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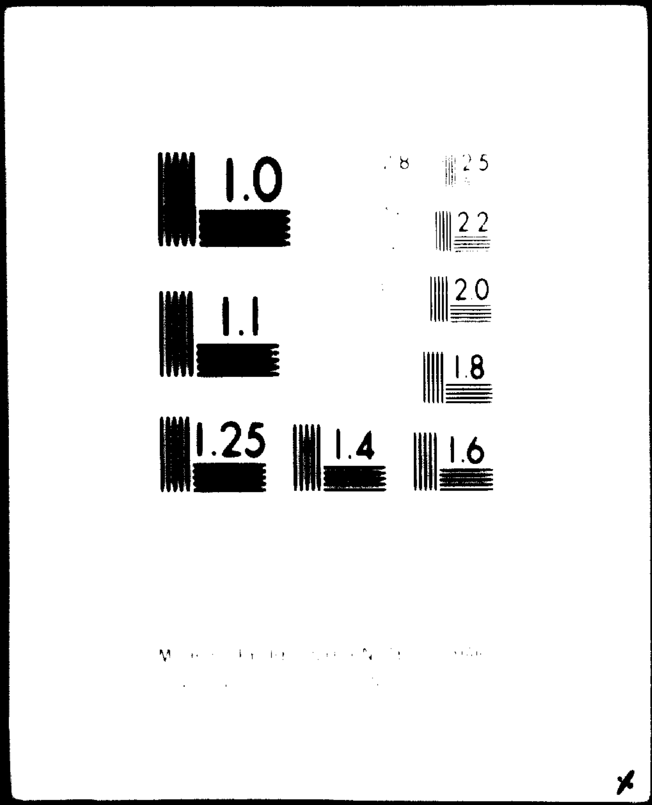

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(R) AGRO-INDUSTRIAL COMPLEX IN CAN THO, VIETNAM

DP/RVN/73/002

(UNIDO CONTRACT 74/21)

MAY. 1975

PACIFIC PROJECTS, LTD.
TOKYO, JAPAN

MITSUI CONSULTANTS CO., LTD.
TOKYO, JAPAN

DP/RVN/73/002

AGRO-INDUSTRIAL COMPLEX IN CANTHO, VIETNAM (UNIDO Contract 74/21)

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(PPL Project No. 177)

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May, 1975

AGRO-INDUSTRIAL COMPLEX IN CANTHO, VIETNAM

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INTRODUCTION

Origin of This Report

The concept of having an agro-industrial complex in the Mekong Delta of Vietnam was discussed in 1972 and 1973 by representatives of the Indstrial Development Bank of Vietnam, the United Nations Development Program, and the United Nations Industrial Development Organisation.

A contract to prepare a master plan for the complex was awarded in September, 1974. The contractor selected was a consortium of consulting companies based in Tokyo. Field surveys were conducted in Saigon and the Mekong Delta in September - November, 1974 by a three-member team consisting of a techno-economist, an expert in soils and tropical agriculture, and a food processing engineer.

Subject of Report

This report analyzes the agro-industrial potential of the Mekong River Delta region around the city of Cantho. Special emphasis is placed on the potential of the Tay Do Industrial Park, a 151 hectare (373 acres) government-sponsored estate located 9 kilometers north-west of the city of Cantho (See Figure I-2).

Tay Do Industrial Park

The Tay Do Industrial Park is one of six industrial estates being sponsored by the Government of Vietnam through an agency called SONADEZI (Sociètè National du Dévelopment des Zones Industriales). By far the most successful of the zones thus far, is the 511 hectare Bien-Hoa Industrial Park, 30 Kilometers north of Saigon where 90 manufacturing plants are located and 50 in operation as of mid-1974.

The Tay Do Industrial Park is only beginning to attract industry but is essentially complete. Land purchases for the Tay Do Park were started in 1968, surface preparation was completed in 1969, a water tower and well were completed by 1972, a power plant (33 MW) went on stream in December 1974, and only an expanded road and drainage system still remain to be completed in 1975.

The total expenditures, according to SONADEZI, from 1968 through 1975 will be 3.9 billion piasters (at the 1974 exchange rate of 685 piasters to US$1.00, the investment in the park alone would be the equivalent of US$5.7 million). Some of the piaster costs of the 33 MW thermal power plant are included in the total but the foreign exchange cost were not included since they were financed by the Japanese government as part of the aid program to Vietnam. (The power plant cost ¥3.2 billion or the equivalent of US$10.7 million or $324 per KW of installed capacity.) (See Bibliography Nos. 26, 26-A)

Despite the impressive progress to date, major capital investment, concessional land rentals, and encouragement from the Government, the Tay Do Industrial Park is not yet fully utilized. Of the total 151 hectares, 26.5 hectares is now occupied by completed plants or facilities. Another 19.8 hectares are under construction, or planned. The plants built or planned by the end of 1974 were as follows, covering 46.3 hectares or 31% of land available. (See Table I-2 on the next page.)

Table I-2

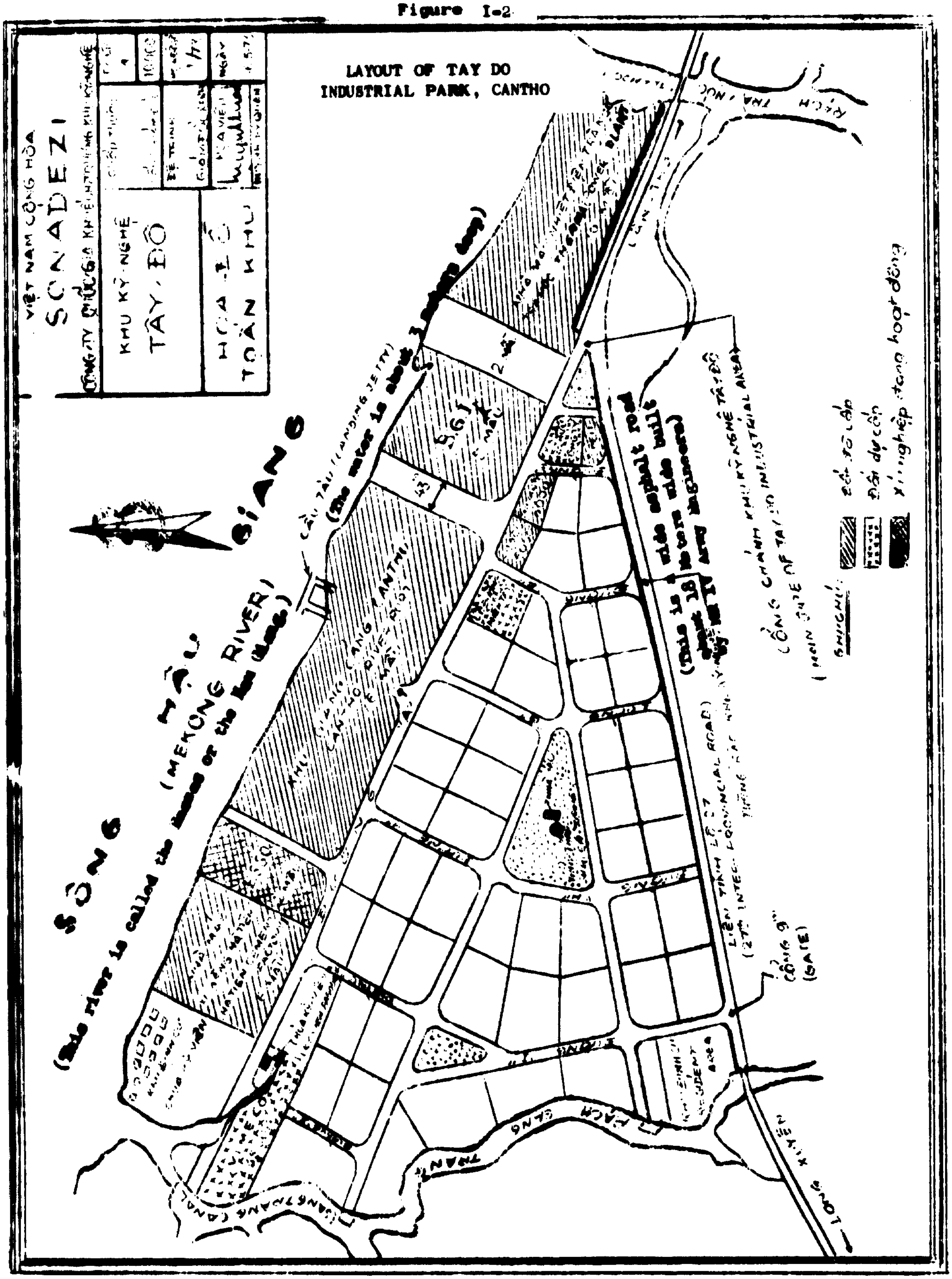
FACILITIES BUILT OR PLANNED ON TAY DO INDUSTRIAL PARK

(as of Oct., 1974)

Status	Product or Service	Hectares	Capital-ization US$millions	Remarks
Built	Fuel oil and asphalt tanks (Esso)	0.2	.04	--
"	Thermal power plant	10.0	10.7	--
"	Pier and warehouse	15.0	n.a.	--
Planned	Carbonated beverages beer, and ice (B.G.I.)	5.0	6.2	--
Built	Acetylene for welding (I)	0.6	0.7	--
"	Raw sugar	0.7	0.7	--
Planned	Gasoline retail stand	0.2	n.a.	--
"	Cement Plant	10.0	n.a.	--
"	Acetylene for welding II)	0.6	0.7 (est.)	--
"	Raw sugar	0.5	0.4	--
"	Rice mill (VI[illegible]CO)	3.5	0.6	--
	Total	46.3	$20.4	Capitalization total is not complete

Source: SONADEZI, Cantho and HAZAMA Gumi Co., Tokyo

Figure I-2



Source: SONADEZI Cantho

Purpose of This Report

This report is intended to identify inter-related and potentially viable industries to utilize local agricultural raw materials, and, in a few cases, to use imported materials for an interim period. Most of the industries described herein would be located on the Tay Do Industrial Park (see Appendix A for "Statement of Work").

In the case of certain industries, however, siting of plants outside the Tay Do Industrial Park is preferable. In a few cases, i.e. the marine products processing plants, siting near the sea coast is more economical and sometimes essential when it becomes necessary to have an assured source of fresh, high quality raw material.

Content of the Report

This report describes the setting of the Tay Do Industrial Park and the city of Cantho, the 16-province Mekong Delta Region, the population, labor force, principle products, and relationship of the Delta region to Vietnam as a whole (Chapter 2).

In accordance with the contract (See Appendix A), a series of 19 potential industries are evaluated as candidates for the Tay Do Industrial Park or other localities in the Cantho region (Chapter 3).

From the 19 candidate industries, plus others identified during the survey, the most feasible industries are described in terms of their potential output, capital requirements, and profitability (Chapter 4), and the time phasing and priorities are suggested (Chapter 5).

The existing agro-industries of the Cantho region are identified (Chapter 6) and policies and incentives recommended to encourage the development of industry and specifically further utilization of the Tay Do Industrial Park (Chapter 7).

The suggested method for executing the development strategy is outlined (Chapter 8) and further required feasibility studies are described (Chapter 9).

Appendixes include a bibliography, supporting statistical data, and exhibits to clarify the text of the report.

Methodology of the Report

The concept of preparing a master plan for the agro-industrial complex at Cantho was conceived during discussions in 1972 and 1973 between representatives of UNIDO, UNDP, and the Industrial Development Bank of Vietnam.

A consortium, consisting of U.S. and Japanese firms, was selected by UNIDO on May 16, 1974 to carry out the survey and to prepare the master plan. The two member firms of the consortium are: (1)Pacific Projects, Ltd., an American-owned firm based in Tokyo and (2)Mitsui Consultants Co., a Japanese firm also of Tokyo. A contract (UNIDO No. 74/21) was signed on September 23, 1974 at the UNIDO headquarters in Vienna.

To conduct the survey in Vietnam, a project team was organized consisting of the following three persons:

Frank L. Turner, Senior Industrial Development Economist, with prior experience in industrial planning in the Ryukyu Islands, Korea, Taiwan, Japan, Ecuador, Peru, Chile, Bangladesh, Cameroon, and Nigeria. Most of Turner's studies were prepared for the Stanford Research Institute of Menlo Park, California.

Tadayuki Aoike, Soils and Tropical Agriculture Expert, with prior experience in Sumatra, Nepal, Indonesia, New Guinea, Iran, and the Philippines. Aoike has also made surveys of agricultural machinery.

Susumu Tsuji, Doctor of Agriculture, Food Processing Engineer, is Chairman of the Food Processing Engineers Assoication of Japan (affiliated with FIDIC). Tsuji's prior experience includes feasibility and planning studies for industry in Nepal, Sri Lanka, Taiwan, Korea, Philippines, Indonesia, Singapore, Thailand, Malaysia. Tsuji is author of a reference work entitled "Food Processing Guidebook" in Japanese.

Turner left Tokyo on Sept. 15, 1974 for Saigon, Cantho and Bangkok, Vienna, Washington D.C. and Menlo Park, California. The objective was to meet representatives of the UNDP, the Vietnam Industrial Development Bank and SONADEZI, in Saigon and Cantho; officials of the Mekong Secretariat in Bangkok; UNIDO in Vienna; and USAID and IBRD (World Bank) in Washington, D.C.

In Menlo Park, Calif., Turner met with persons familiar with the Stanford Research Institute study of land reform in Vietnam, and then returned to Tokyo on Oct. 1, 1974.

On Oct. 20, the three-man survey team left for Saigon and members of the team remained in Vietnam until November 29.

From Oct. 22 to Nov. 7, the team was based in Cantho in order to visit the Tay Do Industrial Park, agro-industrial plants, farms and to interview knowledgeable people in the local government, Cantho University (5 Japanese professors were in residence), and USAID.

The team travelled to the coastal town of Rach Gia to see fish meal processing and the freezing of marine products for export.

Turner spent Nov. 29 and 30 in Bangkok to inspect rice bran oil manufacturing plants in cooperation with FAO representatives.

From Dec. 1 to date, the survey team in cooperation with marketing specialists and engineers in Tokyo, analyzed data and prepared this report.

Acknowledgements

We would like to express our appreciation for the help extended to the project team by the following persons, listed in the sequence in which they were met: (1)Richard H. White, UNDP, Saigon; (2)Eric R. Adams,UNIDO, Saigon; (3)Pierre Sales, UNDP Saigon; (4)Khuong-Huu Dieu, Industrial Development Bank of Vietnam; (5)V. R. Pantalou, Mekong Secretariat, Bangkok; (6)Eric D. Manning, UNIDO, Vienna; (7)Andras Miklovicz, UNIDO Vienna; (8)David Roberts, UNIDO, Vienna; (9)D. F. Mant, UNIDO, Vienna, (10)Nguyen Huu Thu, Industrial Development Bank of Vietnam, Saigon; (11)Tran Thanh Tung, SONADEZI, Cantho (12)Luu Phong Loi, Industrial Development Bank of Vietnam, Cantho; (13)Toshio Mizunaga, Project Manager Hazama Gumi Field Office, Cantho; (14)Toshio Iga, General Manager, Hazama Gumi, Ltd., Tokyo; (15)N. V. Truong, University of Cantho; (16)Clayton C. Ingerson, USAID, Cantho.

H. B. Cushing and Wendell P. Knowles, Director and Deputy Director respectively of the USAID group in Cantho, furnished substantial data and introduced the team to staff members knowledgeable of conditions in the Delta region.

CHAPTER 1

EXECUTIVE SUMMARY

1.1 Conclusions

- This report concludes that it will be feasible to establish an agro-industrial complex on the Tay Do Industrial Park near Can Tho, Phong Dinh Province, about 170 kilometers southwest of Saigon.

- The irrigation water of the Mekong River makes the Delta one of the most potentially productive paddy-growing regions of the world. The current 5.1 million tons of paddy can be substantially increased and premium rice exports and paddy by-product can offset Vietnam's trade deficit.

- The branches of the Mekong have a high potential for the culture of fresh water fish that can be frozen for export.

- Most of the recommended facilities would serve the purpose of achieving better utilization of the Delta's agricultural, fisheries, and livestock raw materials or would help to augment the supply of such raw materials.

- The fixed capital requirement for the agro-industrial complex is estimated at $260.3 million and the annual savings and earnings in foreign exchange are estimated at $172.4 million. The duplication of recommended projects would achieve higher earnings later on.

1.2 Agro-Industrial Projects Proposed

A key facility recommended would be a rice center having annual capacity of 37,000 tons of exportable premium rice. A related near-by facility would produce 960 tons of edible bran oil, 408 tons of industrial oil and 10,200 tons of defatted bran. The bran would help support a mixed feed plant for the hog, poultry and cultured fresh water fish industries.

To support the above facilities and to raise the Delta's productivity, other related plants or services are suggested: (a) a seed distribution center (b) engine repair plant, (c) casting shop, (d) implement and pump manufacturing plant, (e) urea plant (f) intermediate ammonia plant, (g) limestone crushing plant, (h) the culture and freezing of fresh water fish for export.

More regarding the proposed projects is shown in Table 1.2 on the next page.

Table 1.2

PROPOSED AGRO-INDUSTRIES FOR THE TAY DO INDUSTRIAL PARK AND VICINITY, TIMING PRIORITIES, INTERRELATIONSHIP, COSTS, SAVINGS AND EMPLOYMENT

Designater	Timing Priority	Name of Plant or Facility (Related Discussion in Five-year Rural Economic Development Plan 1971-75 Source No. 67)	Interrelationship between Plants and Facilities	Where Plant Description can be Found in This Report	Capital Investment in Fixed Assets (US$ 000's)	Annual Savings or Earnings in Foreign Exchange (U.S$ 000's)	Annual Production Capacity	Direct Employment (indirect employment is 2 to 3 times)	Remarks
A	I	Seed Center (p.127, 130)	Helps assure uniform paddy for Plant D	4.2 4.8	$30	Effect on foreign exchange indirect through Plant C	Sales of 1,000 tons/year of TN variety seeds	15	--
B	I	Engine Repair, Casting Shop, Agricultural Implement and Pump Manufacture (p.131)	Tractor repair and Pumps help supply paddy for Plant D	4.6.2	$221	$5,000 (estimated savings in fuel losses)	Castings, forgings, services worth $200,000/year	31	Assumes fuel losses will decline by half with better maintenance
C	II	Urea Plant and Intermediate Ammonia Plant. (p.131)	Helps assure paddy supply for plant D and other mills	4.7.1	$251,717	$140,145 (value of urea if imported)	480,000 to 612,000 tons per year depending on shifts	335	Assuming multiple shifts foreign exchange savings could be $179 million
D	II	Paddy Cleaning, Drying, Storage and Milling Center (p.32)	Supplies bran to Plant E	4.1.2	$4,601	$18,627 (from export of total output)	37,200 tons milled rice plus 5,100 tons bran	136	If exported and brown rice imported, foreign exchange earnings would be 1/3 to 1/2
E	III	Rice Bran Oil (See p.255 of Source 68)	Supplies defatted bran to Plant F	4.4.7 4.4.8	$806	$1,089 (import substitution)	960 tons edible oil 408 tons industrial oil	34	--
F	III	Mixed Feed (p.67, 131)	Supplies feed to Plant H	4.5.3 4.5.4	$568	$5,414 (import substitution)	51,000 tons of mixed feeds	19	Assumes 22,000 tons imported from Thailand @$160/ton yearly
G	IV	Limestone Crushing on Tay Do Park (p.131)	Improves paddy supply for Plant D	4.7.2	$2,000	Effect on foreign exchange indirect through C or other mills	200,000 tons crushed limestone	50	--
H	IV	Exported Frozen Food Products (p.43)	Cultures fish with feed from Plant F and defatted bran from Plant E	4.9	$415	$2,100 (exports)	1,200 tons of frozen duck, fish or frogs legs	93	After Plant F is in operation, chicken and pork could also processed
I	IV	Milling and Drying of Paddy Outside Tay Do Park (p.126)	For local food supply and bran for Plant E	4.3.1 4.3.2	$832 (milling) $60 (drying)	For local consumption	124,000 tons milled rice plus 19,000 tons bran	520	Assumes 104 mills and 10 drying plants (10 dryers x 8 hours/day x 300 days yr x 9 tons paddy/hour 216,000 tons of paddy
J	IV	Limestone Crushing outside Tay Do Park, 360 kg/hour mills (p.131)	Helps assure paddy for D, bran for E, and feed for H.	4.7.2	$83	Effect on foreign exchange indirect through C and I	25,200 tons of crushed limestone	90	350 kg/hr. x 30 mills x 8 hours/day x 300 days.
Totals	--	--		--	$261,333	$172,375	--	1,323	--

Note: The last two proposed facilities, I and J, would be located outside the Tay Do Industrial Park.

1.3 Location of the Proposed Agro-industrial Complex

The proposed location of the complex is 9 km NW of Cantho City on the Tay Do Industrial Park, consisting of 151 hectares of reclaimed land extending along the Bassac River, one of the major branches of the Mekong River.

Preparation of the estate from 1968 to 1975 cost the piaster equivalent of $5.7 million. Infrastructure built includes an industrial water tower, roads, pier, warehouse and other facilities. Located on the estate is a 33 megawatt thermal power plant, built with Japanese aid at a cost of $10.7 million. There are already 11 manufacturing plants, built or planned, occupying 46.3 hectares or 31% of the estate area.

1.4 Setting of the Complex

Located near the provincial capital city of Cantho, the Tay Do Industrial Park is close to the commercial and transport hub of the Mekong Delta. The urban population of Cantho of 174,422 (1973) can provide a labor force of unskilled and vocationally trained manpower, and the University of Cantho can provide management personnel for some of the proposed plants.

The population of the Delta's 16 provinces is 7.4 million persons or about one third of South Vietnam's population. Growing at an annual average rate of 2.1%, population of the Delta should reach 9.1 million persons by 1985. The population density is moderate, 199 persons per square kilometer (as compared with 296 in Japan and 546 in Bangladesh).

1.5 Agricultural and Fishery Resources of the Delta Region

The top ten agricultural resources in the Delta, as measured by production value in U.S. dollars are as follows (values are for 1973 production):

1.	Paddy	$652.9 million
2.	Hogs	$198.6 "
3.	Oranges and tangerines	$ 91.5 "
4.	Fresh water fishery products	$ 77.4 "
5.	Marine shrimp	$ 72.3 "
6.	Marine fishery products	$ 51.7 "
7.	Chickens	$ 40.8 "
8.	Duck	$ 32.3 "
9.	Sugar cane	$ 22.1 "
10.	Clams, in shell	$ 20.2 "
	Subtotal	$1,259.8 "
	Others	$ 60.5 "
	Grand total	$1,320.3 "

With the exception of marine products (shrimp, red snapper, clams, cuttlefish and fish meal), almost all the Delta's production is consumed within Vietnam. Of the 5.1 million tons of paddy produced in the Delta, about 1.3 million is surplus to the food needs of the Delta, and has traditionally been shipped to Saigon. Vietnam has slipped from being a major rice exporter to a rice importer. Peak exports were 346,000 tons in 1960 whereas in 1965 Vietnam began to import heavily, reaching peak imports of 559,000 tons in 1970.

The potential for Vietnam to resume exports is high. There are several actions that could cause major increases in the Delta's farm productivity and rice milling efficiency such as: higher applications of urea, phosphatic fertilizer, limestone; more deep plowing by tractors; further plantings of the "TN" varieties ("miracle rice" adapted for Vietnam from IRRI varieties); low lift pumping from canals and rivers during the dry season; and improvements in milling practices by using rubber rollers and disc hullers.

Given these improvements, productivity will increase substantially and lead to much higher yields. Improved milling can provide a valuable bran oil by-product not currently possible with inferior mills.

Some of the possible foreign exchange earnings and savings attainable in Vietnam are (see Chapter 7):

Potential value of Delta's exportable rice surplus (1.3 million tons @ $480/ton)	$ 624 million
Correction of current milling losses from inferior milling practices (5% loss of head rice)	$ 105 million
Potential edible oil production from rice bran	$ 38 million
Potential industrial oil production from rice bran	$ 9 million
Total	$ 776 million

The above total is greater than South Vietnam's total imports of $678 million in 1972 and $717 million in 1973.

The principal goals of the proposed program are: (a) to improve paddy processing and cultivation, (b) recover bran and bran oil, (c) provide mixed feeds for animal husbandry and fish culture and (d) to export frozen river fish, duck and possibly frogs legs.

To execute the proposed projects, careful efforts will be required to develop lines of communication with the world's principal sources of financing, both private and public.

Domestic programs will be needed to assure future availability of uniform paddy and adequate supplies of ingredients for a blanced mixed feed for hogs, chickens and cultured river fish.

Managerial skills for some of the proposed plants can be found locally, but in the case of the urea plant, rice bran oil plant, and the rice center, foreign management may be temporarily required during the period of plant start-up.

(Executive summary ends here)

1.6 Comments

The use of the word, "Vietnam" in this report refers to the territory from the 17th parallel to the southern tip of An Xuyen Province.

The plant cost calculations in Chapter 4 are based on the exchange rate of VN$685 to U.S. $1.00, the rate prevailing in December, 1974. There has been devaluation of the Vietnamese piaster. The authors believe that with the return of more normal economic conditions, local currency prices in relation to foreign exchange will tend to seek an equilibrium. In short, it is believed that local currency prices will decline as normalcy returns.

In the text of this report, references are made from time to time to source materials. These source materials are listed in the Bibliography, attached to this report as Appendix F, starting on page 241.

Chapter 2

BACKGROUND INFORMATION REGARDING THE DELTA REGION AND CANTHO

2.0 Purpose of Chapter

This chapter provides basic demographic, geographical, soils, and other data relevant to the future planning of agro-industry in Cantho. (Some of this material is taken from Source 10 in the Bibliography and was written in Feb., 1974)

2.1 Area and Population

The Mekong Delta consists of 16 provinces comprising almost all of Military Region IV (MR IV). The land area is 37,184 square kilometers (14,357 square miles) or about one tenth of the land surface in Japan (372,050 square kilometers). The area of the Delta is about twice that of the American state of New Jersey, is slightly larger than the area of Taiwan and one third the area of Bangladesh (See Tables 2.1 - a and b).

Population in the Delta is rising at an estimated annual average rate of 2.1%, slightly slower than the 2.6% growth rate assumed for all of Vietnam. (Bibliography Nos. 4 and 10.)

We estimate the Delta's 1975 population at 7.4 million persons, or 36% of the total Vietnam population of 20.8 million. We assume that population growth will continue at current rates. On this assumption, the Delta's population by 1985 will be 9.1 million and 34% of the total population of Vietnam of 26.9 million. These projections are tabulated below:

Table 2.1-a

PROJECTION OF POPULATION OF VIETNAM AND THE DELTA

(Unit: millions)

	Vietnam (@2.6% ann. ave. growth)	Delta (@2.1% ann. ave. growth)	Percent of Vietnam Population in Delta
1973	19.9 million	7.1 million	36%
1974	20.3 "	7.2 "	36%
1975	20.8 "	7.4 "	36%
1980	23.7 "	8.2 "	36%
1985	26.9 "	9.1 "	34%

Population density of the Delta is moderate judging by the following comparisons. Phong Dinh Province is where Cantho is located and is one of the most populated provinces in the Delta.

Table 2.1-b

COMPARISON OF THE DELTA REGION POPULATION DENSITY WITH OTHER AREAS

Country or Region	Square Kilometers	Estimated 1975 Population in millions	Population per Square Kilometer
Delta Region	37,184	7.4 million	199
Phong Dinh Province	1,631	0.575 "	353
Rest of Vietnam (i.e. MR's I, II, III.)	133,756	13.4 "	100
All Vietnam	170,940	20.8 "	122
Japan	372,050	110.0 "	296
Bangladesh	142,776	78.0 "	546

Sources: Japan Almanac, 1974; Table 2.1; and calculations by Pacific Projects.

Official Vietnamese Estimates of the 1975 the labor force for Vietnam as a whole show that 69% of the economically active population are engaged in agriculture, 6% in industry and 25% in services.

Since these figures include Saigon, Bien Hoa, Dalat, Hue and other urban areas, the percentage of persons engaged in industry and services is higher than in the predominantly agricultural Delta. On the basis of interviews, we estimate the labor force composition as shown in Table 2.1-c below. Farmers constitute some 80% of labor force.

Table 2.1-c

ESTIMATED BREAKDOWN OF THE DELTA CIVILIAN LABOR FORCE -- 1975
(Source: Estimated by Pacific Projects Ltd. from interviews and source No. 21)

(A)	Total Population of Delta	7,400,000
(B)	Labor Force (40% of A) (Active Population)	2,960,000
(C)	Farmers (80% of B)	2,365,000
(D)	Fisherman (2% of B)	65,000
(E)	Commerce, Industry, Government (18% of B)	530,000

The farm population is largely Vietnamese and thus homogeneous from a language and cultural point of view. About 7% of the Delta population are Cambodians most of whom are engaged in farming. The population of Chinese ethnic origin is small, estimated by the U.S. Consulate in Cantho as being 2% of the toal population or 180,000 persons. Almost none of the ethnic Chinese are farmers, although some are owners of chicken farms. (Persons of Chinese origin, although few in number, are very influential in commerce and industry; we estimate that 80% of the Delta's manufacturing facilities are owned by people of Chinese origin).

The Delta's farm population, when compared with the populations of other developing countries, measures up very well. The farmers are diligent, energetic, skillful and adaptable. Some examples of their adaptability are:

- Starting in 1968, the IRRI varieties of rice ("miracle") were introduced to the Delta. Production of IRRI rice rose at an annual average growth rate of 26%, from 1968 to 1973 (120,000 tons to 3,850,000 tons); hectarage rose even faster from 30,000 hectares in 1968 to 750,000 in 1973. (10)

- The mechanization of agriculture has proceeded rapidly (thanks in part to USAID policies of importing engines in the 2 to 20 HP ranges). The number of 4-wheel tractors imported to Vietnam rose from 484 in 1968 to an estimated 3,600 in 1973 (See Chapter 3); of these, about 76% were destined for the Delta. Tractors have almost entirely replaced the traditional water buffalo in farming regions close to the roads.

- Farmers were quick to see the financial gains from growing sugar which gives them a yield of about 1.0 million piasters per hectare as compared with about 0.6 million piasters per pectare for two crops of paddy (4,000 kg/ha x June, 1974 price of 5,815 piasters plus Dec. 1973 price of 8,711 piasters 581,120 piasters for 2 rice crops. (Bibliography, No. 19.)

- The use of mechanical threshers (rotating drum type with about 4 HP gasoline engine) were introduced by USAID in 1969 and are now used almost universally as opposed to the traditional hand-pounding method of threshing.

- Hog and chicken breeds have been upgraded wherever farmers have supplies of feed.

- A system of fresh water fish culture -- probably unique to the Mekong -- has accelerated very rapidly. We found local estimates of the percentage of cultured fish in town markets running as high as 50%. (See Chapter 3.11)

- Farmers appreciate the importance of irrigation pumps in the dry season, January through March.

Despite the adaptability of the farmers to better methods, there is a fundamental problem of organization that will require careful handling later on when large scale industrial facilities become dependent on local raw materials. The farmers in the Delta are small-holders. About 79% of the agricultural land consists of farms of 1 to 10 hectares in size (*) While this scale of Delta farming may seem better than Japanese or Korean samll-holder farming, it is far smaller than the plantation type of agriculture that characterizes the cultivation of rubber elsewhere in Vietnam, oil palm in Malaysia, corn in Thailand, cocoa in Cameroon, etc.

Therefore the cultivation and collection of raw material for future agro-industries will pose organizational and financial problems. The existing agro-industries in the Delta, such as rice and sugar milling have largely overcome raw material problems. However, future larger scale plants, discussed later in this report, will have to cope with the problem of organizing and financing numerous independent farmers to assure a steady supply of standardized raw material.

On balance, however, the homogeneity and human qualities of the Delta's farming community, the moderate density of population, and even the size of farms (measured by standards elsewhere in Asia) are all plus factors which we believe will contribute to continued and rising productivity of the region around Cantho.

(*) From Bibliography, No. 45

Table 2.1-4

DELTA STATISTICS

POPULATION	DECEMBER 1971	DECEMBER 1972	DECEMBER 1973
DELTA	6,709,703	7,001,340	7,142,243
SOUTH VIETNAM	18,710,710	19,336,397	19,903,236

POLITICAL DIVISION			
PROVINCES	16	16	16
AUTONOMOUS CITIES	3	3	3
DISTRICTS	95	95	95
VILLAGES	798	799	802
HAMLETS	4,297	4,328	4,340

PROVINCE	POPULATION (31 DEC 73)	AREA (SQ KM)	DISTRICTS	VILLAGES	HAMLETS
1. KIEN HOA	636,416	2,084	9	115	620
2. AN GIANG	649,503	1,980	4	38	254
3. DINH TUONG	680,420	1,557	7	98	478
4. CHAU DOC	636,670	2,075	5	57	270
5. VINH LONG	594,042	1,708	7	65	280
6. PHONG DINH	563,633	1,631	7	50	267
7. KIEN GIANG	510,008	5,260	8	47	233
8. BA XUYEN	402,049	2,330	8	54	326
9. KIEN PHONG	432,099	2,303	6	51	210
10. VINH BINH	422,158	2,263	7	56	410
11. BAC LIEU	306,072	2,599	4	19	194
12. SA DEC	314,087	868	4	36	129
13. AN XUYEN	279,145	5,089	6	26	179
14. CHUONG THIEN	208,959	2,298	5	34	168
15. GO CONG	211,907	570	4	32	260
16. KIEN TUONG	[illegible]	[illegible]	4	26	61
Totals	7,142,243	37,184 (14,357 sq. mi.)	95	802	4,340

Source: U.S. Consulate General, Cantho, Phong Dinh Province, Vietnam

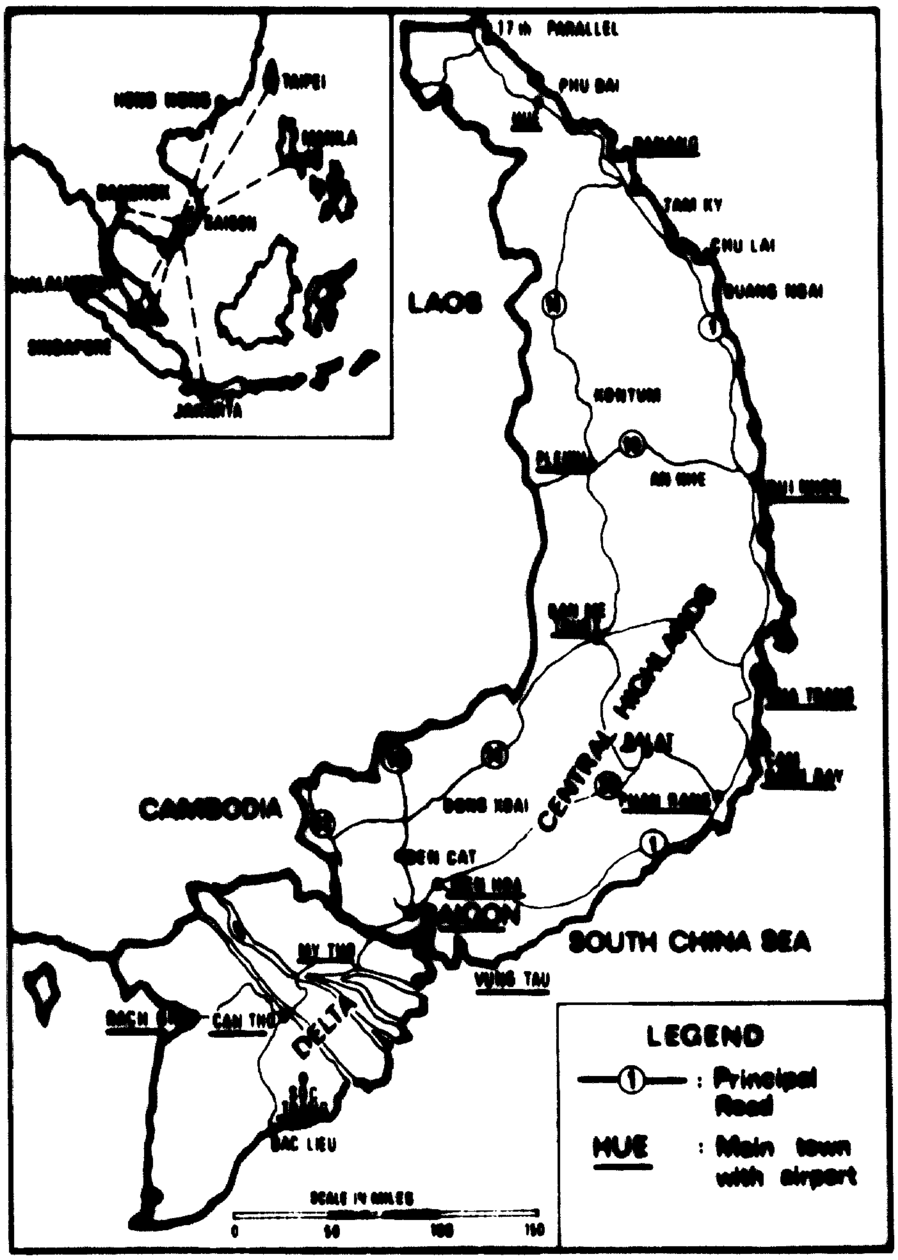
Figure 2.1-a

THE DELTA

Note: The digits appearing in the provinces relate to the digits at the left of Table 2.1- d; see the preceeding page.

Figure 2.1-b

VIETNAM AND THE MEKONG DELTA



Source: Industrial Development Bank of Vietnam

2.2 Soil and Water Characteristics

Our survey group analyzed Delta soils and water in order (a) to determine the potential for growing certain crops; (b) to assess the need for agricultural support industries such as urea manufacture and limestone crushing; (c) to help reach conclusions on the best utilization of rice straw and husk; and (d) to determine the need for mechanization in agriculture.

To accomplish the testing, one of the survey members (Aoike) took instruments to the Delta and tested the soil and water in six localities in the outskirts of Cantho and 1 near the high acidity zone near Kien Tan on the road (LTL 80) to Rach Gia.

Beginning in May and continuing through December, most of the Delta is flooded to a depth of 40 to 80 cm and in some places as deep as 3 meters. From January to May, the soil dries out and becomes "brick" hard. The flood means that the minerals and other properties of both the soil and water have an influence on the suitability of the region for certain crops.

The U.S. Department of the Army (in Source 35)(*) describes the soils as follows:

"Added to the water variations are problems resulting from heavy soil texture, high acidity, inadequate internal and surface drainage, poor surface tilth, slow permeability, and rather low fertility. The problems of poor tilth, crusting, soil hardening and cracking when dry and slow permeability can be ameliorated somewhat with the incorporation of organic residue. To improve the soil, straw and stbble should, as a rule, not be burned unless it impedes tillage. Organic matter can also be added by plowing under cover crops, applying barnyard manure, and growing perennial grasses in rotation with other crops." (*)

Our water and soil analysis resulted in the following findings:

- There is no salinity problem in the vicinity of Cantho, although brackish water in the lower Delta is a problem.

- The pH value in the water was 7.3 which helps offset the soil acidity of 4.3 to 5.0 in our texts of moist samples. (Department of the Army tests on moist soils ranged from 4.2 to a high of 7.0. The neutral pH value of 7.0, however, was found in 5 out of 57 tests only. In the 57 tests, the most frequently found pH values were in the 4 and 5 range. The tests of dry soil specimen s were invariably more acid by as much as 24%, suggesting the beneficial effect of the irrigation water.)

(*) See Appendix F, Bibliography, Source No. 35

● The soils are extremely dense, lacking in organic material, poorly ventilated, and lacking in bacterial action.

From our tests, we concluded that the application of limestone is important for most of the soils, to offset acidity. Although further analysis is needed, we estimated that from 300 to 500 kilograms of limestone per ha. should be applied in most areas to improve productivity. (According to the "Wildman" report (source 45) (*), acidity of Delta soils in the immediate vicinity of the Mekong streams tends to be lower than the acidity of soils located further away from the streams).

Our tests also showed the non-suitability of soils for soybeans or papaya and banana or corn or vegetables having long roots. This was further confirmed by observing the stunted appearance of coconut and papaya which contrast with the very large trees that grow in other tropical areas.

Deep plowing by mechanized methods is important in raising the productivity of soils for all types of agriculture. As a soil conditioner, mulch consisting of husk and straw should be plowed into the soil. This will improve ventilation of the roots, stimulate bacterial action, and improve the absorption of phosphorous.

Phosphatic and ammonia-based fertilizers (e.g. urea) are important to offset the deficiency of elements in the soil.

Aside from the diligence of farmers, the traditional productivity of paddy in the Delta is partly accounted for by the properties of the Mekong irrigation water which compensate for deficiencies in the soil.

These findings are described more fully in Appendix C.

(*) See Bibliography, Appendix F

2.3 Production of Agricultural, Fisheries Products and Livestock

The value of crops, fisheries products and livestock produced in the Delta's 16 provinces is on the order of U.S.$1.3 billion. Vietnam's GNP in 1973 was US$3.1 billion (1973 dollars from Source No. 24, Appendix F) before prices rose sharply in 1974. We estimate that the Delta's production of the above products would account for about one third of Vietnam's GNP in 1974.

Consistent documentation of values from product to product is difficult because some of the prices we have obtained are based on our own field investigation in the fall of 1974 and a few are December 1973 prices taken from Ministry of Agriculture records (Source 19, Appendix F). The result of the analysis of production is shown in Table 2.3 and summarized below.

The top ranking product in terms of market value is, of course, paddy, valued at US$652.9 million (in terms of October 1974 prices at mills in Phong Dinh Province); paddy thus accounts for about half the Delta's output of products listed in Table 2.3.

The second ranking product is hogs, valued at $198.6 million; the third ranking product is oranges and tangerines (193,000 tons), valued at $91.5 million; the fourth ranking product is fresh water fish, valued at $77.4 million, followed by marine shrimp valued at $72.3 million. The market value of the ten leading products is summarized below from Table 2.3:

Rank in Terms of Value Produced in 16 Delta Provinces	Product	Market Value of Production (U.S. Dollars)	Date of Pricing
1 st	Paddy	$652.9 million	(10/74)
2 nd	Hogs	$198.6 million	(10/74)
3 rd	Oranges and Tangerines	$ 91.5 million	(12/73)
4 th	Fresh Water Fish	$ 77.4 million	(10/74)
5 th	Marine Shrimp	$ 72.3 million	(10/74)
6 th	Salt Water Fish	$ 51.7 million	(10/74)
7 th	Chickens	$ 40.8 million	(10/74)
8 th	Duck	$ 32.3 million	(10/74)
9 th	Sugar Cane	$ 22.1 million	(10/74)
10 th	Clams, in shell	$ 20.2 million	(1974 est.)
	Sub-Total:	$1,259.8 million	(95.4%)
	Others :	60.5 million	(4.6%)
	Total :	$1,320.3 million	(100.0%)

Not listed in Table 2.3 is an important crop, sorghum, which has been vigorously encouraged by USAID. Sorghum can become a substitute for imported corn and used as an ingredient in mixed feeds. Sorghum is grown in the region where floating rice is found. (Floating rice has a tall stalk which keeps the grain above the water level during the flood season.) The sorghum potential is high in five provinces near Cantho: (1)An Giang, (2) Chau Doc, (3) Kien Giang (4) Kien Phong and (5) Sa Dec. There is some potential in Phong Dinh as well. (see Figure 2.1-a). As flood waters recede in in October (see Figure 2.3), the moisture content of the soil is ideal, according to USAID, for the planting of sorghum. Harvesting is completed in December, well before planting the next crop of floating rice.

USAID representatives in Cantho believe that the sorghum program will result in substantial growth of hectares planted as follows:

Crop Year	Hectares Planted	Production (MT)	Yield/Hectare (MT)
1970-71 (est.)	200	300	1.5
1971-72 (est.)	6,000	9,000	1.5
1972-73	17,900	21,000	1.2
1974-75 (est.)	20,000	26,000	1.3

The total area now devoted to floating rice is 500,000 hectares, suggesting a very large potential for sorghum. The current yields of 1.3 to 1.5 tons of sorghum per hectare are small, about one third the potential, given more seed and fertilizer. (Assuming the hectarage were to be 100,000, as opposed to the current 20,000, and if proper yields were obtained, the total production could be 500,000 tons, valued at Feb. 1975 prices F.O.B. U.S. Gulf at $111/MT or $55.5 million.)

Despite the generally high productivity of agriculture and fishing in the Delta, there are problems such as: (a) salinity in the lower reaches of the Mekong branches, (b) serious underutilization of land in the dry season (December into April), (c) silting of canals used to ship produce, (d) egregiously poor drying, storage of and milling of paddy, (e) shortages of animal feed, fertilizer and limestone, (f) underutilization of farm tractors owing to inadequate maintenance, (g) security problems along the coast that inhibit fishing, (h) shortages of good seeds (i) fallow land caused by the undermaintenance of irrigation canals, (j) excessive flooding in Long Xuen Province and elsewhere.

Figure 2.3

WATER LEVELS AT CHAUDOC

(This figure shows the receding of water in the region where floating rice is grown. Soil conditions are ideally suited for growing sorghum, starting in October and ending in December.)

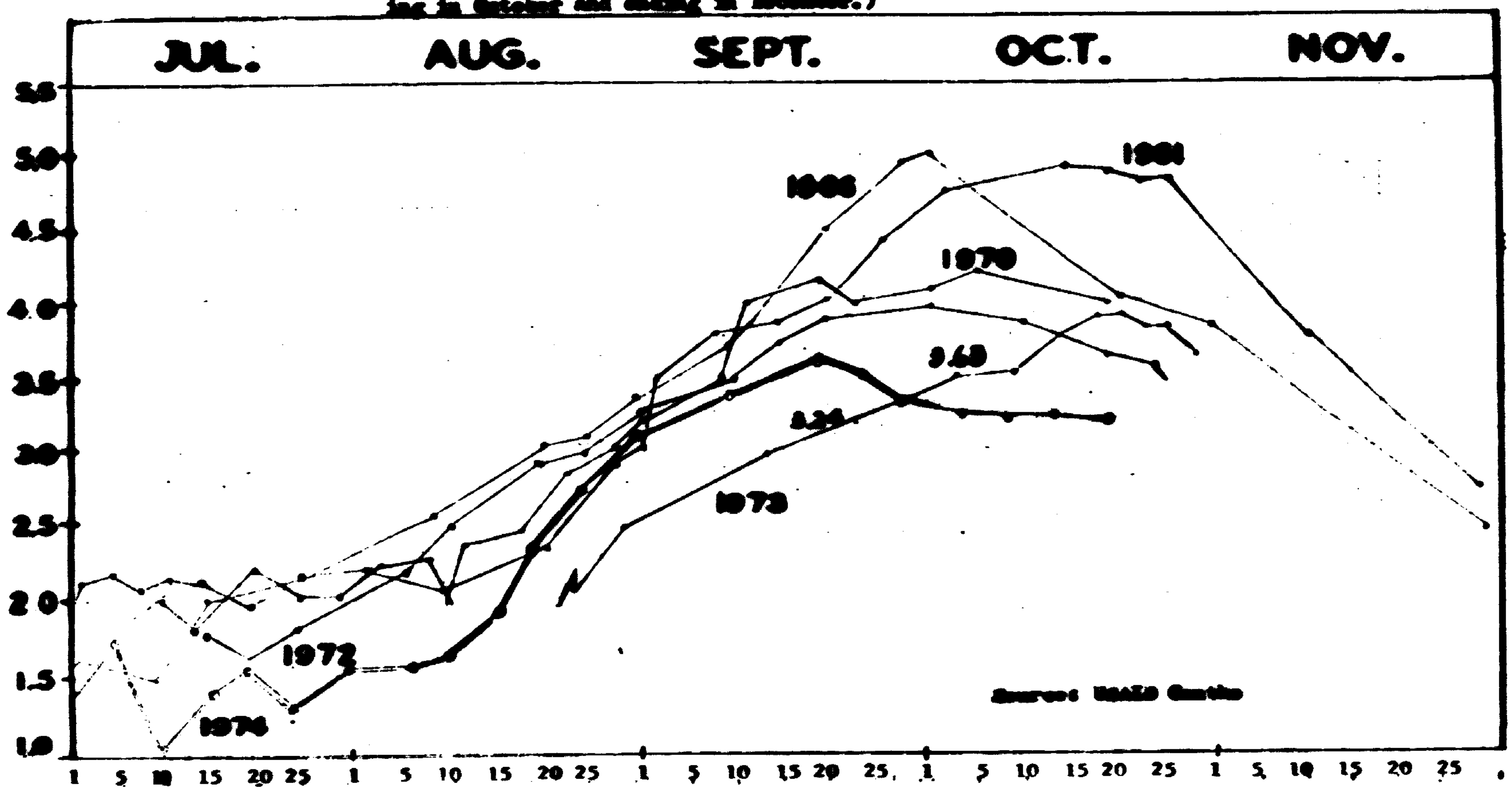


__Table 2.3__

ANNUAL PRODUCTION OF PRINCIPLE AGRICULTURAL AND FISHERIES PRODUCTS, LIVESTOCK AND POULTRY RAISING IN THE SIXTEEN PROVINCES OF THE MEKONG DELTA -- 1975, RANKED BY MARKET VALUE IN MILLIONS OF U.S. DOLLARS

(Sources: Columns A and B were taken from Source 19, __Bulletin of Agricultural Statistics__, __Special Issue__, 1974. The unit prices in Column C were taken from data furnished by the Agricultural Directorate for Phong Dinh Province during the field survey and from price data in Source 19 for Phong Dinh Province. In a few cases, estimates of market prices were made by Pacific Projects, Ltd. from field notes.)

