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• **ABSTRACT**

A deficiency of food oil in Ecuador has incited an increase in soybean production, and it has risen from approximately 1700 metric tons in 1973 to an estimated 7500 metric tons in 1975. Projections for 1976 are 15,000 metric tons of soybeans. Farmers are organizing as associations for industrial development and for establishment of a credit base. The available total oil extraction capacity is 365 metric tons/day. It is reasonable to expect that no more than one-half this capacity will be used for soybean extraction. This represents approximately 11,000 metric tons of soybean oil per year. On this basis, Ecuador's extraction capacity is adequate until 1980 at present consumption levels. An additional 240 metric tons/day will be required to supply 1985 needs. In general, the soybean production program appears to be sound and recommendations are made to make it more efficient.

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EVALUATION OF THE CURRENT SOYBEAN SITUATION  
IN ECUADOR

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AID/ta-C-1162

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## REPORT SUMMARY

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### SUMMARY STATEMENT

A deficient supply of food oil in Ecuador has given impetus to soybean production with the general trend for soybean production upward. Demand for oil has encouraged planting, however, the enthusiasm has been dampened by a lack of demand for soybean meal and a lack of credit to farmers for seeds, herbicides and equipment. Soybean production has increased from approximately 1,700 M.T. in 1973 to an estimated 7,500 M.T. in 1975. Projections for 1976 are 15,000 M.T. of soybeans. Farmers are organizing as associations in an attempt to establish a credit base and for industrial development.

The demand for vegetable oils in Ecuador has exceeded the domestic supply requiring an import program for a number of years. Based on current per capita consumption and projected population increases oil demands for 1975, 1980 and 1985 respectively are 40,000, 47,730 and 56,965 M.T. Quantities required at 150 and 200 percent of current demand are also projected. Required production of soybeans to meet soy oil requirements for 1980 and 1985 are estimated to be 170,475 and 239,740 M.T. respectively assuming per capita consumption at 150 percent of current.

The available total oil extraction capacity is 365 M.T./day. It is reasonable to expect that no more than one-half of the capacity will be used for soybean extraction. This represents approximately 11,000 M.T. of soybean oil per year. On this basis, extraction capacity in Ecuador is adequate

until 1980 at present consumption levels. An additional 240 M.T./day are required to supply 1985 needs. Additional extraction capacity at the 150 and 200 percent per capita consumption levels.

There appears to be an interest in soy flour fortification of bread. This will require import of soy flour until installation of soy flour production capacity at extraction plants can be developed if demand is demonstrated.

In general the soy production program appears to be sound and recommendations are made to make the operation of the program more efficient.

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## PREFACE

At the request of USAID/Quito, Kansas State University under contract AID/ta-C-1162, supplied a consultant to review the current position of soybean production, processing and utilization under the Programme Development and Diversification Agricole (PDDA).

Mr. Donald F. Shimon, Technical Services Engineer for Archer Daniels Midland Company, served as the consultant for this review. Mr. Shimon was in Ecuador for 18 days, June 23 through July 11, 1975, evaluating the current soybean situation and developing recommendations for the soybean program.

ITINERARY

June 23            Quito - Receive assignment and leave for Guayaquil.  
Monday

June 24            Guayaquil - Meeting with Fred, Rick, Mauricio and Gutierrez.  
Tuesday            - Meals for Millions - Caruso  
                     - Phydaygesa- Solvent Plant - Sr. Juardo

June 25            Monta - Ales Solvent Plant  
Wednesday        - INIAP Experiment Station - Portoyiejo test plot

June 26            Guayaquil - Molinas del Ecuador - Superintendent  
Thursday          - Oleica - Solvent Plant - Ing. Piana  
                     - Olyasa - Expeller plant

June 27            Babahoyo - Soy growers  
Friday

June 28            Queuedo - Soy growers  
Saturday

June 30            Guayaquil - Institute of Invest. - Tech. de la Univ. - Dr. Cueva  
Monday            - Molinas del Ecuador - Bill Black  
                     - CENDES - Morales

