplied of corn is much smaller than the percentage increase in price. This elasticity is low and is possibly due to the fact that producers react to nominal prices rather than to real prices. However, this is not an accurate measure because the data is aggregated and does not reflect the dual structure of production. In order to accurately measure the impact of prices on producers, the data should be disaggregated into traditional producers and modern producers. The price elasticity for the former would be expected to be low, whereas the price elasticity for the latter would be expected to be high. The reason for this is that traditional producers are probably less sensitive to price changes than modern producers since modern producers sell most of their production to the market and can shift more readily to other crops.

Consumption Trends

Direct human consumption of corn is: (1) the consumption by farmers of their own production; (2) demand for unmilled corn; and (3) the demand for the traditional processor product (crushed corn). Direct human consumption of corn represented a large percentage of total human consumption during 1960-1981 (Table 2.4). This percentage, however, declined from 88 percent in 1960 to 73 percent in 1981 (the percentages were calculated using data in Table 2.4).

Industrial human consumption of corn is the demand for the products of modern processors such as starch, meal, etc. Industrial human

Table 2.4

Corn Consumption Distribution and Imports, Population and Per capita Consumption of Corn (1960 - 1981)

Years	Direct Human Consumption (000Tons)	Industrial Human ² Consumption (000Tons)	Total Human ³ Consumption (000Tons)	Feed Use ⁴ (000Tons)	Total Consump ⁵ tion (000Tons)	Imports ⁶ (000Tons)	Population ⁷ (000People)	Per capita Consump ⁸ tion (Kilos/ Person)
1960	625	86	711	179	890	24	15416	46.12
1961	546	76	622	152	774	16	15908	39.10
1962	544	75	619	136	755	1	16417	37.70
1963	580	78	658	146	804	22	16941	38.84
1964	702	93	795	173	968	0	17484	45.47
1965	n.a.	n.a.	715	155	870	1	17996	39.73
1966	n.a.	n.a.	686	165	851	1	18468	37.14
1967	n.a.	n.a.	699	151	850	2	18956	36.87
1968	n.a.	n.a.	806	93	899	13	19462	41.41
1969	n.a.	n.a.	745	99	844	3	19984	37.28
1970	n.a.	n.a.	832	100	932	12	20527	40.53
1971	n.a.	n.a.	705	85	785	6	21088	33.43
1972	n.a.	n.a.	615	65	680	85	21668	28.38
1973	n.a.	n.a.	708	75	783	69	22343	31.60
1974	481	145	626	50	676	0	22981	27.24
1975	665	145	810	50	860	0	23644	34.26
1976	657	165	822	60	882	90	24333	33.78
1977	498	253	751	70	821	18	25048	29.98
1978	683	162	845	78	923	35	25645	32.95
1979	635	225	860	80	940	94	26360	32.62
1980	678	250	928	90	1018	160	26900	34.50
1981	690	260	950	70	1020	75	n.a.	n.a.

Sources: 1. It is the difference between Total Human Consumption and Industrial Human Consumption.
2. 1960-1964 Guerra, G., et. al., Maiz y Mollo en Colombia: Situacion general y perspectivas futuras, No 64 Volumen XXV, Revista Facultad Nacional de Agronomia, 1966.

1974-1978 Ministry of Agriculture, Programas Agricolas, 1976-1977 and Cifras del Sector Agropecuario, 1976-1978.

1979-1981 Foreign Agricultural Service, USDA, Attache Report No Co-1001, January 1981.

3. It is the difference between Total Consumption and Feed Use.

4,5,6. Unofficial USDA data, Computer print out.

7. UNITED NATION, Demographic Year Book, 1979.

8. It is the ratio between Total Human Consumption and Population. The last column includes the average of 1978, 1979 and 1980.

n.a. means not available.

consumption of corn increased 200 percent during 1960-1981 (the percentage was calculated using Table 2.4). Several factors are related to this increase, but only the two major ones are discussed here.

(1) The increase in urban population. According to the census of 1961 and 1973, the urban population share of total population increased from 53 percent to 60 percent, respectively. This urban population demands a larger amount of processed corn products, thus, increasing the industry's demand for corn.^{12/}

(2) The increase in annual income of blue collar workers and white collar workers in current and real terms during 1960-1980. Blue collar workers' income increased in current terms from 305 pesos per worker to 9,260 pesos per worker. The increase in real terms for these workers was from 2,033 pesos per worker to 3,940 pesos per worker. White collar workers' income, on the other hand, increased from 686 pesos per worker to 18,190 pesos per worker. The increase in real terms for these workers was from 4,573 to 7,740 pesos per worker. This increase in disposable income means an increase in the demand for processed corn products.^{13/}

Total human consumption of corn (direct consumption plus industrial consumption) represents a large share of total consumption of corn.

^{12/} Demographic Yearbook, United Nations, 1979.

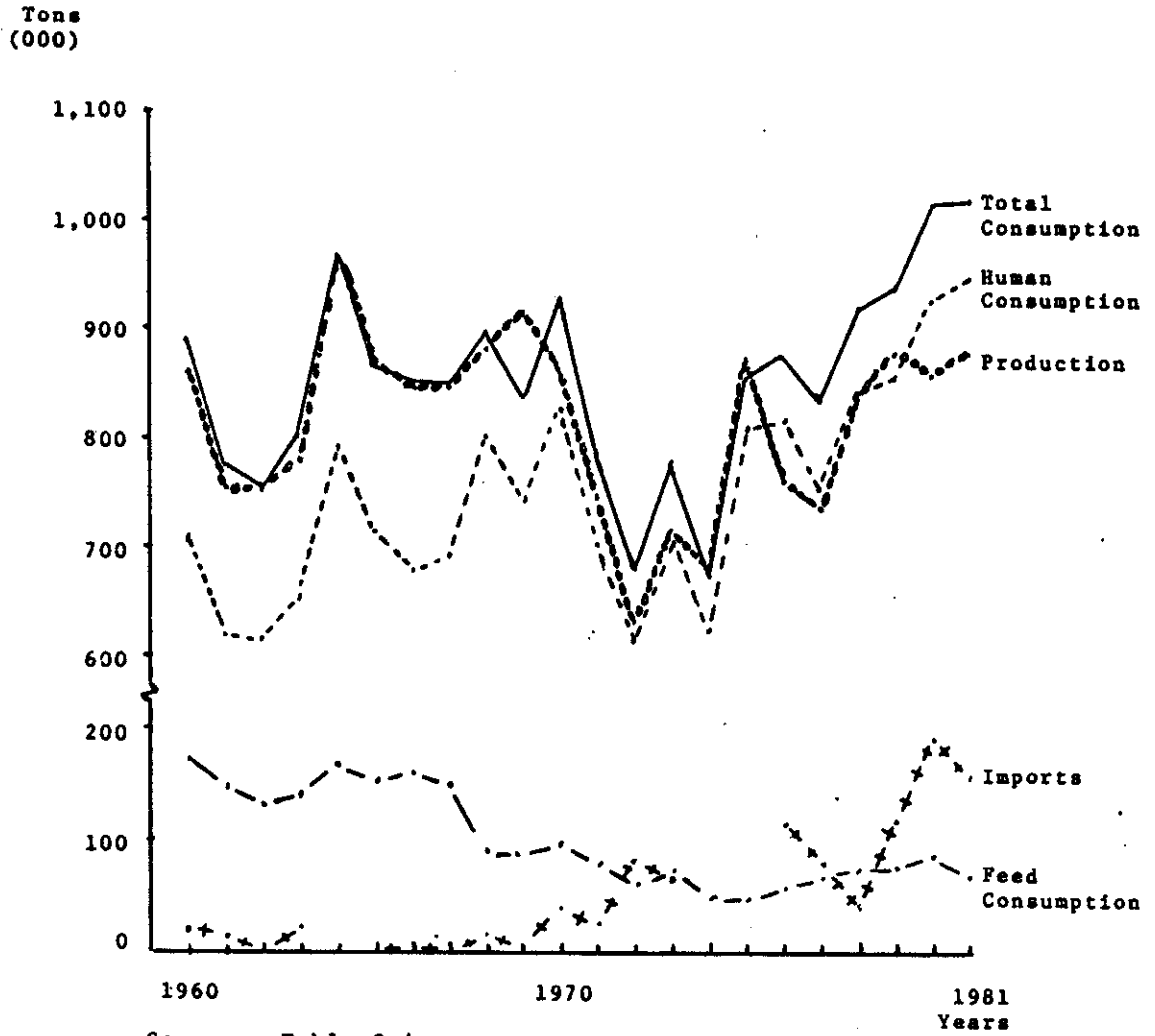
^{13/} Boletín Mensual de Estadística, DANE, January-December 1960; Colombia Estadística, op. cit., 1981; the value for blue collar workers was calculated on eight hours per work day.

This share increased from 80 percent in 1960 to 93 percent in 1981. (The percentages were calculated using Table 2.4.) During the period 1960 to 1975, total human consumption of corn was below corn production (Figure 2.3). With the exception in 1979, total human consumption of corn was above corn production during the period 1976-1981 (Figure 2.3). Per capita consumption of corn decreased from 46 kilos in 1960 to 34 kilos in 1980. However, an increase in per capita consumption of corn occurred in 1964, 1968 and 1970.

Table 2.4 and Figure 2.3 show that the use of corn for animal feed has declined from an average of 165 thousand tons during 1960-62 to only 79 thousand tons during 1978-79. This resulted from high domestic prices for corn and the limited amount of corn imported. The feed manufacturing industry has replaced corn with sorghum as a raw material.

Total consumption of corn did not show a single trend during the period 1960-1981 (Table 2.4 and Figure 2.3). Within these years, however, two periods can be defined. In one period, from 1960 to 1972, total consumption tended to decline slightly from 890 thousand tons to 680 thousand tons. In the period 1973 to 1981, total consumption of corn increased from 783 thousand tons in 1973 to 1,020 thousand tons in 1981. Total corn consumption closely followed corn production during most of the period 1960-1975. The exception was 1969 when corn production was higher than total corn consumption. During the period 1975-1981, total corn consumption was higher than corn production. This increase in total consumption reflects an increase in human consumption and imports.

Figure 2.3
Trends in Corn Production, Consumption and Imports (1960-1981)



Source : Table 2.4

Consumer Response to Prices and Income Change

Alvarado, et. al.,^{14/} show that for the two high income strata in Cali in 1976, corn had negative income elasticities of .26 and .42 and for the lower income strata, it had positive elasticities of .43, .34 and .61. This results in a weighted average income elasticity of .39. This indicates that corn is an inferior good among high income consumers; that is, as income levels increase households spend a decreasing percentage of their income for corn. Lower income strata households spend more for corn as incomes rise, but the percentage increase in corn purchases are much less than the percentage increase in income.

