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A Preliminary Study

URUGUAY'S

FERTILIZER SUPPLY AND NEED

Prepared for the

Agency for International Development

By

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National Fertilizer Development Center
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ABBREVIATIONS

AID	Agency for International Development
ANCAP	National Administration of Fuels, Alcohol, and Portland Cement
AQI	Consortium of Agromax S. A., QUIMUR, and ISUSA
CEPAL	Joint Agricultural Division of the United Nations Economic Commission for Latin America and the United Nations Food and Agriculture Organization
CIDE	Uruguayan Commission on Investments and Economic Development
IBRD	International Bank for Reconstruction and Development (World Bank)
ICDA	International Cooperative Development Association
IDB	Inter-American Development Bank
ISUSA	Industria Sulfúrica S. A.
LAFTA	Latin American Free Trade Association
QUIMUR	Compañia Quimica Uruguaya S. A.
TVA	Tennessee Valley Authority

NOTES

- One metric ton = 2,205 pounds
- One hectare = 2.47 acres
- One kilogram per hectare = 0.89 pounds per acre
- Monetary units, unless otherwise stated, are in U. S. dollars. The rate of exchange in March 1967, was approximately 86 pesos per dollar.

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SUMMARY

The resources and economy of Uruguay are dominantly agricultural. At least 80% of its foreign trade income is derived from export of livestock products. Income from exports has declined from about $254 million in 1950 to about $196 million in 1965, and the external debt reached about $359 million by the end of 1965. While increased livestock production is perhaps the most logical long-term solution to the problem of lagging exports, such increases likely will come slowly. Development of agricultural crops with export potential would not only be more rapid, but would also promote desirable diversification.

The National Plan for Economic and Social Development includes recommendations for strengthening the agricultural economy and projections of agricultural inputs, including fertilizers, required to attain the economic goals. With these projections of fertilizer requirements as a base, an effort was made to determine the most appropriate fertilizers for the market. Also, a preliminary study was conducted to assess the feasibility of constructing new fertilizer production facilities and to obtain information needed to reach a decision as to the type of investment most appropriate for providing future fertilizer requirements.

Uruguay has capacity to produce about 18,000 metric tons*/year of processed P_2O_5. This compares with expected 1975 demand for 60,000 tons. In addition, a market exists in Argentina for 25,000 tons, making a total 1975 potential demand of 85,000 tons of P_2O_5. Additional production facilities appear warranted within a few years to meet the growing demand. It is recommended that these facilities be constructed at the port of Nueva Palmira.

The 1975 demand for nitrogen is expected to be about 40,000 tons. Demand for K_2O is predicted to be about 20,000 tons/year. Nitrogen and potash demands, however, can be better satisfied through imports. For example, the phosphate proposed for export to Argentina would be traded for nitrogen products.

Several proposals for increased fertilizer production facilities were examined; advantages and disadvantages of each, as well as possible alternatives, are discussed. It was recommended that these and other possible alternatives be evaluated in detail on a technical and economic basis by a team of consultants comprising the disciplines of fertilizer economics, engineering, agronomy, and marketing.

*All tonnage figures in this report are metric tons.

Section I

INTRODUCTION

During the period February 5 to March 17, 1967, a Tennessee Valley Authority (TVA) chemical engineer visited Uruguay at the request of the U. S. Agency for International Development (AID). The authorization provided for the following scope of technical services:

> A fertilizer engineer who will investigate the Uruguayan fertilizer market and potential for manufacturing development. He will advise the Ministry on proposed industry projects. He will also review projects for fertilizer granulation at the request of the superphosphate manufacturers.

The report submitted herewith contains an assessment of the fertilizer market and feasibility of the construction of new manufacturing facilities and a preliminary assessment of proposed industry projects and alternatives. The plans of one fertilizer company for the installation of a granulation plant based on normal superphosphate as the source of P_2O_5 were examined and found to be well formulated from the standpoints of design--which is standard--operation, and market demand. Approval for financing had been obtained and there appeared to be no need for further comment on this proposed project.

Organizations contacted during the assignment are listed in appendix 1.

The natural resources of Uruguay are dominantly agricultural, Of a total land area of about 13.7 million hectares, about 16.6 million (8%) are suitable for and currently used for agricultural purposes. In 1964, about 14.9 million hectares were devoted to livestock agriculture, 1.1 million to crop production, and 0.6 million to forestry. It has been estimated that a maximum of 5.8 million hectares are potentially suitable for crop production but only 3.4 million suitable for permanent cultivation without rotation. Traditionally, livestock products account for 80% or more of all exports. For example, in the 1963-65 period, wool accounted for 45% of the value of exports; wool yarn and cloth, 2.4%; meat and derivatives, 309%; hides, 9.5%; animals on foot, 1.0%; agricultural crops, 3.3%; processed agricultural products, 5.3%; extractive industries, 0.5%; and others, 1.2%. Fundamentally, the present unsatisfactory condition of the Uruguayan economy derives from its failure to realize a progressive increase in exports since 1950 and, to some extent, to its almost complete reliance on livestock products for income. The f. o. b. value of exports in 1950 was about $254 million, and 1965 the value was about $196 million. With 1950 as a base, the accumulative external trade balance reached a deficit of about $359 million by the end of 1965, even though imports were restricted by various means.

According to the National Plan for Economic and Social Development, the rate of increase in agricultural production from 1935 to 1963 was 1.4%/year, while the rate of increase in population during the same period was also 1.4%. However, the rate of increase in domestic consumption of agricultural products averaged 1.5% so that production available for external markets decreased during the period. Production

of crops increased by an average of 2.3% while livestock production increased at the rate of only 1.1%. Thus the per capita production of products which traditionally account for the bulk of exports declined seriously.

In 1959, the International Bank for Reconstruction and Development (World Bank) extended a $7 million loan to help finance a program for improvement of pastures on medium-sized ranches. In 1965, a second loan of $12.7 million was extended to expand the program. The operation of this program involves the planting of inoculated legume seeds, heavy applications of phosphate fertilizers (largely ground rock phosphate), and the use of legumes as a source of nitrogen in a 6-year supervised operation. The program is managed by the Honorary Commission of the Agricultural Livestock Plan and is credited with significant success. More than 300,000 hectares of improved pastures have been established with either credit or technical assistance provided by the Commission. The direct effect of this program on aggregate production has not been determined. The program and its influence on pasture management practices, are likely to have positive and reliable results. These are of a long-term nature when compared to prospects for more rapid increases in the production of certain agricultural crops with export possibilities.

The National Plan, extending to 1974, provides for increases in exportable crops, especially cereals and oil seeds, to volumes roughly 10 times 1963 exports. During the same period livestock production for export is projected to increase about 50% over the 1963 level. The amount of land devoted to crop production would double, chiefly at the expense of land now in pastures. Obviously these projections presume vastly improved use of land, especially for crops.

With the exception of rice and grapes, crop yields in Uruguay are generally low when compared with yields obtained in other countries. This is illustrated in table 1.

The relatively low yields are not, of course, entirely attributable to low fertilizer use. For example, wheat yields in Argentina are higher even though more fertilizer is used in Uruguay. Factors such as soil type and climate seem to be quite important. In the case of corn, most agronomists interviewed felt that improvements in yields could be attained through the use of hybrid varieties and fertilizers, but rainfall is so uncertain that it would be best to substitute sorghum for corn. There seems little doubt, however, that increased use of fertilizers, together with improved varieties, irrigation, etc., would lead to a vastly improved crop economy.

The U.S. AID Mission is extending to Uruguay technical and financial assistance directed toward improvements in the crop economy. The major effort involves a loan of $5 million for the purchase of processed fertilizers and equipment for their distribution and application.

Table 1. Comparative Yields of Selected Crops, 1961-64 Average[a]

Crop	Uruguay	Argentina	United States	Italy	France	Brazil
	. . . . .		kilograms/hectare		. . . . .	
Wheat	902	1,365	1,670	1,840	2,488	-
Corn	590	2,030	3,400	3,300	-	1,260
Flax	587	676	543	800	890	-
Sunflower	510	700	-	-	-	-
Potatoes	4,700	9,400	20,900	10,700	17,000	5,500
Peanuts	820	1,240	1,340	-	-	1,290
Rice	3,270	3,870	3,860	5,460	-	1,750
Sugar beets	23,600	-	37,400	34,800	40,300	-
Grapes	6,700	9,600	-	6,300	6,200	-

[a]U. S. Department of Agriculture and Food and Agriculture Organization of the United Nations.

Section II

THE FERTILIZER MARKET

Consumption

The consumption of plant nutrients (N, P_2O_5, and K_2O) for the years 1960 through 1965 is shown in table 2. Preliminary figures are given for 1966. During the 1960-65 period there was a positive, though irregular, annual increase in consumption of each of the plant nutrients. The average annual increases during this period were 29% for nitrogen, 32% for "soluble" P_2O_5, 25% for total P_2O_5, and 22% for K_2O.

The government's policies with respect to subsidies explains, to a large extent, irregularities in rate of increase. In 1961, subsidies were alloted to the consumer at the rate of 1.50 pesos/unit of nitrogen (10 kilograms), 0.50 or 1.00 peso/unit (depending on size of farm) for soluble P_2O_5, and 0.30 or 0.60 peso/unit of insoluble P_2O_5. In addition, the manufacturer received 1.00, 0.60, and 0.40 pesos/unit for fertilizers of domestic manufacture. This system and amount of subsidies remained in effect until 1964, when some minor adjustments were made and a bonus of 100 pesos/ton was alloted to the manufacturer for granulated fertilizers produced domestically. In 1966, the subsidies were increased to compensate partially for price increases due to general inflation and were applied only to fertilizers produced domestically. Thus, subsidies previously applicable to imported fertilizers were eliminated. In addition to subsidies applied to the sale and purchase of fertilizers, there have been certain subsidies applied to specific crops. The apparent decline in the consumption of nitrogen in 1966 is probably a result both of the elimination of subsidies on imports and of the elimination of certain credit provisions for nitrogen on wheat in that year.

Table 2. Consumption of Plant Nutrients (9)

	1960	1961	1962	1963	1964	1965	1966[a]
	'000 metric tons						
Nitrogen	2.7	4.5	6.7	7.3	10.5	10.0	6.8
Soluble P_2O_5[b]	6.3	13.0	14.3	15.6	19.7	21.5	23.0
Total P_2O_5	10.6	19.6	21.3	22.0	26.3	28.2	35.1
K_2O	2.4	3.2	4.5	4.0	5.1	5.1	4.0
Total	15.7	27.4	32.5	33.3	41.9	43.4	45.9
Ratio (N = 1):							
Sol. P_2O_5	2.3	2.9	2.1	2.1	1.0	2.1	3.5
Total P_2O_5	3.9	4.3	3.2	3.0	2.5	2.8	5.1
K_2O	0.9	0.7	0.7	0.5	0.5	0.5	0.6
Concentration[c]	26.9	30.0	29.7	29.0	30.9	32.9	-

[a]Preliminary estimate.
[b]Soluble in 2% citric acid solution - Wagner method.
[c]Based on content of N, total P_2O_5, and K_2O.