July 1             Guayaquil - Meals for Millions - Caruso  
Tuesday            - La Favorita - Solvent Plant - Noboa  
                     - Molinos Del Ecuador - Tom Truegger

July 2             Babahoyo - Soy growers  
Wednesday

July 3             Guayaquil - Phydaygesa - Solvent Plant  
Thursday

July 4             Guayaquil - Vigoro - Feed Plant  
Friday             - CENDES -

July 5             Guayaquil - Molinos Champion -Schmidt  
Saturday          - Meals for Millions - Caruso

July 6             Guayaquil - Report  
Sunday

July 7             Guayaquil - La Favorita - Xavier Vayento  
Monday            - Report

July 8             Guayaquil - Data Compilation  
Tuesday            - Leave for Quito

July 9             Quito - Conferences and Report  
Wednesday

July 10            Quito - Conferences and Report  
Thursday

July 11            Quito - Conferences and Report  
Friday

I. EVALUATION OF THE CURRENT POSITION OF AGRICULTURAL DEVELOPMENT  
AND DIVERSIFICATION PROGRAM AS PERTAINING TO SOYBEANS.

Brief History of PDDA - 1972-73

The Programme Development & Diversificacion Agricole (PDDA) was initiated in 1972 and was designed to prepare Ecuador for a stronger agricultural future, bringing into account then current crops such as bananas, rice, cotton, maize, cacao, coffee and other food stuffs with respect to oil seed production. The program is under the direction of Executive Director Jorge Guitiérrez Gallardo.

One of the important sections of PDDA is the oilseeds development program which includes soybeans. This report will emphasize soybeans, utilizing data and input available on other oilseeds as they supplement the soybean situation.

General Promotion and Position of Soya

Promotion of soya as a crop has had the impetus of a deficient food oil supply in Ecuador based on the following points:

1. Increasing requirements for salad oils, shortening, margarine and other vegetable oil-based products.
2. Desire to decrease oil imports.
3. Demand for soybean oil as a quality product.

Processing of soybeans for oil also produces dry matter which contains proteins, carbohydrates, fiber and ash, and constitutes about 80 percent of the total weight of the bean (includes 10-12 percent moisture). This dry matter portion has many domestic uses i.e. as a highly nutritious soy flour for human consumption and as a protein supplement for poultry and animal feed.

Soybean meal for poultry and animal feeds must compete with other protein sources including cottonseed meal, peanut meal and some fish meal.

Two main problems are currently encountered in utilizing soybean meal for poultry and animal feed:

1. The official price of soybean meal is 260 Sucres/quintale and that of cottonseed meal S/220/qq, with approximately the same protein level. The market price for soybean meal however, is S/380/qq. Although glossypul inhibitors must be added to the cottonseed meal, and soybean meal has other assets contributing to a more nutritional feed, the cost differential is currently sizeable for feed manufacturers and users.
2. There is an excess of cottonseed meal available at the processors' level. It is reported to be approximately 8,000 metric tons (MT) at this date. All of the cottonseed and soybean meal produced is scheduled to be consumed in Ecuador. An export program is, however, of interest to both PDDA and the processors.

Several alternatives for soy flour use will be considered later in this report.

The general trend for soybean crop production has been upward. The demand for oil has encouraged planting of increased numbers of hectares. The enthusiasm for planting, however, has been dampened by the lack of a market for the meal and a lack of credit to farmers for seed, herbicides and equipment for planting and harvesting.

Table 1 indicates the growth pattern.

	1973	1974	1975	Projected 1976
Soya Hectares Planted	1,227	2,378	5-6,000	10-12,000
Soybean Production (metric tons)	1,673	3,245	7,500	15,000
Oil Yield (metric tons)	318	616	1,425	2,850
Meal Yield (metric tons)	1,355	2,629	6,075	12,150

Considerable speculation arises as to the continuing rate of growth. Soybean production at the farm level requires some unique treatments and harvesting equipment.