These authors also state that corn had a price elasticity of the demand of -.40. A price elasticity of the demand of -.4 means that the percentage increase in quantity of corn purchased is lower than the percentage decrease in corn price; that is, a 10 percent increase in the price is associated with a 4 percent decrease in the quantity purchased.

Import Trends

Total corn imports were 1,029 thousand tons during 1960-1981. On the average, 40 percent of these imports came from the United States.^{15/} The Public Law 480 program of the United States, a food aid program launched in 1954, stimulated imports from this source. In recent years, however, the proportion of imports through this program has declined.^{16/}

^{14/} Alvarado, R., et. al., op. cit., May 1978.

^{15/} Unofficial computer printouts from the International Economic Division of the USDA.

^{16/} Spitze, R. and N. Dorow, "Agricultural and Food Situation, Policies and Issues," in Food and Agriculture Policy Issues for the 1980s, June 1980; Jones, B. and B. Stanton, "International Trade Issues," in Food and Agriculture Policy Issues for the 1980s, June 1980.

There were very little corn imported during the period 1960-1969. Imports increased during the 1970s, especially during the period 1976-1981. Imports reached their highest value in 1980.

Summary

Corn is grown throughout Colombia; however, the majority of corn production is concentrated in few states. Corn is not well adapted to all climatic zones. Corn must compete with other crops for prime agricultural land in the lower altitudes and warmer climatic zones; thus, a large percentage of the corn grown in Colombia is grown in medium altitude and temperature zones. This is one of the reasons for the relatively low corn yield figures for Colombia as a whole.

Government policies, which are affected by international and national events, have had a great influence on production trends. During the period under study (1960-1981), rice, cotton and sorghum, crops that compete with corn for the best land available, all showed increases in area harvested whereas for corn the area harvested showed a tendency to decrease.

During the last five years of the period, corn yields were higher than they had been during earlier years of the period. This may indicate an increasing use of modern technological inputs into corn production. The overall variations in corn production over the entire period are thought to be the result of the changes in area harvested, weather and the adoption of modern technology. Corn producers showed a relative inelastic price elasticity of supply of .2 at the mean value during 1960-1981.

Human consumption of corn represented a high share of total consumption of corn, although it did not show a clear upward or downward

trend during the period (1960-1981). There was, however, a clear tendency for total human consumption of corn to increase during the latter part of the period (i.e., 1975-1981). This increase in total human consumption of corn is related to increases in population and increases in per capita income.

Although the income elasticity of demand for corn is positive among low income households, it becomes negative at higher income levels. In 1976 the income elasticity of demand at the mean level of income was +.39. The price elasticity of demand was -.4.

CHAPTER III

THE ORGANIZATION OF THE CORN SUBSECTOR

Marketing Channels

The complex physical flow of corn is shown in Figure 3.1. In this figure the wider line represents the major flow of corn. The continuous lines represent less important flow of corn. Because it was impossible to get recent disaggregated data, the importance of each channel is not presented in quantitative terms. The dotted lines represent the smallest flow of corn. This is the flow that goes through the commodity market exchange. A description of this alternative mechanism for market coordination is presented later in this chapter. The size of the circles represents the relative importance of the agents at each stage of the corn subsector. For example, a larger circle for traditional producers than for modern producers means that the number of traditional producers is larger than the number of modern producers.

An important characteristic of the corn subsector is its dualism (traditional and modern) which pervades all the subsector stages. Most of the literature about corn emphasizes dualism in production.^{1/} Alvaro

^{1/} See for example: Londono and Anderson, Descripcion de Factores Asociados con Bajos Rendimientos de Maiz en Fincas Pequeñas de tres Departamentos de Colombia, Series ES-No. 18, Centro Internacional de Agricultura Tropical, September 1975; Kalmanovitz, S., "La Agricultura en Colombia, 1950-1972," special edition of numbers 276, 277 and 278, Boletín Mensual de Estadística, DANE.

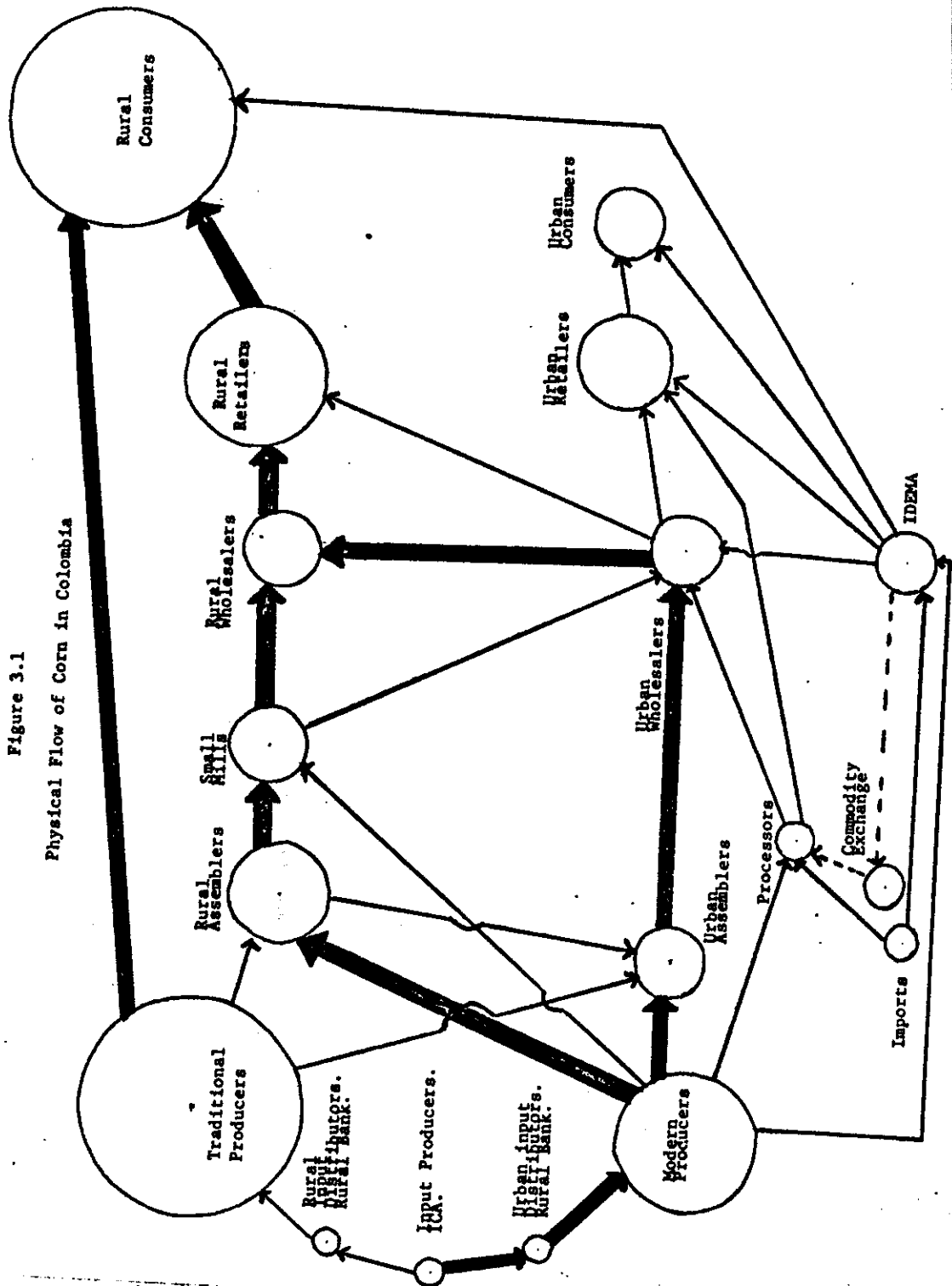


Figure 3.1

Physical Flow of Corn in Colombia

Silva^{2/} also refers to dualism for the grain distribution system. Although there is little reference to it in the literature, there also exists a dualism in processing. The traditional sector is represented by small mills which only break out the germ of the grain and obtains two subproducts, "trillado" (crushed corn) and ground corn. The modern sector is represented by processors that obtain several subproducts such as starch, dextrin, glucose and other products.

Agents and Functions

Farmers

Farmers are characterized by their large number and by the two types of technology used. The characteristics of those who use the traditional technology are:

- Production is subsistence oriented because only 20 percent is marketed.^{3/}
- A large proportion of the farms are less than 10 hectares.^{4/}
- The yield average was 1,124 kilograms per hectare during the period 1974-1979.^{5/}

^{2/} Silva, A., "Evaluation of Food Market Reform: Corabastos-Bogota," Ph.D. Thesis, Department of Agricultural Economics, Michigan State University, 1976.

^{3/} "Estudio del Caso del Cultivo del Maiz," paper presented at Seminar on Características Físicas y Tecnologías de la Agricultura en Colombia, Oficina de Planeamiento del Sector Agropecuario-OPSA, D.A.N. 4., Colombian Ministry of Agriculture, Bogota, February 1980.

^{4/} Ibid.

^{5/} Lesmez, J., "La Demanda Industrial del Maiz en General y en Particular el caso PROMASA," Facultad de Administración de Empresas, Colegio Mayor de Ntra. Sra. del Rosario, 1979.

- The percentage of area under traditional technologies to total area harvested of corn was 71 percent for the period 1974-1979.^{6/}
- Animal power and human labor are used extensively. Most of the labor used is family labor; however, some hired labor is used.^{7/}
- The use of modern inputs (fertilizers, improved seed) is limited. These inputs are obtained through the Rural Bank and rural private sector distributors.^{8/}
- The availability of institutional credit is limited. Most of the credit is obtained through rural input distributors.^{9/}
- Rent is paid in cash or in kind. For example, it is usual in the state of Cundinamarca to have an agreement between the land owner and farmer called "two to four." This means that from four sacks for corn (62.5 kilos each), two go to the owner of the land.^{10/}
- In some areas the sacks for packing the crop are provided by the assembler. In other areas, the farmers sell only the grain and save the sack for another harvest season.^{11/}

^{6/} Ibid.

^{7/} "Estudio del Caso del Cultivo del Maiz," op. cit., Ministry of Agriculture, 1980.

^{8/} Londono and Anderson, op. cit., September 1975.

^{9/} Torres, H. and A. Patrino, Production y Distribucion de Granos en el Valle del Cauca, Informe Tecnico No. 11, Proyecto Integrado de Mercadeo Urbano Rural del Valle, Cali, Colombia, 1970.

^{10/} Lesmez, J., op. cit., 1979.

^{11/} Torres, H. and A. Patrino, op. cit., 1970.