Table 3. Sales of Fertilizers by Type (9)

	1961	1962	1963	1964	1965	1966[a]
	. . . . .	'000 metric tons	. . . . .			
Phosphates						
Normal super	17.5	16.9	17.4	27.4	19.5	33.2
NSP (granular)	-	-	-	0.5	3.3	8.8
TSP	0.1	-	-	0.4	0.2	0.1
Gafsa rock	12.0	12.5	12.9	13.2	15.9	35.9
Thomas slag	2.5	5.4	11.7	7.1	9.0	7.6
Dical	0.2	0.2	1.0	0.5	2.5	NIL
Bone and slaughter-house waste	4.9	4.2	5.6	5.4	6.6	5.7
Total	37.3	39.2	51.1	55.3	59.9	100.5
Mixtures and Complexes						
Mixtures	47.2	52.5	46.5	47.3	37.5	27.6
Complexes	4.8	10.0	9.8	17.1	21.0	15.4
Total	52.0	62.5	56.3	64.4	58.5	43.0
Salts	2.0	6.0	7.7	15.8	13.4	-
TOTAL	91.3	107.7	115.0	135.5	131.9	152.9

[a] Preliminary

Sales of fertilizers by type, from 1961 to 1966 are given in table 3. Note that untreated phosphate rock and Thomas slag, used principally on pastures and to a minor extent in mixtures, have constituted more than one-third of the volume of phosphate fertilizer sales. There was a gradual decline in domestically produced mixtures with a corresponding increase in sales of imported complex fertilizers. Sales of fertilizers increased markedly after import duties were abolished in January 1961.

Geographic consumption of fertilizers during the 1961-65 period is shown in table 4. Referring to the map of Uruguay (inside cover), it is evident that, historically, consumption of fertilizers has been greatest in the area surrounding Montevideo, in the departments west of Montevideo along the de la Plata River, and in the area known as El Litoral bordering the Uruguayan River. Although this area includes land in pastures, it encompasses virtually all of the land now used for crop production and suited to this use.

Table 5 contains data showing the consumption of plant nutrients by crop for the period 1962-65. Use on pastures, principally in the form of rock phosphate and normal superphosphate, accounted for roughly one-third of total use. In 1963, (latest figures available), there were about 14.7 million hectares in pasture, of which only

Table 4. Consumption of Fertilizers by Department (9)

Department	1961	1962	1963	1964	1965	5-Year Average
	. . . . . '000 metric tons					
Canelones	21.5	27.4	24.4	34.7	24.9	26.6
San José	14.1	18.2	17.4	17.4	17.9	17.0
Colonia	12.9	15.5	13.2	15.8	13.4	14.2
Paysandú	5.0	7.2	7.5	12.7	13.3	9.1
Florida	7.4	5.0	8.6	9.9	8.0	7.9
Soriano	3.1	2.7	7.3	6.0	8.9	5.6
Lavalleja	4.1	4.5	4.5	4.9	5.2	4.6
Artigas	2.5	4.9	5.3	3.7	1.9	3.7
Salto	5.2	2.6	1.9	4.1	4.5	3.6
Montevideo	3.5	3.7	3.0	3.2	4.2	3.5
Maldonado	2.4	3.0	3.2	4.4	3.5	3.3
Rocha	2.7	2.7	2.9	3.0	3.5	3.0
Río Negro	1.1	2.0	3.4	3.7	4.5	2.9
Cerro Largo	1.8	1.4	4.1	2.2	4.8	2.9
Durazno	1.6	2.2	2.7	2.1	3.4	2.4
Treinta y Tres	0.8	1.3	2.2	3.0	4.2	2.3
Flores	1.0	1.3	1.8	2.1	3.0	1.8
Tacuarembó	0.4	0.5	1.0	2.2	2.3	1.3
Rivera	0.4	0.3	0.5	0.5	0.7	0.5
Total	91.3	106.4	115.0	135.5	131.9	116.0

Table 5. Consumption of Plant Nutrient by Crop (9) (N, total P_2O_5, and K_2O)

	1962	1963	1964	1965
	. . . . . '000 metric tons			
Pastures	10.0	12.3	11.0	15.3
Sugar beets	4.2	4.9	9.4	7.0
Potatoes	4.0	4.8	4.1	5.1
Wheat	3.2	2.2	10.0	8.3
Horticulture	2.7	2.2	1.9	1.4
Sugar cane	2.6	2.6	2.1	0.8
Other cereals	1.8	1.9	1.2	1.9
Fruits	1.6	1.2	1.2	2.1
Oil seeds	0.6	0.2	0.2	0.5
Rice	mil	0.1	0.1	0.4
Others	0.1	0.3	0.1	0.1
Total	31.5	33.3	41.9	43.4

a little over 100,000 were improved pasture. About 50% of the improved pasture was fertilized, but of the total of 14.7 million hectares less than 1% was fertilized. Virtually all of the land used in the cultivation of sugar beets, potatoes, and sugar cane is currently fertilized. However, in 1963, with the exception of malt barley, only 5% of grain and oil seed crops were fertilized. Of 400,000 hectares planted in wheat, for example, only 12,000 hectares received fertilizer.

The relationship between the consumption of plant nutrients for pasture fertilization and crop fertilization in the period 1961-65 is shown in table 6. The dominant use of phosphatic fertilizer, especially on pastures, is evident. The soils of Uruguay are notably deficient in phosphorus and crops are highly responsive to applications of phosphate fertilizers. Traditionally, and for economic reasons, nitrogen for pastures is supplied from legumes. The soils are generally high in potash.

There has been a definite trend toward higher $N:P_2O_5$ ratios in both pasture and crop fertilization, although preliminary figures for 1966 indicate a reversal of this trend for fertilizers applied to both pastures and crops. This was due, in part, to the abrupt increase in the consumption of phosphate rock (table 3). Most agronomists were of the opinion that the $N:P_2O_5$ ratio of fertilizers used on crops would continue to increase as the levels of fertilization increased and that the use of nitrogen would expand greatly if cheaper forms were made available.

Projections of Demand

Projections of market demand for fertilizers made in recent years were available from the following sources:[a]

1. Uruguayan Commission on Investments and Economic Development (CIDE), the organization responsible for preparation of the National Plan for Economic and Social Development.

2. The Joint Agricultural Division of the United Nations Economic Commission for Latin America and the United Nations Food and Agriculture Organization (henceforth referred to as CEPAL).

3. A consortium of the private fertilizer manufacturers Agromax S. A., Compañia Quimica Uruguaya S. A. (QUIMUR), and Industria Sulfúrica S. A. (ISUSA)--henceforth referred to as AQI.

A comparison of the projections from these sources is shown in table 7. The projections of CIDE are based on the execution of agricultural reforms as outlined in the National Plan for Economic and Social Development, Part 4, 1966. In the case of P_2O_5 the quantities given are for soluble P_2O_5 determined by the Wagner 2% citric acid method. Based on the relationship between soluble and total P_2O_5 consumed in 1965, the equivalent total P_2O_5 would be about 130% of the soluble P_2O_5. However, CIDE made separate projections of demand for P_2O_5 for agricultural crops and for use in livestock production (figure 2). The projections of CEPAL are twofold: a maximum demand which is projected assuming that certain programs designed to encourage the use of fertilizers are put into effect (El Uso de Fertilizantes en America Latina) and a minimum demand based on extrapolation of historical demand. The AQI projections, as revised, are based on a lineal extrapolation of the 1960-64 consumption.

[a] Other projections have been made but were not considered because they were based on those listed or because the data were not available.

Table 6. Consumption of Plant Nutrients - Pastures and Crops (9)

	1961			1962			1963			1964			1965		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	'000 metric tons														
Pastures	0.4	8.1	0.3	0.8	9.0	0.4	1.0	10.8	0.2	1.1	9.6	0.2	1.8	13.2	0.2
Crops	4.1	11.5	3.0	5.9	12.3	4.2	6.3	11.3	3.8	9.4	16.7	5.0	8.2	15.0	4.9
Total	4.5	19.6	3.3	6.7	21.3	4.6	7.3	22.1	4.0	10.5	26.3	5.2	10.0	28.2	5.1
Ratios															
Pastures	1.0	18.0	0.6	1.0	12.4	0.4	1.0	10.5	0.2	1.0	8.7	0.2	1.0	7.3	0.1
Crops	1.0	2.8	0.7	1.0	2.1	0.7	1.0	1.8	0.6	1.0	1.7	0.5	1.0	1.8	0.6
Total	1.0	4.3	0.7	1.0	3.2	0.7	1.0	3.0	0.5	1.0	2.5	0.5	1.0	2.8	0.5

Table 7. Comparison of Projections of Demand for Fertilizers

	1963	1967	1970	1974	1975
	. . . . . '000 metric tons				
Nitrogen	7				
CIDE		14	26	38	
CEPAL Maximum			22		38
CEPAL Minimum			14		21
AQI		16	21	29	31
P_2O_5	16				
CIDE (Soluble)		43	81	136	
CEPAL Maximum (Total)			71		136
CEPAL Minimum (Total)			44		71
AQI (Total)		37	48	62	65
K_2O	4				
CIDE		9	14	19	
CEPAL Maximum			12		19
CEPAL Minimum			9		14
AQI		7	9	12	12

Although other criteria were considered, the projections of CIDE were accepted as a general indication of the market to be expected for the following reasons:

1. The analysis made by CIDE was relatively comprehensive and included projections by crop and type of agriculture.
2. Although the basic analysis was published in November 1964, minor changes in figures recorded in 1966 indicated subsequent revisions.
3. Interviews with interested parties, both in the government and industry, indicated clearly that preferential confidence was accorded to the CIDE projections.
4. There appears to be a degree of urgency with respect to Uruguay's ability to meet its foreign debt obligations and, since the country's resources are dominantly agricultural, it appears that measures must be taken to implement reforms of the type recommended in the National Plan.

The projections of demand for fertilizers for agricultural crops and for livestock production are given in table 8. These projections are also plotted in figures 1, 2, and 3 with rough extrapolations to 1979. Such extrapolations indicate approximate demands for nutrients in 1979 as follows:

N	- 53,000 tons
Soluble P_2O_5	
Cultivated crops	- 70,000 tons
Pastures	- 150,000 tons
Total	- 220,000 tons
K_2O	- 26,000 tons

Table 8. Projections of Demand-Agricultural Crops and Livestock[a]

	1963	1967	1970	1974
	. . . . . '000 metric tons			
Nitrogen				
Crops	6.3	14.3	26.5	38.2
Pastures	1.0	-	-	-
Total	7.3	14.3	26.5	38.2
Soluble P_2O_5				
Crops	8.1	18.9	35.2	49.1
Pastures	7.5	24.6	46.2	87.2
Total	15.6	43.5	81.4	136.3
K_2O				
Crops	3.8	8.6	14.3	18.5
Pastures	0.2	-	-	-
Total	4.0	8.6	14.3	18.5
Total Plant Food				
Crops	18.1	42.0	76.0	105.8
Pastures	8.9	24.6	46.2	87.2
TOTAL	27.0	66.6	122.2	193.0

[a] CIDE.

CIDE projections of land use and fertilizer use by crop are presented in table 9. Included are projected areas devoted to each crop, the proportion fertilized, rates of fertilizer application, and total fertilizer requirements for 1975. In order of total requirement for both nitrogen and soluble P_2O_5, the principal crops are wheat, sunflower, flax, and sugar beets. Those crops with highest requirement for potash are wheat, sunflower, sugar beets, and fruits.

