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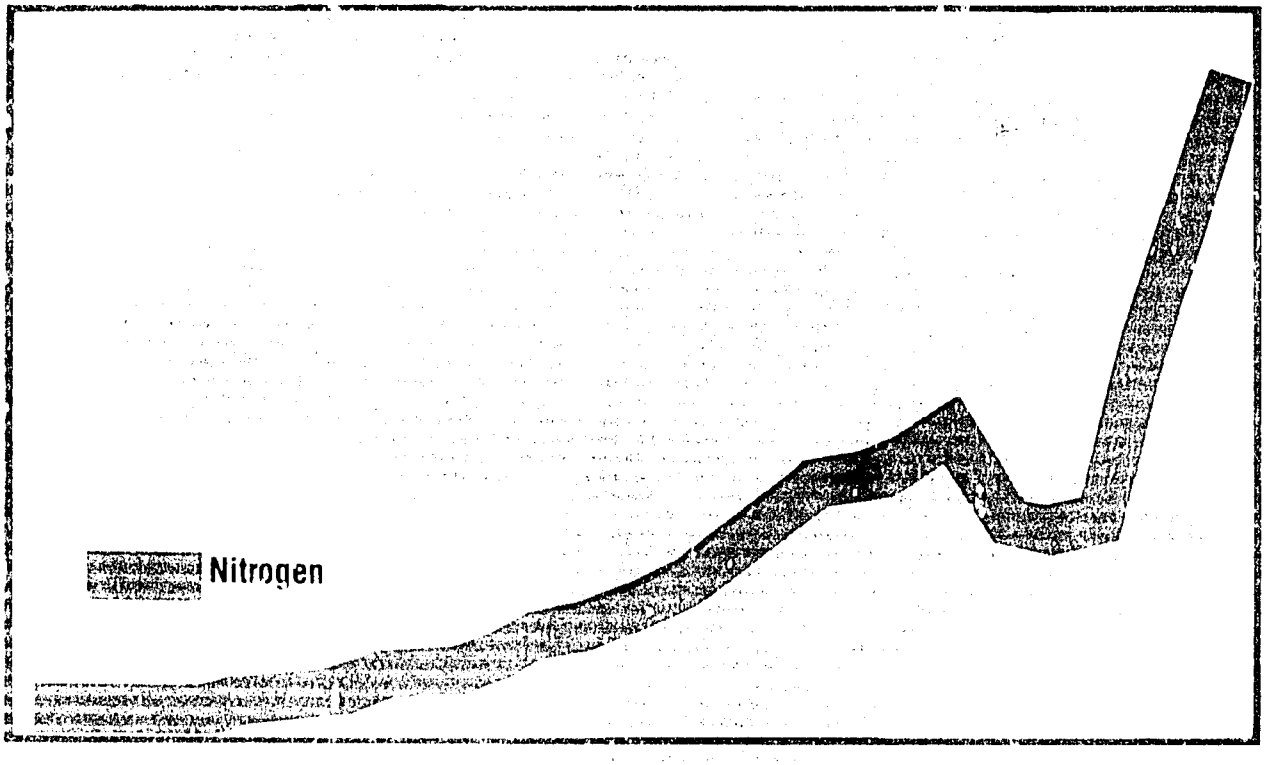
Venezuela
Fertilizer Subsidies and Agricultural Production



International Fertilizer Development Center

PN-ABE-132

Venezuela Fertilizer Subsidies and Agricultural Production

Adolfo Martinez

International Fertilizer Development Center (IFDC)

Abstract

This publication presents an analysis of the Venezuelan fertilizer subsidy and estimations of its impact on the performance of the agricultural sector. The study attempts to isolate and measure the impact that fertilizer subsidies have had on the overall improvement of the agricultural sector, specifically on crop production and crop productivity. The paper identifies and estimates the impact of agricultural credit, crop prices, fertilizer prices, and crop areas on fertilizer use and crop productivity. Additionally, a methodology useful for this type of analysis and the data needed for its application are presented.

Results of the study indicate that modifications to the present fertilizer subsidy program in Venezuela are needed. The study found that the level of subsidies in effect during 1988 and the first quarter of 1989—equivalent to about 90% of the fertilizer price—was too high and was making farmers use excessively large amounts of fertilizers. It was shown that the large doses of fertilizer being used in the country were actually depressing crop yields. A recommendation was made for a drastic reduction in subsidy level; this policy should be accompanied by increases in crop prices and in agricultural credit to farmers so as to reduce its negative impact on the agricultural sector.

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Introduction

Fertilizer subsidies can be an integral part of a nation's agricultural development policy. Subsidies refer to financial assistance given to farmers or farmer groups in buying fertilizer or to individuals or organizations in importing, manufacturing, selling, and/or distributing fertilizers. In Venezuela the main objective of fertilizer subsidies has been to provide farmers with inexpensive fertilizers and thus to promote agricultural productivity and production.

Fertilizer subsidy programs are usually designed to offer short-term financial assistance. It is expected that, after a few years, the objectives for which they were designed can be achieved and they will no longer be needed. Otherwise, as fertilizer consumption increases, and depending on the extent of the subsidy given, they usually become a heavy burden to the national economies.

This paper presents an analysis of the Venezuelan fertilizer subsidy and attempts to measure its impact on the performance of the country's agricultural sector. Objectives in the discussion are to isolate and to measure the impact that fertilizer subsidies may have had on the overall improvement of the agricultural sector, specifically on crop production and productivity. Attention is given to identifying quantifiable factors such as agricultural credit, crop prices, fertilizer use, and fertilizer prices and to measuring their impact on the agricultural sector. Additionally, the paper identifies the data needed and the methodology used for this type of analysis, and it makes recommendations for possible future fertilizer policy.

Background

The Venezuelan economy has traditionally been dependent upon oil export revenues. The 1974 world oil crisis was a bonanza to Venezuela; this crisis was accompanied by high oil prices, which lasted until the early 1980s. During recent years, drastic declines in international oil prices have changed the outlook of the domestic economy. The balance-of-payment situation has deteriorated, and the country is now facing problems in meeting its foreign debt payments and financing its domestic economic development plans. In spite of some recent improvements in the Venezuelan agricultural balance of trade, the country had net imports of agricultural products with a value of more than Bs 1 billion during 1984 and 1985 and of Bs 750 million during 1986.

For many years Venezuela depended, to a large extent, on imports of agricultural products to meet its food requirements. To stimulate the agricultural sector, a series of diverse policy measures was promulgated jointly by the Ministerio de Agricultura y Cria (MAC) and the Oficina Central de Coordinacion y Planificacion (CORDIPLAN) during late 1979. Some of the policy measures that were taken included increasing the availability of agricultural credit, increasing agricultural prices paid to farmers, continuing fertilizer subsidies, increasing agricultural research and extension activities, and improving infrastructure in rural areas.

However, changes in Government policies during early 1981 brought about a diversion from these programs. A change that is of particular interest in this study was the removal of fertilizer subsidies, which had been in effect since 1958. Removal of these subsidies and lack of implementation of other agricultural development policies established during 1979 adversely affected the nation's agricultural sector during the 1980-84 period. As Table 1 shows, during this period the agricultural sector of the country grew erratically and at low rates; its contribution to the Gross National Product (GNP) fluctuated between 6.2% and 7.5%.

Table 1. Rate of Growth and Share of GNP of the Venezuelan Agricultural Sector, 1980-86

	Rate of Growth	Share of GNP
	(%)	
1980	1.9	6.3
1981	-1.9	6.2
1982	3.6	6.4
1983	0.4	6.8
1984	0.8	6.9
1985	5.7	7.3
1986	6.8	7.5

Source: Inter-American Development Bank. 1987. "Progreso Economico y Social in America Latina," p. 42.