Farmers are using combination rice drills for soybeans, but there is also a need for harvesting and threshing equipment. Considerable grain is lost from exposure to weather, shatter and ordinary field loss when harvesting is done by hand. Storage is practically non-existent.

Provision for loans to individual farmers has been handled through the Banco de Fomento and small banks but it is reported that there is actually very little, if any, money available. Since only short term loan money is available and farmers experiencing crop losses often default in payment, there is little, if any, money to continue credit programs. This leaves the farmer with no lead time to arrange alternate financing or changes in crop plans.

#### Soy Grower Associations

Farmers are organizing as associations in an attempt to establish a firm base for a line of credit. Qualified, responsible farmers are selected and

the association assumes financial responsibility for any defaulted loans. PDDA is encouraging the soy growers as a means of furthering soybean production.

The associations also have plans for industrial development; processing soybeans into crude oil and soybean meal, in the near future; with further refinement of products as a longer range project. An economic study is in progress to evaluate a facility to include bean storage, oil expellers, and pelletizing operations for soybeans, with storage also available for corn.

#### Certified Seed Program

Much emphasis has been placed, starting in 1974, on quality seed. Prior to this time yields were limited by germination problems. A Certified Seed Program has been started on the peninsula through efforts of PDDA and Peace Corps Volunteers. Many of the seed beans for 1975 came from Columbia and reports indicate good results. However, this is properly an area for fuller development in Ecuador.

I. PROJECTION OF PRODUCTION REQUIREMENTS OF SOYBEANS AS A  
FUNCTION OF PRESENT AND FUTURE DEMAND

Oil Consumption

The demand for vegetable oils has, to date, exceeded the supply available from Ecuadorian crops and an import program has been in effect for a number of years.

Vegetable oils are used for salad and cooking oils, margarine, and shortening, the latter being hydrogenized for purposes of stability and physical usage. Cottonseed, African palm, Royal palm, peanuts, sesame, and soybean are the sources of oil for Ecuador and are some of the principal crops in the country (See Table 2). Palm and soy oil have been imported as a means of supplementing the population's need for oil, margarine and shortening.

TABLE 2 OIL SEED, OIL AND MEAL PRODUCTION (IN METRIC TONS)

	% Oil in Seed	Oil Seed	1973		1974		
			Oil	Edible Meal *	Seed	Oil	Edible Meal *
Cotton Seed	15	9,273	1,391	7,800	19,545	2,927	16,000
Palm-African Hull	17		9,000			11,000	
Palm-African Kernel	60		1,000			1,200	
Palm-Royal	60		6,000			6,000	
Peanut	50	10,000	5,000	5,000	10,000	5,000	5,000
Sesame	50	2,730	1,365	1,365	2,100	1,050	1,050
Soybean	20	1,673	318	1,355	3,245	616	2,629

\*Human or Animal

Projecting the demand for oil over the next 10 years involves consideration of population increase and per capita consumption. Census figures show 1974 population at about 6,500,000 with 2,680,000 living in urban areas, and 3,820,000 living in rural areas. By 1980 the population can be expected to

be 8,145,000 and by 1985, 9,721,000 people, i.e. approximately 3.6 percent increase per year.

Estimated Population Potential

<u>Year</u>	<u>Population</u>
1975	6,825,000
1980	8,145,000
1985	9,721,000

Consumption of oil and oil products is affected by both population increase and per capita consumption. While the quantity of oil consumed due to population increase follows a fairly defined pattern, the per capita consumption might be altered by various factors. At present (1975), the per capita consumption of oil and oil products is about 5.86 kg. Previous surveys and field observations indicate the rate of growth of oil usage is exceeding the rate of growth of the population.