Table 9. Projections of the Use of Fertilizers on Agricultural Crops (CIDE)

	1963		1967		1974		1975[a]					
	Plant.	Fert.	Plant.	Fert.	Plant.	Fert.	Plant.	Fert.	Rate of Application	Fert. Requirements N	Sol. P_2O_5	K_2O
	'000 hectares						'000 hectares		kg/ha	metric tons		
Cereals												
Wheat	400.5	11.6	630.0	157.5	700.0	385.0	705.0	387.0	30-50-15	11,634	19,390	5,815
Corn	236.2	4.0	234.2	9.4	39.7	11.9	37.0	13.0	60-60-0	780	780	-
Oats	80.6	-	85.8	2.6	27.2	9.5	25.0	8.8	30-40-0	264	352	-
Common barley	40.2	15.7	20.1	0.6	8.3	2.9	7.0	2.8	30-50-15	84	140	42
Malt barley			60.0	24.0	83.0	37.3	85.0	38.3	30-50-15	1,149	1,915	575
Rice	21.0	1.0	28.0	-	45.0	-	-	-	-	-	-	-
Oil seeds												
Flax	159.7	0.9	200.0	-	320.0	144.0	330.0	148.5	40-40-0	5,940	5,940	-
Sunflower	141.1	-	210.0	12.6	300.0	120.0	310.0	139.5	50-50-25	6,975	6,975	3,488
Peanuts	9.4	-	17.0	0.5	35.0	17.5	37.0	20.4	30-60-30	612	1,224	612
Roots & tubers												
Potatoes	23.1	23.1	20.1	18.1	18.2	17.3	18.4	17.5	80-100-60	1,400	1,750	1,050
Sweet potatoes	15.0	-	15.3	-	14.7	-	-	-	-	-	-	-
Dry legumes	6.0	-	9.5	1.1	9.2	3.2	9.0	3.6	25-50-0	90	180	-
Sugar crops												
Sugar cane	3.8	3.8	5.2	5.2	5.5	5.5	5.4	5.4	150-150-180	810	810	972
Sugar beets	13.7	13.7	16.2	16.2	28.5	28.5	29.5	29.5	170-200-95	5,015	5,900	2,803
Wine grapes	18.7	-	20.0	5.0	20.0	8.0	20.0	8.4	150-150-150	1,260	1,260	1,260
Vegetables	22.7	12.8	19.1	12.9	14.5	11.7	14.5	12.0	-	528	600	301
Fruits	29.9	5.0	30.8	6.7	40.2	13.2	43.0	16.3	-	3,025	3,025	3,025
Others	13.8	1.4	16.2	-	13.2	-	-	-	-	-	-	-
TOTAL	1,275.4	107.7	1,707.2	272.4	1,786.2	837.5	1,735.8	878.8		40,646	51,861	19,945

a. Figures for 1975 obtained from unpublished CIDE documents.

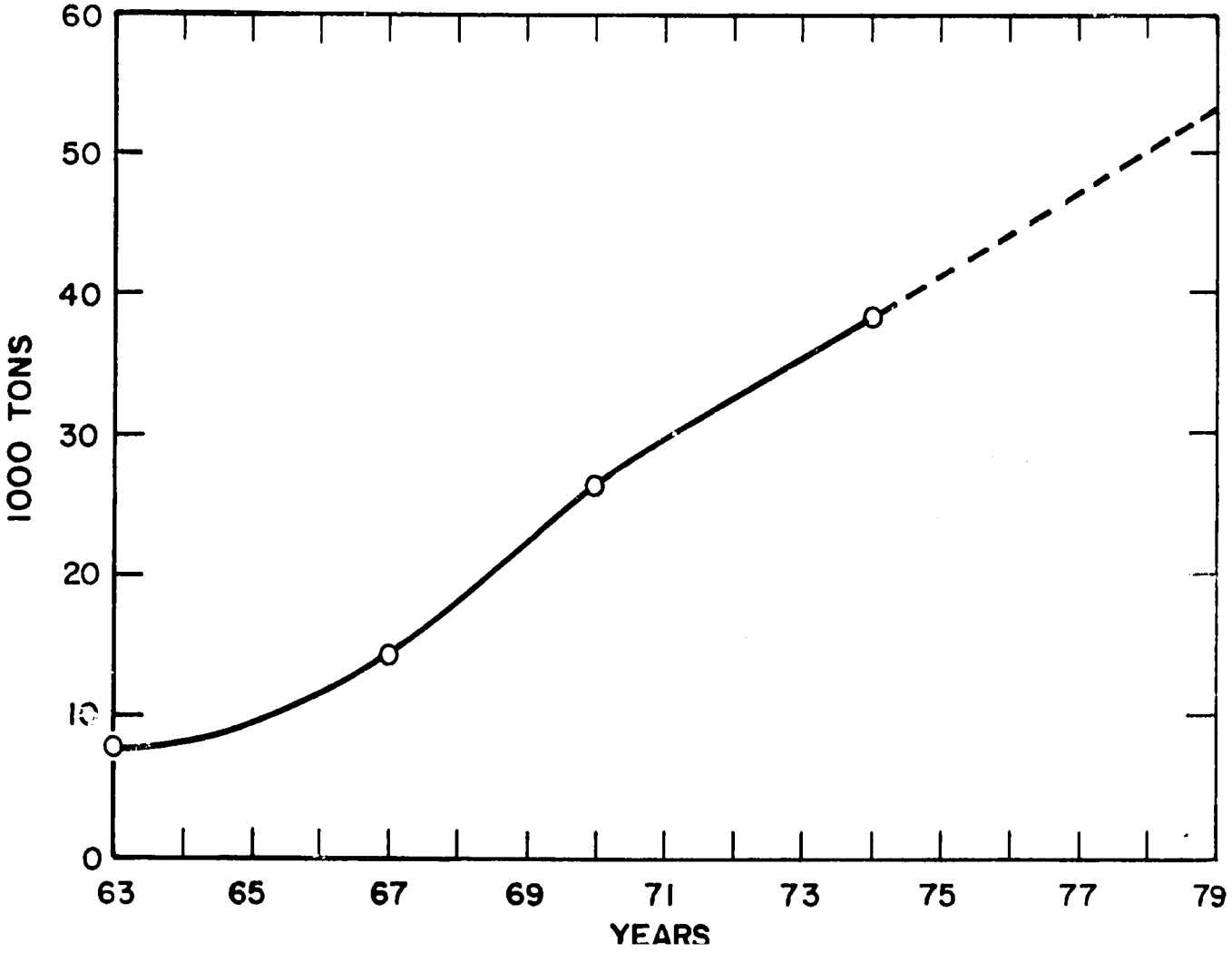

FIGURE 1. PROJECTED DEMAND FOR NITROGEN (CIDE)

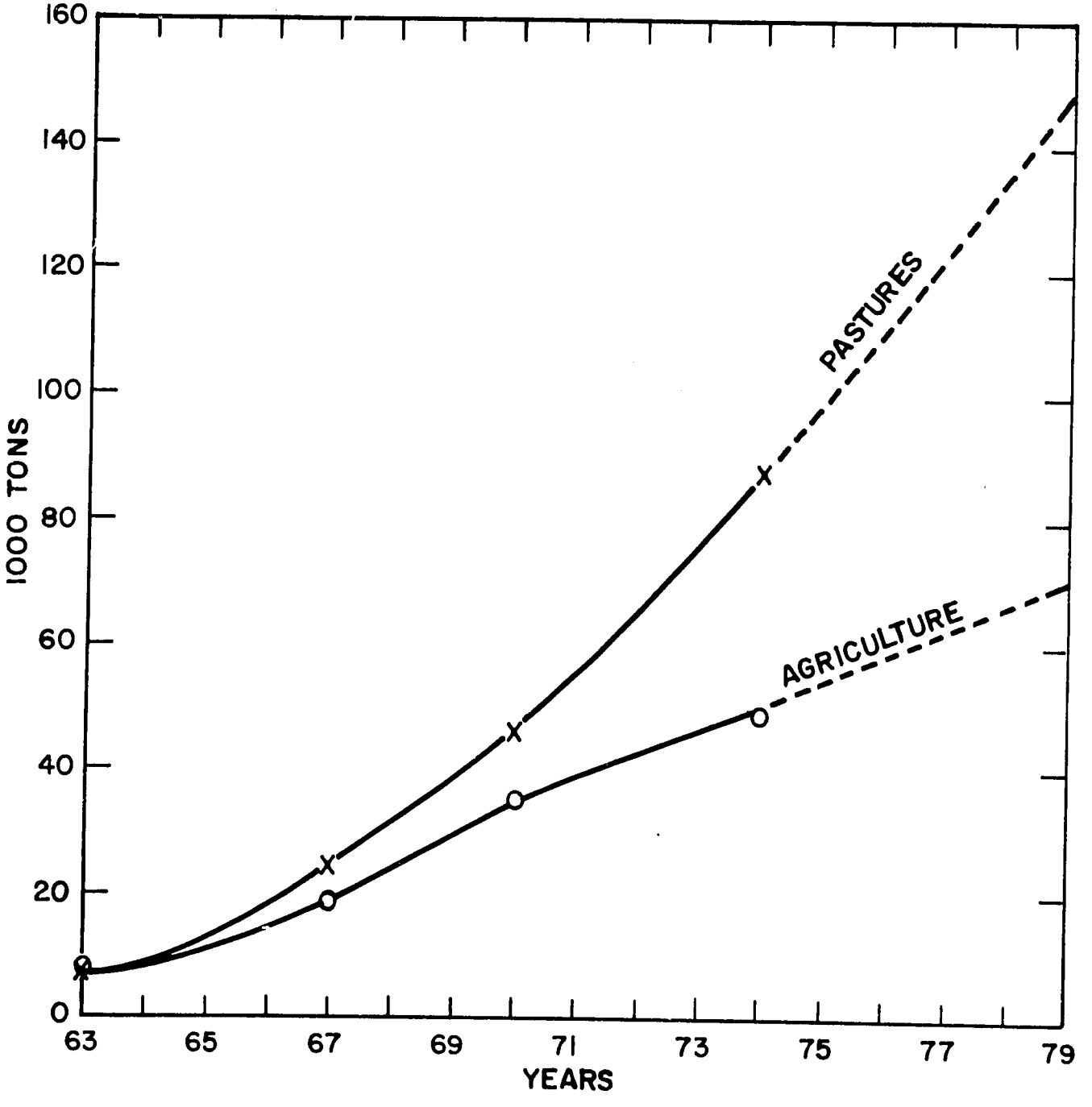

FIGURE 2. PROJECTED DEMAND FOR SOLUBLE P_2O_5 (CIDE)