The characteristics of the modern technology are:

- Most of the production is sold in the open market. Some amount is stored at the farm level or at local elevator facilities in order to try to get a better price. The farmers can get credit based on the corn deposited at the elevator facilities.^{12/}
- A large proportion of the farms are more than 10 hectares.
- The yield average was 2,315 kilograms, for the period 1974-1979, which is double that realized in the traditional system.^{13/}
- Production technology is less labor intensive and more mechanized.^{14/}
- Modern inputs are used to a greater extent than in traditional systems. However, there is a tendency to use local seed stock rather than to purchase improved seed.^{15/}
- Farmers have access to institutional credit.^{16/}
- Farmers can sell large amounts of corn through forward sale agreements with assemblers, wholesalers and processors. These agreements sometimes represent better prices for the producers because the assemblers, wholesalers and processors have the security of getting the product when supplies are scarce.^{17/}

^{12/} Ibid.

^{13/} Lesmez, J., op. cit., 1979.

^{14/} Londono and Anderson, op. cit., September 1975.

^{15/} "Estudio del Caso del Cultivo del Maiz," op. cit., 1980.

^{16/} Ibid.

^{17/} Torres, H. and A. Patrino, op. cit., 1970.

Farmers' Organizations

Grain growers have a national association, FENALCE, Federacion Nacional de Cerealistas (National Federation of Cereal Producers). The main objectives of this association are:

- (1) To act in behalf of members before the national government and other public and private entities, to assure that effective technical assistance is received from public and private sources.
- (2) To assure adequate supplies of agricultural inputs.
- (3) To assist in agricultural marketing.^{18/}

This organization is funded through a tax on production. This tax, 1 percent per kilo traded, is collected in the transaction between farmers and first handlers.^{19/}

Ministry of Agriculture

The Ministry of Agriculture is "...the government agency chiefly responsible for influencing change in the agricultural sector. The Ministry develops agricultural policy, coordinates planning and budgeting of the semi-autonomous agencies in the subsector and is increasingly involved in the coordination of agricultural program implementation and evaluation."^{20/}

ICA, Instituto Colombiano Agropecuario (Colombian Agricultural Institute)

The ICA is an arm of the Ministry of Agriculture. Its main activity for the corn subsector is the development of better methods of corn

^{18/}Colombia Agricultural Sector (analysis paper), USAID's Mission to Colombia, 1972, p. 87.

^{19/}Phone communication with Girardot's wholesaler.

^{20/}Colombia Agricultural Sector, op. cit., 1972.

production. To accomplish this, it engages in the development of new varieties and the study of better ways of implementing new technology.^{21/} These activities are carried out through research and extension.

IDEMA, Instituto de Mercadeo Agropecuario (Agricultural Market Institute)

IDEMA is a public agency which is an arm of the Ministry of Agriculture. It was created to regulate prices and markets for food products through buying and selling activities, importation and exportation and guaranteeing support prices to farmers. This public agency faces the problem of stimulating corn production through prices to farmers (support prices) so as to produce a reasonable volume of corn for processors and low income consumers (rural areas, low and middle income consumers in urban areas) at reasonable prices.^{22/} In the case of corn, IDEMA announces the support price at planting time. The support price is reportedly set in such a way that farmers' cost of production is covered, but the price is usually lower than open market prices. Therefore, the bulk of the crop is handled by private traders.^{23/}

Assemblers

These are firms that "consolidate produce from individual farmers and prepare it for the marketing process."^{24/} The assembler activity

^{21/} Villamizar, M., "Change Agents and Their Relationship to Corn Production Innovativeness by Colombian Small Farmers," Texas A&M University, 1979.

^{22/} Silva, A., op. cit., 1976.

^{23/} Thirsk, W., "Income Distribution Consequences of Agricultural Price Supports in Colombia." This paper reports research related to AID contracts No. CSD-3302, on Distribution of Grain, Wealth and Income from Development, Program of Development Studies, William Marsh Rice University, Fall 1973.

^{24/} Kohls, R. and J. Uhl, Marketing of Agricultural Products, MacMillan Company, Inc., 1980.

is carried out by IDEMA^{25/} and private assemblers.^{26/} Private assemblers can be divided into those that operate in regional markets and those that operate in more locally oriented markets. The assemblers in these local, more subsistence-type markets are characterized by their purchases of small amounts of corn. The assemblers in regional markets, on the other hand, are characterized by purchases of large quantities of corn.

Assemblers are usually characterized by farmers as being less interested in corn quality standards than are processors. Most farmers, therefore, prefer to sell their corn to the assemblers; although, some farmers also have contracts with processors. At the same time, processors prefer to have contracts with assemblers rather than with small producers who often sell corn of low quality. For example, PROMASA (a processor of corn for human consumption) has contracts with four major assemblers located in Bogota, Bucaramanga, Villavicencio and Florencia.^{27/} These cities are in some of the major corn producing areas, especially Villavicencio where more modern production technologies are used.

Processors

Like production, processing activity can also be divided into traditional and modern segments. The traditional segment produces two subproducts. From each ton of corn, 65 to 70 percent is "trillado" or "peto" (crushed corn) and 30 to 35 percent is "meal."^{28/} The trillado

^{25/}Torres, H. and A. Patruno, op. cit., 1970.

^{26/}Ibid.

^{27/}Lesmez, J., op. cit., 1979.

^{28/}Arana, J., "Margenes de Comercializacion y Algunos Aspectos del Mercadeo de Arroz-Maiz-Frijol-Trigo-Papa," Instituto Nacional de Abastecimientos, 1961.

is used for human consumption (soup and corn muffins) and the "meal" is used for animal feed.

The modern segment processes for both human consumption and animal feed; although the majority of the firms' subproducts are for human consumption. These processors can produce the following subproducts from one ton of corn:^{29/}

Meal: 70 percent. There are two kinds of meal: one for making muffins called "arepas" and another that is mixed with wheat flour to prepare pasta.

Ground Corn: 13 percent for the broiler industry and 15 percent for other kinds of animal feed.

Corn Oil: 2 percent.

The principal modern processors producing corn subproducts for human consumption and their locations are presented in Table 3.1.

Table 3.1

Firms Processing Corn for Human Consumption
and Locations in 1979

Firms	Location
Quaker	Cali
Maizena	Cali
Molino Aguila	Cali
PROMASA	Bogota
Inversiones Masapan LTDA	Bogota
Molino Nutibara	Medellin
Del Maiz	Medellin
Barranquillita	Barranquilla
Union-Molinerer	Duitama

Source: Lesmez, J., La Demanda Industrial del Maiz en General y en Particular el Caso Promasa, Facultad de Administracion de Empresas, Colegio Mayor de Ntra. Sra. del Rosario, 1979, p. 37.

^{29/} Lesmez, J., op. cit., 1979.

The firms located in Bogota have some advantage in location since they have access to the production coming from some of the larger producing states such as Cundinamarca, Meta and Caqueta.

The processors of corn for human consumption are characterized by being a concentrated oligopsony.^{30/} In 1979 the four largest firms bought 82 percent of corn purchased by the modern corn processors.^{31/} This percentage would be smaller if the total demand for corn were taken into account. For example, the consumption of those processors, in tons, was 11 percent of the total demand in 1979.^{32/}

The principal animal feed manufacturers are Raza, S.A.; Purina, S.A.; and Distraco. The last firm is integrated with the broiler industry. These manufacturers also constitute an oligopsony and oligopoly industry since 50 percent of the total feed production is accounted for by two firms.^{33/}

ADIMCE, Asociacion de Industriales Manufactureros de Cereales (Cereal Processors Association)

ADIMCE is an association, begun in 1974, that coordinates horizontally the processors of corn for human consumption. The activities of this association are to increase the production of corn, to do research in the development of new seeds, to investigate better places to grow corn, and to investigate problems in the process of obtaining the credit

^{30/} Ibid.

^{31/} Ibid.

^{32/} Ibid.

^{33/} Arteaga, F., La Estructura de Demanda Industrial y sus Implicaciones en la Produccion y Mercadeo del Maiz en Colombia, Centro de Estudios e Investigaciones sobre Mercadeo Agropecuario (CEIMA), Fundacion Universidad de Bogota Jorge Tadeo Lozano, July 1976.

for buying corn.^{34/} This is an important organization which enables processors to control the flow of corn which makes up 70 percent^{35/} of their total production costs. It may also play an important role in the quantity of corn imported.

FEDERAL, Federacion de Fabricantes de Alimentos para Animales
(Animal Feed Processors Federation)

FEDERAL coordinates, horizontally, the animal feed processors. As in the case of ADIMCE, this organization is important for controlling the flow of raw material. This organization can put some pressure on the government to approve the imports of corn. However, the decision on the raw material to be used depends on the relative prices of corn and sorghum.

Wholesalers

The classification of wholesalers by Alvaro Silva and other authors is applicable to the corn subsector. According to Silva, the more common wholesalers in the corn subsector:^{36/} the traditional wholesaler, wholesaler-retailer and the volume wholesaler. The traditional wholesalers usually specialize in a few products. "He earns a low net income and has low working capital and a small warehousing area." Wholesaler-retailers are "...small-scale wholesalers who sell to small-scale retailers and to households." The volume wholesaler is "...a modern wholesaler firm which specializes in few products, normally between one and five, but large volume.

^{34/} Lesmez, J., op. cit., 1979.

^{35/} Ibid.

^{36/} Silva, A., op. cit., 1976.

Elevators

The elevator is a "...marketing facility for purchasing and storing grain."^{37/} Silva identified three grain elevators that are brokers at the commodity exchange. These are^{38/} ALMAVIVA, ALMACENAR and ALMADELCO. IDEMA also operates as an elevator in this subsector.

Large Wholesaler Facilities

Most of the corn transactions are made in traditional spot markets, but the most important cities such as Bogota, Medellin and Cali, have large wholesaling facilities. The main activity of these facilities is to improve the food marketing system in their area of influence.^{39/}

Retailers

As in the case of wholesalers, Silva's classification of modern retail chains and traditional independent retailers is useful for the corn subsector. Modern retailers' chains are large retailers that generally operate in the large urban centers, especially in the high income areas. Traditional independent retailers such as plaza retailers and miscellaneous neighborhood stores are characterized by operating in rural areas and low income areas of the urban centers. Studies in Cali and Bogota have shown that most of the retail distribution for low income groups is done through the traditional independent retailers. Therefore, it is assumed that most of the retail distribution of corn is done through this channel.

^{37/} Kohls and Uhl, op. cit., 1972, p. 589.

^{38/} Silva, A., op. cit., 1976.

^{39/} Ibid.

Storage Facilities

Hugo Torres^{40/} described the storage process for grains that is also applicable to corn. Farmers store the crop in rooms within the farmhouse. The crop can be stored there from one to two months in order to try to get better prices on the spot market. The storage time depends, in part, on the farmer's need for cash. Farmers have the opportunity of storing their products in commercial warehouses, where they can obtain warehouse receipts which can be redeemed at a proportion of government support prices.^{41/}

Rural area assemblers store "...for periods of less than two months during which they send large volumes of grains to other areas (or ship it immediately after harvest), therefore, assemblers have to have their own storage facilities. In many cases, these are warehouses, with some sort of ventilation and sunlight for bag storage. They use modern techniques of pest control. Assemblers can use commercial storage facilities under the condition of simple deposit in which they pay for the service of keeping the product, fumigation, loading and unloading. They are not allowed to obtain warehouse receipts."^{42/}

Processing plants are the main users of commercial storage facilities. "Besides using the service of storage, they obtain warehouse receipts for their raw materials. Warehouse receipts can also be obtained for the grain stored in the processing plant's storage facilities. This system enables them to get working capital for their operations during harvesting periods. The availability of financial

^{40/}Torres, H. and A. Patrino, op. cit., 1970.