Rank in (terms of Column B Value of Production)	Product	Unit	(A) All Vietnam Production	(B) Delta Production	B/A	(C) Value/Unit in Piasters	(D) Value of Delta Production (Converted to U.S.$ @ VN$ 685 to US$1.00) (B x C) (US$ millions)	(E) Remarks or Source Number
1.	Paddy	MT	7,085,100	5,141,200	73%	87,000	$652.9	Oct. 1974 (field survey), price at Phong Dinh mills.
	(T.N. Paddy)	"	(3,190,200)	(2,036,000)	(6.4%)	---	---	("T.N. means "Than Nong" adaptation
	(Local Paddy)	"	(3,834,900)	(3,105,000)	(60%)	---	---	of IRRI variety)
2.	Hogs	Head	3,776,600	1,864,000	49%	73,000	$198.6	1 live pig weighs 100 kg.; Source is Ngoc Thanh breeding farm, Can Tho, Oct. 1974.
3.	Fruit (Oranges and Tangerines)	MT	282,000	192,880	68%	325,000 (est.)	$ 91.5	Average unit price of oranges, tangerines, source 19
4.	Fresh water Fish,fresh	"	91,342	75,726	83%	700,000	$ 77.4	Source 19
5.	Marine Shrimp, unprocessed	"	62,085	39,603	64%	1,250,000	$ 72.3	Source 19
6.	Salt water fish unprocessed	"	508,537	78,657	15%	450,000	$ 51.7	Sept. 1974. Cantho (field survey) 10/74
7.	Chickens	Head	39,524,900	20,709,400	52%	1,350	$ 40.8	900 Piasters per Kg., 1 chicken = 1.5 Kg; source is Field survey in Cantho. 10/74.
8.	Ducks	Head	29,071,800	18,459,100	63%	1,200	$ 32.3	800 Piasters per Kg., 1 duck = 1.5 Kg; source is field survey in Cantho, 10/74.
9.	Sugar Cane	MT	529,900	126,400	24%	120,000 (est.)	$ 22.1	Pacific Projects estimate

(Cont'd next page)

Table 2.3 (Cont'd)

Rank (in terms of Column D Value of Production)	Product	Unit	(A) All Vietnam Production	(B) Delta Production	B/A	(C) Value/Unit in Piasters	(D) Value of Delta Production (Converted to U.S.$ @ VN$ 685 to US$1.00) (B x C) (US$ millions)	(E) Remarks or Source Number
10.	Clams in shell	MT	38,710	27,680	72%	500,000 (est.)	$20.2	Estimated by Pacific Projects
11.	Manioc	"	379,700	50,600	13%	60,000	$ 4.4	- " -
12.	Vegetables	"	357,600	99,120	28%	108,000 (est.)	$15.6	Value is average for carrots and cabbage in Phong Dinh Province in Dec. 1973, (Source No. 19)
13.	Bananas	"	258,000	216,100	84%	40,000 (est.)	$12.6	Pacific Projects estimate
14.	Sweet Potato	"	279,800	132,340	47%	55,000	$10.6	- " -
15.	Cattle	Head	119,000	31,070	26%	98,400	$ 4.5	Live animal weight, 100 Kg. costs 32,800 Piasters in Phong Dinh, Dec. 1973, 1 cow = 300 Kg (est.), Source No. 19
16.	Buffalo	Head	64,900	27,690	43%	91,500	$ 3.7	Live animal weight, 100 Kg. costs 30,500 Piasters in Phong Dinh, Dec. 1973, 1 buffalo = 300 Kg (est.), Source No. 19
17.	Pineapples	MT	34,350	28,355	83%	70,000 (est.)	$ 2.9	Source 19, unit price PPL estimate
18.	Corn, White	MT	50,500	12,405	25%	120,000	$ 2.2	1973, Dec. Source No. 19 (Phong Dinh)
19.	Mung Beans, Green	MT	10,300	3,845	37%	335,000	$ 1.9	- " -
20.	Soybeans	MT	10,600	2,000	19%	365,000	$ 1.1	- " -

(Cont'd next page)

Table 2.3

Rank (interms of Column D Value of Production)	Product	Unit	(A) All Vietnam Production	(B) Delta Production	B/A	(C) Value/Unit in Piasters	(D) Value of Delta Production (Converted to U.S.$ @ VN$ 685 to US$1.00) (B x C) (US$ millions)	(E) Remarks or Source Number
21.	Coconuts	(000 nuts)	135,600	108,770	80%	5,000 (est.)	$1.0	Source 19, unit price estimated
22.	Tobacco	MT	10,380	1,700	17%	n.a.	n.a.	—
23.	Peanuts, shelled	"	44,800	520	—	350,000	negligible	Same
						Total Delta Production:	$1,320.3	

Total for Available Items produced in the Deltas $1,320.3 million = VN$ 904 billion (@ VN$685 = $1.00.)

2.4 Transportation

2.4.1 Highway and Rail

There are good and bad features about the transportation serving the Delta and the Cantho District. The roads are in general good to excellent thanks to the priority placed on their construction and repair by the MR-4 Corps of Engineers.

The road to Saigon (about 170 kilometers) is designated as QL-4. (The numeral, 4, denotes the 4th Military Region and "QL" is an abbreviation for the Vietnamese word for Military Region). This road runs in a northeasterly direction from Cantho and goes through Vinh Long to Saigon. There are no bridges across the Bassac and the Mekong and this entails delays for buses and trucks so that the trip can take 4 to 6 hours. The same road proceeds southwest as far as Bac Lieu.

Another good road, Interprovincial Road "LTL 27" is also a wide two-lane highway and passes by the Tay Do Industrial Estate. Other first class roads go northwest to Sadec and southwest to Vinh Binh.

In short, the road system is quite adequate to permit the hauling of produce from various parts of the Delta to the Tay Do Industrial Park and for hauling goods to and from Saigon.

There is, however, no rail transportation connecting the Delta with Saigon or any other destinations.

2.4.2 Waterways

Starting in the early 1900's, the French administration built a network of canals throughout the Delta. As seen from the air, these canals look like an angular, criss-cross network. From the maps, it appears that the canals are spaced parallel to each other at intervals of about 10 kilometers and in some places as close as 5 kilometers. (In Phong Dinh Province where Cantho is located, there are three major canal systems, the O Mon-Co Do, the Vi Thanh-Can Tho, and the Phung Hiep -- dug in the 1920's.)

These canals, in conjunction with the branches of the Mekong, constitute a low-cost waterway for transportation by tug and barge. (Truck transport, Cantho to Saigon, costs 4,000 piasters per ton but barge transport costs 2,400 piasters, 40% less than by truck).

However, large, ocean-going bulk carriers cannot enter the Delta ports. We found different opinions on prospects for a future port in the Delta; some thought that Cantho could be built for 5,000 GT ships, others preferred a location 30 KM northeast of the city of Khanh Hung, capital of Baxuen Province, where perhaps 5,000 GT vessels could discharge, but only after major dredging.

The recent report (Rehabilitation of the Inland Waterway Fleet in the Republic of Vietnam and the Khmer Republic, UN/ECAFE Commission for Coordination of Investigations of the Lower Mekong Basin, May 1974) recommends the future development of Vinh Long on the Mekong River.

Figure 2.4 shows the many shallow points in the approaches to the Bassac and Mekong. Other depths (including Saigon for comparison) are tabulated below:

	Depth at High Tide (Meters)	Depth at Low Tide (Meters)
Mouth of Bassac River	6.5	2.7
Mouth of Mekong River	3.3	1.8
Cantho	4.3	3.0
Rach Gia (fishing port)	2.2	1.8
Tay Do Industrial Park Pier	4.3	3 (estimated by Tai Do engineer)
Saigon	9.1	8.2

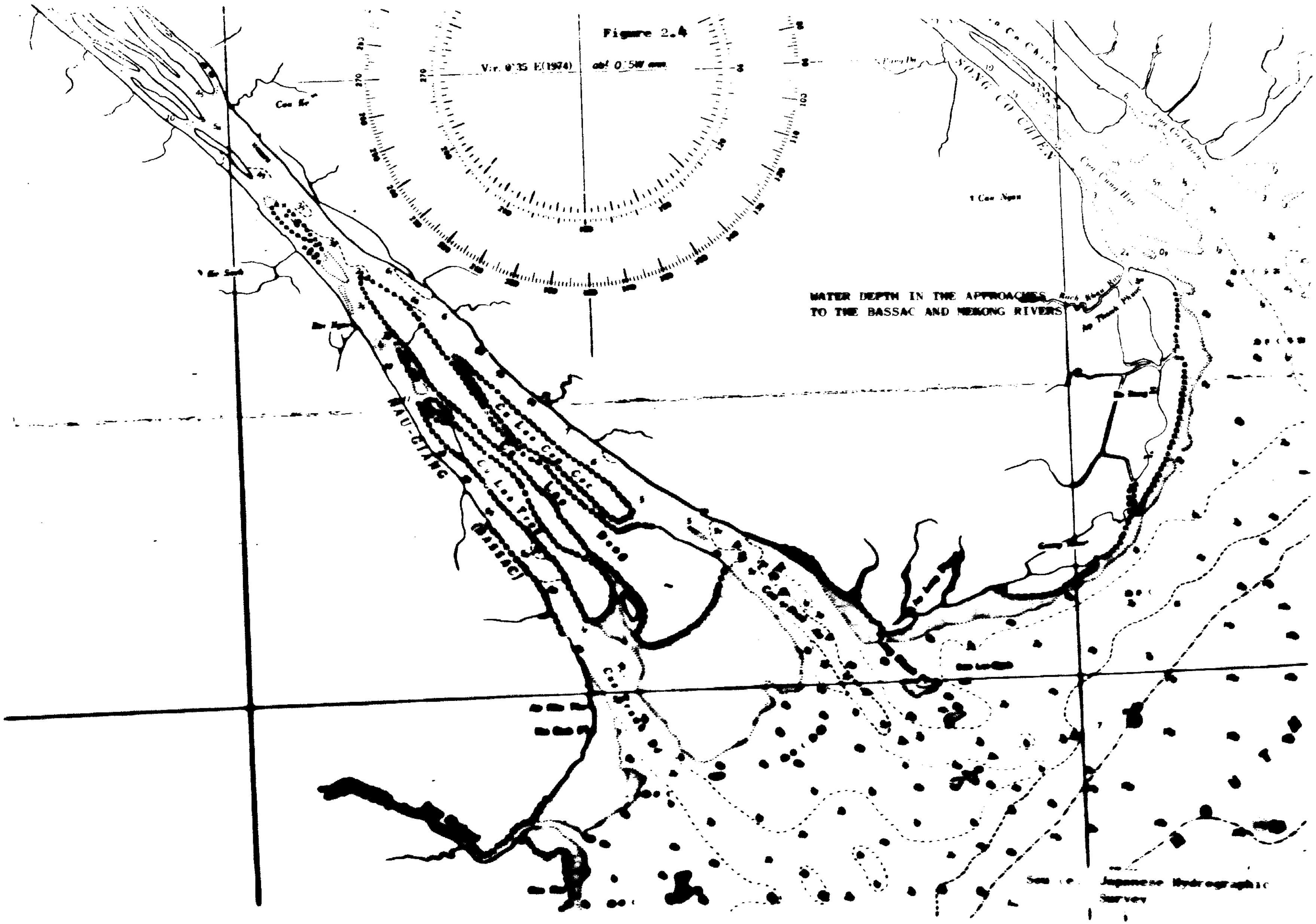
The water depths in the mouth of the Bassac, i.e. the approach to Cantho is enough to accommodate a 500 gross ton coastal vessel having 3.72 draught at high tide only.

Dredging costs worldwide are often calculated at US$1.50 per M^3. Costs in Vietnam are about the same, 1,000 piasters, according to Ministry of Public Works in Saigon. There is an unfulfilled dredging backlog of 50 M^3 annually for all of Vietnam including the Delta. Saigon is now being given priority. Only by spending U.S. $75 million annually (50 million M^3 x $1.50/$M^3$) for several years, it might be possible to assure the Delta of navigable waterways for vessels larger than 500 gross tons.

This means that the traditional towed barge transport system will probably have to continue for some time. This is not necessarily inefficient because a single tug can tow a chain of three or four barges through the waterways. (We saw barges loaded with roasted lime stone, i.e. clinker, being carried from Nha Com, the specialized loading port near Hatien, to the Bien Hoa Industrial Park.

Cantho is served by two airports located just off LTL 27, the interprovincial road to Long Xuyen, which runs past the Tay Do Industrial Park. Piston aircraft are using the fields, and expansion would be required to accommodate jet transports.

Figure 2.4



WATER DEPTH IN THE APPROACHES
TO THE BASSAC AND MEKONG RIVERS

Source: Japanese Hydrographic Survey

2.5 **Industry**

Industry in Cantho will be discussed in greater depth in Chapter 6 later in this report. In general, industry is of the artisanal type, manned by family members. However there are some substantial industrial facilities and public utilities. The major facilities are:

(a) The 33 Megawatt thermal power plant on the Tay Do Industrial Park.

(b) B.G.I. (Brasseries et Glacières de l'Indochine), bottlers of carbonated beverages and beer and ice manufacturers.

(c) Tay Do Phung Hoang, a bakery making bread, cookies (i.e. biscuit) and noodles.

(d) A 4-ton per hour medium size limestone crushing plant, located 40 km northwest of Cantho, close to the junction of LTL 27 and LTL 8, named Than Nong Phanbon (meaning, Miracle Rice Fertilizer) is being built.

(e) Four fishmeal plants are located in Rach Gia (HATICO, SUMACO, FITECO, and INCOMAP).

(f) Freezing plant (Kien Giang Co.) for exporting marine products.

(g) Sugar mills making unrefined sugar.

Unfortunately, some of the plants are operating below capacity because most of them seek to serve local markets where demand is down owing to inflation or because of a shortage of raw materials. The city of Cantho is well served with potable water, thanks to an Australia-financed storage tower and pumping system capable of supplying 7.2 million gallons, a large enough volume to meet the Cantho City needs until 1985.

Aside from agricultural raw materials for industy, the area has limestone reserves at Ha Tien, now being worked to supply clinker to a cement plant in Bien Hoa Industrial Park, as mentioned.

A second raw material is a peat layer reported to be 1 to 2 meters in thickness, located in An Xuen and Kien Giang provinces. (See Figure 2.1-a above.) Security in the peat area has been poor for several years and we were not able to learn much except that briquettes are made and used for fuel by the local people.

Wood and pulp resources are discussed in Chapter 3, Sections 3.14.1 and 2 later in this report. In general there is little prospect for industrial uses of the wood resources and the possibilities of using rice straw or husk are, we believe, likewise doubtful.

2.6 Suitability of Cantho for Industry

As in any developing area, the Cantho region lacks the industrial support base usually associated with modern industry. There are no foundries for example, and castings are usually made in Saigon. However such impediments have been overcome elsewhere and could be more readily overcome in Cantho than in many developing countries.

Although there were labor shortages in 1974 due to the military conscription, Cantho's urban population can provide a labor pool. As of September 30, 1973, the population of Cantho City was 174,422, making it the largest town in the Delta. Of this total, about 70,000 persons are of working age.

Because of the war and the recent-year imports of farm machinery and vehicles, there are mechanical aptitudes, innovative skills, and adaptability in the labor force. Unlike some other predominantly farming areas in developing countries, it will be possible to recruit persons with manufacturing skills in Cantho.

The University of Cantho, the only one in the Delta, offers a curriculum in business subjects. Most young men with managerial qualifications residing in places like Saigon or Dalat are reluctant to move to Cantho, but the local university in Cantho can help in meeting this manpower requirement.

Because of the roads, canals, and airfields, Cantho has become the Delta hub for commerce. There is noticeable growth in the population and business activity and several new office buildings have been erected despite the economically depressing withdrawl of U.S. forces following the ceasefire (Jan. 28, 1973).

Wages in Cantho compare very favorably with those in other localities as tabulated below for the autumn of 1974:

COMPARISON OF MONTHLY WAGE RATES -- Sept., 1974
(Unit: U.S. Dollars)

	Skilled Workman (electrician, mechanic etc.)	Unskilled Labor	Remarks
Cantho	$ 29 - $ 44	$14 - $18	Converted at VN$685=$1.00
Thailand	$105	$ 33	Plus bonus of 1 mo. pay annually
Malaysia	$109	$ 38	Plus bonus of 1 mo. pay annually
Philippines	$143	$ 77	Plus bonus of 1 mo. pay annually
Korea	$160	$100	
Singapore	$218 - $261	$ 55	Plus bonus of 4 mos. pay annually
Taiwan	$300	$120	Bonus included in wage figures
Australia	$384	$346	

Cantho does not compare favorably with other locations with regard to electric power costs. This is because power has been supplied by diesel generators. In Cantho, the installed capacity was 10 MW of diesel capacity generators in Oct. 1974. Now, however, since the 33 MW plant at Tay Do has gone on stream, the total is 43 MW. By contrast, the peak load (night-time) is only 7 MW. This means that surplus power will be available for many years until the industrial load builds up.

COMPARISON OF POWER RATES IN CANTHO WITH RATES ELSEWHERE -- OCT. 1974
(Unit: U.S. cents per KWH)

Korea	1.0 ¢	
Singapore	1.96¢	
Japan	3.07¢	
Australia	3.46¢	
Philippines9	3.54¢	
Cantho	5.4 ¢	(According to Vietnam Power Co., the charges would decline after Tay Do 33 MW went on stream in Dec. 1974.)

Source: Pacific Projects, Ltd. survey for commercial client

The costs of building a steel frame factory building in Cantho are lower than most other localities as tabulated below:

COMPARATIVE COSTS PER SQUARE METER OF BUILDING STEEL FRAME CONCRETE SLAB FACTORY BUILDINGS -- Oct. 1974

(Unit: U.S.$ per M^2)

Cantho	$102 (70,000 piasters)
Japan	$216 - $300
Singapore	$150 - $250
Philippines	$123 - $150
Australia	$127
Korea	$ 55

Source: Pacific Projects, Ltd. survey for commercial client

The cost of leasing industrial land at Tay Do appears quite reasonable when compared with other industrial parks as tabulated below:

COMPARISON OF LEASING COSTS PER SQUARE METER OF LAND ON INDUSTRIAL ESTATES, 1974 (FOR CANTHO AND SINGAPORE), 1975 FOR PHILLIPPINES

(Unit: US$ per M^2)

Singapore (Jurong)	$0.72
Philippines (Export processing Zone)	$0.115 (after June 1975)
Cantho (Tay Do)	$0.30 - 0.50

Chapter 3

CANDIDATE INDUSTRIES

3.0 Content of This Chapter

The contract on which this report is based contains a statement of work attached as Appendix A. The statement requires that we review the possible suitability of 19 candidate industries. We are commenting on these candidates below plus others that have occurred to us since the contract statement was prepared.

3.1 Inter-relationship of Agro-industries

In the developed countries, there is a close inter-relationship between industries using agricultural raw materials. This means that almost total utilization of by-products takes place. In the Delta, full utilization will take many years, but a near future start can be made by concentrating on a few key industries.

Figure 3.1 shows the theoretical inter-relationship of agro-industries. Some of the industries shown are not suitable for the Delta and some will take years to develop. We believe the near-term priorities should be placed on three basic industries plus the raising of poultry, hogs and fish culture:

- Rice milling including storage and drying of paddy
- Oil extraction from rice bran
- Feed Mixing
- Hog, and poultry raising and fish culture

These activities will take advantage of the Delta's paddy, marine products, and the potential for animal husbandry and fresh water fish culture.

3.2 Paddy and By-product Processing

The future of paddy processing (i.e. processing of unhusked paddy into rice and bran) in the Cantho area is promising. The foreign demand is high and rising since rice is the staple food from Japan westward to Iran and is a supplementary staple in other countries.

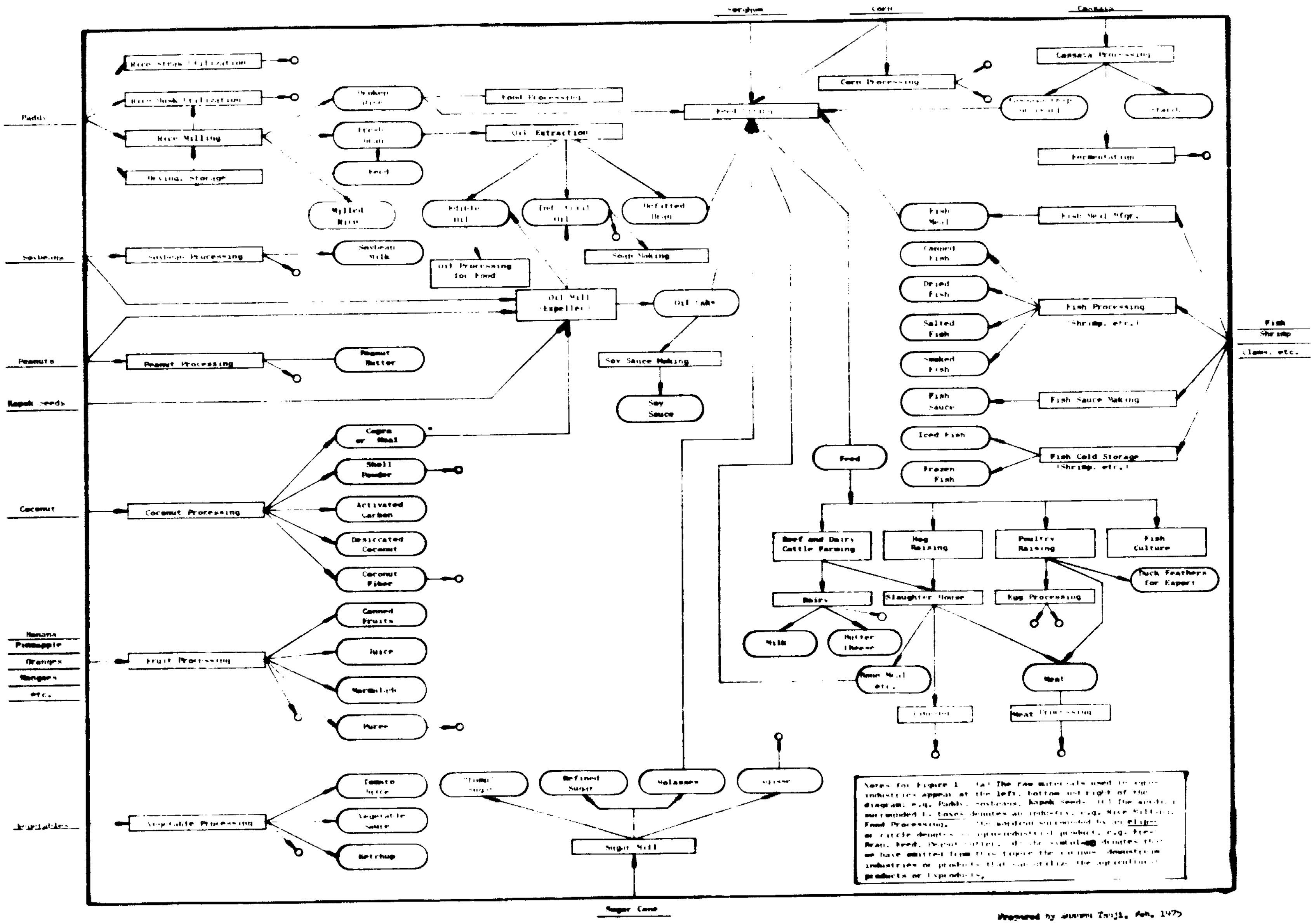
In 1971, 189 million metric tons of rice were consumed in the rice-eating countries from Japan to Iran and was valued at $29 billion or $153 per ton. Bibliography Source No. 39.

Since 1971, we estimate the tonnage consumed in the same area has risen by nearly 10% to about 208 million tons having a value ranging from about $42 billion to $83 billion or $200 to $500 per ton, depending on grade.

Some illustrations of the per ton value of rice moving in international trade are discussed after Figure 3.1:

FIGURE 3.1

THEORETICAL INTER - RELATIONSHIP OF AGRO - INDUSTRIES



Drying and Storage

As the production of paddy in the Delta rises, more will be shipped to other parts of Vietnam as well as overseas. As a precaution against bad-crop years in the future, larger volumes of rice will be placed in storage. In preparation for expanding production and a greater need for storage, improvements in drying and storage will be essential. The traditional methods of drying, storage and milling are inefficient and costly in terms of the high percentage of brokens and the loss of by-products (Bibliography No. 28).

In the Delta, farmers are now raising 2 or 3 paddy crops per year. When only one crop was grown annually, harvesting was traditionally undertaken in the dry season. With the introduction of multiple rice crops, however, some crops are harvested during the wet season. This means that the farmers need drying facilities for their wet-season harvests. Figure 3.2-B shows that harvesting of the TN variety first crop occurs in September, a month of peak rainfall in the Delta (see Table 3.2-C). For the increase in TN production, see Figure 3.2-A(Bibliography No. 28).

Paddy Separation

Many paddy separation methods are being practiced in the Delta but most of them are inefficient and uneconomical. These methods should be improved(Bibliography No. 40).

Rice Milling

Rice milling has to be viewed from two aspects that relate to the distribution of the milled rice. Most of the milling of paddy occurs in the villages where the farmer pays the miller a fee and then takes the milled rice home for his own consumption. The traditional mills are mostly involved in this type of distribution. Large scale mills, if built to supplant the small village mills, would result in many problems of distribution. (Many of these traditional small scale mills are of the "kiskisan" or Engelberg type hullers which abrade the grain and cause a 15% - 20% loss and increase the number of brokens (*) This type of mill is being replaced slowly by more effieient small scale mills.

A second type of milling is on a larger in scale, but mills are small by world standards having daily capacity of over 20 paddy tons per day. These mills perform the function of milling rice for shipment to urban areas in the north, chiefly Saigon, Although more efficient than the village mills, the larger mills nevertheless are inefficient, in terms of the loss of by-product, the failure to separate husk from bran, the high percentage of brokens and excessive power consumption(Bibliography No. 40).

(*) Bibliography, Source No. 40

There are about 1,600 rice mills in the Delta. The Phong Dinh Province (where Cantho is located) Inspector of Industry (i.e. local representative of the Ministry of Commerce and Industry) told us that these 1,600 mills are broadly classified as "big" and "small" mills. There are 145 big mills which typically have a daily capacity of 20 tons of paddy or more. They work more than one shift during the harvest season, and for this analysis, we are assuming that these big mills processed about 870,000 tons of paddy and that the small mills processed about 4,271,000 tons of paddy in 1973. The total paddy processed was 5,141,000 tons in 1973 (see Table 2.3 earlier in this report).

The big mills are located in five Delta provinces as shown below:

Location and Estimated Paddy Capacities of Major Rice Mills in the Delta -- 1973

Province	Number of Mills	Estimated Tonnage of Paddy Processed
Ba Xuen	40	244,000 MT
Phong Dinh	30	183,000 "
Bac Lieu	30	183,000 "
Kien Giang	25	148,000 "
An Giang	20	112,000 "
Total	145	870,000 MT

Source: Inspector for Ministry of Commerce and Industry, Phong Dinh Province

These types of mills will be the most important suppliers for Vietnam's urban areas and eventually for export. Therefore the milling efficiency should be raised not only to produce a higher quality of rice but to obtain the maximum yield of bran (*).

The milling capacity for the future will be determined in large part by the availability of storage capacity, bran defatting capacity (i.e. oil extraction) and the volume of paddy that can be readily collected from the surrounding farms. (*).

(*) Bibliography, No. 40

Japanese Imports of Polished Rice, 1973 and 1974
(SITC No. 042-200)

	Tonnage Imported	Total Value	Value per Ton
1973	14,773	$ 3,604,300	$244
1974	44,074	$23,957,803	$544

Source: Ministry of Finance, Tokyo

Appendix B to this report describes the imports of 15 countries that are the leading trading partners of Vietnam. In 1972, these countries imported 1,206,999 tons of rice valued at $191.2 million or $158 per ton.

In 1974, the price of rice moving in international trade rose sharply, more than doubling from 1973 levels ranging from $220 to $250 in 1973 up to more than $500 in 1974.

Thailand's exports of rice and the per ton value are shown in Table 3.2-A on the next page. Thailand's exports rose from 834,512 tons in 1973 to 1,016,818 tons in 1974 an increase in tonnage of 22% in one year's times. In value terms, the exports rose from $184.6 million to $487.7 million, an increase of 164 percent. On a value per ton basis, the increase was from $221.21 per ton in 1973 to $479.63 in 1974, an increase of 117 percent.

(Narrative continues after Table 3.2-A)

Table 3.2-A

EXPORTS OF THAILAND RICE
1973, 1974

	1973	1974
Exports in Metric Tons	834,512 MT	1,016,818 MT
Value of Exports in Baht	3,692,000,000 Baht	9,754,000,000 Baht
Converted to $U.S. (20 Baht=$1.00)	$ 184,600,000	$ 487,696,417
Value per Metric Ton	$221.21/Ton	$479.63/Ton

Note: Exports in 1974 went to about 60 countries. The largest consumers were: Hong Kong, Singapore, Malaysia, Indonesia, Taiwan, Arab countries.

Source: Royal Thai Embassy, Jan. 31, 1974

Some rice eating countries are striving to restore their erstwhile self sufficiency such as Indonesia, Sri Lanka, India and Bangladesh and success in such countries could reduce world demand. However, the Middle East countries have limited rice-growing capability. In general the spectre of food shortages seems likely to continue for many years.

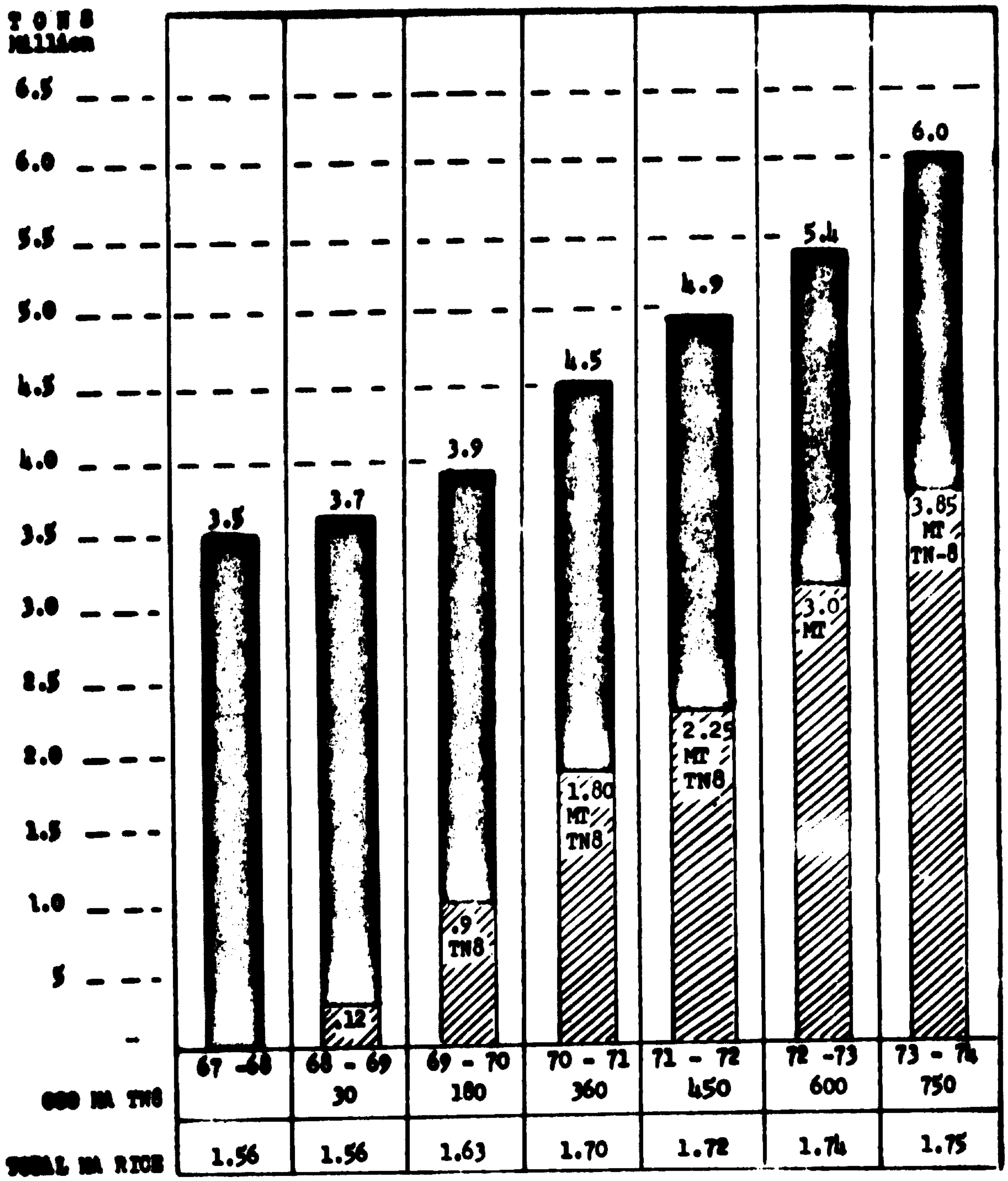
In the light of probable shortages, Vietnam could play a very important role as a supplier. For example, if rice of export grade could be processed in Vietnam, it is possible that Delta exports could reach Thailand's levels.

Also exports would help to alleviate the chronic foreign exchange shortages. For example if Vietnam's peak exports in the 1960's could be duplicated, the foreign exchange revenue would be on the order of $166.1 million (346,000 tons x $480/ton = $166.1). Table 3.1-B shows the historical trend of rice Vietnam's rice imports and exports. From 1957 to 1963 exports ranged from an annual low of 86,000 tons to a high of 346,000 tons. Beginning in 1965, Vietnam switched from a rice surplus to a rice deficit position so that imports are now about 300,000 tons annually.

Rice production has been steadily rising in the Delta as mentioned, thanks in large measure to the new varieties. This growth is shown in Figure 3.2-A. In short, the Delta's unique rice-growing capability is a valuable asset not only for Vietnam but for rice deficit countries worldwide. This report recommends that every effort be made to improve processing so that some of the Delta's surplus rice can be upgraded to export standards.

Figure 3.2-A

DELTA RICE PRODUCTION



THIS PROJECTION OF RICE YIELDS IS ASSUMING 1) 500.000 HA OF DELTA RICE LAND SUITABLE FOR TN8 PRODUCTION.2) AVE TN8 YIELDS 5.0 MT/HA.)DOUBLE CROPPING TN 8 ON 250.000 HA.4) PRESENT TRADITIONAL HA YIELDS REMAIN STABLE.5) TN8 IS USED TO DENOTE ALL IMPROVED VARIETIES AS TN-5 TN-20 TN-22.

(Source: USAID Cantho)

Table 3.2-B

Vietnam Rice Exports and Imports - 1954 - '74

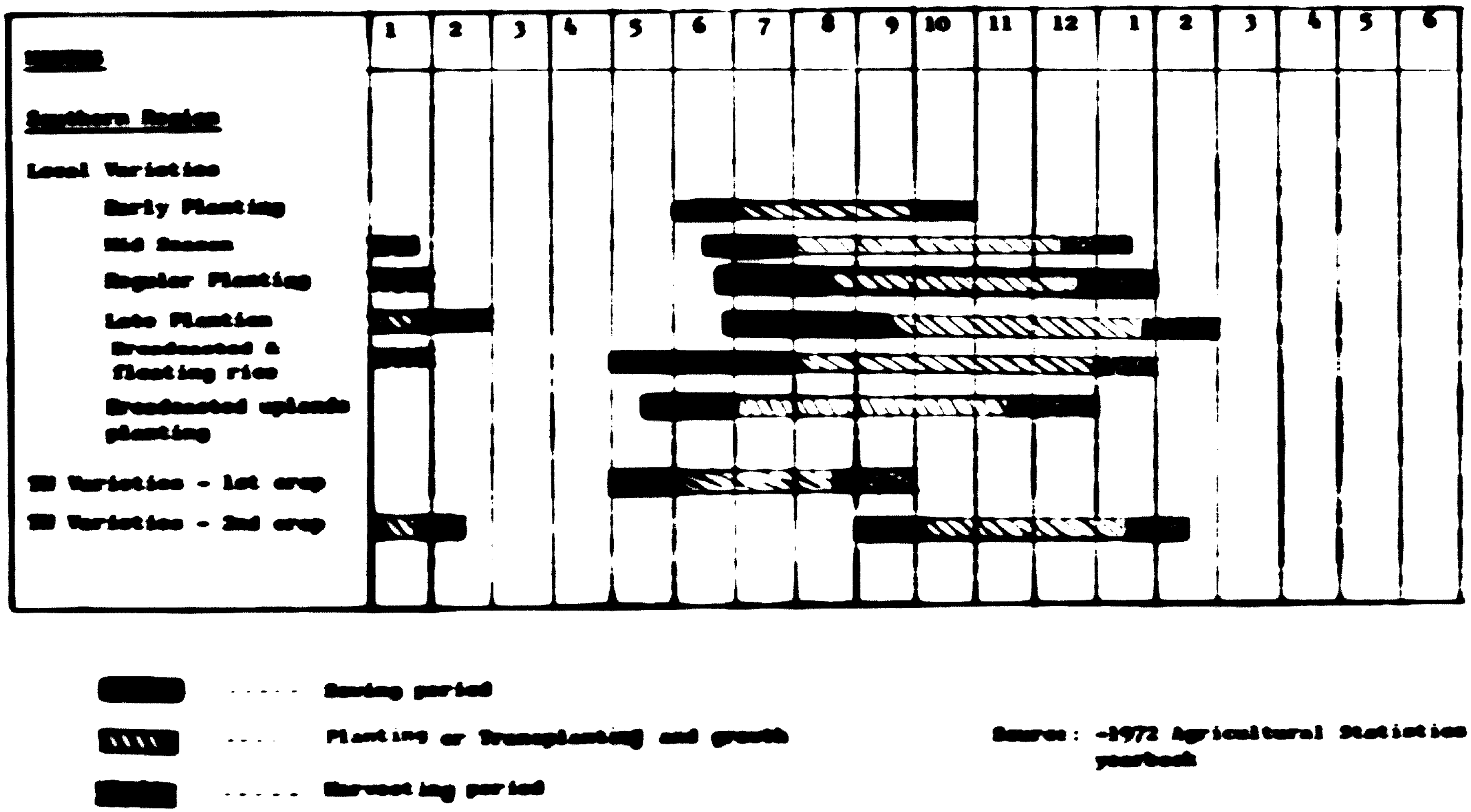
(Unit: 000's of Tons of Milled Rice)

Year	Exports	Imports
1954	173	-
1955	80	-
1956	3	-
1957	202	-
1958	122	-
1959	250	-
1960	346	14
1961	156	2
1962	86	42
1963	333	-
1964	49	-
1965	-	130
1966	-	434
1967	-	765
1968	-	478
1969	-	326
1970	-	559
1971	-	437
1972	-	276
1973	-	304
1974	-	301 (est.)

Source: Directorate of Customs, via FAO Rice Team, Sept. 1974

Figure 3.2-8

RICE PRODUCTION CALENDAR IN VIETNAM



Source: -1972 Agricultural Statistics yearbook

Table 3.2 – 6

[illegible]

([illegible] 1970 [illegible])

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1. [illegible]	6	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2. [illegible]	[illegible]	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	73	8	[illegible]
3. [illegible]	[illegible]	0	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4. [illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5. [illegible]	9	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6. [illegible]	[illegible]	0	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7. [illegible]	9	[illegible]	[illegible]	77	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8. [illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9. [illegible]	[illegible]	0	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	220	[illegible]	[illegible]	[illegible]	[illegible]
10. [illegible]	1	0	0	[illegible]	[illegible]	251	[illegible]	[illegible]	157	[illegible]	[illegible]	[illegible]	[illegible]
11. [illegible]	[illegible]	3	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
12. [illegible]	[illegible]	9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13. [illegible]	3	1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	129	53	[illegible]
14. [illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	270	[illegible]	135	[illegible]	[illegible]
15. [illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16. [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3213	[illegible]	3471	3462	[illegible]	[illegible]	530	[illegible]
[illegible]	11	3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	121	33	[illegible]

[illegible] – [illegible]

In the Delta where paddy cultivation dominates and where the value of the paddy crop substantially exceeds all other forms of agriculture, priority should be given to paddy as the most important base for agro-industry. (See Chapter 2.3 above).

The processing of paddy involves, (a) drying, (b) storing, (c) husking and (d) polishing. Processing also involves the effective utilization of the by-products, especially bran.

UNIDO has long recognized the importance of by-product utilization and sponsored a conference called the "Interregional Seminar on the Industrial Processing of Rice" in Madrar in October, 1971. As the basis for discussion, several important papers were submitted by experts describing world experience in the utilization of by-products (sources 31, 32, 33, 37, 41, 42, 43, 46)(*). Other important publications have come out in recent years describing the research and recommendations of experts in FAO, UNIDO, and USAID (sources 28, 34, 36, 39, 40, 44, 45).(*) We would like to recapitulate as follows some of the keypoints in the literature in so far as they relate to the Delta region.

* See Appendix F Bibliography

(narrative continues on next page)

There are various papers and reports on drying, storage, separation, and milling of paddy in the Delta, one of these, called the "Wildman Report" written in 1970 contains specific recommendations on the large scale, silo-type storage and distribution of paddy in Vietnam (Bibliography 45) including a major storage depot at Cantho.

Another report in 1974 on paddy processing was sponsored by the FAO. Separate sections were written on marketing, storage, drying and milling (sources 27, 28, 34, 40 *) These reports, prepared by experts in their respective fields, point out the importance of better utilization of paddy by-products, improving the drying and storage of paddy, and upgrading milled rice for export.

* The sources cited above are listed in the Bibliography, Appendix F starting on page 241.

(Narrative continues, next page.)

3.2.1 Bran Utilization

Rice bran is the beige-colored, oil-bearing layer called the "pericarp" located under the husk. Beneath the bran, is a further oil-bearing layer called "polish" or "aleurone". Both these are recovered by rice mills in the Delta and sold for feed, but owing to the unsophisticated technologies, much of the bran is classified as "course" bran and includes a percentage of husk. Husk is indigestible and therefore only a form of roughage.(Bibliography No. 37.)

The bran, if properly recovered, contains 12% oil. This oil is useable as edible oil and industrial oil, the latter being an ingredient used in soap manufacture. Technologies for the production of edible rice bran oil have steadily improved since World War II. In the early 1950's, rice bran oil had a distinctive odor and flavor, but since then, the technologies have improved so that even the most fastidious housewife cannot distinguish between rice bran oil, corn, safflower, soybean or palm oils or blends of these products.

By weight, rice bran constitutes about 8% of the paddy and the polish about 2% as shown in the following table (from D. Halliday's paper prepared for UNIDO in February 1971(Bibliography No. 37)

Table 3.2.1

Estimated Rice Production 1969-70 in Different World Regions

	Production (Thousands of Tons)			
Region	Paddy	Milled Rice	Husk	Bran and Polish
S.E. Asia/Far East	260,193	182,135	52,039	26,019
North and South America	12,914	9,040	2,583	1,291
Middle and Near East	3,730	2,611	746	373
Africa, South of Sahara	2,793	1,955	559	279
Western and Southern Europe	1,610	1,127	322	161
Soviet Union	1,500	1,050	300	150
Miscellaneous	3,760	2,632	752	376
Total	286,500 (100%)	200,550 (70%)	57,301 (20%)	28,649 (10%)

Rice bran is highly appreciated in the Delta by persons engaged in the raising of hogs, chickens and fresh water fish. Evidence of this is the selling price of bran at rice mills in Cantho, namely 100 piasters (about US$0.15) per kilogram as compared with course rice selling for 111 piasters (about US$0.16). In short, the bran for animal feed is nearly as valuable as course rice for human consumption.

Rice bran is recognized world wide as a useful ingredient in animal feed. Although bran is being used in the Delta, the material is underutilized because of poor milling.

In some developed countries, rice bran is "defatted", that is the valuable oil products are extracted and the residual bran is sold for feed. In the Delta, however, the bran is not defatted and therefore the oil is wasted. The bran is also unstable and becomes rancid in about 10 days. The rancid bran is not as nutritious, contains less protein by weight, and is even toxic for poultry. Therefore the Delta is losing valuable oils and the nutrient value of the bran is less than it could be.

In Japan about 100,000 tons of rice bran oil are produced annually. The Delta's annual output of paddy, about 5.1 million tons, could in theory yield 331,500 tons of bran which contains about 39,800 tons of oil. Of this, about two thirds or 26,300 tons would be edible oil and one third or 13,500 tons industrial.

The edible oil has a retail value in Vietnam of 1,000 piasters per liter and therefore would have a retail value of about US$38 million (26,300 tons x 1,000 = 26 million liters x VN$1,000 = VN$26 billion divided by VN$685 = US$38 million).

The industrial oil is worth about 46% of the edible oil; therefore the 13,500 tons of industrial oil would be worth about US$11 million (13,500 tons x 1,000 = 13 million liters x VN$460 per liter = VN$6.0 billion divided by VN$685 = US$ 8.8 million). (*)

Therefore oils worth about US$47 million are being lost each year in the Delta. At the same time, inferior feed in the form of fatty rice bran is being consumed by hogs, chickens and cultured fresh water fish. If the bran were defatted (i.e. oil extracted), the protein content of the bran would rise from 15% to 17.6% on a weight basis. In other words, animals would receive more protein per kilogram of feed.

The improved utilization of bran has two important implications for the future use of bran in agro-industries in Vietnam:

a. The farmers now are feeding fresh bran (i.e. bran containing oil) directly to hogs, chicken, and cultured fish. The Delta has a major potential for raising hogs, chicken and cultured fish on a large scale. If these animal husbandry industries are to develop, it will

(*) See page 133 for full tabulation of paddy by-products.

be necessary to establish a feed mixing industry in order to make full use of feed raw materials available in the Delta. Bran by itself is not a perfect feed-stuff, but when other elements are added to make a well balanced feed, bran is a key element in feed. (See Table 4.4)

b. In Vietnam, substantial amounts of foreign exchange have been spent both through Public Law 480 and the Government's own funds to import edible oils. These expenditures of scarce foreign exchange could be reduced or perhaps eliminated if rice bran oil were produced locally. It will be most important therefore to develop industries for extracting oil from bran. This will be described in greater detail in Chapter 4 later in this report.

3.2.2 Processed Foods Derived from Rice

Rice is of course the staple food in Vietnam and is consumed in various ways such as rice wine, crackers, noodles, and many other foods derived from rice. However, the traditional Vietnamese rice cooking processes are deeply rooted and of very long standing. The modernization of cooking and processing methods for rice is important to make full use of the broken rice as a raw material. Since the traditional methods of cooking are closely related to individual taste preferences, the expansion of the market in Vietnam for processed foods derived from rice can only take place gradually.

However, there may be quicker ways of utilizing brokens for making rice flour for export. In other countries, rice cake fried in deep fat is a popular canape.

Various processed products are described by J. Sakurai in his report of July 31, 1974 entitled, "Development Prospects of a Modern Rice Products Processing Industry in the Lower Mekong Basin." (*)

3.2.3 Parboiled Rice

The parboiling of rice is closely associatied with the rice milling processes in certain Southeast Asian countries. Such as Ceylon, India and Bangladesh. Thus far parboiling has not been practiced in Vietnam. Apart from the peculiar flavor of parboiled rice, parboiling serves the purpose of hardening the grain and thus reducing brokens in the milling process. A second advantage of parboiling is the longer shelf life of parboiled rice. A third advantage is the better retention in the rice of nutrients valuable for human consumption.

In the Delta, where rising rice production may soon result in a major surplus, and where storage could become a problem, parboiling could be one of the solutions for storing rice for export. Parboiling is relative inexpensive because the husk, usually a waste by-product, can be used as fuel.

(*) Bibliography, No. 63

3.2.4 Utilization of Rice Straw

There is a long history of straw utilization in Asia. Mats, rope and bags have played an important role as packaging materials for agricultura crops. In recent years, straw products have been replaced by more effieient and durable jute, multi-ply paper, and bags made of woven polypropylene ribbon.

About 100 years ago, sandals made from rice straw were widely used as Japanese shoes. Japanese floor mats (tatami) are still used in place of carpeting in Japanese homes. The tatami mat contains a filler made of rice straw about 3 centimeters thick. With the introduction of western style housing, the demand for tatami has declined. Straw thatching for roofs in rapidly declining. It is unlikely that such uses of straw will offer Vietnam a promising market for rice straw.

Straw can be used, however, as a raw material for pulp in the manufacture of paper. Rice straw fiber is short and is not an ideal material for pulp. In the past, low quality paper was produced from rice straw pulp in Japan and China, but there is little demand for such low quality paper at the present time. As a raw material, rice straw itself is inexpensive in Japan, but to use it for pulp, caustic soda and chlorine to remove impurities are required in larger quantities than in the case of wood pulps. When these chemicals are expensive, straw pulp made from rice straw becomes uneconomical (*).

Nevertheless, the Japanese paper industry is trying to utilize straw pulp because of the growing scarcity of wood pulp,world wide. In such cases, the straw pulp is blended with the long-fibered wood pulp to attain an acceptable fiber length.

It is likely that the rice growing countries of Asia will endeavor to utilize straw pulp in a similar way. (W. Pierce of USAID/Saigon recommends the use of straw for pulp production on the Tay Do Industrial Park in Cantho. His paper is entitled, "A Rice Straw Pulp Plant in the Cantho Area", Source No. 46-A.)

Several factories have been established in Southeast Asian countries to make pulp and paper from rice straw. These projects have not been entirely successful in terms of their effective utilization of rice straw. Pulp manufacture from straw has been tried in Indonesia, the Philippines, and in Vietnam (Bien Hoa Industrial Estate), but all plants have been forced to supplement the rice straw pulp with expensive, long-fibered, imported pulp.

COGIDO, a paper mill in the Bien Hoa Industrial Estate near Saigon, is producing paper from local straw, bamboo, and imported long fiber pulps. Straw pulp made by COGIDO is blended with other pulps and accounts for 20% to 24% of the pulp used for the manufacture of paper. The COGIDO plant operates at only 20% to 40% of capacity throughout the year largely because of the deficit in pulp raw materials (Bibliography, No. 52-A). The rice straw used by COGIDO is baled

(*) Bibliography, No. 52.

in the Delta and shipped to Saigon. Despite COGIDO's vigorous efforts, including the distribution of an ingenious mechanical baler, insufficient quantities of straw are arriving at the plant. Because of the straw shortage, bamboo and imported pulps must be used to keep the plant in operation. This situation suggests several important conclusions in planning new straw pulp factories.

Siting a pulp factory in Cantho would facilitate the gathering and transport of straw from nearby growing areas, but the following problems will probably occur.

a. To make paper from rice straw pulp, a larger volume of long fiber, better quality pulp are required for blending. To be assured of a steady future supply of imported pulp will be a serious problem as it now is at COGIDO.

The use of certain local trees such as mangrove and tram could become a pulping raw material but the harvesting of these trees poses problems, especially the harvesting of mangrove. (See Section 3.14 later in this report.

b. Economical production of pulp requires a major capital investment and high production volumes. Even if a sufficient volume of straw could be gathered, it will be difficult to consume all the products domestically in Vietnam. If the surplus is to be exported, it is doubtful whether the price and quality would be competitive on world markets in view of the high costs of chemicals (caustic soda and chlorine) needed to process the rice straw pulp.

c. The principle problem is the collection of raw material in sufficient volume and quality. So far, the COGIDO case suggests that the collection of the raw material has not succeeded. The very nature of straw means that small volumes must be collected over a wide area. The larger the volumes collected, the higher the cost of collection. In Japan, farmers dry their straw and store it, but in Vietnam, the straw becomes wet during the rainy season. Straw must be kept dry for transportation purposes as well. Storage capacity will be a further problem especially in view of the bulky nature of rice straw. Other pulp material such as wood is less bulky and is usually stored outdoors.

d. Farmers prefer to leave straw on their paddy fields and burn it to clean the field of infestation. They also use small amounts for animal fodder.

In summary, we doubt that further analysis of the feasibility of utilizing straw for pulp would be warranted.

