SOCIO-ECONOMIC EFFECTS
OF
THE CAUCA RIVER REGULATION PROJECT

JUNE 1972

Prepared for

OVERSEAS TECHNICAL COOPERATION AGENCY

GOVERNMENT OF JAPAN

by

ELECTRIC POWER DEVELOPMENT COMPANY

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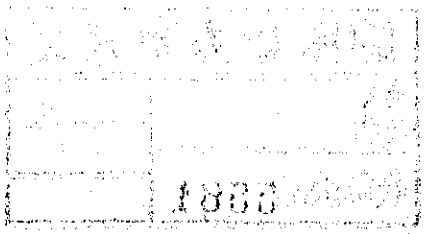

LETTER OF TRANSMITTAL

June 1972

Mr. Keiichi Tatsuke, Director General
Overseas Technical Cooperation Agency

Dear Sir:

Transmitted herewith is the report on the socio-economic effects of the Cauca River Regulation Project in the Republic of Colombia. At the request of the Government of Colombia, the Overseas Technical Cooperation Agency of the Government of Japan sent three experts of the Electric Power Development Company from February to April 1972 in order to cooperate with the Cuaca Valley Corporation about the economic and financial studies of the said project.

The present study is the major result brought forth under the above-mentioned technical cooperation works. It examined the socio-economic effects of the project from the viewpoint of national economy in terms of employment, national income, exports, taxes receipts, and price effects by employing input-output analysis, programming analysis, and econometrical technique. The report is prepared by Akira Kinoshita, economist of the company, and the relevant computations were made by using the computing facilities of the company. It is hoped that those results of the study help prove the viability of the project and that this important project be implemented as soon as possible.

I take this opportunity to record my sincere appreciation to the staff members of the National Planning Department, DANE, Ministry of Agriculture, CVC, Banco de la República, PROEXPO, and the Japanese Embassy in Bogotá for the assistance and cooperation to this study.

Eishiro Mikuni
Manager
Foreign Activities Department
Electric Power Development
Company

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1. Introduction

Development activities depend on propositions concerning how man and society choose, with or without the use of money, to employ scarce productive resources, which could have alternative uses, to produce various commodities over time and distribute them, now and in the future, among various people and groups in society. The solution for optimal technology in underdeveloped economy reduces to attaining efficiency in an ends-means relationship under constraints.

However, it is not so simple to apply this fundamental schema in the political and social environment. How can a social scale of value be given? For whom is a project undertaken? How shall we decide intertemporal preference? Indeed it is a special feature of development investment, that its characteristics cannot be considered merely on the basis of contemporary criteria without regard to long-term considerations. The social scale of value cannot be derived, at least, in a narrow sense, from the theory of economics alone. Corresponding to the intense recognition of the limitations of the market mechanism, this separation between economics and politics has reached its fullest expression in the concept of "people sovereignty" and in the orientation for the "multi-channel society". There has been considerable emphasis on the need to unite economics to politics in a contemporary sense in order to examine the social decision-making processes as a result of a long process of introspection against incompleteness and failure of the market mechanism.

During the past several years, substantial efforts seeking progress in the economic evaluation of water resources development have been made. Although it is true that there were many concrete results concerned with investment criteria and the techniques for estimating the parameters and variables, in general they could not escope estimations based on market values. Consequently, while they recognize the problem, they did not assure that social marginal utilities and social marginal costs were equated and they left the problem of external economies on one side.

It is not be necessary to repeat that prices in the private market may not be intrinsic measures of the social value -- i.e. they ignore the fact that there is no marketprice for pbulic goods, there are external economies, there is incompleteness of competition including presence of potential economies of scale; and they take an unduly short view of the consequences of private investments, and no interest in income distribution.

Benefit-cost analysis has been carried out for decision making processes for the contemporary water resources development. It can be said that its practice is automatically applied to almost all kinds of public investment and is situated to be the most dominant in its processes much more than expected. The objective of most public programs is not simply, not even principally, economic efficiency, and the major limitation of benefit-cost analysis is that it attaches importance only to terms of economic efficiency. Even as far as economic efficiency is concerned, it is beyond the level of ordinary benefit-cost analysis to deal with the overall marginal benefits of a project at the national level. Originally, in any social system of development activities the

concept of comprehensiveness related to the basic feasibility of society -- pattern maintenance, goal gratification, adaptation and system integration -- is significant in the sense of organic system of various factors which take up in the complicative areas. Benefit-cost analysis may indeed be largely irrelevant or relevant to only a small part of the problem of evaluating public project and programs. We need not settle for the current state of benefit-cost analysis, but rather attempt to find ways to satisfy to grasp comprehensively the real issues of public development investment.

Furthermore, we should be careful about the evaluation of non-pecuniary aspects such as water quality, recreation, physical and mental health, community innovation, and other environmental conservation etc. -- so as not to copy the present sufferings of the developed countries. It will not be enough to view the problem merely from economic efficiency in the narrow sense.

Thus, the establishment of the social welfare function is getting more and more difficult. If it were possible to obtain the contemporary social welfare function, it cannot be existed transcendent constituents of society under the idea of democratic society in the present age. It must reflect the preferences of each constituent towards the orientation of society. Now, we do not mean to imply establishing the policy goal which includes the order of preferences for the whole society, but only to secure a basis on which to organize the system in which basic consensus of people can be determined through social processes related to the formation of public opinion. In other words, there cannot be a social welfare function given from outside the system. Orientations of

constituent's preference are ceaselessly changing with his state of consciousness and wants corresponding to continuous changes of components. Especially, in reference to development activities of which dynamic changes are the core, it will be a major of task to maintain flexibility for the future to the multi-oriented society.

Efficiency based on democratic principles is apt to be considered a contradiction, but we should recognize efficiency based on some degree of democratic consensus and understandings as a measure designed to avoid irrationality and social losses, accompanying development planning, in pursuit of scientific objectiveness. We understand that scientific analysis is designed to show the possibilities of ways for development as quantitatively as possible and not being satisfied with purely qualitative analysis. We realize too that it can contribute to opening up channels for wider selection of choice. It was emphasized that essential relations between economics and society have been placed outside analysis while economy advanced in quantitative analysis. However, the more overall efficiency is pursued in conformity with public intention, the more quantification of end-means relationships in development decisions becomes necessary. In this case, incompleteness of data is pointed out emphatically, and this required that ways be devised to quantify the problem despite the limited data.

The report does not therefore intend to settle the absolute objective function related to the socio-economic effects of the Cauca River Regulation Project. We could be free from existing criteria. We have only attempted to make some references to pbulic decision making. Therefore, we do not intend to compel to employ the result of work as the

sole criterion. However, we have intended to express the question as quantitatively as possible, given the extremely restricted data. Therefore, the report is mainly derived from aggregative observation based on quantitative analyses.

In this report, we intend to attach importance to the overall effects of the project not only from the viewpoint of the autonomy of Valle area but also from that of development of Colombia as a whole, understanding that regional development is a process which combines the efforts of the people in the region and of the people nation-wide.

This report consists of four parts. First an outline of the strategic situation of the project, the relative outlooks of importance of Valle's economy to the Colombian economy and basic ideas for the project, - the creation of employment opportunities, superiority of agricultural productivity, the substantial significance of effects on the international balance of payments, and strategic opportunity for the improvement of trade structure taking account of the location of Valle facing the Pacific. Second, overall impact of the project both in the process of construction and after the start of operation are measured employing input-output analysis and multiplier techniques. Third, the potential for export of agricultural products produced by this project and its shadow prices is analyzed according to econometrical method and programming analysis. Fourth, price impact of the project is intended to estimate in the relation to the addition of agricultural products. In addition to that, we try to compute the overall impact of electricity prices by means of input-output analysis.

We would like to emphasize that implementation of the project cannot be decided merely by the benefit-cost ratio, but global strategic ideas based on public consensus penetrating into possibility of jump in consideration of comprehensive aspects now and in the future. We hope this report will contribute to and encourage the opening the Cauca River Regulation Project.

2. Strategic Situation of the Project

2.1 Relative Outlook of Cauca Valley

In 1971, 2,172,800 people lived in Valle del Cauca. This figure corresponds to 9.97 percent of the national total population. From 1964 to 1971, the area's population has increased by 3.28 percent, in the average growth rate exceeding 3.20 percent of the national total during the same period. According to the DANE's projection of population, the growth rate of the area's population is estimated at 3.22 percent during the next decade in which the total is estimated at 3.19 percent.

(Tab. 2-1)

Trend of Population
(thousand population)

	Valle (a)	Colombia (b)	(a)/b (percent)
1964	1,733	17,485	9.91
1971	2,173	21,794	9.97
1980	2,892	28,930	10.00
Average growth rate (percent)			
1964 - 1971	3.28	3.20	
1971 - 1980	3.22	3.19	

Source: DANE

It is more useful, though, to pay attention to the economically active population.

(Tab. 2-2)

Economically Active Population in Valle
(Thousand population)

	Valle (a)	Colombia (b)	(a)/(b)
1964	529.5	5,134.1	10.3
1970 a/	685.2	6,225.8	11.0
Average growth rate (percent)	4.4	3.3	

Source: DANE, Encuesta de Hogares, 1970

a/ Estimated by CVC, El Valle del Cauca en La Economia Nacional

In 1964-1967, the active population in Valle grew by 4.4 percent per annum according to the CVC's study. In 1964-1970 the annual growth rate of the national economically active population was 3.26 percent.

However, gross production in the area did not keep pace with the growth of population.

(Tab. 2-3)

Trend of Gross Regional Production

	Calle		Colombia	
	Million of Pesos in 1958 prices	per Capita (US$ in 1970)	Million of Pesos in 1958 prices	per Capita (US$ in 1970)
1964	(14.2) 4,002.2	420	(100) 28,088.8	288
1965	(14.5) 4,223.6	429	(100) 29,100.0	294
1966	(13.0) 3,997.7	392	(100) 30,658.2	297
1967	(12.0) 3,833.7	354	(100) 31,947.0	304

Source: Banco de la Republica
CVC

Accordingly, area's per capita GDP declined by 26 percent in real terms in 1964-1967, while the national per capita GDP grew by 5.6 percent (1.8 percent per annum). There are some limitations of these regional data, but share of the area in respect to GDP can be said to have been decreasing, although there are various possibilities of development in the Valley. Even with decreasing trend, the area's gross production stands at 12 percent of the GDP, thus exceeding its proportion of the total population. It is therefore important that we should consider how to maintain and promote the relatively high productivity of this region.

It may be emphasized that we should consider the regional development problem from a global view point, and we should not forget that this area is relatively remarkable in terms of its industrial structure.

(Tab. 2-4)

Gross Domestic Product by Industry, 1967

	Valle	Colombia
Agriculture	20.7%	30.2%
Mining	0.6	2.1
Manufacturing	30.8	17.3
Construction	4.4	4.9
Transportation, Communication, Electricity, Gas and Water	8.9	8.0
Commerce	15.8	14.1
Services	6.5	7.7
Others	12.3	15.7
Total	100.0	100.0

Source: CVC,
Banco de la Republica

Since the overall impact or global benefits cannot be debated without knowledge of the industrial structure which defines the direct and indirect inter-relations of economic activities, it will be analyzed in chapter 3 of this report. As shown in the table 2-3, the position of the manufacturing industries in Valle is greater than in the national total, composing 30.6 percent at the factor cost compared with 17.3 percent in the national total. In 1959-1968, added value of the manufacturing industry at the current base in Valle has grown by 20 percent per year corresponding to 16 percent in the national total, and it makes up 20.7 percent of the total in 1968.