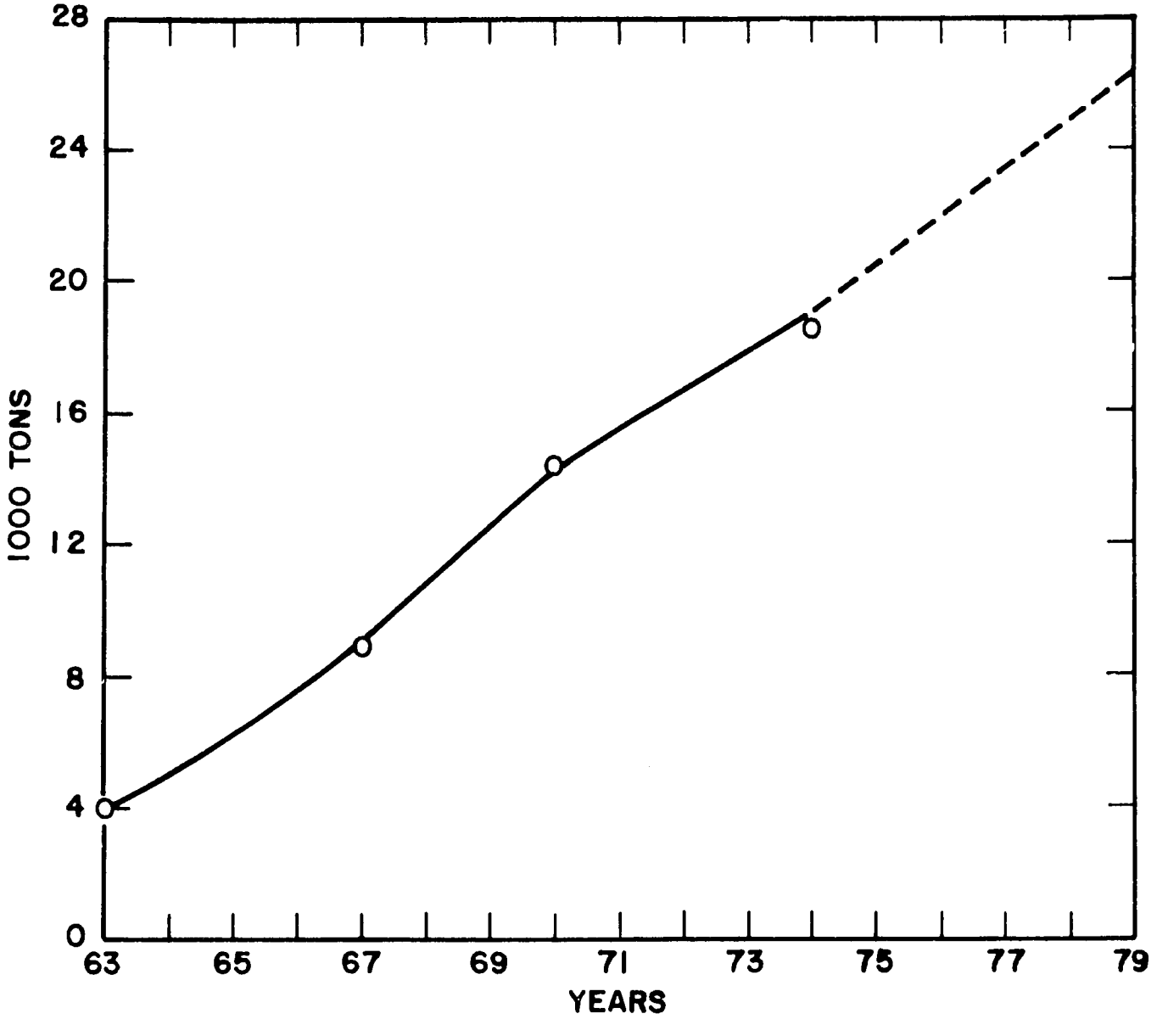

FIGURE 3. PROJECTED DEMAND FOR K_2O (CIDE)

Section III

THE FERTILIZER INDUSTRY

Domestic Fertilizer Manufacture

The manufacture of fertilizers is limited to (1) the production of normal superphosphate from imported phosphate rock and sulfur, (2) the grinding of phosphate rock (principally Gafsa rock) and Thomas slag for direct application and use in mixtures, and (3) the production of mixtures from imported nitrogenous materials and potash, with P_2O_5 supplied from normal superphosphate, phosphate rock, and slag. Small quantities of fertilizer are produced from bone and slaughterhouse waste.

The firms which can be classified as manufacturers are Agromax S. A., Fosfato Thomas S. A., Industria Sulfúrica S. A. (ISUSA), and Compañia Quimica Uruguaya S. A. (QUIMUR). The facilities of these companies have been described elsewhere (Fertilizantes en Uruguay), but brief descriptions including new information are given here:

Agromax--This company operates a fertilizer plant in the suburbs of Montevideo in which it produces finely ground Gafsa phosphate rock and fertilizer mixtures. Although the maximum capacity for grinding and bagging Gafsa rock is about 70,000 tons/year, only about one-third of this amount is produced. The nominal capacity for pulverized mixtures is 12 tons/hour. In 1961, Agromax installed a pan granulator (capacity 6 to 9 tons/hr.) incorporating the same handling system used in the production of pulverized mixtures. Before 1960, the company produced about 20,000 tons/year of pulverized mixtures. The demand for granular fertilizers has grown so that in 1966 Agromax produced about 16,000 tons of granular mixtures and only about 2,000 tons of pulverized mixtures. A small, but growing, quantity of granular normal superphosphate is also produced in the pan granulator.

Materials used in the production of granular fertilizers are listed in table 10, which gives formulations for typical grades. Normal superphosphate and sulfuric acid used in these formulations are usually purchased from the nearby plant of QUIMUR.

Fosfato Thomas--Little information concerning this company was available. Fosfato Thomas began production of finely ground Thomas slag in 1962 and is reported to have a grinding capacity of 20,000 tons/year. However, in recent years the company has also offered finely ground Israeli phosphate rock. It was reported that the company also manufactures nongranular mixtures, but the amount is small.

ISUSA--This company operates a fertilizer plant and an aluminum sulfate plant on an 18-hectare tract adjoining the de la Plata River at the mouth of the Santa Lucia River about 25 kilometers from the center of Montevideo. The fertilizer manufacturing facilities consist of a sulfuric acid plant, a normal superphosphate plant, and a mixing plant. The acid plant is of Kuhlman design with a

Table 10 Typical Formulations for Granular Fertilizers - Agromax

	6-12-6	9-9-9	10-10-10	8-20-0	0-20-0
	. . . . .		kilograms	. . . . .	
Urea	60	60	90	100	-
Ammonium sulfate	164	326	300	175	-
Gafsa rock	230	163	145	150	150
Thomas slag	40	40	40	45	40
Normal superphosphate	320	203	95	250	750
Triple superphosphate	-	-	100	230	-
Potassium chloride	100	154	170	-	-
"Complement for granulation"[a]	95	104	100	100	100
Loss	9	50	40	50	40

[a] "Complement for granulation" consists of sulfuric acid (98%) and Thomas slag in the weight proportion 2:1.

capacity of about 50 tons/day (17,500 tons/year). The product of the plant is used in the manufacture of normal superphosphate, aluminum sulfate, and for other industrial purposes.

The superphosphate plant consists of a batch mixer and Sturtevant den with a nominal capacity of 8 tons/hour. Two Raymond mills are used for grinding phosphate rock. The company estimates that the total annual capacity for normal superphosphate could be 40,000 to 45,000 tons if sufficient sulfuric acid were available.

Nominal capacity for mixing and bagging NPK fertilizers is 12 tons/hour, or about 30,000 tons/year. The company has obtained a commitment for funds for the construction of a TVA-type granulation plant and will convert completely to granular products. The total capacity for NPK fertilizers, however, will increase only slightly.

QUIMUR--Quimur operates a fertilizer plant in the suburbs of Montevideo. Facilities are similar to those of ISUSA except that the sulfuric acid plant is of Monsanto design and has a capacity of about 29,000 tons/year. The capacity of the normal superphosphate plant is about 42,500 tons/year, with rock grinding capacity the limiting factor. Nominal capacity of the mixing plant is 8 tons/hour, or between 20,000 and 25,000 tons/year.

Other Manufacturers--The National Administration of Fuels, Alcohol, and Portland Cement (ANCAP) has obsolete sulfuric acid and normal superphosphate plants located on the Port of Montevideo. The acid plant has a nominal capacity of 7,200 tons/year and the capacity of the superphosphate plant is about 4,000 tons/year. About 1,000 tons of superphosphate was produced in 1966, but the superphosphate plant was reported to have been shut down recently. ANCAP has applied for a loan from the Inter-American Development Bank (IDB) to construct entirely new fertilizer manufacturing facilities on the site of the existing plant. This is discussed elsewhere in this report.

Several small firms process bone and slaughter-house waste, the largest being Colagel S. A. The total production of these companies is about 6,000 tons/year (1,000 tons of soluble P_2O_5).

Total installed capacity for sulfuric acid is about 53,700 tons, of which 21,700 tons are used for purposes other than the production of normal superphosphate. The use of the available acid would permit the production of about 17,800 tons of soluble P_2O_5, equivalent to 89,000 tons of normal superphosphate. The total consumption of soluble P_2O_5 in 1965 (table 2) was 21,500 tons, exceeding domestic production capacity by nearly 4,000 tons.

The capacity for grinding phosphate rock and Thomas slag is not considered to be pertinent to this study. Such capacity can be increased with relatively small investments as the demand requires.

Importation of Fertilizers

Imports of fertilizers and raw materials are given in tables 11, 12, 13, and 14. The data were obtained from the Ministry of Livestock and Agriculture.

Essentially all of the nitrogen consumed is synthetic nitrogen imported as nitrogen salts and NPK fertilizers. Importation of nitrogen has increased from about 2,600 tons in 1960 to 11,700 tons in 1966 and the proportion of nitrogen originating from complex fertilizers has increased from a negligible proportion to about 40% of the total annual import of nitrogen. The current demand for nitrogen may be said to be on the order of 10,000 tons/year (table 2) and the average annual increase in both demand and imports since 1960 has been about 700 tons.

The proportion of P_2O_5 imported in the form of processed fertilizers averaged about 20% of the total P_2O_5 imported during the period 1960-65 and there was a tendency for this proportion to increase to about one-third in the last three years of this period. The current demand for total P_2O_5 (table 2) is about 35,000 tons/year. One-third of this would represent a possible current demand for P_2O_5 of about 12,000 tons/year in the form of finished imported fertilizers. Very little triple superphosphate is imported. This fact probably reflects the still small demand for high-analysis granular phosphate fertilizer application on pastures and points to uncertainty in the future demand for granular triple superphosphate that may be produced in the country.

The demand for K_2O (table 2) has been between 4,000 and 5,000 tons/year the past four years. Nearly half of this has been supplied in the form of NPK fertilizers. This, of course, suggests an order of magnitude of savings if the amount of potash imported in the form of NPK fertilizers could be replaced by potassium chloride.

The general increase in fertilizer imports was reported to reflect a strong consumer preference for granular high-analysis fertilizers. This has not only stimulated a rapid increase in the importation of granular high-analysis NPK fertilizers but also an increase in fertilizer materials which make it possible for local manufacturers to upgrade mixtures. This trend has apparently taken place in spite of high prices for imported granular fertilizers and in spite of the absence of extensive educational programs encouraging the use of high-analysis granular fertilizers.