It is possible to produce particle board from straw, as is being done with jute stalks in Bangladesh (The product is called "Partex" and is based on German technology). However the cost of the binder and the costs entailed in assuring a steady supply of raw material rice straw would probably result in a product cost that would make the particle board more expensive than natural wood. In Bangladesh, there is a shortage of natural wood, but Vietnam is an exporter of wood.

Agronomists and specialists in horticulture agree regarding the effectiveness of straw as a soil conditioner. In future years, as cultivation intensity increases and soil nutrients are depleted, the inherent productivity of the soil will decline. The use of chemical fertilizers to supply plant nutrients is expensive and will not fully restore the balance of organic and chemical elements in the Delta's densely packed, clayey soils.

A good balance of organic materials in the soil is important especially for the cultivation of vegetables and fruits. In paddy fields, supplementary elements such as silicon dioxide (SiO_2) are important in addition to the essential plant foods, N, P and K. Experts suggest that the best utilization of straw is to return it to the soil by procedures such as the following:

a. In harvesting paddy, only the upper extremity of the stalk should be removed leaving the straw in the ground to be plowed under when preparing the soil for the next planting.

b. Burn the straw, leaving the ash on the surface of the soil.

c. Mix straw with dung as a fertilizer after decomposition.

These three methods have good and bad points, but detail is outside of the scope of this report.

3.2.5 Utilization of Husk

In many rice milling areas of the world, the disposal of husk has posed serious problems. The burning of husk creates air pollution, the storage takes up space, and dumping into rivers pollutes the water.

One of the worst problems has occurred in Malaysia which Eldon Beagle described as follows in a paper prepared for UNIDO:

> "The rice mills in the Kuala Lumpur area can be considered an example of the ultimate stage in the husk enigma. The ecological implications of their disposal methods have boomeranged on them. Originally located in Kuala Lumpur proper, these mills moved to the suburbs some years ago to escape from the rapid expansion of the city. However, during the past ten years, this suburb has grown into a highly industrialized area and the mills are surrounded by large businesses that exert significant political influence. As a result, the rice mills have been subjected to numerous fines for polluting the air and surrounding area with the ash from their practice of burning husks in incinerators or open piles." (Bibliography Source No. 31).

Despite the problems posed by husk disposal and the challenge to obtain commercial benefit from the husk, there are few entirely effective means of utilization for developing countries. In developed countries, where there is a sizeable infrastructure of supporting industry, commercial and large-scale utilization of husks is in fact taking place.

Some of the commercially proven uses of husk are: soft grit blasting (i.e.an abrasive), oil obsorbtion (greasweep), material for roofing paper, a carrier for vitamins or medicines, various feed uses (extender, poultry feed, ruminant feed, retarder feeds), an anti-caking agent for fertilizer, fuel for steam generation, insulating material, fruit juice processing, a source of ferrosilicon, a source of furfural silica (for refractory brick), soil conditioning mulch, litter and nesting for poultry.

The authors observed the following utilization in the Delta:

1. Farmers use the ash from burned husks as a soil conditioner when cultivating paddy seedlings. This is traditional practice that Delta farmers have learned from experience of many years.

2. Some of the older rice mills are burning husk, primed with kerosene, to generate steam for steam engines. This is a very low cost fuel. (The Mekong Rice Mill near Saigon has capacity for milling 100 tons of paddy per day; there are two engines, one is a 77 HP

diesel and one a 100 HP steam engine. The owner hopes to replace the diesel engine with another steam engine, but none were available for sale.)

3. Sale as a milling by-product for fuel (husk sold for 300 piasters per 50 kg. bag in 1974.)

4. Litter and nesting material for poultry.

In other Asian countries where rice is traditionally parboiled (Bangladesh, India, Sri Lanka), husk is used as a fuel for the boiling process as well as for a fuel for steam engines.

In times of serious fuel shortages in Japan, farmers have used a portable home range for cooking. A prototype of this kind of stove is reportedly available through the Ministry of Agriculture in Tokyo. (See also Figure 3.2.6. p. 69)

We have calculated that rice hulls, as a fuel, cost about one fourth as much as fuel oil as follows (the calculation assumes that husk will yield 6,000 BTU/lb. or 13,200 BTU/kg.):

	Rice Hulls	Fuel Oil
A. BTU yield	13.2 million BTU/MT	37 million BTU/Kl
B. Cost in Vietnam	$ 8.76 (6,000 piasters per MT)	$100.73 (69,000 piasters per kiloliter)
C. Cost per 1000 BTU	$ .0007 or 0.45 piasters	$ .003 or 1.86 piasters

The conclusion from this data is that 1,000 BTU from husk is one fourth the cost of 1,000 BTU from fuel oil (0.45 piasters/1.86 piasters=24%).

We have conducted a survey in Japan to determine if small steam engines in the 20 to 100 HP range are being marketed. We found that no manufacturer in Japan is making steam engines and that if such engines were made, the cost per horsepower would be prohibitively higher than diesel, electric or other types of engines.

It is not practical to think in terms of a widespread use of husk as a fuel for steam engines until such time as high production volumes bring down the cost. But the use of husk as a fuel for other heating purposes is feasible. However this is a project that CARIC, the machinery manufacturer in Saigon, should investigate. Also the manufacture of a portable husk stove for home cooking would merit study. (See Figure 3.2.6.)

After burning, the ash weighs 15 to 22% of the original husk. The ash contains the following elements:

Silica	(SiO_2)	4.50 per cent
Calcium Oxide	(CaO)	0.25 per cent
Manganesium Oxide	(MgO)	0.23 per cent
Potassium Oxide	(K_2O)	1.10 per cent
Sodium Oxide	(Na_2O)	0.78 per cent
Phosphoric Oxide	(P_2O)	0.53 per cent
Sulphates		1.13 per cent
Natrium	(Na)	(not available)

Aluminum, Managanese and Ferric Oxide traces

The noticeable fact about this analysis is the high silica content of the ash. It is this component which accounts for the number of processes used and proposed for the utilization of rice hulls based on their ash content (Bibliography, No. 32).

Of the commercially proven uses of husk reported in the literature, applications in Table 3.2.5 (next page) would appear to have some future promise in the Delta. In the long run, an important utilization could be for the manufacture of furfural. In the United States, furfural is made from oat husk, corn cobs, and paddy husk. Consumption of furfural in the United States was about 60,000 tons annually in 1969 and 1970 and was valued at $18.8 million and $20.2 million respectively. The main uses for furfural are for plasticizers and synthetic rubber (see Figure 3.2.5). The theoretical maximum yield of furfural from the Delta's 5.0 million tons of paddy produced annually would be 40,000 tons (5,000,000 tons of paddy x .16%=800,000 tons of husk x 5% = 40,000 tons of furfural).

Some prerequisites for the manufacture of furfural are: (a) assured volumes of husk on the order of 100,000 tons per year and (b) assured export markets until such time as Vietnam has a domestic requirement for furfural. The collection of husk from scattered mills would jeopardize raw material supply, but the establishment of a large mill or mills capable of generating 100,000 tons of husk is conceiveable but would require capacity larger than presently exists. (A mill to supply 100,000 tons of husk would have an annual milling capacity of 600,000 tons or 2,000 tons per day; one of Vietnam's largest mills, e.g. S.E.D.I.C. in Cholon has a daily capacity of only 648 tons per 24-hour day or 194,400 tons per 300-day working year.)

The manufacture of furfural would require large capital investment, probably on the order of $10 million (estimated costs were $5.5 million in 1971, according to source No. 32). There are large scale furfural plants in the United States owned by the Quaker Oats Company and there are smaller scale plants in Europe. (See list of plants following Table 3.2.5). (See Appendix F for sources.)

Table 3.2.5

POSSIBLE INDUSTRIAL APPLICATIONS FOR PADDY HUSK
(Bibliography: 29, 30 and 31)

(This is only a partial list; please see sources.)

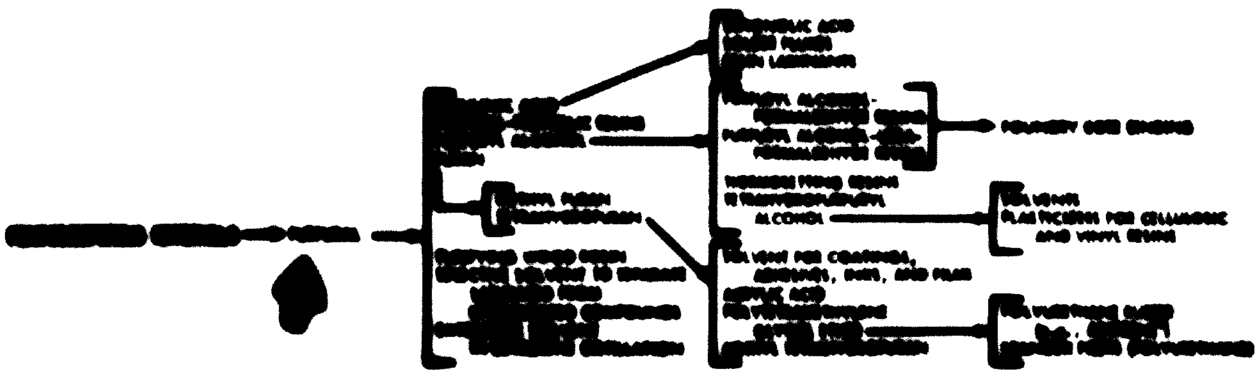
Product to be Manufactured from Husk (Bibliography Source)	Estimated Minimum Husk, Raw Material Required (MT)	Estimated Initial Capital	Suitability for Delta
Feed for ruminant animals (31)	3 Tons/day	n.a.	Product not competitive with rice straw for buffalo in Delta. Also requires use of some bran which has more effective applications.
Silica for fire-brick or grease absorption compounds (31)	40,000 Tons/year	$ 1.0 million (est.)	Possible if export markets assured.
Furfural and Silica 5,000 Ton/year of furfural used for chemical applications (29, 31, 32)	100,000 Tons/year	$10.0 million	Possible if export markets assured and if 2,000 Ton/day rice mill were built.
Pressing aid for fruit juice manufacture (31)	1,000 Tons/year		Parboiled husks are preferred and parboiling is not practiced in Vietnam. Transport costs to developed country markets would probably make this product non-competitive
Activated carbon (32)	n. a.	n.a.	High volume of zinc chloride required and transport costs to Delta plus export market pose problems.
Panel boards using cement by tropical Products Institute or Italian "Secondite" process (32)	n. a.	n.a.	Probably not competitive with wood

Product to be Manufactured from Husk (Bibliography)	Estimated Minimum Husk, Raw Material Required (MT)	Estimated Initial Capital	Suitability for Delta
Panel boards using French "Silicior" process (32)	n. a.	n.a.	Probably not competitive with wood
Bricks made of rice husk ash and soil or cement		If done in artesanal manner, capital would be minimal	Could be feasible considering dense clayey Delta quality of soils. Sun-drying would avoid kiln costs.

(Table 3.2.5 ends here)

Figure 3.2.5

INDUSTRIAL APPLICATIONS FOR FURFURAL



Source: Stanford Research Institute,
Chemical Origins and Markets,
1967, Menlo Park, California

FURFURAL PLANTS IN THE UNITED STATES -- 1971

Owner	Location	Annual Capacity in Metric Tons
The Quaker Oats Co., Chemicals Division	Belle Glade, Florida	22,675
"	Cedar Rapids, Iowa	9,070
"	Memphis, Tenn.	18,140
"	Omaha, Nebraska	18,140 (same)
International Petro-Chem, Inc. (Planning Stage)	Bayou Teche, (Lafayette) Louisiana	18,140 (same)

Source: Stanford Research Institute, 1971 Directory of Chemical Producers

The furfural possibility and others noted in the literature (Bibliography sources 29, 31, 32) are shown in Table 3.2.5. With the exception of the final item listed, namely bricks for building construction, there appears to be some impediment to effective utilization of husk, for example high raw material costs in the case of the production of activated carbon or raw material limitations in the case of furfural. Husk is used as roughage in feed for ruminant (i.e. cud-chewing) animals, but in the Delta, the readily available low cost rice straw for water buffalo would probably render the husk non-competitive. (There is no significant dairy cattle industry in the Delta.)

We conclude that until rice milling capacity is raised substantially and concentrated in one locality, that the best uses for husk are: (a) as a fuel if suitable stoves and engines can be manufactured, (b) as a mulch to loosen the dense, clayey soils, and (c) as a soil conditioner in ash form in keeping with the traditional practice in the case of paddy seedlings, (d) litter and nesting material for chickens.

Figure 1.2.6

COOKING STOVE FOR BURNING HUSK

The following article from the March 17, 1975 Asahi Newspaper, Tokyo, describes a stove used to burn husk. Such a stove could be made in the Delta for household cooking. The retail price is the yen equivalent of $93 (about 70,000 piasters). Farmers having 1.5 hectares of paddy can produce enough husk to cook for 5 persons for one year. The required husk is stored in a small warehouse having 3 square meters of floor space. The manufacturer planned to sell 50 units in 1975, but has already sold 250. (The manufacturer is Hitachi Koki Haramachi Factory in Fukushima Prefecture.)

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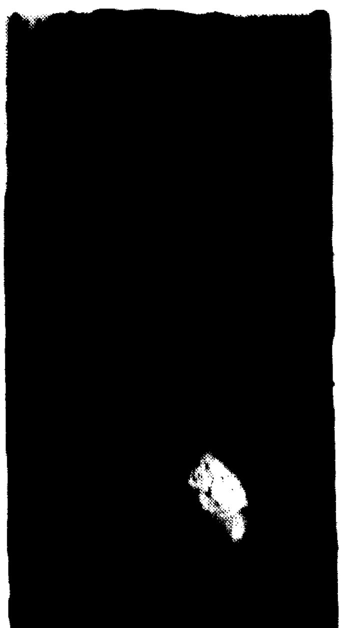

See translation on the next page.

3

4

(See translation next page)

FACTORY STARTS TO PRODUCE HUSK-FIRED STOVES
UNLIMITED SUPPLY OF FREE FUEL

SALES EXCEEDED EXPECTATIONS

(This is a translation of Japanese News Article on Page 69)

The Haramachi Factory of Hitachi Koki Company located in the outskirts of Haramachi City, is one of the main foundries of the Hitachi group of companies. A joint conference attended by representatives of management and labor took place in the conference room of the factory in November, 1974. The subject for discussion was, "How can the company cope with the reduced level of sales and profits caused by the business recession?". The recession had caused a reduced scale of operations ranging from 60% to 80% of full capacity.

"Have you any suggestions to make? We are very hard-pressed," the factory manager asked the group.

A vice-chairman of the labor union rose to his feet. "Suppose we make stoves that burn paddy husks. Farmers seem to be harrassed by mountains of husks." Another member of the union remarked," Electric po er and petroleum are too high priced to be used these days."

The factory operations manager, the manager of the general affairs department and the foundry manager went out to visit many rice-growing areas in Fuku-shima prefecture the following day. Information started to come in soon afterwards. "There is a stove manufacturer, located in Kawaguchi City, Saitama prefecture: because of the inadequate supply of parts, however, only a few stoves are actually in use." "Most farmers will produce enough husks to burn for a full year." "All farmers had husk-burning stoves in pre-war days."

In December, stoves were manufactured for trial purposes based on the prototype made by the Kawaguchi manufacturer. Since the validity of the patent registration and utility model had expired, the model was copied without going the trouble of makeing prototypes. The factory decided to sell stoves for ¥29,500 (U.S.$93), which was cheaper by more than ¥10,000 ($34) than the stoves manufactured in Kawaguchi.

A trial of the stoves was held at the factory: 3 sho (or 5.4 litres) of rice was cooked in 20 minutes and 5 sho (or 9 litres) in 30 minutes. The taste of the cooked rice was superb, the grains were well rounded and the heat remained after the cooking was completed.

From the beginning, the factory did not expect a large volume of orders. While castings for electric equipment that Hitachi makes are 6 milimeters thick or more, the castings for husk-burning stoves are only 4 milimeters thick,"We thought we would have to obtain technology for producing thin castings," confided Mr. Hiroshi Tanigawahara, the casting manager. They anticipated a maximum order of 50 stoves. It turned out that orders for as many as 310 units have been received so far. Orders for wood-burning stoves came in also, which the factory has also begun to manufacture. At a price of ¥25,000 ($US 85) 200 stoves have been sold. At present, a special production team for manufacturing stoves has been formed with 30 employees out of the total of 350.

Some of the repercussions are as follows: (1) A farmer close to the factory has paddy field of 1.5 hectares. From the paddy grown there, enough husk will be produced to fill to the ceiling a warehouse with 3 square meters of floor space. Rice lasting for three meals or a full day for a 5-member family is cooked once a day in the morning hours and kept in a jar. Husk stored in the storeroom will last a year. The head of the family declares,"The rice tastes perfect." (2) "Stoves are sold in the adjoining Miyagi prefecture. The popular reception of stoves is a surprise to us. As the stoves require an uninterrupted supply of parts, we intend to continue even after the present depression is over," says Mr. Hide Seya, the factory manager.

In the city of Haramachi in Fukushima prefecture, a manufacturer of electric equipment suffering from a reduced volume of business, noticed that paddy-growing farmers were finding it difficult to dispose of husks. He now manufactures husk-burning stoves. "The farmers who use the stoves have no fuel costs and they can cook efficiently." Orders are coming in from farmers. The factory says that they will start full production since there is an inexhaustible supply of husks. In view of energy shortages, the revival of husk-burning stoves is likely to become a success.

(Translation of article ends here; text of report continues on next page.)

3.3 Vegetables and Fruits

3.3.1 Vegetables

The production of vegetables in Vietnam has increased steadily in recent years as shown in Table 3.3.1 below. Out of the total production of 357,600 tons in 1973, the Delta accounted for 28% (Chapter 2, Table 2.3.)

Table 3.3.1

PRODUCTION OF VEGETABLES IN VIETNAM -- 1965-73

	Area (ha)	Production (m. tons)	Yield (MT/ha)
1965	11,720	132,955	11.3
1966	12,100	143,470	11.9
1967	13,540	192,180	14.2
1968	13,620	193,055	14.2
1969	16,885	234,955	13.9
1970	17,850	217,550	12.2
1971	18,065	230,155	12.4
1972	22,900	294,000	12.8
1973	30,160	357,600	11.9

Source: Ministry of Agriculture
Source No. 30

The principle vegetables produced are: tomatoes, cucumbers, egg plant, water melon, chives, garlic, red pepper and cabbage, scallion, ginger root, white radish, Chinese cabbage, carrots.

Figure 3.1 in Chapter 3 shows that vegetables can be processed to produce tomato juice, puree, ketuchup, etc. However the domestic market for these products is as yet small and they are not part of the traditional Vietnamese diet. In cities like Saigon, there is a limited demand in hotels; also urban residents will probably begin to consume these products in a few years. This growth in demand should permit the establishment of a small-scale processing industry later on, but it would probably be premature to establish a large-scale, modern, efficient plant in the Delta at this time.

An industry for the manufacture of tomato juice for export faces possible problems of acceptance by food and health authorities overseas. These must be overcome in order for the juice to compete effectively in international markets.

A substantial volume of pickled (i.e. brined) vegetables are being consumed in Japan and some portion comes from Taiwan. Because of freight costs, it is likely that the future supplies of pickled vegetables will originate in areas closer to Japan than Vietnam.

We believe that if a steady sales outlet were available, farmers in the Delta would be prepared to grow vegetables because the return per hectare is high. One hectare can yield more than 11 tons of vegetables, according to Table 3.1.1. We do not have the retail price of tomatoes in Cantho, but the price of cabbage in October, 1975 in Cantho was 200 piasters (US$0.29) per kg.

A broker buying vegetables for a manufacturing plant would pay 60 to 70% of retail. Therefore the farmer would probably receive the equivalent of US$174 per ton ($0.29 x 1000 kgs = $290 x 60% = $174). The return to the farmer on a hectare of vegetables could be about $1,740 (10 tons of vegetables per hectare x $174). The return on a hectare of paddy would be only $848. (581,120 piasters)

In planning procurement of tomatoes, long term procurement contracts would have to be made. Tomatoes require greater labor inputs to preserve the crop during the growing season and more preparation to aerate the soil than is the case of paddy.

3.3.2 Fruits

The principal fruits grown in the Delta are tangerines and oranges. Of the total 282,000 tons produced in Vietnam, 192,880 tons or 68% were produced in the 16 Delta provinces in 1973 (Table 2.3 in Chapter 2).

There are a few medium-size orchards; one is at Tho Long Village, Phong Phu District (20 kilometers WNW of Cantho on Road LTL 27). According to USAID in Cantho, the owner has 10 hectares planted in oranges. In Thot Not, Angiang Province (40 kilometers NW of Canthe on LTL 27), there are more orchards, some reportedly having 10 to 20 hectares planted in oranges. Orange and tangerine production in Vietnam is shown in Table 3.3.2 below. As mentioned, about two thirds are grown in the Delta.

Table 3.3.2

PRODUCTION OF ORANGES AND TANGERINES IN VIETNAM -- 1962-73
(Note: these figures include about 5% papaya)

Year	Area Planted (ha)	Production (m. tons)	Yield (MT/ha)
1962	35,090	219,625	6.259
1963	35,880	263,540	7.345
1964	34,570	231,730	6.703
1964	37,225	233,260	6.266
1966	35,990	201,900	5.610
1967	33,730	191,165	5.668
1968	32,340	221,880	6,681
1969	32,030	222,885	6.959
1970	32,920	235,705	7.160
1971	33,800	254,000	7.515
1972	38,300	230,500	6.018
1973	42,850	282,000	6.581

Source: Ministry of Agriculture
(Source 20)

The production of oranges and tangerines is profitable and would become more so for the farmers if a steady industrial outlet for the fruit were available. For example, 1 hectare of orange plantings could yield the farm the equivalent of almost $4,000 per hectare per year (60 piasters for one quality orange at retail x 60% = wholesale price x 12 oranges per kg. x 1,000 = one metric ton x yield per hectare of 6 tons = 2,592,000 piasters divided by 685 piasters per one US$=$3,784 per hectare).

Bananas are also grown in the Delta. Of the total Vietnam production of 258,000 tons in 1973, the Delta's 16 provinces produced 216,100 tons or 84% (Table 2.3 in Chapter 2). However, bananas are grown on a small-holder scale rather than on plantations as in Latin America, West Africa or Jamaica.

Although the quality and taste is satisfactory, the size of the fruit is small and the trees are stunted. This is because the species need upgrading, the roots have difficulty in penetrating the soil, and lack aeration. During our field survey in October, we inspected banana trees standing in water which could be a further factor in the stunted growth.

We believe that banana growing in the Delta on a commercial scale for export does not warrant further investigation, although the supply of banana for local markets will remain profitable for the Delta farmers.

Pineapples are grown in the Delta. Of the total Vietnam production of pineapple of 34,350 tons in 1973, the Delta produced 28,355 tons or 83% of the total.

As in the case of banana, pineapple are grown by small holders and it would probably not be feasible to re-arrange farming on a large-scale plantation basis. Even if certain soils in the lower Delta can be desalinated in the future, the large-scale planting of pineapples would probably not be an optimum use of farmland owing to the densely packed nature of the soil (Appendix C).

In tropical countries such as Vietnam, it is usually difficult to develop a local market for processed or preserved fruits because fresh fruits are in abundant supply throughout most of the year. However, Vietnam's processed fruits, especially oranges, can eventually find a market in the United States, European countries and Japan. The international market for canned or bottled fruits is keenly competitive, and under these circumstances, it is not easy to penetrate foreign markets. For Vietnam to compete, the following points would have to be considered:

a. It is important to secure a steady and sufficient volume of good quality raw material. The quality has to meet the taste criteria of consumers in the market countries and should equal or surpass the quality of competing countries. It is also important to recognize the sanitation and quality regulations of the importing countries.

b. It is important to increase productivity in Vietnam. More study is required regarding the productivity of other competing countries and it will be necessary to improve Vietnam's productivity to the level of the competing countries.

c. Containers and packaging are also important to success in exporting. In the case of canned food exports, local supplies of tin plate and cans would be preferable. The shipment of cans from abroad to Vietnam would not be feasible, and probably the best container would be blown polyvinl bottles, mentioned in Chapter 4 in connection with rice bran oil.

Fruits, especially oranges, in the Delta have an export potential as juice or puree but it will be necessary to study the market demand in prospective importing countries and to promote appropriate export policies and strategies aimed toward specific export markets. We believe that despite the long-run potential for future exports, conditions in the Delta do not now offer sufficient assurance for the collection of raw material from scattered orchards. More important is the fact that export channels are not sufficiently developed to consider fruit processing as a successful agro-industry.

We believe however that the processing of jams, marmalade for the domestic market should start on a small scale and gradually expand. In view of the Delta's leadership in orange and pineapple production, Cantho would be a logical site. However, we are not recommending this for the Tay Do Park since production would probably be on an artesanal scale for some years.

3.4 Sugar Milling

Imports of sugarare large and have risen in recent years to 362,000 tons in 1973, costing $55 million as tabulated below:

Vietnamese Imports of Sugar, 1971-73

	Tons	U.S. Dollar Value
1971	228,493	$37,580,000
1972	163,971	$16,988,000
1973	362,000	$55,044,000

Source: Sydney M. Cantor Associates (See Bibliography Source 9 and Source 20)

During the peak of hostilities, sugar cane cultivation was banned in some areas resulting in the a decline from the 1965 peak of 1.1 million tons of cane down to a low in 1969 of 321,445 tons as shown in Table 3.4.

Table 3.4

PRODUCTION OF SUGAR CANE IN VIETNAM, 1965-73

Year	Area (ha)	Production (m. tons)	Yield (MT/ha)
1965	33,900	1,092,850	32
1966	30,050	935,670	31
1967	25,770	769,960	30
1968	15,265	426,070	28
1969	11,670	321,445	28
1970	11,620	335,720	29
1971	12,600	340,500	27
1972	12,400	331,000	27
1973	17,400	529,900	30

Of the total sugar cane cultivated, 529,900 tons in 1973, the Delta accounted for 126,400 tons or only 24% of the total. (Table 2.3)

The Government is providing incentive programs to encourage the farmers to cultivate sugar cane, chiefly loans on preferential terms from the Agricultural Development Bank (ADB). The purpose of the incentives is to save some portion of the heavy costs in foreign exchange occasioned by sugar imports. The current world-wide high price of sugar has primed domestic prices; this has encouraged the farmers to start sugar cane cultivation. (In July 1972, sugar cost $136/ton; in March 1974, $480 per ton f.o.b.) At present, sugar cane cultivation and processing in Vietnam is expanding rapidly. However, sugar imports remain substantial.

In spite of the Governmental incentives, however, and the farmers eagerness to grow cane, the productivity in Vietnam is low by international comparisons.

The average sugar yield in Vietnam has consistently been low since 1960, fluctuating between 27 and 30 tons of cane per hectare (Table 3.4). This compares with the average yield in Taiwan of 76 tons per hectare. The sugar content of the Vietnamese cane is typically 8% compared with Taiwan's 12% (A new variety is being introduced into Vietnam which reportedly has a sugar content as high as 14%, but we were not able to confirm this during our survey.)

The sugar cane observed by the writers in the Delta was stunted and the sugar content probably below 8%. This seems to be caused by the undersirable (for sugar) characteristics of the Delta soil and insufficient drainage where the water table is high. In addition, the methods of cultivation are crude i.e. shallow plowing, and some farmers are not as familiar with cane as they are with paddy.

The sugar refining process consists of: (a) crushing the cane, (b) boiling the syrup in open pans, (c) pouring viscous syrup into molds to make a product called "lump sugar". This actually is a sugar cake about 6 cm. long and 2 cm. thick. The resulting sugar has a dull-sweet flavor and would be classified as raw sugar. The "lump sugar" is probably adequate for local consumption, but could not be exported.

There is some modern refining capacity in Vietnam, four mills with a combined capacity of 650,000 tons of cane, capable of producing some 60,000 tons of plantation whites annually (See Source 9 and Pearson, J.L. and Summers, L.V., "Processing of Sugar Cane and Raw Sugar in Vientam -- An Economic Appraisal, "July 1972, USAID.) However the four mills, as of August 1974 had been shut down since 1967 because of a lack of raw material. (*)

Even if the four large mills were in operation, they could account for no more than 15 to 20% of estimated Vietnamese consumption of 300,000 ton

(*) Source 9 in Bibliography

400,000 tons (Source 9). Therefore the bulk of the sugar consumed is produced by the small-scale, crude methods described above.

In the six provinces immediately adjacent to Cantho, there are 66 sugar mills producing sugar similar to the lump sugar metioned. (Source 10 in Bibliography).

The largest of these has a production capacity of only 3 tons of lump sugar per day. These small-scale, scattered, low-productivity plants are primitive, and do not produce molasses.

The construction of a modernized, highly efficient sugar mill at Tay Do will not be promising for the following three reasons:

(a) Efficient modern sugar mills require economies of scale and large volumes of cane grown in the immediate vicinity. The current small-scale, widely scattered farms could not support a modern sugar industry.

(b) The quality and sugar content of the cane species is below international standards.

(c) Delta soils are less suited to cane than soils elsewhere in Vietnam.

Given the handicaps facing the sugar industry, future expansion should be geared to the growth in local demand.

Two lump sugar factories are being established on the Tay Do Industrial Park in Cantho, and one was scheduled to start operations during the harvest season which began in October-November of 1974.

In a modern sugar mill, the molasses produced as a by-product is a valuable material for cattle feed and for industrial use. No molasses is produced from the present lump sugar factories.

Bagasse (i.e. cane residual after crushing) is being used as a fuel in the lump sugar factories. Bagasse can also be used as a raw material for particle board or paper. However since bagasse is a low-cost fuel for the lump sugar mills, it is doubtful that enough bagasse could be diverted to the manufacture of particle board or paper. See 3.21 below for comments on starch as a partial sugar substitute.

3.5 Oils and Fats Processing

Raw materials available for oils and fats in the Delta are: rice bran, soybeans, peanuts, coconuts, sesame seed, kapok seed and corn. Other oil-bearing raw materials produced in minor volumes are: rubber, rubber seed, jute and kenaf seeds, fish oil, tallow (from water buffalo), lard (from hogs). Among the raw materials mentioned above, rice bran will be dealt with in detail in chapter 4 of this report. (See Bibliography No. 48, King, Frank P. "Feasibility Study: Edible Oil Seed Production, Marketing, and Processing in Vietnam, 1971.")

3.5.1 Soybeans

Soybeans are an important raw material not only for oils and fats but also for mixed feed and for food processing industries. This is because the protein content is high. Table 3.5.1 shows production of soybeans in Vietnam for 1965 through 1971. Out of a total production of 10,600 tons in 1971, the 16 Delta provinces accounted for 19% of the total, namely 2,000 tons. Most of production in the Delta comes from Chau Doc, An Giang and Phong Dinh. However, the Delta is not ideally suited for soybean cultivation, and other areas of Vietnam have climatic, soil or humidity advantages.

The soil in the Delta is generally acid (See Appendix C), the pH value can be as high as 3.5. Soybeans tend to thrive in neutral soil (i.e. pH 7 soil) and thus it is necessary to neutralize the acidity by applying calcium, usually in the form of limestone. Vegetables and fruits can be grown in the same acid soils and thus compete with soybean cultivation. Under the present situation, vegetable cultivation is usually more profitable to the farmer than the growing of soybeans.

The variety of soybean now being grown in the Delta is intended for direct human consumption rather than for oil extraction. The cost of cultivation is comparatively high and if oil-bearing varieties are introduced, the oil will probably not be competitive on the international market. It is estimated that 50 percent of soybean consumption in 1970 was used for bean curd, 40% was used directly as edible beans, and 10% for bean sprouts and other uses. (Bibliography No. 48).

Under these circumstances, it is difficult to count on large volumes of soybeans as raw material for oil extraction. Vietnamese authorities are planning to increase the production of soybeans in the future for oil extraction as well as for the production of soybean cake for use in mixed feeds. If the increased use of soybeans in fact materializes, the following developments will have to take place: (a) improvement of the soybean varieties, (b) increase in the yield per hectare, (c) decrease in the production costs, (d) creation of a stable market (e) and incentives for the farmers sufficiently attractive to induce them to cultivate soybeans rather than other crops.

The increase of soybean production should be encouraged where soils are suitable. Soybeans are important not only as raw material for oil extraction but also for human consumption.

Total Vietnam production of soybeans is shown in Table 3.5.1 below.

Table 3.5.1

VIETNAMESE PRODUCTION OF SOYBEANS, 1965-73

Year	Area (Ha)	Production (m. tons)	Yield (MT/Ha)
1965	5,100	4,110	0.805
1966	6,610	7,585	1.148
1967	7,555	5,660	0.749
1968	7,800	7,465	0.955
1969	6,545	5,965	0.911
1970	6,835	7,455	1,091
1971	7,700	8,400	1,091
1972	8,300	6,400	0.771
1973	11,150	10,600	0.951

Source: Ministry of Agriculture (No. 20)

1.5.2 Peanuts

As a raw material for fats and oils, peanuts have greater promise than soybeans. Table 1.4.2 below shows the production of peanuts in Vietnam from 1965 to 1973. Out of the total production of 44,800 tons, in 1973, the Delta's 16 provinces accounted for only a fractional 520 tons in 1973. Other parts of the Southern Region accounted for 75%, the Central Lowland Region accounted for 19%, and the Central Highlands, 6%.

Table 1.5.2

PEANUT PRODUCTION IN VIETNAM -- 1965 - 1973

Year	Area (ha)	Production (M. tons)	Yield (MT/ha)
1965	31,720	32,595	1.028
1966	30,640	34,520	1.123
1967	30,190	33,710	1.119
1968	29,680	32,055	1.080
1969	31,295	34,410	1.100
1970	30,240	32,185	1.064
1971	34,400	37,000	1.076
1972	35,200	38,900	1.105
1973	39,200	44,800	1.141

Source: Ministry of Agriculture, Source No. 20

Peanut cultivation does not compete with paddy cultivation because the peanut grows in sandy, well-drained, and generally poorer soils where paddy cannot be grown. Peanuts have a long history of production in Vietnam and peanut utilization is well known. According to the report of the 1971 Chinese Agricultural Technical Group (via Source No. 48), of the total production of 25,990 tons in 1970, two thirds was consumed directly as food, and about one third, namely 8,287 tons, was used as raw material for oil extraction, yielding 2,900 tons of peanut oil. This calculation is based on the assumption that about 70% of the total peanut crop is shelled and the oil content is about 30%. The residual peanut cake, after extracting the oil, is used as fertilizer for the cultivation of tobacco or as food for animals or as raw material for the manufacture of soy sauce.

The variety of peanuts being grown in Vietnam is not ideally suited for oil extraction and thus is similar to soybean in the sense that the main utilization is for human consumption. However, the productivity per hectare is greater than that of soybeans. Under these circumstances, peanuts should be given greater emphasis as a raw material supply source for agro-industry. However, we cannot foresee peanuts becoming a promising raw material for agro-industry on the Tay Do Industrial Park because of the Delta's low output.

3.5.3 Coconuts

Table 3.5.3 shows the production of coconuts for 1965 through 1973. Of the total production of 133,600,000 coconuts in 1973, the Delta accounted for 81%. The Central Lowlands, accounted for 16%.

The main growing areas in the Delta are in Kien Hoa and Dinh Tuong provinces.

Table 3.5.3

COCONUT PRODUCTION IN VIETNAM 1965-1973

Year	Area (ha)	Production (1000 nuts)	Yield (1000 nuts)
1965	88,390	147,330	1.668
1966	39,015	129,460	1.338
1967	38,110	130,900	1.526
1968	29,905	110,705	1.702
1969	32,909	98,545	2.000
1970	32,290	118,590	1.671
1971	31,900	125,000	1.711
1972	29,100	116,100	1.909
1973	31,460	111,600	1.992

Source: Ministry of Agriculture, Source 20

Vietnamese coconut production is, however, very small as compared with the Philippines (7.8 billion coconuts), Thailand (900 million), Malaysia (830 million) in 1970. It is clear from the Vietnam statistics (Table 3.5.3) that the war had a seriously adverse effect on coconut production. The comparatively poor drainage of the Delta soils is not ideal for coconut trees and the trees are stunted as in the case of banana and sugar cane.

However the coconut is usually considered as one of the most important raw materials for agro-industries in tropical climates. The oil can be consumed both as a food for human consumption and as a raw material for industry. The residual cake can be used for mixed feeds. The fiber (called coir) can be used as the raw material for rope and matting; the coconut milk can be used as pure drinking water, and the shell can be used to manufacture activated carbon and shell powder. The copra, prior to extraction of oil, can be used as desiccated coconut, a raw material for the food and confectionary industries. The sap from the coconut tree can be fermented to make an alcoholic beverage. Thus coconut-derived materials have a wide variety of applications.

Assuming that at least 100 grams of fats and oils are extracted from a single coconut, the total coconut production of Vietnam could in theory yield 11,100 tons of oil. However, in practice, many coconuts are consumed as food or beverages. In the Philippines, less than half the coconut crop is being used for oil extraction. Although data are not available, we believe that only 30% of the coconuts grown in Vietnam are used for oil extraction.

In the Delta, coconut oil is not used as cooking oil whereas other southeast Asian countries follow the practice of using coconut oil for cooking. However coconut oil is essential for the soap industry in Vietnam and some is being imported from Indonesia via Singapore to supplement local supplies ([illegible] Soap Co., Saigon).

Under present circumstances, the processing of coir products or shell products are not important industries and our survey team did not see coir products for sale in markets.

The increase of coconut production is highly desirable for Vietnam but will be difficult to attain due to such factors as the 10-year period required for trees to mature and the replanting of trees destroyed during the war. There are only a few suitable areas for coconut trees to grow in the Delta as the statistics suggest. We believe that the comparatively small volumes of raw material and the scattered location of trees would pose supply problems for a modern plant at [illegible].

1.5.4 <u>Sesame Seeds</u>

The production of sesame seeds in Vietnam has increased in recent years, but in 1971, there was a sharp decline to a total production of only 110 tons much of which was produced in the Central Lowlands. The Delta produced only 15 tons. Sesame seeds are consumed directly for food and are not used in Vietnam for oil extraction.

1.5.5 <u>Kapok</u>

Data on Kapok production is limited, but most of this product is cultivated in the Southern Region of Vietnam, but not in the alluvial plains of the Delta where the trees would suffer from excessive moisture. Total Vietnam production in 1973 was only 500 tons (Bibliography, 19). Kapok can be a valuable export product in tropical countries. The application of the fluffy, cotton-like material is for the manufacture of such products as pillows, cushions, mattress fillers, life jackets, sleeping bags and insulation material for cold weather garments.

The hard seed portion of the kapok ball can be crushed to make a high quality edible oil or industrial oil. Kapok trees do not grow in paddy lands and therefore would not compete with the Delta's principal crop.

After oil extraction from the hard seeds, the residual cake makes an excellent raw material for animal feed.

Since Kapok is not available in large volumes, we believe this material cannot constitute the basis for a modern agro-industry in Cantho.

3.5.6 Corn

Tables 3.5.6-A and B show Vietnam's production, exports and imports of corn. Of 50,500 tons of corn produced in 1973, the Delta accounted for 25%, that is 12,605 tons (Table 2.1).

Table 3.5.6-A

VIETNAMESE PRODUCTION OF CORN -- 1965-1973

Year	Area (ha)	Production (M. tons)	Yield (MT/ha)
1965	36,100	41,830	1.211
1966	29,100	35,900	1.211
1967	28,955	31,830	1.168
1968	28,700	31,760	1.106
1969	28,565	30,515	[illegible]
1970	28,640	31,415	[illegible]
1971	31,000	31,790	[illegible]
1972	35,900	41,700	1.175
1973	40,600	50,500	[illegible]

Source: Ministry of Agriculture, Source No. 20, App. 7

Table 3.9.6-B

VIETNAMESE IMPORTS AND EXPORTS OF CORN - 1960-73

Year	Export Quantity (m. tons)	Export Value (1,000 VN$)	Import Quantity (m. tons)	Import Value (1,000 VN$)
1960	1,445	2,714	1,549	5,878
1961	1,117	1,917	36	68
1962	227	395	5,680	23,674
1963	"	"	95,500	216,212
1964	"	"	26,800	54,752
1965	"	"	43,000	149,855
1966	"	"	33,000	140,580
1967	"	"	20,000	332,100
1968	"	"	41,000	236,447
1969	"	"	82,540	597,755
1970	"	"	116,564	988,191
1971	"	"	70,885	631,357
1972	"	"	99,705	2,762,066
1973	"	"	77,177	4,636,535

Source: Directorate of Customs,
Source No. 20 in Bibliography.

The soil condition of the Delta does not seem especially suited to the cultivation of corn and other areas of Vietnam are better suited.

Although the production of corn in the Delta is limited, it is one of the important raw materials for the mixed feed industry.

An industry designed to extract fats and oils, protein, and starch cannot be planned on the basis of the Delta's meager corn production alone and would require supplementary raw materials.

3.9.7 Kenaf and Jute

The seeds of these fiber crops can also be used for edible oil, but the volumes in the Delta are small and could not, as in the case of corn, be counted on as the raw material base for industry. These products are discussed in Section 3.17 (regarding gunny bags) later in this chapter.

3.6 Animal Feedstuffs

Animal feedstuffs (sometimes called, "animal feed supplements") have been imported largely from the United States under the AID program and the PL 480 program. The principal materials imported in recent years have been: meat meal, fish meal, soybean cake, alfalfa meal, bone meal, and corn. We were told by USAID that imports of corn were being discontinued because low cost corn imports act as a disincentive to the growing of sorghum (See Section 2.3 above). Imports of animal feeds have been as follows in recent years. (Source No. 9 in Bibliography).

Imports of Animal Feeds in Millions of U. S. $

Fiscal Year	PL480/I a/	USAID b/	Vietnam's Own Forex c/	TOTAL
1967	0.	0.	0.055	0.055
1968	1.248	0.	0.661	1.909
1969	2.862	0.	6.822	9.684
1970	7.688	0.	5.060	12.748
1971	8.086	5.527	3.417	17.030
1972	9.136	7.380	0.706	17.222
1973	5.530	1.748	0.664	7.942

a/ Corn

b/ Meat and bone meal, soybean meal, alfalfa meal

c/ SBN 081 - feeds and fodder through 1972

The currently high cost of imports, about $500 per ton, is forcing the commercial hog and poultry raisers to curtail their operations and the West German-financed slaughter house in Saigon (VISSAN) is finding that their meat prices are becoming non-competitive on world markets, according to our interviews with the management.

The price situation means that hog and poultry raisers are turning more and more to domestically produced feeds, i.e. especially rice bran, sorghum, broken rice and low grade brown rice, and fish meal.

The currently tight supply of feed on world markets and the high price is making it difficult for the Delta to even maintain the existing level of livestock raising.

The Delta however has a high potential for becoming self supporting in feed. The Delta should be able to raise livestock and poultry at low cost assuming that feed self-sufficiency can be attained. The Delta can theoretically produce important feed raw materials such as: (a) rice bran, (b) corn, (c) sorghum, (d) maniec, (e) oil cake, (f) molasses, (g) fish meal, (h) bone meal, (i) feather meal, (j) the residual materials from fruit processing, (k) vegetable processing wastes.

Sorghum could become one of the most important crops in the Delta largely due to the promotional efforts of USAID. (See Section 2.3 earlier in this report).

The Delta production of sorghum accounts for more than 90 percent of the Vietnam's total production, and about 21,000 tons were produced in 1972-73. Although the current output is still small, production can be increased rapidly and will probably become one of the most important raw materials for the mixed-feed industry, playing a role similar to corn.

In order to make full utilisation of these raw material resources, a mixed feed industry should be established in the near future. Live-stock, poultry and freshwater fish culture on a large scale in the Delta will become possible only by the establishment of a mixed-feed industry. This will be discussed later in greater detail in Chapter 4.

3.7 Dairy Products

There are almost no dairy cattle in the Delta, except that the water buffalo can produce small yields of milk. The population of these animals was as follows in 1973 in the 16 provinces of the Delta (Bibliography, 19).

Buffaloes	194,480	(14% reported slaughtered each year)
Draft and Beef Cattle	246,140	(13% reported slaughtered each year)
Hogs	2,345,140	(81% reported slaughtered each year)

The absence of grazing land and the high cost of feed, would make it difficult for a dairy products industry to be viable in the Delta.

Milk is, however, appreciated and condensed and powdered milks are being increasingly consumed and imported; 21,190 tons of condensed and powdered milk, valued at $11.6 million were imported in 1972, and the imported volumes have probably risen substantially since then.

Imports of all dairy products including powdered and concentrated milk, butter or anhydrous milk fat, cream and sweetened condensed milk, were as follows in recent years:

Imports of Dairy Products, FY 71-73

(Unit millions of U.S.$)

Source of Financing	FY 71	FY 72	FY 73
United States PL 480	$15.5	$12.0	$1.5
Vietnam's Own Foreign Exchange	3.4	11.7	16.6
USAID	--	--	1.2
Total	18.9	23.7	19.3

Despite the need for a dairy products industry, areas of Vietnam other than the Delta would be far better suited as a site.

3.8 Meat Processing

There is strong world demand for pork, chicken and in certain countries a demand for duck, all of which are being produced in the Delta by farmers and by a few modern poultry and hog farms raising upgraded species. The latter, however, have almost shut down their operations or are facing financial uncertainty owing to the high price of feed. (For production, see Table 2.1, items ranked 2, 7 and 8).

Appendix B, showing export markets, indicates that Vietnam's 15 most important trading partners imported processed poultry valued at $295.1 million in 1972. West German imports accounted for $226.5 million or 76% of the total imports.

As in the case of processed fruits and vegetables, there is a negligible demand within Vietnam for processed meats. This is because fresh chicken, duck, and pork are available the year-around in public markets and because consumers would not be prepared to pay higher prices for processed and packaged meats. (Preferences will doubtless change over time, assuming a continued improvement in GNP and personal incomes.)

However, the intermediate-term goal would be export markets for processed meats. As mentioned, there is a modern slaughter house and meat processing plant near Saigon called VISSAN (the full name is Vietnam Ky-Nghe Suc-San). The plant management people and German advisers had different opinions, but the consensus was that duck and chicken exports (the latter, only if species are upgraded) and pork exports had promise. Japanese and German importers prefer frozen meats, but there is a world market for canned meats as well.

However, even the export market for chicken and pork cannot be penetrated at present because of one conclusion that emerged from our visits to VISSAN and to a commercial hog raiser. The conclusion is that exports from Vietnam are not competitive now and will not become so until the price of feed declines.

Therefore chicken and pork processing should be a future goal, but not pursued until the creation of a successful mixed-feed industry.

Export of frozen duck is a more readily attainable goal. Given the very large flocks of ducks in the Delta, the absence of a feed requirement (ducks feed on insects and plankton), it may be possible to organize develop and industry; see Chapter 4.

1.9 Slaughter House

A slaughter house at the Tay Do Park in Cantho is a very desirable long run objective. Aside from meat, such a facility could supply bone and meat meal with a high protein content similar to that of fish meal, i.e. over 60% protein. The lips, ears and other parts could be used for glue manufacture and the linings of stomachs and other internal organs can be used to manufacture enzymes. However the viability of the slaughter house would depend on the ability of buyers to bring animals to the slaughter house at a price low enough to sell competitively on the market. With the current shortage of animal feed adversely affecting the hog raisers, we think a slaughter house would face difficulties in obtaining enough raw material.

There are two principal slaughter practices in the Vietnam, one is controlled slaughter under Government regulations and the other is uncontrolled slaughter usually performed in rural districts. Of the 1.8 million hogs slaughtered annually (Table 2.1), we estimate that about 1.0 million or only one fourth are slaughtered under Government controls (Bibliography, 44).

A slaughter house in Cantho would have to compete with the uncontrolled slaughter by paying higher prices for hogs which could in turn raise its selling price of pork or beef cattle to non-competitive levels. The VISSAN company (slaughter house near Saigon; see Section 1.8) is operating at only 30% of capacity and the main reason is that it must buy animals at high prices and then try to sell meat competitively on the market.

We learned from the Ngoc-Thanh Pig Breeding Farm in Cantho, that premium hogs (Yorkshire - 79, Bel) were selling in October for 75,000 piasters per 100 kg. The same purchase price of 75,000 piasters was quoted to us by VISSAN, the slaughter house near Saigon. The open market price for live hogs in Cantho in October 1974 was 71,000, or about 10% less than the price paid by VISSAN.

The pig farm in Cantho told us that to raise a hog to a weight of 100 Kg. in Cantho, cost 65,000 piasters in terms of feed alone in October 1974. Interest on debt, overhead, wages and profit could not be covered by the 10,000 piaster difference (75,000 - 65,000 piasters). The main reason for this was that the wholesale price of meat has risen more slowly than the cost of feed. Fine rice bran is one of the elements composing hog feed, usually about 20% of the total. The increase in feed prices is similar to that of other elements. Recent trends in the relationship of meat prices to feed prices show that feed and most of the feed components) rose 67% from January to October, 1974 while the wholesale price of live hogs rose only 4% as shown below:

	Wholesale Price of Live Hogs	Cost of Feed
Jan. 1974	VN$720/Kg.	VN$ 90/Kg.
May 1974	VN$740/Kg.	VN$110/Kg.
Oct. 1974	VN$750/Kg.	VN$150/Kg.
Increase from Jan. to Oct.	+4%	+67%

Until the prices for pork and feed are brought into a better alignment, and until the uncontrolled slaughter practices are sharply reduced, a modern slaughter house at Tai Do would probably not be viable.

If there were more farms like the Ngoc-Thanh Pig Breeding Farm in Cantho and if such farms could operate viably, then a slaughter house would be assured of enough raw material. However, under the present circumstances, a slaughter house would have to draw on widely scattered, individual farmers to obtain raw material. A large scale modern slaughter facility would probably be underutilized. We believe that a solution to the feed problem (see Chapter 4) should come first.

The major center of meat consumption in Vietnam is the city of Saigon and its environs. We believe that since the transport of live cattle 170 km. to Saigon is comparatively inexpensive, it would be more economical to supply meat from slaughter houses in Saigon where in fact there already is a major, modern slaughter house (VISSAN). Transport of cattle from Cantho to Saigon costs 1,000 piasters per 100 kg, or 10 piasters per kg — less than 2 US¢ per kg.

3.10 Tannery

As mentioned in Section 3.7 above, the cattle population of the Delta's 16 provinces was 266,140 in 1971 (*). Of these animals, 11,070 were slaughtered. The slaughter figure is about 4% of the total which suggests that some of the slaughter may not be reflected in the official statistics. The buffalo population was 196,680 in 1971 and about 4% are killed yearly.

(*) See Source 19 in Bibliography

In any event, the slaughter of cattle occurs over a wide area, rather than being concentrated in a few single facilities. Obtaining raw material for a tannery would require collecting hides from a wide area and rapid transportation to the tannery to avoid bacterial action and spoilage.

In the case of pig skin, the same problems would arise and the uncertainty of viable, large-scale hog farming, mentioned in Section 3.9 would make the supply of pig skin raw material questionable for the tannery.