(Tab. 2-5)

Manufacturing Industry, Employment and Production by Region, 1968

	Employment		Added Value		Gross Output	
	Thousand Person	%	Thousands in Pesos	%	Thousands in Pesos	%
Cundinamarce	13.6	4.5	879.5	4.8	2,017.1	5.0
Antioquis	77.8	26.0	4,554.9	25.0	9,349.1	21.0
Valle del Cauca	52.8	17.5	3,794.9	20.7	8,896.7	20.3
Atlantico	27.3	9.0	1,296.8	7.0	3,209.1	7.3
Others	130.7	43.0	7,788.9	42.5	20,315.5	46.4
Total	302.3	100.0	18,315.1	100.0	43,787.6	100.0

Source: DANE, Industria Manufacturers Nacional

34.7 percent of the total added value of manufacturing industries in Valle for 1968 is taken by food industry including beverages, 17.5 percent by chemical, and 9.6 percent by paper. In 1968, the food industry in Valle formed 39.7 percent of the national total of the corresponding sector, chemistry 28.3 percent, and paper 28.3 percent at added value.

(Tab. 2-6) Production of Major Industries, 1968

	Gross Output (Millions of Pesos)		
	Valle	Colombia	%
Foodstuffs	3,596	15,451	23.3
Chemicals	1,278	4,901	26.1
Paper	954	1,416	67.3

Source: DANE, CVC

As shown above, major parts of the manufacturing industry are allied to the agricultural sector, and its industrial complex allied to the agricultural sector, including the chemical industry which is highly dependent on agricultural sector, makes up 37 percent of the total gross regional product in Valle.

Valle holds 11 percent of the total acting farm land, and its shares of the farm land of the national total are as follows.

(Tab. 2-7)

Situation in Farm Land
(Thousand of Hectares)

	Valle	Colombia	%
Permanent Crops	251.3	1,459	17.2
Annual Crops	134.1	2,015	6.7
Land under fallow	82.4	1,581	5.2
Sub Total	467.8	5,054	9.3
Grazing Land	566.0	14,626	3.9
Others	203.3	1,296	15.7
Total	1,236.8	20,976	5.9

Source: Censo Agropecuario, 1970-1971 and 1964

In 1967, the area's agricultural product at factor cost formed 13.6 percent of the corresponding national total. The following figures indicate the magnitude of the major agricultural products in Valle compared with the national total.

(Tab. 2-8)

Production of Selected Crops, 1969
(Millions of Pesos)

	Valle	Colombia	%
Cotton	131.6	890.9	14.8
Rice	91.8	1,172.5	7.8
Beans	35.3	217.5	16.2
Corn	350.5	1,081.6	32.4
Sorghm	51.5	126.0	40.9
Soybean	337.9	367.5	91.9
Sugarcane	752.5	1,320.0	57.0
Total	1,751.1	5,176.0	33.8

Source: CVC

As shown above, in respect to these important crops, Valle's production hold 33.8 percent of the national total at the current prices.

Turning now to the contribution to the exports, Valle achieved 20.2 percent of the national total export as registered to the INCOMEX including manufacturing and semi-manufacturing industries in 1970.

(Tab. 2-9)

Export by Major Sector
(Thousands of U.S. Dollars)

	Valle	Colombia	%
Shellfish	161	4,753	3.4
Sugar	12,422	14,311	86.8
Oil cakes	4,628	8,358	55.4
Cotton	6,406	34,671	18.5
Tabaco	265	7,373	3.6
Hides and skins	777	5,962	13.0
Wood articles	696	6,043	11.5
Other agricultural products	1,380	50,792	2.7
Sub Total	26,735	132,263	20.2
Other products	17,941	88,794	20.2
Total	44,676	221,057	20.2

Source: Banco de la Republica, as registered to the INCOMEX

Agricultural products account for 20.2 percent as well as other products including the mineral products but excluding petroleum.

Looking at the regional distribution of electricity production, this area supplies 12.8 percent of the national total, standing next to Antioquia and Cundinamarca.

(Tab. 2-10)

Electric Energy Production by Region
(1969)

	Million Kwh	%
Antioquia	1947	27.4
Cundinamarca	1942	27.3
Valle	912	12.8
Atlantico	555	7.8
Caldas	424	6.0
Others	1320	18.7
Total	7110	100.0

Source: ICEL

To mention about the strategy of regional development, there are several basic important view points to be considered, balanced growth and unbalanced growth, and regionalism and nationalism. Valle's economic activities, built around its agriculturally-based industrial complex, are to be considered from the point of view of the resource-potential of Valle itself as well as the wider picture of the development of Colombia as a whole.

2.2 Strategic Effects of the Project

It can be repeated that in the large scale multipurpose project as in the Cauca River Regulation Project, overall considerations and decision criteria in connection with comprehensive national economy shall be eagerly requested. The objective of economic policy, in

reality, must be pluralistic in any case, and fundamentally speaking, it naturally follows that the basic goal is to increase the welfare and to make progress towards reducing the inequality of income distribution. Now concreately, we shall consider from the aspects of i) reduction of unemployment ii) increase of productivity or efficiency in development investment iii) improvement of international economic relations. In respect to evaluation and decision on the implementation of the Cauca River Regulation Project, it is essentially important to pay attention to the strategic characteristics of the project effects as follows:

a) absorbing effects for employment, b) superiority of agricultural productivity in the area concerned, c) contribution to the improvement of international balance of payments, d) significance of moment for a advancement of the structure of exterior relations.

a) Absorbing Effects for Employment

It is doubtless that solving the unemployment is very basic problem in all countries, especially in the developing countries which are bounded by various constraints. Therefore, the value of economic and noneconomic impacts of the project both during the construction process and after the start of operation must be fully understood. Although, there are some difficult problems to handle the date related to unemployment statistics, it is not so difficult to estimate existence of the great number of unemployment. According to the INCORA's study, the rural unemployment rate in 1969 was 19.2 percent in the national total and 22.8 percent in Valle area. The following indicates substantial unemployment on the assumption that people, who do not declare the income,may be defined to be included in the definition of those unemployed.

(Tab. 2-11)

Economically Active Population without Declared Income
(Thousands of persons)

	Economically active population (a)	Population with declared income (b)	(a)-(b)	%
National Total	6,225.8	5,059.8	1,166.0	18.7
Region of Pacifica	1,226.0	990.5	235.5	19.4

Source: DANE, Encuesta de Hogares, 1970

In such circumstances, employment generation effects of the project, including not only the direct but also the indirect impacts through the inter-industrial inducing process, should be carefully evaluated not merely in terms of economy.

b) Raising of Agricultural Productivity

The high productivity of agriculture in Valle is obviously well known, and it may be fairely said that this high productivity was one of the motives for carrying out the multi-purpose river development project. Following indicates yield and cost per hectare of the selected crops concerned in the project, in the comparing Valle and the national figures.

(Tab. 2-12)

Agricultural Productivity, 1970

	Yield kgs/ha			Cost Pesos/ton		
	Valle	National Average	%	Valle	National Average	%
Cotton	2,310	1,371	168.5	3,084	5,423	56.9
Rice a/	4,350	2,702	161.0	1,657	2,883	57.5
Beans	1,300	471	276.0	3,875	8,885	43.6
Corn	3,407	1,255	271.5	1,239	3,046	40.7
Soybean	2,100	1,833	114.6	2,079	2,341	88.8
Sorghm	3,218	2,028	158.7	1,165	1,637	71.2

a/ Data in 1969

Source: Banco de la Republica
DANE
MIN. AGRICULTURA, OPSA

As shown above, there is a remarkable gap in Velle's yield and the national average, and hence the large gap in the production costs. As far as sorghm and soybean are concerned, Valle produces almost the whole of national output. Furthermore, the growth rate of yield in Valle is also higher than the national average, even although, its absolute level is higher.

(Tab. 2-13)

Growth Rate of Yield
(kg/ha)

	Valle			Colombia		
	1960	1970	1960=100	1960	1970	1960=100
Cotton	2,056	2,310	112	1,278	1,371	107
Rice a/	2,715	4,350	160	1,982	2,702	136
Beans	560	1,300	232	454	471	103
Corn	3,010	3,407	113	1,179	1,255	106

a/ Data in 1969

Source: DANE, Banco de la Republica, Cali.

The reason why these high productivities have been achieved in Valle area, excluding the advantage of soil and climate, may be considered as follows: a) farm size is relatively large b) therefore, modern inputs and technologically advanced production systems have been easily introduced c) excellent labor and local information to promote innovations, research and dissemination systems, are abundant.

(Tab. 2-14)

Distribution of Farm Plot by Size Group
(Number of Plot, Percent)

Farm Size (Hectares)	Valle	Colombia
Less than 1.0	24.8	33.4
1 - 3	19.9	27.1
3 - 5	9.9	10.5
5 - 10	12.7	10.3
10 - 20	12.0	7.1
20 - 30	4.9	3.1
30 - 50	5.8	3.0
50 - 100	4.6	2.8
100 - 500	4.4	2.4
Over 500	1.0	0.3
Total	100.0	100.0

Source: Instituto Geografico Agustin Codazzi, 1963
DANE, Censo Agropecuario, 1970-1971

As shown above, there is a characteristic difference in the distribution of farm plot which has an important influence on the agricultural productivity. In Valle, farm plots larger than 5 hectares form 45 percent of the total compared with 29 percent in the national total.

It may be said that this high productivity has been accelerated by efficient investment, and it is easy to prospect the agricultural productivity in the area will be stimulated much more by the additional production programed in the beneficial area of this project. Such stimulus must necessarily be provided through the innovation in

agricultural technology without being interrupted by the existing situation. Furthermore, through these repercussive processes, the high productivity of the area will be able to serve as an incentive to lower the average price and to extend the export of these products.

c) Impacts on Balance of Payments

Needless to say, not to emphasize, the Colombian economy heavily depends on imports for its growth, and the balance of payments definitely is a severe and binding constraint on Colombia's development. Unemployment is also a binding restriction, as trade-off problem with balance of payments.

(Tab. 2-15)

Balance of Payments
(Millions of U.S. Dollars)

	FOB Export	Non-factor Service Receipts	FOB Import	No-factor Service Payment	Balance
1966	534	129	-639	-228	-204
1967	558	154	-464	-232	16
1968	609	179	-615	-251	-78
1969	672	205	-648	-302	-73
1970	779	215	-821	-316	-123

Source: Banco de la Republica

The resource gap trend shown above will not be necessarily resolved in the future if Colombia's GDP growth keeps at approximately 7 percent in line with its potential. This report does not aim to project economic growth of Colombia in the future and there is no time to analyze its trend in detail, but the minus

gap between exports and imports will tend to increase in the coming years. From these observations, it is clearly necessary for the primary sector to contribute substantially to overall economic growth at this stage. Especially, it is considered as a basic conclusion that there is not substantial strategy except rapid growth of the minor export (excluding coffee) to diversify exports and thereby to reduce the excessive dependence upon the coffee market.

Therefore, in the Colombia's economic policy the minor export promotion plan has necessarily been given importance to extricate the Colombian economy from fluctuations caused by value of coffee exports. According to the PROEXPO, Export Plan 1972-1975, it is planned to increase agricultural exports by 92 percent over the 1971 level. The export target of the selected crops concerned with this project is as follows:

(Tab. 2-16)

Agricultural Export Plan, Selected Crops
(Thousand of Tons)

	1971	1972	1975
Rice	-	32	50
Corn	-	50	100
Sorghm	-	30	50
Cotton	42	48	95
Soybean	40	35	32

Source: PROEXPO, INCOMES, Plan Cuatrienal de Exportaciones 1972-1975.