A new administration took office in early 1984 and announced a new agricultural development policy to revitalize the agricultural sector. The overall goal of the new policy was to reach self-sufficiency in the nation's cereal crop requirements by 1993 and to reduce dependence on imports for other agricultural crops by increasing domestic production through crop area expansion and increases in productivity. To attain these goals, several important changes in policy were announced and implemented during 1984. The new administration's key policy measures included agricultural credit expansion, increases in crop prices, and the restoration of the fertilizer subsidies.

These policies stimulated the agricultural sector, which grew at rates of 5.7% and 6.8% during 1985 and 1986, respectively—rates that were considerably higher than those of previous years. Also, during these 2 years, agriculture's share of the GNP increased to 7.3% and 7.5%, respectively, as compared with 6.9% in 1984.

Fertilizer Subsidies

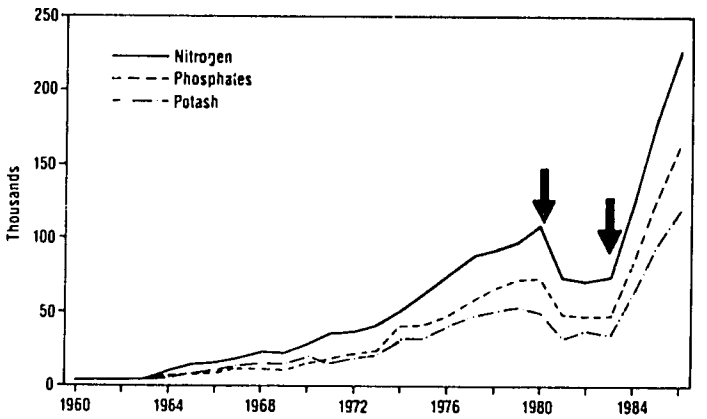
Except for the period between March 22, 1981, and March 21, 1984, fertilizer prices paid by farmers in Venezuela have been highly subsidized since 1958 when the country began producing fertilizers at a small plant at Moron. The amount of fertilizer subsidies increased significantly each year as the costs of fertilizer procurement, transportation, and marketing rose and fertilizer use in the country increased. Estimated amounts of subsidies were Bs 249 million and Bs 362 million in 1978 and 1979, respectively. The former figure represented 54% of the total cost of fertilizer to farmers, and the latter represented 62% of the total cost. In 1980 the estimated amount of subsidies escalated to Bs 631 million; this amount accounted for 72% of the total farm-level cost.

On March 22, 1981, the Government eliminated subsidies on retail fertilizer prices to make the fertilizer industry self-supporting. As can be seen in Table 2 and Figure 1, the sudden removal of subsidies drastically reduced farmers' fertilizer demand in 1981, 1982, and 1983, as unsubsidized fertilizer prices doubled or tripled. This sharp drop in fertilizer demand and newly initiated imports by growers' associations left PALMAVEN (PEQUIVEN's marketing arm), which had assumed marketing responsibilities from VENFERCA, with fertilizer inventories of about 330,000 tons. Because of the large inventories, PEQUIVEN was forced to operate its production facilities at low capacity rates, which in turn led to higher operating and production costs.

Table 2. Fertilizer Sales by Product, 1980-86

	1980	1981	1982	1983	1984	1985	1986
	(10³ t)						
Urea	109.4	71.2	69.8	75.9	135.7	197.3	242.1
Ammonia sulfate	49.3	37.7	36.1	35.6	40.5	46.4	58.1
DAP	13.2	8.6	10.3	18.8	37.8	60.9	95.3
TSP	14.4	4.9	5.2	6.5	8.8	11.8	13.2
Potassium chloride	6.9	2.9	8.3	5.5	12.1	22.6	45.9
Potassium sulfate	3.5	0.3	1.3	2.3	5.4	8.3	11.3
TOTAL STRAIGHT	196.7	125.6	131.0	144.6	240.3	347.3	465.9
12-24-12	118.6	104.3	89.2	60.8	143.1	183.7	228.9
15-15-15	55.4	66.0	64.0	64.6	78.4	146.6	203.3
13-13-21	22.8	4.2	2.0	1.3	0.0	0.0	0.0
12-12-17	50.1	33.5	61.4	69.9	127.7	188.1	123.8
13-26-06	20.3	0.0	0.0	0.0	0.0	0.0	0.0
12-12-06	12.9	6.1	2.7	9.6	14.0	0.0	0.0
16-16-08	0.0	0.0	0.0	0.0	0.0	15.4	78.9
Powders	71.5	13.0	6.5	6.8	3.1	0.0	0.0
TOTAL NPKs	351.6	227.1	225.8	213.0	366.3	533.8	634.9
Other NPKs	5.6	2.2	0.1	1.1	0.0	5.7	2.3
GRAND TOTAL	553.9	354.9	356.9	358.7	606.6	886.8	1,103.1

Source: PALMAVEN.



Source: PEQUIVEN.

Figure 1. Fertilizer Use in Venezuela, 1960-86.

To help cope with this situation, PEQUIVEN and PALMAVEN, in an agreement with the Government, offered a 15% discount on unsubsidized prices for most products at PALMAVEN's zonal points of sale between October 29, 1982, and March 22, 1984. This price discount had little impact on fertilizer demand because it was an isolated event not accompanied by complementary agricultural development policies.

On March 22, 1984, the newly-elected Government reinstated the price subsidy on fertilizers. It reduced retail fertilizer prices to 50% of the 1983 levels and budgeted

Table 3. Estimated Fertilizer Subsidy, 1986

	Quantity	Production Cost	Import[a] Cost	Selling Price	Total Cost	Total Subsidy
	(10³ t)	(Bs/t)			(10⁶ Bs)	
Urea	242.1	1,088	-	649	263.4	106.3
Ammonium sulfate	58.1	781	-	550	45.4	13.4
FDA Domestic	33.3	1,707	-	706	56.8	33.3
Imported	62.0	-	4,514	-	279.9	236.1
SFT	13.2	-	3,098	616	40.9	32.8
KCl	45.9	-	2,077	540	95.3	70.5
Sulfato de Potasio	11.3	-	4,298	685	95.3	40.8
12-24-12	208.1	1,346	-	735	280.1	127.1
	20.8	-	3,564	-	74.1	58.8
15-15-15	84.0	1,264	-	700	106.2	47.4
	119.3	-	2,791	-	333.0	249.5
12-12-17	123.8	-	3,567	735	441.6	305.6
16-16-08	78.9	-	3,383	663	266.9	214.6
TOTAL					2,332.2	1,536.2

a. US $1 = Bs 20.25 commercial rate.

Source: Estimated from data provided by PEQUIVEN.

Bs 411 million through MAC to compensate PALMAVEN for its 1984 financial loss that resulted from the reduction in selling prices. The new price subsidy and other agricultural policies implemented by the new Government had a substantial impact on fertilizer sales. Sales by PALMAVEN in 1984 increased far above expectations, and a resumption of fertilizer imports was necessary to satisfy farmer demand. As Table 2 shows, fertilizer sales increased from approximately 359,000 tons of product in 1983 to nearly 607,000 tons in 1984, an increase of 69%, and to 1,103,100 tons during 1986. Fertilizer consumption increased rapidly, and so did the subsidy, which reached Bs 1.5 billion during 1986, or 66% of PEQUIVEN's total cost of fertilizers (Table 3).

The amount of subsidy shown in Table 3 for 1986 does not represent the total fertilizer subsidy provided by the Government. Two other forms of subsidy were and are provided: (1) the operational expenses of PALMAVEN incurred in fertilizer marketing and distribution and (2) the costs associated with the preferential exchange rate given to PALMAVEN and PEQUIVEN for the importation of raw materials and finished fertilizer products. At present rates, the amount of funds needed to support fertilizer subsidies will reach Bs 2.0 billion very soon or may have already reached that level. Because this level of subsidy represents a heavy burden on the national economy, it is imperative that the fertilizer subsidy program be carefully evaluated. This paper is intended to analyze the subsidy's impact on agricultural production and to serve as a guide for appropriate authorities within the Government to reassess the value of the subsidy program.