3.11 <u>Livestock Ranching and Poultry Farming</u>

In Catho, there is a modern, scientifically operated hog farm as mentioned. There is also a chicken farm raising birds bred from imported stock (Leghorns, Plymouths, Rhode Island Reds). Both are impressive facilities. The former is facing financial problems because of the high price of feed and competition from the lower cost hogs, bred and slaughtered in the traditional manner.

The chicken ranch in Cantho (Huynh De at Binh Thuy, Cantho) was barely in operation in October, 1974. The chicken farm raised a peak of 20,000 birds in 1973, but the number fell to about 2,000 in October 1974.

Formerly, the owner used to export frozen chicken to Thailand and Singapore, but because of the high price of feed, these operations have been discontinued.

There is no substantial cattle ranching in the Delta. This is because of the shortage of grazing land and the predominant use of land for paddy. Other places in Vietnam north of Saigon are better suited for grazing because of the available pastures.

Given the a solution to the problem of feed, poultry and hog raising should become viable.

Duck farming is being undertaken by the small holder farmers. As mentioned in Section 3.7 above, duck can thrive on the insects and plankton of the rice paddies and therefore do not require feed. We saw many herds of ducks numbering thousands of birds each, clogging highways and in paddy fields. These ducks already constitute the basis for one of Vietnam's major exports namely duck feathers valued at U.S.$621,675 in 1972, US$1.3 million in 1973, and $925,941 in January-June 1974, (data from the Export Development Center, Saigon). Duck farming is a viable industry.

3.12 Processing of Aquatic Products

The Delta has a major potential for fresh water and marine products. Table 3.12-A shows the number of persons engaged in fishing, and the number of boats powered and manually propelled. Table 3.12-B shows fresh aquatic products and Table 3.12-C processed aquatic products. Tables 3.12-D and 3.12-E show further data on the fishing industry and processing for 1973.

The tables show that the Delta produces 87% of the fresh water fish of Vietnam. The volume of fresh water fish caught is about the same as the catch of marine products in the Delta. The Delta also accounts for a high percentage of the output of shrimp and mollusks as well.

These aquatic products of the Delta contribute greatly to the animal protein consumed in Vietnam. We believe that the inhabitants of the Delta are producing large volumes of cultured, fresh water fish which are not adequately reflected in the statistics. The acquatic products of the Delta constitute resources ranking along with paddy as a major national asset, and they hold promise for a variety of processing industries.

3.12.1 Fishing Operations

Fishing operations for marine shrimp and fish are centered in fishing ports in Kien Giang and Bac Lieu provinces. The fishing port of Rach Gia in Kien Giang province is the largest. With the current marine fishing methods, it will be difficult to increase production further. It will be necessary to expand the fishing area by increasing the size of vessels, equipping them with sonar, radio communication gear and freezing equipment both on shore on board the vessels. Shrimp could probably cultivated in coastal waters to increase the catch substantially.

The fresh water fishing is especially successful in An Giang and Chau Doc, but such fishing is generally practiced elsewhere in the Delta as well. There are special local methods for the culture or farming of fresh water fish, and thus overfishing of fresh waters in the Delta is not a problem.

(Narrative continues after
Tables 3.12-A through D.)

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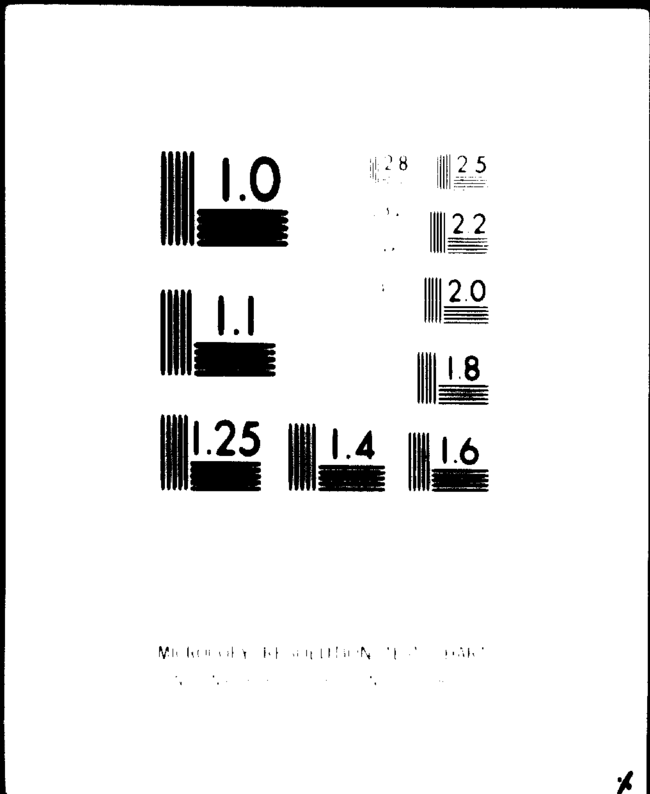

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Table 3.12-A

DATA ON FISHING OPERATIONS IN VIETNAM, 1961-73

Year	Fisherman	Fishing Boats	Motorized Boats	Non-Motorized Boats
1961	198,000	39,000	-	-
1962	198,610	35,600	3,600	32,000
1963	210,000	41,500	6,500	35,000
1964	245,520	56,470	9,710	46,760
1965	159,331	42,177	4,324	37,853
1966	171,480	41,737	32,360	9,377
1967	270,408	76,190	23,195	52,995
1968	272,304	79,959	29,968	47,991
1969	277,118	81,956	39,001	42,955
1970	317,442	88,209	42,603	45,606
1971	335,690	91,424	48,842	42,582
1972	342,797	95,062	55,247	39,815
1973	354,894	92,265	63,709	28,556

Directorate of Fisheries via Source No. 20, Bibliography.

Table 3.12-B

FRESH AQUATIC PRODUCTS OF VIETNAM - 1960-73

Year	Sea Fish	Fresh Water Fish	Total
	ton - m. tons		
1960	-	-	165,000
1961	-	-	250,000
1962	200,000	55,000	255,000
1963	298,000	34,000	332,000
1964	345,000	52,000	397,000
1965	318,000	57,000	375,000
1966	315,790	64,710	380,500
1967	351,200	59,500	410,700
1968	358,995	51,045	410,000
1969	400,171	63,673	463,844
1970	530,310	74,140	577,450
1971	516,424	71,066	587,490
1972	501,278	81,772	583,050
1973	508,537	91,342	599,879

Directorate of Fisheries via Source No. 20, Bibliography

Table 3.12-C

TONNAGES OF PROCESSED AQUATIC PRODUCTS -- 1960-73

Year	Fish Sauce (000's of liters)	Dried Fish (MT)	Salted Fish (MT)	Canned Fish (MT)
1960	-	-	-	194
1961	-	-	-	235
1962	-	-	-	140
1963	-	-	-	234
1964	41,116	16,011	17,365	214
1965	42,650	11,264	16,322	232
1966	53,783	12,329	17,557	187
1967	61,000	15,000	35,024	182
1968	59,000	20,205	24,830	80
1969	60,850	20,769	30,242	20
1970	64,192	27,981	34,425	-
1971	69,830	41,608	36,728	-
1972	68,737	46,050	43,327	-
1973	64,480	45,993	45,035	-

Source: Directorate of Fisheries via Source 20, Bibliography

Table 3.12-D

PROCESSED FISHERY PRODUCTS AT FISHING PORTS (1973)

(Unit: Tons)

	Dried fish, sharks' fins & bladders	Dried Shrimp	Dried cuttle fish	Steamed salted fish	Salted fish	Ground salted shrimp	Total	Fish sauce (1,000 Lit.)
Vietnam Total	39,307	5,665	1,021	20,576	24,459	1,965	92,993	64,480
Southern Region	28,603	5,471	252	8,026	17,179	1,648	61,179	24,511
(Delta)	(12,912)	(5,337)	(150)	(6,268)	(14,096)	(539)	(39,322)	(23,475)
(Delta / Vietnam %)	(33%)	(94%)	(15%)	(30%)	(58%)	(27%)	(42%)	(36%)
Central lowlands	10,704	194	769	12,550	7,280	317	31,814	39,969
Central highlands	-	-	-	-	-	-	-	-

Source: 19 Bibliography

Table 3.12-E

FRESH FISHERY PRODUCTS AT THE FISHING PORTS (1973)

(Unit: Tons)

	Marine fish	Fresh Water fish	Shrimp	Cuttle-fish	Mollusks	Total
Vietnam Total	508,537	91,342	62,085	12,922	38,710	713,596
Southern Region	206,255	83,155	55,569	7,819	30,967	383,765
(Delta)	(78,657)	(79,756)	(39,603)	(723)	(27,680)	(226,419)
(Delta / Vietnam %)	(15%)	(87%)	(64%)	(6%)	(72%)	(31%)
Central lowlands	302,282	8,187	6,516	5,103	7,743	329,831
Central highlands	-	-	-	-	-	-

Source: 19 Bibliography

3.12.2 Fish Culture

Relatively shallow water and good sunshine produces large volumes of plankton. These factors together with fresh bran from the rice mills creates good conditions for fish culture in the Delta's waterways.

If similar efforts were made to practice eel culture, the exports could become very successful since the Japanese consider eels a delicacy and consume eels in large volumes.

We believe some comment is warranted in this report regarding fish culture. This is because Dr. V. R. Pantalou, Fishery Advisor to the Mekong Secretariat in Bangkok urged our survey group to inspect methods of fish culture in Delta and because the outlook is promising for industry.

The method of culture is referred to in the literature as "cage culture". The species of fish vary, but a common fish is the cyprinus carpio, which sold last fall in the Cantho fish markets for 800 piasters per kg. or $1.17 per kg.

The fish cage is an extension of house boat, moored in shallow water along the river bank. The cage we inspected was 4 x 6 x 2 meters, about the same size as the house boat occupied by the fisherman and his family. (Dr. Pantalou thought the cages could be substantially larger, 16 x 6 meters; this size cage could not be handled by a single fisherman and his family but could be operated in conjunction with a freezing plant.)

The 4 x 6 x 2 meter cage which we inspected contained 25,000 fingerlings, 10 cm. long when they were first cought. When sold on the market 10 months later, the fish will weigh 0.2 kg each and be 20 cm. long. The fisherman pays about 6,500 (U.S.$9.50) piasters per day for feed (course rice bran, pumpkins, vegetables) or a total of 1,950,000 piasters (US$2,847); he sells his 5,000 kg. of fish on the market for 3,500,000 piasters (US$5,109)

The oxygen supply imposes an upper limit on the number of fingerlings as they grow in size and are packed densely in the cage. However, the oxygen supply is better in flowing river water than it would be in sea or lake water which is not moving. As mentioned earlier (Section 2.1), the Delta fish culture practices may be unique, are very promising, and could become the basis for frozen fish industry for export to Hong Kong and Singapore. Dr. Pantalou believes that the Delta fresh water fish is more appreciated in Asian markets than in Europe or the U.S.

We have made tentative calculations about the feasibility of culturing fresh water fish in rafts in large enough volumes to supply a fish meal plant at Tay Do. We have concluded that (a) the suitability of fresh water species for fish meal would have to be confirmed, (b) the capital required to build enough rafts would be substantial (e.g. To supply a 100 TPD palnt would require 962 M^3 of fish per day or 289,000 M^3 per year weighing 30,000 tons. To raise such volume would require about 1,000, 20M x 6M x 2M rafts working on a 10-month cycle. 1 M^3 of fish weighs 104 kg. Plant would require 100 tons fresh fish to produce 20 tons fish meal per day or 6,000 tons per year. For edible fish, culture should be efficient (see 4.9)

3.12.3 Cold Storage and Refrigeration

There are ice plants in almost all villages and, of course, in urban communities. The latter are fairly well equipped and efficient. (The Brasserie et Glacière de l'Indochine in Cantho has very modern facilities). These plants are supplying ice largely for the transport and preservation of fresh fish.

Freezing facilities for shrimp, fish, and clams to be exported have been established Rach Gia, Kien Giang Province. Plants for domestic distribution (through a cold chain, for example) have not yet been created. The domestic market for frozen fish or shrimp is not promising. The reasons are: (1) The distribution of frozen fish requires chilling equipment and also a complete system including freezing, refrigerated storage and transportation, sales channels, and defrosting both in commercial establishments and in private residences. Under present conditions, such elaborate facilities would be too costly. (2) Fresh fish are generally available in local markets at reasonable cost throughout the year and are generally more palatable than defrosted fish. Frozen fish differs from frozen meat in regard to the deterioration of flavor after defrosting. (Frozen fish is regarded as inferior in quality to fresh fish in Japan.)

The export market for frozen aquatic products is far more promising than the domestic market. (See Appendix B).

3.12.4 Processing

Drying, salting and smoking are inexpensive methods for preserving marine products, but in Vietnam where there are numerous rivers and canals and a long coastline, people in most areas can generally obtain fresh marine products and thus the demand for processed products is very limited.

There is a small factory in Rach Gia equipped with facilities for drying, but sales are not promising at present.

Canning potential for the domestic market is not promising in view of the abundance of fresh fish in most areas, plus the cost of cans (See Section 3.3.2, para c). However, an export potential does exist if black and tin plate were imported. Freezing is the best process.

3.12.5 Fish Meal

In view of the recent world wide shortage of fish meal caused by the decline of Peruvian anchovy, the fish meal industry developed rapidly in the Delta. It is estimated that the annual fishmeal production in Vietnam is about 20,000 tons. But with the 1973-74 improvement of Peruvian production, several fish meal factories in Rach Gia and nearby Phu Quoc Island have been shut down due to the non-competitive cost of their product. The industry has also been troubled by the high cost of fuel and insufficient raw material. Fish meal is an important protein ingredient for the mixed feed industry in the Delta. It will be necessary to procure the needed volume of fish meal if necessary by providing special incentives for the industry, since fish meal is of prime importance as an import substitute for mixed feeds (See Chapter 4).

3.12.6 Fish Sauce

Fish sauce (nuc maum) is an important sector of the food processing industry in Vietnam. It is regarded as one of the necessities for food preparation (like soy sauce in Japan and China or ketchup in the United States). Production of fish sauce is quite large, but the factories are small scale and widely scattered except for the Rach Gia area and Phu Quoc Island. The processing is based on traditional artesanal methods. (See above Table 3.12-C, for production.)

It will ultimately be possible to establish a modern, large-scale factory as was seen in the evolution of the soy sauce industry in Japan but preferably at Rach Gia, not Tay Do.

3.13 Peanut Processing

This subject has been discussed in Section 3.5 above.

3.14 Wood Pulp and Other Materials for Pulp

The utilization of rice straw as a source of pulp was discussed in Section 3.2.4 earlier in this report.

There are two other potential sources of pulp in the Delta, the mangrove forests in brackish water along the southeast coast line and the tram forests chiefly north of Rach Gia on high and where waters are fresh and the soil clayey. (Tram is sometimes called, "Climax Type Mangrove".) (The scientific name of the principal mangrove species is *Rhizophora conjugata* and the scientific name of the Tram is *Melaleuca leucadendron* -- Source 54-A).

3.14.1 Mangrove Trees

Mangrove trees grow in deep mud consisting of alluvial clay and brackish water. There are an estimated 329,000 hectares of mangrove in the Delta. (Another estimate is 500,000 ha.) Typically there are 10,000 mangrove trees per hectare and one hectare can yield from 50 to 100 m^3 of wood. The mature mangrove tree can be 5 to 6 meters in height and 10 cm. in diameter after about 10 years of growth. However, in the typical mangrove stand, the height of the trees is 2 meters and the diameter of the trunks range from 4 to 7.6 centimeters (Source 54-A in Bibliography).

A continuous supply of mangrove could be obtained by a 10-year rotation. For example, by cutting 33,000 hectares per year, about 2.5 million m3 of wood could be obtained. In harvesting mangrove, it is necessary to replant seedlings in the clear-cut areas.

Logging operations for the mangrove trees are often thought to be fairly simple and inexpensive since the trees grow near the coast and roads and bridges are not required for logging. However, there are many difficulties encountered in actual practice. One of the difficulties is the fact that the density of mangrove wood is about 1.05 (Bibliography 54-A); the logs do not float and cannot be hauled through the water as rafts or logs. Therefore the collection and landing operations entail substantial cost. A chip factory would have to be located at the logging site to reduce transportation costs.

Mangrove logging operations elsewhere have not proved to be economically viable. There are two known attempts to harvest mangrove trees for pulp -- one in North Borneo where the Japanese company, Oji Paper Co. Ltd., abandonned operations and the other in southern Sumatra where Japan Inter Co. Ltd. also failed.

Some of the reasons for the difficulty of mangrove logging operations are:

(a) The ebb and flow of the tide permits logging only during the low tide period. (b) Along the coast line of the Delta area, logging operations would be jeopardized by ocean waves which roll far inland during typhoons. (c) The shallow water depth for some distance out from the shore precludes the approach of large vessels. (d) An economical chip plant would require a pier, the construction of which would be difficult due to the unstable soil and the need for extensive piling. (e) Since the mangrove trees grow in fairly narrow stands, the siting of the pier would pose problems; namely; as the adjacent stands of mangrove were harvested, the pier would become more and more remote from the sources raw material. This problem might be solved by a special purpose vessel on which the logs could be processed into chips. However the mechanization of harvesting still remains an obstacle. (f) The mangrove tree is not an ideal pulp wood because of its density and the heavy chemical costs involved in pulping processes.

The mangrove wood is now used for:

Charcoal
Firewood
Fishing Poles
Rafters
Tannin (for dyes)

3.14.2 Utilization of the Tram

Tram trees can grow to large size but are usually lumbered off when the trunks are 8 to 15 cm. in diameter. The stands of tram trees are estimated to cover an area of 200,000 hectares, but the total volume of wood of the tram tree is small. The tram is used for the following purposes:

- Fuel wood
- Charcoal
- Rafters to support the roofs of houses
- Piles for houses built on soft earth where flooding is likely
- Cork substitute, made from the bark

During our field survey, we did not inspect the tram forests, but discussions with a forestry expert (Le Viet Du, Director of Waters and Forests) and an inspection of the literature (Bibliography 54, 54-A, and 54-B), lead to the conclusion that the tram should not be considered a source of pulp until such time as reforestation and aforestation programs are well established. The pulp outlook is unfavorable because the stands of tram trees are uneven and would not lend themselves readily to mechanical harvesting and because the tram is being lumbered off quite rapidly to meet the growing demand for construction, chiefly for piling. For construction timber alone, some 20,000 m^3 of tram was being consumed in the 1960's (Bibliography, 54-A) and because of population increases since then, greater volumes are probably being consumed today. A sudden depletion of the tram forests for pulping purposes would give rise to a requirement for a substitute piling material, probably brought into the Delta from outside.

3.15 Agricultural Implements and Engine Repair Services

3.15.1 Engine Repair Services

There are some primitive, small scale repair shops and metal working shops in Cantho. They are operating without the benefit of modern tools, equipment and measuring instruments. Given their handicaps, it was surprising for to us see the quality of repairs being undertaken thanks to the ingenuity and diligence of the operators.

Regardless of their skills, however, it is impossible for these shops to repair engines, especially diesel engines, without precision equipment such as test benches for f.i.e. and nozzle grinders.

The number of diesel engines fitted on four wheeled tractors, boats and trucks and buses in the Delta is estimated to be 41,120 (See Table 3.15-A).

(narrative continues after tables)

Table 1.15-A

Estimated Number of Diesel Engines Operating in Delta by Equipment Application--1974 (Civil only)

	1968	1969	1970	1971	1972	1973	Total	Estimated Sold to Delta	Estimated No. still in Operation in 1974 in Delta
4-wheel tractors over 30 HP a)	480	855	3,572	1,744	2,000	2,600	11,251	9,001 (80%)	8,101 (90%)
4-wheel tractors under 30 HP a)	4	180	676	778	800	1,000	3,438	2,063 (60%)	1,135 (55%)
Marine diesel engines a)	2,947	6,841	841	1,000	1,000	1,200	13,829	4,149 (30%)	3,942 (95%)
Diesel engine "marine type" a)	7,690	23,050	8,658	14,207	10,000	12,000	75,585	22,676 (30%)	21,542 (95%)
Sub-Total	11,131	30,986	13,747	17,729	13,800	16,800	104,103	37,889 (36%)	34,780 (92%)
Privately owned trucks b)	991	1,669	2,117	2,911	1,396c)	1,300c)	10,384	6,230 (60%)	6,000 (96%)
Buses	200d)	200d)	136e)	400e)	179e)	200d)	1,315	473 (36%)	400 (85%)
Total	12,312	32,775	16,000	21,040	15,375	18,300	115,802	44,592	41,120

Notes:

a) Source: 1968-71 from USAID Agr. Eng./ADPA Saigon. Other figures estimated by PPL or provided by ANTRACO agents for I.H.Inc. in Saigon.

b) Based on new truck registrations as reported in the Vietnam Statistical Yearbook, 1972 National Institute of Statistics, Saigon.

c) According to the official import statistics, Vietnam Statistical Yearbook 1972, in 1972, the total imports of trucks weighed 4,889 tons. The GVW of a 5-ton payload truck is 9.2 tons; of the 9.2 tons, the body weight is usually about 4.2 tons. Most of the imported trucks are 5-ton payload trucks, and trucks are imported as chassis only. Therefore we are assuming the weight is 3.5 tons (4.2 tons less 0.7 tons of local content = 3.5 tons). Therefore, 4,889 tons/3.5 tons = 1,396 trucks. The figure for 1973 is a PPL estimate and is not based on official statistics.

d) This is a PPL estimate.

e) The actual tonnage of bus chassis imported was 477 (1970), 1,401 (1971) and 628 (1972). We are assuming the body weight is 3.5 tons and have divided the tonnage figures by 3.5 tons.

f) The Delta population is about 6.7 million or 36% of the South Vietnam total of 18.7 million. We have multiplied the total buses by 36% to estimate the number of buses sold to the Delta.

Table 3.15-B

Estimated Diesel Fuel Consumption of Engines Operating in Delta--1974

	Engines Operating in Delta(a)	Hours or Kilometers of Operation per year	Diesel Fuel Consumption per hour or per Km. (liters)	Total Annual Consumption KL
4-wheel tractors over 30 HP	8,101	1,000 hours	10 liters/hour (b)	81,010 (b)
4-wheel tractors under 30 HP	1,135	800 hours	6 liters/hour (c)	5,448
Marine diesel engines 200 HP and over	3,942	1,000 hours	24 liters/hour (d)	94,608
Diesel engines marine type (Ave 30 HP)	21,542	500 hours (e)	6 liters/hour	64,626
Sub-total	34,720	-	-	245,692
Privately owned trucks	6,000	30,000 km (f)	15 liters/km.	12,000
Buses	400	30,000 km (f)	15 liters/km.	800
Total	41,120	-	-	258,492
Converted to Barrels (1 kl = 6.29 bbls)				1,625,915 bbls
Converted to Metric tons (1 Met. Ton = 7.7 bbls)				211,157 MT

Notes:

a) From Table 3.15-A

b) John Deere 35 HP tractor operating at 50% maximum load consumes 2.5 gallons/hour or 10 liters/hour x 1,000 liters = 10 MT x 8,101 tractors. (32 HP International Harvester Tractor consumes 2 gallons/hour or 8 liters per hour.)

c) A 23 HP International Harvester consumes 1.5 gallons per hour at 50% load or 6 liters per hour x 800 hours = 4.8 kilo liters.

d) Assumes consumption of 24 liters per hour of 200 HP engine at 50% full load. (Some examples are: Massey Ferguson 183 HP engine consumes 6.2 gallons or about 24 liters/hour operating at 50% maximum load: 163 HP International Harvester turbocharged engine consumes 6.5 gallons or about 25 liters per hour.)

e) Seasonal or sporadic use for rice mills, irrigation pumping, casava grinding, threshing.

f) Assumes that trucks and buses travel 30,000 kilometers per year. (in Japan, typical annual distance travelled by trucks is 30,000 to 40,000 kilometers.)

Vietnam imported about 421,779 tons of diesel fuel in 1974 for civilian uses, an estimated 50% of which was consumed in the Delta, namely about 211,000 tons. (See Table 3.15-B). The cost of this diesel fuel is about U.S.$22 million (See Table 3.15-C).

Table 3.15-C

DIESEL FUEL IMPORTS -- 1973-75

Year	Barrels Imported	Converted to Metric Tons (7.7 barrels = 1 MT of diesel oil)	Value of Imports (US$ 000's)
1973	3,753,000 bbl.	487,402 MT	$30,308
1974 (Jan.-Sept. actual)	2,430,000 bbl.	315,584 MT	$33,582
1974 (Jan.-Dec. estimated)	3,240,000 bbl.	420,779 MT	$44,777 ($106/MT)
1975 (Estimated)	3,300,000 bbl.	428,571 MT	$45,606

The estimates of engineers vary, but from one third to one half of the fuel is being wasted because of improper maintenance. The Vietnam government, as a means of helping agriculture, fisheries and transportation are subsidising the users of diesel fuel by VN$30 per liter; when this is taken into account, annual waste is conservatively estimated at US$10.2 million, according to our calculations based on two interviews with Esso Eastern, the Vietnam subsidiary of Exxon. (See Table 3.15-D)

Table 3.15-D

ESTIMATED COST AND WASTE OF DIESEL FUEL IN THE DELTA -- 1974

	U.S.$ (millions)	Converted to VN$ (millions @US$1=VN$670)
A. Cost of 211,157 MT of Diesel Fuel used in Delta annually ($106/MT)	22.4	14,996
B. Waste of Diesel Fuel in Delta annually @30% x A.	6.7	4,502
C. Waste of Government Subsidy of VN$30/liter (VN$30 x 258,492,000 liters x 30% waste)	3.5	2,326
D. Total Waste (B + C)	US$10.2	VN$6,828

Added to this loss, are similar losses arising from the use of gasoline engines, the lower performance of all engines, and the shorter engine life.

It could be argued that Vietnamese governmental investment in repair facilities could be justified as a means of reducing the national drain of foreign exchange.

The repair facilities need to be equipped with a variety of measuring instruments (for f.i.e. and nozzles), jigs and tools and machine tools. The latter would pose several difficulties. Some machine tools are necessary, but the utilization would be inevitably low.

3.15.2 Agricultural Implements

We also recommend that a small-scale foundry and forge be established adjacent to the engine repair facilities to help assure fuller utilization of the machine tools and to manufacture tools and pumps.

There is no foundry in Cantho, and a foundry is basic for all kinds of mechanized processing and plays an important role in the production and maintenance of pumps, and various other agricultural implements and fishing vessels. Facilities for welding would be needed. We recommend unsophisticated facilities as the first step as described in Chapter 4. This is because a major facility such as the CARIC foundry and forge (across the river from the Majestic Hotel in Saigon) would not be needed in Cantho for some years.

3.16 Forest Products

Timber in the Delta consists of two principal species described in Section 3.14 above, namely, the tram and mangrove.

The tram could grow to large size if not cut prematurely. However, the stands are uneven and the trees are usually small. According to Source 54-A, tram typically have malformed trunks, of rapid taper, and of small value as merchantable timber.

The mangrove likewise is not suitable as saw mill timber; saw mills in Cantho cut light logs that are towed down from the north by tug boats. The logs are typically 60 cm. to 120 cm. in diameter. The logs are sawn into planks used to make boats and furniture for the local market. Since mangrove does not float, it cannot be towed.

During our field survey, we visited what was described (by the Industrial Development Bank of Vietnam representatives) as the largest saw mill in Cantho. The mill had 1,200 M^2 of floor space and was equipped with a 150 HP band saw. The manager said that they did not cut tram or mangrove because the wood was not sufficiently uniform or was too small in diameter. Instead, the types of timber processed were those listed in Table 3.16 below:

Table 3.16

TYPES OF TIMBER USED IN CANTHO -- OCTOBER 1974

Vietnamese Name	Scientific Name b/	Application a/	Remarks a/
Cam Lai	Dalbergia bariensis	Boats/furniture	"Rose wood," the most expensive, US$219/M3
Den Den c/	Xylopia pierreii	Boats	Best seller
Giai Ngua c/	Swietenia	Boats	--
GoM Mat	Sindora cochinchinensis	Boats	--
Sao	Hopea Dealbata	Boats/furniture	Best seller
Thao Lao	Lagerstroemia divers	Boats	Best seller
Dav c/	Morus indica	Boats	" "

a/ Pacific Projects field survey, October 1974

b/ Source No. 53 in bibliography

c/ Least expensive

The most economical location for modern saw mills would be close to the source of raw material. A modern saw mill at Tai Do would probably operate at a competitive disadvantage given the resumption of normal commerce with the timber growing areas to the north of Saigon.

3.17 <u>Gunny Bag Manufacture</u>

In the event that a rice center is to be built at Tai Do Chapter 4), an assured supply of bags will be required. The approximately 1.0 million tons of paddy shipped out of the Delta annually requires about 10 million bags. Additional bags are required for paddy milled for local consumption in the Delta.

The life of a kenaf or jute bag was reported to us as being 3 to 5 years. Therefore some 2.0 to 3.0 million new bags are needed annually for the Delta's surplus alone. For paddy milled for local consumption probably some 10 to 18 million additional bags are needed. Total annual requirement for paddy and rice alone ranges from 12 to 21 million yen bags per year, depending on the years in service.

The bag industry is facing the following uncertainties at present:

(a) In July, 1974 a new regulation was approved by the Government to reduce the capacity of bags from the former standard of 100 kg. down to 50 kg. It was argued that lifting and carrying of a 100 kg. bag of paddy was injurious to the health of porters. Some of the agencies are opposing the 50 kg. bag and the ultimate outcome is not clear.

(b) The plastic bags sold ex factory in October 1974 for 150 to 160 piasters which is cheaper per kg. of capacity than the 100 kg. kenaf or jute bags. The kenaf bag in October 1974 sold ex factory for 460 piasters in large volumes to the National Food Administration (Bibliography No. 34). New kenaf bags in smaller volumes sold for as much as 500 piasters in October 1974.

(c) A further uncertainty is the future trend in bags used for imported commodity shipments. If fertilizer or rice were shipped or bagged locally in plastic bags, then these bags will further penetrate the market and replace many of the jute bags now in use.

(d) The supply of kenaf or jute is uncertain. At present, the raw material is partly obtained locally (Central Lowlands and Central Highlands) and partly imported from Thailand. The continued availability of the local supply is now in doubt because imports were cheaper.

(e) There is substantial bag making capacity available in Vietnam as follows (the manufacturers cannot switch from jute to plastic or vice versa since the weaving machines are completely different):

Table 3.17

BAG MANUFACTURING CAPACITY IN VIETNAM -- OCT. 1974

Name of Company	Product Line	Maximum Capacity per 300-day Operating Year (equivalent in 100 kg. bags.)
SOVIJUTE	100 kg. Kenaf or jute bags	4.5 (4.5) million bags
DOFITEX	Same	1.6 (1.6) " "
Trieu Quang	50 kg. polypropylene bags	2.6 (1.3) " "
Vietnam Ky Nghe Nhua Deo	Same	1.8 (0.9) " "
Dong Thanh	Same	2.6 (1.3) " "
Thong Dung	Same	2.6 (1.3) " "
Uniplastic	Same	3.0 (1.5) " "
Others	100 kg. Kenaf or jute	1.4 (0.7) " "
Total		20.1(13.1) million bags

The kenaf bag manufacturers told us that 1973 and to a lesser extent 1974 were unfavorable business years for them because USAID began to use plastic bags on a larger scale than before. Therefore much of the capacity in Table 3.17 above lay idle.

We believe that until there is a clarification of future uncertainties as to (a) plastic vs. kenaf, (b) the supply of domestic kenaf, and (c) the partially idle bag making capacity, that further study of bag manufacturing facility at Tai Do should be deferred.

3.18 Fertilizer and Limestone

3.18.1 Fertilizer

In the 1973-74 crop year, 2,039,400 hectares of paddy fields were cultivated (Bibliography, 19) in the 16 Delta provinces; this was 72% of the total paddy hectarage in Vietnam.

In 1973, Vietnam imported 407,000 tons of fertilisers, of which we estimate some 293,000 tons were used in the Delta, i.e. 72% of the total. This means that only 144 kg. per hectare was used in the Delta. In contrast to this 144 kg. per hectare, the optimum application would have been at least 300 kg. per hectare and in the case of multiple cropping of TN (i.e. IRRI varieties), the application should have been 500 to 600 kg. (The figure of 144 kg. per hectare is close to the USAID/Cantho estimates of 150 kg. per hectare.) These figures are restated in tabular form below:

A.	Estimated total fertiliser applied in Delta	293,000 tons
B.	Per hectare application for paddy	144 kg.
C.	Per hectare minimum required application	300 kg.
D.	Per hectare optimum application	500 - 600 kg.
B/C	....	48%
B/D	....	24% to 29%

Therefore, the Delta paddy land is using about one fourth to one half of the fertiliser that is actually needed.

Despite the natural nutrients available in the Mekong irrigation water, paddy production needs fertilizer for economical farming. Using the effect of urea as an example, the farmer obtains a yield 76% greater with urea than without urea in the dry season, and 39% greater in the wet season, as tabulated below:

	Paddy Yield Without urea	Paddy Yield With urea	Added Yield from urea
Dry season yield	3,400 kg.	6,000 kg.	2,600 kg. (+ 76%)
Wet season yield	3,300 kg.	4,600 kg.	1,300 kg. (+ 39%)

In terms of the financial return to the farmer, his expenditure of 24,000 piasters ($36) to buy 120 kg. of urea for dry season cultivation brings him revenue of 226,200 piasters ($338). That is, the investment in urea brings a 742% return to the farmer as follows:

A. Cost of 1 kg. of urea .... 200 piasters
B. Selling price of 1 kg. of paddy .... 87 piasters
C. Cost of urea used in dry season (120 kg. x 200 piasters):........................... 24,000 piasters
D. Selling price of extra yield of paddy (2,600 kg x 87 piasters).................. 226,200 piasters
E. Farmer's extra cash by using urea (D-C) 202,200 piasters
F. Farmer's return on investment in urea (E/C-1.00) = 742%

The conclusion is that the Delta's productivity could rise substantially, possibly 30 to 50%, if adequate quantities of fertilizer were applied. Instead of a Delta surplus of some 1.0 million tons, the surplus could be raise to 1.3 to 1.5 million tons by the application of fertilizer supplies. (This does not take account of various other measures to raise yields such as dry season irrigation, more deep plowing by tractors, and wider cultivation of TN varieties.)

Expressed in a different way, 1 kg. of urea brings 22 additional kg. of paddy, as shown below (this assumes the farmer applies an annual total of 180 kg. of urea):

Dry season crop $\frac{\text{2,600 kg of extra paddy}}{\text{120 kg of urea applied}} = 21.67$ kg

Rainy season crop $\frac{\text{1,300 kg of extra paddy}}{\text{60 kg of urea applied}} = 21.67$ kg

Vietnam's imports of fertilizer cost $45 million in the year ending June 1974 (USAID, $36, GVN $9 million). Tonnages for prior years are shown in Table 3.18.1 and have risen from 323,000 tons of material in 1963 to 407,000 tons in 1973. However, as indicated, this 407,000 tons is less than half the optimum quantities. Therefore to assure future supply, the manufacture of fertilizers is required in Vietnam. Other countries in Asia have proceeded with the construction of urea plants (Bangladesh, Pakistan, India, Philippines, Taiwan, Korea).

Ideally the Delta paddy farmers need a mixed fertilizer similar to what is being used today. USAID has been financing a mixed fertilizer, called AMOPHOSCO, consisting of 16 parts P_2O_5, another 16 parts of nitrogen, and 8 parts of potassium.

The intention is to shift to a different mixture: 18 parts of P_2O_5 and 46 parts of nitrogen, and no potassium. In addition to the mixture, USAID will finance urea containing some 40% nitrogen. The mixed fertilizers will probably be imported in bulk and mixed at a mixing plant. Preliminary plans contemplate the site as being Vung Tau (SE of Saigon on the coast). We are recommending Tay Do (See Chapter 4).

Table 3.18.1

FERTILIZER: IMPORTS AND ESTIMATED USE, CALENDAR YEARS*
1,000 Metric Tons

Year	Imports: Nutrients N	Imports: Nutrients P	Imports: Nutrients K	Imports: Nutrients Total	Imports: Material	Estimated Use: Material	Estimated Use: Nutrients
1963	58.4	36.9	10.8	106.1	323	-	-
64	32.9	41.3	8.3	82.5	261	-	-
65	26.4	56.9	11.1	94.5	251	-	-
66	65.7	35.5	13.2	114.3	267	193	-
67	59.7	21.0	25.8	105.4	205	217	-
68	24.3	3.8	1.2	29.2	70	220	-
69	137.5	51.6	25.4	214.4	483	303	-
70	135.3	61.9	24.9	222.3	518	323	139
71	59.1	15.1	6.5	80.6	179	350	154
72	95.7	31.4	18.0	145.2*	315	364	164
73	131.8	39.8	24.3	195.9	407	380	182
74							
75							
76							

* Through 1967 contracts awarded; 1968 to date-arrivals.

* Includes 0.1 of Mg.

Source: Imports based on reported unloadings. Use based on USAID estimates.

3.18.2 Urea Manufacture

To manufacture urea, an ammonia plant would be required, fueled by some form of hydrocarbon. Ideally, if gas in commercial quantities were found off the Vietnam coast, the hydrocarbon could be natural gas pumped by submarine pipe-line to the plant site. Alternatively, naptha could be provided from a petroleum refinery to be built in the future. As an interim step imported naphtha is suitable.

The ammonia plant would produce the two essential ingredients for urea, ammonia and CO_2.

The economics of the following alternatives for hydrocarbons would have to be studied: (a) potential offshore gas from Vietnam, (b) naphtha produced in a refinery to be built in future in Vietnam, (c) imported naphtha, (d) possibly imported LPG or LNG (the last alternative is probably the least desirable since gasification facilities will be needed).

Naphtha, the principal feedstock for petrochemicals, is now in surplus in Japan, and only half the 17% naphtha fraction is consumed owing to the currently underutilized ethylene capacity. Even after the recovery of Japan's ethylene industry, long range supply arrangements could be made a geographically close supply source such a Singapore where crude is refined.

We believe that it would be logical to site the a urea plant at Cantho, on or near the Tay Do Park, depending on land availabilities when such a plant is built. (Of the 151 hectares in the Tai Do Park, 46.3 hectares are already committed -- see Section 1.2 above). A urea plant might well require 8 to 10 hectares for the ammonia plant and related facilities. (The Vietnam Industrial Development Bank recommends a 425,000 T/year plant -- Bibliography, Source No. 55).

The location in Cantho would seem economical because of the following factors:

(a) The distance from some of the drilling concessions to Cantho is greater than to other sites. but in the case of other concessions, is shorter. In general, the distances are similar (See Figure 3.18.1). If naphtha were imported, it could be piped to Cantho.

(b) Engineering studies made in Cantho by the Hazama Gumi Co., Ltd. (builders of the 33 MW power plant) show that it is possible to construct plant buildings and install machinery at costs that are higher, but not unreasonably higher, than for example, Japanese costs. Piling costs are $51/meter in Cantho vs. $32/meter in Japan (Cantho piling costs includes transport of steel piles from Japan to Cantho).

(c) From our talks with plant engineers, buildings in Cantho, if properly piled, could support 20 to 25 tons/M^2, which is probably less than the weight of such equipment as the ammonia compressors,

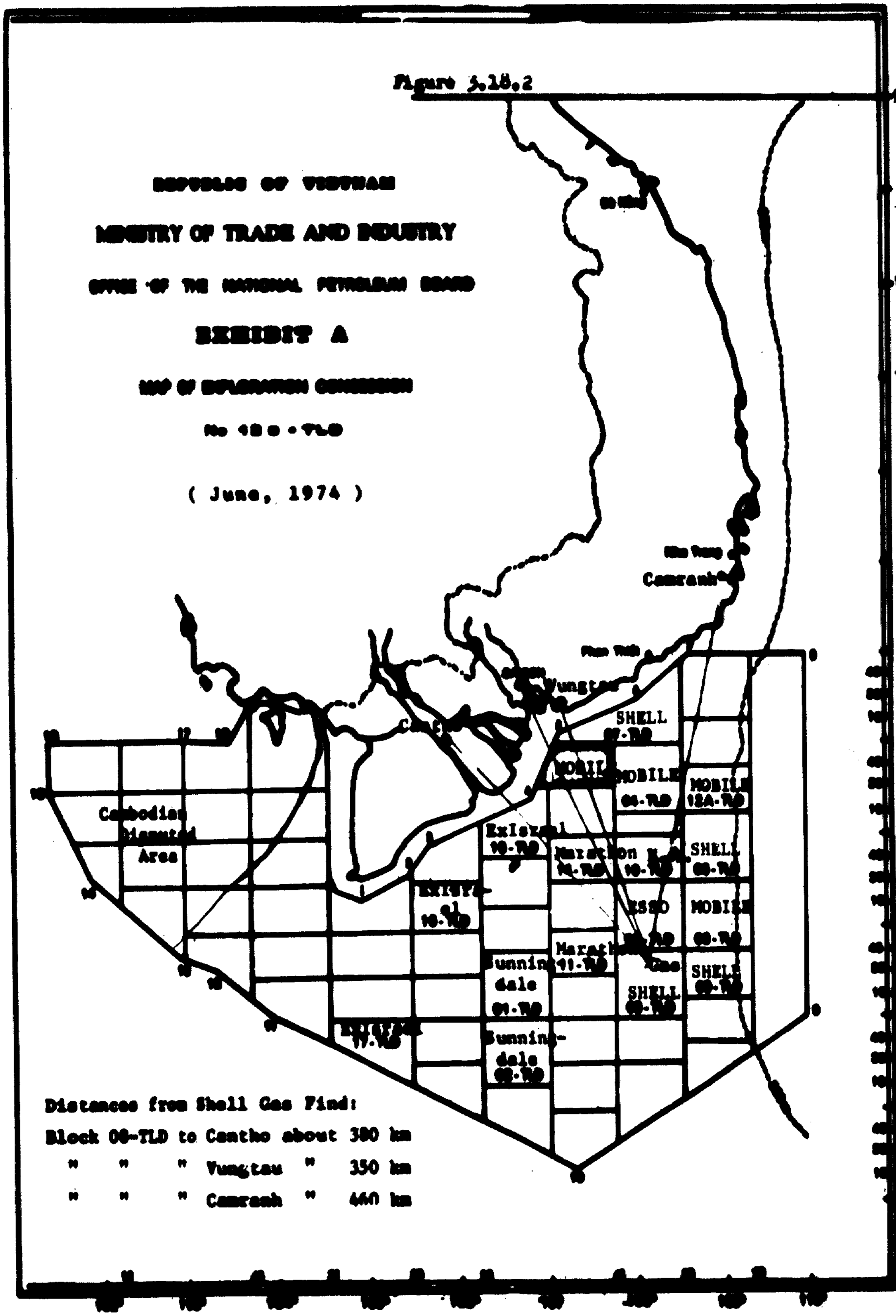

MINISTRY OF TRADE AND INDUSTRY
OFFICE OF THE NATIONAL PETROLEUM BOARD
EXHIBIT A
(June, 1974)
Camranh
Vungtau
SHELL
MOBIL
MOBIL
MOBIL
SHELL
ESSO
MOBIL
Marathon
Gas
SHELL
SHELL
Cambodian Disputed Area
Distances from Shell Gas Find:
Block 08-TLD to Cantho about 380 km
" " " Vungtau " 350 km
" " " Camranh " 460 km

Figure 3.18.2

the furnance or urea prilling towers.

(d) Urea would be made near the paddy growing area, rather than 170 kilometers away, if the Vung Tau site were selected.

3.18.3 Phosphatic Fertilizers

Vietnam needs a phosphatic fertilizer plant because P_2O_5 as a component in mixed fertilizers is essential to stiffen paddy stalks and thus avoid stalk breakage in typhoons. All phosphatic materials are imported.

A plant to manufacture phosphatic materials could be sited economically near a major port where bulk handling of phosphate rock is possible. By 1976, dredging programs are scheduled to be completed to allow vessels with a 36-foot draft to discharge at Cocan Gio near Vung Tau.

At present, the largest vessels that can discharge near Saigon are the 26,400 gross ton LASH ships (for example the Pacific Far East Lines, Golden Bear with a 32 foot draft). Vessels of such size can now discharge at Thien Lien, northwest of Vung Tau.

However the siting of a phosphate fertilizer plant cannot be decided until several factors are examined such as: (a) the comparative costs of barging the rock to Cantho vs. barging the finished fertilizer, (b) the possibility of having plants in Cantho for mixing and bagging phosphatic, nitrogenous, and potassic materials.

3.18.4 Limestone Crushing

Much of the Delta soil is characterized by high acidity, typically in the 4 to 5 pH range for dry soils and sometimes as low as 3, (See Section 2.2 and in Appendix C). In general, the closer the soils are located to the branches of the Mekong, the lower the acidity, thanks to the neutralizing effect of the irrigation water.

There are large areas of the Delta, shown in Figure 3.18.4, that are characterized by especially high acidity; on the official soils map (Bibliography, 79), these areas are labelled, "very acid alluvial soils". We estimate that these areas cover about 1.4 million hectares of which much is planted in paddy. We estimate 700,000 hectares are planted in paddy.

These areas, consisting of 700,000 hectares, represent the most serious acid problem areas. If 300 to 500 kg. of limestone were applied per hectare, the high acid areas would require 210,000 to 350,000 tons of limestone per year.

There is one USAID-assisted limestone crushing plant now under construction located southwest of Thotnot in An Giang Province. The capacity of the plant will be 5 tons per hour or 120 tons per 24 hour day and 36,000 tons per 300-day working year. This plant will be able to meet some 10% to 17% of the needs of the 700,000 hectares of high acid soils (There would also be requirements for limestone where acidity is more moderate.)

Given adequate limestone applications, the Delta's annual paddy yield of 5.1 million tons (See Table 2.3) would rise. Many variables will affect the yield, but assuming a 5% improvement, an additional 255,000 tons could be produced, valued at $32.4 million (87,000 piasters/685 x 255,000 tons) at domestic prices prevailing in October, 1974. The value of milled rice on world markets would be 2 to 4 times the domestic paddy price, depending on the rice grade, that is an annual range of $60 to $120 million (See Table 3.2-A for Thailand prices).

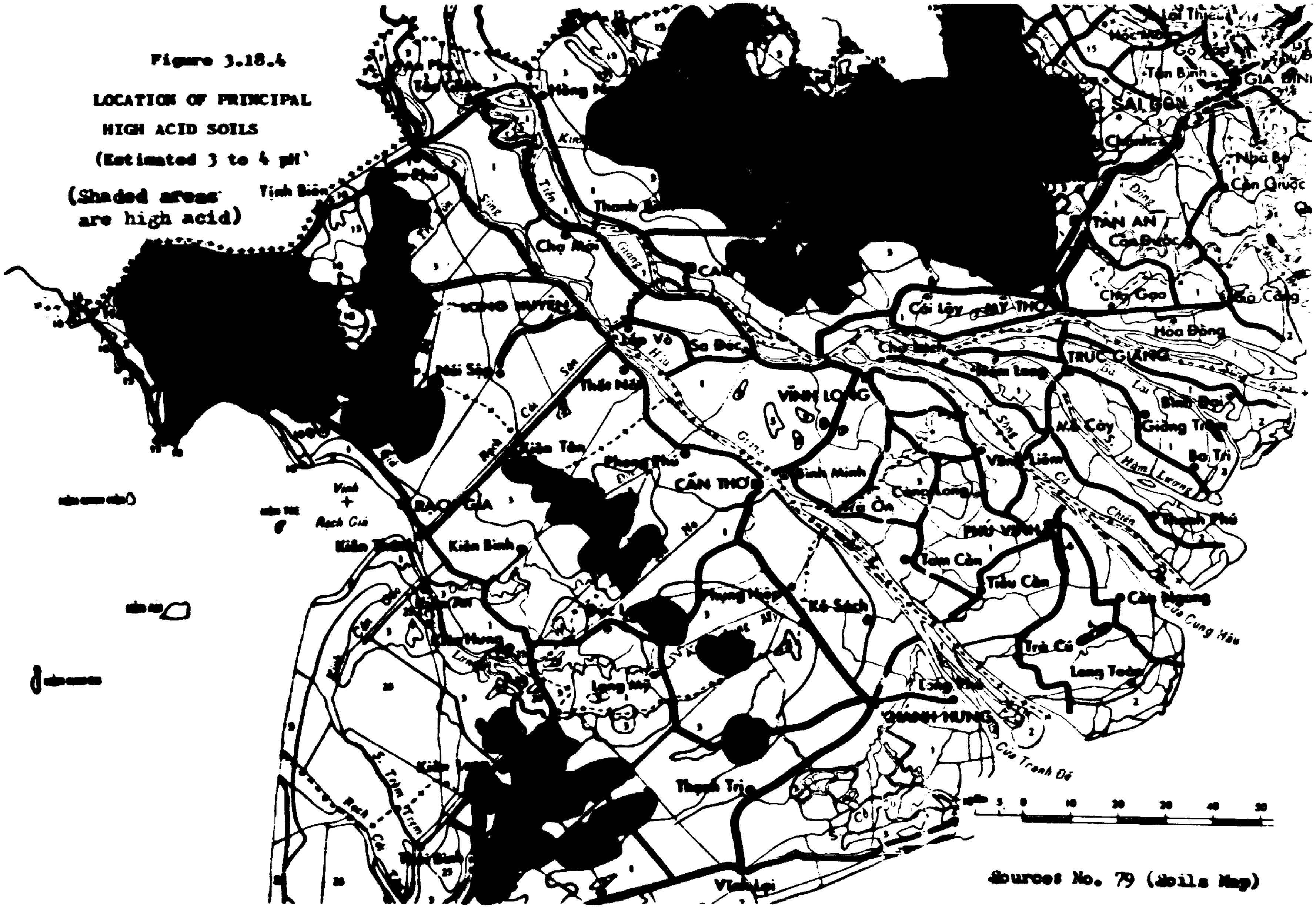
One of the few mineral resources of the Delta is limestone located near Hatien near the coast of the Gulf of Thailand in Kien Giang Province close to the Cambodian border. We were told by USAID that the reserves near Hatien are very substantial, well over 20 million tons. The limestone reserves are large enough to have justified a major investment in a clinker plant near Hatien, a barge fleet to haul clinker to a cement plant (at Thu Duc, near Bien Hoa). The Thu Duc plant produced 263,300 tons in 1971, 243,100 tons in 1972 and 265,200 tons in 1973. Plans are underway to double this cement capacity.

This leads to the conclusion that enough limestone exists to justify a plant to crush limestone at Tay Do. However, we believe that the application of limestone on paddy fields is not widely practiced at present. As in the case of TN rice and the use of urea, several years will be required to build an assured demand. We think that the experience of the Thot Not plant, described earlier in this section, should be watched closely and the willingness of farmers to purchase limestone at current prices should be studied before a decision is reached to proceed with a large scale crushing plant.