If we consider the impacts on the balance of payments, it should be emphasized that even if the amount of export does not appear to be so large, its overall value must be clearly evaluated through analyzing the "shadow price", that is the marginal value given by the incremental value of the overall economic activities at the optimum resources allocation. Overall economic activities can be increased by easing balance of payments constraint through this project and thus increasing the import needed for efficient development. Expansion of the capacity to import is the most critical for the future industrial growth of Colombia. This global view of the effects on the balance of payments might be greater compared than the primary direct benefits of the project.

d) Opportunity for Innovation of Trade Structure

When we discuss regional development we should not neglect the relationship with the exterior. Especially, in the case of the economy which tends to depend on export activities, this view point should be greately emphasized. It is one of characteristics of the Valle area in addition to the high productivity of land that the area is located facing the Pacific.

In connection with strategy to increase export or to improve the trade mechanism it is important to diversify the market structure as well as to intensify the international competitive power of industries.

The following table shows that, minor export of Colombia (excluding coffee) directed to the Pacific area occupy only 5.4 percent of the total, although the growth possibilities of the export to the Pacific area will be easily recognized from the economic potentiality and continuous trend of change in the industrial structure in the Pacific countries.

(Tab. 2-17)

Minor Export by Area, 1970
(FOB, Thousands of US Dollars)

North America	55,922	25.3%
South America	50,734	23.0
Central America	13,549	6.1
Antilles	15,805	7.1
Europe	63,217	28.6
Asia and Pacific	11,927	5.4
Others	9,903	4.5
Total	221,057	100.0

Source: Banco de la Republica, INCOMEX

Furthermore, it may naturally follow that decentralization of the export market is important not only in the sense of exterior commerce but also political international relations. As one of strategic aspects of this project, the motive of stimulating the possibility of reorganization of the exterior market through this project should be given global significance, as well as intensification of the relationship with the Group.

3. Overall Impacts of the Project

3.1 Application of Interindustry Analysis

It can be said that one of the most useful and operational methods to analyze the overall impacts for the economy induced from an investment activity is Interindustry (Input-Output) Analysis which was pioneered by Leontief. In the recent national economic planning in many countries it is effectively operated to analyze the relationships between the final demand and the total economic activities including employment or imports, through the interindustrial technological structure. Furthermore, as described in Chapter 5, it is well applicable to the analysis of the price impact on the assumption of direct and indirect cost push processes. However, there are necessarily several problems in this analysis. It is originally static analysis, and it assumes stability of the technological structure, that is, input coefficients. It is also difficult for the analysis to treat the changes of activities corresponding to the price changes, because of limitations of analysis with respect to the commodities flows. In addition to that, the accuracy of basic data is a most serious problem, let alone, in the case of incompleteness of the statistic collecting system. Although there must be many problems in this analysis, there is hardly found any useful and operational method that is practical except the input-output analysis to grasp the overall impacts quantitatively. Furthermore, even if there are changes in the coefficients we need not assume that obtained result would be useless for the actual decision making.

To review of concept of the analysis, it is shown as follows.

$$\begin{matrix} x11 + x12 \ldots\ldots\ldots xin + y1 = x1 \\ \vdots \qquad\qquad\qquad\qquad\qquad\quad \vdots \\ xn1 + xn2 \ldots\ldots\ldots xnn + yn = xn \end{matrix}$$

Where 1, 2 ..... n designate industries, Xij is sales by industry to industry j, y1, y2, ... yn are final demands for products or services of industry 1, 2, ... n, respectively, and x1, x2 ..... xn are total outputs of goods and services for industry 1, 2 ..... n respectively. These flow relations can be converted to input-output coefficients by dividing each of the Xij's by the corresponding total output, so that production of Xj requires aijxj of the jth input.

They are expressed as follows in the matrix:

$$\begin{bmatrix} a11 & a12 & \ldots & a1n \\ \vdots & & & \vdots \\ an1 & an2 & \ldots & ann \end{bmatrix} \begin{bmatrix} x1 \\ \vdots \\ xn \end{bmatrix} + \begin{bmatrix} y1 \\ \vdots \\ yn \end{bmatrix} = \begin{bmatrix} x1 \\ \vdots \\ xn \end{bmatrix}$$

$$A = \begin{bmatrix} a11 & a12 & \ldots & a1n \\ \vdots & & & \vdots \\ an1 & an2 & \ldots & an \end{bmatrix}$$ (Input coefficient matrix)

$$X = \begin{bmatrix} x1 \\ \vdots \\ xn \end{bmatrix}$$ (Production vector)

$$y = \begin{bmatrix} y1 \\ . \\ . \\ . \\ . \\ . \\ yn \end{bmatrix}$$ (Final demands vector)

Where I is identify matrix

$(I-A)X = Y$

Therefore,

$X = (I-A)^{-1}Y$

The inverse matrix, interdependence coefficients, provides estimates of both direct and indirect effects of changes in final demands for products and services, of one or more of the industries.

Thus, we can estimate the direct and indirect effects induced by the river development investment in terms of effective demands for the total economy both at the level of overall production and or at the level of industrial sector by means of the input-output analysis. To observe the effects induced by the development activities, there are generally two stages. One is process effects during the construction, and another is demand effects after the start of operation of the project. This report will offer the direct and indirect impacts of the project formation for each of the two stages from the aspect of gross output including intermediate inputs, gross production, employment and taxes both by sector and by national total level.

In addition to the direct and indirect effects, the induced changes in net income resulting from increased spending by households will be estimated taking into account the chain of intersector reactions in income, output, and consumer expenditures. When the output of one sector increases, the direct income effects are measured by the

increase in payments such as wages, salaries and operator earnings made in the sector. The indirect effects are the increases in net income in all other sectors which supply the original sector. Induced effects are those which follow through their consumption functions to increase expenditures on goods and services. In this report, the multiplier of this type will be given for the stage after the operation.

Input coefficients and added value coefficients employed in this analysis are based on the interindustry table, 1966, consisted of 31 sectors provided by the National Planning Department. The labor coefficient was given on the basic data in 1968, principally depending on the information from DANE. 1/ (See Appendix 1)

When we discuss about large scale infrastructural investment, we should not forget the aspect of returns or increase of government revenue which will serve not only to enlarge public investments for the coming period, but will also affect public decision making taking into consideration of financial assistance by the government in the present period. Now, we will examine the marginal propensity of current receipts of the government to GDP. Then, its impact to the government induced by the project will be given through the tax function. The current receipts of the government is given in the relation to GDP depending on the basic data of 1958-1969 as follows. (See Appendix 2)

$$T = -1776.24 + 0.157169\ Vp \qquad R = 0.98978$$
$$(0.007159)\text{2/} \qquad S = 721.04$$

Where, T is the general governmemt current receipt in millions of pesos, and Vp is current GDP in millions of pesos.

1/ DANE, Industrial Manufacturera Nacional, 1968
DANE, Encusta de Hongares, 1970

2/ Figure in the parentheses indicates error of parameter

3.2 Process Effects of the Project

To estimate the direct and indirect effects induced by the project undertaken through the construction process, the demand composition of the project must be given by sector. Construction costs of the project were broken down into inputs by a sector taking account classification of work such as excavation, concrete, or steel work according to the item of equipment to be constructed.

(Tab. 3-1)

Construction Costs
Excluding Interest During the Construction Period
(Thousands of US Dollars)

Dam	34,695
Power Plant	16,465
Transmission, Transformation and Other Associated Facilities	1,590
Levees	16,366
Drainage	22,981
Total	92,097

(Tab. 3-2)

Inputs Composition of Construction for the Project

Sectors	Composition
Mining	0.010 165
Wood	0.011 637
Paper	0.000 844
Printing	0.000 318
Rubber products	0.000 159
Chemicals	0.014 639
Petroleum and coal	0.001 415
Non-metallic minerals	0.120 920
Basic metal products	0.085 964
Metal products	0.008 707
Non-electric machinery	0.000 064
Electrical Machinery and materials	0.021 541
Miscellaneous manufactures	0.000 240
Transportation	0.004 783
Communication	0.002 398
Electricity, gas and water	0.009 311
Real estate	0.009 341
Others	0.022 144
Sub-Total	0.324 620
Added Value	0.236 622
Leakage	0.438 758
Total	1.000 000

Costs of each part of work were broken down into the minor classification, materials, depreciation and hire of machines, miscellaneous expenses, wages and salaries, indirect costs, and power expense, according to the standard composition of corresponding construction projects in Colombia. In reference to break-down of the work costs into sectors, actual standard data in Japan were useful. In principle, depreciation and hire of the construction machines and major equipments of the plant excluding a part of installation costs and indirect costs were considered to be imported. In this way, the inputs composition of the project indicated in the Table 3-2 shows the percentage of the total construction costs excluding interest during the construction period.

These direct and indirect effects of the project formation differ by the amount of the leakage mainly coused by direct imports, and the following table indicates its degree by the part of facilities as a percentage of the total costs excluding interest during the construction period.

(Tab. 3-3)

Direct Leakage out of Final Demand
(Percentage)

Dam and Reservoir	60.6 %
Power Plant	81.8
Transmission, Transformation and Other Associated Facilities	74.2
Levees	12.0
Drainage	12.0
Total	43.9

The remains of direct leakage are not intended to be built in the domestic products, and some part will be input by the non-competitive imports.

Table 3-4 indicates the direct and indirect effects on gross output, gross added value, and employment, induced by the project investment less direct leakages during the period of construction.

(Tab. 3-4)

Direct and Indirect Process Effects

	Sectors	Gross Outputs (Millions of Pesos)	Added Value (Millions of Pesos)	Employment Opportunities (Pesos)
1 - 4	Agriculture and forestry	9.7	8.7	458
5	Mining	82.8	71.0	419
6	Foodstuffs	1.4	0.2	1
7	Beverages			
9	Textiles	1.9	0.7	18
10	Clothing	0.1		2
11	Wood	25.0	11.1	439
12	Wooden furniture	2.0	0.9	46
13	Paper	13.6	3.5	61
14	Printing and publishing	4.0	1.5	54
15	Leather products	0.5	0.2	4
16	Rubber products	5.0	1.9	34
17	Chemicals	39.9	14.2	199
18	Petroleum and coal products	31.4	15.2	39
19	Non-metallic minerals	254.8	118.1	3,450
20	Basic metal products	257.1	37.2	741
21	Metal products	25.8	10.1	308
22	Non-electric machinery	1.3	0.6	21
23	Electrical machinery and materials	50.2	18.0	379
24	Transportation equipment	3.7	1.4	50
25	Miscellaneous manufactures	2.1	1.0	41
26	Construction a/	1,085.5	457.6	21,098
27	Transportation	64.9	40.9	1,382
28	Communication	7.6	6.5	161
29	Electricity, gas and water	38.1	28.8	405
30	Real estate	33.5	23.7	1,524
31	Banks and other services	93.6	93.6	4,265
	Total	2,135.5	966.6	35,599

a/ All primary gross outputs of the project are expressed in the construction sector. Numbers of employees of the project are tentatively estimated according to labor coefficients of construction sector.

First of all it should be noted that there is not particular designation or specification of time for which the project effects remain, but the implication is that these values were estimated in the sense of quantative marginal inter-relation between final demand and output without dimension of time. Therefore the increase of employment is merely defined in relation to the increase of output without the concept of period, that

is, the number of employees is expressed as a number unit of gross output. According to the result, possibility of income growth directly and indirectly induced by the project will amount to 967 million pesos on the GDP basis, and employment generation will come to 36 thousand persons, which is equivalent to 0.9 percent of the estimated total employment, on the assumption that the labor coefficients employed in this analysis are kept constant, although there will certainly be changes in the productivity.

Looking over the impacts by sector, this development investment principally stimulates non-metallic industry, that is cement, basic metal industry such as steel, and transportation, at the gross output base. In reference to the employment effects, there will be important effects of cement industry, forestry and timber industry, transportation, steel industry, and wood industry.