Costs of Imported Materials

Shown in table 15 are cost data obtained from several sources. Included are CIF costs and port handling costs. Note that in most cases shipments were of small

Table 11. Importation of Raw Materials and Fertilizers

	1961	1962	1963	1964	1965	1966[a]
	'000 metric tons					
Processed Fertilizers						
Urea 45.5 - 46% N	2.6	5.4	6.6	8.8	4.1	9.9
Ammonium sulfate - 21% N	11.5	12.9	5.8	14.4	4.9	8.5
Sodium nitrate - 16% N	0.2	0.2	-	1.1	-	-
Ammonium nitrate sulfate - 26% N	0.7	-	-	0.3	1.5	1.5
Calcium amm. nitrate - 20.5% N	1.4	0.5	0.5	0.5	-	-
Ammonium phosphate - 18-46-0	1.5	3.9	2.4	5.9	7.2	1.7
Triple superphosphate - 46% P_2O_5	0.1	-	-	0.7	0.5	0.3
Dicalcium phosphate - 40% P_2O_5	1.0	4.3	3.0	2.0	4.0	N.A.
Others	NIL	NIL	0.5	0.2	NIL	N.A.
Raw Materials						
Sulfur - 99%	4.4	4.5	1.3	5.4	5.5	8.0
Phosphate rock - 30-37% P_2O_5	45.7	49.1	12.5	67.5	34.4	86.7
Thomas slag - 20% P_2O_5	3.0	10.0	4.9	9.7	11.7	N.A.
Potassium chloride - 60-62% K_2O	4.3	5.0	2.3	6.4	3.8	3.1
Potassium sulfate - 50% K_2O	1.1	0.4	-	0.3	0.1	N.A.
Complex Fertilizers (NPK)	6.4	7.2	10.0	13.2	18.6	31.2[b]
TOTAL	83.8	103.4	49.8	136.2	96.2	-

[a] Preliminary
[b] Of this amount, 77% was 15-15-15.

Table 12. Importation of Nitrogen (9)

	1960	1961	1962	1963	1964	1965	1966[a]
	. . . . . '000 metric tons						
Urea	0.6	1.2	2.5	3.0	4.0	1.9	4.5
Ammonium sulfate	1.3	2.4	2.7	1.2	3.0	1.0	1.8
Sodium nitrate	0.1	NIL	NIL	NIL	0.2	-	-
Ammonium nitrate sulfate	NIL	0.2	0.1	NIL	0.2	0.4	0.4
Calcium ammonium nitrate	NIL	0.3	-	0.1	-	-	-
Ammonium phosphate	0.5	0.3	0.7	0.5	1.0	1.3	0.3
Complex fertilizers	NIL	1.3	1.1	1.3	1.8	2.5	4.7
Others	0.1	NIL	0.1	NIL	0.1	NIL	NIL
Total	2.6	5.7	7.1	6.1	10.2	7.1	11.7

[a]Preliminary

Table 13. Importation of P_2O_5

	1960	1961	1962	1963	1964	1965	1966[a]
	. . . . . '000 metric tons						
Processed Fertilizers							
Ammonium phosphate	1.3	0.7	1.8	1.0	2.4	3.0	0.8
Triple superphosphate	-	-	-	-	0.3	0.2	0.1
Dicalcium phosphate	0.4	0.4	1.7	1.2	0.8	1.6	N.A.
Complex fertilizers (NPK)	NIL	1.4	1.1	1.7	2.2	3.1	4.9
Total	1.7	2.5	4.6	3.9	5.7	7.9	5.8
Raw Materials							
Phosphate rock	9.9	14.9	17.1	4.0	22.3	11.3	27.7
Thomas slag	1.3	0.5	2.0	1.0	1.7	2.3	N.A.
Total	11.2	15.4	19.1	5.0	24.0	13.6	-

[a]Preliminary

Table 14. Importation of K_2O

	1960	1961	1962	1963	1964	1965	1966[a]
	. . . . . '000 metric tons						
Processed Fertilizers							
Complex fertilizers (NPK)	NIL	1.3	1.1	1.3	1.8	2.6	4.4
Straight Materials							
Potassium chloride	1.5	2.6	3.0	1.4	3.9	2.3	1.9
Potassium sulfate	0.2	-	0.2	-	0 2	NIL	N.A.

[a] Preliminary

tonnage and, except for raw materials, were received in bags. Costs obtained from the Ministry of Livestock and Agriculture were estimated. Monetary conversions were made at the rate of exchange applicable to the CIF cost.

Costs of Fertilizers

The most recent (January 1967) and complete costs of producing normal superphosphate (21% soluble P_2O_5) were obtained from information supplied to the Ministry of Livestock and Agriculture by QUIMUR. These are tabulated below:

Raw Materials	US $ (at 80 pesos/$)
Sulfuric acid (98%), 379 kg at $30.10/ton	11.40
Apatite, 610 kg at $32.90/ton	20.10
Sterox, 0.075 kg at $126/ton	0.90
	31.59
Loss	0.21
	31.80
Manufacture	8.75
Sales and distribution	5.78
Administrative	4.52
Bank interest	1.92
Profit	6.70
Bags	3.94
Total	63.41

The cost (less profit) of normal superphosphate in bags f.o.b. the QUIMUR plant was $56.71/ton, or $270/ton of P_2O_5[a]. The cost of imported granular triple superphosphate stored in bags, as reported by Agromax in March 1967, was $116/ton, or $252/ton of P_2O_5. Personnel of the World Bank program reported that a recent

[a] Agromax reported in March 1967 that the purchase price of super f.o.b. QUIMUR was $48.50/ton, or $231/ton of P_2O_5.

Table 15. Cost of Imported Fertilizers and Raw Materials

	Approx. Quantity	Date	CIF	Bagged or Bulk	Customs Fees	Port Handling Plus Loss	Bank Fees	Trans. or Plant or Whse	Total	Source
	'000 mt		. . . . .			US $/ton	. . . . .			
Raw Materials										
Florida phosphate rock (34% P_2O_5)	3,000	1/67	26.80	Bulk	-	5.37	1.07	1.24	34.48	QUIMUR
"	-	1966	26.00	Bulk	0.24	4.03	0.18	1.25	31.70	MINISTRY
Gafsa phosphate rock (29% P_2O_5)	-	3/67	21.00	Bulk	-	9.97	0.74	1.65	33.36	AGROMAX
Sulfur, U. S. bright	-	1966	52.00	Bulk	0.10	1.27	0.07	1.25	54.69	MINISTRY
"	1,000	5/66	48.30	Bulk	-	-	-	-	-	ETL. EX. CORP.
Potassium chloride (61% K_2O)	1,000	1/67	56.30	Bulk	1.12	4.73	1.69	0.80	64.64	QUIMUR
"	-	1966	56.00	Bulk	0.16	1.78	0.10	1.25	59.29	MINISTRY
"	-	3/67	50.50	Bulk	10.50		1.77	1.31	64.08	AGROMAX
Fertilizers										
Urea	200	1/67	125.00	Bagged	0.63	7.49	3.75	0.80	137.67	QUIMUR
"	-	1966	131.30	Bagged	0.47	3.95	0.47	1.25	137.44	MINISTRY
"	-	3/67	111.25	Bagged	17.64		3.90	1.31	134.10	AGROMAX
Ammonium sulfate (21% N)	2,000	1/67	55.20	Bulk	2.48	2.48	1.66	0.80	62.62	QUIMUR
"	-	3/67	54.70	Bagged	11.03		1.35	1.31	68.39	AGROMAX
Ammonium phosphate 18-46-0	200	1/67	118.50	Bagged	3.14	5.62	2.62	0.80	130.68	QUIMUR
Triple superphosphate (46% P_2O_5)	300	1966	97.07	Bagged	42.10				139.17	ESSO
"	-	3/67	95.43	Bagged	15.70		3.34	1.31	115.78	AGROMAX
15-15-15	-	1/67	98.00	Bagged	1.24	10.13	8.83	1.31	119.51	QUIMUR
"	-	1966	107,75	Bagged	1.63	13.63	1.08	1.25	125.34	MINISTRY

price paid for superphosphate was $51.20/ton ($244/ton of P_2O_5) but this price was lower than the general market price because the World Bank absorbs inflation risk on purchases of raw materials for use in the production of fertilizers used in the program. It is, therefore, difficult to assess the actual cost of production of normal superphosphate, but it is assumed that $50/ton of bagged material ($238/ton of P_2O_5) represents a realistic, although high, cost and that the cost of production is currently roughly competitive with imported granular triple superphosphate per unit of P_2O_5.

One of the companies reported receipt of a bulk shipment of Gafsa rock (30.5% total P_2O_5, 12.5% soluble P_2O_5) in January 1967 at $21.00 CIF. The port costs, transportation, grinding, and bagging costs were $28.50, so that the f.o.b. plant cost in bags was $49.50, or $396/unit of soluble P_2O_5 ($162/unit of total P_2O_5). Thus, on the basis of soluble P_2O_5, the cost of Gafsa rock is more than 50% higher in cost than normal or triple superphosphate. In the case of Florida rock (34% total P_2O_5, 9.7% soluble P_2O_5), QUIMUR reported a cost in January 1967 of $60/ton f.o.b. plant in bags, equivalent to $619/ton of soluble P_2O_5 and $176/ton of total P_2O_5.

Agromax reported the total cost of production of granular 10-10-10 (bagged, f.o.b. plant) to be $84.55, or $282/ton of nutrient. This compares with an in-storage cost (table 15) of $120, or $267/unit, for imported 15-15-15 and is again indicative of an unfavorable situation in respect to local production of granular fertilizers in competition with imported fertilizers of higher analysis.

The cost of urea nitrogen in warehouse storage is about $294/ton; that for ammonium sulfate is about $326/ton. If, in granular 15-15-15, the P_2O_5 and K_2O are assigned values equivelant to the in-storage costs of triple superphosphate and potassium chloride, the cost of the nitrogen content would be about $430/ton of nitrogen. Since nearly 40% of the nitrogen imported (table 12) is imported in the form of complex fertilizers, this suggests that an inordinate price is paid for nitrogen and, of course, suggests that considerable savings could be achieved through importation of nitrogen in cheaper forms.

The prices for fertilizers paid by the farmer, as mentioned earlier, are subject to policies of subsidies. The principle of subsidizing agricultural inputs appears to be well established and, although variations are expected, the practice of using subsidies to increase agricultural production is likely to continue. However, since the funds for such subsidies are derived from export taxes on agricultural products, most agricultural producers pay for the actual cost of inputs in the final analysis. Although the costs of fertilizers and prices obtained for agricultural products are such as to encourage the use of fertilizers to some extent, only a few crops, such as potatoes and sugar beets, are fertilized to obtain maximum yields. The use of nitrogen, particularly, is restricted because of high price and because in most cases good response is obtained to the use of phosphate alone on the generally phosphate-deficient soils in Uruguay.