Also the installation of some pilot facilities, described in Chapter 4, would be a useful preparatory step to assure wider acceptance of limestone by the farming community.

Figure 3.18.4

LOCATION OF PRINCIPAL
HIGH ACID SOILS
(Estimated 3 to 4 pH)
(Shaded areas
are high acid)



Sources No. 79 (Soils Map)

3.19 Low Lift Pumps

As mentioned, much of the Delta's paddy growing area is flooded in the wet season but becomes brick hard in the dry season. During February through April no paddy culture whatever takes place (See Figure 3.2-B). Because of the lack of irrigation, the abundant water of the Mekong and Bassac and the immediately adjacent "desert" presents an unappy contrast in the dry months.

The dry months could become productive given a wider use of low lift pumps. The Report of the PASA Water Management Team,(Bibliography, Source No. 23) points out that dry-season irrigation could play a major role in raising annual paddy yields as follows:

Type of project and location	Additional Hectares that Could be used druing the Dry Season
Opening of new areas for double cropping in Go-Kong, Kien Hoa, and Cai San	250,000 hectares
Reclamation of new paddy growing areas in An Xuyen and Ton	200,000 hectares
Drainage of brackish water in Thie Tiep-Nhut, Vinh Loi, Quan-Lo, Phung-Hiep	330,000 hectares
Total	780,000 hectares

Assuming a yield of 2.5 to 3.3 tons per hectare, the above new, reclaimed or drained areas could produce 2.0 to 2.6 million additional tons, of paddy raising the Delta's output from the 1973 level of 5.1 million tons to 7.1 to 7.7 million tons, a percentage an increase of 39% to 51%.

The Report of the PASA Water Management Team (Source No. 23) * concludes with the following statement,

> "The major need is for an efficient propeller-type pump to lift water from 3 to 10 feet that can be powered by a small gasoline or diesel engine....
> We recommend that the development of this low-lift pump be given a very high priority as it is related to immediate increases and diversity in crop production dependent on water supply and drainage."

* The source is listed in the Bibliography, starting on p. 241.

Since 1970, when the PASA report was written, there has been substantial progress in the local manufacture of pumps in Vietnam. We inspected the following operating pumps (among others) in October, 1974:

Pumping Capacity and Power Source	Costs
1,800 M^3/hour, powered with a 36HP Yanmar Diesel engine (Japanese)	US$1,022 for engine plus $1,606 for pump total $2,628
54 M^3/hour power by a 5 HP Kohler gasoline engine (U.S.)	About $250

The engines were imported, but the pumps where machined in Ankiang Province northwest of Cantho. Pumps with other capacities were also available.

The performance of the pumps was good and the technology, to us, was surprising to find in the Delta. The costs of the larger pumps however were high.

A plant to manufacture pumps, taking advantage of existing management and technical skills, should be given high priority in future planning for the Delta (See Chapter 4).

3.20 Soap Manufacture

We are recommending the establishment of a rice bran oil mill on the Tay Do Industrial Park. (See Chapter 4 later in this report). The recommended annual capacity will yield 408 tons (34 tons per month) of industrial grade oil extracted from rice bran.

This is not a large volume and probably not enough to support a soap plant of economic scale. For example, the NAKYDACO soap making plant in Ba Queo, northwest of Saigon, uses about 1,200 tons per year (200 tons p r month). In addition they use about 330 tons of tallow, if available, to make toilet soaps.

If additional rice bran oil extraction capacity in Tay Do is added later on, enough fatty acid (industrial grade oil) would be available for a soap plant. In order to make toilet soap, tallow would have to be imported or else obtained from the slaughter house near Saigon (see Chapter 3.9). Probably the best course of action on the Tay Do Park would be to start out with laundry soap, utilizing the locally extracted bran oil. As more raw material were available, toilet soap capacity could be added.

Local kapok seed, peanut, coconut or soybean oil could also be used, but the collection of these oil-bearing materials would be far more costly than rice bran oil extracted near the site of a future soap plant on the Tay Do Industrial Park.

3.21. Starch

Table 3.21 shows the production and per hectare yields of manioc. Of the Vietnam total of 379,700 tons, in 1973, about two thirds was produced in the Southern Region, and the remaining one third in the Central Highlands and the Central Lowlands. The production in the Delta is small, accounting for only 13 percent of the total production, namely 50,600 tons (See Table 2.3 above.)

Manioc has the following characteristics: (1) Manioc can be grown in poor tropical soils where other crops cannot be cultivated. (2) The starch yield obtainable from manioc is far above the per hectare yields of starch equivalent from other types of starch-yielding crops (e.g. corn, sorghum, rice). (3) The starch content of the root is 25%. (4) Normal production per hectare in Vietnam is now 8 tons, but 30 to 40 tons per hectare is attainable if soil conditions and fertilization are ideal.

There are many uses for manioc such as a substitute for rice in rice-deficit areas, an emergency food in the event of crop failures, an animal feed, and the starch from manioc is used as a raw material for food processing industries, baker's yeast, confectionary, soft drinks, brewing, monosodium glutamate (MSG), sizing of textiles, paper coating, adhesives, pharmaceuticals, alcohol,, rubber, abrasives, printing ink pigment carrier, ceramics etc.

Table 3.21

VIETNAMESE PRODUCTION AND PER HECTARE YIELDS OF MANIOC -- 1963-1973

	Area ha.	Production m. tons	Yield M.T/ha
1963	51,570	389,460	7.552
1964	43,000	288,600	6.712
1965	43,020	236,020	5.486
1966	38,960	280,280	7.194
1967	36,500	261,185	7.175
1968	35,130	260,190	7.406
1969	32,150	233,485	7.262
1970	30,380	215,710	7.100
1971	35,800	270,000	7.542
1972	32,100	247,300	7.704
1973	47,780	379,700	7.947

Source: Ministry of Agriculture,
Source No. 20.
See Bibliography, p. 241

Manioc is widely grown in Southeast Asian countries, Thailand being the world's largest exporter. Thailand exported 124,454 tons of starch, 1,109,363 tons of manioc pellets, 2,150 tons as manioc chips, and 1,750 tons of manioc starch cake in 1972. These exports were a major contributor to Thailand's foreign exchange earnings. The pellets are exported mainly to the Netherlands, France, and West Germany where they are consumed as animal feed.

Various proposals have been made to create a manioc industry in Vietnam; these are discussed in a Dec. 13, 1973 memorandum by Maurice V. Sorenson (of USAID Washington; contained in Bibliography No. 10, Annex "O"). Sorenson's memo is entitled, "Prospects for Vietnamese Exports of Cassava Products." Sorenson points out that it will be extremely difficult to establish an export industry based on manufactured manioc products. This is because of the substantial advantage now enjoyed by Thailand and Thailand's reputation in a sophisticated market. The Thailand success originated from German and other European efforts to install quality control and standards of product uniformity so as to gain acceptance as a scientific feed for European consumption.

We agree with Sorenson's opinion about near-term exports, but there are many benefits to be gained from the encouragement of manioc production for domestic consumption for feed and sugar substitutes. The Delta is not as well suited to manioc cultivation as other areas of Vietnam since manioc grows best in dry soil. However wherever it can be grown, cultivation does not compete with paddy cultivation but is, rather, complementary because manioc grows in areas not suitable for paddy. The cultivation of manioc in soils not suited for paddy should be encouraged to supply chips and pellets as raw material for the mixed feed industry. Manioc by itself is not a high grade feed because the protein content is low, but is an important additive for mixed feed because its cost of production is low. (See 4.5.3).

At present, starch and manioc pellets and chips are being produced in Vietnam on an artesan basis. The starch is for human consumption, glucose syrup, chips and pellets for feed.

Raw manioc contains glucoside which is toxic. The toxicity has to be completely removed during the processing and the quality of processed manioc has to be further improved over existing standards. These factors, as well as means for reducing the production cost, will require further study before this industry can be successful in Vietnam.

Where feed is not a priority objective, a modern, large scale starch producing plant would be a highly worthwhile investment for Vietnam. Bibliography Source No. 9, states manioc starch can be used as a starting point for sweeteners in the soft drink and confectionary industries and could save $6.0 million of imported sugar per year. Starch can replace up to 80% of the molasses now used in making baker's yeast and MSG, and could save an additional nearly $1.0 million in sugar import costs. (See 3.4 above).

Experience in the United States indicates that starch from corn, used as the basis for sweetners sold for about 44% less than sugar in the first half of 1974. The same order of savings are possible in Vietnam from manioc. Source No. 9 concludes that any country with a reliable local supply of starch such as Vietnam can use starch in substitution for costly sugar-based commercial sweetners.

Starch is also the basis for the soy sauce and monosodium glutamate ("Accent") manufacture.

3.22 Other Industry Candidates

3.22.1 Essential Oils

Some tropical countries are cultivating plants for the production of essential oils used for perfume and odorizing products. The outlook for essential oil cultivation in the Cantho area is not promising as shown in the tabulation below (see Section 2.2 above for soils discussion).

The main reason for the unsuitability of the Delta is the lack of well-drained and ventilated soils and the high acidity of the soils.

(Table 3.22.1 continues on next page)

Table 3.22.1

COMPARISON OF CONDITIONS REQUIRED FOR CULTIVATING ESSENTIAL OIL PLANTS WITH CONDITIONS IN THE MEKONG DELTA

(A) Type of Essential Oil Plant	(B) Suitable Soils and Weather	(C) Suitable pH Value Range etc.	(D) Suitability of Delta Conditions
Citronella	non-clayey, regular rainfall	pH. 6.5-7.3	Unfavorable because of 4 - 5 pH Soil
Lemon Grass	Can grow in lateritic (red) Soils (Xacat and Don Thuan) or gray soils (Ong Yem) Regular rainfall on high ground	n.a.	Clayey soils of Delta not suitable
Patchouly	Well drained, loose soils, regular rain-fall	n.a.	Judging by the fact patchouly grows in well-drained, non-acid soils of Sumatra, Malaysia, Reunion on high ground, doubt Delta suitable. Also March-December cultivation precludes well-drained soild needed by patchauly.
Mentha Arvensis	Well drained, Sandy Soils. Regular rain-fall	n.a.	Delta Soils do not match conditions in column B
Cannelle	High ground as on western slopes of mountains in Quang Nam, Quang Ngai Provinces		Believe Delta too low and dry season would stunt plants dring 3 year growing cycle.
Eucalyptus	High humus, well ventilated, sandy soils	n.a.	Delta Soils are not sandy

Source No. 65
in Bibliography, Appendix F

3.22.2 **Mushrooms**

Mushrooms could become an industry, dried in the near future, but canned later on when Vietnam imports or makes blackplate and has economical canning processes. The mushroom could become an valuable additional cash crop for the farmers, as it has in Taiwan and Japan for example.

In Japan, mushrooms (called "Enokidake") are cultured in urns filled with rice bran and saw dust. Such culture has reached large-scale proportions and 20,000 tons are produced monthly, centered in Nagano Prefecture. (Bibliography Source No. 63).

In Vietnam, mushrooms are already being cultured successfully using chopped rice straw as a medium

3.23 Insecticides and Pesticides

In the calendar year 1973, 3,238 metric tons of pesticides and herbicides were imported or approved for import. The value of this 3,238 tons was U.S. $5,985,448.

In the calendar year 1974, imports of similar magnitude were reported for all types, except that DDT imports declined.

Of the total imports in 1973, 11% were financed with foreign exchange allocated by the Government of Vietnam and 89% were financed by USAID. The top ten products imported in 1973 are listed in Table 3.23 on the next page. Not shown in the table are imports of "Endrin technical" which, along with DDVP (Vapona), is important for the new TN paddy varieties.

No records are kept, according to USAID, of the consumption of pesticides and herbicides by region, but the major use is for paddy cultivation. Since 85% of the paddy is grown in the Delta's 16 provinces (See Table 2.3), we estimate that about two thirds of the tonnage or 2,100 tons are used in the Delta.

We suspect that the application of these materials is substantially below optimum norms. The Industrial Development Bank of Vietnam branch in Cantho states that the ideal application is about 15 kg. per hectare. If this is correct, the Delta's 2.0 million hectares, would have a requirement of 30,000 tons or more than 10 times the tonnages now being applied.

At a later stage, it would be useful to examine the pesticide/herbicide distribution system, the economics of importing in larger bulk, and packaging on the Tay Do Industrial Park.

The improved application of pesticides would reduce predatory insects, eliminate more weeds and could well increase the Delta paddy yields by 5 percent or more. At today's prices of over $450 per ton (Table 3.2-A), this would represent substantial foreign exchange earnings for Vietnam (5.0 million tons x 5% = 250,000 tons x $450/ton = $112 million).

Table 3.23

VIETNAMESE PESTICIDE AND HERBICIDE IMPORTS -- CY 1973
(Unit: Metric Tons of Active Ingredient)
(Source: USAID/Cantho, Letter from Sr. Ag. Advisor, Am Emb/CG-4)

Rank	Type	USAID Imports	USAID Approved Licenses	GVN Imports and Licenses	Total
1.	DDT 75%	569	-	-	569
2.	Microsol A/ca Silicate	164	128	-	292
3.	Diazinon	229	52	-	281
4.	DDVP (Vapona)	167	62	-	229
5.	2,4-D Herbicide	161	50	-	211
6.	Dibron Technical	70	100	-	170
7.	Malathion Technical	60	100	-	160
8.	Azodrin 5	108	24	-	132
9.	Sevin Technical	76	27	-	103
10.	Toxaphine Technical	-	80	-	80
	(Top 10 Subtotal)	(1,604)	(623)	-	(2,227)
	Others	463	197	351	1,011
	Total	2,067	820	351	3,238

3.24 **Seed Center**

In Chapter 4, we are suggesting the establishment of a future paddy processing center on the Tay Do Park. Central to this proposal, is a modern mill for maximum recovery of by-product bran and the production of premium grade rice for export. Hopefully this would be only the first of such facilities aimed at gradually upgrading the Delta's exportable rice surplus to world market standards.

The success of milling operations using the rubber roller system depends in large part on the continuous, uninterrupted processing of uniform paddy.

Frequent shut downs to adjust the rollers has been one of the main problems encountered in the period of mill start-up operations in developing countries. Such interruptions frequently stem from the fact that precise adjustments of the rollers are needed and any change in the size or shape of the grain can jeopardize the outturn quality and the profitability of the mill.

Since 1968, the new TN varieties have been introduced from the International Rice Research Institute at Los Banos in the Philippines. These varieties are rapidly being accepted (see Figure 3.2-A).

During our field survey, we interviewed a farmer who showed us seed for the TN 5, TN 8 and TN 20. He was growing all three varieties plus the local long grain (Nan Keg) variety.

The following principal varieties of paddy are found in Vietnam:

Paddy Variety	Grain
Local Long (Nang Keg)	Long
TN 5	Medium
TN 8	Medium
TN 22	Medium
Floating Red	n.a.
TN 20	Medium
Aromatic (Nang Thom)	Long, slender

(Bibliography Source No. 40)

To assure the success of future milling operations, agreement should be reached on the paddy varieties that certain farmers will grow; contracts should be executed to assure uniform raw material for the mill; and a rigid inspection system adopted at the mill to help assure continuous out-turn of a quality product.

During our field survey, we found that the seed dealers and farmers were not always sure about the identity of seeds. Dealers were reported to have sold "sorghum" seeds, but the buyers learned the seeds were something else. Confusion over the new rice varieties will linger for years, especially in the more remote areas of the Delta.

To help assure the delivery of uniform paddy to the new mill, we are suggesting the establishment of a certified seed center, stressing the wholesale distribution of certified varieties of seeds (See Chapter 4, p. 171)

CHAPTER 4

POTENTIALLY FEASIBLE INDUSTRIES

(PRE-FEASIBILITY STUDIES)

4.1 Rice Milling

Almost all the rice milling in Vietnam is based on the abrasive, out-dated type of milling resulting in a high percentage of brokens, 4 to 11%, (See Table 4.1-A)

Table 4.1-A shows typical mill outturn found by the FAO team in the autumn of 1974 (*). Table 4.1-B shows the recovery goals of the Mekong Rice Mill in Saigon, as reported to our own field survey group. We think that the results shown in Table 4.1-B are goals only and are rarely achieved.

Rice milling at the village level is still predominantly based on the old "Kiskisan" or Engelberg type screw-type huller. Even the "hand pounding" method is still used as a milling method in rural areas.

In order to achieve a reduction in brokens and a better bran yield, and to produce rice of export grade, a modern facility is needed based on the rubber roller technique i.e. rubber or plastic rollers rotating a differing speeds to remove husk and bran by pressure rather than abrasion.

Rice mills should have a minimum daily capacity of at least 500 tons per day in order to yield 40 tons of bran per day (i.e. 8% of the paddy intake; see Section 4.3 below).

For village level operations, off the Tay Do Park, an improved disk or centrifugal type mill is desirable and represents an intermediate technology between the present wasteful methods and the moderately large scale milling, we are suggesting for the Tay Do Park. (See Appendix

4.1.1 Adequacy of Raw Materials and Potential Surplus in Delta

The demand-supply balance of paddy in Vietnam is not clear- cut, but we have made some estimates. The population of Vietnam was 19.9 million in 1973 and paddy production was 7,025,100 tons for the same year (Source 19). Assuming a milling rate of 62 percent (62 per cent of the paddy by weight), the production of milled rice was 4,355,560. Dividing this figure by population, suggests an annual per capita consumption of milled rice of 219 kg. which is too high judging by other evidence. Other evidence suggests that annual consumption per capita is about 150 kg in the Delta ; see Table 4.1-E for comparisons with other countries.

(*) From Source No. 34 in Bibliography

Table 4.1-A

LARGE MILL RICE MILLING TESTS CONDUCTED IN VIETNAM BY FAO RICE STUDY TEAM -- OCTOBER 1974

	Long local variety "good" paddy	TN 8 and TN 5 "ordinary" paddy	Local ordinary paddy. Medium to short
Grade of Rice expected to be produced	Long grain 1 - 15	Medium 1 - 25	Medium 1 - 25
	%	%	%
Finished milled rice	52.3	57.7	61.5
Brokens No. 1-2	9.9	6.4	3.7
Brokens No. 3-4	1.3	1.3	0.7
(Broken subtotal)	(11.2)	(7.7)	(4.4)
Total rice	63.5	65.4	65.9
Fine bran (contains husk)	7.3	5.8	7.5
Coarse bran (contains more husk)	5.0	6.2	4.4
Total recovery rice + bran	75.8%	77.4%	77.8%

Preliminary FAO Report, Source 34

Table 4.1-B

OUTPUT GOALS OF MEKONG RICE MILL, SAIGON, SEPT. 1974

Product	Kg.	% of Total
Finished head rice	100	62.5%
Brokens No. 1-2	7	4.4%
Brokens No. 3-4	3	1.9%
(Rice subtotal)	(110)	(68.8%)
Fine bran	13	8.1%
Course bran	7	4.4%
(Rice + bran subtotal)	(130)	(81.3%)
Husk	25	15.6%
Immature grains	5	3.1%
TOTAL	160	100.0%

We believe that if the process of threshing, drying, storage, milling and the utilization of bran are effectively managed, including the village level milling, yields, as shown in Table 4.1-C, will be attainable. According to these yields, we have calculated the demand-supply situation for rice of the Delta and of Vietnam as a whole in the form of milled rice as shown in 4.1-D, namely a surplus of 1,375,560 tons annually.

In preparing Table 4.1-D, we assumed that the annual per capita consumption of milled rice in Vietnam as a whole is 150 kg. This figure does not include broken rice used for rice cake. Since Vietnam is producing large volumes of rice, and rice constitutes a major proportion of the total food intake, Table 4.1-D indicates a per capita consumption considerably higher than that of other rice consuming countries in Asia shown in Table 4.1-E.

Based on these assumptions, Table 4.1-D shows that there is a surplus of 1,370,560 tons of surplus rice in Vietnam, but in actual fact, the demand and supply appeared to be out of balance in 1973 and 304,000 tons were imported. (See Table 3.2-B).

The reasons for this "imbalance" include incorrect statistics plus the following loss factors

a. The loss of rice due to the security situation, which has probably been substantial. (figures are unobtainable.)

b. The losses during storage and transportation because of spoilage, insects, rats, and leakage from ripped bags. No exact percentage of loss is known, but estimates of 15%, were often reported to us in Vietnam. If such losses are actually 15%, then they could be 516,000 tons of milled rice annually in the Delta (3.4 million tons x 15%).

c. Excessive quantities of broken rice due to checked grains caused by inferior milling practices and inferior drying technology.

See Table 4.1-A for the results of tests conducted by the FAO rice team in Sept. 1974. More than 10% of the rice was broken in one case, about 7.7% in a second case and 4.4% in the third case.

During the field survey in Vietnam, we observed milling operations in village mills where the percentage of broken rice appeared to exceed 10 percent. The broken rice is sometimes mixed with milled rice to produce a low grade of milled rice for human consumption, but is usually sold for feed or for the manufacture of rice products at lower prices than normal milled rice. This means that the reported yield of milled rice is accordingly less. If the percentage of broken rice is reduced by modern milling methods, to half the existing percentages i.e. to about 3%, this alone would mean a Delta milled rice production increase of 140,000 tons of milled rice. (7% x 5.6 million tons of paddy minus 3% x 5.6 million tons of paddy x 62% =138,923 tons.)

Table 4.1-C

ASSUMED YIELDS OF RICE AND PADDY BY-PRODUCTS IN DELTA
(Assuming Efficient Processing)

	Quantity		Basis for Calculation
Paddy	100	kg.	--
Brown rice	72	kg.	Paddy x 0.72
Milled rice	62	kg.	Paddy x 0.62
Broken rice	3	kg.	Brown rice x 0.04
Fine bran	6.5	kg.	Brown rice x 0.09
Course bran	3	kg.	Fine bran x 0.54
Bran oil	0.78	kg.	Fine bran x 0.12
Defatted bran	5.7	kg.	Fine bran - Bran oil

Source: S. Tsuji, member of
Cantho survey team

Table 4.1-B

CONSUMPTION OF MILLED RICE PER CAPITA, 150 kg/year
(t - metric ton)

Vietnam (1973)

Population: 19.9 million
Production: 7,025,100 t (paddy)

Milled rice	4,355,560 t
Consumption	2,985,000 t
Surplus	1,370,560 t

Delta (1973)

Population: 7.1 million
Production: 5,552,000 t (paddy) a/

	Milled rice	Broken rice b/	Bran
Quantities	3,442,240 t	166,500 t	361,000 t c/
Consumption in Delta	1,065,000 t	51,500 t	111,000 t
Consumption out of Delta	1,006,680 t	115,000 t	250,000 t
Export	1,370,560 t		

a/ The figure of 5,552,000 tons includes 410,800 tons from Long An Province By deducting Long An, the total is 5,141,200 as shown in Table 2.3

b/ Assumes improved rate of 3% brokens only (5,552,000/166,500) as compared with about 7% under current milling technologies.

c/ 6.5% fine bran yield under current processing conditions; see Table 4.1-C

Table 4.1-E

PER CAPITA CONSUMPTION OF MILLED RICE IN FOUR SELECTED SOUTHEAST ASIAN COUNTRIES -- 1972

(FOR COMPARISON WITH VIETNAM CONSUMPTION)

	Population	Paddy (MT) 1/	Brown Rice (MT) 2/	Milled Rice (MT) 3/	Milled Rice Per Capita (kg)
Indonesia	123,110,000	18,585,000	13,009,000	11,708,000	95.1
Philippines	39,000,000	5,437,000	3,759,000	3,383,000	86.7
Thailand	40,550,000	13,270,000	9,289,000	8,360,000	206.2
Malaysia	10,440,000	1,786,000	1,250,000	1,125,000	107.0
TOTAL	213,100,000	39,078,000	27,307,000	24,576,000	115.3 (average for four countries)

1/ FAO Production Yearbook, 1972

2/ Paddy x 0.70 (loss is largely husk)

3/ Brown rice x 0.96 (loss is largely brokens and bran)

The above calculations mean that there already exists a potential of surplus rice. Even if the losses attributed to the current hostilities were to continue, an improvement in the percentage of brokens would further contribute to a rice surplus.

Table 4.1-D above shows the demand/supply of rice in the Delta, and suggests that there is a theoretical surplus, after the consumption needs of Vietnam are met, of 1,370,000 tons.

If the surplus were in fact to materialize, rice would play an improtant role in the total economy. Furthermore, the bran is widely in demand as feed for chickens, cultured fish, and hogs. The bran would be even more valuable if the oil is extracted first and then the residual oil cake used as an ingredient in mixed feed.

The edible oil is an important material for human consumption the defatted bran is raw material for agro-industries and feed. This will be discussed in greater detail in Section 4.2.

The following factors could increase the surplus even more:

a. Better irrigation in the dry season (Section 3.19)

b. Dams to prevent inland flow of brackish water at high tide (Section 3.19)

c. Better application of pesticides and herbicides (Section 3.23)

d. More deep plowing by tractors (Section 3.15)

e. Greater cultivation of the TN varieties (Section 3.2 and 3.24)

f. More limestone and fertilizer (Section 3.18)

4.1.2 **Integrated Receiving and Cleaning, Drying, Storage, and Milling**

The proposed paddy processing facilities would consist of four elements as described below. The receiving and cleaning unit and the drying unit would operate in phase with the harvests (February and September for TN rice; see Figure 3.2.-B earlier in this report). These units would operate only 60 days per crop or 120 days during the year.

The milling unit would operate continuously 20 hours per day, with down time for maintenance and some hollidays, on an assumed 300-day operating year. The objective of the four units would be to provide an even flow of paddy in such way as to maximize utilization of the milling section. A description of the four units follows:

1. Receiving and Cleaning Section

This sections is capable of handling wet paddy at the rate of 50 metric tons per hour.

The above capacity assumes the following conditions:

1. Quantity of paddy to be processed per crop: 30,000M. tons
2. Working period per crop : 60 days
3. Paddy receiving time per day : 10 hours per day

From the above, the quantity of incoming paddy per day is,

$$\frac{30{,}000 \text{ tons}}{60 \text{ days}} = 500 \text{ tons /day}$$

As result, maximum receiving and cleaning capacity is

$$\frac{500 \text{ tons} \times 1.2\ (*)}{10 \text{ hours}} = 60 \text{ tons/hour}$$

(*) Safety factor

The safety factor is needed to provide more paddy than the minimum capacity of the dryer see below.

2. Drying Section

This section is capable of drying wet paddy at the rate of 50 tons per hour (straight-run capacity) and is capable of reducing the moisture content of wet paddy from a maximum of 18% down to 14% by weight of dry paddy. This requires five passes through the dryers with a certain tempering time between passes. The above capacity assumes the following conditions:

1. Quantity of incoming Paddy per day : 500 tons minimum
2. Working hours per day : 24 hours/day

From above, maximum drying capacity per day is:

$$500 \times 1.2\ (*) = 600 \text{ tons/day}$$

(*) Safety factor

As a result of the safety factor, the maximum drying capacity per hour is,

$$600 \text{ tons} \times \frac{2 \text{ passes}}{24 \text{ hours}} = 50 \text{ tons per hour}$$

3. Storage Section

This section is capable of storing 15,000 tons of dried paddy having a moisture content of 14% in steel corrugated silos.

4. Rice Milling Section

This section is capable of taking in paddy of average quality and conditions and process the intake at the rate of about 15 tons per hour. (14.3 tons dry)

The above capacity assumes the follwing conditions:

1. Quantity of paddy to be processed per crop : 30,000 tons
2. Working period per crop : 150 days/per crop
3. Working time per day : 20 hours/per day

From above, the intake capacity of the milling section is:

$$\frac{30{,}000 \text{ tons}}{150 \text{ days} \times 20 \text{ hours} \times 0.7\ (*)} = \text{about } 15 \text{ tons/hour } (14.3 \text{ tons dry})$$

(*) Safety factor

5. Assumptions regarding Raw Materials (Paddy) and Final Products (White Head Rice)

1. Incoming paddy is of Fair Average Quality (F.A.Q) of the laest crop, having maximum moisture content of 24% w.b. and containing not more than 2% of immature chalky or red kernels, and not more than 5% of cracked grain by weight of paddy.

2. Variety of paddy is TN or traditional varities grown in the Delta, Vietnam.

3. Specific gravity of the above paddy is assumed to be 0.58 ton/m^3 .

4. Ratio of husk against paddy is below 23%.

5. The final product is to be export quality, white rice.

6. The specific gravity of white rice is assumed to be 0.8 ton/m^3.

6. **Assumptions Regarding Operating Conditions**

1.	Average mean temperature	:	25° C
2.	Average mean relative humidity	:	70%
3.	Annual rain fall	:	1,500mm
4.	Wind velocities	:	Average 3.0-4.0m/second
5.	Soil bearing pressure	:	1 ton per square foot (10.8 tons/M^2) at a depth of 2 meters
6.	Estimated required horse power	:	Approx : 850kw. (1,139 Hp)
7.	Fuel for dryer	:	Light oil or Kerosene Calorific value -- 10,000Kcal/kg Density -- 0.9 kg/liter

Comments on Above Description and Assumptions

There is already a warehouse for storage near the landing jetty on the Tay Do Industrial Park (See Figure 1.2). This warehouse is 30 x 140 M or 4,200 M^2 and is capable of storing 10,000 tons of paddy Bibliography, Sources 10 and 27. If this warehouse were used, the total costs of the rice center would be reduced. (The Wildman Report," Source 45, recommended 69,000 tons of storage space of Cantho by 1974-75.)

The average mean temperature, humidity and rainfall at Tay Do are higher than the above assumed conditions: Mean temperature is about 26°, mean relative humidity is about 83%, and rainfall is 1,756 mm. Bibliography source 21 for An Xuen Province, and Source 11 for Phong Dinh Province.) The assumptions stated above are "average means," and up and down deviations are contemplated in the plant design specifications. We believe that conditions at Tay Do will be found adequate for the mill.

The soil bearing pressure of 1 ton per square foot or 10.8 tons per square meter can be met with about 93 piles. The steam turbine already installed and operating at the 30 MW power plant in Tay Do weighs 10 tons per M^2 plus cement of 2 tons per M^2. This is only half the allowable maximum of 20 to 25 tons per M^2 according to engineers who built the Tay Do power plant (Hazama Gumi Co., Ltd. of Tokyo).

The 30,000 KW power plant at Tay Do is currently underutilized, and there is ample power to meet the connected load of 1,139 KW assumed for the rice mill.

Recapitulations of Annual Processing Capacity

The foregoing capacity data, re-expressed in terms of annual capacities, are as follows:

Receiving and Cleaning: 10 hours per day x 60 tons per hour x 60 days per crop x 2 crops per year = 72,000 tons of wet paddy per year.

Drying: 500 tons per day x safety factor of 1.2 x 60 days of operation per crop x 2 crops = 72,000 tons of wet paddy per year.

Milling: 14.3 tons per hour x 20 hours per day x 300 days per year x 0.7 = 60,060 (60,000/300 days x 20 hours x 0.7).

The products of the mill would be approximately as follows:

Product (% of Paddy Intake)	Tons per 300-day Year	Tons per Day of 20 hours
Milled Rice (62%)	37,200	124
Brokens (3%)	1,800	6
Fine bran (6.5%)	3,900	13
Course bran (2.0%)	1,200	9

Profitability on Dryer, Storage Facilities and Mill

We have estimated that the dryer, storage and milling sections would have a favorable profit outlook as follows (rounded to U.S. dollars, millions):

I.	Invested capital in fixed assets	$4.6 million
II.	Investment in working capital	$5.8 million
III.	Total (I + II)	$10.4 million
IV.	Annual recurrring costs	$14.9 million
V.	Annual revenue from sales	$18.6 million
VI.	Annual profit (V - IV)	$ 3.7 million
VII.	Return on sales (VI/V)	20%
VIII.	Return on fixed asset investment (VI/I)	81%
IX.	Return on total capital investment (VI/III)	36%

The calculations are shown in greater detail in Table 4.?.2 below. The estimated profit of $2.1 million assumes that export grade rice will sold to foreign buyers at $480 per ton.

The direct foreign exchange capital for imported items or services is $2.7 million (items A-1 through A-4 plus 85% of item A-18 and 60% of item A-20).

The local currency capital required is $5.8 million (working) plus $1.9 million (fixed assets) or a total local currency capital of $7.7 million.

The ratio of local to foreign capital is about 3 to 1 ($7.7/2.7 = 2.85).

Table 4.1. 2

Profitability Estimates on Rice Mill Complex Proposed for Tay Do Industrial Park

(Unit: 000's of U.S.$)

Assumptions:
(1) The exchange rate from VN$ to US$ is VN$685 = U.S.$1.00
(2) First class construction costs are VN$70,000/$M^2$ (US$102)
(3) Rent will be paid for 10 hectares on the Tay Do Park at US$0.50/$M^2$
(4) Milled head rice of premium grade will be sold at $480.
(5) Power costs are VN$36.8/KWH, 1974 industrial rate.
(6) About 93 piles will be required, driven to a depth of 50 meters (as in the case of the 30 MW power plant at Tay Do), and piling will cost US$49/Meter driven.

A. Non-recurring Costs (Invested capital in fixed assets...... $4,601

A-1	Imported machinery for milling section	949
A-2	Imported transformer	17
A-3	Imported machinery for drying and storage Sections...	1,441
A-4	Engineering fee for installation....................	10
A-5	Unloading of equipment and transportation to site from Saigon..	34
A-6	Transport of piles from Saigon (930M of steel tubes).	20
	Civil engineering work:	
A-7	Storage silos (30 x 120 M = 3,600 M^2).................	367
A-8	Paddy receiving station (8 x 16 = 128 M^2)............	13
A-9	Rice mill building, 3 stories (10.5 x 52 x 3 = 1,638 M^2)	167
A-10	Husk collection station (7 x 7 M 49 M^2)............	5
A-11	Warehouse, 20 x 40 = 800 M^2	82
A-12	Transformer installation, 7 x 7 = 49 M^2............	15
A-13	Garage, 8 x 16 = 128M^2	13
A-14	Dormitory and Canteen, 15 x 7 = 105 M^2.............	11
A-15	Office, 15 x 7 = 105 M^2	11
A-16	Truck weighing scales installation, 15 x 7 = 105 M^2..	11
A-17	Guard house, 2 x 2 = 4 M^2...........................	1
A-18	Piling and cost of piles, 10 M long steel tubes, 5 per piling welded end-to end, 93 piles 50 M deep, costing $49 per meter (93 x 50 x $49)..............	228
A-19	5 trucks, 2 cars (average $6,429 each, no customs duty; see C. 15 below)................................	45
A-20	Two foreign engineers in residence 12 months	100
A-21	Ocean freight..	643
	(Subtotal)...	($4,183)
	Contingencies 10% of subtotal	418

B. <u>Working Capital</u>

Should have working capital in first year sufficient to process 1 crop, i.e. 6 month or 0.5 x $11,505 (see subtotal of recurring costs below). ....$ 5,752

C. <u>Recurring Annual Costs</u> (1st year only; item C-16 lower in 2nd year)..................................$14,907

C-1	Wages, day shift (54 men x VN$800/day average x 300 days)..................................	19
C-2	Wages, evening shift (38 men at VN$800/day ave. x 300 days)...........................	13
C-3	Wages, night shift (38 men at VN$800/day ave. x 300 days)...........................	13
C-4	Management and technical staff at plant (6 men x US$8,000).....	48
C-5	Paddy procurement staff (5 at US$8,000/yr.)...........	40
C-6	Electric power costs (1,139 KW connected load x 300 days x 20 hours/day x VN$36.80 per Kwh = VN$251.5 mill.)....	367
C-7	Paddy raw material costs (VN$109,500/T x 60,000 tons)..	9,591
C-8	Jute bags (half of 372,000 jute bags containing 100 kg each costing VN$500 each -- polypropylene 50 kg. bags would be cheaper.)..	186
C-9	Spare parts, roller replacements, maintenance..........	250
C-10	Fuel oil for dryer (194 liters/hour x VN$69/liter x 24 hours/day x 120 days/year =VN$38.6 million).........	56
C-11	Interest at 9% on invested capital in fixed assets (9% of Item A)..	412
C-12	Rent on 10 hectares in Tay Do Park (100,000 M² US$0.50)	50
C-13	Depreciation on plant @ 10% annually (Item A x 20%)....	460
	(Subtotal of annual recurring costs)..................($11,505)	
C-14	Contingencies and overhead n.e.c. 10% of subtotal of recurring costs..	1,150
C-15	Taxes on income, land, and customs duties (exempted under Law 4/72, June 1972, Regulating Investment in Vietnam, Chapter III, Articles 3,5,7)....	none
C-16	Interest at 20% on half of recurring cost sub-total ...	1,150
C-17	Cost of sales at 5% of item D below.....................	932
C-18	Debt service on A (Starting in 3d year), 30-year loan	170

D. <u>Annual Revenue from Sales</u> $18,627

D-1	Sale of 37,200 tons of milled rice ($480/ton transport to Saigon by truck at US$6/ton...............	17,633
D-2	Sale of fine bran (3,900 tons @VN$90,000/ton)..........	512
D-3	Sale of course bran (1,200 tons @VN$50,000/ton)........	88
D-4	Sale of brokens (1,800 tons @VN$150,000/ton)...........	394

E. Revenue Compared with Annual Recurring Costs	First Year
Item D, Annual revenue from sales......................	$18,627
Item C, Annual recurring costs (includes debt service, depreciation, contigencies)......................................	14,907
F. Annual Profit (D - C)......................................	3,720
G. Return on Sales (F/C= 3,720/18,627).........................	20%
H. Return on Invested Capital in Fixed Assets (F/A= 3,720/4,601)	81%
I. Return on Total Capital (F/A + B = 3,720/4,601 + 5,752)......	36%

(Note: Profitability improves in second and later years because of reduced interest burden on working capital; see C-16 above)

4.2 Related Agricultural Programs

Before the rice mill is erected, careful steps should be taken by the Ministry of Agriculture, the related extension services, and the Agricultural Development Bank to initiate a program of farmer education regarding the cultivation of uniform paddy.

A related step is the establishment of a seed center as mentioned in Sections 3.24 and 4.8.

4.3 Milling and Drying outside the Tay Do Park

4.3.1 Milling

Mills in rural areas will doubtless serve a local purpose for many years. However, they are usually the Kiskisan or Engelberg type hullers which attain a head rice yield of about 50 to 55%, compared with a proper yield of about 62%.

Inefficient hullers are being replaced gradually by a type of mill representing an intermediate technology, the disk sheller (known in Japan as the "enshin ryoku riyo no shogeki shiki momi suriki"). These are already beginning to be marketed in the Delta through the Mekong Agricultural Machinery Co., No. 17 Le Van Duyet, Angiang Province.

Such mills typically have a capacity of 600 kg. per hour, they require 4 persons to operate and cost about $5,000 c.i.f. Cantho (including diesel engine, mill, scales, parts, jigs and fixtures). The building should cost about $3,000, raising the total price to $8,000. Illustrations of this type of mill and the housing therefor are shown in Appendix F.

In the event that capital is not available for the large, modern mill ($10.4 million; see Section 4.1.2), a series of these smaller-scale, but high-productivity mills, located within a radius of 10 kilometers of the Tay Do Industrial Park, could theoretically supply enough bran for a bran oil mill with a daily capacity of 40 tons per day. This bran oil mill is discussed in Section 4.4 below.

The calculations for this assumption are as follows: To obtain 40 tons of bran per day, about 104 modern disk shellers would work 200 days per year, milling 620 tons of paddy per day from two crops yielding 3 tons per hectare each or 124,000 tons of paddy per year. One hectare of paddy land could yield 6 tons of paddy from two crops; 124,000 tons of paddy divided by 6 tons would require 20,667 hectares, and there are more than enough, i.e. 31,400 hectares of paddy land within a radius of 10 miles of Tay Do.

About 104 rice mills, would be needed to process 124,000 tons of paddy annually i.e. 104 mills x 0.62 tons per hour x 10 hours x 200 days annually = 128,960 tons yearly of milled rice.

The required 104 mills would cost less than a million in U.S. dollars (104 mills x $8,000 each = $832,000). However, to be a successful source of bran, the 104 mills would have to be organized efficiently and bran transported to Tay Do within three days of milling to avoid spoilage.

4.3.2 Drying

The seriousness of the problem of drying paddy in the Delta can hardly be exaggerated. Paddy harvested in remote areas is spread on bare earth to "dry" in the sun (sometimes paddy is spread out on concrete slabs if the farmers are well off). Paddy collected near roads is spread along the edges of highways where it is frequently crushed by vehicles and re-dampened by squalls. Foreign matter, dirt, cracked grains, and bird losses abound. Some of our respondents in Vietnam guessed that only half the paddy harvested in rural areas ever reaches a mill. Because of double and triple cropping, drying by artificial means in the wet season warrants urgent consideration.

Aside from the large scale mechanical dryer (see Section 4.1.2), small, inexpensive dryers in rural areas could reduce much of the current loss.

4.4 Rice Bran Oil

4.4.1 Background

The refining of rice bran oil is not widely practiced in Europe or the United States. This is partly because of the comparatively greater availability of other oil-bearing raw materials (soy beans, oil palm, safflower, cotton seed, peanuts, corn, lard.) In Japan, a chronically oil-deficit nation, the rice bran oil industry has prospered, especially since 1950. Today, Japan produces about 70,000 tons of edible oil from rice bran and 30,000 tons of industrial oil (i.e. for soap) from rice bran.

Certain tropical countries are also successfully producing rice bran oil, such as Burma, India and Thailand. These countries share in common a shortage of oil-bearing crops other than rice (Bibliography, 37,41 and 42).

4.4.2 Market for Oil

Vietnam is chronically short of edible oils. Imports in recent years have ranged from a low of 5,000 tons in (7/1/73 to 6/30/74) to a high of 26,260 tons (7/1/71 to 6/30/72) valued at $3.6 to $5.6 million respectively (See Table 4.4).

The deficit in edible oil is not really shown by the import data. Retailing at 1,000 piasters per liter, imported edible oil is out of the reach of most of the Vietnamese population who go without or satisfy themselves with locally crushed peanut oil.

The world market for edible oils is large and rising. In 1972, Vietnam's best trading partners imported edible oils, valued at more than a half billion U.S. dollars; see following tabulation from Appendix B.,

SITC Code No.		Imports in US$, Millions
421.2	Soybean oil	$ 59.1
421.3	Cotton Seed oil	27.3
421.6	Sunflower Seed oil	113.1
421.7	Rape, Colza, Mustard oil	39.2
422.2	Palm oil	243.1
422.3	Coconut oil (copra)	141.4
	Total	$623.2

Table 4.4

VIETNAMESE IMPORTS OF REFINED EDIBLE OIL, CALENDAR AND FISCAL YEAR DATA COMPARISON, 1970-74

(Units: Metric Tons, abbreviated MT, and U.S. Dollars)

Table A - Calendar Years				Table B - U.S. Fiscal Years (7/1-6/30)			
Calendar Years	MT Imported	$/MT (Price/MT)	Import Value US$000's	Fiscal years	MT Imported	$/MT (Price/MT)	Import Value U.S.$000's
1970	14,491	$ 400 (Est.)	$5,796 (Est.) a)	FY 1970	n.a.	n.a.	n.a.
1971	7,437	$ 385 (Est.)	$2,877 (Est.) a)	FY 1971	9,600	$385	$3,696
1972	22,108	$ 213 (Est.)	$4,709 (Est.) a)	FY 1972	26,260	$213	$5,593
1973	6,744	$1,134 (Actual)	$7,684 (Actual) b)	FY 1973	5,200	$425	$2,200
1974 (Jan.-June)	2,490 c)	$ 920 (Actual)	$2,291 (Actual)	FY 1974 (Jan-June)	2,552 c)	$720	$1,838
Note: Table A contains customs figures; data for the months after June, 1974 were not yet published in Nov. 1974 when the survey group left Saigon.				FY 1974 (July 1, 1973 to June 30, 1974)	5,000	$720	$3,600

Notes: a) The total import value is available in Vietnamese piasters from the Directorate of Customs; however, the conversion rate of the VN$ to the US$ changed during the period 1970-72; therefore, we have estimated the dollar import value on the basis of prices paid for PL 480 imports.

b) The sharp decline of imports as between 1973 and 1972 is accounted for by the following factors: The price of soybean oil in 1972 was only $213 per ton and the USAID thought imports would find a ready market and help generate local currency; in 1973, however the price had almost doubled and the market fell. Also the Title II PL 480 imports originally intended in 1972 for refugee relief and other charitable purposes were sold in 1973 by the recipients thereby decreasing the local demand for edible oil.

c) The discrepancy between the January-June 1974 data in Tables A and B may be accounted for by the fact that the calendar year figures are based on the customs clearance date in Vietnam whereas the U.S. fiscal year data for the same period are based on the payment date to the shipper in the United States.

Sources: Table A Calendar year data are from Vietnam Statistical Yearbook, 1972 National Institute of Statistics;

Table B U.S. Fiscal Year Data, USAID, Saigon.

4.4.3 Market for Defatted Bran

Bran oil extraction is primarily intended to yield high value edible oil, but it is also necessary to take into consideration the high value of defatted bran as an animal feed.

Fresh bran is utilized for various purposes world-wide, but in Japan, it is usually not used as feed directly, but the defatted bran is used as a feed. The fresh bran becomes rancid in a few days and, the nutrients are no longer available.

On the other hand, defatted bran is stable for longer periods of time and is a valuable mixed feed ingredient. Furthermore the protein content of defatted bran is higher than fresh bran and thus is a more valuable feed. Table 4.4.3 shows that defatted bran contains 17.6% protein as compared with 14.8% in fresh bran. (17.6/14.8 = 19% more protein on a weight basis.)

Table 4.4.3

COMPARISON OF FRESH AND DEFATTED BRAN BY AVERAGE PERCENTAGES OF COMPONENT MATERIALS
(Unit: Percentages)

	Fresh Bran	Defatted Bran	Range of Content Found in Defatted Bran
Moisture	13.5	11.3	10.4 - 12.8
Crude Protein	14.8	17.6	16.6 - 18.2
Oil content	18.2	1.8	1.2 - 2.2
Soluble Non-nitrogenous Materials	35.1	48.5	47.3 - 49.6
Gross Fiber Content	9.0	9.5	8.3 - 10.9
Ash	9.4	11.4	10.3 - 12.1

Source: S. Tsuji, Member, Cantho Survey Team

These data were prepared by conducting a series of tests in Japan during 1962.

In other countries, defatted bran has gained acceptance because of its stability and acceptance by animal breeders. We believe that the added quality of stability will enhance the acceptability of rice bran in Vietnam. (As mentioned in Section 3.12.2, rice bran is in demand for fish culture and for hog and chicken raising.

4.4.4 Problems in Oil Extraction

There are problems in bran oil extraction, but we believe these can be overcome in Vietnam as they have in Thailand or Burma. Bran oil is recovered by the solvent extraction process as in the case of soybean oil. This solvent extraction process requires a large. scale processing plant. The minimum economic size of an extraction plant is 40 tons per day (described in Sect. 4.4.7 and 4.4.8)

The solvent used is hexane, a volatile petroleum fraction, and plant safety standards must be carefully observed.

Bran oil is composed of very small particles so special care is required to separate the micella. Soybean oil, for examples consists of particles which are larger than those in bran oil and the separation of the micella does not require the sophistication characteristic of bran oil processing.

Fresh bran from rice mills contains enzymes which cause deterioration and instability and lowers the quality in as little as 3 days of storage. Therefore the fresh bran from rice mills has to be processed almost immediately. An integrated system is needed ideally consisting of a large-scale rice mill and a nearby bran oil extraction plant.

The oil extraction efficiency is directly related to the oil content of the bran. The existing rice mills in Vietnam are producing course bran containing substantial percentages of husk plus fine bran which is relatively free from husk. An admixture of husk seriously reduces the efficency of extraction. It is therefore desirable to obtain a bran supply from mills which produce relative pure bran, as is currently being done in Japan.

4.4.5 Outer Limits on Delta Production of Rice Bran Oil

In most countries, it is unreasonable to assume a 100% recovery of the oil content of rice bran. However, a desirable goal for the Delta would be to extract oil from about half the surplus paddy. Assuming an oil recovery of less than one percent (0.78%) of the paddy by weight, the Delta's 1,371,000 ton paddy surplus (See Sect. 4.1.1) could yield about 5,347 tons of oil (1,371,000 tons x .0078 x 0.5 = 5,347 tons).

We are recommending that production be started on a minimum economic scale at the Tay Do Industrial Park, and then be gradually expanded as more sources of bran materialize (See below, 4.4.7).

We are not implying any reduction of efforts to maximize the production of other oils, coconut, kapok, peanut or soy bean oil. However, rice bran in the Delta offers the most promise for an edible oil industry since the raw materials for other types of oils are widely scattered or limited.

In the event that capital is not available for a bran oil plant described in the following section or in the event that bran or other oil-bearing materials are in short supply, an intermediate technology for extracting oil in smaller volumes could be adopted for a plant at Tay Do. We are referring to the expeller method of extraction which is often used when raw materials are in short supply. This method has the disadvantage of producing a by-product cake containing an oil residual; this becomes rancid in a few days and is therefore not a suitable for feed unless consumed almost immediately after crushing. However, in the long run, oil-bearing by-product cake, just like bran, can be further processed by the solvent extraction method. Therefore an expeller plant, although not an ideal process, could find a market for its cake when a full scale bran oil plant were to go on stream in the future.

4.4.6 Raw Materials for Bran Oil Plant

In Section 4.1.2 above, we pointed out that the modern, rubber roller type mill could yield 3,900 tons of fine bran per year or 13 tons per day in a 300-day operating year. This would be only one third of bran requirement for the 40 ton per day bran oil plant.

We are proposing that the required bran supply be collected as follows:

Source of Bran	Tons/Day to be Supplied	Remarks
New mill recommended in Section 4.1.2 of this report	13	In building such a mill, allowance should be made for the 8 - 10 month delivery plus 12 months or more for civil engineering work at Tay Do.
VIMECO	5	See Table I-2 in Introduction of this report. This mill is already planned for Tay Do.