Framework for Analysis

Fertilizer subsidies are implemented by governments to promote fertilizer use by farmers; it is expected that the farmers will increase their agricultural production and productivity. Fertilizers are only one of the inputs used in agricultural production; because many other factors also affect the agricultural sector of a country, the determination of appropriate fertilizer subsidy policies is not a straightforward process. Instead, consideration has to be given to the magnitude and stability of the subsidy's impact on crop production, productivity, and fertilizer demand. Agricultural planners and policymakers should therefore consider alternative policies and their associated benefits and costs before selecting a given policy or making a recommendation.

In evaluating fertilizer price subsidy policies, three aspects of the subsidy have received special consideration in this paper:

1. Its impact on agricultural production.
2. Its impact on agricultural productivity.
3. Its impact on fertilizer demand.

It is known that as fertilizer decreases in price its use by farmers increases. Increases in fertilizer use should be accompanied by gains in agricultural production through expansion in crop areas and in crop yields. Low fertilizer prices encourage farmers to develop and/or to bring into production marginal lands having low fertility. Additionally, increased fertilizer use in presently cropped land will produce greater crop yields. However, the extent to which increases in agricultural production take place is subject to wide variations and uncertainty. Therefore, to determine the impact of a fertilizer subsidy program, it is necessary to understand and estimate the farmers' reaction to fertilizer price changes and also to estimate the crop response to different fertilizer use levels.

The farmers' reaction to changes in fertilizer prices is measured through price demand elasticities, i.e., the percentage of change in quantity demanded due to a given percentage of change in price. The crop response to fertilizer is measured through production functions. An important link exists between fertilizer price demand elasticities and crop response functions. The effectiveness of a fertilizer subsidy program can be measured by increases obtained in crop production and productivity; therefore, if a subsidy program is to be effective, the benefits obtained through increases in crop production should be greater than the cost of the subsidy. As fertilizer subsidy programs are implemented, the quantity of fertilizer demanded is expected to increase. Fertilizer use in crop production is subject to the "Law of Diminishing Returns," and the economic benefits derived from a subsidy program depend on the crop response to fertilizers, specifically to the amount of fertilizer that farmers use before and after the subsidy is instituted.

The identification and measure of factors affecting agricultural production at a national level are complex issues because many factors are involved. To help explain changes in agricultural production in Venezuela during the past few years, the following variables were considered: total cropped area, agricultural credit, crop prices, fertilizer prices, fertilizer use, fertilizer:crop price ratio, and cropped area for six key crops, i.e., rice, maize, sorghum, cotton, coffee, and sugarcane.

Data Used and Limitations

The data used in the preparation of this study appear in the Appendix. They consist of time series data obtained from secondary sources for the 1960-86 period. The following data were collected and analyzed in this study:

Table A-1. Cropped Areas for Rice, Maize, Sorghum, Cotton, Coffee, and Sugarcane, 1960-86.
Table A-2. Rice, Maize, Sorghum, Cotton, Coffee, and Sugarcane Yields, 1960-86.
Table A-3. Official Crop Prices for Rice, Maize, Sorghum, Cotton, Coffee, and Sugarcane, 1960-86.
Table A-4. Total N, P_2O_5, and K_2O Use in Venezuela, 1960-86.
Table A-5. Fertilizer Retail Prices Paid by Farmers, 1960-86.
Table A-6. Total Fertilizer Nutrient Demand, Average Nutrient Price, Total Cropped Area, Agricultural Credit, and Agricultural Price Index, 1960-86.

These data were used in the estimation of the parameters of various regression models. Some variables were used as shown; others were used as averages (i.e., crop yields and prices), national aggregates (i.e., crop areas for key crops), and linear transformations (i.e., fertilizer:crop price ratios, use of nutrients/hectare). Table 4 presents the values for variables estimated from the data in the Appendix tables. It includes the fertilizer:crop price ratios, the average crop price for the six key crops, three estimates of the amount of fertilizer used per hectare, and the average crop yield for the six key crops.

The data used have been collected by IFDC, with PEQUIVEN's assistance, through several years of IFDC's involvement with the Venezuelan fertilizer industry. Although the data used are believed to be the best available from secondary sources, they do not necessarily constitute an optimum data set for this kind of study. A fertilizer subsidy program could be evaluated more effectively through the use of time series data on fertilizer by crop; these data are not available in Venezuela. An alternative to this is the development of stratified annual farm surveys, which is an expensive and time-consuming task. However, considering the large amount of funds invested in the fertilizer sector in Venezuela, a systematic data collection process is warranted.

Table 4. Fertilizer:Crop Price Ratios, Average Key Crop Prices, Fertilizer Use/Hectare, and Average Crop Yield for Six Key Crops

Year	Fertilizer: Crop Price Ratio	Average Crop Price[a]	Fertilizer Use[b] #1	#2	#3	Average Crop Yield[c]
		(Bs/ton)	(kg/ha)			
1960	5.51	174.4	7.8	13.1	10.5	1,777.8
1961	6.65	141.0	9.3	14.6	11.7	1,666.6
1962	6.62	148.4	7.4	11.0	8.8	1,910.9
1963	6.71	144.4	7.6	11.6	9.3	1,791.0
1964	5.44	169.0	14.5	22.2	17.8	1,738.6
1965	6.60	149.2	18.8	28.9	23.1	1,809.1
1966	6.99	146.1	22.0	34.5	27.6	2,056.8
1967	6.73	146.3	24.5	37.6	30.1	1,835.9
1968	5.80	165.7	27.2	42.5	34.0	1,822.9
1969	6.19	153.8	26.0	41.0	32.8	1,859.0
1970	6.73	144.0	34.9	57.2	45.7	2,120.7
1971	7.61	134.1	38.3	62.1	49.7	2,010.5
1972	9.36	114.4	48.8	80.5	64.4	2,028.3
1973	6.27	163.3	54.3	89.0	71.2	2,486.0
1974	6.05	173.1	71.2	119.1	95.2	1,970.3
1975	4.27	248.5	77.7	123.3	98.7	2,212.7
1976	4.76	222.9	94.1	152.9	122.3	1,736.4
1977	3.17	340.0	105.5	166.9	133.5	2,385.6
1978	2.84	386.5	116.7	179.5	143.6	2,404.0
1979	2.43	456.5	127.4	183.0	146.4	2,226.6
1980	2.02	537.1	130.2	189.8	151.8	2,241.2
1981	4.67	657.0	91.4	133.8	107.1	2,226.5
1982	5.45	652.1	94.6	139.6	111.7	2,157.6
1983	4.65	647.7	100.0	150.5	120.4	2,197.7
1984	1.40	1,055.1	175.2	254.5	203.6	2,145.3
1985	1.33	1,106.1	222.6	311.4	249.1	2,183.3
1986	1.46	979.2	241.3	324.3	259.4	2,092.0

a. Average weighted price of six key commodities.
b. #1 equal to total NPK use divided by total crop area.
#2 equal to total NPK use divided by area with key crops.
#3 equal to 80% of NPK use divided by area with key crops.
c. Expressed in maize equivalents.

Model Estimation

The development of regression models designed to evaluate agricultural sector policies includes the selection of a set of variables, some of which can be influenced by decisionmakers, by climatic factors, or by market forces. These variables are usually referred to as "exogenous," or variables whose values are not determined by the model developed. The regression models also attempt to explain another set of variables. These variables, which are correlated with the exogenous variables, are called "endogenous," and their values are estimated by the model. The regression model developed here presumes to explain the dynamic structure implied by the relationship between exogenous and endogenous variables. Figure 2 presents an illustration of the model estimated.