These increases in income will necessarily yield an increase of taxes. According to the regression equation given already, based on the basic data in 1958-1969, an increase of GDP of 967 million pesos implies the induction of increase of general taxes of 152 million pesos. This suggests that there should be wide viewed attempt to compare the amount of government expenditure for the project and the revenue or actual return from the project.

3.3 Overall Impact of the Project in Operation

According to the estimation of the CVC, the summary of agricultural products, which will be added in the beneficial area of the project owing to the changes in the land utilization due to implementation of the project, is as follows:

(Tab. 3-5)

Outlook of Agricultural Products Added by the Project
(1970 Price)

	Tons	Thousands of Pesos
Cotton	18,500	99,900
Rice	59,416	132,178
Beans	45,176	212,328
Corn	48,002	74,405
Sorghm	153,824	209,203
Soybeans	69,113	200,429
Other temporary crops		-19,175
Sugar Cane	-976,517	-97,647
Other permanent crops		-43,145
Sub Total		768,476
Cattle		28,012
Total		796,488

Source: CVC

In addition to that, various outputs must be added but these are difficult to estimate except in the case of the electricity production which forms a part of the project. The electricity production is estimated 158,026 thousand pesos where unit price per Kwh for final consumers is 32.5 centavos. Accordingly, the sum of the additional agricultural production and the electricity production might be considered as exogeneous demand for the both regional economy and national economy.

The inputs of the agricultural products have been given by crops as shown in Appendix 3, according to the information of the CVC, the study data of the Banco de la Republica related to the cost and productivity, and the general inputs comprising the agricultural sector. [1/] Consequently, the direct demands which will be generated by the project after the start of operation are estimated as shown in the Table 3-6. They in turn will induce indirect effects on the various industries through the inter industrial processes. However, it should be noted that these values contain the effects of the implementation of irrigation works, which is not taken into consideration at the primary stage of the project, because it is not clear how to divide the effects with irrigation and without irrigation.

(Tab. 3-6)

Direct Effects Generated through Operation of the Project
(1970 Prices)

Sectors	Thousands of Pesos
Agriculture	22,681
Clothing	9,998
Chemical products	153,369
Oil refining	12,975
Metal industry	1,867
Non-electric machines	5,065
Vehicle industry	4,473
Miscellaneous manufactures	2,292
Transportation	141,407
Electricity	158,026
Direct added value	442,361
Total	954,514

1/ Banco de la Republica, Estudio de Productividad y Costo de Produccion de Cultivos Anuales en Seite Zonas del Pais, September 1970.

Following to this direct demands for these industries, the total production including the indirect repercussive effects will be induced through each sector as shown in the Table 3-7. In this table, primary production, from which other sectors make direct demands, in the area of agriculture is included in the agricultural sector. As for the primary creation of employment in the agriculture, sector this is estimated for each crop, and then totalled to 9,019 persons, according to the CVC's study, and is included in the number of the agricultural sector in the same way.

(Tab. 3-7)

Direct and Indirect Effects of the Project after the Start of Operation

Sectors	Gross Output (Millions of Pesos)	Gross Added Value (Millions of Pesos)	Employment (Person)
Agriculture, livestock, timber	801.1	465.6	10,455
Mining	22.0	18.9	112
Foodstuffs	2.8	0.5	11
Textiles	7.3	2.6	69
Clothing	10.1	2.8	164
Wood industry	1.7	0.8	36
Paper	4.6	1.2	20
Printing	4.2	1.6	56
Rubber goods	10.0	3.7	69
Chemical products	169.2	60.4	842
Petroleum and coal products	47.4	23.0	59
Non-metallic industry	4.2	1.9	56
Basic metal industry	5.2	0.8	15
General metal goods	11.3	4.5	136
Non-electric machinery	5.6	2.7	89
Transportation equipments	13.0	5.1	177
Miscellaneous manufactures	3.4	1.6	65
Transportation, communication	165.1	104.4	3,516
Electricity, Gas, and water	176.5	132.1	1,877
Real estate and financial services	11.9	8.4	540
Others and other services	38.8	37.8	1,717
Total	1,515.4	880.4	20,081

The table 3-7 indicates the total gross income to be generated every year by the project after start of operation reaches 880 million pesos and the total employment comes to 20 thousand persons.
Looking at industrial sectors, chemicals, transportation, and oil refining industry form the major growth of production due to the project, excluding agriculture and electricity sectors which are the starting points of the repercussive impacts.

In this Leontief analysis, the repercussive process through the induction of households consumption is left out of consideration, and private consumption is treated as a part of the exogeneous final demand. In the Keynesian system, capital formation is the origin of the economic chain and it decides the level of economic activities through the consumption function. The increase in final demands generate increases in output in the industries, increase of employment, increase of wages and salaries, and this leads to an increase of consumer expenditures through the marginal propensity to consume. Then it induces the direct and indirect effects through the Leontief system again in the repetition of this second stage, and the third stage. Thus, there is a combination of the Leontief system and the Keynsian system. The total increase of production ($\triangle X$) to be generated by the end of this chain originally stimulated by the increase of final demand ($\triangle Y$) can be given as follows:

Inverse matrix: $B = (I-A)^{-1}$

Added value vector: $V = [v, \ldots\ldots\ldots vn]$

Consumer expenditures vector: $G = \begin{bmatrix} g1 \\ \vdots \\ gn \end{bmatrix}$

Marginal propensity to consume: α

$$X = \left\{ B + B\,(G\alpha VB) + (G\alpha VB)^{2} \cdots \right\} \triangle Y$$

Now, the consumption-induced effect coefficient matrix is defined as follows:

$$C = G\alpha VB$$

Consequently,

$$\Delta X = B\,(I-C)^{-1}\,\Delta Y$$

Namely, $B(I-C)^{-1}$ can be defined as the enlarged multiplier taking account of the continuous repercussive effects of consumer expenditures.

Furthermore, to estimate this multiplier process more accurately there should be introduced dimension of income class. The consumption structure is different by income class. We are interested in this aspect of multiplier effects in consideration of differences of consumption patterns by income class, but in this report they are not handled because of statistical restrictions.

The marginal propensity to consume is given based on the actual data in 1956-1969. (See Appendix 4)

$$Cpc = 37.5982 + \underset{(0.005860)}{0.756890}\ Vp \qquad \bar{R} = 0.99961,\quad S = 645.3$$

Where, Cpc is consumer expenditure at the current price in millions of pesos, and Vp is GDP at the current price. Consequently, in this computation α is placed 0.756890. The consumer expenditures vector is given by means of the components employed in the consumer price index. Based on the component of consumer expenditures, the induced effects coefficient for consumer expenditures is estimated. (See Appendix 5) In consequence, the overall multiplier effect is given as follows:

(Tab. 3-8)

Overall Impacts of Project in Operation
(Millions of Pesos)

Primary direct and indirect effects on income		(a)	880.4
Marginal propensity to consume		(b)	0.75689
Induced effects coefficient of consumer expenditures for income	a/	(c)	0.9495
Overall generation of income including the total induced effects of consumer expenditures		$(d)=(a)x\frac{1}{1-(b)x(c)}$	3129.7
Marginal ratio of the taxes receipts for the increase of GDP		(e)	0.157169
Primary direct and indirects effects on the tax receipts		(f)=(a)x(e)	138.4
Overall generation of taxes including the total induced effects of consumer expenditure		(g)=(d)x(e)	491.9
Primary impacts on employment		(persons)	20,081
Overall impact on employment including the total induced-effects of consumer expenditure		(persons)	216,578

a/ See Appendix 5

If the overall increase of income is given, the overall increase of government revenue will be obtained in the same way as explained before. According to the result of this estimation, the overall increase of general government receipts to be generated with the additional products through the project operation per year will reach 492 million pesos. The value, even though obtained on these assumptions, will imply much that is significant for budget considerations. If these values, under

the limitations of the assumptions, can be evaluated it is natural that public decision-making in implementation of the project which may include the investment of public funds should be influenced by them.

In reference to the impacts on employment also, the overall employment effects generated by the project will be given through the multiplication of the labor coefficient, on the assumption of independence from the level of production scale, by the gross outputs created over the multiplier process.

4. Impact on the Balance of Payments

4.1 Potential for Exports from the Project

Now, promotion of minor exports is one of the principal aims of Colombian economic policy in recent years, although there are some problems far from reassuring in the trend of minor exports growth. In general, there will be three potential obstacles to export growth: first, the continuing increase of exports will be diverted to satisfy rising domestic demand; second, price problems related to competing power will become severe as exports grow and third, it is impossible to develop the long-term markets without increasing the ability to deliver a sufficiently high and stable volume.

The increase of exports resulting from the project is estimated in the CVC as follows. However, sugar is not included because it is thought that production of sugar cane will decrease with the project because of switch in planting.

(Tab. 4-1)

Increase of Export from the Project

	for Export (tons)	Export Price (US$/ton)	Value (Thousands of US Dollars)
Cotton Fiber	6,000	590.0	3,540
Cotton Seed	4,000	67.5	270
Beans	32,000	270.0	8,640
Soybeans	36,000	120.0	4,320
Cattle and Beef	9,660	900.0	8,694
Total			25,464

Source: CVC

In general, agricultural exports from Colombia have increased at a 15.6 percent compound annual rate in 1960-1970 as follows:

(Tab. 4-2) Index of Agricultural Export
(1963=100)

	Export	Production	Real Trade Term
1960	75.0	96	101.3
61	89.3	96	92.4
62	131.3	102	93.2
63	100.0	100	100.0
64	151.7	105	84.0
65	199.4	107	117.4
66	190.0	110	98.5
67	219.9	115	101.6
68	299.0	121	108.0
69	366.2	122	108.6
70	380.6	127	116.9

Source: UN, Monthly Bulletin of Statistics
DANE

The "real trade term" is expressed in the interior wholesale prices of foodstuffs deflated by dollar, divided by the world export price of basic agricultural goods. Based on these data, increase of agricultural export can be analyzed in relation to increase of agricultural production as follows. As far as the actual data flows are concerned, there is not such an obvious relation between export levels and the terms of trade as with production level.

$$\log \quad Eag = -8.63579 + \underset{(0.40056)}{5.33983} \log \bar{O}ag \qquad R=0.97560 \quad S=0.05594$$

Where, Eag is index of agricultural export, and $\bar{O}ag$ is an index of agricultural production.

According to this equation, agricultural exports have increased five times faster than the increase of agricultural production up to present, and have not been much influenced by competitiveness which is said to be heavily dependent on exchange rate arrangements. In this analysis, the correlation coefficient between exports and production is 0.98 against 0.59 with the real trade term.

To observe the export trend of cotton fiber, actual data in 1960-1969 are shown as follows:

(Tab. 4-3) Export of Cotton Fiber

	Export Thousands of US Dollars	Export Price 1963=100 (a)	Import Price 1963=100 (b)	Trade Term (a)/(b)	Production Thousands of tons
1960	13,283	89.6	148.0	60.5	66.9
61	10,770	101.0	138.4	73.0	76.5
62	20,230	101.7	125.5	81.0	82.3
63	6,212	100.0	100.0	100.0	72.6
64	9,296	97.4	95.4	102.1	66.0
65	6,662	88.8	90.7	97.9	65.5
66	4,954	82.1	116.4	70.5	88.0
67	19,607	86.7	134.2	64.6	101.0
68	33,695	91.5	138.3	66.2	120.2
69	36,695	94.9	143.4	66.2	125.2

Source: DANE

The export elasticity to production is given as follows:

$$\log Ecot = -0.07590 + \underset{(0.67686)}{2.17613} \log \bar{O}cot$$

$R = 0.75081$
$S = 0.21321$

Where, Ecot is the export of cotton fiber in thousands of U.S. Dollars, and $\bar{O}cot$ is production of cotton fiber in thousands of tons.