(Tabulation continued, next page)

Source of Bran	Tons/Day to be Supplied	Remarks
Mills in Ba Xuen Province or in Cantho (Cai Rang District)	22	For mills in Ba Xuen and Phong Dinh Province, see Section 3.2. Ba Xuen is the largest Delta milling center with 244,000 tons of paddy capacity per year or nearly 16,000 tons of fine bran per year or 53 tons per day. Distance to Tay Do from Ba Xuen is about 70 km on L.T.L. 4.
Total Bran Supply	40	

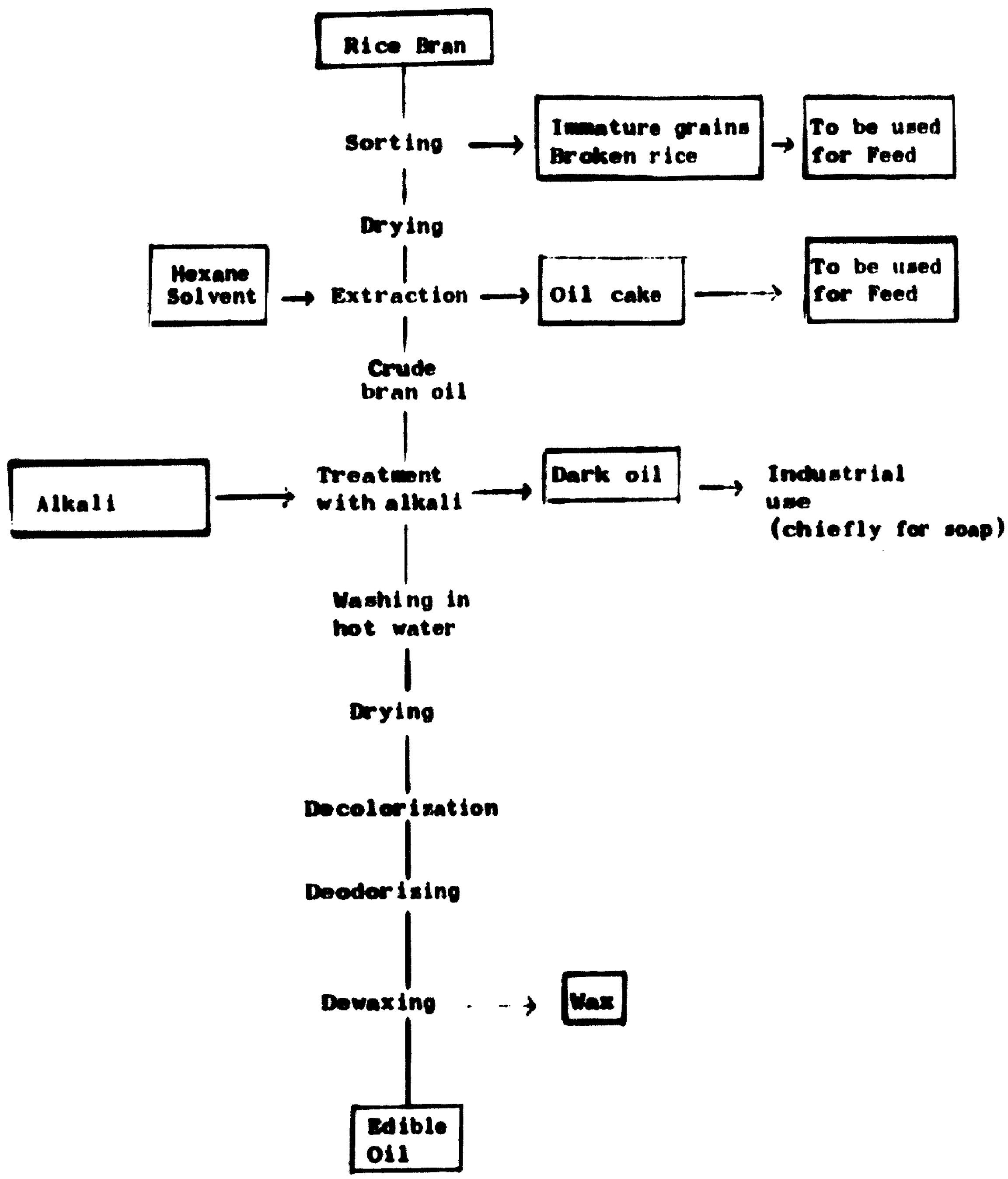
4.4.7 Processing Method

Bran from the mills is sorted to remove immature grains, brokens or other non-oil-bearing foreign matter. After passing through the hexane solvent, the volatile hexane is evaporated off for subsequent liquefaction and reuse. The cake falls to the bottom with crude bran oil floating on surface. The oil cake is then removed for feed. An alkaline process removes about one fourth of the crude oil as industrial oil and the balance becomes edible oil after deodorization and color removal processes and dewaxing. See Figure 4.4.7 below.

Blown polyvinyl bottles would be good containers as they are in Thailand (Industrial Enterprises Co., near Bangkok.)

Figure 4.4.7

RICE BRAN OIL PROCESSING -- FLOW CHART



4.4.8 Profitability of Bran Oil Plant

The bran oil plant appears profitable as shown in Table 4.4.8. However a critical factor in the profitability is the cost of raw material. Mills were now selling bran in small lots to farmers or animal husbandry companies at VN$100/kg. in Oct. 1974. We are assuming that the oil plant can buy in large lots for VN$90/kg. and sell defatted bran to the feed mill for VN$105 because of the higher protein content (see Table 4.4.3). In Saigon, fine bran was sold by the Mekong rice mill for VN$90/kg. (Oct. 1974).

In summary, the calculation in Table 4.4.8 is as follows (in U.S. dollars thousands):

A.	Investment in fixed assets	$ 806
B.	Investment in working capital..........	862
C.	Annual revenue from sales..............	2,652
D.	Annual recurring costs.................	2,380
E.	Annual profit (C-D)....................	272
F.	Return on sales (E/C)..................	10%
G.	Return on fixed assets (E/A)...........	34%
H.	Return on total capital (E/A+B)........	16%

Table 4.4.8

Annual Profitability Estimates on Rice Bran Oil Plant

(Unit: 000's of US$)

(for assumptions, see Table 4.1.2 above)

A. Non-recurring Cost (Investment in Fixed Assets)............... $ 806

A-1	Plant building, 15M x 40M x 2 Stories = 1,200 M^2 = VN$ 84 million	123
A-2	Warehouse, 20M x 20M = $400M^2$ = VN$ 28 million.........	41
A-3	Related buildings, 15M x 10M = $150M^2$ = VN$ 10.5 million	15
A-4	Office, 8M - 10M = VN$	8
A-5	Machinery, VN$300 million............................	438
A-6	Two Foreign engineers to supervise start-up...........	100
A-7	Short-term Training of 2 Vietnamese engineers in Thailand, Burma, or Japan............................	6
A-8	Contingency @ 10% of A-1 through A-7	71

B. **Recurring Costs** $2,380

B-1 2 Managers, @$8,000 16

B-2 21 Skilled workman @VN$1,400/day x 300 days (3 shifts for some, 2 shifts for others) 13

B-3 11 unskilled @VN$1,000/day x 300 days 5

B-4 Purchase of fresh bran, 12,000 tons (300 days x 40 tons) @VN$100/kg., less 10% for volume purchases = VN$1,080 million 1,577

B-5 Hexane Solvent, alkali etc 35

B-6 Fuel, electricity, water 79

B-7 Land rental, 5,000M^2 x US$0.50 2

B-8 (subtotal of recurring costs) .... ($1,727)

B-9 Depreciation @ 10% of A (less item A-8) 73

B-10 Contingencies @ 10% of B-8 173

B-11 Interest on A @ 9% 73

B-12 Interest at 20% on working capital to buy 6 months supply of bran and raw materials and other recurring costs ($1,727/2 =6 months working capital = $863) 173

B-13 Cost of sales 5% x C 131

B-14 Debt service on A, starting 3r year, 30-year loan 30

C. **Revenue** $2,652

C-1 Edible oil sales, 960 tons x VN$ 650/kg. = VN$624 million 910

C-2 Industrial oil sales, 408 tons x VN$300/kg. = VN$122 million 179

C-3 Sale of defatted bran, 10,200 tons x VN$105/kg = VN$1,071 million 1,563

D. **Working Capital (50% x B-8)** 862

E. **Revenue Compared with Annual Recurring Costs**

Revenue $2,652

Annual Recurring Costs $2,380

F. Annual Profit (C-B)....................................$ 272

G. Return on sales (272/2,652)............................ 10%

H. Return on fixed assets (272/806)....................... 34%

I. Return on total capital (272/806 + 862)................ 16%

4.5 Mixed Feed Industry

4.5.1 Demand

Imports of ingredients for feed have been as high as $17 million in recent years (See Section 3.6 earlier in this report). The commercial chicken and hog raising industries and individual farmers raising animals have suffered and some have discontinued or curtailed their operations. The Huynh De Chicken Farm in Cantho reduced their holdings from 20,000 birds in May to 2,500 in October, 1974, and exports of frozen chicken to Singapore and Thailand were stopped. The Ngoc-Thanh hog farm was losing money because the price of feed rose faster than the price of pork in 1974.

There are only two small mixing plants in the Delta at present (My Tho in Dihn Tuong and Long Xuen in Kien Kiang Provinces). These plants depend heavily on imported raw materials.

Mixed feeds are needed in the Delta for hogs, chickens, and fresh water fish. Mixed feed for these animals and fish should be supplied by a medium scale plant, which we are recommending be considered for the Tay Do Park. Ducks can be raised with a minimum of human attention and special feeding, and the traditional practice of feeding them waste vegetable matter or letting them forage in harvested paddy fields minimizes the feed requirements for ducks.

A mixed feed plant is needed to increase productivity in raising pigs and chickens and to make better use of the feed materials available in Vietnam and particularly in the Delta.

If the production of pigs and chicken in the Delta is increased by providing a sufficient supply of feed, hogs and poultry can become the basis for an agro-industry and a major export industry for Vietnam. Appendix B (see, BTN 010500 and 020200) shows that Vietnam's major trading partners imported $352 million worth of poultry in 1972.

The best policy to stimulate the growth of the mixed feed industry in the Delta would be to make maximum utilization of the resources available in the Delta. At present, the resources for a mixed feed industry are partially in deficit supply, but it will be possible to increase the degree of self sufficiency by starting a medium scale factory and expanding the industry gradually. The potential for obtaining the necessary raw materials is explained below. Vietnam's major trading partners imported feeds valued at nearly $2.0 billion in 1972 (App. B. see, BTN 230700) and thus feed could find an export market if it were surplus to Vietnams needs.

4.5.2 Locally Available Raw Materials

Defatted bran -- If oil were extracted from bran removed from the Delta's surplus paddy, about 89,115 tons of defatted bran would be available for mixed feed (1,371,000 tons surplus x 6.5% = 89,115, See Section 4.1.1). Bran will undoubtedly become the most important ingredient for the mixed feed industry in the Delta.

Defatted bran is, of course, not being produced in Vietnam at the present time. With the modernized milling system (See Chapter 4 above) in the future, the Delta's bran resources can be more fully utilized.

Corn -- About 12,405 tons of corn was produced in 1973 in the Delta (See Table 2.3) much of which can be used for mixed feed. An increase in the production of corn can be expected.

Sorghum -- About 21,000 tons of sorghum was produced in 1972 - 1973 in the Delta (See Section 2.3). When planned increases materialize, sorghum will be one of the most important components for the mixed feed industry.

Manioc -- The Delta produces only a limited volume of manioc, 50,600 tons (Table 2.3) but manioc from other regions of Vietnam can be used and could become an important material for mixed feed. Policies are needed to encourage the cultivation of this product.

Oil Cake -- Oil cake, especially the residual cake after extracting oil from peanuts, kapoc and coconut, is a suitable material for mixed feed. (Peanut oil cake is also important as the raw material for the manufacture of soy sauce.)

Molasses -- This byproduct from sugar refining is another important material for mixed feed, but the existing sugar mills are using a primitive process which does not provide any molasses byproduct (See Section 3.4).

Fish Meal -- This is a critical material for a future mixed feed plant. At present, about 20,000 tons of fish meal are being produced in Vietnam most of which is being produced in the Delta. Most of the output is being exported to Singapore, Hong Kong or other Asian destinations. (See 3.12.5)

Bone Meal -- Bone meal can be produced as a slaughter house byproduct and is important for mixed feed. It is not produced in the Delta, and only small quantities are being produced at VISSAN, the slaughter house near Saigon; see 3.9 above.

Feather meal -- This meal can be made from the feathers of chickens and ducks, however the utilisation of feathers is difficult at present since feathers have been exported in recent years; the value of exports in 1973 was $1.3 million; See Appendix B, BTN 050700.

4.5.3 Ingredient Mix

The above materials can be mixed in different proportions depending on the end-use of the feed. To make the best use of locally available ingredients, it will be necessary to supplement local supply by imports at least for a transitional period. We are recommending the priority establishment of a mixed feed plant having a production capacity of 50,000 tons annually in the Tay Do Industrial park. According to Bibliography Source 21, imports of feed in recent years were 19,618 tons (1970), 20,117 (1971), and 13,820 (1972) but this has fallen far short of meeting local requirements.

Table 4.5-A shows the general composition of mixed feed is Southeast Asian countries. Table 4.5-B shows a suggested composition for feed that could be produced in a mixed feed plant at the Tay Do Park having an annual capacity of 50,000 tons as mentioned.

Table 4.5-B

SUGGESTED FEED MIX FOR TAY DO PLANT

Defatted bran	8,700t	40t/day-bran from extraction plant in Tay Do plus other mills
Corn	8,000t	Partly from Delta
Sorgum	5,000t	From Delta; see Section 2.3 of this report.
Manioc	22,000t	Imported from Thailand
Oil cake	300t	Partially from Delta
Fish meal and offal	6,000t	Partially from Delta
Small quantity of Vitamins		Imported

Note: Offal amounting to less than 100 tons (see Section 4.9)

The feed composition shown in Table 4.5-B has 12 to 13 percent crude protein content. This kind of mixed feed alone will be sufficient to raise 130,000 to 140,000 hogs weighing about 100 kg. at maturity. Supplementing the mixed feed would be other products available in the Delta such as roughage consisting of waste vegetable and fruit material plus fish residue from sauce plants. Such materials in conjunction with the mixed feed would be sufficient to raise even more hogs.

When a mixed feed industry is established, there will be increased demand for the several ingredients listed in Table 4.5-B and this will exert upward price pressure on the various ingredients now being consumed in the Delta as a single-element feed. But this could be a factor to stimulate the production of corn, manioc, sorghum, soybeans (in Long Xuen and Chau Doc) and fishmeal (at Rach Gia and Phu Quoc).

With the development of new materials for mixed feed such as sorghum and increases in animal husbandry, a mixed feed industry would appear promising. The production of defatted bran will, of course, play a key role in the development of the industry.

4.5.4 Profitability Estimates for Mixed Feed Plant

We are making the assumption that mixed feed would sell for VN\$120 per kg. This price is lower than what was being paid for vitamin-enriched balanced feeds which was VN\$150 per kg in Oct. 1975. (VN\$150/kg was paid by the Ngoc-Thanh Hog Farm in Cantho). However we are assuming that the volume purchase of ingredients will lower costs of raw materials. The assumed VN\$120/kg sales price is wholesale and the remaining VN\$30 is the retailers mark-up.

In summary, profitability is estimated as follows based on Table 4.5.3; units are thousands of U.S. dollars:

A.	Non-recurring Costs (Investment in Fixed Assets)	\$568
B.	Working Capital	\$3,581
C.	Sales of Mixed Feed	\$8,934
D.	Recurring Costs	\$7,327
E.	Annual Profit (C-D)	\$1,607
F.	Return on Sales (E/F)	18%
G.	Return on Investment in fixed Assets (E/A)	35%
H.	Return on Total Capital (E/A+B)	39%

(Table 4.5.4 follows on the next page.)

Table 4.5.4

Annual Profitability Estimates for Mixed Feed Plant Proposed for Tay Do Industrial Park

(Unit: 000's of U.S. dollars)

(Note: Please see assumptions at beginning of Table 4.1.2 above)

A.	NON-RECURRENT COSTS (INVESTMENT IN FIXED ASSETS)	568
A-1	7,000M^2 of Land (See item B-1 for rent)	none
A-2	Plant building (height is 4M, 1 story)	46
A-3	Warehouse, 25x20, 3 stories = 1,500 M^2	153
A-4	Office, 10 x 20M = 200M^2	20
A-5	Imported machinery	292
A-6	2 cars	5
A-7	(Sub total)	(516)
A-8	Cantingencies @10% of A-7	52
B.	RECURRING COSTS	7,327
B-1	Rent on 7,000M^2 of Tay Do Park Land	3
B-2	2 managers	16
B-3	Skilled labor (3 shifts), 8 men x VN$800 x 300 days ...	3
B-4	Unskilled labor, 9 men x VN$700 x 300 days	3
B-5	Cost of raw materials (51,000 tons x VN$95/kg = VN$4.8 million) .... (VN$95 is an average price for materials in Table 4.5-B)	7,073
B-6	Fuel, power, water	7
B-7	Depreciation @10% of A-7	57
B-8	Interest on A @9%	
B-9	(Subtotal)	(7,162)
B-10	Contingercies @10% of B-8	72
B-11	Interest @20% on half of B-8	72
B-11	Debt service on A, starting 3d year loan	21
C.	WORKING CAPITAL .... Six months Working Capital B-8 x 0.5	$3,581
D.	ANNUAL REVENUE FROM SALES .... 51,000 tons x VN$120/kg	$8,934
E.	REVENUE COMPARED WITH ANNUAL RECURRING COSTS	
	Item D. Revenue	$8,934
	Item C. Annual Recurring Costs	$7,327

F. ANNUAL PROFIT (D-E) $1,607

G. RETURN ON SALES (1,607/8,934) 18%

H. RETURN ON INVESTED CAPITAL IN FIXED ASSETS (1,607/968) 99%

I. RETURN ON TOTAL CAPITAL (1,607/968 + 3,981) 39%

Table 4.5-A

Principle Ingredients Used in Mixed Feeds in Asian Countries

	Moisture	Gross Protein	Gross Fat	Soluable Non-nitrogerous Material	Remarks
Corn	10-16	8-10	4-5	67-71	
Broken Rice	13-14	8-9	2-3	71-72	
Cottonseed	7-8	23-24	21-23	26-27	
Cottonseed Cake	6-8	41-42	5-6	28-29	Expeller method
Soybeans	10-13	36-38	14-18	23-25	
Soybean Cake	13-14	39-40	8-9	29-30	Expeller method
	9-13	45-47	1-2	29-33	Extraction method
Peanuts	5-6	30-31	47-48	11-12	
Peanut Cake	8-12	31-46	6-9	23-35	Expeller method
	8-12	47-52	1-2	25-27	Extraction method
Coconut Cake	7-14	30-21	6-7	45-48	Expeller method
	8-13	21-22	1-3	48-51	Extraction method
Rice Bran	9-14	13-14	15-18	37-41	
Palm Oil Cake	7-8	18-19	7-8	51-52	Expeller method
	12-13	18-19	1-2	55-56	Extraction method
Sesame Cake	9-10	44-45	12-13	14-15	Expeller method
Kapok Cake	14-15	26-27	7-8	20-21	Expeller method
Molasses	22-26	3-4	0-0.5	63-67	
Tapioca Meal	13-14	1.8-1.9	0.5-1	76-77	
Dried Chrysalis	7-9	50-59	23-30	3-8	
Fish Meal	12-13	41-42	9-10	1-2	
Sorghum	10-13	9-11	2.5-3.4	71-73	

Source: S. Tsuji, Member,
Cantho Survey Team

4.6 Engine Repair, Casting Shop, Agricultural Implement, Pump Manufacture

4.6.1 Rationale for Facilities

Section 3.15, in Chapter 3 of this report, pointed out the estimated annual waste in the Delta of diesel fuel of $10.2 million. The waste occurs because of maintenance neglect and the resulting waste of diesel fuel plus the VN$30 per liter paid as a subsidy by the Government to support agriculture and fisheries, principal user industries of diesel engines.

Section 3.15 also pointed out that a foundry (i.e. casting shop) was critical to any mechanical processing and a pre-requisite to the growth of industry. Similarly, the local manufacture of tools in the Delta could take place with minimum casting and forging facilities. We think it would be prudent to start out with non-sophisticated and small scale operations. One of the priority products would be pumps(3.19).

4.6.2 Three Facilities Proposed

We are suggesting three related facilities to be sited close to each other on a 7,000M^2 plot (less than 1 hectare) on the Tay Do Industrial Park. The three facilities are: (1) Engine Repair Shop, (2) Casting Shop and (3) Machine Shop. A suggested layout of these facilities is shown in Appendix D. A list of the equipment needed is shown in Appendix D-1.

4.6.3 Doubtful Profitability in Starting Years

If similar facilities were operating in Japan, the rule of thumb in the engine repair and metal working industries would suggest monthly revenue of over ¥10 million (about $33,000) or annual revenue equivalent to $396,000. However Japanese experience is not comparable with the Delta since the cost of castings and repairs of engines are high in Japan by world standards. The utilization of the proposed facilities would surely be low in Tay Do at first since the practice of regular engine maintenance is not well entrenched. The number of castings ordered from the foundry on Tay Do would be low initially. Parts inventories for the many makes of tractors (See Section 3.15) would also be uneconomical.

We think that in planning these facilities, an assumption should be made that sales during the first two years would not be high enough to cover costs. Probably by the third year, operations would begin to be profitable.

For the above reasons, we are making the calculations in Table 4.6 for the third year of operation. We are also suggesting that this project not be viewed and financed as a commercial venture because the period of loss operations at the beginning can well justfy government financing in view of foreign exchange losses incurred annually due to fuel waste as mentioned above.

4.6.4 Profitability Estimates for Third Year of Operations

In summary, the estimated profitability for the third year of operations would be as follows in thousands of U.S. dollars:

A.	Non-recurring Costs (Investment in Fixed Assets)	$221
B.	Recurring costs	
C.	Annual Sales Revenue in Third Year	$200
D.	Working Capital	$50
E.	Annual Profit in (Third Year) (C-B)	55%
F.	Return on Sales in (Third Year) (E/C)	27%
G.	Return on Fixed assets (Third Year) (E/A)	25%
H.	Return on Total Capital (Third Year) (E/A + D)	20%

More detail is shown in Table 4.6.4 and Appendixes H-1 through H-4.

Table 4.6.4

PROFITABLITY ESTIMATES FOR ENGINE REPAIR, MACHINE SHOP AND CASTING SHOP IN THIRD YEAR OF OPERATIONS

(Note: See assumptions in Table 4.1.2 earlier in this report)

(Units: 000's of U.S. Dollars)

A.	Non-recurring Costs (Investment in Fixed Assets)		$221
A-1	Engine Repair Shop Equipment (See Appendix H)	41	
A-2	Machine Shop Equipment (See Appendix H)	51	
A-3	Casting Shop Equipment (See Appendix H)	9	
A-4	Construction costs (40x15, 30x8, 25x6 @$102/$M^2$) .... (See Appendix H for layouts)	100	
A-5	(Subtotal)	(201)	
A-6	Contingency @10% of A-5	20	
B.	Recurring Costs		$145
B-1	Managers, 3 @$8,000/year	25	
B-2	Clerical, 2 @$VN1,200/day x 300 days	1	
B-3	Engineers, 4 @$6,000/year	24	
B-4	Skilled workmen @VN$1,400/day, 11 x 300 days	7	
B-5	Unskilled workmen @VN$1,000/day, 11	5	
B-6	Land Rent on 7,000M^2 @at Tay Do US$50/$m^2$	3	
B-7	Fuel, power, water (Power is 51KW x 1000 hours x VN$36.8/KWH)	7	
B-8	Raw materials, maintenance	58	
B-9	(Subtotal)	(130)	
B-10	Interest on A @9%	7	
B-11	Interest @20% on B-9 for 6 mos.	8	
C.	Revenue .... $33,000 x 12 mos. or $396 annually based on experience of similar facilities in Japan. However, sales in the Delta would be much, lower; see narrative above in Section 4.6)		$200
D.	Working capital .... 6 mos. x B-9		$50
E.	Annual Revenue Compared with Annual Recurring Costs		
	C. Revenue	$200	
	B. Annual Recurring Costs	$145	
F.	Annual Profit (C-B)	$ 55	

G. Return on Sales (55/200) 27%

H. Return on Fixed Assets (55/221) 25%

I. Return on Total Capital (55/221 + 50) 20%

4.7 Fertilizer and Limestone

4.7.1 Fertilizer

As described in Section 3.18 earlier in this report, Vietnam needs a urea plant, limestone crushing and phosphatic fertilizer plants. The phosphatic fertilizer should be manufactured near ports where bulk discharge facilities for phosphate rock are available. Because of the shallow draft of ports in the Delta (See Figure 2.4), ocean going bulk carriers can not discharge in the Delta.

The urea and limestone plants, however, could be sited in the Delta and in the Tay Do Industrial Park if sufficient land from the Park's 151 hectares remains available when the plant is built.

The Delta's 2,039,400 hectares of paddy land requires a minimum of 300 kg. per hectare of urea annually or a total of 611,820 tons (See 3.18). Based on imported naphtha, a urea and related ammonia and CO_2 plants would cost about US$250 million judging by the following recent examples.

Country:	Indonesia	Bangladesh
Total cost (US$ millions):	$192.0	$249.4
Foreign Exchange (US$ millions):	$115.0	$ 88.0
Local currency (US$ millions):	$ 77.0	$161.4
Tons per day of urea:	1,900	1,600
Tons per 300-day year of urea:	570,000	480,000
Foreign Exchange Financing Agency:	IBRD	IDA
Est. Completion date:	1977	1978
Date of announcement:	2/27/75	2/18/75
Remarks:	--	Financing is provisional and depends on six other contributers

Even using imported naphtha, the plant should be profitable judging by the following estimates taken from Table 4.7.1. (For costing, we are using the Bangladesh plant as a model):

A. Non-recurring costs (investment in fixed assets)..$252 million
B. Recurring costs.................................$ 71 "
C. Working Capital.................................$ 20 "
D. Sales...$ 112 "
E. Profit (D-B)....................................$ 41 "
F. Return on sales (E/D).............................. 37%
G. Return on value of fixed assets (E/A).............. 16%
H. Return on total capital (E/A + C).................. 15%

The following table shows estimated costs for a 480,000 TPY plant. We believe by operating additional shifts, annual capacity can be raised to meet the Delta's annual requirement of 611,820 tons of urea.

Table 4.7.1

PROFITABILITY ESTIMATES FOR UREA PLANT

A.	Non-recurring Costs (Investment in Fixed Assets)		$251,717
	A-1	Plant construction (ammonia and CO_2 plants, prilling tower, urea plant, bagging plant, naphtha tank farm 12,000 M^2 x $102	1,224
	A-2	Piles (150 piles x 50M x $49)	367
	A-3	Equipment (See Appendix I)	250,000
	A-4	Training overseas (20 persons x $5,000)	100
	A-5	Contingencies @ 10% A-1 plus A-2	26
B.	Recurring Costs		$ 70,632
	B-1	Managers, 5 x $8,000/yr	40
	B-2	Skilled labor (30 x VN$1,400/day x 300)	18
	B-3	Unskilled labor (300 x VN$ 1,000/day x 300)	131
	B-4	Imported naphtha 161,000 tons x $85 (to make 277,500 tons of 82.4% N ammonia)	13,681
	B-5	Land rental @ U.S. 0.50/M^2 x 100,000 M^2	50
	B-6	50 kg. Bags 9,600,000 x VN$160/bag divided by VN$685	2,242
	B-7	Cost of Sales 5% x D	5,606
	B-8	Power VN$36.80 x 300,000,000 KWH divided by VN$685	16,117
	B-9	(Subtotal)	(37,885)
	B-10	Contingecies at 10% of Subtotal B-8	3,788
	B-11	Interest @ 9% of A	22,654
	B-12	Interest on working capital 20% x C	3,788
	B-13	Debt service on A, 50 year loan, 10 year moratorium; same terms as Bangladesh	2,517

C. **Working Capital** $18,942

Six months, i.e. 0.5 x B-9

D. **Sales** $112,116

480,000 tons x VN$200,000 divided by 685
less 20% (Retail price is VN$200/kg.)

E. **Sales Revenue Compared with Annual Recurring Costs**

Item D Revenue $112,116

Item C Recurring Costs .... $ 70,632

F. Annual Profit .... $ 41,484

G. Return on Sales (F/D) 37%

H. Return on Invested Capital in Fixed Assets (F/A) 16%

I. Return on Total Capital (F/A + C) 15%

4.7.2 Limestone Crushing

Section 3.18.4 earlier in this report described the AID-financed limestone crushing plant near Thotnot (30 km NW of Cantho). That plant, when completed, will be able to meet an estimated 10 to 17% of the limestone needs of the Delta's high-acid soils.

It would be reasonable therefore to site an additional and larger plant in the Tay Do Industrial park assuming transportation economics are satisfactory for barging limestone from Hatien to Tay Do.

As mentioned in 3.18.4, the acceptance of farmers would have to be tested and the experience of the Thotnot plant carefully noted. However, imported limestone has been sold by the owners of the Thotnot plant and these sales gave rise to the plan for building the existing plant and the owner believes he can thereby replace imports and sell at lower cost. This suggests that a substantial number of Delta farmers are familiar with the benefits of limestone on acid soils.

We are assuming an annual requirement of 225,000 tons (700,000 hectares of high-acid soils and 50,000 of medium acid soils using 300 kg. of limestone per hectare). Assuming a plant were built to operate on 3 shifts, 300 days per year to produce 200,000 tons annually, the capacity would be 28 tons per hour. (200,000 tons divided by 24 days hours x 300 days). We have not been able to obtain reliable data on such a crushing plant but we believe a crushing plant could be built for about $2.0 million. If the limestone were sold at the 1974 price of VN$90 per kg., total sales would amount to $263,000 (VN$90 x 200,000 tons x 1,000 kg/685). Assuming profits of 20% on sales, the profit would be $53,000 representing about a 5% return on invested capital invested in fixed assets.

In the event that the 200,000 ton mill is not found acceptable, a lower cost and smaller scale alternative could also be considered:

The small-scale mill is a multi-purpose hammer mill, capable of crushing limestone or sorghum, manioc, bone meal etc. The mill would have the following characteristics.

Number of hammers: 16
Hourly crushing capacity: 350 kg.
Power requirement: 4 to 5 HP diesel, kerosene or gasoline engine
Depreciation: 8 years, but depends on utilization

The cost of the mill would be as follows:

Hammer mill, including jigs, fixtures, spare parts C & F Cantho..	$1,200
Engine (VN$800,000) imported........................	1,170
Locally made steel covered table and mounting (VN$274,000)......................................	400
Total..................	$2,770

We estimate that the cost of grinding limestone would be about the equivalent of $17.00 per metric ton or about $0.02 per kilogram. The cost of limestone is about VN$90 (Oct, 1974) or the equivalent of $0.13. The ex-factory cost would then be about $0.15 per kilogram.

4.8 Seed Center

To help bring about a standardization and upgrading of paddy and sorghum, a certified seed center is needed (see Section 3.24). According to Wendell P. Knowles (USAID Deputy Director, Cantho) the shortage of sorghum seeds is the main bottle neck in expanding the production of sorghum in the floating rice regions of the Delta. (See Section 2.3). Uniform paddy is a prerequisite to the success of the rice mill described in Section 4.1.2

It is difficult to say how large a seed center would be needed until experience were gained with sales volumes. However it would probably be prudent to start small. Farmers now produce their own seed or obtain seed from other farmers; in a few cases, farmers purchase seed from commercial seed dealers. These practices will continue and in order to make sure that proper varieties are planted, the cooperation of the Agricultural Development Bank would seem desirable. Possibly farmers showing evidence of seed purchases from the center would be given preferential treatment by the Bank or their applications for loans given priority. In future, assuming a large modern mill were built (Section 4.1.2), sales of paddy to the mill would be conditional upon the farmer's ability to deliver uniform paddy of correct grade.

To plant one hectare requires about 20 kg. of seed. To plant enough hectares to assure the delivery of uniform paddy to the mill, would require 4,000 tons of seed (20 kg. x 20,000 hectares yielding 3 tons each = 60,000 tons of paddy, the annual requirement of the large scale mill; see 4.1.2)

The achievement of uniform paddy plantings would probably be phased over several years and farmers would procure from each other in the traditional way. Therefore seed storage capacity for 4,000 tons would not be required. Possibly a seed center to accommodate 1,000 tons only would be a reasonable starting point and this would require a building one tenth the cubic capacity of the warehouse already built on the Tay Do Industrial Park. The calculation for the storage space for 1,000 tons of seed is as a follows:

1 U.S. bushel = 1.2445 cubic feet
(Wendell Adnerson, FAO Rice Team)
49 bushels = 1 metric ton
1 metric ton can be stored in 61 cubic feet
61 cubic feet/35.3 = 1.73 M^3 of storage per metric ton
1,000 MT/1.73 M^3 = 578 M^3 of required storage space for seeds.

A structure 10M x 22M with a 3 meter ceiling would probably be sufficient to accommodate the above 578 M^3 of seeds plus room for an office etc.(10M x 22M x 3M = 660 M^3).

The seed center, would be equippped with a dehumidifying system and sheet metal bins. The capital requirement for such a structure would be on the following order:

A.	122M^2 floor space @$102/$M^2$	$12,444
B.	Sheet metal bins, arranged with aisles and air space (4 rows, 19 M long)	8,000
C.	Office equipment	2,000
D.	Dehumidifying equipment	5,000
E.	Contingence 10% of A though D	2,740
	Total	$30,184

4.9 **Exported Frozen Food Products Plant**

We are suggesting a plant capable of processing at least three products frozen for export. The three products would be cultured river fish (see Section 3.12.2), ducks (see 3.11, last paragraph) or frogs legs.

Later on, as the mixed feed plant goes into operation (see 4.5), the plant could be expanded to handle chicken and ultimately pork but only for export since fresh meats are available in local markets all year round. Chicken and hogs without proper feed, yield a type of meat that would not meet export standards.

We have estimated the profitablility of a plant producing 1,200 tons of frozen fish and duck. (See Table 4.9-B), however, freezing of fish only may prove to be more profitable since the raw material supply could be better assured by creating a captive supply from rafts moored in the Bassac river near the Tay Do Park.

The freezing of frogs legs is a potentially high-profit business and is being done successfully in Bangladesh (viz. the former Fancy Company plant on the airport road near Chittagong). Frog species in Southeast Asia are Tigrana Rana Catasbiana , Rana Escalanta; these or similar species are sold in Vietmamese fish markets, but are not a popular local meat. Frogs could be readily cultured with only moderate feeding.

The freezing of ocean products at Tay Do is probably not feasible because even the freezing plants in Rach Gia adjacent to or near the marine fish market have problems maintaining a steady supply of marine raw material,

Shrimp especially, and to some extent fish are easily bruised in transport, and, unless kept alive in water or frozen , will quickly be affected by fungus, ruining their saleability in discriminating overseas markents.

Dr. V. R. Pantalou, Fishery Advisor of the Mekong Secretariat told us that as a converter of protein into flesh, fish are more efficient than most other animals. Some comparisons are as follows (based in part on our field notes):

Hogs: 4 tons of feed yields 1 ton of pork.

Chickens: 3 tons of feed yields 1 ton of meat.

Fresh water fish: 2.5 tons of feed yields 1 ton of fish.

Fresh water fish: 1.5 tons of rice bran plus 1 ton of /vegetables and offal yields 1 ton of fish.

Dr. Pantalou said that he had prepared a study of a project for fresh water fish culture (without freezing) that would require $588,000 of invested capital and would yield an annual profit of $214,600 (36% return on fixed asset capital).

The project we are proposing for frozen Products in Table 4.9-B is modelled in part on the Kien Giang Co. plant in Rach Gia which freezes marine products and ships by refrigerated van to Saigon for export in containers to Japan. Although the products are not fully comparable, actual sales prices paid to the Rach Gia plant in January-September 1974 are listed below as background for evaluating the validity of the sales and profit estimates in Table 4.9-B.

Table 4.9-A

ACTUAL SALES PRICES FOR MARINE PRODUCTS FROZEN AND EXPORTED BY THE KIEN GIANG CO. -- JAN. - SEPT.,1974

Frozen Product	Tons Sold	Sales Revenue (US$)	Revenue per Ton (US$)
Large shrimp	464	$1,759,000	$3,791
Small shrimp	71	100,000	1,408
Cuttlefish	12.7	32,000	2,520
Red Snapper	39	115,000	2,949

The fresh water fish may not command as good prices as those shown above; therefore we are estimating the sales price of frozen river fish at $2,000 per ton or $2.00 per kg.

In summary, the annual profitability estimates on the frozen food products plant are as follows in thousands of US dollars, based on Table 4.9-B:

A. Non-recurring costs (investment in fixed assets)...$415
B. Recurring costs......................................$1,384
C. Working Capital......................................$535
D. Sales..$2,100
E. Profit(D-B)..$716
F. Return on Sales(E/D)................................ 34%
G. Return on capital in fixed assets(E/A).......... 73%
H. Return on total capital(E/A + C)................. 76%

In addition to the freezing of river products and duck for export, there could also be an industrial fish culture project to supply local markets with fresh fish, iced for transport to Saigon.

The 1,200 tons of processed and frozen animals would yield a small volume of offal, but less than 100 tons on a dry basis.

Table 4.9-B

ANNUAL PROFITABILITY ESTIMATES ON FROZEN FOOD PRODUCTS (RIVER FISH DUCK, FROGS LEGS.)

A. Non-Recurring Costs (Investment in fixed Assets).................$415

A-1 Thirty rafts, $16^M \times 6^M \times 2^M$ @$9,600/raft assuming $50/$M^2$ for construction.................$288

A-2 Two 75 HP compressers for freezing plant.................$10

A-3 Other refrigeration equipment, amonia, polystyrene sheets for insulation.................$11

A-4 600M^2, 1-story construction @$102/$M^2$.................$62

A-5 Three Refrigerated 5-ton (payload basis) vans to carry frozen products to container port costing $8,000 each (assumes 2 vans making overnight trip to Saigon with van for standby.).................$24

A-6 Processing equipment (cutters, conveyers, fork lift, washers thrashing machine, packaging machines).................$20

B. Recurring Costs.................[illegible]

B-1 Purchase of fingerlings.
(These may be hatched by the plant or purchased.
The calculation for this item is 30 rafts x 192M^3 each divided by 2 because fingerlings are half the size or less of mature fish x 104 kg. per M^3 of fish x US$0.05/kg of fingerlings.
Actual price in Oct. 1974 was VN$27/kg for small fish 10 cm or less in length.).................$15

B-2 Feed for cultured fish (grown in 30 rafts to produce 600 tons of fish. Feed per raft costs $11,388.
Rafts are $16^M \times 6^M \times 2^M$ producing 192 M^3 of fish each;
1M^3, weighs 104 kgs;
192M^3 x 104kg x 30rafts = 600tons).................$342

B-3 Purchase of ducks, 600tons
(1.5 kg each @VN$800 each means a requirement of 400,000 ducks x VN$800 =VN$320 million = US$467,153).................$467

B-4 Packaging materials.................$180
(cardboard boxes, cellophane wrapping for 12
1,200,000 kg of frozen product @US$0.15 per package)

B-5 One Manager @$8,000.................$8

B-6 Two-Sanitation and feed processing Technicians @$6,000
Technicians @$6,000 each.................$12

B-7 90 unskilled cutters, packers, dressers, machinery..............$39
operators and raft tenders @VN$1,000/day
for 300 days

B-8 Land rent on 900M^2 @US$0.05/M^2..................................$1

B-9 Daily trip to Saigon by refrigerated van..........................$3
(340 km daily, 6.5 km/liter of diesel fuel x VN$95/liter
x 365days divided by 685)

B-10 Power (44,000 KWH @VN$36.80)....................................$8

B-11 Water (24,000M^3 @VN$40/M^3)...................................$1

B-12 (Subtotal)...($1,070)

B-13 Contingencies @10% of B-12......................................$107

B-14 Interest on A at 9%...$37

B-15 Interest on C at 10%..$53

B-16 Cost of Sales 5.6% x D..$117

C. Working Capital $535

6 months, i.e. 1/2 x B-12

D. Sales..$2,100

D-1 600 tons of frozen fish @$2,000/ton $1,200
(Oct. 1974 export price from Rach Gia was higher but for more
popular fish.)

D-2 600 tons of frozen duck...$900
@$1,500/ton

E. Profit (D-B)... $786

F. Return on Sales (E/D)..................................... 37%

G. Return on Invested Capital in Fixed assets (E/A)........... 73%

H. Return on Total Capital (E/A plus C)........................ 76%

Chapter 5

PRIORITIES IN ESTABLISHING NEW AGRO-INDUSTRY

5.1 Vietnam's Long Range Plans as Related to Recommendations Herein

In 1974, the long range development of agro-industry was described in two basic documents:

> "Four-Year National Economic Development Plan, 1972-1975" (See Bibliography, Source 68)
>
> "Five-Year Rural Economic Development Plan (Agriculture, Fisheries, Forestry and Animal Husbandry), 1971-1975" (Source No. 67)

The agro-industries proposed in this report are consistent with both plans although a few of our recommendations are not specifically stated in the plans.

The "Four-Year National Economic Development Plan" (page 255) specifically proposed the following plants for Canthe: manufacturing and repair of agricultural machinery, production of fertilizer, food processing ("such as edible oils"), and animal feeds.

5.2 Summary of Recommendations and Time Scheduling Priorities

Table 1.2(*) shows the agro-industrial development we are proposing in this report. We suggest that priority be given to the seed center (item A in Table 1.2) and related agricultural extension or information services. The seed center and related activities are critical to the cultivation of uniform paddy for Plant C, the Rice Center, and to the expansion of the sorghum output, needed for Plant F, the Mixed Feed Plant. The seed center itself will cost only $30,000.

The importance of maintaining the Delta's fast-depreciating tracter fleet, justifies immediate attention to the Engine Repair Casting Shop, Agricultural Implement and Pump Manufacturing Plant (Plant B). This facilitity can be built with a capital expenditure of $221,000. Deep plowing by tractors of the Delta's clayey soils will be a key factor in the increase of paddy and sorghum output.

(*) See Executive Summary, Chapter 1, p. 17.

Second priority, in terms of time scheduling, should be given to the Urea Plant (Plant C) and to the Paddy Cleaning, Drying, Storage and Milling Center (Plant D). These will require a lead time of 3 or 4 years because of the need for mobilizing capital and the time required for construction. Meanwhile the steady improvement of seed quality and uniformity and the expanded use of TN varieties can proceed.

Plants C and D are of basic importance if Vietnam is to attain her potential as one of the world's leading suppliers of milled rice. The foreign exchange savings and earnings from these two projects are estimated at $159 million (See Table 1.2). The rice center, Plant D, could hopefully serve as a pilot project and lead to additional storage, drying and milling capacity for export grade rice. Expanded milling capacity for high grade rice could prepare the way for future exports of edible oils as well.

In the event that the Delta's paddy production is required in the near future to supply the expanded needs of unified Vietnam, it would still be worthwhile to export high grade rice and to replace such rice with lower cost brown or lower grade rices. (Indonesia is planning to import lower cost sulfurous crude oils and export high cost sweet crudes).

In terms of timing, we are suggesting the following projects be started after the urea plant and the rice center:

(a) Rice Bran Oil, (b) Mixed Feed, (c) Limestone Crushing on Tay Do Park, (d) Exported Forzen Food Products, (e) Milling and Drying Outside Tay Do Park, (f) Limestone crushing outside Tay Do Park.

Table 1.2 contains further information on the capital requirement, annual savings or earnings of foreign exchange, production capacity and employment generated. In summary, key conclusions from the recommended program are as follows:

(narrative continues, next page)

A.	Number of plants or complexes recommended for siting on the Tay Do Industrial Park:	8 plants
B.	Number of smaller scale plants recommended for siting outside the Tay Do Industrial Park:	104 rice mills, 10 drying plants, 30 limestone crushing mills
C.	Total capital requirement to finance fixed assets:	$261 million
D.	Total direct foreign exchange earnings per year for Vietnam:	$27.2 million
E.	Total direct foreign exchange savings per year for Vietnam:	$145.1 million
F.	Total improvement in Vietnam's trade balance (D + E)	$172.3 million

5.3 Important Agro-Industries Excluded

The plants and facilities suggested in Table 1.2 do not include many useful agro-industrial or supporting industries. These have been omitted because we think other locations in Vietnam, outside the Cantho region, would be better suited. For example, insecticide blending, manufacture or packaging is important for the Delta, but we think this can be handled more efficiently in Saigon, close to major shipping facilities, the international airport, and to the head offices of importing companies.

Starch-based industries are also important, but the Delta's minimal production of manioc (see Table 2.3) suggests that other localities to the north would be better suited.

Phosphatic fertilisers are important for paddy, but the absence of deep water ports precludes the discharge in bulk of phophate rock, as mentioned.

Monosodium glutamate (MSG) and soy sauce can be produced in Vietnam, but areas outside the Delta are closer to the manioc supply.

Marine products such as fish meal, frozen shrimp, molluscs, cuttlefish, and snapper can best be processed at Rach Gia or other coastal locations.

Bag manufacturing capacity already exist in the Saigon area and can be expanded to provide bags needed in the Tay Do park.

Chapter 6

EXISTING INDUSTRY AROUND CANTHO

6.0 Existing Manufacturing or Processing Plants

Earlier in this report (Section 2.5) an overview of industry in the Cantho vicinity was provided. Of the industries listed earlier, some will have a direct bearing on the viability of the projects we are proposing for Tay Do. The 33 MW plant, already on stream, is needed to meet the connected load of the 8 plants or complexes listed in Table 1.2 at a reasonable cost per KWH.

The 5 ton per day limestone plant at Thot Not can play an important role in heightening the awareness of farmers to the need for limestone. The fishmeal plants in Rach Gia will be important as suppliers of raw material to the Mixed Feed Plant.

Other industries in the Cantho area are listed in Table 6.0. The majority of these plants are of artesanal scale, producing medium quality goods in small volumes. Most of the establishments in Table 6.0 will continue to serve local markets with lower cost products and should neither be contributors to or competitors of the plants we propose for Tay Do.

6.1 Integration with Proposed Tay Do Plants

There are some plants in the Cantho region that will have a definite contribution to make to Tay Do as follows:

The larger rice mills included in the 857 total in Table 6.0 below will have to be counted on as suppliers of fresh bran for the Rice Bran oil plant (See 4.4.6 above). Out of the 40 TPD fresh bran requirement, only 18 ton TPD can be supplied by mills on the Tay Do Park. The residual 22 TPD could best be supplied by the larger rice mills in Ba Xuen Province or the Cantho region (Cai Rang especially).

The 40 machine shops listed in Table 6.0 can become customers of the Engine Repair and Casting Shop for more complex repairs that they are not capable of handling (e.g. nozzle grinding, f.i.e. adjustments, timing adjustments). In the long run, some of these machine shops or their personnel could be integrated with the Tay Do facility.

The 92 saw mills shown in Table 6.0 will be important during the construction phases of plants on the Tay Do Park. Similarly the brick kilns and tile manufacturers can be suppliers.

The 63 fish sauce plants might become suppliers of fish for the Mixed Feed Plant, but the effect of fermentation on protein in fish residue will have to be confirmed.

The other industries shown in Table 6.0 should have no connection with the Tay Do complex, i.e. bakeries, ice making, soy sauce and sugar mills. The sugar mills, if modernised to produce molasses, could make an important contribution to the Mixed Feed Plant.

(Table 6.0 follows next page)

Table 6.2

MANUFACTURING OR PROCESSING ESTABLISHMENTS IN SIX PROVINCES ADJACENT TO CAN THO CITY, AS OF MID - 1974

PROVINCE	Rice-Mills	Baker-ies	Fish Sauce Making Plants	Saw Mills	Machine Shops	Cement Tile Facto-ries	Brick Kilns	Ice Mak-ing Plants	Soy-Sauce Making Plants	Sugar Mills	TOTAL
AN - GIANG	99	31	18	28			31	17		30	254
BA - XUYEN	211	8	3	8	5	2	8	8	4	2	259
PHONG - DINH	148	29	12	13	23	11	11	11	5	7	270
SA - DEC	71	4	8	8			11	2			104
VINH - LONG	170	20	19	32			53	9		15	318
VINH - BINH	152	12	3	3	12			12		12	212
TOTAL	857	104	63	92	40	13	114	59	9	66	1,417

Source : [redacted] Office, Cantho

Chapter 7

POLICIES AND INCENTIVES TO ENCOURAGE AGRO-INDUSTRY

7.0 National Goal

Given the world food shortages and Vietnam's need for foreign exchange, development of the Delta's agro-industrial potential could be an important national policy objective.

Given the basic importance of paddy and feed to Vietnam's economy, Government-wide coordination, cutting across traditional jurisdictions, is needed. The successful development of the paddy and feed resources will require a total effort directed toward improving all phases of production and sales outlined below:

ELEMENTS OF AN INTEGRATED PROGRAM TO DEVELOP VIETNAM'S PADDY AND FEED RESOURCES

- Better and uniform seeds especially for sorghum and TN varieties.
- Better and higher volumes of urea and phosphatic fertilizers.
- More limestone for acid soils.
- Better farm equipment, especially threshers and tractors.
- More deep plowing by tractors and better tractor maintenance.
- Facilities for the cleaning, drying and storage of paddy.
- Milling to raise the yields of head rice from the typical 57% to 62% of the paddy intake.
- Better recovery of bran to permit oil extraction.
- Local bran oil production to reduce edible oil imports.
- Better distribution of bags to reduce leakage and spoilage.
- Reconstruction or new building of irrigation canals.

In terms of financial returns, execution of such programs can be significant. The export of 1.3 million tons of the Delta's surplus rice could bring $624 million (1,300,000 tons x $480/ton) and raise Vietnam's rice export earnings above the Thailand level of $488 million of exports in 1974 (See Table 3.2-A p. 48)

Even if domestic consumption needs were to preclude such high volume exports, the international exchange of Vietnam's export quality rice for lower cost grades could yield earnings in the hundreds of millions of dollars.

Vietnam's mills are typically losing about 5 percent of the head rice milled (See Tables 4.1-A and 4.1-C). This loss at wholesale prices (VN$182,000 per ton in 1974 or US$266 per ton) is $58 million, or at international prices ($480 per ton), would become $105 million (7,025,100 tons of paddy in 1973 x 5% = losses of 351,258 tons of paddy x 62% = milled rice).

In theory, if all the oil resources in Vietnam's paddy were utilized, the total recovery would be 54,800 tons (1973 paddy production of 7,025,100 x .0078). Of this oil, two thirds would be edible, valued at US$33.2 million (Jan-June 1974 price of $920 per ton x 36,500 tons) and the industrial oil would be valued at about $8.0 million (18,300 tons x $438/ton).

Vietnam's rice bran, even the "fine" bran, contains husk and is therefore not comparable with ideal bran out-turns (See Tables 4.1-A and 4.1-C). However, the continuation of conventional milling almost precludes oil extraction because of the husk contained even in the fine bran from most Vietnamese mills.

A recapitulation of the above figures is as follows:

Potential value of exportable milled rice ....,	$624 million
Current losses of rice from poor milling .... (at international prices)	$105 "
Value of potential edible oil production	$33 "
Value of potential industrial oil production	$8 "
Total	$770 million

To put the above figures in perspective, the total imports of South Vietnam were $678 million in 1972 and $717 million in 1973. South Vietnam's exports were $23 million in 1972 and $60 million in 1973 (Bibliography, 24).

The conclusion is that focussing chiefly on the production of paddy, bran, and feed, Vietnam's economic potential from the Delta is very favorable, given the administrative mechanisms to assure the best use of resources.