Time series data used for model estimation present a strong likelihood that a disturbance occurring in one time

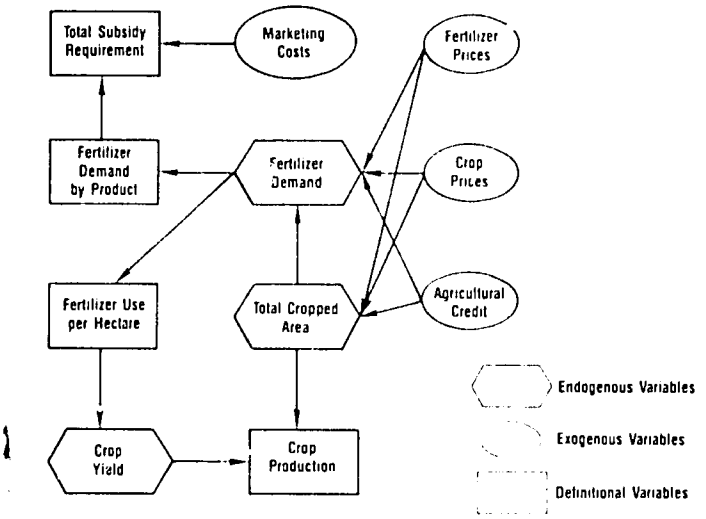


Figure 2. Estimated Regression Model of Relationship Between Exogenous and Endogenous Variables.

period will have an effect on the next period and, hence, give rise to autoregressive disturbances. Another problem common to time series data is that they contain independent variables having a high degree of multicollinearity. Even though these problems can be persistent, an effort was made here to rid the estimated models of independent variables by carefully selecting the variables and by estimating alternative models to observe variation in the estimated coefficients.

By using a set of structural equations, an attempt was made to represent the effect of fertilizer price subsidies on crop production, productivity, and fertilizer demand. The structural form of the regression models was not set a priori; instead, several models were estimated and analyzed. In selecting the models, consideration was given to their statistical properties (i.e., R-square, t-values, and D.W. values) and to expectations with respect to signs and magnitudes of coefficients. The structural form of the models selected can be represented as follows:

(1) $CA_t = f(CA_{t-1}, FCPR_t)$.
(2) $AVY_t = f(NPK_t, NPK_t^2)$.
(3) $FD_t = f(FD_{t-1}, RPF_t, KCA_t)$.

where:

CA_t = Cropped area during year t.
CA_{t-1} = Cropped area lagged 1 year.
$FCPR_t$ = Fertilizer:crop price ratio in year t.
AVY_t = Average yield for six key crops expressed in maize equivalents in year t.
NPK_t = Amount of N, P_2O_5, and K_2O used per hectare in year t.
FD_t = Total demand for fertilizers in year t.
FD_{t-1} = FD_t lagged 1 year.
RPF_t = Real price of fertilizers in year t.
KCA_t = Cropped area for six key crops during year t.

The regression parameters for these equations were estimated by using ordinary least squares.

Crop production is defined by the product of model (1) and (2). The model of cropped area (CA_t) implies that crop area planted in Venezuela is a function of the cropped area during the previous year and the fertilizer:crop price ratio. This model allows for the evaluation and measurement of the impact of Government policies related to crop and fertilizer price policy. This model was estimated for the total cropped area of the country and for the cropped area of the selected six key crops.

The average yield model (AVY_t) specifies a production function for the six key crops selected, expressed in maize equivalents. It represents the crop yields that can be expected on an aggregate basis at different fertilizer application rates. This model allows for a measurement of the impact on crop productivity of changing levels of fertilizer use.

The fertilizer demand model (FD_t) identifies factors affecting fertilizer use by farmers. It includes the cropped area for the six key crops, the real fertilizer prices, and the quantity of fertilizer used during the previous year. This model provides estimates of the impact on fertilizer demand of alternative fertilizer pricing policies and of programs to expand cropped area. Ancillary to this model, a model was formulated to allow for short-term and long-term fertilizer demand elasticity estimations. This model can be represented as follows:

(4) $FD_t = f(FD_{t-1}, RPF_t)$.

This model assumes that the effects of fertilizer price changes are not exerted all at once but instead are distributed over time. When this model is estimated in its logarithmic form, the regression coefficient for the RPF_t variable is an estimate of the short-term elasticity of demand; the coefficient of the lagged variable estimates the distribution of the lag and allows for the estimation of the long-term elasticity of demand.

Model of the Cropped Area

In the estimation of the model of cropped area, several independent variables were considered along with some linear transformations. The model was estimated for the total cropped area and for the cropped area of the six key crops. The following models were selected to explain variation in cropped areas:

$$\text{(1a)}\ CA_t = 571.29 + \underset{(4.97^{**})}{.746}\,(CA_{t-1}) - \underset{(-2.59^{**})}{25.42}\,(FCPR_t)$$

R-Square = 62%

$$\text{(1b)}\ KCA_t = 499.63 + \underset{(4.27^{**})}{.696}\,(KCA_{t-1}) - \underset{(-3.57^{**})}{29.22}\,(FCPR_t)$$

R-Square = 70%

The lagged variable of the dependent variable was included in both models to account for the fact that cropped area brought into production is a medium- to long-term

venture. When expanding cropped areas, farmers incur capital expenses (i.e., farm machinery, irrigation systems) that are paid over several years. Therefore, once a tract of land is developed and brought into production, it will remain in production for an extended period. The estimated coefficient values and their statistical significance confirm this assessment.

The coefficients for $FCPR_t$ indicate the average changes in crop areas that have occurred during the 1960-86 period due to changes in Government fertilizer price and crop policies. The coefficients are of similar magnitude, but a slightly higher impact of price policies can be noted when the six key crops are considered alone. The values and the statistical significance of these coefficients confirm the effect of crop and fertilizer pricing policies on cropped areas and, subsequently, on crop production.

Because previous studies made by IFDC in Venezuela indicated the importance of agricultural credit in cropped areas, several of the estimated models included real agricultural credit as an independent variable. Results indicate that there is a positive relationship between the areas cropped and the agricultural credit used by farmers; however, this relationship was found to be insignificant. The reason for this is probably the fact that, in real terms (1968 = 100), agricultural credit per hectare of cropped area increased steadily from 1960 until 1979 when it reached Bs 590/ha, as shown in Figure 3. Since 1979, however, agricultural credit per hectare has decreased dramatically, and it was equal to only Bs 200/ha during 1986, or approximately what it was in the late 1960s. Therefore, the role of agricultural credit in promoting agricultural development in Venezuela has decreased considerably during the past 8 years.

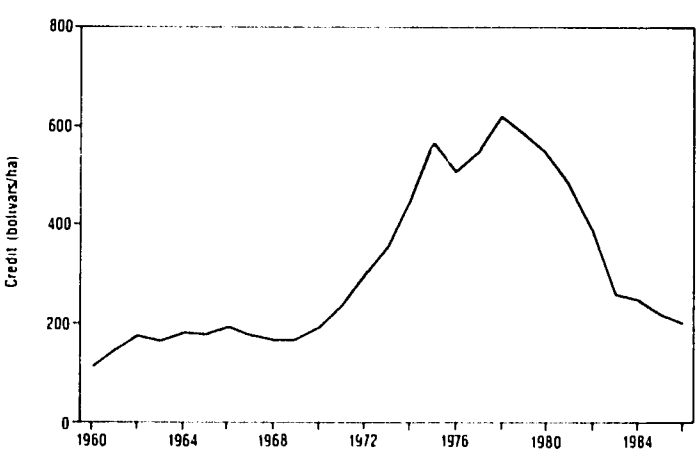


Figure 3. Real Agricultural Credit per Hectare, 1960-86.