The elasticity of export to production has been high in the case of cotton fiber also during past decade, and correlation coefficient between export and production is 0.75 as against 0.18 with the trade term given by export price index divided by import price index.

What is inferred from these characteristics is that increase of production will be directly related to increase of exports at present so long as price is kept more or less at present levels in reference to the agricultural export in Colombia, in spite of anxiety above diversification to meet increasing domestic demands. However, it is true that the consumption of cotton by Colombian textile industry should not be neglected because its industry naturally has the potential to expand at a growth rate higher than 7 percent, corresponding to the economic growth. This would imply a demand of 142,000 tons by 1980. Therefore, it is not so difficult to project that production elasticity to exports will decrease to be less than at present, especially when one considers the trend of labor productivity gap between the agricultural sector and the textile industry. Consequently, it can be said that the more the domestic demands grow the more the strategic value of production of this kind will rise up.

Long staple cotton, which has been relatively competitive in the world market, is characteristics of cotton produced in Valle, and various possibilities will be observed from the following market.

(Tab. 4-4) Percentage of Market, Long Staple Cotton

	1970	1971
Free Europe	34	42
Latin America	23	37
Socialist	27	12
Others	16	9
Total	100	100

Source: PROEXPO

The export price of long staple cotton is estimated US$590 per ton in the CVC's projection, but the actual average price of the same item was US$613 in 1970 and US$639 in 1971 according to the information of DANE. On the other hand, according to the information of PROEXPO, export price of long staple cotton destined for Argentina in 1971 marked US$735 per ton.

CVC estimates exports of beans at 32,000 tons, and the following table gives the actual data in recent years:

(Tab. 4-5) Actual Trend of Beans Export

	Exports		Total Production		%	
	tons	US$/ton	tons	US$/ton	tons	US$/ton
1966	35	-	38,600	271	0.9	
1967	203	144	40,300	261	5.0	55.2
1968	2,620	175	55,000	309	4.8	56.6
1969	3,564	208	48,000	291	7.4	71.4
1970	3,546	254	40,000	250	8.9	101.6

Source: DANE

As shown above, exports of beans have rapidly increased in the past few years and it comes to 9 percent of the total production. Comparing export prices with domestic prices, the data show the estimated export price in the CVC to be little higher, but from the actual trend of market, which is expanding in spite of rise in price, as follows, there can be optimistic expectations for increase of exports.

(Tab. 4-6) Export Market of Beans
(percentage)

	1968	1969	1970	1971
Venezuela	96	63	59	64
Brasil	1			
Japan	3	3	7	11
Salvador		32	11	8
Puerto Rico		2		
Costa Rica			23	8
Guatemala				5
Panama				1
U.S.A.				3

Source: DANE

As for export of soybean cake, there is scarcely any information given, but it is a fact that oil cake is in strong demand both domestically and abroad. Approximately, more than 40 percent of total production of oil cake has been exported, of which 60 percent goes to Europe and 40 percent to Latin America. Taking into consideration that in 1969, 73 percent of the total production of soybean cake went to export in Valle del Cauca, as much as half the additional production from the project could be exported. In respect to export of cattle and beef also, there is scarcely information enough to analyze, but during the past five years the export increased at compound increase rate of 37 percent per annum, although there was rise in domestic prices, as follows:

(Tab. 4-7) Export of Cattle and Beef

	Thousands of US Dollars	Rate of Increase %
1965	6,079	-
1966	6,378	4.9
1967	4,072	63.9
1968	4,471	9.8
1969	10,970	145.4
1970	29,273	166.8

Source: Banco de la Republica

According to the ambitious government plan, the minimum target implies an annual average rate of increase of 20 percent, while the alternative maximum target implies 45 percent. The FAO projects that world demand for beef will rise at an average rate of 3 percent during this decade and that by 1980 there will be a world dficit of 1.7 million tons. In addition to that it is not difficult to project that production level of beef in developed countries is expected to remain at current levels as even fall slightly, despite expectations of a rise of consumption. Anyhow, there may be no doubt that world market could absorb the increase from this project.

For example, in the case of Japan, imports of food reached 2,574 million U.S. dollars in 1970 from 548 million dollars in 1960 at the compound increase annual rate of 16.7 percent as follows:

(Tab. 4-8) Import of Foodstuffs, Japan

	Millions of US Dollars	Rate of Increase (%)
1960	548	10.2
61	669	22.2
62	740	10.6
63	1,088	46.9
64	1,386	27.4
65	1,470	6.0
66	1,676	14.0
67	1,804	7.7
68	1,879	4.1
69	2,141	14.0
70	2,574	20.2

Source: Ministry of Finance, Japan

4.2 Imputed Value of Impact on the Balance of Payments

In addition to the increase of agricultural exports from the project, there will be a contribution to petroleum export owing to savings of fuel. This could be consumed if the power supply equivalent to power generation by the project was substituted by oil fired steam electric power, and its value should be evaluated. On the assumption that heat efficiency is 9,400 B.t.u per net kilowatt-hour, oil fuel of 189,687 kl would be needed to substitute energy equivalent to that of the Cauca River Regulation Project. This works out at US$2,028,323 in terms of export of crude petroleum of which unit value per barrel is estimated US$1.7 Accordingly, direct impacts on the balance of payments from the project including increase of agricultural export come to a total of 27,492 thousands of U.S. Dollars.

To evaluate the value of exports from the project in terms of the marginal value to the economic growth in the optimal allocation of resources, linear programming, which pertains to answering operationally how to program diverse production in order to maximize the social gains given a set of limited resources and a technology in the form of a set of constant production coefficient, can be a better test for the policy maker.

In general, we could write the standard maximum problem in the linear programming as follows:

$$\text{To maximize : } S = p_1 x_1 + p_2 x_2 \cdots\cdots\cdots p_n x_n$$

$$\text{Subject to : } a_{11} x_1 + a_{12} x_2 \cdots\cdots\cdots + a_{1n} x_n \leqq b_1$$

$$a_{21} x_1 + a_{22} x_2 \cdots\cdots\cdots + a_{2n} x_n \leqq b_2$$

$$\vdots \qquad\qquad \vdots \qquad\qquad \vdots \qquad\qquad \vdots$$

$$a_{m1} x_1 + a_{n2} x_2 \cdots\cdots\cdots + a_{mn} x_n \leqq b_m$$

Where, (S) is the objective function, (p_1, ...,p_n) is value vector, and (b_1, ...b_m) is the constraints vector. In this analysis vector (b_1, ...b_m) imply constraints of demand and supply, capital, labor, and foreign exchange. In reference to the optimal solution under these constraints we are going to find the increment of the objective function (ΔS) when resource constraints are changed by (ΔB). This marginal productivity of the marginal input to the objective function, to assure the full use of the scarce factors of production available, can be considered as a set of prices, the well known "shadow prices" or "accounting prices", otherwise, "imputed prices".

The theory of accounting prices has come to take a central place in the current development planning, and has been recommended by many authorities including the United Nations, although there are serious arguments about its recognition of the basic problem.[1/] [2/]

The basic structure of this model is to obtain the optimal activities of 31 industrial sectors to maximize GDP under the constraints of demand and supply balances, of capital accumulation, of labor population, and of international balance of payments, assuming the economy scale nearly equivalent to that in 1969. The technology coefficients are based on the interindustry table, National Planning Department, 1966. The total fixed capital is estimated according to the capital coefficient by industrial sector, as shown in Appendix 1 based on the information from the National Planning Department, and it is set to be

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1/ United nations, Planning for Economic Development, 1963
J. Tinbergen, The design of Development, 1958

2/ W.F. Stolper, Planning without Facts, 1966

108,000 million pesos. The total labor population is estimated 4,116,400 persons according to the survey by DANE, 1/ and the same labor coefficients as employed in the input-output analysis are applied. In respect to the constraints of balance of payments, the upper limit of the total imports for intermediate materials is set under 8,000 million pesos, and its coefficients, which were given based on data from the National Planning Department, are also shown in Appendix 1.

Consequently, in the optimal allocation of economic activities assumping the constraints mentioned above, the imputed prices of capital, labor, and the balance of payments are obtained as follows:

Fixed capital	1.01489 thousand pesos/thousands of pesos
Labor	None
Balance of Payments	12.46062 thousand pesos/thousands of pesos

When we consider three elements of capital, labor, and balance of payments as the basis elements of the production problem, the result of analysis implies that relative value of the balance of payments is the h highest and labor's is the lowest as a natural conclusion, at the present stage in Colombian development. This implies that the supply of labor at the present wage is substantially greater than the demand for it, however it does not mean to deny that labor should be employed even when its marginal product is negative. Even if there is unemployed labor which can be utilized without involving a reduction of outputs in other sectors and the price which must be paid for such labor employed does not represent a social cost, then the value of creating employment

1/ DANE, Encuests de Hogares, 1970

should be examined in the real full employment policy.

From these results, the socio-economic role of the Cauca River Regulation Project, which will contribute to the improvement of the balance of payments, should be substantially emphasized and clearly understood. On the assumption that direct effects to improvement of balance of payments with the project are estimated to be 27,500 thousand U.S. dollars, its potential gain is 342,567 thousnad U.S. Dollars to GDP of Colombia in addition to direct increase of net exports of goods and services in GDP. This is equivalent to 6,509 million pesos at an exchange rate of 19 pesos, and it corresponds to 5 percent of the estimated GDP in 1970.

5. Impacts on Prices

5-1 Price Impact of Increase of Agricultural Products

Intensification of price pressures can not be ignored in considering economic problems. In 1967-1971, consumer prices for wage workers increased by 9.4 percent and 7.0 percent, of the total and foodstuffs.

(Tab. 5-1) Percentage Increases of Prices

	Consumer Prices for Obreros		Wholesale Prices	
	Total	Foodstuffs	Total	Foodstuffs
1967	8.1	5.0	6.8	5.2
1968	13.3	7.2	6.3	6.7
1969	6.9	5.8	6.7	5.4
1970	6.7	5.6	7.6	6.1
1971	11.8	11.5	10.2	11.5

Source: DANE

The weight of foodstuffs is 49.3 percent in the consumer prices index for wage worker and 39.7 percent for salaried employees. It is quite serious problem at this moment that the rises of foodstuffs prices directly push the overall cost of living up. Although it is difficult to analyze the process of prices rising, including the market structure, production and distribution mechanisms, and natural phenomens, it cannot be denied that they are influenced by the quantitative level of production in general. In the present overall agricultural price policy, there is little doubt that promotion of greater agricultural production and higher productivity of basic crops as well as the improvement of transportation system are fundamentally effective.

Now, from the standing point of the substantial relationship between price and production or productivity, as well as the international comparison, deflated dollar prices will be examined to avoid the problem

of the periodic devaluation of the currency, although the price problem is expressed in the current prices. Table 5-2 indicates the trend of the wholesale price index deflated by dollar and production of foodstuffs.

(Tab. 5-2) Trend of Wholesale Price of Foodstuffs

	Wholesale Price Index (1963=100) (a)	Peso Value (1963=100) (b)	Real Wholesale Price Index (1963=100) (a)/(b)	Production Index (1963=100)
1959	69.1	71.1	97.2	95
1960	71.9	73.9	97.3	96
1961	77.5	74.4	104.1	96
1962	78.4	76.7	102.3	102
1964	124.1	100.0	124.1	105
1965	132.2	150.0	88.1	107
1966	154.1	150.0	102.7	110
1967	162.1	163.7	99.0	115
1968	173.0	187.8	92.1	121
1969	182.4	190.6	95.7	122
1970	193.5	212.6	91.0	127

Source: DANE

Based on these data, the trend of "real wholesale prices" of foodstuffs (Pf) might be estimated in relation to the production level of agricultural products ($\overline{O}ag$).

$$\log Pf = 5.86360 - 0.272969 \log Oag \qquad R = 0.67533$$
$$(0.10539) \qquad S = 0.035136$$

Although there is complicated background behind the foodstuffs prices, and it is not so easy as handled in such way to analyze the price mechanism, the elasticity of production to price is given as 0.27, as far as can be roughly estimated from these data. On the assumption that total agricultural production will be increased by 5.7 percent which is estimated as the ratio of additional products from the project to the total production in 1971, wholesale prices of foodstuffs

might decrease by 1.5 percent in the sense of simple translation of these statistical data, given other variables are constant.