^{41/}Ibid.

^{42/}Ibid.

resources through warehouse receipts allows them commercial buying advantages."^{43/}

According to a report from the Ministry of Agriculture^{44/} and the research of Alvarado, et. al.,^{45/} the warehouse and silo capacity increased from two million tons in 1975 to 4.2 million tons in 1977. Alvarado, et. al., define three locations for storage facilities. These locations are: local assembly centers, regional assembly centers and consumer centers. The local assembly centers are characterized by being related to small towns; however, they influence marketing in the regions around them through their market. The regional assembly centers are in intermediate-sized cities which influence an economic region and sometimes the national market. The consumer centers are the principal cities such as Bogota, Medellin, Barranquilla and Cali which have 50 percent of the nation's population. These are centers that determine the major rural to urban flow of food. They also tend to be important at the national level in the food processing industry (see Table 3.1).

In 1977, 18.9 percent of the warehouse and silo capacity was located in local assembly centers; 29.6 percent was in regional assembly centers and 51.5 percent in consumer centers.^{46/}

Corn bag storage competes with other crops, especially coffee and rice, for the storage facilities. This competition and the low

^{43/} Ibid.

^{44/} Mercadeo Agropecuario en Colombia, Diagnostico General del Sistema propuestas para su mejoramiento, Oficina de Planeamiento del Sector Agropecuario, Colombian Ministry of Agriculture, 1976.

^{45/} Alvarado, R., et. al., Ponencia sobre Mercadeo y Productividad Agricola en Colombia, presented at I Seminar on Productividad Agropecuaria, Neiva, Colombia, May 1978, p. 197.

^{46/} Ibid., p. 199.

percentage of storage facilities in local assembly centers increase the price and income risks for farmers.^{47/}

The Commodity Exchange, La Bolsa Agropecuaria

The Commodity Exchange started in 1973. Its objectives in the corn subsector are to "...implement an institutional infrastructure to facilitate transactions and price formation in cash and futures markets for corn and other commodities, to publish quotations so that market participants in other channels are oriented and by this, to contribute to improvement in the functioning of the corn marketing system and agricultural development."^{48/}

The commodity exchange is regulated by Public Law (decreto) 789 of 1979. The purpose of this Law is to regulate the transactions that are made on the commodity exchange and to increase the confidence of the participants in this pricing mechanism. The most important characteristic of this commodity exchange is the simultaneous trading that occurs in the principal production and consumption regions of the country. This is arranged through telephone communication among the different trading centers.

The most important corn trading centers in the commodity exchange in Colombia are: Medellin; Barranquilla; Bucaramanga; Bogota; Villavicencio; and Cartago (see Figure 2.1). The main operation center is Bogota.

There are three kinds of transactions carried out on the commodity exchange. These transactions are distinguished by the timing of the

^{47/} Ibid., p. 199.

^{48/} Silva, A., op. cit., 1976.

delivery period. Immediate delivery involves a three-day delivery period; corn subproducts were traded on these terms in 1980. Definite time delivery is characterized by a four to 30-day delivery period. Futures trading, in which it is not necessary to have the product on hand at the time of agreement, is characterized by 150-day delivery period. A characteristic of futures trading in Colombia, in contrast to that on more developed commodity exchanges, is that actual commodities are usually delivered rather than closing out the contract with an offsetting transaction.^{49/}

It seems that the Bolsa is still in a developmental stage and the organization of the cash market is necessary in order to make it feasible to later develop "futures" contracts. Speculators should be included within the organization of a futures market. A speculator is defined as a trader who "holds a market position in anticipation of a favorable price movement."^{50/} After the existing cash market becomes well established, hedging (taking "equal and opposite position on the cash and futures markets")^{51/} activities can be incorporated into the Bolsa. Hedging reduces the risk, due to corn price fluctuations, that confront producers and processors at harvesttime when the producers want to sell their crop and the processors want to buy the raw material.^{52/} The risk in price fluctuation is reduced because hedgers

^{49/}Ibid.

^{50/}Kohls, R. and J. Uhl, op. cit., 1980.

^{51/}Kohls, R. and J. Uhl, op. cit., 1980.

^{52/}Purcell, W., Agricultural Marketing: Systems, Coordination, Cash and Futures Prices, Reston Publishing Company, Inc., 1979.

shift risks to speculators who also provide volume and liquidity that are important to the functioning of a futures market.^{53/}

The development of a futures market can be promoted through an extension service of the commodity exchange. To stimulate hedging activities in Colombia, it is important to keep records of price fluctuation by day and month. These records can be used for two kinds of analysis: (1) an economic price analysis using the concepts of supply and demand to determine whether to hedge;^{54/} and a technical price analysis in which statistical tools are used to project the direction of the price movements to determine when to hedge.^{55/} Both types of analysis are necessary to set the hedging strategy.

Table 3.2 shows that yellow corn tended to be more heavily traded in the commodity exchange than white corn. The volume of total corn traded (sales) on the commodity exchange increased from 495 tons in 1974 to 72,405 tons in 1980. Total trade (sales) of all products on the commodity exchange has also increased from 23,818 tons in 1974 to 294,822 tons in 1980.

IDEMA's participation in the sale of imported corn through the commodity exchange has been quite strong. However, IDEMA's volume decreases during harvesttime.^{56/} This is because it purchases corn directly from farmers and then sells this corn directly to processors, wholesalers and retailers.

^{53/} Ibid.

^{54/} Purcell, W., op. cit., 1979.

^{55/} Ibid.

^{56/} Consideraciones sobre la Bolsa Agropecuaria de Colombia, Colombian National Planning Department, 1978.

Table 3.2
Volume of Corn Trading
in the Commodity Exchange, Tons. (1974-1977 and 1980)

	1974	1975	1976	1977	1980 ²
Total Corn Traded in the Commodity Exchange ¹	495	32367	16176	16636	72405
Yellow Corn ¹	100	12547	8397	16521	67477
White Corn ¹	395	19820	7779	115	4928
Total Products Traded in the Commodity Exchange ¹	23818	110792	64512	38041	294822
Percent of Corn Traded over Total Products Traded in the Commodity Exchange	2	29	25	44	25
Corn Available for Trading (Production + Stocks + Imports) (Thousand Tons)	732	915	932	871	1133
Percent of Total Available Corn Traded in the Commodity Exchange	.07	3.5	1.7	1.9	6.4

Sources : 1. Departamento Nacional de Planeacion, Consideraciones sobre la Bolsa Agropecuaria de Colombia, Bogota, Enero de 1978. p. 11. The values in 1977 are mostly imports traded by IDEMA.

2. Bolsa Nacional Agropecuaria S.A., Informe de Actividades 1980, Bogota, Marzo de 1981, p. 44-45.

3. USDA, -unofficial Data, computer print out.

Credit

Traditional farmers receive most of their production credit through rural input distributors and the Caja Agraria (Rural Bank). The Rural Bank is the largest development bank in Colombia. The principal activity of this institution is to provide credit to farmers and small industries for purchasing machinery and farm supplies, for rural housing and for the development of farmer cooperatives.^{57/}

Modern farmers receive their financing from wholesalers, the Rural Bank and FFA, Fondo Financiero Agropecuario (Agricultural Finance Fund). FFA is one of the central banks specializing in rediscount lines for agricultural credit that flows through the commercial banks. "FFA rediscounted credit includes funds for the mandatory employment of technical assistance from the private sector by the borrower." Modern farmers also obtain credit through formal and informal agreements with assemblers.

Assemblers and wholesalers receive credit from financial institutions. Some assemblers also have contracts with processors. The assemblers obtain the crop by paying cash to the farmers. The crop is then sent to the processors. The processors make reimbursement for the crop within a period of eight to 30 days. This is one way for the processors to finance the purchase of raw material. The other way is through financial institutions.

Table 3.3 shows the decline in corn area financed by FFA, Rural Bank and PRODESARROLLO from 73 percent of the total corn area harvested in 1974 to 47 percent in 1979. The total value of financing increased

^{57/} Colombia Agricultural Sector, Op. cit., 1972.

Table 3.3
Credit Used for Corn Production

	1974	1975	1976	1977	1978	1979
Area harvested (000 ha.)	570.1	572.7	647.5	580.5	670.0	615.6
Area financed (000 ha.)	420.9	363.9	369.4	315.7	324.8	289.4
Percentage of total area financed	73	63	57	54	48	47
Total value financed (million pesos)	528	580	792	883	1167	1375
Percentage of the Rural Bank to the total value financed	69	74	63	70	66	66

Source Data : Ministry of Agriculture, Cifras del Sector Agropecuario,
1980, November 1981, p. 46.

from 528 million pesos in 1974 to 1,375 million pesos in 1979. The total value of financing showed a tendency to decrease in real terms from 652 million pesos in 1974 to 585 million pesos in 1979. This decrease in percentage was 1.7 percent per year.

Table 3.3 also indicates that an average of 68 percent of total corn production was financed by the Rural Bank during the period, 1974-79.

Quality Standards

Private sector wholesalers and assemblers still do not use standardized grades or grading equipment when buying grain; rather, they "...rely more upon experience, grain appearance and feel. The price they pay reflects quality differences, but subjective, unscientific grading cannot accurately nor consistently determine quality."^{58/}

Quality standards are different among IDEMA, the commodity exchange and processors. Corn producers had a price discount according to percentage of moisture and foreign material. IDEMA's quality purchasing standards for corn are 24 percent moisture and 6 percent foreign material.^{59/} However, the commodity exchange and processors' quality standards are 14 percent moisture and 1 percent foreign material.^{60/}

Market Information

The interpersonal information network (farmers-farmers, farmers-assemblers, farmers-wholesalers-retailers, etc.) still plays an

^{58/} Riley, et. al., Market Coordination in the Development of the Cauca Valley Region-Colombia, Research Report No. 5, LAMP, Michigan State University, 1970, p. 213.

^{59/} Attache Report No. Co-1001, FAS-USDA, 1981, p. 25.

^{60/} Reglamentos, Bolsa Nacional Agropecuaria, S.A., 1980, p. 83.

important role in disseminating price information within the corn subsector.^{61/} The grain report of PIMUR^{62/} shows that farmers' information is obtained by talking with other farmers of the region, assemblers, wholesalers and transporters. The assemblers obtain information by talking with farmers, generally one month before the harvesttime; talking with other assemblers in other cities by phone; reading newspapers and listening to radio. Processors obtain information through their purchasing manager who receives information by talking with farmers, assemblers and wholesalers; reading newspapers and official reports; and listening to radio.