TABLE 3 Potential Oil Consumption Demand  
150% and 200% of current consumption

Year	Population	At Current Usage-Oil Consumption	At 150% of Current	At 200% of Current
		(5.86 kg/c)	(8.79 kg/c)	(11.72 kg/c)
1975	6,825,000	39,995 MT	-	-
1980	8,145,000	47,730	71,595 MT	95,460 MT
1985	9,721,000	56,965	85,448	113,930

If production of oil from all other seeds, including imported oil, stays fairly constant at the 1974 level, then soybean oil from locally grown beans must be produced according to the schedule in Table 4.

TABLE 4 Soybean Oil Production Requirements at Three Levels of Consumption - Metric Tons

Year	Local soybean oil Production Requirements			Imported Soy Oil	Other Oils Incl. Imports	Total Oil Requirements (From Table 3)		
	100%	150%	200%			100%	150%	200%
1974	616	-	-	10,046	27,177	37,839	-	-
1980	10,230	34,095	57,960	10,000	27,500	39,995	71,595	95,460
1985	19,465	47,948	76,430	10,000	27,500	56,965	85,448	113,930

TABLE 5 Projected Soybean Production Schedule (For Oil Requirements Only)

	Soy Oil Requirements (From Table 4)		Soybean Requirements at		Hectare Requirements- 30 qq/HAS at	
	150% Level	200% Level	150% Level	200% Level	150% Level	200% Level
	MT	MT	MT	MT	MT	MT
1980	34,095	57,960	170,475	289,800	125,015	212,520
1985	47,948	76,430	239,740	382,150	175,809	280,243

Currently there is an estimated 200,000 hectares available in the central coastal area for soybean production at a production rate of 30 qq/HAS.

Soy Flour Consumption

The demand for soybean flour is currently negligible in Ecuador. All residue from the extraction of oil from soybeans has been used in poultry feed. Although highly desired as a protein ingredient, there has been a concern with high market price compared to cottonseed meal for a similar ingredient. Also the supply has been limited. All bean extraction (meal production) occurs at harvest time and storage is limited.

As a means of furthering the promotion and coordination of the total soybean program, an analysis can be made of potential uses for soy flour relative to bean production.

Use in Bread Flour as a Wheat Replacer

Quantities of soy flour of up to 12 percent of the total wheat flour have been successfully used in the baking industry when treated with conditioners to allow proper baking qualities.

Wheat mills in Ecuador supplied 156,000 MT of flour in 1974 and anticipate an annual increase to about 175,000 MT in 1975. Total capacity of all the wheat mills is approximately 200,000 MT of flour per year.

The two major mills in Guayaquil currently are furnishing 50 percent of the total Ecuadorian flour and would provide excellent sources to begin the addition of soy flour.

A 12 percent replacement based on the 1975 demand for flour would require 21,000 MT of soy flour. At 80 percent extraction, this replaces 26,250 MT of wheat. This represents 21.2 percent of anticipated 1975 wheat imports.

In terms of production, 21,000 MT of flour is equivalent to approximately 48,800 MT of field beans or 35,786 HAS of planted crop. The remaining portion of the beans not used as flour consists of oil, fiber (hulls), foreign material, cracked or reject beans and other matter not used in quality flour. This material, other than the oil, is usable as animal feed.

Following the population increase potential, and an annual average increase in consumption of 10 percent, Table 6 shows the projection of soy flour, field beans, and hectares planted.

TABLE 6 Projected Soy Flour & Bean Requirements for 12% Addition to Wheat Flour

	Population	Soy Flour		@ plus 10% Beans MT	@ plus 10% HAS @30 qq/ha
		@ 3.08 kg/c	@ plus 10%/yr		
1975	6,825,000	21,000 MT	--	--	--
1980	8,145,000	25,086 MT	40,400 MT	93,953	68,899
1985	9,721,000	29,940 MT	77,656 MT	180,595	132,436

Other Soy Flour Uses

Soy protein is a very flexible product. Besides the large range of flour uses in bread, pastries, cookies, etc., there are other refinements and processes such as:

- 1) Textured vegetable proteins used as meat analogues
- 2) Soy protein concentrates (70% P) for bolstering low protein foods
- 3) High soy concentrates (90% P) for use in beverages, such as milk substitutes.