The following numbers indicate relative comparison of the additional agricultural production with the project to the national total in 1971. It is easy to recognize that additional production resulting from the project cannot be neglected at least so far as based on the basic projection in this project is concerned.

(Tab. 5-3) Relative Comparison of Additional Production

	Addition with the Project		National Total (1971)		Percentage	
	Area Under Cultivation (ha)	Production (ton)	Area Under Cultivation (ha)	Production (ton)	Area Under Cultivation	Production
Cotton	5,000	18,500	217,000	323,000	2.3	5.7
Rice	9,019	59,416	240,000	841,000	3.8	7.1
Beans	21,647	45,176	81,000	43,000	26.7	105.1
Corn	4,449	48,002	804,000	915,000	0.6	5.2
Sorhm	20,924	153,824	93,000	219,000	22.5	70.2
Soyabeans	23,671	69,113	46,000	81,000	51.5	85.3

Source: CVC
DANE

There are limitations to analyzing the production elasticity to price by product in such way of macro-observations, but some examples will be given in reference to cotton and rice based on the basic data in 1960-1970. (See Appendix 6)

$$\log Pcot = 3.05297 - \underset{(0.087822)}{0.308344} \log \bar{O}ct \qquad R = 0.76026 \quad S = 0.03176$$

Where, Pcot is price of cotton seed in dollar and $\bar{O}cot$ is tonnage of cotton seed production.

The equation indicate 0.308 as the elasticity of production to price at the deflated base according to U.S. dollar. In the same way, an equation related to the price of rice and its productivity is given, although statistical reliability is not so good in this case.

$$\log Pr = 3.86725 - \underset{(0.22168)}{0.531273} \log Yr \qquad R = 0.62415 \quad S = 0.04968$$

Where, Pr is price of rice per ton, and Yr is average yield per hectare (Kg/ha).

In this connection, if the average yield of rice, 3504 kg/ha, in 1971, is changed to 3,616 kg/ha, by 3.2 percent, its average price might decrease by 1.7 percent, given that other factors remain constant, owing to the addition of rice production of high productivity induced by this project.

5-2. Price Impact of Electricity

Demand for electricity in Colombia has increased at 10.0 percent per annum in 1958-1969 corresponding to the steady economic growth. Table 5-4 indicates the actual data of the national electric power generation related to the GDP in 1958-1970.[1/]

1/ $\log_e En = 7.69788 + 0.099828t \qquad R = 0.99589 \quad S = 0.034344$

Where, En is national total electric power generation in millions of Kwh.

(Tab. 5-4) Trend of Electricity Demand

	Electric Power Generation Millions of Kwh	GDP in 1958 price Billions of Pesos
1958	2,432	2,068.3
59	2,768	2,217.7
60	3,105	2,312.3
61	3,123	2,430.0
62	3,400	2,561.5
63	3,964	2,645.7
64	4,565	2,808.9
65	5,034	2,910.0
66	5,494	3,065.8
67	5,936	3,194.7
68	6,522	3,390.2
69	7,345	3,606.1

Source: U.N. Year Book

Banco de la Republica

Based on these actual data, the increase of power demand may be analyzed in relation to GDP at constant prices as follows:

$$\log_e En = 7.97306 + 2.067271 \log_e V \qquad R = 0.99425$$
$$(0.07023) \qquad S = 0.04058$$

Where, En is the national total power generation in millions of Kwh, and V is GDP in millions of 1958 pesos.

On the assumption that the basic structure of demand is constant as shown above, if economic growth maintains more than 7 percent in the future, electricity demand will increase at more or less 14 percent per annum as long as based on these aggregative outlooks. This implies that even if there may be changes in the basic structure of demand, the pressure of demand for electricity may be expected not to decrease very rapidly in the future.

On the other hand, digressing from the problem of cost allocation based on economic feasibility, there should be sometimes adjustable considerations in relation to the aspect of repayment in the multipurpose project. Considerations of this kind should definitely depend on public decision or public preference, but it may not be useless to estimate the overall price impacts is to be estimated at the national level by means of the input-output analysis which was already described. Let us look at its price impact to consumer price and export price.

The impacts of change of electricity price to various industrial products must be analyzed not only in terms of the direct cost of the goods themselves but also in terms of the indirect cost of the materials which are the inputs to producing the good, and the costs of its materials which depend upon costs of materials which are inputs to produce the material itself. These overall impacts through these interindustrial linkage as well as the impacts of project construction and production can be analyzed by means of the interindustry analysis. In this analysis, we assume a cost push price mechanism. Price consists of price of intermediate inputs and added value.

$nP = nP \cdot nA + nQ$ Where, Price, $nP = (P_1 \ldots\ldots\ldots P_n)$

input coefficient matrix, $nA = \begin{pmatrix} a11 & \ldots\ldots\ldots & a1n \\ \vdots & & \vdots \\ an1 & \ldots\ldots\ldots & ann \end{pmatrix}$

added value vector, $nQ = (q1 \ldots\ldots\ldots qa)$

In consequence,

$$nP = nQ \cdot (nI - nA)^{-1}$$

However, price of electricity must be changed to exogeneous variable from endogeneous variable, to fix the price of electricity

itself independent from the change of prices of other sectors.

$$mP = (mQ + Pe \cdot mAe) \qquad (mI-mA)^{-1}$$

Where, mP, mQ, mI, mA, indicates the excluded the electricity sector.

(See Appendix 7)

$$mAe = (ae1,\ ae2\ \ldots\ ae,\ e-1,\ ae,\ e+1\ \ldots\ aen)$$

If, mQ is placed constant, $\triangle$ mP, obj3ctive price change, is given as follows:

$$\triangle mP = \triangle Pe \cdot mAe\ (mI-mA)^{-1}$$

Through these computations the direct and indirect price impacts on the respective industrial sector is given as shown in the Table 5-5. The value indicate the direct and indirect changed of prices of the respective goods in the ratio to the price change of electricity. Thus, if the price of electricity changes by 10 percent, the price of the basic metal products changes by 0.495 percent.

Accordingly, the overall impacts of an electricity price change on the consumer price and export price is given through summation of multiplication of the integrated price coefficient (p) and components of private consumption by sector (C) or components of exports by sector (E). Hence, if electricity price changes by 10 percent, consumer prices will change by 0.159 percent and export prices will change by 0.0449 percent.

(Tab.5-5)

IMPACT OF ELECTRICITY PRICE

	Sectors	Impacts of Power Price P	Personal Consumption		Export	
			Composition C	Weighted Impact P x C	Composition E	Weighted Impact P x E
1.	Coffee	0.0004	0.0167	0.000007	0.556552	0.000223
2.	Agriculture	0.0017	0.4048	0.000688	0.171233	0.000291
3.	Fishery and hunting	0.0044	0.0025	0.000011	0.009719	0.000043
4.	Forestry	0.0016				
5.	Mining	0.0038				
6.	Foodstaffs	0.0091	0.0418	0.000380	0.013642	0.000124
7.	Beverages	0.0140	0.0159	0.000223		
8.	Tobaco	0.0029	0.0128	0.000037	0.012589	0.000037
9.	Textiles	0.0212	0.0067	0.000142	0.006320	0.000134
10.	Clothing	0.0137	0.1145	0.001569		
11.	Wood	0.0155			0.008583	0.000133
12.	Wooden furniture	0.0214	0.0083	0.000178	0.003155	0.000068
13.	Paper	0.0261	0.0007	0.000018	0.013149	0.000343
14.	Printing and publishing	0.0140	0.0129	0.000181	0.015254	0.000214
15.	Leather products	0.0113				
16.	Rubber products	0.0178				
17.	Chemicals	0.0160			0.013189	0.000211
18.	Petroleum and coal products	0.0028	0.0250	0.000070	0.094759	0.000265
19.	Non-metallic minerals	0.0267	0.0043	0.000115	0.015355	0.000410
20.	Basic metal products	0.0495			0.032637	0.001616
21.	Metal products	0.0180	0.0062	0.000112	0.005762	0.000104
22.	Non-electric machinery	0.0145				
23.	Electrical machinery and materials	0.0136			0.001418	0.000019
24.	Transportation equipment	0.0094			0.001792	0.000017
25.	Miscellaneous manufactures	0.0109	0.0283	0.000308	0.021759	0.000237
26.	Construction and buildings	0.0190				
27.	Transportation	0.0068	0.0239	0.000163		
28.	Communication	0.0104	0.0055	0.000057		
29.	Electricity, gas, and water	1.0000	0.0116	0.011600		
30.	Real estate	0.0286				
31.	Banks and other services	0.0000	0.0101			
	Total			0.015859		0.004489

Note: Depend on the inputs coefficients, 1966.

It turn out that exports are definitely important, as was emphasized repeatedly. Based on data in 1958-1969 the export function (limited to the minor exports) is given as follows:

(Tab. 5-6) Minor Export Function

	Minor Export	Export Price Index	Exchange Rate	Real Export Price	World Export Price	Trade Term	World Trade
	Thousands of U.S. Dollars	1958=100 (a)	1958=100 (b)	1958=100 (c)=(a)/(b)	1963=100 (d)	(e)=(c)/(d)	Billions of U.S. Dollars
1958	21,407	225.3	255.4	88.2	101.0	87.3	101.3
59	23,030	192.4	255.0	75.5	99.0	76.3	113.3
60	33,297	203.8	264.9	76.9	100.0	76.9	122.9
61	45,673	202.7	266.9	75.9	99.0	76.7	124.5
62	53,943	192.5	274.9	70.0	99.0	70.7	132.1
63	48,576	220.0	358.6	61.4	100.0	61.4	143.4
64	73,635	262.5	358.6	73.2	102.0	71.8	161.0
65	96,667	285.6	537.9	53.1	103.0	51.6	174.8
66	105,701	297.8	537.9	55.4	105.0	52.8	192.0
67	119,196	390.6	586.9	66.6	105.0	63.4	201.2
68	154,171	446.8	673.3	66.4	104.0	63.8	224.4
69	204,331	478.5	683.3	70.0	107.0	65.4	255.6

Source: *Banco de la Republica*
U.N. Monthly Bulletin of Statistics

Based on these data, the export function, in which world imports and trade terms are given by dividing export prices by world export price, is estimated as follows:

$$\log Ex = -0.547628 + \underset{(0.37816)}{2.86293} \log Tw \; \underset{(0.33327)}{-0.378299} \log Pe/P_e^W$$

$$\bar{R} = 0.98225 \qquad S = 0.059339$$

Where, Ex is minor exports, FOB, in thousands of U.S. Dollars, Tw is total world imports in Billions of U.S. dollars, Pe is the export price index (1963=100)

deflated by dollars, and P_e^w are both taken from the U.N. Monthly Bulletin of Statistics.

Now, electricity generation by this project is situated not very influential in terms of its quantity in relation to the national total. However, assuming that the electricity price rises by 1 percent at the national level, minor exports of Colombia will decrease only by 0.0017 percent, although statistical reliability of parameter related to the trade term is not so sufficient, and the rise in export prices will only be 0.00449 percent.