It seems that the media of radio is an important information source (e.g., CARACOL's agricultural reports from CORABASTOS) because of its easy access by all the participants in the subsector.

The institutions that generate technical reports for the corn subsector are: IDEMA, ICA, the Commodity Exchange, the Producers Association, the Processors Association and the Ministry of Agriculture. Access to the Processors Association information is sometimes limited.

Summary

This chapter has described corn marketing channels. It has identified a dualism (modern and traditional) in the agents and their functions. The majority of the producers are small farmers who engage in subsistence production. The government, through the Ministry of Agriculture and other agencies, has a great deal of participation in

^{61/} Alvarado, et. al., op. cit., 1978.

^{62/} Torres, H. and A. Patrino, op. cit., 1970.

the corn subsector. The dualism characteristic of this subsector, however, makes it difficult to manage the functions of the agencies involved in the subsector. IDEMA is a very important government agency that establishes support prices for the farmers and participates in the assembly stage with private enterprises.

Modern processors are horizontally coordinated through associations. Due to small numbers of firms and their collaborative effort, they are able to exercise oligopsony and oligopoly powers. Some processors are horizontally integrated with other industries. The wholesaler, elevator and retailer functions are carried out by private enterprises. There has been an expansion in the storage facilities of Colombia, but corn must still compete with other crops, especially coffee and rice for bag storage facilities.

The commodity exchange is a pricing mechanism used to some extent in the corn subsector; however, its influence in the subsector is limited. The main operation center of the commodity exchange is in Bogota. There are three kinds of transactions carried out on the commodity exchange. These transactions are: immediate delivery, definite time delivery and futures trading. The commodity exchange is in a development stage. Further development of the cash market can provide the way for a futures contract market enabling hedging activities that could reduce the risk of price variation for farmers and processors. Risk will be reduced because it will be shared by hedgers and speculators. For future hedging activities, the long-term accumulation of information about prices and market-related conditions is important.

Traditional farmers receive most of their production credit through rural input distributors and the Rural Bank. Modern farmers, on the

other hand, receive their financing from wholesalers, the Rural Bank and the FFA. Assemblers, wholesalers and processors obtain credit through financial institutions. For corn, the area financed declined during the period 1974 to 1979. The value of corn financed, however, increased in current terms, but decreased in real terms.

One of the immediate problems in the corn subsector is the lack of homogeneity in the quality standards used within the subsector. Another problem is that the interpersonal information network still plays the primary role in disseminating price information within this subsector.

CHAPTER IV

AN ANALYSIS OF CORN PRICE MOVEMENTS, 1970-1980

This chapter describes the corn price movements at producer wholesaler and retailer levels during the period 1970-1980. It compares producer selling prices and government support prices for the period 1970-1980. It also compares producer selling prices and world prices during this period. Finally, it compares the retail level prices of corn meal, rice and wheat flour.

Inflation has played an important role in long-term price increases. The Colombian CPI (Consumer Price Index) during 1970-1980 had an average annual increase of 21 percent. For this reason the analysis of price movements is based on real prices. Information in tables is presented in both real prices and current prices. Real prices were obtained by dividing current prices by the Consumer Price Index (CPI). There are two reasons for using the CPI:^{1/} (1) the CPI is the principal index used to measure changes in the price level; and (2) the CPI was conveniently available. The problem with using the CPI is that the price level changes can be exaggerated.^{2/}

^{1/} Tomek, W. and K. Robinson. Agricultural Product Prices, Cornell University Press, 1981.

^{2/} Ibid.

Price Movements at Producers Wholesaler and Retailer Levels

The producer selling price is an average Colombian average calculated by the Central Bank. The sources did not specify whether this price refers to crop years (July-June) or to calendar years. Wholesale prices for corn meal (first quality) and unmilled white corn (quality not specified) refer to the city of Bogota and a crop year average. Bogota's wholesale price can be considered the representative base for Colombia for two reasons: (1) Bogota is one of the principal assembly (CORABASTO) centers; and (2) Bogota has the largest population in Colombia which makes it an important consumer center. Corn meal (first quality) retail prices refer to the city of Girardot. This city was chosen because the retail corn products prices were not available for the city of Bogota. Therefore, it was decided to choose the closest city to Bogota for which information was available. It is important to point out the limitation of the comparison below because the price difference between wholesaler and retailer prices include the transportation cost between Bogota and Girardot, a distance of 129 kilometers.

Table 4.1 shows that unmilled white corn prices at the wholesale level continued to increase during the period 1970-1980. Meanwhile producer selling prices, wholesaler prices for corn meal and retail price for corn meal increased until 1977 (a very dry year) and then decreased in 1978. In the last two years, 1979 and 1980, producer selling prices, wholesale prices for corn meal and retail prices for corn meal showed increases.

In real terms, all corn producer, unmilled corn and corn meal prices showed an upward trend and a similar pattern during 1970-1980 (Figure 4.1). Corn producer and unmilled white corn prices at the

Table 4.1

Current Producer, Wholesaler and Retailer
Prices of Corn Products, Pesos/Ton (1970 - 1980)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Producer Selling Price ¹ Wholesaler	1490	1696	2170	3330 ²	3364 ²	4103 ²	4853 ²	9321 ³	7029 ⁴	9200 ⁴	15500 ⁴
Corn Meal	2745	2964	4040	5534	6144	7214	8989	14000	12285	15210	22054
Unmilled White Corn Retailer :	1912	2102	2917	3680	4305	5034	7716	8442	9247	13462	17628
Corn Meal	3674	3914	4882	7031	7768	8483	11254	17800	17345	21767	27733

Sources :

1. Salomon Kalmanovitz, La Agricultura en Colombia, 1950 - 1972, Separata - Boletín Mensual de Estadística, DANE.
2. Alvarado, et. al., Ponencia Sobre Mercadeo y Productividad Agrícola en Colombia, Documento presentado al I Seminario sobre Productividad Agropecuaria, Neiva - Mayo de 1978.
3. Jorge E. Lesmez, La Demanda Industrial del Maíz en General y en Particular El Caso Promasa, Colegio Mayor de Ntra. Sra. Del Rosario, B.S. Thesis, 1979.
4. Foreign Agriculture circular June 8, 1981 Grains Table No 6 p.66.
5. DANE, Boletín Mensual de Estadística, Several issues.
Prices refer to Bogota's Wholesaler Prices.
Corn Flour refers to first quality.
The quality of Unmilled White Corn is not specified.
6. DANE, Boletín Mensual de Estadística Several issues.
Prices refer to Girardot's first quality Corn Flour.

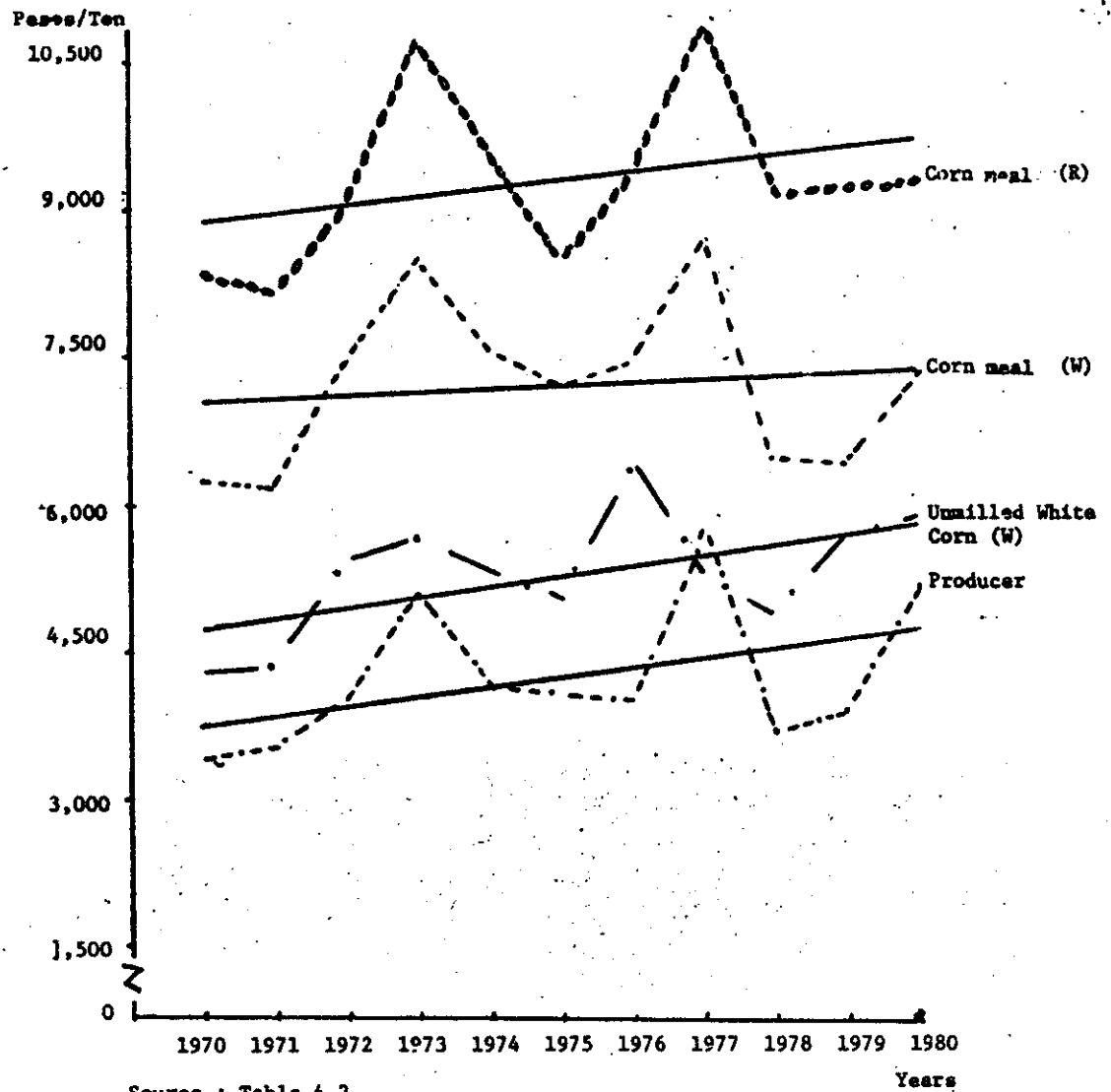
Table 4.2
 Real Producer, Wholesaler and Retailer Prices of Corn Products,
 Pesos/Ton, (1970-1980)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Producer Selling Price	3386	3533	4018	5123	4153	4103	4044	5826	3719	3915	5201
Wholesaler :											
Corn Meal	6239	6175	7481	8514	7585	7214	7491	8750	6500	6472	7401
Unmilled White Corn	4345	4379	5402	5661	5315	5034	6430	5276	4892	5728	5915
Retailer :											
Corn Meal	8350	8154	9041	10817	9590	8483	9378	11125	9177	9262	9306
Consumer Price Index ² (1975=100)	44	48	54	65	81	100	120	160	189	235	298

Sources : 1. Table 4.1

2. International Monetary Fund, International Financial Statistics, Several Years.
 The Consumer Price Index is a national average for low and middle income urban families.