7.1 **Foreign Investment Policies**

Treatment of foreign investment has been highly favorable to the investor and numerous incentives were offered under the terms of Law No. 4/72, June 2, 1972, "Regulating Investment in Vietnam." (Bibliography, 70)

Investors were given a five-year exemption from customs duties on imports, income taxes, property and land taxes, and export taxes, among others. Capital and profits could be repatriated. There were no percentage limits on expatriate personnel.

Special services for investors were provided such as market research and site location services (performed by the Industrial Development Bank of Vietnam, 40 Nguyen Hue, Saigon and the Investment Service Center, 100 Tu-Do, Saigon).

Despite the chronic insecurity of recent years, the policies to attract foreign investment have been reasonably successful. From June 1972 to December 1974, 144 foreign investment projects were approved involving the investment of $61.9 million in foreign exchange:

FOREIGN INVESTMENT
1972 - 1974

Country of Investor	Equity Capital (US$)
Liechtenstein......	15,000,000
Hong Kong	8,736,461
Indonesia	7,500,000
Japan	6,414,771
The U.S.A.	4,835,051
France	4,623,799
Republic of China .	3,917,558
Federal Republic of Germany	3,664,600
Great Britain	2,093,443
Korea	1,783,030
Singapore	1,191,292
Thailand	621,125
Israel	337,600
Khmer Republic	281,171
Panama	250,400
Australia	216,854
Switzerland	155,275
Sri-Lanka	127,634
Luxemburg	50,000
Spain	50,000
Laos	14,000
Total	61,864,064

Source : Industrial Development Bank of Vietnam.

7.2 <u>Policies regarding Domestic Investment</u>

There are three banks in Vietnam which in 1974 were providing credit for economic development:

Industrial Development Bank of Vietnam	(IDB)
Agricultural Development Bank	(ADB)
Investment and Development Bank	(IDEBANK)

There is an additional institution, NEDEF, which has acted as an intermediary bank, collecting funds from the Government and USAID for dispersal to the above three banks against approved loans.

The above institutions have some very worthwhile achievements to their credit, as summarized below from Source 24, see bibliography, Appendix F.

The <u>ADB</u> was established in 1967 to provide low cost credit to farmers. The ADB has made substantial gains in recent years and by the end of 1973 was estimated to be the source of twenty percent of total rural credit. Expansion of rural credit is one aspect of the government's overall effort to make agriculture the leading edge of economic development, and ADB can be expected to continue playing a dominant role. ADB branches, which are located in every province, are complemented by a Private Rural Banking System, which was inaugurated in 1969. Almost seventy private rural banks (PRB) were in operation as of mid 1974 in almost every province of the country, with a heavy concentration in the Mekong delta. PRBs are privately owned with the ADB holding a minority capital interest, providing expertise and certain banking assistance. PRBs make loans which are required to stress agricultural development and production.

The <u>IDB</u> makes medium and long term credit available to investors for construction of factories as well as equipment purchases. In some situations the IDB will take a temporary equity position in an industrial project. The IDB is also involved in the development of industrial estates in Vietnam, an activity it pursues along with SONADEZI (National Company for Development of Industrial Estates). (The most notable achievement of SONADEZI has been the Bien Hoa Industrial Park where 52 factories have been completed as of mid-1974 producing a variety of products from asbestos roofing to steel reinforcing bars.)

The IDEBANK is a private development lending institution which was organized by a consortium of private banks in 1961 with the Credit Commercial du Vietnam currently holding approximately 45 percent of the outstanding shares. IDEBANK, initially named SOFIDIV (Society for Financing Industry in Vietnam), enjoys Government support and encouragement in making medium to long term loans at concessional rates to new and expanding industrial projects. IDEBANK also participates in industrial projects through direct equity participation.

Despite the successes, even during a trying period of insecurity, there are some changes in policies and procedures that may help to accelerate industrial development and give incentives for new industry to site itself outside the urban complex of Saigon-Gia Dinh-Bien Hoa. These suggestions are as follows:

a. The approval of industrial projects in 1974 required the concurrence of the Ministries of Trade and Industry, Agriculture, Interior, Communications and Transportation, Public Works, and Land Reform. Sometimes the approval of NEDEF was also required and in the case of foreign investment, the approval of the Office of the Board of Investment an agency within the Ministry of Trade and Industry. To expedite the approval process, it would seem better to have a single authority where only the Ministries directly concerned could be represented.

b. Under Vietnamese law in 1974, the banks could not accept buildings as collateral unless the owner had a fee simple title to the land. This was a disincentive to investors seeking to locate on industrial parks such as Tay Do.

c. IDB, as a matter of policy, did not attempt to influence entrepreneurs to build plants on the Industrial Parks. This seemed to be a factor in retarding the utilization of the SONADEZI Industrial Parks.

d. The development banks as a matter of policy have not approved loans for industrial working capital. Working capital, for most of the proposed projects in Chapter 4, is equal in importance to the capital for fixed assets.

e. Industrial borrowers needing working capital can only borrow from the commercial banks at annualized rates ranging from 20 to 28%. If industrial development is to become a national goal, the necessary legislation should be enacted to enable the IDB to make loans for working capital and to reduce the interest rates charged by commercial banks.

f. To encourage future manufacturing in Cantho, certain zoning restrictions should be considered. (There was a recent case of a detergent plant whose sponsors wanted to locate in Saigon, but for pollution reasons, the plant site was changed to an area near Danang.) In order to site agro-industry near the sources of raw materials and on the Tay Do Park, zoning should be encouraged.

g. In general, the ADB and the IDB regard their spheres of activities as mutually exclusive. However in the case of agro-industry in Cantho, cooperation and joint planning will be essential on the part of the two banks and the Ministries of Agriculture and Trade and Industry as well. This will help assure (a) the availability of correct varieties of paddy (b) help make sure farmers commit themselves to supplying ingredients for the mixed feed plant and (c) help make sure rice mills agree in advance to sell their fresh rice bran to the bran oil plant. In short, the financial leverage of the two banks could operate as an incentive to coordinate the farmers and manufacturers.

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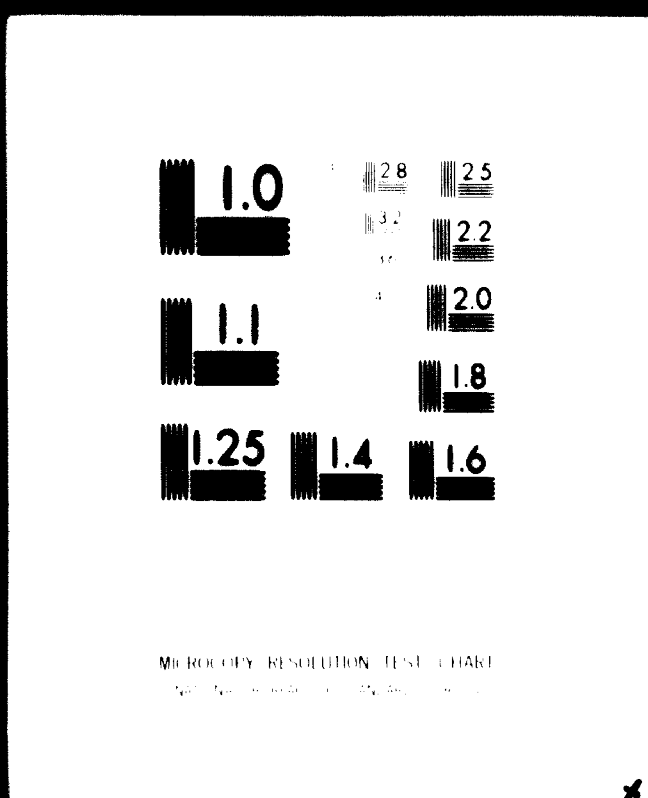

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Chapter 8

EXECUTION OF THE DEVELOPMENT STRATEGY

8.0 Suggested Sequence of Actions

Preparatory steps to the execution of the agro-industrial development program in Canthe would include the following:

a. Because of the capital investment involved and the potential benefits to the Vietnamese economy, Government-wide agreement in principle should be achieved on the acceptability of a program such as that outlined in Table 1.2 in the Executive Summary in Chapter 1.

b. Policies and procedures should be agreed upon whereby the farming community and certain existing rice mills will cooperate in providing the raw materials for plants and facilities listed in Table 1.2, namely: (a) TN variety paddy and sorghum seeds for the seed center, (b) at least 27 tons per day of fresh bran for the bran oil plant, (c) raw materials for the mixed feed plant, (d) limestone for the crusher, (e) 60,000 tons of uniform paddy for the rice center.

c. Preparations should be made for meeting the local currency and working capital needs of the new plants (See Chapter 7).

d. Selection and training of managers for plants to be established (see below in this chapter) should be planned.

e. Preliminary approaches should be made to lending and investment institutions, foreign governments, and private companies and channels of communications laid for close liaison with such sources of capital and technology (See below in this Chapter).

f. Preparation of feasibility studies should proceed as soon as possible (See Chapter 9).

g. Final approaches to financing institutions and private investors should follow the feasibility studies.

h. Contracting for plant construction and plant management during the start-up phases should proceed for the (a) Urea Plant, (b) Paddy Cleaning, Storage and Milling Plant, and (c) Rice Bran Oil Plant (We believe that local Vietnamese management will be available for the other plants (See below in this Chapter).

8.1 Availability of Local Management for Future Plants at Tay Do

Overseas training of Vietnamese and the recruitment of foreign plant managers for the start-up phases will probably be necessary for the plants mentioned under paragraph "h" in Section 8.0 above. However, locally skilled people can be found for certain of the plants as follows (digits in parentheses refer to Sections of this report):

Name of Proposed Plant	Locally Available Management
Engine Repair, Casting Shop, Agricultural Implement and Pump Manufacture (4.6.2)	For the foundry and forging operations, local skills are available through the CARIC, No. 17 Ben Bach Dang Saigon (French-owned comapny). For the manufacture of pumps, the Nhuyen Van Xe Co., No. 20 Gia Long Xa My Luong, Quan Cho Moi - Tinh, An Kiang Province is already building 1,800 M^3/hour pumps. For diesel engine repairs and tractor repairs, a company called Trung Tom Nong Co., was established in 1967 under a C & I Ministry decree to repair tractors in Cantho. Mr. N. H. Gia, Manager of the AMTRACO assembly and repair plant, helped organise a consortium of tractor importers to establish the Trung Tom Nong Co. However, the operations in Cantho were never started because of a shortage of capital. AMTRACO head office is located at No. 44/8 Ngo-duc Ke, Saigon.
Paddy, Cleaning Drying, Storage and Milling Plant (4.1.2)	One of the most progressive mills in Vietnam is the Nghia Thanh Mill in Ba Xuyen Province. The mill is equipped with rubber roller huskers and polishers (Source 40 in Bibliography)
Rice Bran Oil Plant (4.4.7)	The Truong-Khac-Can Soap Co. in Saigon formerly procured rice bran oil from a supplier in Ta Vinh. Because of a shortage of raw material and inferior equipment, the plant shut down in 1968.
Mixed Feed Plant (4.5.3)	There are mixed feed and bagging operations at Long Xuhen, Angiang Province and at My Tho in Dinh Tuong Province.
Limestone Crushing Plant	The 5 TPH, crushing mill near Thot Not in An Kiang Province should be in operation 1975. The cement clinker plant at Ha Tien in Chau Doc Province has had experience in handling limestone along with the Ha Tien Cement Co. in Bien Hoa Industrial Park.
Exported Frozen Food Products Plant (4.9)	There are several frozen marine product plants in Rach Gia. One of the most progressive is the Kien Giang Co.

8.2 Sources of Foreign Exchange Financing

Probably no single source will be willing to provide financing for a program such as that suggested in Chapter 5.
For example the $249 million urea plant in Bangladesh is being financed by a consortium of lending institutions headed by the International Development Association (IDA), 1818 "H" Street, Washington, D. C.

The following financing institutions could also be approached:

1. Asian Development Bank, Roxas Boulevard, Manila, Republic of the Philippines.

2. Banque de l'Indochine, Paris (also Asian office 5th Floor Araza Bldg. 8735 Paseo de Roxas, Makati Rizal, Republic of the Philippines)

3. Caisse Centrale de Cooperation Economique, 233 Blvd, de St. Germain, Paris 7, France

4. Credit Lyonnais, 19 Blvd.des Italiens, Paris 2, France

5. Frankfurter Bank, 6000 Frankfurt 1, 3821, West Germany

6. International Bank for Reconstruction and Development (IBRD), 1818"H"Street, Washington, D. C., U.S.A.

7. International Finance Corporation (IFC), 1818 H Street, Washington, D. C. 20433

8. Industrialization Fund for Developing Countries, Fredericagade, 25 DK 1310, Copenga Copenhagen K, Denmark

9. Overseas Economic Cooperation Fund, Ino Bldg., 2-1-1 Uchisaiwai Cho, Chiyoda Ku, Tokyo, Japan

10. Private Investment Company for Asia S. A. (PICA), Kokusai Building, 3-12 Marunouchi, Chiyoda Ku, Tokyo

Many more sources of financing can be provided by UNIDO because UNIDO has sponsored international conferences attended by representatives of banking institutions and multinational companies. These meetings have served to identify organizations which are willing to invest in potentially viable projects in developing countries.

Chapter 9

TERMS OF REFERENCE FOR FUTURE FEASIBILITY STUDIES

9.0 Purpose of this Chapter

This Chapter has been prepared in compliance with Section 2.01.12 of Contract UNIDO Contract No. 74/21 dated September 23, 1974.

Section 2.01.12 of Contract 74/21 reads as follows:

"Based on the findings and conclusions resulting from the pre-feasibility studies, the Contractor shall write detailed Terms of Reference for carrying out subsequent work including, inter alia, a series of exhaustive technical and economic feasibility studies for the establishment of the industries identified by the Contractor as being potentially viable."

9.1 Basic Model for Feasibility Studies

We recommend using the standard format for feasibility studies contained in the "Technical Notes" at the beginning of Extracts of Industrial Feasibility Studies, Volume I, Industrial Planning Series No. 7, UNIDO, published by the United Nations, New York, 1973. A copy of the "Technical Notes" is attached as Appendix G.

Rather than repeating the standard wording from Appendix G for each of 8 types of facilities, we are only repeating the paragraph headings and are describing below the exceptions or special caveats that relate to the situation in Vietnam or to the specific industry concerned.

These special points peculiar to Vietnam or to the industry are discussed below for 8 types of plants. The relevant paragraph designators, e.g. II, 2, are listed below, based on Appendix G.

9.1.1 Rice Center (Receiving, Cleaning, Drying, Milling)

Major Input Materials, II, 2

A detailed study of paddy availability is required. This should include interviews with the Directorate of Agriculture in Cantho, the Agricultural Development Bank, large scale millers in Ba Xuyen large scale paddy farmers, and persons who buy paddy wholesale ("remasseurs").

The first key question to ask will be: "Can enough farmers be counted on to grow the same variety of paddy to supply a 15 TPH plant?"

A second key question is "What would be the best procedures for assuring the delivery of uniform paddy?"

Alternative Technologies, II, 3

The German Schuler system, the Japanese Kyowa and Satake systems, and U.S. systems at least should be considered and evaluated.

Suppliers should be asked for customer lists in developing countries and field visits then made to inspect the mills to determine operating history in at least three developing counties. Some countries have reported operating difficulties with rubber roller mills e.g. the Philippines.

Locational Factors, II, 4

Millers, farmers, and agricultural experts should be asked if the Tay Do Industrial Park poses problems of paddy delivery that could be avoided if another site were selected. (We believe, however, that the river-front location on the Bassac will permit low-cost transport of paddy by boat just as is being done in the Cai Rang District of Cantho.)

Market, III, 1

The research team should have discussions with Vietnamese rice exporters to determine the acceptability of local TN rice in various foreign markets. Rice exports were stopped in 1964 prior to the introduction of TN rice, and there is no experience in TN exports. If such discussions prove inconclusive, the following further steps could be taken.

The market for imported rice could be investigated in at least three of the principal rice importing countries and TN samples sent for evaluation. This should first be done by a data search of the to determine the imports of the nearby countries buying in large volumes (e.g. Singapore, Hongkong, India). See Table 3.2 below for importing regions.

Table 9.1.1

AVERAGE ANNUAL QUANTITY AND VALUE OF RICE IMPORTED BY CONTINENTS AND WORLD TOTAL, 1962-1967

Continent	Quantity (metric tons)	Value (millions)
Europe	864,400	$ 130.3
USSR	300,800	$ 43.5
North and Central America	407,600	$ 67.0
South America	58,600	$ 9.7
Asia and Middle East	4,799,800	$ 644.6
Africa	687,800	$ 96.0
Oceania	55,200	$ 9.0
World Total	7,174,200	$1,000.1

Source: Rice Chemistry and Technology, American Association Cereal Chemists, 1972

Meetings should be held with the grain departments of at least two leading Japanese trading companies familiar with world rice trade. Samples of specific Vietnamese TN varieties should be tested by the trading companies and an assessment made of the suitability of the rice for various markets. (We are suggesting these discussions take place in Japan because rice trade experts are concentrated in one location, and the Japanese trading companies, through their world-wide network of branches, would have access to information on world markets.)

If a demand for imported parboiled rice is found (e.g. in India, Bangladesh, Sri Lanka) the study should include parboiling facilities in Para V, 1.3 of the Appendix G "Machinery and Equipment". (Parboiled head rice yields are higher than non-parboiled rice and shelf rice is longer.)

Product Mix, III, 3

In selecting the product mix, consideration should be given to the grade of paddy (e.g. TN 5,8,20 or 22 -- we suggest TN rather than traditional varieties because of the higher yields.)

Land Site Development, V. 1.1

The cost of piling should be taken into account; see Chapter 4, Table 4.1.3, line A-18. This can best be done through the Hazama Gumi of Tokyo, the only people with experience in building large structures on the Tay Do Industrial Park.

Working Capital Annex, V. 2

The following payment practices should be investigated: (a) payments by mills or ramasseurs to farmers, (b) payments by brokers to mills. The need for working capital should then be assessed and entered in the cash flow analysis (Appendix G. part XIII).

The possibility of loans for working capital should be investigated and the research team should schedule meetings with the potential lending banks to impress them with the importance of working capital loans, now prohibited by IDB policy in Vietnam.

Other Investments, V. 3

The cost of rubber rollers should be assessed (if the roller technology is to be used) since frequent roller changes are necessary.

Pricing Policy, VII. 3

The discount structure as between dealers, millers and farmers should be determined.

Planned Sales Organisation, VII. 4

An assessment should be made of the advisability of selling exports through brokers or direct from the mill to the overseas importer.

The research team should read Sources No. 27, 34, 40 and 46, including storage, marketing, and milling reports of the FAO rice team in September, 1974 (See Bibliography items Nos. 27, 34, 40 and 46 in Appendix F.)

Our suggestion is that the research team be composed of the following experts:

1. Techno-economist with experience in rice milling analysis,
2. Agricultural product marketing expert with experience in paddy procurement, rice exporting, and bran sales.
3. To obtain data regarding farmer's willingness to produce sufficient volumes of uniform paddy, surveys could be made by team of professors and graduate students, based on a questionnaire under the direction of Dr. N.V. Truong, Ph. D. Vice Rector and Dean, Faculty of Agriculture, University of Cantho, 5 Hoa-Binh Avenue, Cantho, Vietnam Tel 21-061.

9.1.2 Rice Bran Oil Plant

This plant is described in Section 4.4 of this report, and the costs are outlined in Table 4.4.8 on page 153. The annual capacity of the plant is 960 tons of edible oil, 408 tons of industrial oil, and 10,200 tons of defatted bran for feed. The capital required for fixed assets is about $806,000 and $862,000 of working capital is needed in the first year.

Major Input Materials, II.2

The success of this plant depends on the availability of 40 tons per day of fresh rice bran containing a minimum of husk. The assumption was made in this report (Section 4.4.6), that the bran would be supplied by a new modern rice mill on the Tay Do Park (13 tons), by VIMECO a rice mill being planned for the park (5 tons), and by some of the larger mills in Ba Xuen or Cantho (22 tons). The 2 ton/hour Nghia Tan Mill in Ba Xuen is already using rubber rollers and their bran should be especially good in quality with a minimum husk content. The SEDIC and Cuu Long rice mills near Saigon should be approached to see if they can ship fresh bran promptly to the Tay Do Park. These mills have 27 TPH and 9TPH capacity respectively.

The research team should make sure that mills are capable and willing to supply fresh bran in the required 40 TPD volumes.

Alternative Technologies, II.3

We have recommended the solvent extraction method (page 151 of this report) for producing bran oil, however the research team should also consider the expeller process as an intermediate technology.

Market, III

The Vietnamese domestic market for edible and industrial oil should be examined to determine the saleability of bran oil at higher prices than peanut oil or coconut oil. Export markets especially in Singapore, Hong Kong, Japan should be studied.

The acceptability of defatted bran for animal feed should be studied.

The general practice in Vietnam's smaller mills is to mill paddy for individual farmers on a fee basis and to return the bran and milled rice to the farmer. Selling bran to the bran oil mill would be a departure from this traditional practice, and the millers' willingness to sell large volumes to the bran oil plant would have to be explored. The sales price of bran in large volumes would be critical to success.

Capacity of the Proposed Plant, IV

In Chapter 4, Section 4.4, we have recommended a 40 TPD bran plant, that is a plant having a daily processing capacity of 40 tons of fresh bran. This is a minimum economic size, and a larger mill would be better if circumstances warrant.

Pricing Policy, VII, 3

The retail and wholesale prices of competing edible oils, i.e. peanut, soy, coconut should be studied. If the bran oil cannot sell competitively in Vietnam, export sales should be considered.

We suggest the research team should consist of (a) an expert familiar with the solvent extraction process for recovering oil from rice bran, (b) Agricultural economist to determine the marketing channels and pricing structure of rice bran at different distribution levels to determine sales prices likely to assure public acceptance of the edible oil, and soap industry acceptance of the industrial oils.

9.1.3 Mixed Feed Plant

The mixed feed plant is described in Section 4.5 of this report. Capitalization in fixed assets is $568,000, and annual capacity is 50,000 tons.

Products, II.1

The mix of ingredients shown in Table 4.5-B of this report is in our judgement a nutritionally adequate mixed feed for chickens. Other mixes for (a) piglets of different ages, (b) male and female hogs for breeding, (c) cultured fish are needed.

There may be farmer preferences favoring one type of feed over another, some of these preferences may be dietetically unsound, but nevertheless can affect sales volumes and pricing. It may be prudent to start with mixes that are less than ideal and gradually shift to better mixes later on.

Major Input Materials, II, 2

Having determined the optimum nutritional mix for the above animals and fish, locally availability ingredients should be identified and costs of volume procurement and the best procurement procedures identified. For ingredients not available locally, the cost of imports should be determined. These would probably include manioc from Thailand, and corn unless local sorghum can be used in substitution for corn.

Locational Factors, II, 4

We have assumed that this 50,000 TPY plant would be located on the Tay Do Park. This would mean hauling mixed feed by truck or by boat. The location of potential users of feed should be analyzed to see if any serious cost disadvantages would arise from siting the plant on the Tay Do Park.

Product Mix III, 3

See comments under "Products, II, 1" above

Capacity of Proposed Plant IV, 1

We believe it would be useful to conduct a farmer opinion survey based on a questionnaire to determine (a) farmer preferences on types of feed, (b) acceptable prices, (c) volumes likely to be consumed, (d) seasonality of demand, (e) animals or fish being raised. The University of Cantho (Dr. N. V. Truong, Vice Rector indicated a willingness to assist in organizing a survey team.)

In the event that acceptability problems are indicated by the survey, the feed plant may have to Planned on a reduced scale, i.e. less than 50,000 tons, but room allowed for expansion.

Working Capital, V, 2

In studing the availability of raw materials (see above, "Major Input Materials"), seasonality factors involving sorghum for example (see Section 2.3, Chapter 2 of this report) may affect the need for working capital. Sorghum is harvested in December and the proposed plant would have to consider such options as (a) borrowing money to obtain sorghum at low prices after the harvest or (b) paying higher prices in the off-season.

Planned Sales Organization, VII, 4

The sales channels for feed mixed at the existing My Tho and Long Xuen plants (see Section 4.5, page 156) should be explored. The desirability of having wholesale and retail distributors should be assessed.

9.1.4 Engine Repair, Casting Shop, Agricultural Implement and Pump Manufacturing Plant

This facility is described in the basic report in Section 4.6 starting on page 163. The capital required for fixed assets is about $221,000 and annual sales of services and products could amount to $200,000 to $300,000 after two years of initial operations.

The product mix of the machine shop (see Section 4.6, page 163) should be tentatively decided in the feasibility study. Some candidate products to consider would be: medium capacity irrigation pumps of about 1,800 M^3 per hour and small capacity foot pumps.

A farmer survey using a pretested questionnaire and photographs should be conducted to find out (a) what the farmers need and (b) what prices they would be willing to pay.

The organization and management of the engine repair shop could be recommended in the study. In 1967, a company called Trum Tam Nang Co. was established by Government decree for the purpose of performing engine repairs at Cantho (see p. 190 of this report). If this company could be reactivated, good management of the engine repair shop would be better assured.

The size of engine parts inventories and the willingness of the tractor importers to finance the inventories should be explored. The principal tractor importers of 4-wheeled tractors in the autumn of 1974 were as shown in Table 3.4. A similar analysis of the 2-wheel tractor importers and their sales would be needed.

Table 9.1.4

MARKET SHARES IN VIETNAM OF FOUR-WHEEL TRACTOR IMPORTERS -- 1974

Importers	Name of Supplier	Market Share in Vietnam for 4-wheel tractors	Number of 4-wheel tractors imported in '74
1. CIBGECO	Massey Furguson, Ltd.	39%	1,400
2. John Deere	John Deere	28	1,000
3. AMTRACO (American Trading Co.)	International Harvester	17	600
4. Renault	Renault	11	400
5. Ford	Ford Motor Co.	3	100
6. VIKYNO	Kubota Ltd.	1	50
7. VINAPRO	Yanmar Diesel Engine Co., Ltd.	1	50
		100%	3,600

With respect to the casting shop, the existing market for castings should be explored and potential users of castings identified. This part of the work should be initiated after meeting with CARIC, the machinery and boat building company in Saigon, who have a 7-ton foundry making gears etc. We believe that the market for castings will be slow to develop because the industrial base in the Delta is small. Therefore this part of the complex might be deferred unless the production of implements creates a captive demand for castings.

Input Materials, II, 2

Engine parts, pig iron, steel, brass, sheet metal, sand, pattern making material and welding materials would depend on the forecast of sales of castings, pumps, and implements developed under the heading, "III Market" i.e Part III-1 of Appendix G.

Alternative Technologies, II, 3

The type of cupola and furnance will depend in part on what fuels are available at least cost. In this connection, the possible use of peat from An Xuen and Kien Giang provinces should be explored along with the suitability of coals from North Vietnam. These coals are now being exported from Hanoi to Japan.

Selection of Product Mix, III, 3

See above under "Products, II, 1"

Investment, V

The following comments relate also to "Annual Operating Costs and Profits" (Part VIII of Annex) and "Financing Proposal (Part IX of App. G). As mentioned in Section 4.6 of this report, the utilization of the engine repair, and casting shop, and machine shop may be slow to develop. This is because of (a) the lack of tradition for tractor maintenance, (b) some farmer reluctance to pay for first class tractor repairs, and (c) the practice of having castings made in Saigon.

Nevertheless the high cost of fuel waste and the ultimate need for metal working facilities when industry expands on the Tay Do Park are realities which require early remedial action.

The feasibility study should make assumptions as to costs and losses or profits, on a year-by-year basis, for the first three years. We would suggest that the establishment of the facilities might be justified as a Government investment and considered part of the necessary cost of building a foundation for future industry on Tay Do and as a basis for training personnel. At the same time, sales of pumps, threshers, cultivators and customized parts should probably be looked upon as the principal source of revenue in the start-up period.

Implementation, X

Management contracts or other collaboration should be explored as follows:

For pump manufacture: The Nguyen Van Xo Co., No. [illegible] Gia Long, Xa My Luong, Quan Cho Moi-Tinh, An Giang Province.

For casting shop: CARIC S. A. No. 17 Ben Bach Dang, Saigon

For the machine shop: Same as above.

Survey Team

The team to make this feasibility study could consist of (a) a specialist in engine repairs to assess the needs for equipment and inventory and (b) a foundry and machining specialist.

9.1.5 Fertilizer Plant (Urea)

This plant is described in Section 4.7.1, page 167, of this report. Capital required for fixed assets is estimated at $252 million. The output is a minimum of 480,000 tons of urea.

Land Site Development, V, 1.1

Piling requirements for the prilling tower,ammonia compressors, and storage tanks should be discussed with the Hazama Gumi Co. of Tokyo which installed the steam turbine in the 30 MW thermal power plant at the Tay Do Park.

Buildings, V, 1.2

This plant will probably employ more than 330 persons and dormitories near the site should be provided to assure manning of multiple shift operations.

Machinery and Equipment, V, 1.3

In addition to the urea plant itself, cost estimates and site recommendations should be made for the naphtha pipeline and the storage tank, probably at Can Gio, opposite Vung Tau, near Saigon. In 1974, this port was being dredged to accomodate vessels with a 36 foot draft; the original plan was to complete dredging by 1976.

Our plant engineering associates, estimate that to supply 161,000 tons of naphtha,a continuously operating, six inch pipeline will be necessary. In Japan, such pipe costs $6.85 per inch of diameter per meter of length. The installed costs in Vietnam will be about 61% higher; our estimates for the pipeline are $8.9 million of foreign exchange (6 inch pipeline, 135 km long, Can Gio to Tay Do.)

The size of naphtha storage facilities at Can Gio or other port cannot be estimated until the status of the dredging program at Can Gio is determined. This will limit the size of incoming carriers.

Working Capital, V, 2

The rate at which payments flow from the farmer, to retailers, to wholesalers and to the urea supplier should be estimated to determine the time lag in cash receipts by the supplier. On this basis, conclusions can be reached regarding the amount of working capital required.

Inventories, V, 2,1

The speed of physical distribution from the plant to the farmer should be estimated and the size of urea storage capacity at Tay Do estimated to assure effective deliveries during the period of peak use. Figure 3.2-B on page 52 of the basic report shows the TN planting schedule.

Total Annual Expected Maximum Output, VII, 1

The operation of multiple shifts for the CO_2, ammonia, urea, and the bagging plants should be annalyzed to determine the combination of single and multiple shifts needed to raise urea yields to the maximum.

Pricing Policy, VII, 3

Urea sold retail in the fall of 1974 for VN$200/kg. All supplies were imported and it may be possible to reduce selling prices for locally produced urea and, at the same time, assure a reasonable financial return to the plant. On page 169 of the this report, the return on sales was estimated at 37% and the return on fixed asset capital at 16%.

Financing Proposal, IX

On February 18, 1975, the IBRD announced the financing of a urea plant to be located as Ashuganj, 60 kilometers northeast of Dacca. The terms of the loan included a 50 year amortization schedule,a 1% service charge but no interest, on capital repayments, and joint participation in the foreign currency financing by a total of six lending agencies.

The above loan terms relate to the obligations of Bangladesh to the lenders. The loan terms applicable to the operators of the urea plant are less generous. In the financial planning for Vietnam's plant, the loan repayments of the operators should be adjusted in such a way as to assure viable plant operations, but yet achieve a maximum return to the Government of Vietnam from the plant operators.

Implementation, X

The machinery suppliers should be required to provide start-up services for a period of one or two years and to provide training for Vietnamese managers and engineers in similar plants built elsewhere overseas.

Research Team for the Feasibility Study

The feasibility study team could consist of the following:

Executive Manager of an Operating Urea Plant, Project Leader
Process Engineer, CO_2
Process Engineer, Ammonia
Process Engineer, Urea
Manager, Bagging Plant
Financial Analyst, to estimate cash flow requirements.
Agricultural Economist, to (a) determine sales prices for urea in relation to competitive products and historical price trends, (b) to determine prices likely to be acceptable by wholesalers, retailers, and farmers. (c) to estimate seasonal variations in demand resulting from double cropping of TN varieties, and (d)to estimate non-paddy requirements of urea, e.g. sorghum, vegetables, soybeans, (e) To determine desirability of mixing urea with phosphatic materials for a pre-mixed P and N material best suited to paddy cultivation.

9.1.6 **Limestone Crushing Plant**

This plant is described in Section 4.7.2, page 174 of this report. Total investment in fixed assets is about US$2.0 million and capacity is 28 tons per hour or 216,000 tons per 300-day working year.

General Comments

In order to gain farmer acceptance of crushed limestone, data should be collected from Vietnamese sources to determine the effect of limestone applications on acid soils in various sections of the Delta. (We were informed that tests were conducted by USAID and by the Directorate of Agriculture in Cantho and data recorded. During the survey in October-November, 1974, data were requested in Saigon, but there was insufficient time to collect the data from Cantho.)

Products, II, 1

As mentioned earlier in this report, imported crushed limestone has been sold in the Delta for reducing the acidity of paddy field soils. There is also a new plant near Thot Not, An Giang Province, financed in part by USAID that should be on stream during 1975.

The prior experience in imported limestone and the experience gained by the Thot Not plant should be carefully noted to determine the quality and fineness of the crushed limestone that would be most acceptable to the farmers.

Major Input Materials, II, 2

Estimates differ with regard to the limestone reserves near Ha Tien in Chau Doc Province. Some respondents said, "unlimited"; others said 20 million tons; others said, much less. In any case, the requirements of the Ha Tien Cement Plant in the Bien Hoa Industrial Park are substantial and several hundred thousand tons are being consumed yearly.

The Ha Tien reserves plus other reserves in Thua Thien Province and near Cam Ranh Bay should be investigated to make sure that reserves are sufficient for both future cement manufacture and for the proposed Tay Do plant.

Locational Factors

The traditional practice is for tug-drawn barges to transport limestone through the Delta's canal and river network from Ha Tien to Bien Hoa. Because of the Bassac River and the connecting canals, we believe that transport by barge to Tay Do will be feasible, but this should be confirmed.

Market, III

As mentioned, the farmer acceptance of crushed limestone and the preferred fineness should be confirmed and estimates of domestic demand prepared.

Capacity of Proposed Plant, IV

The capacity should be based on the market findings in Section III, "Market" of Appendix G.

Working Capital, V, 2

Willingness of farmers to purchase at prices high enough to assure plant viability should be confirmed.

Suggested Research Team

We suggest the research team include: (a) an agronomist, familiar with the effect of limestone applications on acid soils, to estimate optimum volumes needed for varying pH values, and to then estimate total demand in the Delta region. (b) Processing Engineer familiar with the commercial crushing of limestone, preferably for acid soil applications. (c) If limestone reserves are found to be adequate for future cement and agricultural use, techno-economist should be included to estimate the effect of limestone applications on total productivity and to determine export prospects. (d) A survey team using a pre-tested questionnaire should determine farmer acceptance of limestone and willingness to pay prices high enough to assure plant viablity. This could be organized through the Agriculture Department of the University of Cantho.

9.1.7 Export Frozen Food Products Plant

This plant is described in Section 4.9, page 173, of the basic report. The capital investment in fixed assets is about $415,000 and the proposed output is 1,200 tons of frozen duck, cultured river fish, or frogs legs. As the supply of feed improves, this plant could process chicken and pork, also for export.

General Comment

We believe that the feasibility study for this plant should be approached in a different manner from those for other plants.

There should be a study of foreign markets for duck, especially in Singapore and Hong Kong where imports of poultry and the consumption of duck is high among the local residents of Chinese origin. Similarly, French duck imports should be explored. Importers of duck or wholesalers should then be identified in the market countries.

Samples of the Vietnamese duck species should then be frozen or vacuum-packed and sent to importers or wholesalers in the leading market countries to determine if the species is acceptable to consumers.

The same procedures should be followed with the type of river fish that can be best cultured but only after a local study of culture economics. In connection with fish culture, we invite attention to a Ministry of Agriculture publication, Bulletin of Agricultural Economics, Special Issue, 1974 pages 7 through 19, in Vientnamese with an English abstract (see next page for English summary).

The cited article contains data on culturing costs and technology, cultured species, and some market data. Despite the background information in the cited article, it would probably be desirable to confirm in Vietnam the availability of proper fingerlings, the optimum dimensions of rafts, and the economics of fish culture. This study, if favorable, should be followed by the same overseas market study described above for duck.

The foreign market for frogs legs in general has been confirmed, but the feasibility of frog culture, the economics involved and the feed requirement should be ascertained. We would recommend communicating with Dr. V. R. Pantalou, Fishery Adviser, Mekong Secretariat, Bangkok to determine where frog culture has in fact taken place. An inspection should then be made of existing facilities.

This should be followed by a determination of the feasibility in Vietnam of duplicating successful practices of other countries.

After these studies, a market acceptance study should follow and the shipment of samples overseas as described above for duck.

Major Input Materials II, 2

Aside from the economics of fish culture and frog culture, the procurement of duck in sufficient volumes should be studied as well. The volume of ducks available appears to be substantial in the Delta area. However, with the current feed shortage and shortage of chicken, there is a strong local demand and town market places are typically well stocked with duck. This means that the proposed frozen product plant would be competing with the traditional consumers. There may also be seasonal shortages and surpluses of duck because we believe fattening takes place just after the paddy harvests, twice yearly.

There should be a study of local river fish fingerlings and fish culture as mentioned under "General Comment" above plus a study of the frog culture economics.

Alternative Technologies Available, II, 3

The freezing plants in Rach Gia should be inspected including the refrigerated vans being used to transport snapper, clams, cuttlefish and shrimp to Saigon for containerized shipment abroad.

The plants in Rach Gia use convential ammonia compressors, but freon technology could be considered as well. It is our recommendation that unless space is very limited and maintenance guaranteed, ammonia would be preferable to freon as a refrigerant. The main reason for this is that ammonia compressors are low stress, low RPM, long-lived machines.

Locational Factors, II, 4

Tay Do Industrial Park would appear to be ideally located for fish culture, but there may be problems of riparian rights that would complicate the positioning of rafts or access to the rafts by attendants.

There may be transport problems of ducks from farms to Tay Do and the feasibility of tranporting frogs to Tay Do from culturing ponds would also have to be confirmed.

Capacity of Proposed Plant, IV

The decision on capacity would depend on the outcome of the export market study for duck and river fish and on the feasibility of collecting all three types of raw material as mentioned above.

Conclusion on Frozen Food Plant for Export

All other Sections of the standard feasibility study in Appendix G herewith would depend on the outcome of the foreign market and local supply availability studies mentioned above.

Composition of the Research Team

We think that a techono-economics firm with connections in Singpore, Hong Kong, and France should conduct the overseas market surveys for duck and species acceptability.

A marine products specialist with experience in fresh water fish should study the feasibility of commercial fish culture in the volumes necessary for processing, for example at a level of 600 tons per year or more. The same expert should study frog culture economics with assistance from Dr. Pantalou of the Mekong Delta Secretariat.

The techno-economics firm should study the overseas markets for, and acceptability of, river fish and frogs legs. The river fish study would be confined to nearby Asian countries where the Vietnam species is likely to be acceptable. The frogs leg market study and the acceptability of the Vietnam species should be conducted in the developed countries, e.g. France and the United States.

9.1.8 Seed Center

This facility is described in the basic report in Section 4.8 page 171. The total capital investment in fixed assets is about $31,000. Some parts of the standard outline in the Annex herewith are not applicable to the seed center since it is a service facility and no manufacturing is involved. However VII to XIII are applicable with adaptations.

We think the scope of work for a contractor writing the feasibility study could cover the following points:

a. Determine the distribution channels for seeds in the Delta including exchange between farmers the existing wholesale and retail outlets their sales volumes, inventory, size storage facilities,adequacy of storage facilities and the present effectiveness of seed sorting and identification.

b. Determine the pricing structure for seeds, the purchase price of seeds from farmers, wholesale prices to retailers and the ultimate sale to individual farmers at retail.

c. Estimate the capability of the present distrubution system at current prices to disseminate enough seeds to plant TN paddy sufficient to yield 30,000 ton voumes of paddy for two crops annually (i.e. yearly total of 60,000).

d. If the distribution system is inadequate to assure dissemination of enough and proper seeds, recommend the optimum storage capacity for a seed center at the Tay Do industrial park, taking into account the seasonality of demand (See Figure 3.2-B of page 52 of this report for TN planting season.

e. On the basis of findings above, recommend optimally sized seed center, manning,distribution,sales prices,equipment,capital required, cash flow, profits.

f. From the suppliers of rice milling equipment, identify the TN varieties that lend themselves best to milling and polishing with rubber rollers. (Suppliers in Italy and Japan know the varieties but other suppliers may insist on samples.)

Suggested Composition of Research Team

We propose a team of two persons: (1) a specialist in the marketing of paddy seed from whoesale through retail levels and (2) a techno-economist who would prepare the cost estimates in part (e) above, taking appropriate guidance from sections VII through XIII of Appendix G herewith.

9.1.9 <u>Proposals for Industry Located Off the Tay Do Park</u>

Village level mills to provide rice for local consumption are described in Section 4.3.1, page 144. These mills would be located off the Tay Do Park. The Kiskisan and Engelberg type mills now used in many localities are attaining a head rice yield of some 50 of 55% whereas a modern disk sheller can attain about 62%.

To introduce the improved disk sheller for local milling, literature could be obtained from the following firms. If the mills are suitable, licensing agreements or local assembly agreements could be reached with overseas suppliers of disc shellers.

Import licenses for improved types of mills only such as disc shellers should be approved.

Small scale limestone crushing mills, 350 kg/hour capacity, were described in Section 4.7.2 of this report, page 170 and in Appendix E. These machines can be obtained from almost any industrialized country.

(Text of report ends here; appendixes follow.

APPENDIXES

APPENDIX A

STATEMENT OF WORK

(Excerpt from UNIDO Contract No. 74/21, dated 23 September 1974)

2.00 __RESPONSIBILITIES AND DUTIES OF THE CONTRACTOR__

2.01 __Statement of Work__

The Contractor is required to prepare a master plan based on the results of a series of pre-feasibility studies which he is to carry out to identify potentially viable industries which could be established in Can Tho, and form the basis of a vertically integrated agro-industrial complex. The components of the master plan shall consist of, but not necessarily be limited to, the following:

2.01.1 A general market survey to investigate and analyse the existing and future market demands to ascertain which products should be produced to meet this demand;

2.01.2 A general survey to ascertain the existing and future availability of the raw materials required to produce the products in demand;

(Statement of work continued on following page)

2.01.3 The selection of industries for pre-feasibility study based on the results of the work carried out under 2.01.1 and 2.01.2 above and also the criteria agreed to resulting from consultations between the Contractor and the Industrial Development Authorities in Vietnam. Some of the criteria which can be used are listed in items (a) through (o) below. The following industries shall be examined as potential candidates for the subject of pre-feasibility studies:

rice processing; fruits and vegetables; sugar processing; vegetable oil; animal feedstuffs; dairy products; meat processing; slaughter houses; tannery; livestock-ranch using industrial methods for breeding and fattening high quality animals, fish products and fishmeal; peanut processing; Italian poplar for pulp wood, manufacture of agricultural implements and equipment; forest products (low cost wooden houses etc.); gunny bag manufacturing; fertiliser plants; low lift fractional pumps and engines; soap.

(a) Relative importance to the success of the complex
(b) Employment generation
(c) Value added
(d) Labour intensity (i.e. jobs per unit of investment)
(e) Compatibility with the Four-Year Development Plan of Vietnam (1972 - 1975)
(f) Local aivailability of raw materials
(g) Availability of qualified labor
(h) Current availability of infrastructure adequate to support the proposed industry
(i) Availability of supporting industry
(j) Proximity to national markets
(k) Proximity of potential export markets
(l) Probable availability of financing (this means that industries requiring very substantial capital investment would be given a lower rating than those requiring a smaller investment)
(m) Import substitution potential
(n) Pollution characteristics and effect on ecology
(o) Potential profitability to investors.

2.01.4 Preparation of pre-feasibility studies for the establishment of optimum-size food processing industries to produce the semi-processed and/or final products in demand, and based upon existing raw materials or those which could be cultivated in the future or imported.

2.01.5 Each pre-feasibility study shall contain a description of the industry studied, the reasons why it is potentially viable, the size of the markets for its products, its production capacity, number of persons to be employed, fixed and working capital required, and its potential profitability. In cases where a pre-feasibility study indicates that an industry is not viable the reasons shall be given.

2.01.6 The industries selected for further study should be assigned a priority rating according to the Government's Four-Year Development Plan 1972-1975 and their importance as a component of the vertically integrated agro-industrial complex, and their interrelationship should be stated;

2.01.7 The master plan report and the pre-feasibility studies shall contain all of the data which has been used as the basis for preparing them;

2.01.8 A report on the existing agro-industries located in the Can Tho area, and indicate whether they could be technically and economically integrated into the complex in their present form, or by reorganisation. If these industries cannot be integrated into the complex the reasons will be given;

2.01.9 A review of government policies, legislation, taxation and infrastructure to determine any constraints which affect operating agro-industries or prevent them from operating in the most efficient and profitable way; and recommend actions on any changes needed to attract private investors, both local and foreign, to establish agro-industries in the Can Tho region; and advise as to the system of incentives and controls necessary to ensure an early agro-industrialisation of the Can Tho area, in view of the considerable influence of the Saigon - Gia Dinh-Bien Hoa metropolitan area on private investment activities.

2.01.10 The elaboration of a "strategy" for the rational development of a vertically integrated agro-industrial complex;

2.01.11 The industrial estate in Can Tho shall be examined to determine whether it would be a suitable site for the agro-industrial complex;

2.01.12 Based on the findings and conclusions resulting from the pre-feasibility studies the Contractor shall write detailed Terms of Reference for carrying out subsequent work including, inter alia, a series of exhaustive technical and economic feasibility studies for the establishment of the industries identified by the Contractor as being potentially viable.

2.01.13 The Contractor's draft and final reports must include an "Executive Summary" containing a short summary of the conclusions of the study to facilitate the work of those responsible for deciding whether or not it is technically, economically and financially feasible to establish the agro-industrial complex.

2.01.14 The text of the final report would be organised into chapters conforming with the foregoing outline, items 2.01.1 through 2.01.13. Supporting appendices would contain the basic data on which recommendations would be based.

2.01.15 The components of the master plan listed above are not necessarily exhaustive and the Contractor is required automatically to carry out any additional work which he finds essential for the preparation of the plan.

2.01.16 The Contractor is required to cross-reference the work performed with the work specified above in items 2.01.1 through 2.01.13. This cross-referencing shall be presented in a separate supplement to the draft and final reports.

2.02 Contractor Services

For the performance of his obligations under this Contract, the Contractor shall make available a total of 148 man-days of service, as follows:

a) Project Area Services

77 man-days of service shall be carried out in the Project Area by a team comprising the Team Leader and other personnel as named in paragraph 2.03 hereinafter. Time spent in briefing and de-briefing of Contractor's personnel in UNIDO, Vienna (see paragraph 2.04 hereinafter) and travel time to and from the Project Area or UNIDO, Vienna, are not included in the number of man-days stated above. A man-day of service in the Project Area is defined as an eight hour work-day.

b) Home Office Services

71 man-days of service shall be carried out at the Contractor's Home Office by personnel as named in paragraph 2.03 hereinafter. For purposes of this Contract, a man-day of service in the Home Office is

APPENDIX B

EXPORT MARKET APPENDIX

COMPARISON OF (A) VIETNAMESE EXPORTS OF PRODUCTS NOW PRODUCED OR POTENTIALLY PRODUCED IN THE DELTA AND (B) IMPORTS OF MAJOR FIFTEEN CONSUMING COUNTRIES

Explanatory Comments

1. The purpose of the graphs and data which follow is to show the potential outer limit of Delta export markets in countries which are Vietnam's largest trading partners. There are, of course, other countries where markets can also be developed in due course, especially markets for the Delta's surplus rice. (In 1972, the 15 countries reported herein imported 1,206,999 metric tons of rice valued at $191 million or $158 per metric ton.)

2. The following Vietnamese export data, on the right-hand side of each figure, are for calendar year 1973 and are taken from the IBM Print-out of the Directorate of Customs, Saigon.

Import data on the left-hand side of each figure show the total imports of the 15 countries which have been the largest consumers of Vietnamese products in recent years. The import data are from U.N. sources where possible, and in three cases (Australia, Indonesia and Taiwan) are from the official import statistics of the countries concerned for 1972.

The 15 countries are: (1) Australia (2) Belgium (3) Canada (4) France (5) Germany, West (6) Hong Kong (7) Indonesia (8) Italy (9) Japan (10) Netherlands (11) New Zealand (12) Singapore (13) Taiwan (14) United Kingdom, and (15) United States.

It was not possible to find data for both (a) the 15 country imports and (b) Vietnam exports for 1973. Vietnamese data for 1972 were, of course, available, but Vietnam's exports in 1973 were used because they are considered as being more representative of the near future export pattern. Also the breakdown of 1972 exports from Vietnam was too broad.

3. The 1973 Vietnamese exports and the imports of the 15 counties are expressed in thousands of U.S. dollars.

4. In three cases (Australia, Indonesia, and Taiwan) where U.N. import data were not completely available, the value of imports was converted to U.S. dollars at the average exchange rate prevailing in 1972 as used by the U.S. Department of Commerce for trade reporting.

5. Abbreviations used in the following figures are: BTN=Brussels Tariff Nomenclature; SITC=Standard International Trade Classification; "neg."= negligible, that is, the figure was less than one thousand U.S. dollars.

MEKONG DELTA PRODUCTS THAT HAVE HIGH POTENTIAL FOR PRODUCTION AND WHICH ARE IMPORTED IN SUBSTANTIAL VOLUMES BY VIETNAM'S MAJOR FIFTEEN TRADING PARTNERS

(Unit: Thousands of US$)

(A) Rank in terms of market size in column D	(B) Product Potentially Produced in Mekong Delta (BTN No.)	(C) Amount Exported from Vietnam in 1973	(D) Amount Imported by 15 Major Trading Partners in 1972
1st	Animal Feed (230700)	0	$1,962,678
2nd	Shrimp, lobster, frozen (030300)	$12,801	966,424
3rd	Vegetable oils (includes rice bran oil) (150720)	0	754,919
4th	Dressed poultry (020200)	7	295,296
5th	Soap (340120 and 340190)	4	280,425
6th	Salted, dried fish (030200)	152	200,034
7th	Rice, glazed or polished (100630)	0	191,189 (*)
8th	Vegetable for animal feed (includes bran) (120890)	7	110,331
9th	Other frozen animals including frogs legs (020400)	40	70,117
10th	Live poultry (010500)	4	57,024
11th	Cereal flour, except wheat flour (including rice flour) (110100)	0	4,090

(*) Much larger markets exist if more than 15 countries are included, e.g. OPEC, India, Pakistan etc.

6. The Delta is ideally suited for the production of some of the products listed in the attachment but less well suited for others. Some products could be grown in the Delta but only at the sacrifice of more valuable crops. A few of the products would not be as suitable for cultivation in the Delta as in other regions of Vietnam. For the sake of completeness, we have included all types of products, ranging from those with a high to a low potential for cultivation or production in the Delta.