Appendix 1

Added Value, Capital, Labor, and
Import Coefficients to Gross Output

	Sectors	Added Value	Capital	Labor (Persons per Thousand of Pesos)	Import (Intermediate)
1.	Coffee	0.972770			
2.	Agriculture	0.846333	0.9200	0.052672	0.00435
3.	Fishery and hunting	0.765850			
4.	Forestry	0.900927			
5.	Mining	0.857967	0.4200	0.005066	0.06083
6.	Foods	0.190191	0.1476	0.003776	0.07252
7.	Beverages	0.555700	0.2608	0.004302	0.05062
8.	Tobaco	0.691999	0.1048	0.003287	0.02306
9.	Textiles	0.360769	0.2297	0.009466	0.06076
10.	Clothing	0.274114	0.1276	0.016221	0.00502
11.	Wood	0.442123	0.3818	0.017542	0.01730
12.	Wooden furniture	0.477251	0.2766	0.023393	0.00251
13.	Paper	0.253915	0.4209	0.004449	0.12922
14.	Printing and publishing	0.381499	0.2477	0.013324	0.21640
15.	Leather products	0.375757	0.0823	0.009365	0.06330
16.	Rubber products	0.373861	0.1354	0.006879	0.25444
17.	Chemicals	0.356874	0.3654	0.004977	0.32544
18.	Petroleum and coal products	0.484357	0.3600	0.001245	0.02406
19.	Non-metallic minerals	0.463733	0.4988	0.013540	0.14856
20.	Basic metal products	0.144850	0.9880	0.002882	0.24360
21.	Metal products	0.393395	0.1709	0.011952	0.20986
22.	Non-electric machinery	0.477404	0.2355	0.015746	0.14425
23.	Electrical machinery and materials	0.358986	0.2371	0.007547	0.40519
24.	Transportation equipment	0.393824	0.1545	0.013606	0.58152
25.	Miscellaneous manufactures	0.461032	0.2157	0.019354	0.17679
26.	Construction and buildings	0.509035	0.0614	0.019436	
27.	Transportation	0.629805	2.4000	0.021280	
28.	Communication	0.854538	1.6704		
29.	Electricity, gas, and water	0.748705	4.4500	0.010635	
30.	Real estate	0.707237	0.4000	0.045570	
31.	Banks and other services	1.000000			

Source: Based on data from the National Planning Department, DANE, and Banco de la Republica etc.

Appendix 2

GENERAL GOVERNMENT CURRENT TAXES RECEIPTS
(Millions of Pesos)

	Indirect Taxes	Direct Corporate Taxes	Total Direct Household Taxes	Total (a)	Current GDP (b)	% (a)/(b)
1958	1,410.6	341.4	515.5	2,267.5	20,682.5	10.96
1959	1,564.0	434.6	616.4	2,615.0	23,648.8	11.06
1960	1,735.3	538.7	701.7	2,975.7	26,746.7	11.13
1961	1,824.3	569.2	723.9	3,117.4	30,421.0	10.25
1962	1,844.1	580.6	808.3	3,233.0	34,199.2	9.45
1963	2,346.5	816.9	1,081.7	4,245.1	43,525.5	9.75
1964	3,481.6	1,232.8	1,376.4	6,090.8	53,760.3	11.33
1965	4,017.8	1,247.4	1,526.5	6,791.7	60,799.6	11.17
1966	6,065.5	1,497.9	1,964.0	9,527.4	73,612.3	12.94
1967	6,335.9	1,839.9	2,736.3	10,912.1	83,082.7	13.13
1968	7,869.2	2,173.4	3,385.0	13,427.6	96,421.7	13.93
1969	9,521.5	2,992.4	4,361.6	16,875.5	110,953.3	15.21

Source: Banco de la Republica

Appendix 3

INPUTS COMPOSITION OF AGRICULTURAL PRODUCTS

	Corn	Soybeans	Sorghm	Rice	Cotton	Beans	Sugar Cane
Agriculture	0.064849	0.08166	0.077018	0.051972	0.049590	0.060028	0.050032
Clothing	0.011398	0.014266	0.013537	0.009135	0.008716	0.010551	0.008794
Chemicals	0.180691	0.141567	0.073935	0.273862	0.153374	0.247078	0.080895
Petroleum and coal products	0.014790	0.018511	0.017565	0.011853	0.011310	0.013690	0.011411
Basic metal products	0.002128	0.002663	0.002527	0.001705	0.001627	0.001970	0.001642
Non-electric machinery	0.005773	0.007226	0.006856	0.004627	0.004415	0.005344	0.004454
Transportation equipments	0.005099	0.006382	0.006056	0.004087	0.003899	0.004720	0.003934
Miscellaneous manufactures	0.002613	0.003270	0.003103	0.002094	0.001998	0.002419	0.002016
Transportation	0.189924	0.168333	0.245614	0.178829	0.252702	0.120439	0.330795
Wages and salaries	0.291635	0.279760	0.284930	0.321395	0.357081	0.114443	0.317180
Other added value	0.231100	0.276362	0.268859	0.140441	0.155288	0.419318	0.188847
Total	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

Principally depended on information from CVC; Banco de Republica, Planeacion, Interindustry Table, 1966; and Japanese government, Interindustry Table, 1960, 1965.

PERSONAL COMSUMPTION EXPENDITURES, 1956-1969
(Millions of Pesos)

	Personal Consumption Expenditures	Current GDP
1956	11,232.3	14,773.6
1957	12,987.9	17,586.2
1958	15,004.9	20,288.9
1959	17,198.2	23,342.9
1960	19,589.3	26,444.4
1961	22,584.5	30,026.4
1962	25,699.7	33,699.3
1963	33,024.8	42,714.1
1964	41,467.6	52,962.9
1965	45,482.1	59,900.0
1966	55,842.6	72,369.4
1967	62,038.5	82,054.5
1968	70,935.8	94,380.5
1969	81,230.1	108,276.8

Source: DANE

Appendix 5

DILECT AND INDIRECT EFFECTS OF PERSONAL CONSUMPTION

	Sectors	Final Demand Composition	Induced Gross Outputs	Induced Added Value
1.	Coffee	0.0167	0.027936	0.027175
2.	Agriculture	0.4048	0.449974	0.380828
3.	Fishery and hunting	0.0025	0.002698	0.002066
4.	Forestry		0.000724	0.014012
5.	Mining		0.015552	0.013343
6.	Foodstuffs	0.0418	0.048494	0.009223
7.	Beverages	0.0159	0.016954	0.009442
8.	Tobaco	0.0128	0.012838	0.008884
9.	Textiles	0.0067	0.071577	0.025823
10.	Clothing	0.1145	0.114873	0.031488
11.	Wood		0.001455	0.000643
12.	Wooden furniture	0.0083	0.009017	0.004304
13.	Paper	0.0007	0.009145	0.002322
14.	Printing and publishing	0.0129	0.016222	0.006189
15.	Leather products		0.006456	0.002426
16.	Rubber products		0.004952	0.001852
17.	Chemicals	0.0286	0.061977	0.022118
18.	Petroleum and coal products	0.0250	0.040874	0.019798
19.	Non-metallic minerals	0.0043	0.006874	0.003188
20.	Basic metal products		0.026668	0.000386
21.	Metal products	0.0062	0.013481	0.005303
22.	Non-electric machinery		0.000791	0.000378
23.	Electrical machinery and materials		0.000506	0.000182
24.	Transportation equipments		0.003130	0.001233
25.	Miscellaneous manufactures	0.0283	0.032088	0.014793
27.	Transportation	0.0239	0.058329	0.036736
28.	Communication	0.0055	0.070420	0.006018
29.	Electricity, gas and water	0.0116	0.017826	0.013347
30.	Real estate		0.019424	0.013738
31.	Banks and other services	0.0101	0.053399	0.053399
	Direct added value	0.2189		0.218900
	Total	1.0000		0.949515

Appendix 6

TREND OF AGRICULTURAL PRODUCTS

		Unit	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
GDP Implicit Deflator		1958=100	115.7	125.2	133.5	164.5	191.4	208.9	240.1	260.1	284.4	307.7	336.9
Consumer Price Index		1955=100	160.5	174.1	181.6	231.1	272.1	291.3	339.9	367.3	394.5	421.9	450.2
Peso Evaluation		Pesos/Dollar	6.65	6.70	6.90	9.00	9.00	13.50	13.50	14.73	16.90	17.15	19.13
Seed Cotton	Price in U.S. Dollar	US$/ton	258	262	205	248	285	260	263	237	226	227	205
	Current Price in Peso	Peso/ton	1,726	1,753	1,844	2,236	2,567	3,506	3,550	3,750	3,830	3,886	3,929
	Defracted Price in Peso	Peso/ton	1,492	1,400	1,381	1,359	1,341	1.678	1,479	1,442	1,347	1,263	1,166
	Production	Tons	115.0	132.0	142.0	126.0	114.3	114.0	125.0	175.0	200.0	213.5	224.3
	Yield	Kg/ha	1,278	1,298	1,239	1,255	1,173	1,201	1,267	1,514	1,693	1,513	1,372
Rice	Price in U.S. Dollar	US$/ton	132	142	102	116	150	126	140	127	124	109	97
	Current Price in Peso	Peso/ton	883	954	919	1,046	1,347	1,703	1,884	2,505	2,106	1,867	1,850
	Defrated Price in Peso	Peso/ton	763	762	688	636	704	815	785	963	741	607	549
	Production	Tons	450.0	473.6	585.0	550.0	600.0	672.0	680.0	661.5	786	689	737
	Yield	Kg/ha	1,982	2,000	2,089	2,173	1,987	1,841	1,943	2,206	2,837	2,702	3,218
Beans	Price in U.S. Dollar	US$/ton	298	340	223	269	461	257	271	261	309	291	250
	Current Price in Peso	Peso/ton	2,000	2,270	2,006	2,419	4,151	3,477	3,662	4,130	5,230	4,995	4,774
	Defrated Price in Peso	Peso/ton	1,729	1,813	1,503	1,471	2,169	1,644	1,525	1,588	1,839	1,623	1,417
	Production	Tons	39.8	44.2	47.6	43.9	42.0	40.0	35.0	38.6	40.3	40.0	40.0
	Yield	Kg/ha	454	520	523	547	555	522	536	550	575	606	545
Corn	Price in U.S. Dollar	US$/ton	71.3	93.9	76.2	88.2	115.6	66.9	81.8	78.1	76.6	76.9	77.9
	Current Price in Peso	Peso/ton	474	629	526	794	1,040	903	1,104	1,150	1,294	1,319	1,490
	Defrated Price in Peso	Peso/ton	410	502	394	483	543	432	460	442	455	429	442
	Production	Tons	866	758	754	782	968	871	850	850	887	880	826
	Yield	Kg/ha	1,179	1,195	1,215	1,205	1,286	1,043	1,050	1,121	1,143	1,175	1,255
Soybeans	Price in U.S. Dollar	US$/ton	120	121	127	119	122	111	141	131	128	140	154
	Current Price in Peso	Peso/ton	800	810	875	1,075	1,100	1,500	1,900	1,930	2,167	2,397	2,945
	Defrated Price in Peso	Peso/ton	691	645	655	653	575	718	791	742	762	779	874
	Production	Tons	19.0	20.0	22.0	30.0	40.0	50.0	52.0	83	82	100	96
	Yield	Kg/ha	1,500	1,429	1,562	1,500	1,600	1,667	1,486	1,660	1,708	1,754	1,778

Source: Banco de la Republica
DANE
Ministerio de Agricultura Valle University

INVERSE MATRIX EXCLUDING ELECTRICITY SECTOR (1)