Figure 4.1
Real Producer, Wholesaler (W), and Retailer (R) Prices of Corn Products,
Pesos/Ton, (1970-1980)



wholesale level tended to maintain a parallel and constant spread during 1970-1980. The years 1973 and 1977 were critical years because they produced the highest increase in real prices (1977 was a very dry year). The decrease in real prices in the period 1973-1975 is explained by the increase in production because of government promotion of production during those years. It is important to notice that real prices decreased from 1974 to 1975 when the government promoted the substitution of wheat for corn.

Real prices of unmilled white corn tended to increase 110 pesos per ton per annum. Producer prices tended to increase 100 pesos per ton per annum. The lowest tendency to increase in real prices was for corn meal. The retail corn meal price tended to increase 91 pesos per ton per annum and the wholesale corn meal price tended to increase 40 pesos per ton per annum. Corn meal prices' low tendency to increase may be explained by government price control. This price control policy has been complemented by an increase in the authorized imports (see Chapter II).

Comparison of Producer Selling Price and Government Support Price

In real and current terms the support price was generally below the producer selling price with the exception of 1974. This may be because the world food shortage in that year pressured the government to stimulate the production of corn by increasing support prices.

Corn support prices follow the same pattern as corn producer selling prices during the period 1970-1980. Corn support price variations were less marked than corn producer selling prices during the same period. The biggest differences between these prices were in 1973, 1977 and 1980.

Table 4.3
Current Producer Selling Price
and Support Price of Corn, Pesos/Ton (1970-1980)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Support Price ¹	1350	1600	1830	2750	3550	4000	4300	6340	6800 ²	7950 ²	10592 ³
Producer Selling ⁴ Price	1490	1696	2170	3330	3364	4103	4853	9321	7029	9200	15500

Sources : 1. Alvarado, et al., Ponencia Sobre Mercado y Productividad Agrícola en Colombia, Documento presentado al I Seminario sobre Productividad Agropecuaria, Neiva-Mayo de 1978.

2. Foreign Agriculture Circular June 8, 1981, Grains Table No 6 p. 66.

3. USDA, Foreign Agriculture Service, Report number Co-1001 January, 1981 p. 85.

4. Table 4.1

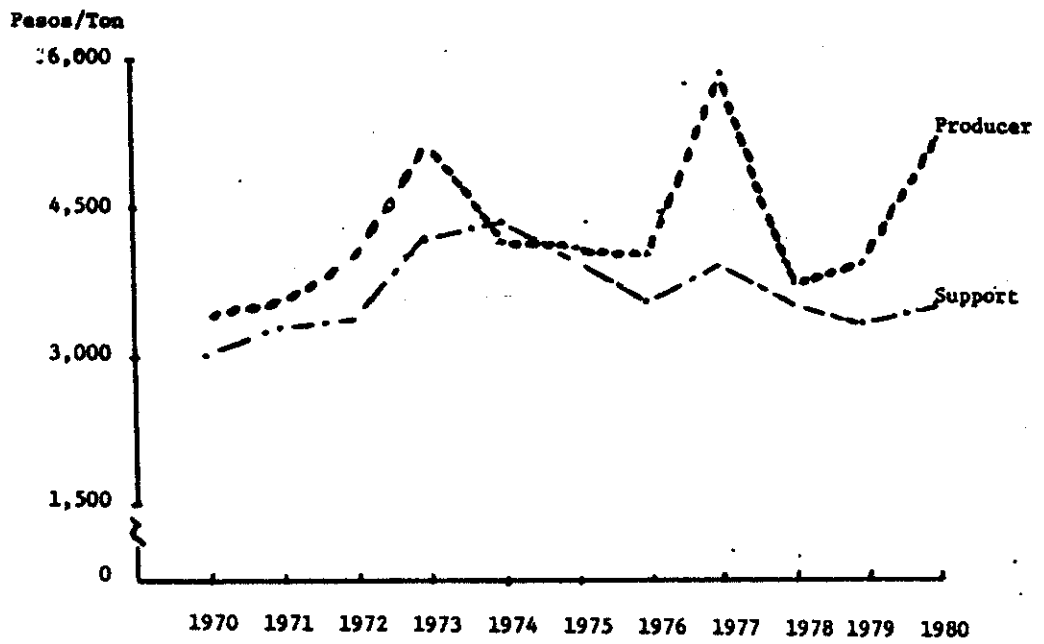
Table 4.4
 Real Producer Selling Price
 and Support Price of Corn, Pesos/Ton (1970-1980)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Support Price	3068	3333	3389	4231	4383	4000	3583	3960	3598	3383	3554
Producer Selling Price	3386	3533	4018	5123	4153	4103	4044	5826	3719	3915	5201

Sources : Table 4.3
 Table 4.2

Figure 4.2

Real Producer Selling Price and Support Price, Pesos / Ton, (1970-1980)



Source : Table 4.3

Years

These years had severe weather which sharply reduced the supply of corn. The result was more favorable market prices for producers.

The Comparison of Producer Selling Price and World Price

The analysis in this section is presented in U.S. dollars. World corn prices have been generally lower than Colombian producer selling prices during the period 1970-79. The exceptions were in 1974 and 1975. In 1974 there was a worldwide food production shortfall which caused a sharp increase in corn prices.^{3/}

During the period 1970-1976 Colombian and world prices of corn were close. After 1976, the Colombian producers' price diverged from and were higher than world prices. This can be explained by the fact that the demand for corn increased more rapidly than production (Chapter II) which resulted in an upward pressure on prices. The difference between Colombian producer price and world price during 1977-1980 may also be related to the possible higher cost of inputs for the Colombian producers.

Comparison at the Retail Level of Corn Meal, Rice and Wheat Flour

At the production level, wheat and rice are competitors with corn. At the consumption level, wheat flour is a substitute for corn. The degree to which wheat flour can be considered a substitute for corn products depends on the economic strata and the region. In light of the income elasticities discussed in Chapter II, it is expected that wheat will likely be substituted for corn by the higher income strata. In the

^{3/}Paarlberg, P. and A. Webb. "International Trade Policy Issues," in Agricultural Food Policy Review: Perspectives for the 1980s, United States Department of Agriculture, April 1981.

Table 4.5
 Producer Selling Price and
 World Price of Corn, US Dollars/Ton (1970-1980)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Producer Selling Price ¹	78	81	95	134	117	124	133	245	171	209	304
World Prices ²	69	73	69	98	141	151	134	125	126	142	
Exchange Rate ³	19.17	21.00	22.88	24.89	28.69	33.09	36.46	38.11	41.00	43.98	50.92

Sources : 1. Table 4.1 divided by the exchange rate.

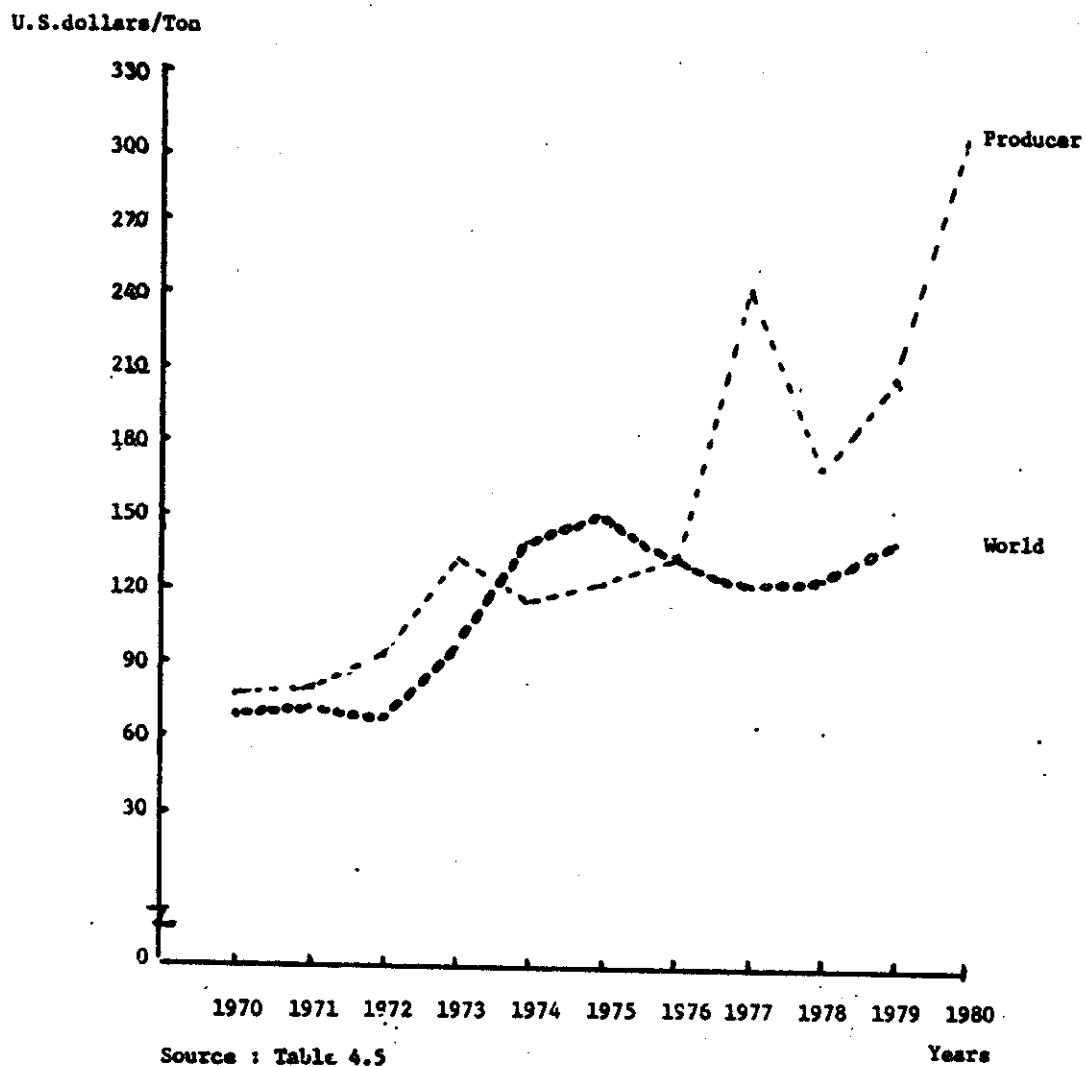
2. FAO, Trade Year Book, several Issues.

The value of total world imports was divided by total world quantity imports.