Transportation costs within the country are relatively minor when compared with those in larger countries. The maximum distance shipped is no more than about 500 kilometers and rail freight rates for fertilizers do not exceed about $4/ton in lots of 10 or more tons. More than half of the fertilizer shipments are, however, made in trucks at a cost 20 to 30% higher than rail costs. This is true because, although Uruguay has a good system of railroads, the rolling stock is depleted and freight cars are not readily available as required. There are no large warehouses for the storage

of fertilizers within the country and consumers are, for the most part, forced to arrange for trucking directly from the plants in the Montevideo area. It was reported that frequently during the peak season trucks are held up at the plants as long as 2 days awaiting loading. This is, of course, an undesirable and costly condition warranting encouragement of the establishment of strategically-located distribution centers by the fertilizer companies, cooperatives, or by a company such as Cademar, Ltda., which has recently been established in Florida to offer fertilizer application service. The location of new production facilities in an area remote from Montevideo would alleviate this condition as well as difficulties encountered in the unloading of ships at the Port of Montevideo.

Section IV

FUTURE SUPPLY OF FERTILIZERS

General Considerations

There seems little question but that Uruguay could achieve some economies in its current expenditures for fertilizers. Phosphate rock, sulfur, and slag are imported in bulk, but most shipments of processed fertilizers are received in small lots and in bags. Charges for bags and bagging for ocean shipment probably range from at least $7 to $10/ton. QUIMUR and ISUSA pool shipments of sulfur, but other materials and fertilizers are purchased individually by the various manufacturers and importers. Any effort directed toward pooling of shipments should help to effect cost reductions, particularly if purchases under long-term contracts could be arranged. Most fertilizers, including phosphate rock and slag, are distributed in bags. ISUSA is making a concerted effort to ship mixtures in bulk. The terms of the AID fertilizer loan are such as to encourage the receipt and distribution of fertilizers in bulk and also provide for collective purchases of fertilizers. This should serve as a demonstration of the prospects for improvements in the current trade.

The feasibility of producing nitrogen in Uruguay to satisfy a current demand of some 10,000 tons/year and a projected demand of perhaps 40,000 tons in 1975 is doubtful and there is general acceptance of this conclusion on the part of authorities. ANCAP operates a petroleum refinery on the Port of Montevideo which produces sufficient byproduct hydrogen to supply an ammonia plant with a capacity of 50 to 60 tons of ammonia/day. However, with advice from a foreign engineering firm, ANCAP concluded that the production of ammonia from this gas would not be economical and a decision has been made to utilize it for another undisclosed purpose.

The economic advantages of the use of anhydrous ammonia as a fertilizer for direct application have been demonstrated in other countries, primarily the USA. At present this practice is being introduced into southern Brazil and in Argentina. Uruguay would do well to give serious consideration to the use of anhydrous ammonia as a direct application material.

In combination with investments in the production or importation of acid and/or as a result of the development of a market for the direct use of anhydrous or aqua ammonia plus adaptation of the existing plants to the use of ammonia in mixtures, considerable savings could result from the importation of ammonia as a substitute for at least part of the present imported nitrogenous fertilizers. The potential savings with a total demand of 10,000 tons/year approach $1.2 million/year. If the consumption of nitrogen in 1975 approaches CIDE's projection of about 40,000 tons, the savings, at current prices, could amount to as much as $4.7 million/year.

Considerable effort was made to obtain information that could be used to determine the most appropriate $N:P_2O_5$ ratios for 2- or 3-component fertilizers, the potential use of triple superphosphate for pasture fertilization, the preferred degree of water solubility of phosphatic fertilizers for use on crops, and the need for sulfur on Uruguayan soils. Unfortunately, very little information on these points was

available. Generally speaking, the traditional emphasis on livestock production has left crop agriculture in a relatively neglected state, with only few exceptions. Only one Uruguayan agronomist was found whose major interest and experience lay in the field of soil fertility. The data available from this agronomist (a staff member of the Estanzuela) was both very limited and to a large extent inconclusive.

The concensus of the agronomists interviewed was that complete fertilizers with an $N:P_2O_5$ weight ratio of 1:2 and 1:1 should satisfy the bulk of requirements. A general recommendation for wheat, for example, is a pre-plant application of 20 kilograms of nitrogen and 40 kilograms of P_2O_5 plus 20 kilograms/hectare of nitrogen as topdressing. The current importation of 15-15-15, 12-24-12, and 20-20-0 and the current manufacture of 9-9-9, 6-12-6, and 8-20-0 tend to confirm a market demand for the 1:2 and 1:1 ratios. Also, a straight nitrogen fertilizer is required for topdressing. Very little need appears to exist for straight phosphatic fertilizers for use on crops. Predictions by CIDE of fertilizer application rates in 1975 (table 9) also support these generalizations. There appears to be no strong motive for directing future expansion of production facilities toward a bulk blending system of the type which has developed in the United States. Although it is possible that manufacturing costs could be reduced, the advantages of this system, such as bulk handling, storage, and application, can be achieved with granulated complete fertilizers. Also, it is unlikely that the practice of soil testing and determination of precise plant food requirements will be developed sufficiently to justify prescription blending in the near future.

The soils of Uruguay are predominantly acid; the four major soil types range in pH from 5.4 to 6.2. Data from three experiments conducted by La Estanzuela on acid soils and one experiment on soil of pH 7.2 were examined. In the experiments on acid soils the response of wheat to Gafsa rock and normal superphosphate was compared on a total P_2O_5 basis. Although the yields were higher with superphosphate, the results on acid soils were not significantly different. On the alkaline soil the response to Gafsa rock was "very poor" compared with normal superphosphate. In another series of tests on the four major soil types the response to Gafsa rock and Thomas slag was about the same but significantly lower (average of 80%) than normal superphosphate on a total P_2O_5 basis. It can be concluded from this limited amount of data that in some cases the degree of water solubility of the phosphate source is important. Some agronomists felt that "to be on the safe side" any new phosphate fertilizers produced in Uruguay should be highly water soluble.

There is overwhelming opinion that Gafsa rock is equal to superphosphate on a cost basis as a source of P_2O_5 for the establishment of improved pastures. Although no data from controlled experiments were available to support it, the opinion of most agronomists was that a water soluble phosphate fertilizer gave better results on refertilizing pastures. This was not a universal opinion, however, and personnel of the World Bank program were of the opinion that the general phosphate deficiency was such that it did not matter what form of phosphate fertilizer was applied to pastures. Thus, the demand for triple superphosphate on pastures is likely to depend partly on the comparative advantages of applying a granular high-analysis fertilizer. This may be affected to some extent by the growth of aerial application and the growth of aerial application will depend on economics since there is very little pasture land which cannot be fertilized with ground applicators.

Processed Phosphate Fertilizers

By 1975 (table 9), it is expected that 52,000 tons of P_2O_5 in processed form will be required for field crop use. About 90,000 tons of P_2O_5 will be required for fertilization of pastures. Given the circumstances discussed earlier it is virtually impossible to predict the amount of soluble P_2O_5 destined for pasture fertilization that would be supplied in the form of processed fertilizers. In 1966, about 50% of the soluble P_2O_5 applied to pastures was in the form of normal superphosphate. There was a small preferential subsidy on soluble P_2O_5 vs total P_2O_5, but this subsidy did not compensate for the lower cost of P_2O_5 from phosphate rock and slag. In this year subsidies did not apply to imported finished fertilizers, including triple superphosphate. If it is assumed that in 1975 the same proportion of processed and unprocessed phosphate materials are used on pastures, the total demand for soluble P_2O_5 in the form of processed fertilizers would be 97,000 tons of P_2O_5. With an existing capacity for about 18,000 tons of P_2O_5, the deficit would be 79,000 tons. Since it can be expected that a growing proportion of phosphate applied to pastures will be refertilization of improved pastures, this deficit may not be unrealistic. If, on the other hand, there was no market for processed phosphates for pasture fertilization in 1975, the deficit would be only about 34,000 tons of P_2O_5 in processed form. It is highly unlikely that there will be no demand for processed phosphates in one form or another and it seems reasonable to expect that the amount used in 1966 (8,000 tons of P_2O_5) could be regarded as minimum future demand for processed fertilizers on pastures. This would raise the minimum total requirement for processed phosphates to 42,000 tons of P_2O_5.

According to CEPAL the 1975 demand for P_2O_5 in Argentina will be 66,000 tons. The projected capacity for that year is 5,000 tons, leaving a deficit of 61,000 tons. As will be discussed later, there exists a reasonable basis for marketing phosphate and/or NPK fertilizers in Argentina, particularly along the Uruguay and Paraña Rivers. Uruguay would, of course, compete with other sources of supply for this market, but an interchange of nitrogen and phosphates between Argentina and Uruguay is quite feasible. If arrangements for such interchange are made on a value basis (ammonia and triple superphosphate), the potential market in Argentina would be about 25,000 tons of P_2O_5. Adding this to the minimum Uruguayan market of 42,000 tons, this would represent a potential market for 67,000 tons of P_2O_5 from a new fertilizer plant.

Proposed Projects

Agromax-QUIMUR-ISUSA--In 1964, Agromax, QUIMUR, and ISUSA, conscious of a growing demand for granular high-analysis fertilizers, the growth in imports of finished fertilizers, and the inadequacy of their existing facilities to satisfy this market, agreed to take steps toward a joint investment in a new fertilizer plant. They proposed to build the plant within the free trade zone of the port of Nueva Palmira on the Uruguay River where the modern ship loading facilities used in the trans-shipment of manganese ore from Brazil exist. They drew up a preliminary proposal for

facilities which would include the manufacture of sulfuric and phosphoric acids, ammonium phosphate 16-48-0, granular triple superphosphate, and granular NPK fertilizers. Plant capacities, raw materials requirements, and estimated investment cost were listed as follows:

Plant Capacities (tons/yr.)			Raw Materials (tons/yr.)		
Sulfuric acid (100%)	-	10,706	Phosphate rock	-	111,296
Phosphoric acid (P_2O_5)	-	30,280	Sulfur	-	34,290
Triple superphosphate	-	32,000	Ammonia	-	13,428
Ammonium phosphate (16-48-0)	-	18,000	Potassium chloride	-	14,230
Granular:					
(15-15-15)	-	26,000			
(12-24-12)	-	26,000			
(10-20-20)	-	6,000			

Fixed capital	-	$4.1 million ($3.3 million for equipment)
Working capital	-	3.1
Total		$7.2

The plant size was predicated on a total P_2O_5 market in 1970 (demand of 87,000 tons less existing capacity for 45,000 tons) of about 42,000 tons. Actual plant capacity would be about 35,000 tons of soluble P_2O_5/year. It was assumed that about 13,000 tons of P_2O_5 (as finished phosphatic and NPK fertilizers) would be marketed in Argentina and Paraquay. More than half of the P_2O_5 exported would be in the form of triple superphosphate.

The size of Nueva Palmira was chosen for the following reasons:

1. It is centrally located with respect to the area devoted to cultivation of crops in Uruguay and provides ready access by river to all El Litoral as well as parts of Argentina, Paraguay, Bolivia, and the State of Mato Grosso in Brazil. Possible future development of the de la Plata River system, which would stimulate and facilitate trade, was also considered to be an important factor.

2. It is the deepest port west of Montevideo and can handle ships with cargos up to 12,000 tons.

3. An area adjacent to the port has been designated as a free trade zone, permitting the importation and exportation of materials free of duty or export tax. (It was later realized that this was a greater disadvantage than advantage because shipments, however small, from the plant to consumers in Uruguay would be subject to customs inspection and associated formalities as well as duties in the event that import duties were imposed on products of the type produced in the plant.)