All of these processed flours use the same base soy meat or flake.

Meals for Millions is doing a great amount of testing and promotion in the Guayaquil area on textured proteins and soy flakes at the consumer level, however, too many new products too fast can be a problem in getting the basic project started.

## II. EVALUATION OF EXISTING FACILITIES FOR OILS AND FATS

Nearly all facilities for refining crude oil and production of refined oils, margarines and shortenings have been associated with extraction or expeller operations. As evidenced by the total oil processed in 1974, there is a minimum refining capacity of about 40,000 MT/yr. Since these refineries switch seed oils on a basis of availability, both from import and domestic crush, there is probably closer to 60,000 MT/yr capacity when running on one product.

Each of the refineries visited were increasing deodorizing capacity as well as first refining equipment. These plants are well integrated in that they all produce consumer goods. Present facilities can not provide adequate refining and finishing for the estimated 85,000 to 114,000 MT/yr oil requirement in 1985.

The new extraction plant, La Favorita in Guayaquil, is incorporating degumming and lecithin production equipment in their facility. This is the only lecithin system found in Ecuador.

#### IV. PERSPECTIVE ON EQUIPMENT REQUIREMENTS AND OTHER REQUIREMENTS FOR SOYBEAN INDUSTRY

##### Extraction Production Facilities

Three solvent extraction plants are in operation in Ecuador in 1975. They have a combined capacity for soybeans of 245 MT/24 hours, with 75 MT at Oleica, 50 MT at Phydaygesa, and 120 MT at Ales-Manta. This is equivalent to 85,750 MT per year when operating on beans only and with efficiency. This figure must be modified for existing conditions and more than likely there is a 15 to 20 percent reduction.

Another solvent extraction plant is being constructed (La Favorita) in Guayaquil and will go on stream in late 1975 or early 1976. The capacity of this plant will be 120 MT/day on soybeans, or a potential capacity of 42,000 MT per year operating on beans only and efficiently. Total Ecuador extraction capacity if used only for beans is 127,750 MT/year theoretically, and about 105,000 MT/year actually.

Each of the extraction plants is now extracting mostly other oilseeds than soybeans. Estimates of reported actual running volume in 1974 and 1975 by percentage of the potential capacity is:

Phydaygesa	-	50%
Ales	-	95%
Oleica	-	90%
La Favorita	-	New

None of the plants have operated for any extended length of time on soybeans. Efficiency and production capability can be improved with help from the plant designers (Desmet and Krupp).

Individual Plant Capabilities for Soy Flour

Phydaygesa - Krupp Design - 50%

This plant is currently the best equipped with minimum conversion or additions to start producing specification base flakes for soy flour. It has a horizontal tube and conveyor desolventizer-toaster, commonly known as "Schnecken Type." This system with four sections, properly managed, should be capable of making the high PDI (Protein Dispersable Index) soy flakes that are needed for bread flour addition.\*

This plant also is equipped with a gravity air table for proper final clean-up of flakes before grinding into flour.

Building and warehouse space are, spacewise, adequate for the installation of dehulling equipment.

Storage facilities, either bag or bulk, for field beans, base soy flour flakes, and finished flour storage are extremely limited. There are no facilities or equipment for grinding and handling soy flakes into flour.

This plant has a primary function of producing crude oil for their food oil refinery.

<u>Ales</u>	-	Desmet Design	120 TM/D
<u>Oleica</u>			75 TM/D

\*NOTE: Soy Flour for "Blend K" @ 12% in wheat flour should be 70 to 75 PDI and very light in color. PDI of 35 to 45 will work with some loss in loaf volume and darker crumb color.

These two plants are discussed together, since both have similar extraction and desolventizing equipment from the same manufacturers. These plants were designed and are currently operated first for the oil produced and secondly for the meal.

To produce base soy flakes for soy flour (high PDI) a different deodorizer-desolventizer would be required. The existing tray and sweep system now installed actually over-toasts and lowers PDI too far. Color is also too dark.