Model of Crop Productivity

The crop productivity model developed here represents the crop response to different fertilizer ($N + P_2O_5 + K_2O$) use rates. Because time series data on fertilizer use by cropped area are not available in Venezuela, three models were estimated using different data on application rates. Data for 1976 were excluded from the analysis as outliers. The fertilizer application rate for the first model (2a) was estimated by dividing the total fertilizer used in the country by the total cropped area, excluding pastures. This model is assumed to overestimate the effect of fertilizer on crop yield because of the magnitude of the cropped area values. For the second model (2b), the application rate used was estimated by dividing the total fertilizer used in the country by the area of the six key crops considered. This model, as opposed to model (2a), underestimates the crop response to fertilizer used. The third model (2c) assumes that the six key crops considered have used an average of 80% of all fertilizer used in the country during the 1960-86 period. This model was estimated for comparison purposes and to observe the reliability and stability of estimates obtained with the other models. The dependent variable in all three models was the crop production per hectare of the six key crops selected, expressed in maize equivalents. Pasture land that has been fertilized in the past was not accounted for in any of these models. However, it is estimated that less than 3% of the fertilizer used in the country is applied to pastures. The following models were estimated:

$$\text{(2a)}\quad AVY_t = 1735.6 + \underset{(6.31^{**})}{7.88}\,(NPK_t) - \underset{(-4.98^{**})}{.027}\,(NPK_t^2)$$

R-Square = 68.6%

$$\text{(2b)}\quad AVY_t = 1713.0 + \underset{(6.33^{**})}{5.68}\,(NPK_t) - \underset{(-4.88^{**})}{.014}\,(NPK_t^2)$$

R-Square = 70.3%

$$\text{(2c)}\quad AVYt = 1735.0 + \underset{(4.43^{**})}{5.10}\,(NPK_t) - \underset{(-3.29^{**})}{.018}\,(NPK_t^2)$$

R-Square = 54.0%

As an illustration of these results, Figure 4 presents a plot of the data used for estimation of model 2b and estimated values from the model. Models 2a through 2c show that the estimated regression coefficients were of similar magnitude. The linear coefficients indicate the increase in yield that can be expected at low fertilizer use rates in Venezuela; the quadratic coefficient defines the diminishing returns' nature of the production functions. These three models were used to determine rates at which maximum yields occur, maximum possible yield increases, optimum application rates, expected net returns, and value:cost ratios. These results are presented in Table 5, which also includes an estimation of present (1986) fertilizer use rates, under the assumptions of each one of the models.

As Table 5 shows, maximum yields are obtained at fertilizer rates ranging from 145 to 203 kg/ha, which generate yield increases of 512 to 576 kg of maize equivalents/ha, or between 3.07 and 4.15 kg/kg of nutrient used. Economic optimum application rates were estimated using 1986 prices for fertilizers (Bs 1,426/ton) and for maize (Bs 3,000). Application rates that corresponded to

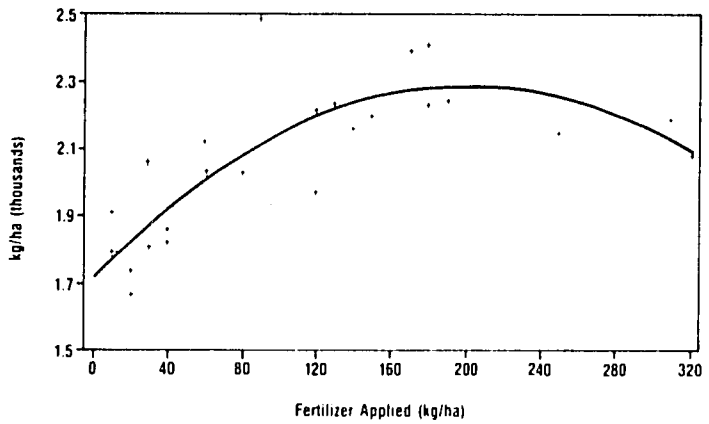


Figure 4. Crop Response to Fertilizer Use.

Table 5. Economic Evaluation of Crop Response Models, Subsidies Present, 1986

Model	Maximum Yield Rate	Maximum Yield Increase	Economic Optimum Rate	Yield Increase	Net Returns	VC Ratio	Actual Use[a]
	(kg/ha)				(Bs/ha)		(kg/ha)
2a	145	570	137	569	1,512	8.8	241
2b	203	576	186	572	1,451	6.5	324
2c	168	512	155	508	1,305	6.9	259

a. 1986 estimated as per Table 4.

Fertilizer price = Bs 1,426/ton.
Crop price = Bs 3,000/ton.

the economic optimum were estimated to range from 137 to 186 kg/ha. At the estimated rates, the yield increases ranged from 508 to 572 kg/ha; the net returns due to fertilizer use ranged from Bs 1,305 to Bs 1,512, with value:cost ratios of 6.9 and 8.8. This means that, during the 1986 period, the optimum fertilizer application rate was estimated to have been between 137 and 186 kg/ha. However, commercial and progressive farmers using advanced technological packages (i.e., mechanization, irrigation, improved varieties, etc.) can surely benefit from higher fertilizer rates.

The last column of Table 5 presents the estimated 1986 rate of fertilizer nutrient used in Venezuela under the assumptions of each model. It is evident that the estimated fertilizer use rates, which ranged from 241 to 324 kg/ha, are higher than the estimated agronomic maximum and the economic optimum rates. Results of the analysis of these production functions strongly suggest that, given the level of agricultural production technology of the country, farmers are using fertilizer in excessive amounts, i.e., beyond the economic optimum rates.

To determine the impact that a subsidy removal program would have on fertilizer use, crop production, and farmers' returns, Table 6 was developed using an estimated fertilizer price equal to three times the 1986 price: Bs 4,278/ton. Crop prices are assumed to remain const This table shows that, if subsidies are removed, farn will decrease their fertilizer use and have lower net retu and lower value:cost ratios. However, it is estimated t crop yields (in maize equivalents) obtained by farmers increase about 10% from the 1986 level. Because large fertilizer price increase (300%) will place a heavy l den on farmer resources, it should be accompanied by increase in crop prices, which did not change during 1984-86 period in spite of the high inflation rate of country.

Table 6. Economic Evaluation of Crop Response Models, Subsidies Removed

Model	Economic Optimum Rate	Yield Increases	Crop Yield	Net Returns	V R
	(kg/ha)	(kg/ha)	(kg/ha)	(Bs/ha)	
2a	120	556	2,291	1,155	2.
2b	152	540	2,253	970	2.
2c	130	489	2,224	911	2.

Fertilizer price = Bs 1,426 x 3 = 4,278.
Crop price = Bs 3,000.

The fertilizer application rates estimated by the th models should not be interpreted as being fertilizer rec mendations to farmers. Rather, they provide evidence tl at the national level an inefficient use of fertilizer is curring because of its extremely low price.

Model of Fertilizer Demand

Several independent variables and linear transforn tions were considered in developing the fertilizer dema model. The model selected to represent fertilizer dema in Venezuela can be expressed as follows:

$$(3)\ FD_t = 510{,}801 + .646\,(FD_{t-1}) - 160.9\,(RPF_t) + .117\,(KCA_t)$$
$$(4.00^{**}) \qquad (-3.78^{**}) \qquad (1.5)$$

R-Square = 94.7

This model includes as explanatory variables the lagg value of the dependent variable, the real fertilizer pri and the area planted with key crops. The lagged varial was included because of the fact that farmers, after usi fertilizers for the first time, realize the benefits that c be derived from them and continue their use. Also, far ers need more than 1 year to adjust to the changing ec nomic environment.

The RFP_t variable accounts for changes in fertilizer use due to changing fertilizer pricing policies. The value of its regression coefficient represents the average variation in demand for fertilizers in the country due to unit changes in fertilizer prices. The regression coefficient for the variable KCA_t represents the average change in fertilizer use due to changes in the area planted with the six key crops selected.

To enable policymakers to evaluate the effect of government fertilizer pricing policy on fertilizer demand and crop production and productivity, it is necessary to have an estimate of the fertilizer demand elasticity. In view of the time series data available, it was decided to estimate a short-term and a long-term price elasticity for fertilizers. This was accomplished by using the following logarithmic regression model:

$$(4)\ \ln FD_t = 4.40 + .84\,(\ln FD_{t-1}) - .381\,(\ln RPF_t)$$
$$(15.6^{**}) \qquad (-3.2^{**})$$
$$\text{R-Square} = 97.3\%$$

This model estimates the short-term demand elasticity of fertilizer to be equal to -.38 (inelastic); the long-term elasticity is estimated to be -2.38, from [-.38/(1-.84)] (elastic). These elasticity values are in line with expectations and with previous fertilizer elasticity estimates prepared by IFDC for Venezuela and other countries.