3. International Monetary Fund, International Financial Statistics, Several Years.

Figure 4.3

Producer Selling Price and World Price, U.S. dollars / Ton
(1970 - 1980)



states that are larger producers of corn, such as Antioquia, it is expected that the substitution of wheat for corn will be low.

The trend lines in Figure 4.4 show how wheat flour and corn meal prices tend to increase while rice prices tend to decrease during the period 1970-1980. This is because domestic rice production is higher relative to demand than the production of wheat and corn.

Real prices of rice and corn meal followed a similar pattern during 1970-1980. The wheat price pattern, on the other hand, was quite different from those of corn meal and rice during the same period. The difference, which was greater during the mid 70's, is explained by the elimination of the subsidized price for wheat in 1972 and the world food production shortfalls in 1974. The subsidy on wheat prices and world availability of wheat are very important variables in wheat price movements since most of the wheat consumed in Colombia is imported.

Summary

Inflation in Colombia was high during 1970-1980 and this caused a significant upward trend in current prices of corn, corn products, rice and wheat. Therefore, a description of price movements in real terms was made.

Real producer prices for corn, unmilled white corn at wholesale level, and corn meal at wholesale and retail levels followed the same pattern of upward trend during 1970-1980. The government support price for corn was below the corn producer selling price for most of the period 1970-1980. With the exceptions of 1974 and 1975, producer selling prices for Colombian corn were above corn world prices during 1970-1980. At

Table 4.6

Current Corn Meal, Rice and Wheat Flour Prices at
the Retail Level, Pesos \$/Ton (1970-1980)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Corn Meal	3674	3914	4882	7031	7768	8483	11254	17800	17345	21767	27733
Rice	4602	5320	5430	8247	10083	10160	11614	18597	19500	22040	30390
Wheat Flour	4180	4483	5285	7852	11572	15167	18709	19667	19975	26480	31486

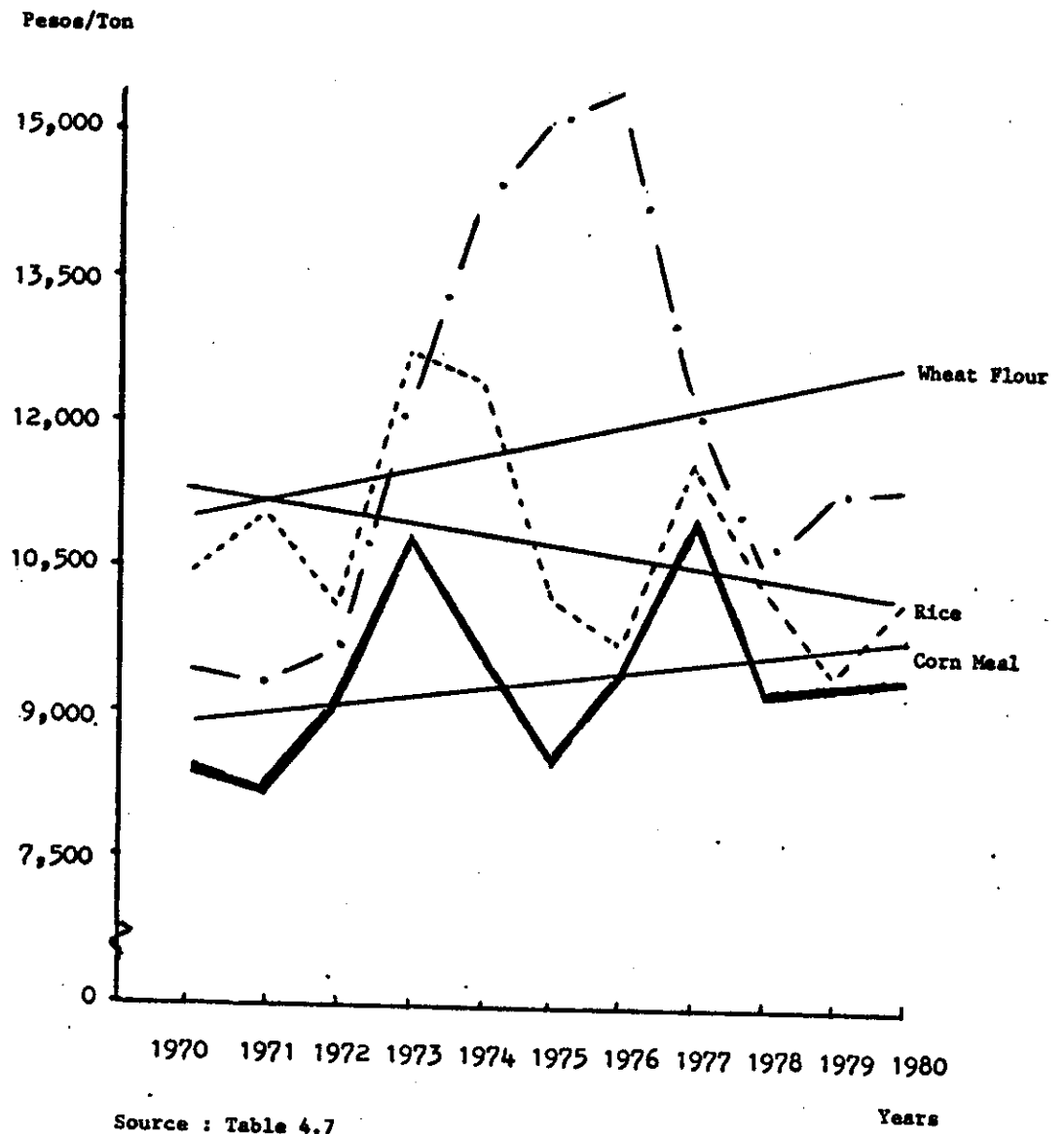
Source : These are Girardot Retailer Prices (first quality).
DANE, Boletín Mensual de Estadística, several issues.

Table 4.7
Real Corn Meal , Rice and Wheat Flour Prices
at the Retail Level Pesos/Ton. (1970 - 1980)

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Corn Meal	8350	8154	9041	10817	9590	8483	9378	11125	9177	9262	9306
Rice	10459	11083	11055	12688	12448	10166	9678	11623	10317	9379	10198
Wheat Flour	9500	9339	9787	12080	14286	15167	15590	12292	10569	11268	10566

Sources : Table 4.6
 CPI From Table 4.2

Figure 4.4
 Real Corn Meal, Rice and Wheat Flour Prices at the Retail Level,
 Pesos/Ton. (1970-1980)



Source : Table 4.7

the retail level, corn meal and wheat flour real prices tended to increase while rice prices tended to decrease during 1970-1980.

CHAPTER V

SUMMARY AND PROBLEMS FOR FURTHER STUDY

Summary

The corn subsector has been affected by government policies such as import substitution, export promotion and increased subsistence crop production. Government policy, in turn, has been affected by international and national events. International events that have influenced government policy include: the international price of coffee, which directly affects the Colombian balance of payments and the world food shortfalls of the mid 1970's, which stimulated the promotion of subsistence crops such as corn. The national events that have influenced government policy have been the rapid increase in population, migration from rural to urban areas, inflation and domestic production shortfalls.

The result of the various environmental changes and government policies has been a decrease in the corn area harvested during the period 1960-1981. During the same period, rice, cotton and sorghum, crops that compete with corn for the best land available, all showed increases in area harvested. During the last five years of the period, corn yields were higher than they had been during earlier years of the period. This may indicate an increasing use of modern technological inputs in corn production. Except for a sharp decline in production in the 1972-74 period, output has remained at the same general levels as in the 1960's.

Corn consumption did not follow a clear trend during the period 1960-1981. Total corn consumption moved close to corn production until 1975. From 1976 to 1981 total corn consumption moved far ahead of total corn production. This difference was provided through increased imports. The increase in total corn consumption is accounted for by the increase in human corn consumption. This increase in human consumption has been stimulated by government policy, increase in population, and a positive income elasticity of demand for corn products. On the other hand, the consumption of corn for animal feed has decreased because of the relatively high cost. Feed manufacturers have replaced corn with cheaper grains such as sorghum.

The main characteristic of the corn subsector is the traditional/modern duality, throughout all stages of the subsector. This dualism creates difficulties in vertical coordination within the subsector because of the problems in implementing a homogeneous policy across both segments of the subsector.

IDEMA plays an important role in the corn subsector. IDEMA's tasks are: to set the support prices; to control assembly and distribution activities; and to control imports.

Modern processors are few in numbers and are horizontally coordinated through associations that constitute oligopsony and oligopoly powers. Some processors are horizontally integrated with other industries. The wholesaler, elevator, and retailer functions are carried out by private enterprises. There has been an expansion in the storage facilities of Colombia but corn must still compete with other crops, especially coffee and rice for bag storage facilities.

The commodity exchange is a pricing mechanism used to some extent in the corn subsector; however, its influence in the subsector is limited. The main operation center of the commodity exchange is in Bogota. There are three kinds of transactions carried out on the commodity exchange. These transactions are: immediate delivery, definite time delivery and futures trading. The commodity exchange is in a developmental stage. Further development of the cash market can provide the way for a futures contract market enabling speculation activities is necessary to promote hedging activities that could reduce the risk of price variation for farmers and processors. Risk will be reduced because it will be shared by hedgers and speculators. For future hedging activities, the long term accumulation of information about prices and market related conditions is important.

Traditional farmers receive most of their production credit through rural input distributors and the Rural Bank. Modern farmers, on the other hand, receive their financing from wholesalers, the Rural Bank and the FFA. Assemblers, wholesalers, and processors obtain credit through financial institutions. For corn the area financed declined during the period 1974 to 1979. Value financed, however, increased in current terms but decreased in real terms.

One of the immediate problems in the corn subsector is the lack of homogeneity in the quality standards used within the subsector. Another problem is that the interpersonal information network still plays an important role in disseminating price information within this subsector.

Inflation in Colombia was high during 1970-1980. This caused a significant upward trend in current prices of corn, corn products, rice

and wheat. Therefore, a description of price movements in real terms was made.

Real corn producer prices, unmilled white corn at wholesale level, and corn meal at wholesale and retail levels followed the same pattern and upward trend during 1970-1980. The government support price of corn was below the corn producer selling price for most of the period 1970-1980. With the exceptions of 1974 and 1975, producer selling prices for Colombian corn were above world corn prices during 1970-1980. At the retail level, corn meal and wheat flour prices tended to increase while rice prices tended to decrease during 1970-1980.

Problems for Further Study

This paper was based on secondary data and on the author's personal experience in the corn subsector. It is recommended that future studies in this area begin with more disaggregated data. This is necessary because of the dualistic (modern-traditional) nature of this subsector. Some problems for further study are listed below; however, this list is not intended to be exhaustive.

What are the interests of professionals in the public and private sectors in using more accurate data for forecasting corn acreage, yields, production and consumption and to estimate the storage stocks required to stabilize corn supplies and prices?