No soybean dehulling or flake cleaning is available.

As with Phydaygesa, facilities for field bean storage are limited. Also, new facilities for flour grinding, and flake and flour storage and handling would need to be provided.

#### La Favorita - Desmet Design - 120 MT/D

This extraction plant is designed currently like Ales and Oleica with some small differences. The major improvements are field bean storage and the ability to look forward to soy flour production while in the construction stages.

Again, the deodorizer-desolventizer is a tray and sweep device and not proper for light colored, high PDI soy flakes. Dehulling, flake clean-up flake grinding and flour storage and handling equipment is lacking.

I was unable to observe any bean expeller operations. Most expellers (about 10 machines of various vintage and capacity) were in use on pre-press ahead of solvent extraction.

Comparison of Extraction Facilities to Production Needs for Oils and Flour

The available total extraction capability in Ecuador is approximately 365 MT/D rated capacity on soybeans. This figure could vary upward with concentrated effort on the part of the manufacturers (Desmet and Krupp) and the owners and operators. However, for this report, the figure of 365 MT/D will be used.

For Oil production:

365 MT/Day Beans X 350 Days = 126,750 MT/Year  
x 85% Plant Efficiency = 108,588 MT/Year  
20% X 108,588 MT/Year = 21,718 MT/Year of Oil

For Soy Flour production:

365 MT/Day Beans X 350 Days = 127,750 MT/Year  
X 85% Plant Efficiency = 108,588 MT/Year  
43% X 108,588 = 46,692 MT/Year of Flour

If all extraction facilities in Ecuador were used for soybean extraction there would be approximately 22,000 MT of oil and 47,000 MT of soy flour made available for consumption.

It is reasonable, however, to predict that no more than half of the total extraction capacity can be made available for soybean extraction, therefore, oil and flour production capability is:

Oil - 11,000 MT/Year  
Flour - 23,500 MT/Year

On this basis, the extraction plants in Ecuador are adequate to produce enough soy oil until 1980 at the same level of consumption (5.86 Kg/c/yr) as 1974. See Tables 3 and 4. An additional 440 TM/Day extraction capacity will supply total soy oil requirements til 1985 at the 150 percent level; 900 TM/Day additional are required at the 200 percent level.

For flour, the existing extraction plants in Ecuador can produce enough soy flour to about 1977 with consumption at the same level as 1975 (3.08 Kg/c/yr) and 1976 at the 10 percent increase level. See Table 6. Beyond 1977 and with increased consumption per capita, the supply becomes inadequate. An additional 240 TM/Day extraction capacity will supply total soy flour requirements until 1985 at the 10 percent increase/year level.

Estimated Additional Plant Facility Costs for Soy Flour Production

Ales  
Oleica

1) Field Bean Storage (15 Days)	\$185,000
2) Bean Dehulling	170,000
3) Different Deodorizer-Desolventizer	250,000
4) Flour Grinding, Classifying, Storage and Handling	276,500

Phydaygesa

1) Field Bean Storage (15 Days) (Some flat bldg. storage available)	150,000
2) Bean Dehulling (Some equipment available)	125,000
3) Deodorizer-Desolventizer (Modify Existing)	100,000
4) Flour Grinding, Classifying, Storage and Handling	276,500

La Favorita (Not completed)

1) Field Bean Storage	Adequate
2) Bean Dehulling	\$125,000
3) Deodorizer-Desolventizer	250,000
4) Flour Grinding, Classifying, Storage and Handling	276,500

These cost figures are representative only and may vary widely with supplier, type of equipment selected and quality of facility erected.

V. CONCLUSIONS AND RECOMMENDATIONS CONCERNING THE AGRICULTURAL DEVELOPMENT AND DIVERSIFICATION PROGRAM WITH SPECIAL EMPHASIS ON SOY

Conclusions

1. All persons and groups contacted regarding the soy program showed tremendous interest in the program and expressed their hopes that positive actions would be taken.