The inelasticity of fertilizer demand in the short term is due to (1) the lack of substitute products for fertilizers, (2) fertilizers representing a small percentage of the total production cost (around 20%), and (3) the fact that fertilizers do not have alternative uses.

In the long term, the fertilizer demand elasticity is greater because (1) farmers need time, usually at least 1 year, to adjust production plans to new fertilizer pricing policies and (2) in the long term, agricultural land can be incorporated or taken out of production.

From detailed analysis of the Venezuelan fertilizer demand situation during the 1980-86 period, it is evident that, following the termination of subsidies at the beginning of 1981, fertilizer demand decreased during the year and remained at that level, approximately 155,000 tons of nutrients, during 1982 and 1983 (Table A-4). When fertilizer subsidies were established again at the beginning of 1984, fertilizer demand increased dramatically, and subsequent increases were registered during 1985, 1986, and 1987 (preliminary data). However, not all of the increase in fertilizer demand can be attributed to the fertilizer subsidy alone in that prices were also increased for the key agricultural crops and for agricultural credit. The data suggest that Venezuelan farmers adjust faster to increasing fertilizer prices than to decreasing fertilizer prices.

Prices in Latin American Countries

Table 7 presents crop and fertilizer prices for several countries in Latin America. It can be seen that fertilizer and crop prices in Venezuela are the lowest. With respect to fertilizers, Venezuelan prices are less than 10% of prices in neighboring countries, i.e., Colombia, a fact that has promoted smuggling. Venezuelan crop prices are more in line with regional prices, but they are also the lowest. The large difference between prices in Venezuela and those in neighboring countries, especially Colombia, has made smuggling of produce an attractive alternative. Furthermore, in the past few years, crop price increases have not kept up with inflation in Venezuela, and as a result, the financial condition of farmers has deteriorated.

Table 7. Crop and Fertilizer Prices in Various Countries in Latin America, June 1988

Country	Maize	Rice	Urea	DAP
	(US $/ton)			
Argentina	99	143	231	330
Brazil	93	135	190	350
Chile	129	132	218	300
Colombia	195	180	209	315
Costa Rica	182	339	228	305
Salvador	198	246	211	232
Mexico	108	105	102	225
Venezuela	85	85	19	20

Bs 35 to US $1.05.

As shown in Table 4 and in Figure 5, the fertilizer:crop price ratio in Venezuela was equal to only 1.46 during 1986. Figure 5 shows the dramatic decrease in this ratio after the fertilizer subsidy was activated during 1984 and crop prices were increased.

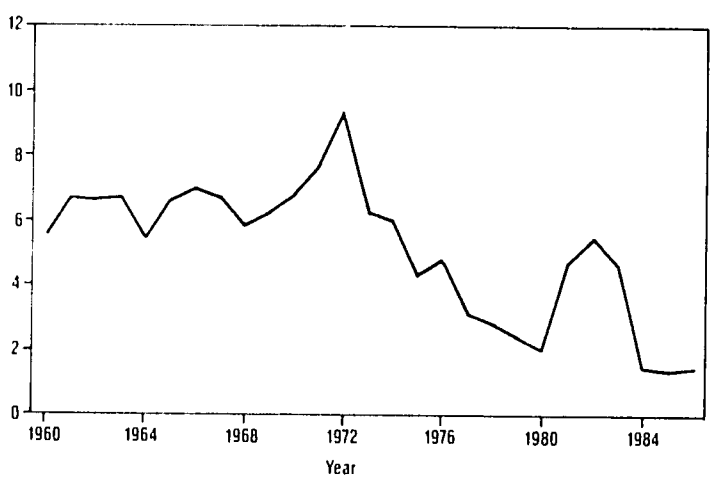


Figure 5. Fertilizer:Crop Price Ratios, Venezuela, 1960-86.

Analysis of Results

The regression models developed in this study identify factors affecting crop production, crop productivity, and fertilizer demand in Venezuela. They also provide a measure of the impact that various crop and fertilizer pricing policies may have in the agricultural sector of the country. As such, results presented here provide guidelines for future agricultural policy formulation.

The models of cropped area developed (1a and 1b) reveal the importance of fertilizer and crop prices in agricultural production. Model estimates indicate that during the years included in this study and on the average, a unit change in the fertilizer:crop price ratio has caused an average change of 25,000 to 29,000 ha in the cropped area. Unit changes in this variable can be accomplished through fertilizer price decreases or through price increases for the key crops selected. The lagged variable in the model is an indication of the lack of flexibility of capital resources in the agricultural production process. The absence of the agricultural credit variable in these models implies that, as the level of available credit to farmers has decreased, its importance in promoting agricultural development has also decreased.

The results obtained for the crop productivity models (2a through 2c) show an important fact, that is, the low response to presently high fertilizer use rates, which places Venezuelan agriculture beyond the economic optimum level and also beyond the maximum agronomic yield. This implies that, given the present stage of agricultural technology development in Venezuela, higher crop yields could be obtained on a national level by decreasing fertilizer use rates. It has been suspected for some time that farmers in the country were using excessive amounts of fertilizers. Results obtained with the crop productivity models confirm this.

The results of the crop productivity models indicate that farmers were making a rational use of fertilizer during the 1978-80 years before the subsidies were suspended. During the 1981-84 period, fertilizer subsidies were suspended, crop prices remained basically unchanged from previous years (in current terms), fertilizer use decreased about 30%, and crops yields decreased only slightly. In an effort to promote agricultural development, fertilizer subsidies were established again during 1984 and were accompanied by substantial increases in crop prices. These actions were followed by increases in fertilizer use (+100% over 2 years), in cropped areas (+30%), and in the production of the six key crops. However, in spite of the large increase in fertilizer use, crop yields did not increase; they actually show a slight decrease from the presubsidy period level. It is suspected that the highly favorable fertilizer:crop price ratios and the simultaneous decrease in agricultural credit available has induced farmers to invest their limited capital resources in inexpensive fertilizers, ignoring investments in capital-intensive ventures such as farm equipment, irrigation, and development of adequate infrastructure. Therefore, without the proper use of other capital-intensive agricultural inputs, the agronomic efficiency of fertilizers is low.

The fertilizer demand model indicates that fertilizer use in Venezuela is largely determined by its price, the areas planted with key crops, and its use during the previous year. An increase/decrease in real fertilizer prices of one unit causes an average decrease/increase in fertilizer demand of 160.9 tons, and an increase/decrease of 1 ha in the area of the key crops causes an increase/decrease of .117 tons. The coefficient for the lagged variable (.646) indicates that farmers, as expected, cannot alter production plans immediately following a change in fertilizer policy.

The determination of short-term and long-term price elasticities for fertilizers allows the estimation of the impact of alternative price policies on fertilizer demand. The short-term elasticity was estimated to be equal to -.38, and the long-term elasticity was estimated at -2.38. The short-term elasticity indicated that a 10% increase in the real price of fertilizer would cause demand to fall about 3.8%, or the equivalent of 19,300 tons of nutrients, at the consumption level of 1986. A 10% increase in real fertilizer prices would represent savings in subsidy in the amount of at least Bs 14.0 million in real currency, or Bs 99.1 million in current currency. These savings are made up of two estimated components: (1) price increases for all fertilizers sold in the country and (2) a decrease in the amount of subsidy needed, due to a demand contraction. The long-term effect of a sustained 10% increase in price changes will be of a higher magnitude, as indicated by the long-term elasticity estimate. From data available, it is estimated that, over a 2- or 3-year period, farmers in Venezuela fully adjust their agricultural production plans to fertilizer price changes.