What are the recent corn consumption patterns of different consumer income strata?

What are the possible institutional changes that may improve vertical coordination in this subsector?

Is it possible to increase corn production through extension activity oriented towards teaching traditional producers the use of modern inputs?

What would be the best form of organization for the corn producers' association? Would it be more effective to have just one producer organization for all grains?

How can the commodity exchange be used more effectively as a mechanism for coordination?

Should the orientation of credit policy be to provide low cost credit or to easier access to farmers? How can traders inventories be financed? Should warehouse receipts be extended to traders?

How can uniform product grades and standards be implemented within the corn subsector?

How can contracts between producers and processors for specific types of corn for processing be implemented?

How can information availability and use of the information by the different subsector agents be improved? Would an extension agency for teaching the use of the information be effective?

APPENDIX I

ESTIMATION OF PRODUCER PRICE ELASTICITY, CORN PRODUCTION AND CONSUMPTION

The purpose of this appendix is to review some statistical and econometric tools that can be useful for the estimation of production price elasticity, corn production and consumption. The accuracy of these calculations is limited, however, by the limitations of funds and of time for obtaining additional information and using more sophisticated econometric approaches.

Production Price Elasticity

A single regression equation was developed for the period 1960-1981 as a basis for estimated corn supply elasticities. Because of the lag variables, however, only 20 observations were taken into account in the calculation of the parameters. Corn production (QP-thousand tons) was defined as a function of: one year lag of real corn producer selling price (P_{t-1} -pesos per ton); one year lag of corn production (QP_{t-1} -thousand tons); and a dummy variable (D-one when production increases and zero otherwise).

The corn producer price was introduced as a lag variable based on the assumption that producers react to prices received in the previous

harvest. Economy theory suggests that the coefficient should be positive.^{1/}

A lagged dependent variable was included in order to measure any distributed lag effect in the response of producers to the other independent variables.^{2/}

The dummy variable was introduced in order to recognize the possible irreversibility of the production equation.^{3/}

A Texas Instrument Programmable 59 calculator was used in estimating the parameters. The least squares procedure was used to estimate parameters. A matrix notation is used to present the estimation of the parameters.

$$\text{Parameters estimated} = (X'X)^{-1}X'Y.$$

Where:

X represents the right inside variables matrix.

Y is the dependent variable vector.

The results of the calculation were:

$$QP = 102 + .01 Pt-1 + .76 QPt-1 + 132D$$

(8.5) (3.3) (51) (6.8)

$$R\text{-squared} = .7$$

$$\text{Corrected R-squared} = .6$$

$$d = 2.4$$

$$F_{3,16} = 10.35$$

^{1/}Ferris, J., Use of Ratios and Gross Margins in Time Series Supply Analysis, J. Ferris is professor of Agricultural Economics at Michigan State University.

^{2/}Ibid.

^{3/}Ibid.

The values in parentheses represent the t-statistics, F is the F-statistic value and d is the Durbin-Watson statistic value. These values are presented only because it is usual to present them when a multiple regression is calculated. The t-test statistics, F-test statistics and R-squared are not valid, when serial correlation (correlation among error terms of the estimated equation) occurs.^{4/}

The problem of serial correlation can be checked by using a Durbin-Watson -d-test. The above regression, however, cannot be tested by the Durbin-Watson d-test because of the inclusion of the dependent variable on the right side of the equation.^{5/}

The possibility of serial correlation and the use of the least square procedure in the estimation of the parameters suggests that these parameters are inefficient, biased and inconsistent.^{6/} In other words, they do not have the desirable properties of efficiency, unbiased and consistency as the sample becomes larger. These properties are especially important in making projections of the dependent variable. The inefficiency problem means that the estimator's variances are not the smallest.^{7/}

The bias problem occurs when the mean at estimated parameters in repeated samplings are different from the true parameter value.^{8/} Finally,

^{4/} Gujarati, D., Basic Econometrics, McGraw-Hill, Inc., 1978.

^{5/} Ibid.

^{6/} Hanushek, E. and J. Jackson, Statistical Methods for Social Scientists, Academic Press, Inc., 1977.

^{7/} Ibid.

^{8/} Kennedy, P., Econometrics, The MIT Press, 1979.

the inconsistency problem exists when the probability limits of the estimated parameters are not the true parameters.^{9/} The problem of serial correlation can be corrected by using an instrumental variable or a Maximum-Likelihood Technique. (For an explanation of these techniques and the property of the new parameters see Pindyck and Rubinfeld, *Econometric Models and Economic Forecasts*, 1981.)

The formulation of a lag model presents two kinds of effects: the short run effect (SRE) and the long run effect (LRE).^{10/} These effects, which represent the change in corn production over the change in corn deflated producer selling price for corn were calculated as follows:

SRE = .01. This value is the parameter estimated from the lag price variable.

LRE = $.01/(1-.76) = .04$. This value is the SRE divided by one minus the parameter value of the corn production lag variable.

These effects are used to calculate the short run and long run elasticities of production. Both elasticities measure the relationship between changes in quantity produced and prices. The first elasticity refers to a short period of time up to the present, and the second elasticity refers to a longer period of time up to the present. During the period 1961-1980, the deflated producer selling price averaged 3,796 pesos per ton and corn production averaged 812 thousand tons. The Short Run Elasticity (SRE) and Long Run Elasticity (LRE) at the mean values were:

^{9/} Pindyck, R. and D. Rubinfeld. *Econometric Models and Economic Forecasts*, McGraw-Hill, Inc., 1981.

^{10/} Ibid.

$$\text{SRE} = .01 * (3,796/812) = .05$$

$$\text{LRE} = .04 * (3,796/812) = .2$$

It is possible to find an interval within these values that holds at some level of significance.^{11/} Because of the possible serial correlation problem, however, they were not calculated.

Estimation of Corn Production

The single regression equation presented above was not used to estimate the corn production by 1983. One reason for this is that the parameters estimated did not have the asymptotic properties (consistency, efficiency and unbiased). The other reason is that limitations of time and resources (information and finance) that did not permit the author to develop a better equation. Therefore, it was decided to estimate the corn production by 1983 using only time as the independent variable. This simple extrapolation technique provides an acceptable means of forecasting when the time series presents a clear tendency.^{12/}

The corn production period (1960-80) described in Chapter II did not present a clear trend. Therefore, it was decided to extend the time period of analysis to 32 observations from 1950 to 1981.^{13/} Using this length of time produced a clear tendency for corn production to increase (from 500 thousand tons to 880 thousand tons). The functional form used was a log-log function. A least square procedure was used to estimate the parameters.

^{11/} Ibid.

^{12/} Ibid.

^{13/} 1950-1959 data comes from: Kalmanovitz, S. La Agricultura en Colombia 1950-1972, Special Edition of Nos. 276, 277 and 278, Boletín Mensual de Estadística, DANE.

$$QP = 6.38753567 + .1020007777 \text{ TIME}$$

$$F_{1,3} = 13$$

$$R\text{-squared} = .3$$

$$d = 1.54$$

The Durbin-Watson -d-test suggests no clear evidence of positive auto correlation. The high value of the F-test suggests that the null hypothesis, the parameters of the equation are equal to zero, is rejected at the one percent level of significance. The R-squared of .3 means that only 30 percent of the total variation in corn production is explained by the regression model (corn production as a function of time). The proposed regression suggests an estimate of 851 thousand tons by 1983. This value has to be seen as a very rough approximation of corn production because of the limitations of the regression equation such as low R-squared and lack of ability to identify the turning points.

Estimate of Human Corn Consumption by 1983

The prediction of human corn consumption by 1983 was based upon the following formula.^{14/}

$$Qc \ 83 = Qc \ 81 (1 + r_1 + r_2 E_1)^{** n}$$

Where:

Qc 83 is expected human consumption in 1983 in thousand tons.

Qc 81 is total human corn consumption in 1981. Human corn consumption was 950 thousand tons in 1981.^{15/}

r_1 is annual percent projected growth rate of population 1981-83. It is assumed that the population growth will

^{14/} Agricultural Commodity Projections, 1970-1980, FAO-United Nations, Vol. II, Rome 1971.

^{15/} See Table 2.4.

continue during 1981-1983 as it did during the period 1967-80. In Chapter I it was noted that the population growth during this period was 2.99 percent per annum.

r_2 is annual percent projected growth of per capita income 1981-83.

The income taken into account is the average of white and blue collar workers. In current terms, the average was 1,646 pesos per year in 1967 and 13,275 pesos per year in 1980.^{16/} These figures were deflated by the consumers price index which was 636 in 1967 and 2,635 in 1980 (1975 = 100). The comparison of the two prices showed an increase in per capita income for these workers of 1.7 percent per annum. It is assumed that this percentage is maintained constant from 1981 to 1983.

E_1 is the projected income elasticity of the demand. It is assumed that the period 1981-83 will have a constant income elasticity of .3946. (This value comes from Chapter II.)

n is the number of years human corn consumption is to be projected over the last available value. In this case, it is two years.

$$Q_c 83 = 950 (1 + .0299 + .017 (.3946))^{**2}$$

$$Q_c 83 = 050 (1 + .0366082)^{**2} = 1,021$$

It is expected that human corn consumption will be 1,021 thousand tons in 1983.

^{16/} Boletín Mensual de Estadística, January-December 1967. Colombia Estadística, DANE, 1981. International Monetary Fund, International Financial Statistics.

Summary

The price elasticity of supply and the estimations of corn production and consumption should be seen as a very rough approximation because of the statistical problems and assumptions in the estimation of the parameters. The results of the estimates were:

1. an expected producer price elasticity of supply of .2 during the period 1961-80;
2. an estimated corn production of 851 thousand tons by 1983; and
3. human corn consumption of 1,021 thousand tons by 1983.

APPENDIX II
TREND EQUATION RESULTS

Corn Area = 804 - 9.7 Time

R = -.64

R² = .41

t = 3.7

V = 20

Rice Area = 228 + 7.9 Time

R = .74

R² = .55

t = 5

V = 20

Cotton Area = 141 + 6.6 Time

R = .67

R² = .45

t = 4

V = 20

Sorghum Area = - 33 + 12 Time

R = .96

R² = .92

t = 21

V = 19

Corn Meal (W) = 7,015 + 40 Time

R = .15

$R^2 = .02$

t = .43

V = 9

Corn Meal (R) = 8,788 + 91 Time

R = .32

$R^2 = .1$

t = 3

V = 9

Unmilled White Corn (W) = 4,649 + 110 Time

R = .58

$R^2 = .34$

t = 2

V = 9

Producer = 3,674 + 100 Time

R = .43

$R^2 = .18$

t = 1.4

V = 9

Wheat Flour = 10,925 + 156 Time

R = .23

$R^2 = .05$

t = .69

V = 9

Rice = 11,403 - 111 Time

$R = -.34$

$R^2 = .12$

$t = 1.1$

$V = 9$

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