Appendix 7

	1	2	3	4	5	6	7	8	9	10
	Coffee	Agriculture	Fishery and Hunting	Forestry	Mining	Foodstaffs	Beverages	Tobaco	Textiles	Clothing
1.	1.000025	0.000163	0.015877	0.000086	0.000041	0.258472	0.016246	0.000280	0.000430	0.000400
2.	0.000293	1.053779	0.015456	0.000166	0.000482	0.217588	0.056900	0.156982	0.179087	0.083093
3.	0.000000	0.000029	1.000115	0.000002	0.000002	0.001871	0.000122	0.000008	0.000032	0.000675
4.	0.000032	0.000147	0.000381	1.000141	0.007337	0.000532	0.003353	0.000311	0.000465	0.000969
5.	0.003188	0.003211	0.041282	0.007855	1.007415	0.009025	0.010829	0.003677	0.009602	0.008699
6.	0.000113	0.000692	0.067384	0.000364	0.000174	1.096993	0.068949	0.001187	0.001823	0.001699
7.	0.000002	0.000010	0.000057	0.000008	0.000005	0.000636	1,056909	0.000024	0.000086	0.000161
8.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.003295	0.0	0.0
9.	0.001736	0.006477	0.015175	0.000318	0.002871	0.024492	0.002804	0.001392	1.266219	0.508310
10.	0.000012	0.000038	0.002090	0.000047	0.001834	0.000139	0.000135	0.000055	0.001538	1.000819
11.	0.000016	0.000481	0,000136	0.000051	0.000029	0.000585	0.016111	0.000194	0.001117	0.002318
12.	0.000036	0.000223	0.000307	0.000045	0.000030	0.001585	0.000854	0.000263	0.001841	0.001839
13.	0.000242	0.001272	0.002921	0.000266	0.000542	0.028838	0.007394	0.023004	0.007807	0.015560
14.	0.000507	0.001410	0.001651	0.001259	0.002864	0.005804	0.006475	0.014979	0.003994	0.005460
15.	0.000016	0.001909	0.000259	0.000114	0.000139	0.001221	0.000360	0.000417	0.001954	0.046099
16.	0.000239	0.001122	0.001791	0.004762	0.002001	0.005380	0.004864	0.003108	0.010378	0.015258
17.	0.007009	0.046605	0.039751	0.000432	0.000499	0.029162	0.025796	0.022538	0.073553	0.038772
18.	0.009327	0.008408	0.121220	0.022758	0.021794	0.023437	0.024420	0.010103	0.025872	0.022347
19.	0.000176	0.001145	0.002406	0.000089	0.000066	0.004309	0.015704	0.000600	0.002129	0.002817
20.	0.000046	0.000266	0.000543	0.000356	0.000166	0.001618	0.005625	0.000402	0.003174	0.005240
21.	0.000259	0.001465	0.003578	0.002692	0.001165	0.010487	0.047473	0.002412	0.006738	0.019831
22.	0.000013	0.000076	0.000123	0.000103	0.000050	0.000351	0.001041	0.000125	0.000306	0.001921
23.	0.000012	0.000072	0.000110	0.000061	0.000030	0.000297	0.000845	0.000089	0.000417	0.001128
24.	0.000211	0.001050	0.001516	0.003737	0.001551	0.004347	0.004058	0.002542	0.004327	0.005057
25.	0.000034	0.000233	0.000381	0.000064	0.000067	0.002422	0.001932	0.000918	0.002914	0.016025
26.	0.0	0.0	0.0	0.0	0.0	0.0	0,0	0.0	0.0	0.0
27.	0.003732	0.016905	0.027865	0.083806	0.034709	0.087881	0.079001	0.052982	0.085732	0.098444
28.	0.000402	0.000908	0.000554	0.001428	0.001720	0.002289	0.002068	0.001481	0.002636	0.003751
30.	0.009477	0.019759	0.004223	0.004596	0.006420	0.027036	0.015002	0.011206	0.030695	0.034903
31.	0.002952	0.029144	0.018653	0.009835	0.041942	0.078918	0.081717	0.044786	0.091035	0.125409

INVERSE MATRIX EXCLUDING ELECTRICITY SECTOR (2)

	11	12	13	14	15	16	17	18	19	20
	Wood	Wooden Furniture	Paper	Printing and Publishing	Leather Products	Rubber Products	Chemicals	Perruleum and Coal Products	Non-Metallic Minerals	Basic Metal Products
1.	0.000891	0.000452	0.009396	0.001378	0.001387	0.000307	0.003375	0.000261	0.000418	0.000218
2.	0.001674	0.009801	0.009136	0.002250	0.244901	0.017784	0.007788	0.000513	0.001228	0.000509
3.	0.000026	0.000097	0.000081	0.000049	0.015402	0.000322	0.000042	0.000005	0.000008	0.000007
4.	0.208097	0.038083	0.012198	0.001823	0.004663	0.000289	0.000859	0.002725	0.001845	0.001274
5.	0.019061	0.011992	0.013607	0.006670	0.019533	0.008440	0.018099	0.358668	0.147969	0.141718
6.	0.003783	0.001919	0.039877	0.005850	0.005887	0.001305	0.014322	0.001106	0.001776	0.000925
7.	0.000555	0.001410	0.000708	0.000166	0.000193	0.000164	0.000186	0.000064	0.000060	0.000028
8.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.	0.002907	0.053913	0.006462	0.002171	0.004571	0.052934	0.009328	0.001448	0.004489	0.001176
10.	0.000708	0.015919	0.000519	0.000895	0.002363	0.001074	0.000382	0.000695	0.000416	0.000348
11.	1.070550	0.088759	0.001088	0.001012	0.022529	0.000820	0.001886	0.000084	0.001733	0.000417
12.	0.002509	1.002723	0.006090	0.001428	0.001025	0.000453	0.004789	0.000085	0.002086	0.000736
13.	0.004262	0.006219	1.383278	0.174804	0.006052	0.002804	0.025111	0.000449	0.039556	0.001539
14.	0.006158	0.009063	0.037898	1.040449	0.001864	0.001807	0.013690	0.001327	0.003629	0.001922
15.	0.001319	0.006404	0.000966	0.002705	1.055355	0.021953	0.001236	0.000197	0.000343	0.000391
16.	0.011762	0.026339	0.005087	0.006084	0.009669	1.037959	0.006285	0.006876	0.004522	0.009432
17.	0.047242	0.059125	0.059071	0.047040	0.060074	0.030087	1.086323	0.004104	0.018111	0.008453
18.	0.050868	0.024383	0.037924	0.017579	0.040886	0.017608	0.034885	1.064931	0.047973	0.062438
19.	0.003616	0.012744	0.002456	0.002112	0.031480	0.003404	0.025009	0.001560	1.072726	0.011831
20.	0.011853	0.021546	0.002733	0.002534	0.002908	0.002453	0.004303	0.000558	0.018961	1.497577
21.	0.020750	0.052742	0.006125	0.008248	0.011907	0.010568	0.022614	0.004019	0.009913	0.007852
22.	0.003059	0.027104	0.000570	0.001953	0.001996	0.001363	0.001230	0.000154	0.000435	0.001473
23.	0.001906	0.006225	0.00492	0.001086	0.002075	0.000440	0.001309	0.000101	0.005777	0.027192
24.	0.009753	0.014602	0.003850	0.004059	0.004887	0.003282	0.009468	0.005404	0.004405	0.007397
25.	0.016797	0.019315	0.008459	0.003249	0.012518	0.003648	0.004232	0.000119	0.001859	0.001444
26.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27.	0.189430	0.106903	0.075308	0.080945	0.088400	0.040288	0.058204	0.120649	0.067917	0.157845
28.	0.004434	0.003910	0.003748	0.011357	0.001753	0.002844	0.004229	0.001983	0.002645	0.005364
30.	0.038674	0.060327	0.036549	0.054819	0.012586	0.022805	0.037948	0.006921	0.021825	0.027628
31.	0.054025	0.081879	0.126064	0.123576	0.071774	0.049790	0.085577	0.025277	0.105722	0.085243

INVERSE MATRIX EXCLUDING ELECTRICITY SECTOR (3)

	21	22	23	24	25	26	27	28	30	31
	Metal Products	Non-Electric Machinery	Electrical Machinery and Materials	Transportation Equipment	Miscellaneous Manufactures	Construction and Buildings	Transportation	Communication	Real Estate	Banks and Other Services
1.	0.000265	0.000186	0.000299	0.000546	0.000503	0.000269	0.001024	0.000039	0.000102	0.0
2.	0.002128	0.001316	0.001235	0.002019	0.003901	0.000724	0.001987	0.000087	0.000180	0.0
3.	0.000020	0.000014	0.000017	0.000035	0.000088	0.000006	0.000027	0.000001	0.000003	0.0
4.	0.001352	0.001557	0.002236	0.002134	0.000870	0.010201	0.001413	0.000121	0.000140	0.0
5.	0.018075	0.023065	0.011210	0.008623	0.009639	0.060941	0.051042	0.001814	0.002433	0.0
6.	0.001124	0.000791	0.001268	0.002316	0.002137	0.001140	0.004345	0.000164	0.000432	0.0
7.	0.002169	0.000179	0.000189	0.000102	0.002651	0.000090	0.000087	0.000006	0.000011	0.0
8.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9.	0.010001	0.005988	0.003981	0.006605	0.012958	0.001828	0.003767	0.000207	0.000254	0.0
10.	0.001329	0.005514	0.000785	0.006682	0.002191	0.000245	0.000480	0.000048	0.000060	0.0
11.	0.004481	0.006555	0.008099	0.009919	0.002186	0.029014	0.000613	0.000178	0.000075	0.0
12.	0.009547	0.001965	0.022331	0.004430	0.002645	0.002061	0.000509	0.001761	0.000149	0.0
13.	0.011872	0.001898	0.007726	0.002132	0.033257	0.009197	0.000866	0.001605	0.007535	0.0
14.	0.006267	0.002531	0.006678	0.002663	0.011245	0.002851	0.001254	0.009407	0.04468	0.0
15.	0.001252	0.000896	0.001048	0.002117	0.005762	0.000260	0.001365	0.000069	0.000173	0.0
16.	0.009497	0.009558	0.011739	0.014775	0.007325	0.003243	0.058834	0.001557	0.002716	0.0
17.	0.025943	0.018753	0.039131	0.023851	0.062350	0.047975	0.004231	0.000635	0.002198	0.0
18.	0.021762	0.025239	0.018039	0.018159	0.012609	0.018601	0.144481	0.005172	0.006833	0.0
19.	0.008277	0.008515	0.020545	0.005364	0.003116	0.199875	0.000883	0.000065	0.000128	0.0
20.	0.114212	0.141203	0.027959	0.019879	0.022389	0.055090	0.004362	0.000168	0.000292	0.0
21.	1.075485	0.037291	0.048280	0.023106	0.016873	0.028820	0.033170	0.000987	0.001740	0.0
22.	0.020745	1.034674	0.014311	0.012799	0.003526	0.001466	0.001244	0.000095	0.000137	0.0
23.	0.014851	0.028954	1.056102	0.006381	0.004554	0.058724	0.000741	0.000039	0.000078	0.0
24.	0.006970	0.023688	0.009632	1.052443	0.003708	0.002896	0.046174	0.001205	0.002100	0.0
25.	0.007324	0.003314	0.008659	0.007061	1.049649	0.001613	0.000741	0.000081	0.000172	0.0
26.	0.0	0.0	0.0	0.0	0.0	0.0	1.00000	0.0	0.0	0.0
27.	0.061920	0.068804	0.066851	0.041372	0.045468	0.042573	1.035771	0.026564	0.046660	0.0
28.	0.003067	0.004305	0.006764	0.006279	0.003284	0.008238	0.001175	1.002179	0.039240	0.0
30.	0.024474	0.034981	0.050472	0.044124	0.023368	0.029504	0.014519	0.032983	1.012215	0.0
31.	0.073725	0.088421	0.080676	0.052322	0.067804	0.089395	0.077335	0.053306	0.148375	1.000000