In the evaluation of the possible impact of alternative fertilizer subsidy policies, it is important to consider both the effect of price changes on fertilizer demand and their effect on crop production and productivity. The regression models developed here provide the necessary tools for such estimations. Using data for 1986 as base, model (1b) estimates that a 10% increase in fertilizer prices would cause a reduction in areas with key crops of about 4,265 ha, which, with an average yield of maize equivalents to 2,092 tons/ha, would cause a reduction in crop production of 8,920 tons. The estimated price elasticity model (4) indicated that a 10% increase in fertilizer price would cause the short-term demand to decrease by 19,300 tons, which together with results from model (1b) indicates that the demand for nutrients per hectare during 1986 would have been 308 instead of the actual 324. When these values are used with the crop productivity model (2b), it is clear that a reduction in the rates of fertilizer use on a national level would increase crop yields by about 50 kg/ha. An increase in crop yield of 50 kg/ha represents

an increase in total production of key crops of about 78,000 tons. Therefore, to the previously estimated savings in subsidy funds due to a fertilizer price increase of 10%, an added benefit is the expected increase in agricultural production and productivity.

The models developed can be used for making projections and extrapolations up to a certain point. The crop productivity models indicated that optimum production occurred at rates ranging from 137 to 186 kg of nutrient/ha. This rate is considerably lower than the rate presently used in Venezuela or that estimated after a 10% increase in fertilizer prices. Therefore, it is estimated that fertilizer price increases beyond the 10% level, which was used as an example here, could be beneficial to the Venezuelan agricultural sector.

From the results of the models developed here, it is evident that Venezuela, in terms of its economy and its farmers, can benefit from a reduction in the fertilizer subsidy program. To avoid drastic changes in the agricultural sector of the country, the subsidy reduction program should be implemented in a stepwise manner, accompanied by a continuous monitoring and assessment of farm-level fertilizers and crop prices, fertilizer use rates, and the availability of agricultural credit. The expansion in crop production achieved in the sector during the past few years is clearly evident; however, higher benefits to the country can be achieved by a more reasonable fertilizer subsidy program.

It is important to note that the estimations presented here are subject to *ceteris paribus* condition, especially with reference to agricultural credit and to the prices for the six key crops. Changes in these two policy instruments can accentuate or undermine the intended effect of a fertilizer subsidy reduction program.

Recommendations

It is evident from the results presented here that some modifications to the present fertilizer subsidy program in Venezuela are needed. However, as the results presented here have shown, fertilizer subsidy policy cannot be isolated from other Government policies that have a direct impact on the agricultural sector. The recommendations presented below refer to the subsidy program and to other factors affecting agricultural development in Venezuela.

1. In view of the presented facts, the fertilizer subsidy program should be reduced as quickly as possible. Fertilizer prices should be increased by at least 50% as soon as possible. Presently, farmers are paying only about one-tenth of the cost of fertilizers; therefore, a 50% increase will still leave a heavy subsidy burden. Further price increases are warranted, but they should be carefully timed to avoid major disruptions in the agricultural sector. Increases in fertilizer prices will force farmers to use them more efficiently and will discourage smuggling to neighboring countries.
2. Agricultural credit available to farmers should be increased to as close to the 1978-80 levels as possible if it is to play an important role in further development of the agricultural sector. This will enable farmers to make necessary investments in technology that will allow them to make better use of fertilizers.
3. Crop prices for the key crops should be increased to match the inflation rate so that they remain attractive to farmers. Crop prices should increase to reflect farmers' production costs and inflation. An increase in crop prices will stimulate crop production and at the same time make smuggling less attractive.
4. A campaign should be undertaken by the fertilizer industry, fertilizer dealers, and agricultural research and extension organizations to better educate farmers about the more efficient use of fertilizer.
5. The Government of Venezuela should continue its efforts to develop adequate infrastructure aimed at bringing new areas into crop production (i.e., irrigation projects) and to make institutional and infrastructural changes to facilitate crop marketing.
6. There should be a joint effort by the Ministry of Agriculture and the fertilizer industry to gather fertilizer use data at the farm level so that a detailed analysis of fertilizer use and farmers' practices can be undertaken.

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Table A-1. Cropped Areas for Rice, Maize, Sorghum, Cotton, Coffee, and Sugarcane, Venezuela, 1960-86

Year	Rice	Maize	Sorghum	Cotton	Coffee	Sugarcane
	(ha)					
1960	41,882	398,200	0	54,940	330,200	40,000
1961	58,450	388,720	0	50,318	330,200	40,000
1962	68,998	483,256	0	46,870	340,000	41,201
1963	73,699	426,718	0	41,940	340,000	45,630
1964	90,721	443,040	985	48,093	340,000	45,596
1965	105,102	461,784	1,720	54,934	340,000	52,266
1966	110,101	466,893	4,552	43,732	303,000	51,363
1967	114,318	616,075	6,824	49,807	303,000	54,833
1968	115,206	626,337	9,265	46,374	288,628	50,283
1969	118,596	641,053	5,356	48,670	284,990	53,936
1970	130,254	558,120	2,954	43,291	286,824	63,119
1971	112,626	587,702	2,440	50,765	288,120	68,305
1972	65,336	465,062	5,039	56,320	276,629	73,610
1973	113,034	438,918	6,121	58,803	272,461	69,601
1974	117,309	462,383	28,394	64,668	272,497	75,977
1975	113,548	506,151	43,996	78,362	275,438	77,151
1976	92,875	488,674	72,209	51,409	268,483	79,662
1977	169,616	432,093	156,110	47,180	258,168	84,059
1978	166,148	413,522	185,465	46,570	265,804	74,532
1979	196,712	408,860	241,183	38,466	256,390	68,673
1980	208,583	366,298	264,884	36,261	257,804	77,140
1981	243,279	311,661	229,231	20,102	261,174	73,726
1982	227,436	304,995	222,178	14,284	259,114	80,890
1983	164,407	310,208	196,760	22,804	254,522	79,799
1984	151,062	312,811	238,588	27,639	256,361	78,799
1985	180,769	466,966	249,591	45,753	269,346	87,279
1986	124,142	650,095	380,760	48,808	256,628	104,560

Sources: MAC "Anuario Estadistico," several issues.
BCV "Series Estadisticas," several issues.

Table A-2. Rice, Maize, Sorghum, Cotton, Coffee, and Sugarcane Yields, Venezuela, 1960-86

Year	Rice	Maize	Sorghum	Cotton	Coffee	Sugarcane
	(tons/ha)					
1960	1.716	1.104	NA	0.539	0.179	53.344
1961	1.380	1.079	NA	0.723	0.173	80.000
1962	1.495	1.118	NA	0.687	0.159	68.062
1963	1.779	1.008	NA	0.701	0.178	66.427
1964	1.827	1.072	2.229	0.742	0.165	69.090
1965	1.902	1.128	2.131	0.755	0.160	72.941
1966	1.771	1.194	2.320	0.807	0.201	77.271
1967	1.951	1.028	2.311	0.751	0.204	79.248
1968	2.123	1.055	2.356	0.824	0.205	76.579
1969	2.056	1.046	1.026	0.844	0.213	79.210
1970	1.737	1.272	2.211	0.924	0.211	79.649
1971	1.359	1.214	0.986	0.917	0.203	78.303
1972	2.521	1.089	1.415	0.928	0.146	77.930
1973	2.671	1.035	1.418	1.021	0.242	75.296
1974	2.528	1.198	1.199	1.076	0.168	77.082
1975	3.196	1.291	1.600	1.117	0.235	71.109
1976	2.980	1.089	1.718	1.158	0.186	72.412
1977	2.924	1.561	1.794	1.234	0.223	63.723
1978	3.019	1.430	1.832	1.226	0.222	64.783
1979	3.119	1.498	1.641	1.268	0.210	69.450
1980	3.145	1.568	1.331	1.321	0.226	64.642
1981	2.800	1.451	1.512	1.248	0.243	61.462
1982	2.676	1.643	1.698	1.249	0.226	61.411
1983	2.734	1.573	1.850	1.557	0.231	60.350
1984	2.700	1.749	1.980	1.506	0.247	63.019
1985	2.610	1.860	1.929	1.698	0.248	65.000
1986	2.590	1.804	1.985	1.710	0.258	70.400

Sources: MAC "Anuario Estadistico," several issues.
BCV "Series Estadisticas," several issues.