4. The sedimentation rate is satisfactorily low and the port can be maintained with a minimum of dredging.

5. The river flow is estimated to be sufficient to allow discharging byproduct gypsum into the river. However, the plant should be so situated that alternate means

of disposal (such as settling pond) could be provided in the event that direct discharge into the river proves to be objectionable.

6. The port is equipped with automatic bulk loading and unloading equipment which would make it possible to reduce costs to about 25% of those prevalent in the Port of Montevideo.

7. No site adjacent to protected waters at the Port of Montevideo is available.

The types of products were selected to provide the market with the same types of fertilizers which were being imported and which had received favorable acceptance on the part of the farmers. Although it was assumed that the use of granular triple superphosphate would grow appreciably, the proposed plant would be sufficiently flexible to adjust the proportion of all final products to suit market demand.

The process chosen for the production of granular triple superphosphate, ammonium phosphate, and granular NPK fertilizers was a TVA-type granulation plant modified to permit the production of any of the proposed products. This process was chosen because of its relative simplicity and flexibility.

Discussion of AQI Proposal

This proposal is preliminary in nature and now out of date. It appears reasonable to expect a market for about 67,000 tons of soluble P_2O_5 for a new plant in 1975. Allowing 3 years for reformulating plans, arrangements for financing, engineering, and construction, it seems reasonable to size the plant for the 1975 market. This would almost double the size originally proposed in 1964.

AQI considered the production of nongranular triple superphosphate and granular NPK fertilizers based on ammoniation of triple superphosphate but discarded the idea because this would not permit them to produce NPK fertilizers of the high plant food content of imported fertilizers. Also, there was considerable feeling that ammonium phosphate would be a popular fertilizer, particularly for use on wheat, There is, as stated earlier, no evidence that the high degree of water solubility (nearly 100%) in products based on phosphoric acid is required. The manufacture of products based on triple superphosphate would reduce the requirement for sulfur by about one-fourth. The phosphate solubility of these products would be roughly 50% which should be adequate for Uruguayan soils.

The market for granular triple superphosphate (discussed elsewhere in this report) is somewhat uncertain. It seems quite possible that a better market might exist for nongranular triple if arrangements are made with Argentina for exchange of nitrogenous and phosphatic fertilizers. PETROSUR is constructing a nitrogen plant[a] at Campana near Buenos Aires and is also constructing a granulation plant at Rosario on the Parana River. The capacity of the Rosario plant is not known, but it has been reported that the company plans to import nongranular triple superphosphate for use in this plant. It would seem quite reasonable for the superphosphate to be supplied from the new Uruguayan plant. Consideration should be given to producing nongranular superphosphate at Nueva Palmira and negotiating for this market. Part of the nongranular superphosphate would, of course, be used to produce granular NPK fertilizers. In this case, perhaps consideration should be given to the production of 5-45-0 with ammonia and triple superphosphate to satisfy demand for a granular phosphate fertilizer.

[a] 200 TPD ammonia, 162 TPD urea, 147 TPD ammonium sulfate.

The physical properties of this product are superior to those of granular triple superphosphate, and it is easier to produce, and contains no free acid so that attack on bags and handling equipment would be eliminated.

The products proposed do not include a straight nitrogenous fertilizer. In the interest of providing a more complete range of products for the agricultural market, it would seem desirable to furnish a nitrogenous fertilizer for sidedressing applications. The offer of anhydrous or aqua ammonia for direct application would, of course, be the simplest manner of providing a nitrogenous product from the standpoint of the manufacturer. However, the question of acceptance and utility of such a source of nitrogen warrants the consideration of producing or importing a solid nitrogen fertilizer. The most logical approach to the production of a solid nitrogen product would seem to be the production of granular ammonium sulfate in the granulation plant. A process for this product has been recently developed by TVA in which sulfuric acid is partially neutralized in a preneutralizer and further neutralized and granulated in a standard TVA granulation plant. At the present it does not seem reasonable to consider the production of ammonium nitrate because of the added investment which would be required, the small demand, and the opportunity for obtaining urea from PETROSUR. If a decision should be made to proceed with the production of ammonium phosphate-type fertilizers, it is suggested that the advent of overseas ship nents of acid (either superphosphoric or standard grade) be studied with the view toward importing acid, at least during the first stage, until the sulfur supply situation is stabilized.

In view of the current shortage and high cost of sulfur, some consideration should be given to the use of one of the nitric phosphate processes. The Odda calcium removal process has several important advantages; no sulfur is required, products of reasonably high water solubility are produced, production costs are relatively low, and a coproduct solid nitrogen fertilizer may be produced. An important disadvantage, however, would be that, although granular NPK products having the desired $N:P_2O_5$ ratio could be produced, the overall output of the plant would be about 5 parts of nitrogen and 3 parts of P_2O_5.

The question of the choice of site for a new fertilizer plant was discussed with a number of people and Nueva Palmira appears from these conversations to be the most logical one. In addition to the reasons for the choice given by AQI, it seems quite evident that the location of the plant at Nueva Palmira would stimulate the development of a relatively undeveloped section of the country. There is, however, a disadvantage in the fact that there is no rail connection to Nueva Palmira. Roads are satisfactory and part of the output of the plant could be expected to be shipped in barges. AQI has an option to buy a site for the plant within the free trade zone but now plans instead to purchase land adjacent to or as near the port as possible outside the zone. It is expected that arrangements can be made to ship finished products from the plant through the port with no serious handicap resulting from customs services. The land surrounding the zone, however, is owned by Shell, which also has plans for construction of a fertilizer plant at Nueva Palmira. Since the market is not sufficiently large for two plants, AQI expects no problem in acquiring land from Shell if the AQI project is authorized.

Shell-Albatros--Shell Chemical and Albatros Superfosfaatfabrieken presented a proposal a few years ago for the construction of an ammonium phosphate and granular

NPK fertilizer plant in Nueva Palmira. The size of the plant was not reported but Shell personnel said the investment was estimated to be $30 million. The necessary capital would be acquired through the resources of the two companies. Shell at that time requested of the government, as a condition for this investment, a protective tariff of 60% of CIF costs for imported finished fertilizers. This was not approved by the government, and Shell withdrew its proposal.

An interview with Shell personnel revealed that Albatros is currently preparing a proposal for a nitric phosphate plant at Nueva Palmira. No details of the proposal were available, but it was reported that the investment cost of the nitric phosphate plant would be appreciably lower than that of the plant first proposed. Shell has an interest in PETROSUR and the new plans, of course, include importation of ammonia from the PETROSUR nitrogen plant at Campaná. PETROSUR owns a 1,000-ton ammonia barge which is currently being used in connection with the development of a market in Argentina for direct-applied anhydrous ammonia, using at present imported ammonia. The personnel of Shell were very firm in the conviction that the market and general conditions in Uruguay justified the construction of a medium-sized modern fertilizer plant.

It is, of course, quite possible that the Uruguayan project is only one of many under consideration by Shell and associated companies. There is no evident assurance that the company would elect to invest in fertilizer manufacturing facilities in Uruguay. The fact that the company previously sought import protection of 60% casts a certain amount of doubt on the extent of the company's interest in making such an investment. On the other hand, the possible complementation with the facilities of PETROSUR points to a certain degree of logic in an investment in a primarily phosphatic fertilizer plant in Uruguay.

National Administration of Fuels, Alcohol, and Portland Cement (ANCAP)--ANCAP is an autonomous government organization engaged in the refining of petroleum, production of alcohol and cement, and processing of chemicals. Its present fertilizer manufacturing facilities were described in the section "The Fertilizer Industry." The fertilizer plant is located in a confined area (1.6 hectares) on the Port of Montevideo adjacent to ANCAP's petroleum refinery. ANCAP has proposed that the present facilities be scrapped and that a new fertilizer plant be built on this site. A formal petition for a loan of $2 million has been submitted to the Inter-American Development Bank. The balance of the fixed capital required (76,855,000 pesos)[a] and part of the working capital (30,000,000 pesos)[a] would be provided from ANCAP reserves. The balance of the working capital (50,000,000 pesos)[a] would be obtained through short-term credit.

The proposed plant consists of the following facilities:

Sulfuric acid plant	- 100 tons/day (32,000 tons/yr.)
Phosphoric acid plant	- 25 tons P_2O_5/day (7,500 tons/yr.)
Ammonia terminal	-1,500-ton capacity
Ammonium sulfate plant	- 50 tons/day (10,000 tons/yr.)
Granulation plant	- 140 tons NPK fertilizers/day (30,000 tons 12-24-12/yr.)

[a] Rate of exchange in March 1967 was approximately 86 pesos/US $.

The phosphogypsum byproduct of the phosphoric acid plant would be rewashed, filtered, and dried for use in the production of cement and wall board.

ANCAP bases its proposal mainly on the following considerations:

1. The present facilities are obsolete and production is uneconomical.
2. Law No. 12.376, January 31, 1957, stipulates that ANCAP place preferential attention to the fabrication of basic products, such as fertilizers and chemical products, for the agricultural, livestock, and manufacturing industries.
3. The growing demand for high-analysis granular fertilizers.
4. The substitution of ammonia for other forms of imported nitrogen.

ANCAP, with assistance from Mitsubishi Shoju Kaisha and other engineering firms, considered the alternatives of producing normal superphosphate and triple superphosphate. The reasons for the choice of phosphoric acid were not adequately explained in the proposal.

Discussions with ANCAP personnel indicated that ANCAP was reluctant to consider modifications of their present plans. It would appear that, as a government organization, it could render a service to the country by directing its resources toward the importation of ammonia, accepting the risk which private industry is not willing to assume of developing the market for direct application in the Montevideo area, and supplying local manufacturers with ammonia for use in the production of complete fertilizers. It is reasonable to assume that the importation of ammonia under favorable terms could only be accomplished with a dependable captive outlet for ammonia. This, of course, might be realized by the production of a nitrogenous fertilizer such as ammonium sulfate. It would be virtually impossible to justify the construction by ANCAP of a small phosphoric acid and granulation plant if a larger plant of the same type is constructed at Nueva Palmira.

Esso Standard Oil--The company imports small quantities (2,100 tons in 1964) of high-analysis granular fertilizers. Personnel of the Montevideo office reported that the company has no plans for investing in fertilizer production facilities in Uruguay. However, the area office in Buenos Aires is currently considering new investments in the de la Plata River Basin. The commercial manager of the office in Montevideo said he would recommend that any investment made in Uruguay be restricted to the importation of ammonia and development of a market for its use for direct application.

Section V

DISCUSSION

This report should be regarded as a preliminary survey and should be followed by a detailed technical and economical evaluation. It is suggested that the Mission request the services of a TVA team (or other consulting organization) comprising the disciplines of fertilizer economics, engineering, agronomy, and marketing for this evaluation. The team should be expected to consider all alternatives and (1) recommend the most economical solution to the problem of future supply of fertilizers in Uruguay; (2) point out the economic consequence of alternative solutions based on political considerations as specified by the Mission; and (3) point out the economic consequence of alternate solutions which may seem appropriate due to social or economic conditions peculiar to Uruguay. In the event a TVA team is employed in this study, much of the work required could be accomplished at TVA. However, in order to confirm the data and opinions contained in this report and to provide the team a firsthand acquaintance with the Uruguayan fertilizer industry and agriculture, a visit to the country would be required.