2. The area under soy cultivation and the resulting production of soybeans will increase with the improvement of production technology and, more importantly, the technology for processing and utilization.

3. Wheat millers (especially one with 25 percent of the national milling capacity) appeared to be interested in and mechanically capable of implementing flour fortification with soy up to 12 percent. The majority of the national milling capacity would be favorably disposed to immediate implementation of the fortification program.

4. It would be necessary to import soy flour for wheat flour fortification until the oil extractors have installed equipment and capacity for production of soy flour. The installation of such soy flour production capacity could be quite rapid if potential demand is demonstrated.

5. Through 1985 a great imbalance will exist between utilization of the projected soy oils and the soy meal.\* Although availability of oil seeds will increase during the coming years, the great majority of fats and oils will be derived from soy, whether domestic or imported.

\*Approximately one-half the field bean tonnage required to produce soy oil at 150% of the current per capita consumption will have to go to animal feed. This allows for soy flour in bread wheat flour at 10% increase/year level.

6. The actual oil refineries' capacity and production of fats and margarine is approximately 60,000 metric tons per year. Full utilization of this capacity will be reached within 2 to 3 years. The present soy extraction capacity including La Favorita is 54,3007 metric tons of beans per year at 85 percent efficiency, allowing one-half of the total Ecuador oil extraction capacity for soybeans. This amount of soybeans is equal to 10,800 metric tons of crude oil and 43,400 metric tons of soybean meal which could be used to produce soy flour and animal feed.

7. There is, at present, sufficient extraction capacity at one-half the total to produce and supply enough soy flour for the fortification of wheat flour at 12 percent until 1978-79. Additional extraction capacity of 40 MT/Day are needed to supply the needs in 1985.

8. Additional extraction capacity of 440 MT/Day will supply soy oil in 1985 at the 150 percent level; 900 MT/Day additional are required to supply soy oil in 1985 at the 200 percent level.

#### Recommendations

In general, the soy production program appears to be sound. In order to achieve a more efficient operation of the program, the following suggestions are made:

There is a need to increase storage capacity for soybeans. At the farm level, this would encourage spreading out delivery and provide leverage for market price. Increased processor storage is also important to provide for leveling production when switching extraction.

2. Better harvesting methods and equipment are needed now. Loans to farmers must be processed and completed far enough ahead of the season to allow proper planning. Simple mechanical harvestors and threshers should be promoted to facilitate harvest speed and reduce field losses.

3. Extraction facilities that will be utilized for soybean meal and subsequent flour production will need certain improvements.

a) Dehulling - for plants requiring 50 percent protein meal, including soy flour, equipment for a 120 MT/Day plant will cost approximately \$170,000.

b) Soy flour processing - A separate building for grinding, packing and storage is needed. The building and equipment cost is estimated at \$275,000 per plant. For those plants with marginal equipment to produce specification flakes ahead of grinding, the investment is estimated at \$250,000 per plant.

c) Total potential cost - any plant

Bean process storage	\$185,000
Dehulling	170,000
Desolventizing	250,000
Grinding, packing, storage	<u>275,000</u>
	\$880,000

d) Recognition by extraction plant owners and operators that the soybean meal is a valuable protein commodity, as well as the oil.

4. As requirements for soy oil and flour are proven, there must be re-evaluations of processing facilities in time for private industry to respond.

5. Food technologists are vital to the success of a total nutrition program. Also a continuing research program on soy protein should be emphasized.

6. PDDA should be reinforced to support a total program. An excellent job is being done on the bean production end through farmer promotion, INIAP Experiment Stations, and efforts towards investigating vertical integration through Soy Grower Associations. More effort is needed immediately in the mechanical phase, including planting and harvesting equipment. This would be an excellent place to utilize some of the AID allotments in terms of perhaps a small factory to build simple but adequate equipment. Soybean planting and harvesting is not as receptive to labor-intensive cropping as rice, bananas, cacao, cotton, and coffee.