Table A-3. Official Crop Prices for Rice, Maize, Sorghum, Cotton, Coffee, and Sugarcane, Venezuela, 1960-86

Year	Rice	Maize	Sorghum	Cotton	Coffee	Sugarcane
	(Bs/ton)					
1960	600	310	290	1,200	2,920	42
1961	590	370	320	1,180	2,940	38
1962	610	280	300	1,230	3,130	36
1963	600	320	300	1,180	2,830	36
1964	610	390	350	1,180	3,700	38
1965	600	380	340	1,200	3,360	38
1966	580	350	320	1,220	3,340	37
1967	610	370	330	1,260	3,070	38
1968	600	390	350	1,260	3,460	37
1969	610	380	340	1,290	3,190	38
1970	620	380	340	1,290	3,700	37
1971	630	380	340	1,260	3,730	38
1972	660	390	550	1,300	3,530	38
1973	680	420	440	1,330	4,650	41
1974	800	590	570	1,870	5,090	41
1975	850	690	670	2,140	6,410	48
1976	800	830	800	2,110	6,390	54
1977	810	860	810	2,480	11,500	63
1978	800	890	800	2,890	13,420	64
1979	1,100	1,100	800	2,850	13,460	91
1980	1,340	1,320	1,030	3,090	16,450	100
1981	1,510	1,580	1,240	3,910	17,490	138
1982	1,610	1,780	1,400	4,630	17,520	151
1983	1,610	1,780	1,400	4,650	17,510	151
1984	2,600	3,000	2,200	4,650	18,700	218
1985	4,200	3,000	2,200	4,650	18,700	218
1986	4,200	3,000	2,200	4,650	18,700	218

Sources: MAC "Anuario Estadistico," several issues.
BCV "Series Estadisticas," several issues.

Table A-4. N, P_2O_5, and K_2O Use in Venezuela, 1960-86

Year	N	P_2O_5	K_2O	Total
	(ton)			
1960	3,740	3,552	4,025	11,317
1961	4,550	3,706	4,401	12,657
1962	4,078	3,084	3,591	10,753
1963	4,239	3,014	3,534	10,787
1964	10,080	4,892	6,521	21,493
1965	13,955	7,189	8,183	29,327
1966	15,427	8,140	10,221	33,788
1967	18,540	10,798	13,695	43,033
1968	22,641	11,194	14,450	48,285
1969	22,146	10,450	14,684	47,280
1970	27,833	15,082	19,090	62,005
1971	35,073	18,426	15,394	68,893
1972	36,126	21,517	18,179	75,822
1973	40,811	23,543	20,996	85,350
1974	50,192	39,813	31,577	121,582
1975	62,715	40,591	31,716	135,022
1976	74,332	46,779	39,896	161,007
1977	87,318	57,377	46,813	191,508
1978	90,642	65,646	50,533	206,821
1979	96,191	71,526	53,737	221,454
1980	108,056	72,165	49,634	229,855
1981	72,185	47,982	32,301	152,468
1982	70,620	46,821	37,365	154,806
1983	73,356	46,624	34,759	154,739
1984	124,100	83,900	63,100	271,100
1985	180,534	126,096	94,953	401,583
1986	226,164	162,821	118,511	507,496

Table A-5. Fertilizer Retail Prices Paid by Farmers in Venezuela

Fertilizer Product	Before 3/22/81[a]	3/22/81 to 10/29/82[b]	10/29/82 to 3/22/84[c]	After 3/22/84[d]
	(Bs/mt)			
Straight Materials				
Urea	438	1,570	1,298	649
Ammonium sulfate	270	1,160	1,100	550
Triple superphosphate	359	1,450	1,232	616
Diammonium phosphate	606	1,660	1,411	706
Potassium chloride	425	1,270	1,079	540
Potassium sulfate	550	1,410	1,370	685
Granular NPK Compounds				
12-24-12 CP	542	1,650	1,399	700
12-24-12 SP	-	1,730	1,470	735
12-12-17/2 SP	496	1,720	1,462	672
12-12-17 CP	489	1,410	1,197	599
13-26-6 CP	508	1,580	1,343	672
15-15-15 CP	485	1,550	1,318	659
15-15-15 SP	-	1,650	1,399	700
16-16-8 CP	-	1,390	1,182	591
16-16-8 SP	-	-	-	663

a. Subsidized prices prior to removal on March 22, 1981.
b. Unsubsidized prices.
c. Unsubsidized prices with some percentage discount from PALMAVEN. A 15% discount for most products except for urea (17%), ammonium sulfate (5%), potassium sulfate (3%), and powder NPK compounds (38%-40%).
d. Subsidized prices after reinstatement of a 50% subsidy (on previously discounted prices) on March 22, 1984.

Source: PALMAVEN/PEQUIVEN.

Table A-6. Fertilizer Nutrient Demand and Prices, Cropped Are Agricultural Credit, and Agricultural Price Index, Venezuela, 1960-86

Year	Total Nutrient Demand	Average Nutrient Price	Total[a] Crop Area	Agricultural Credit	Agricu Pri Inc
	(ton)	(Bs/ton)	(10^3 ha)	(10^6 Bs)	
1960	11,317	958.7	1,458	143.1	8'
1961	12,657	936.8	1,368	180.4	9
1962	10,753	966.9	1,448	227.0	8
1963	10,787	949.1	1,422	212.8	9
1964	21,493	908.6	1,486	263.0	9
1965	29,327	982.0	1,559	266.6	9
1966	33,788	1,014.1	1,537	292.0	9
1967	43,033	1,005.1	1,737	300.7	9
1968	48,285	968.9	1,776	292.2	10
1969	47,370	954.0	1,819	312.3	10
1970	62,005	967.0	1,776	349.6	10
1971	68,893	1,011.2	1,799	440.5	10
1972	75,822	1,046.1	1,553	512.3	11
1973	85,350	1,030.1	1,573	693.6	12
1974	121,582	1,040.8	1,708	1,116.8	14
1975	135,022	1,070.2	1,738	1,686.2	17
1976	161,007	1,061.4	1,711	1,642.1	18
1977	191,508	1,072.2	1,815	2,241.3	22
1978	206,821	1,089.9	1,772	2,623.8	23
1979	221,454	1,106.4	1,738	2,787.3	27
1980	231,390	1,077.5	1,765	3,217.5	331
1981	152,468	3,070.8	1,669	3,122.0	384
1982	154,806	3,587.7	1,637	2,576.8	401
1983	154,739	3,058.0	1,548	1,742.7	431
1984	270,403	1,480.4	1,547	1,986.6	518
1985	401,583	1,469.4	1,804	2,362.0	60
1986	507,496	1,425.9	2,103	2,984.9	707

a. Excludes pastures.

Sources: Cropped area for 1960-77 from BCV "La Economia Venez en los Ultimos 35 Años," 1978. For years 1978-83 from "Series Estadisticas." Agricultural credit for 1960-72 from "Anuario Estadistico 1976." For years 1972-83 from BCV ies Estadisticas." Data for credit include loans made by DAGRO and ICAP. They also include FCA loans that a considered long term and used mostly for development frastructure. Price index for years 1960-77 from BCV "La E mia Venezolana en Los Ultmos 35 Años," 1978, and for 1978-83 from BCV "Series Estadisticas." Data for crop agricultural credit, and agricultural price index for 1984-86 BCV "Anuario de Cuentes Nacionales," 1985-86 issues.

Basic data used in estimation of nutrient use and price p of nutrient were obtained from IVP "Estadisticas Basicas," 74 for years 1960-74. For years 1975 and 1976 from MAC ario Estadistico, 1976." For 1977 data were obtained di from VENFERCA's office. For 1978 and 1979 data were obt from VENFERCA's "Anuario Estadistico" for 1979-86 dat supplied by PALMAVEN/PEQUIVEN.