There seems little question of the need for increased production facilities to satisfy Uruguay's fertilizer requirements. Tentative recommendations as to means for providing these facilities based on this preliminary survey are as follows:

Nitrogen

With the assistance of the Latin American Free Trade Association (LAFTA), negotiations should be initiated for an agreement between the governments of Argentina and Uruguay for reciprocal trade of nitrogenous and phosphatic fertilizers. This could effectively eliminate drain on foreign exchange currently expended for nitrogenous materials. Nitrogen could be purchased from Argentina in the form of urea, but, with or without a reciprocal agreement, it probably would be of long-term advantage to import ammonia. The general advantages of the importation of ammonia would be lower CIF cost regardless of supplier, it would encourage the practice of using ammonia directly as a fertilizer with resulting economic advantage to the farmer, and it would also provide a low-cost source of nitrogen for use in domestic production of NPK fertilizers.

There is little doubt that the market requires and will continue to require nitrogen in a solid form and preferably as a granular material. If nitrogen is supplied to the country basically in the form of ammonia the production of a solid nitrogenous fertilizer resolves itself into these obvious alternatives:

1. Production of urea with CO_2 supplied from the combustion of fuels.
2. Production of ammonium nitrate, calcium ammonium nitrate, or ammonium nitrate sulfate.
3. Production of ammonium sulfate.
4. Production of a nitrate fertilizer as a coproduct of a nitric phosphate plant.

Of these alternatives it is suggested that the demand for a solid nitrogenous fertilizer could be supplied by the production of granular ammonium sulfate possibly by the TVA process[a] in a granulation plant, whether it be the new granulation plant to be installed by ISUSA or a completely new facility for the production of granular fertilizers. This suggestion is based on the fact that virtually no additional investment would be required. The cost of production, of course, must be compared with importation of urea, but the effect of importing ammonia instead of urea for other uses must also be taken into account.

Considered in the light of the limited demand for nitrogen, the impending production of nitrogen in Campana (near Buenos Aires), the increasing international trade in ammonia, the incipient export potential from large plants in Venezuela, Trinidad, Brazil, Chile (being planned), Argentina, and other areas in the world where certain economic advantages exist, the lack of raw materials in Uruguay, and the possibility of obtaining nitrogen from Argentina without loss of foreign exchange, it is concluded that at this time it is unwise to produce nitrogen in Uruguay.

Phosphate

Normal Superphosphate--In a report to the Agency for International Development, February 1964, the International Cooperative Development Association (ICDA) recommended that future requirements for phosphatic fertilizers be supplied by augmenting present facilities for the production of normal superphosphates instead of producing triple superphosphates. The reasons for the recommendation were given as follows:

1. Lower requirement of sulfur/unit of P_2O_5.
2. It was estimated that the cost of imported materials for the production of normal superphosphate was $77.14/ton of P_2O_5 compared with $90.89/ton for triple superphosphate.
3. Production of normal superphosphate is a simpler process.
4. Production of triple superphosphate would require higher import expenditures for fuel and maintenance parts.

There is no evidence that the arguments presented by ICDA favoring normal superphosphate are not valid under present conditions. However, there is an established farmer preference for high-analysis granular fertilizers, and storage, transportation, and application costs would be somewhat higher for normal superphosphate based fertilizers. These disadvantages could be overcome to some extent by importing either urea or urea-ammonia solutions and phosphoric acid for use in the granulation plant to upgrade the products.

In the case of a granular phosphatic fertilizer for pasture application, superphosphate could be granulated as produced in a continuous den as is done in several European plants. However, the possible demand for a high-analysis granular phosphate for aerial application probably would make it desirable to produce granular enriched superphosphate (about 30 to 32% P_2O_5) by acidulating phosphate rock with both sulfuric and phosphoric acid. Enriched superphosphate could also be employed as the basic source of P_2O_5 in the production of granular NPK fertilizers.

There is no evidence of sulfur deficiencies in the soils of Uruguay, but the lack of such evidence may be in part due to the fact that most of the fertilizers used contain

[a] This process is now under study.

sulfur and such evidence has been obscured. Continued application of sulfur-free fertilizers based on phosphoric acid may eventually reveal sulfur deficiencies. The production of fertilizers based on normal superphosphate would resolve this possible future problem.

ICDA did not suggest that any new production facilities be constructed at a new location, leaving the implication that increased production would be achieved through extension of the present facilities of the two superphosphate producers or that Agromax construct a sulfuric acid and superphosphate plant at the site of its present facilities. Agromax, QUIMUR, and ISUSA all have sufficient area at their present sites for expansion, but only ISUSA is located at a point which is potentially accessible to ocean-going vessels. The construction of a port at the ISUSA site would involve construction of a channel and dock at a cost that probably could not be borne by the company.

The Port of Montevideo has the ignominious reputation of being a high-cost port and one plagued with frequent work stoppages. The bulk unloading facilities consist of dockside cranes which are not suitable for the handling of all materials, particularly free-flowing granular materials. The port is a congested one, and trucks which haul materials to the fertilizer plants are frequently confronted with dock congestion and must pass through congested traffic en route to the plants.

Another disadvantage of increasing production capacity at the sites of the present manufacturers is the geographic location with respect to the crop market and any possible market along the Uruguay or Parana Rivers into Argentina and other countries.

If the apparent economic advantage of supplying the future market for fertilizers by increasing the production of normal superphosphate overrides other considerations, it is recommended that a new plant consisting of a modern continuous den and granulation plant be built at Nueva Palmira, even though some of the existing auxiliary services available at the present plant sites would have to be duplicated.

Nitric Phosphates--The outstanding advantages of the nitric phosphate processes are the low consumption of sulfur and, usually, the low cost of raw materials, basically because the nitric acid used in the process serves the dual purpose of solubilizing the phosphate rock and furnishing a part of plant food content. The economic advantage of the use of nitric acid over the use of sulfuric acid depends largely on the costs of ammonia and sulfur and a detailed economic evaluation would be required to be able to select between nitric acid and sulfuric acid processes under the conditions expected. Certain inherent restrictions in flexibility of $N:P_2O_5$ ratios in nitric phosphate products and in P_2O_5 water solubility are not regarded as being sufficiently limiting to eliminate consideration of the production of nitric phosphates.

If Shell, in fact, proposes the installation of a nitric plant at Nueva Palmira and is willing to take whatever financial risks are involved, it would, of course, relieve Uruguay of a substantial investment requiring a large proportion of foreign exchange. There is every indication that the government possesses the necessary instruments for imposing reasonable restraint on profits from activities financed by foreign capital. Also, the fact that Shell holds an interest in PETROSUR should facilitate interchange of nitrogenous and phosphatic fertilizer products between Argentina and Uruguay.

Phosphoric Acid Processes--The production of phosphatic fertilizers based on phosphoric acid was discussed in connection with the proposed Agromax-QUIMUR-ISUSA project. In addition to the comments previously made, mention should be made of the

possible advantages of proceeding with the construction of a granulation plant and using imported phosphoric acid as the source of P_2O_5 in finished products. Since the amount of ammonia nitrogen that could be fixed with phosphoric acid is limited, the supply of supplemental nitrogen would have to be considered in conjunction with the alternative of importing phosphoric acid.

It has been reported that a Canadian company is planning overseas shipment of elemental phosphorus and that the company has offered phosphorus delivered to a port in India at the CIF price of about $145/ton of P_2O_5. The cost of conversion to phosphoric acid should not exceed about $10/ton of P_2O_5. It would seem wise to consider this possibility in comparison with the production of wet-process phosphoric acid from phosphate rock and sulfur.

Potash

There is evidence tha some potash, in the form of mixtures and complex fertilizers, is applied on soils where the need has not been established. More than three-quarters of the NPK fertilizers imported in 1966 (table 11) was 15-15-15. Since Uruguayan soils are known to require more phosphorus than potash, it is very likely that future money could be better spent on fertilizer having higher phosphorus-potash ratios. It is suggested that agricultural extension agents be alerted to give special attention to this in their respective areas.

In relation to the question of supplying future requirements for NPK fertilizers, the importation of potash in the form of potassium chloride (or potassium sulfate, as required) unquestionably has advantages over importation in the form of NPK fertilizers. This, of course, would be reflected in an economic analysis of increased domestic production of complete fertilizers.

Fertilizer Materials for Bulk Blending

It is reasonably certain that there will be no need for prescription blending on a customer-by-customer basis in the foreseeable future and that the requirements for fertilizers can be supplied with no more than four or five grades. It seems likely that under these conditions it would be preferable to produce fertilizers consisting of granules in which the plant food content is homogeneously distributed. The consensus of the Uruguayan agronomists interviewed supports a preference for this type of fertilizer as contrasted to blended fertilizers, even though experience in other countries has demonstrated little agronomic superiority of homogeneously granulated fertilizers over blends of granular materials.

There are, however, possibilities for achieving economies and flexibility in the production of NPK fertilizers by producing, for example, a granular phosphatic fertilizer and blending with other granular materials. The investment required for such blending facilities could be substantially lower than that of a granulation plant. Such facilities could be constructed in strategic locations within the country, and some advantage could result from the shipment of straight granular materials of high concentration rather than complete NPK fertilizers.

Miscellaneous Comments on Technical and Financial Aspects

It is expected that in the construction of any new production facilities, foreign technical and financial assistance would be required. Agromax, QUIMUR and ISUSA each has one chemical engineer, one of which has received extensive training in modern technology in France. ANCAP also has several competent chemical engineers, but their experience in modern fertilizer technology is limited. The civil engineering work could be handled by local firms, but foreign technical assistance would be required in the design, construction, and initial operation of the plant. There is an excess of labor of high quality. As a matter of fact, the government is quite interested in providing industrial employment for the excess labor supply and, logically, considers a fertilizer industry to be appropriate as a means of providing industrial employment in addition to other benefits anticipated.

It is clear that all foreign exchange required for new production facilities would have to be provided through funds made available externally. AQI has stated that they would be able to furnish 30 to 40% of the capital required for their proposed project, but this would be largely in the form of Uruguayan currency. Industrialists reported that the fixed investment could be expected to be 50% higher in Uruguay than a similar investment in the United States.

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8. Informe Preliminar Sobre Proyecto de Instalacion de una Fabrica de Superfosfato Triple, Fosfato de Amonio y Complejos en la Zona France de Nueva Palmira. Agromax S. A., February 1964.

9. Honorary Commission of the Plan for Agricultural Development.

APPENDIX 1

LIST OF ORGANIZATIONS CONTACTED

1. Comision Honoraria del Plan de Desarrollo Agropecuario
2. Comision Honoraria de Desarrollo Agropecuario
3. Comision de Inversiones y Desarrollo Economico
4. Centro de Investigaciones Agricolas
5. Administracion Nacional de Combustibles, Alcohol, y Portland
6. Asociacion Latinoamericana de Libre Comercio
7. Agromax S. A.
8. Compañia Quimica Uruguaya S. A.
9. Industria Sulfúrica S. A.
10. Shell Chemical Company (Uruguay)
11. Esso Standard Oil Company (Uruguay)