As a rough indicator of the Delta region's capability to produce or cultivate the products, we have graded each product by a letter symbol, A, B or C. A means, high potential; B means, moderate potential, C means low potential. These ratings are based on the findings of the survey made prior to this report. (*)

7. Conclusions from this Appendix

Only a fraction of the import requirements of Vietnam's most important trading partners are being met from the Mekong Delta at present. However, in the case of a few products, the Delta's contribution is more substantial. For example, in the case of feathers, chiefly duck feathers, Vietnam is supplying 2.9% of the requirements of the 15 trading partners. Of these feathers about 83% originated in the Delta (see Bulletin of Agricultural Economics, Special Issue, 1974, page 53, showing duck production; we used this as the basis for estimating the 83% figure). The export of feathers by Vietnam in 1973 was valued at US$1.3 million whereas the imports of the 15 countries were valued at $45.5 million ($1.3/$45.4=2.9%, cited above in this paragraph).

In the case of frozen shrimp and lobster, Vietnam's exports of $12.8 million in 1973 amounted to about 1.3% of the imports of the 15 major trading partners. The Delta contributed about 95% of the exports (judging by the Bulletin of Agricultural Economics cited above).

Probably the most important conclusion from this appendix is that there are several products which the Delta could supply in larger volumes than at present, given better organization of production, and, in the case of rice, changes in policy to encourage exports. Some of these are listed below together with the recent year import volumes of the 15 major trading partners.

(Table follows, next page)

(*) The cited source is listed in the Bibliography as item 19.

IMPORTS BY FIFTEEN COUNTRIES OF PRODUCTS CURRENTLY OR POTENTIALLY PRODUCED IN THE MEKONG DELTA OF VIETNAM -- 1972

(See Explanatory Notes on Page)

(Unit: Quantity=Metric ton, Value=US$1,000)

BTN Code Number	Description	SITC Code Number	(1) Australia		(2) Belgium		(3) Canada		(4) France	
			Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
010500	Live poultry (including duck)	001.4	-	-	7,071	4,834	10,180,000(N)	4,221	1,274	3,392
020200	Poultry meat (including duck)	011.4	1	2	6,899	7,417	5,150	3,927	5,280	4,543
020400	Other frozen animals (incl. frog legs)	011.890	10	23	4,741	6,461	10	30	15,555	18,245
030100	Fresh fish	031.1	n.a.	19,751	48,121	38,178	16,121	16,705	129,776	114,027
030200	Salted, dried fish	031.2	"	3,701	9,739	5,420	1,332	1,610	20,563	14,586
030300	Shrimp, lobster, frozen	031.3	"	3,377	28,070	15,724	10,684	31,911	91,199	79,028
040600	Natural honey	061.6	53	47	2,543	1,548	592	519	4,451	2,548
050700	Feather	291.961	-	483	568	520	44	274	2,807	5,461
070400	Dehydrated vegetables	054.8	n.a.	180	430,107	40,360	n.a.	4,289	154,081	15,490
070500	Dried leguminous vegetables	054.2	"	3,075	58,603	10,109	11,243	3,990	123,057	31,781
070600	Fresh manioc, sweet potato	054.1	-	-	219,564	13,457	106,553	8,458	172,392	20,325
080100	Oranges, tangerines and mandarines	051.1	-	-	196,472	34,053	208,782	39,631	814,127	141,480
	Banana, fresh	051.3	-	-	94,088	14,115	207,284	35,819	506,526	109,326
	Nuts edible, fresh or dry (incl. coconuts)	051.7	n.a.	10,545	10,571	12,090	29,831	31,321	43,999	53,991
	Fresh fruits, n.e.s. (incl. pineapples mangoes, avocados, etc.)	051.9	"	298	78,722	25,010	170,938	42,068	164,051	55,236
090200	Tea	074.1	"	22,573	1,412	2,349	23,837	24,625	4,130	8,898
090600	Cinamon and other spices	075.2	"	1,180	1,130	1,666	2,549	3,526	5,653	8,083
100500	Maize	044	605	268	1,489,080	150,280	429,671	27,152	250,843	20,942
100630	Rice, glazed or polished	042.2	n.a.	93	35,119	5,928	29,937	6,413	100,545	26,571
110100	Cereal flour, except flour of wheat or of meslin (incl. rice flour)	047.01	30	13	8,647	1,071	19	8	2,403	420
110110	Flour of wheat or of meslin	046.01	4	2	14,359	2,500	n.a.	n.a.	515	91
110600	Vegetables etc. preserved or prepared (incl. manioc)	055	n.a.	7,525	79,709	35,196	79,737	36,582	104,524	50,525

(Note: N:Number, V:Volume in cubic meter, L:Litre, A:Area in 1,000 sq. meter)

IMPORTS BY FIFTEEN COUNTRIES OF PRODUCTS CURRENTLY OR POTENTIALLY PRODUCED
IN THE MEKONG DELTA OF VIETNAM — 1972
(See Explanatory Notes on Page)
(Continued)

(Unit: Quantity=Metric ton, Value=US$1,000)

BTN Code Number	SITC Code Number	(5) Germany		(6) Hong Kong		(7) Indonesia		(8) Italy		(9) Japan		(10) Netherlands	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
010500	001.4	5,904	2,955	28,209	16,882	n.a.	n.a.	15,973	12,068	2,203,000(H)	5,627	3,497	1,908
020200	011.4	278,708	224,470	30,314	16,561	"	"	4,591	4,633	29,278	22,402	2,343	2,185
020400	011.890	21,085	24,219	252	256	"	"	12,030	12,570	3,596	3,213	4,416	4,097
030100	031.1	208,375	106,904	n.a.	34,152	"	"	124,643	104,592	134,151	111,893	49,791	28,910
030200	031.2	29,855	20,445	7,903	12,819	2,648	266	42,185	46,106	14,348	61,189	16,146	2,925
030300	031.3	5,060	8,987	17,890	27,606	n.a.	n.a.	28,822	18,865	88,486	292,688	7,794	9,089
040600	061.6	44,794	24,277	817	431	"	"	1,922	1,203	23,604	14,088	3,197	1,890
050700	291.961	10,622	29,379	18	87	"	"	516	506	551	2,184	14,786	981
070400	054.8	504,691	53,887	13,369	901	"	"	74,740	8,746	n.a.	15,024	743,198	51,795
070500	054.2	110,563	21,942	22,113	3,924	"	"	205,546	36,520	182,507	40,145	261,645	31,193
070600	054.1	1,026,000	77,173	24,760	1,519	"	"	414,543	35,645	3,000	2	77,760	4,630
080100	051.1	896,571	157,385	118,319	32,085	"	"	n.a.	n.a.	13,479	4,573	345,566	58,331
	051.3	669,002	108,052	20,839	2,047	"	"	351,750	56,435	1,063,000	147,669	117,035	15,969
	051.7	112,228	137,751	15,851	8,030	"	"	13,146	15,928	27,638	30,374	20,582	20,104
	051.9	662,761	213,836	96,871	19,302	"	"	38,695	12,492	72,566	10,984	65,957	20,299
090200	074.1	10,007	15,472	7,623	7,569	"	"	24,620	4,164	18,921	26,473	34,878	25,229
090600	075.2	10,465	11,636	2,452	1,436	32,330	32,188	2,610	2,129	33,521	12,147	4,000	3,770
100500	044	3,280,000	269,564	134,326	9,116	23,908	2,230	4,842,000	316,587	6,052,000	378,769	2,483,000	216,212
100630	042.2	72,673	16,639	455,876	65,272	6,083	600	17,554	1,831	3,197	373	36,313	5,917
110100	047.01	4,744	644	4	1	n.a.	n.a.	65	40	-	-	489	56
110110	046.01	38,234	5,942	26,973	2,444	"	"	550	84	222,000	41	13,874	2,139
110600	055	627,963	273,947	57,081	26,342	"	"	47,706	26,783	66,760	33,242	78,149	29,777

IMPORTS BY FIFTEEN COUNTRIES OF PRODUCTS CURRENTLY OR POTENTIALLY PRODUCED
IN THE MEKONG DELTA OF VIETNAM -- 1972
(See Explanatory Notes on Page)
(Continued)

(Unit: Quantity=Metric ton, Value=US$1,000)

BTN Code Number	SITC Code Number	(11) New Zealand		(12) Singapore		(13) Taiwan		(14) U.K.		(15) U.S.		Total	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quanity	Value
010500	001.4	151,593(N)	127	5,430(N)	2,147	0	81	1,533,000(N)	1,072	n.a.	1,710	97,103	57,024
020200	011.4	n.a.	n.a.	3,198	2,123	0	1	9,333	7,032	"	n.a.	375,095	295,296
020400	011.890	-	-	-	-	0	3	-	-	991	1,000	48,606	70,117
030100	031.1	35	100	n.a.	7,401	-	96	n.a.	82,138	704,201	553,970	1,415,214	1,218,817
030200	031.2	n.a.	n.a.	5,952	2,210	0	10	3,216	1,643	30,525	27,104	184,412	200,034
030300	031.3	"	"	18,090	10,335	-	7	9,736	26,428	n.a.	442,379	305,831	966,424
040600	061.6	"	"	336	327	0	0	16,462	9,629	17,672	8,900	116,443	65,327
050700	291.961	"	"	-	-	0	-	1,989	694	2,284	4,869	34,185	45,438
070400	054.8	"	598	10,994	777	175	519	27,213	7,192	n.a.	16,048	1,958,568	215,806
070500	054.2	1,429	510	22,048	4,269	25	3,182	154,702	43,094	18,933	4,979	1,172,414	238,713
070600	054.1	n.a.	n.a.	28,184	2,648	0	-	280,607	43,613	34,294	2,020	2,387,657	209,490
080100	051.1	18,863	4,131	41,854	10,524	0	-	446,882	98,280	49,798	6,988	3,150,713	587,381
	051.3	26,926	5,207	20,481	840	n.a.	n.a.	310,881	58,024	1,940,000	191,350	5,327,812	744,853
	051.7	2,520	1,780	45,645	2,343	-	163	67,528	54,728	n.a.	115,088	389,539	494,236
	051.9	1,049	365	78,702	8,055	-	-	199,444	72,696	"	31,098	1,629,756	511,739
090200	074.1	8,117	8,623	3,427	2,581	-	-	212,246	205,708	68,717	62,827	395,935	417,091
090600	075.2	n.a.	381	24,996	25,824	n.a.	n.a.	7,066	4,928	26,813	32,914	153,585	141,808
100500	044	"	n.a.	13,730	842	554	39	3,145,000	209,594	31,151	4,360	22,175,788	1,605,875
100630	042.2	5,455	1,150	358,101	44,676	0	-	71,989	13,915	14,157	1,811	1,206,999	191,189
110100	047.01	n.a.	n.a.	-	-	n.a.	-	1,462	26	14,157	1,811	32,030	4,090
110110	046.01	"	"	-	-	1	-	64,412	1,138	-	-	380,922	14,381
110600	055	"	558	43,504	13,607	n.a.	n.a.	265,955	82,260	n.a.	169,096	1,451,088	785,440

IMPORTS BY FIFTEEN COUNTRIES OF PRODUCTS CURRENTLY OR POTENTIALLY PRODUCED
IN THE [illegible] DELTA OF VIETNAM — 1972
(Continued)

(Unit: Quantity=Metric ton, Value=US$1,000)

BTN Code Number	Description	SITC Code Number	(1) Australia		(2) Belgium		(3) Canada		(4) France	
			Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
120110	Peanuts	221.1	n.a.	451	3,150	1,145	53,978	14,836	148,685	39,230
120120	Coconut, milk	221.3	3	5	n.a.	n.a.	n.a.	n.a.	20,707	2,510
120130	Soybeans	221.4	7	5	336,928	44,485	308,482	39,498	458,447	58,998
120700	Medical herbs	292.4	n.a.	349	2,472	1,429	n.a.	884	13,046	8,779
120890	Vegetable for animal feed	081.1	-	19	183,052	9,150	81,346	3,359	6,288	452
140200	Kapoc	292.941	-	-	-	-	60	33	2	2
150720	Vegetable oil (Soybean oil)	421.2	3,597	980	16,120	4,321	17,012	4,755	39,562	13,086
	(Cotton seed oil)	421.3	268	101	102	21	10,191	2,897	8	3
	(Sunflower seed oil)	421.6	246	88	41,586	14,434	1,926	623	62,478	23,529
	(Rape, colza, mustard oil)	421.7	411	125	5,770	1,464	n.a.	n.a.	6,169	1,854
	(Linseed oil)	422.1	1,863	426	2,832	579	"	"	11,907	2,558
	(Palm oil)	422.2	7,168,448(L)	1,400	22,732	5,291	30,861	5,776	41,532	10,466
	(Coconut (Copra) oil)	422.3	9,782,638(L)	2,376	22,317	5,510	32,295	6,374	37,978	9,745
	(Palm kernel oil)	422.4	493,352(L)	108	4,883	1,425	5,749	1,270	28,870	6,980
	(Castor oil)	422.5	1,808	1,158	4,215	1,873	2,171	1,046	39,086	15,413
151200	Animal fats and oils	431	n.a.	2,460	61,968	17,060	24,798	9,282	125,661	36,750
200120	Vegetable preserved or prepared (including canned vegetable)	055	"	7,525	79,709	35,196	79,737	36,582	104,524	50,525
200200	Fruit preserved or prepared (including canned fruits)	053	"	4,452	93,342	39,798	n.a.	88,412	284,893	89,989
200500	Fruit or vegetable juice (including canned juice)	053.5	"	765	28,519	11,423	"	44,086	146,203	29,380
200600	Fruits and nuts, n.e.s. preserved	053.9	"	1,568	50,168	20,272	88,324	33,259	103,541	44,405
230700	Animal feed	081	"	7,230	2,038,000	191,270	359,106	43,535	2,038,000	246,716
330100	Essential oils	551.1	"	3,288	187	1,337	1,011	8,109	5,674	47,330
340120	Soap	554.1	"	1,164	9,428	6,518	4,207	3,494	7,119	4,580
340190	Other soap	554.2	"	5,064	72,279	28,817	n.a.	23,082	95,785	42,948
442700	Improved, reconstituted wood	631.4	"	687	51,518	8,383	9,525(A)	6,597	120,688	17,551
570400	Jute	264	12,269	1,656	85,994	25,450	2,447	734	51,671	16,060

IMPORTS BY FIFTEEN COUNTRIES OF PRODUCTS CURRENTLY OR POTENTIALLY PRODUCED
IN THE MEKONG DELTA OF VIETNAM -- 1972
(Continued)

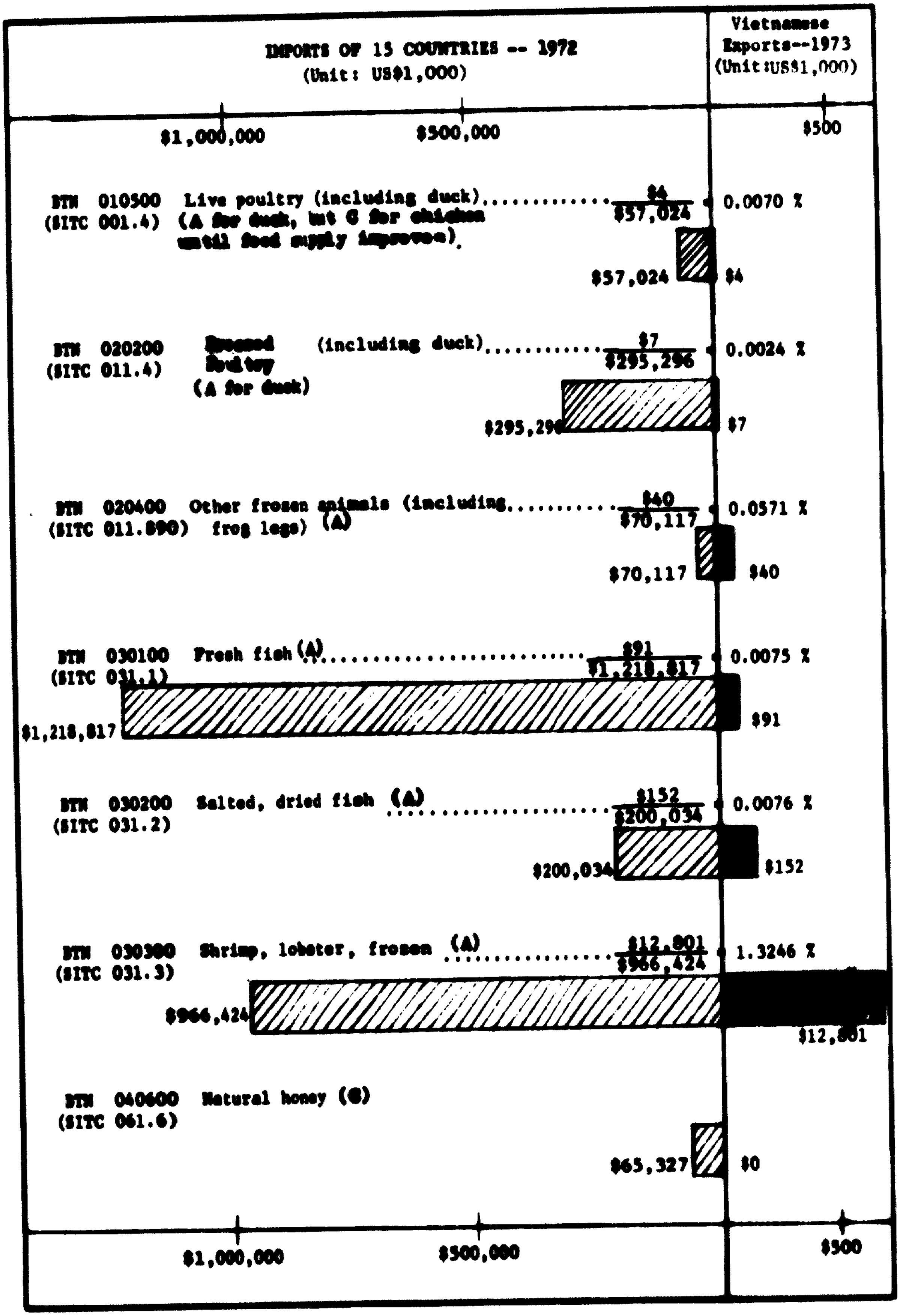
(Unit: Quantity=Metric ton, Value=US$1,000)

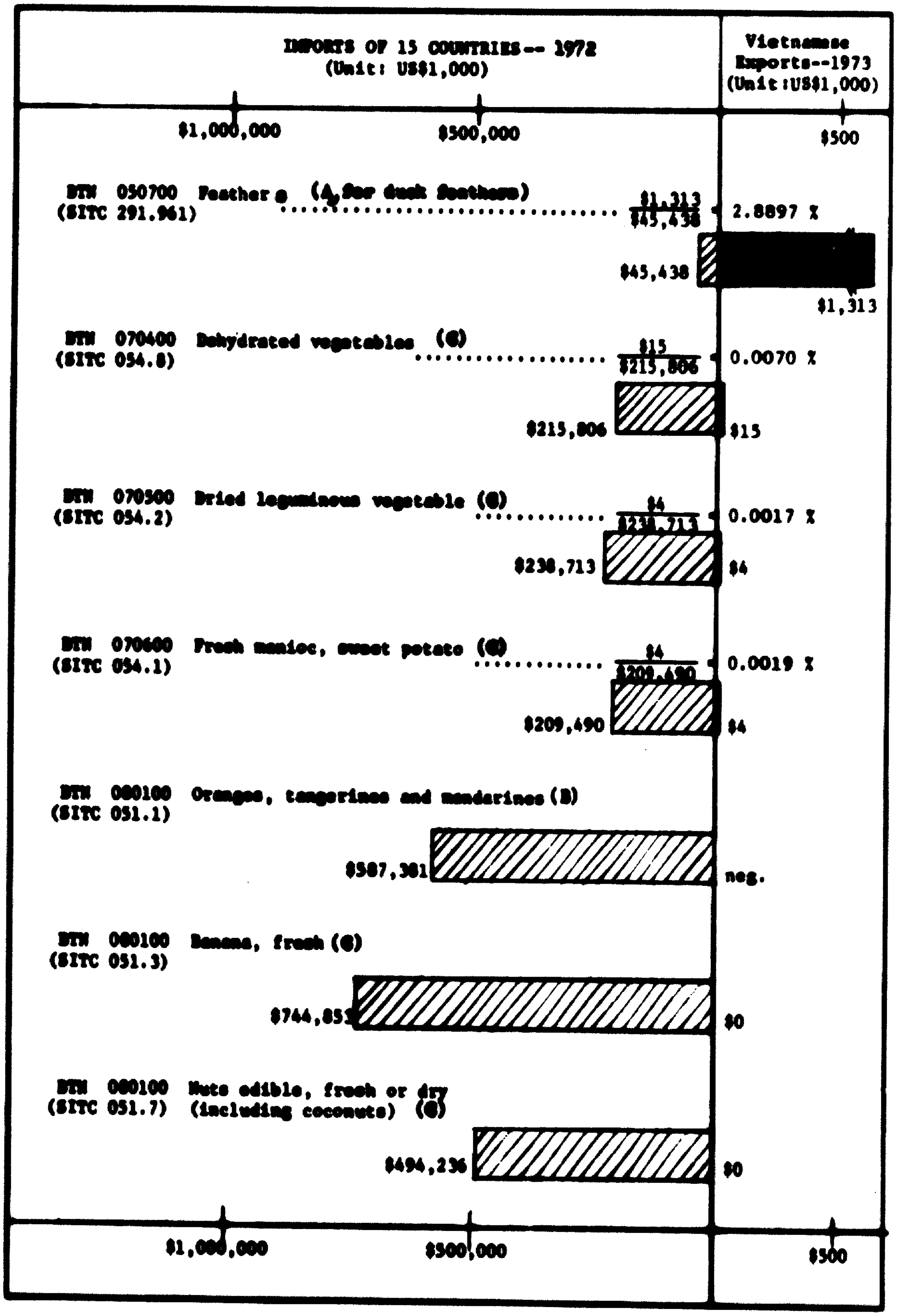
BTN Code Number	SITC Code Number	(5) Germany		(6) Hong Kong		(7) Indonesia		(8) Italy		(9) Japan		(10) Netherlands	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
120110	221.1	55,836	18,769	10,873	3,775	n.a.	n.a.	111,956	30,131	62,325	24,304	50,230	17,109
120120	221.3	24,719	2,734	n.a.	n.a.	"	"	595	60	21,682	2,083	233,418	28,339
120130	221.4	2,237,000	284,415	18,543	2,740	"	"	818,642	106,612	3,396,000	474,175	1,631,000	213,807
120700	292.4	22,793	18,973	17,446	42,056	875	181	7,340	5,013	12,938	10,218	5,117	3,315
120090	081.1	321,485	21,638	6,874	451	n.a.	n.a.	81,828	5,116	521,994	34,648	529,663	26,027
140200	292.941	1,219	64	3	7	"	"	605	37	5,779	301,280	74	13
150720	421.2	26,719	7,885	4,103	1,332	"	"	12,297	3,852	19	274	14,155	3,900
	421.3	26,274	8,786	n.a.	n.a.	"	"	12	12	13,648	4,685	734	243
	421.6	146,262	49,065	"	"	"	"	2,354	855	n.a.	n.a.	45,931	14,617
	421.7	12,907	3,431	29,099	9,266	"	"	56,840	16,045	3,265	822	10,345	2,455
	422.1	37,324	7,213	320	118	262	102	12,508	2,555	4,751	950	34,366	7,138
	422.2	151,375	34,333	n.a.	n.a.	n.a.	n.a.	51,973	12,552	54,865	11,202	165,373	34,618
	422.3	44,534	9,296	861	263	"	"	21,265	5,867	10,741	2,045	76,186	17,866
	422.4	22,021	5,637	n.a.	n.a.	"	"	15,765	4,419	n.a.	n.a.	1,909	495
	422.5	10,299	4,514	"	"	"	"	5,481	2,358	2,855	1,289	8,054	3,222
151200	431	123,739	28,582	264	153	1,284	404	35,484	15,215	10,757	5,590	61,850	16,784
200100	055	627,963	275,947	57,081	26,342	n.a.	n.a.	47,706	26,783	66,760	33,242	78,149	29,777
200200	053	802,606	287,378	22,545	10,515	"	"	50,798	16,366	n.a.	44,716	150,132	61,233
200500	053.5	283,365	105,922	4,669	2,707	622	148	16,525	5,121	9,969(V)	6,257	51,219	26,509
200600	053.9	417,437	140,700	16,894	7,276	1,246	217	27,701	8,304	70,600	27,375	62,771	22,161
230700	081	4,396,000	461,289	132,297	14,363	n.a.	n.a.	1,160,000	190,541	1,407,000	121,757	4,243,000	337,420
330100	551.1	3,164	19,847	270	1,257	463	728	1,287	5,774	3,383	25,456	1,391	8,310
340120	554.1	4,543	4,972	5,966	3,493	3,046	959	4,135	3,242	3,226	4,133	5,788	5,567
340190	554.2	51,995	25,122	15,257	5,663	456	146	57,992	30,231	11,487	9,405	69,745	32,281
442700	631.4	287,997	33,827	n.a.	n.a.	n.a.	n.a.	23,097	3,752	2,944(V)	352	262,435	32,898
570400	264	53,140	14,906	5,450	1,199	"	"	13,699	4,383	61,091	15,996	13,756	3,608

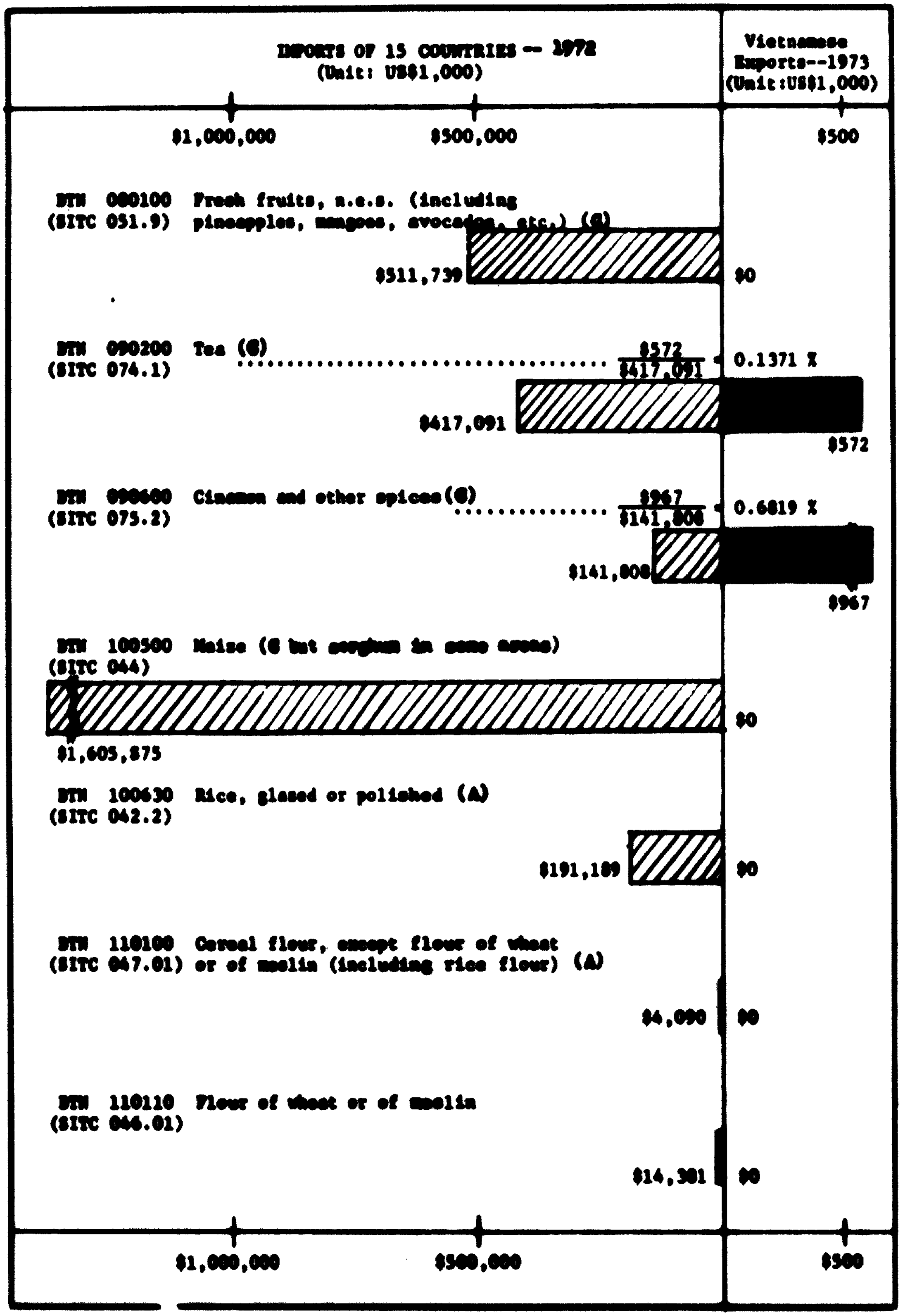
IMPORTS BY FIFTEEN COUNTRIES OF PRODUCTS CURRENTLY OR POTENTIALLY PRODUCED IN THE MEKONG DELTA OF VIETNAM -- 1972
(Continued)

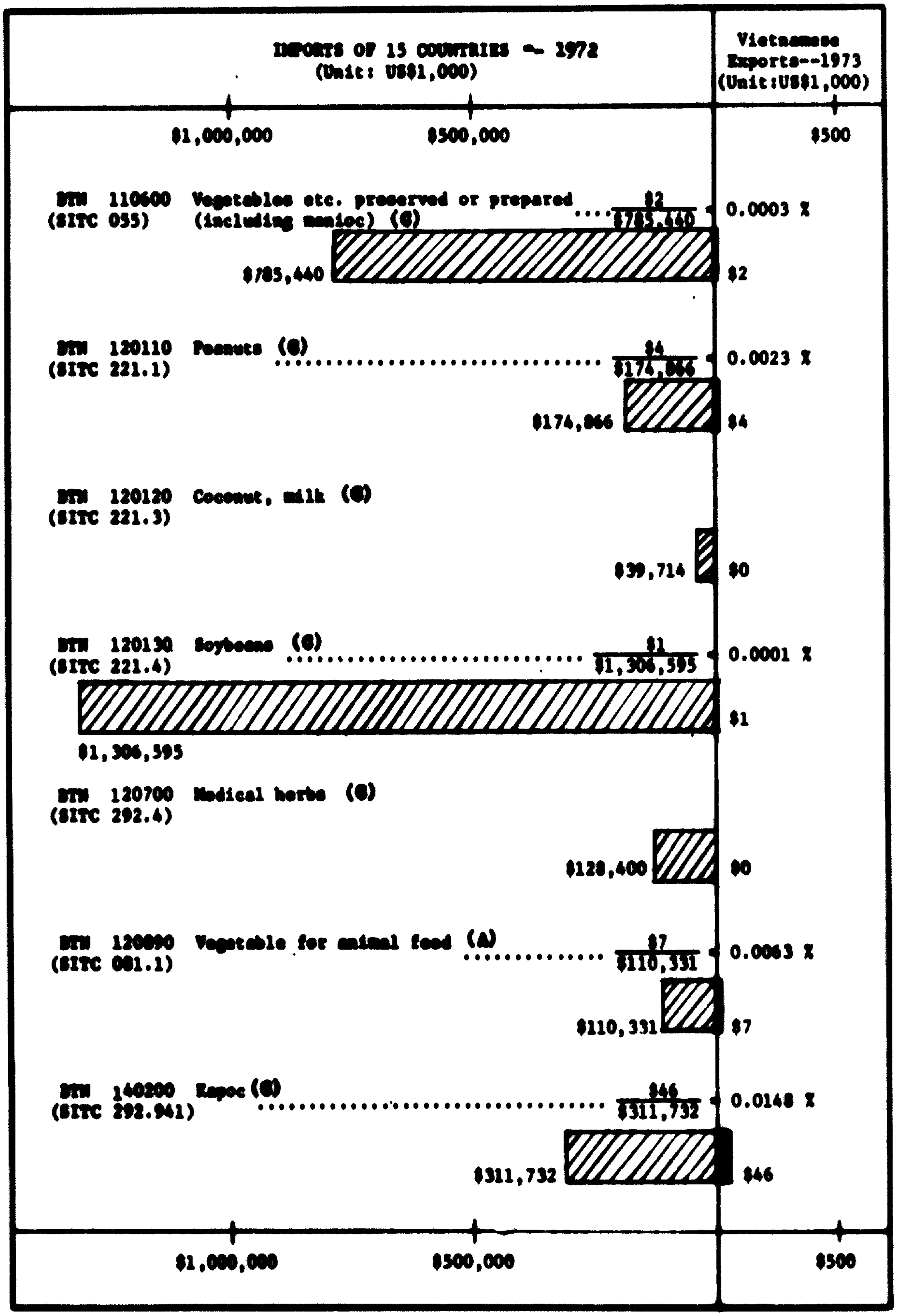
(Unit: Quantity=Metric ton, Value=US$1,000)

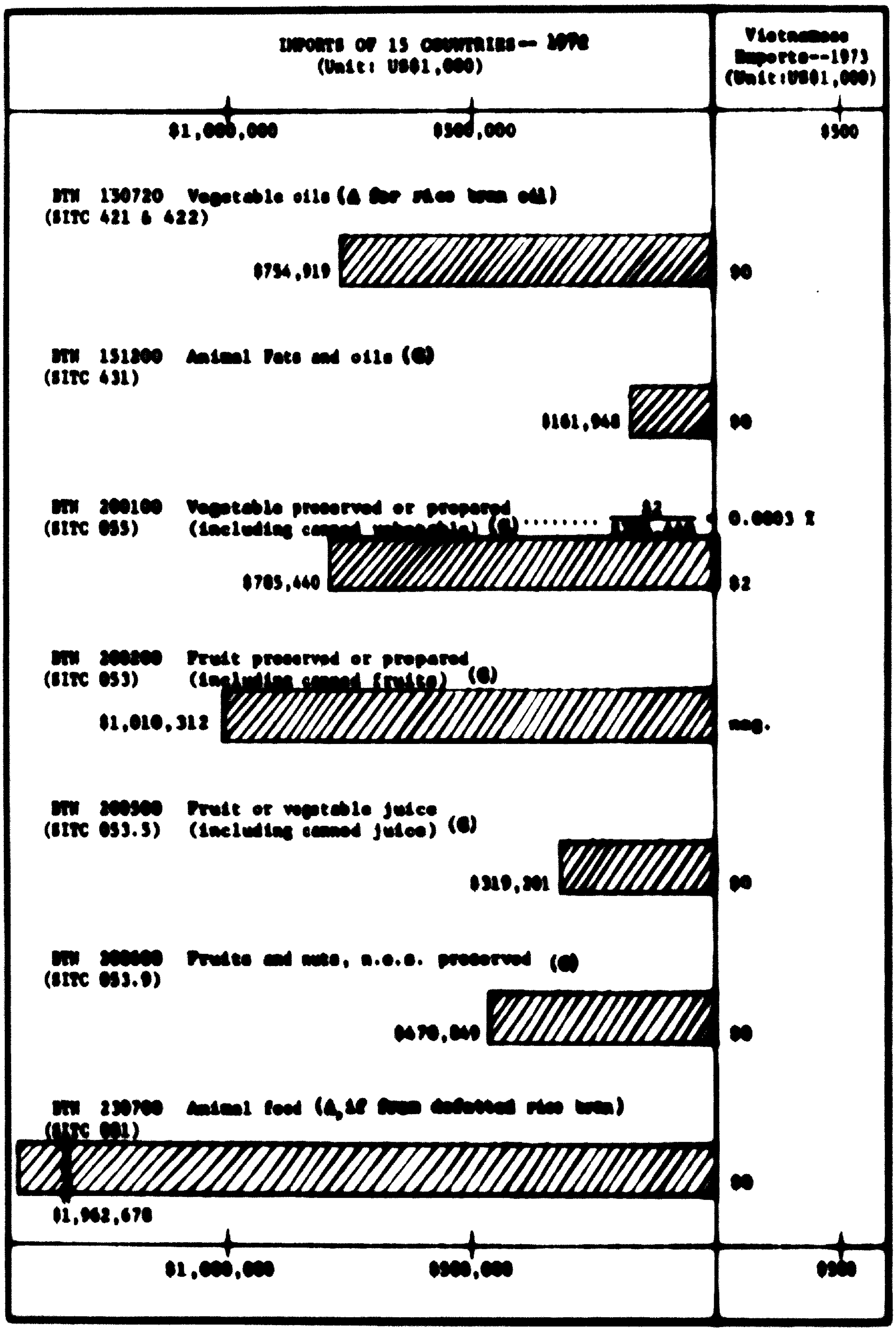
BTN Code Number	SITC Code Number	(11) New Zealand		(12) Singapore		(13) Taiwan		(14) U.K.		(15) U.S.		Total	
		Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
120110	221.1	5,098	1,958	4,597	1,481	-	-	64,879	21,094	1,288	583	572,895	174,866
120120	221.3	n.a.	n.a.	7,759	613	-	-	28,148	3,370	n.a.	n.a.	337,031	39,714
120130	221.4	"	"	63,865	9,419	523	69	538,538	72,372	"	"	9,807,975	1,306,595
120700	292.4	"	"	n.a.	9,606	5	5	3,580	3,196	"	24,398	85,612	128,400
120090	081.1	"	"	25,715	1,878	-	-	26,493	1,381	62,383	6,212	1,847,121	110,331
140200	292.941	"	"	81	1	-	-	-	10,295	n.a.	n.a.	7,823	311,732
150720	421.2	2,792(V)	1,152	266	144	1	-	62,680	17,401	"	"	199,323	59,082
	421.3	723(V)	286	n.a.	n.a.	-	-	30,037	19,286	"	"	81,997	27,320
	421.6	299(V)	164	"	"	-	-	28,789	9,759	"	"	329,871	113,134
	421.7	474(V)	180	"	"	-	-	8,720	2,167	4,713	1,399	138,713	39,208
	422.1	n.a.	n.a.	"	"	1,869(L)	-	33,418	7,089	n.a.	n.a.	139,553	28,728
	422.2	"	"	"	42,776	2	-	207,998	45,908	195,548	38,739	929,427	243,061
	422.3	"	"	16,173	3,051	2	-	50,304	12,636	341,463	66,412	663,902	141,441
	422.4	"	"	2,244	508	-	-	58,663	14,795	45,822	12,080	186,499	47,717
	422.5	"	"	218	110	-	-	19,201	7,441	41,173	16,804	134,561	55,228
151200	431	"	367	n.a.	1,189	n.a.	n.a.	75,950	19,728	8,579	8,384	530,334	161,948
200100	055	"	558	43,504	13,607	"	"	265,955	82,260	n.a.	169,096	1,451,088	785,440
200200	053	"	3,316	78,790	23,996	"	"	588,144	212,780	"	127,361	2,071,250	1,010,312
200500	053.5	538(V)	258	5,320	2,527	-	-	155,962	45,808	344,734(V)	38,290	1,047,636	319,201
200600	053.9	7,924	2,866	65,931	18,195	-	-	376,496	143,604	922	647	1,289,955	470,849
230700	081	n.a.	365	557,687	39,800	24	12	1,589,000	210,756	n.a.	97,624	17,920,114	1,962,678
230100	551.1	71	575	280(V)	1,136	1	1	n.a.	31,198	7,030	48,969	24,212	203,315
340120	554.1	n.a.	n.a.	4,109	3,730	-	-	482	864	1,791	3,260	53,840	45,976
340190	554.2	4,640	2,926	6,801	3,974	-	-	20,881	15,486	22,795	9,304	430,113	234,449
442700	631.4	n.a.	n.a.	54(V)	118	-	-	563,287	77,383	15,967	2,496	1,378,296	184,044
570400	264	3,057	658	1,774	619	-	-	95,741	35,724	13,421	3,645	413,510	124,638

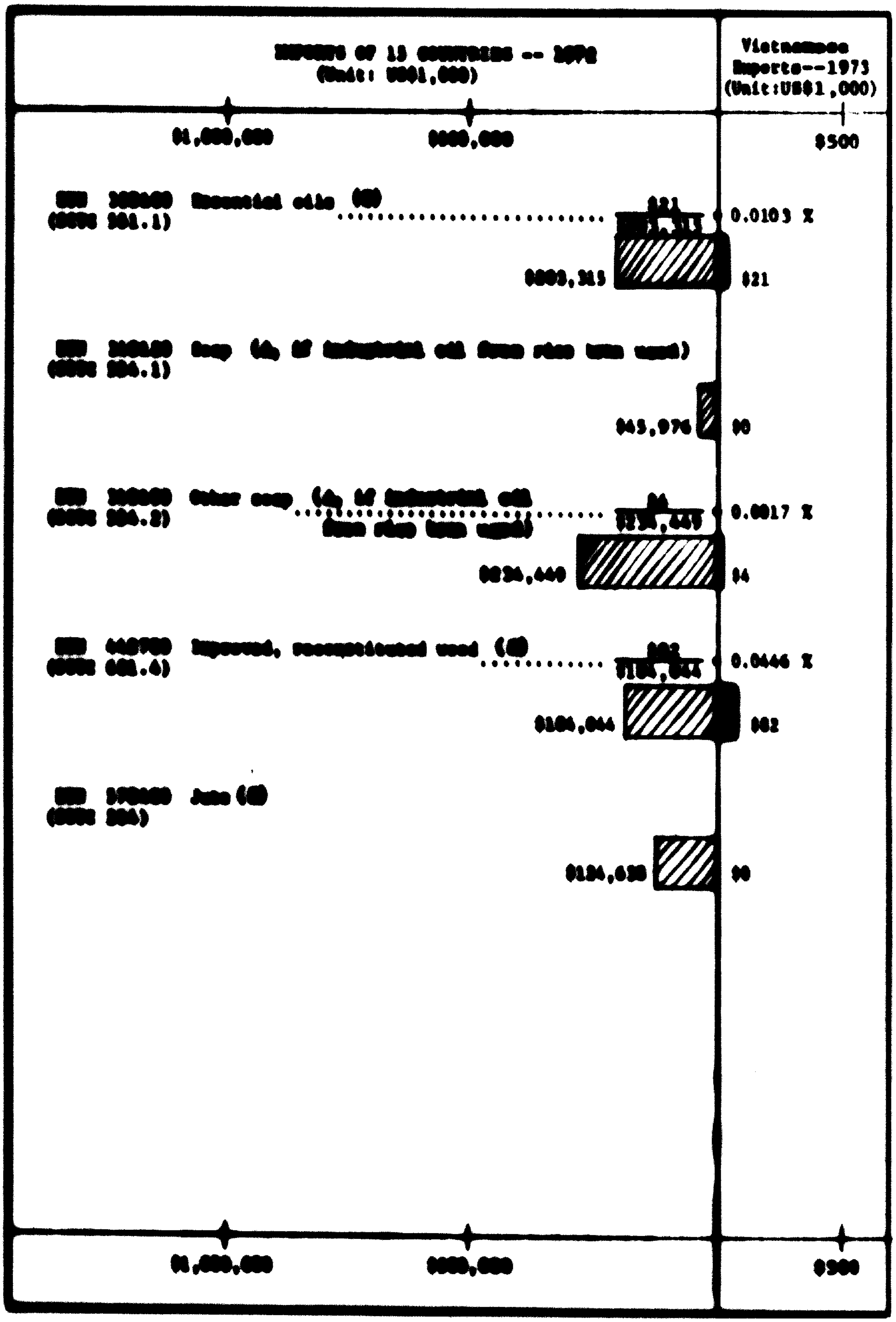

IMPORTS OF 15 COUNTRIES -- 1972
(Unit: US$1,000)
Vietnamese Exports--1973
(Unit:US$1,000)
$1,000,000
$500,000
$500
BTN 010500 (SITC 001.4)
Live poultry (including duck)
$4 / $57,024
0.0070 %
$57,024
$4
BTN 020200 (SITC 011.4)
(including duck)
(A for duck)
$7 / $295,296
0.0024 %
$7
BTN 020400 (SITC 011.890)
Other frozen animals (including frog legs) (A)
$40 / $70,117
0.0571 %
$70,117
$40
BTN 030100 (SITC 031.1)
Fresh fish (A)
$91 / $1,218,817
0.0075 %
$1,218,817
$91
BTN 030200 (SITC 031.2)
Salted, dried fish (A)
$152 / $200,034
0.0076 %
$200,034
$152
BTN 030300 (SITC 031.3)
Shrimp, lobster, frozen (A)
$12,801 / $966,424
1.3246 %
$966,424
$12,801
BTN 040600 (SITC 061.6)
Natural honey (G)
$65,327
$0
$1,000,000
$500,000
$500


IMPORTS OF 15 COUNTRIES-- 1972
(Unit: US$1,000)
Vietnamese Exports--1973
(Unit:US$1,000)
$1,000,000
$500,000
$500
BTN 050700 Feathers
(SITC 291.961)
$1,313 / $45,438
2.8897 %
$45,438
$1,313
BTN 070400 Dehydrated vegetables (G)
(SITC 054.8)
$15 / $215,806
0.0070 %
$215,806
$15
BTN 070500 Dried leguminous vegetable (G)
(SITC 054.2)
$4 / $238,713
0.0017 %
$238,713
$4
BTN 070600 Fresh manioc, sweet potato (G)
(SITC 054.1)
$4 / $209,490
0.0019 %
$209,490
$4
BTN 080100 Oranges, tangerines and mandarines (B)
(SITC 051.1)
$587,381
neg.
BTN 080100 Banana, fresh (G)
(SITC 051.3)
$744,855
$0
BTN 080100 Nuts edible, fresh or dry
(including coconuts) (G)
(SITC 051.7)
$494,236
$0
$1,000,000
$500,000
$500


IMPORTS OF 15 COUNTRIES -- 1972
(Unit: US$1,000)
Vietnamese Exports--1973
(Unit:US$1,000)
$1,000,000
$500,000
$500
BTN 080100 Fresh fruits, n.e.s. (including
(SITC 051.9) pineapples, mangoes, avocados, etc.) (G)
$511,739
$0
BTN 090200 Tea (G)
(SITC 074.1)
$572 / $417,091 = 0.1371 %
$417,091
$572
BTN 090600 Cinamon and other spices (G)
(SITC 075.2)
$967 / $141,808 = 0.6819 %
$141,808
$967
BTN 100500 Maize (G but sorghum in some areas)
(SITC 044)
$1,605,875
$0
BTN 100630 Rice, glazed or polished (A)
(SITC 042.2)
$191,189
$0
BTN 110100 Cereal flour, except flour of wheat
(SITC 047.01) or of meslin (including rice flour) (A)
$4,090
$0
BTN 110110 Flour of wheat or of meslin
(SITC 046.01)
$14,301
$0
$1,000,000
$500,000
$500


IMPORTS OF 15 COUNTRIES -- 1972
(Unit: US$1,000)
Vietnamese Exports--1973
(Unit:US$1,000)
$1,000,000
$500,000
$500
BTN 110600 Vegetables etc. preserved or prepared
(SITC 055) (including manioc) (G)
$2
$785,440
0.0003 %
$785,440
$2
BTN 120110 Peanuts (G)
(SITC 221.1)
$4
$174,866
0.0023 %
$174,866
$4
BTN 120120 Coconut, milk (G)
(SITC 221.3)
$39,714
$0
BTN 120130 Soybeans (G)
(SITC 221.4)
$1
$1,306,595
0.0001 %
$1
$1,306,595
BTN 120700 Medical herbs (G)
(SITC 292.4)
$128,400
$0
BTN 120890 Vegetable for animal feed (A)
(SITC 081.1)
$7
$110,331
0.0063 %
$110,331
$7
BTN 140200 Kapoc (G)
(SITC 292.941)
$46
$311,732
0.0148 %
$311,732
$46
$1,000,000
$500,000
$500


IMPORTS OF 15 COUNTRIES-- 1973
(Unit: US$1,000)
Vietnamese Exports--1973
(Unit:US$1,000)
$1,000,000
$500,000
$500
BTN 130720 Vegetable oils
(SITC 421 & 422)
$754,919
$0
BTN 151300 Animal Fats and oils
(SITC 431)
$161,948
$0
BTN 200100 Vegetable preserved or prepared
(SITC 055)
$2
0.0003 %
$785,440
$2
BTN 200200 Fruit preserved or prepared
(SITC 053)
$1,010,312
neg.
BTN 200500 Fruit or vegetable juice
(SITC 053.5) (including canned juice)
$319,201
$0
BTN 200800 Fruits and nuts, n.e.s. preserved
(SITC 053.9)
$470,849
$0
BTN 230700 Animal food
$0
$1,962,678
$1,000,000
$500


(Unit:US$1,000)
$500
0.0103 %
$21
$45,976
$0
0.0017 %
$4
0.0446 %
$82
$0

Appendix C

CHARACTERISTICS OF SOIL AND WATER IN THE VICINITY OF CANTHO
(By Tadayuki Aoike, member of the Cantho Agro-industry Survey Team.)

1.0 Soils

1.1 Physical Properties

The soil of the paddy growing region is olive-gray in color and clayey (called "cat clay" in some literature). The soil consists of fine particles and is impermeable to air.

1.2 Chemical Properties

1.2.1 Acidity (pH)

The soil acidity ranges from values of 4.3 to 5.0 after analysis by the KCl method. It is therefore necessary to raise alkaynity of the soil by applying limestone to the soil.

1.2.2 Phosphoric Acid (P_2O_5)

The soil tests disclosed no P_2O_5 content whatever. Therefore phosphastic fertilizers are important for agriculture in the Delta.

1.2.3 Iron (Fe_2 and Fe_3) Content

The tests showed that content iron ranged from 1,500 PPM to 2,500 PPM so that the iron content is suitable for paddy production.

1.2.4 Calcium Oxide Content (CaO)

The CaO content was found to be 0.07% to 0.2% and is therefore sufficient for paddy growing.

1.2.5 Magnesium Oxide (MgO)

The content of MgO was found to be 300 PPM to 350 PPM. This is a very soluable element and is radpidly leached from the soil.

When the pH value falls below 6, the water soluable MgO sharply increases and tends to be washed away. However the content of the Delta soil contains sufficient MgO for paddy production. The minimum content of MgO is 100 PPM is required for paddy growing.

1.2.6 Nitrous Antimony (NH_4N)

The content of NH_4N in the soils tested was 10 to 50 PPM which is barely sufficient for paddy. Nitrogen in the form of NH_4N is less than 1% of the total nitrogen content in the soil.

Organic nitrogen is generated mainly by bacterial action and is then absorbed by growing plants and vegetables. Therefore it is important to break-up and loosen the soil to encourage the growth of bacteria and permit root ventilation.

1.2.7 Soluable Alumina (Al_3)

We found 250 to 300 PPM of Al_3 which is too much for ideal growing conditions, A content of less than 100 PPM is more nearly ideal. It is therefore necessary to deactivate a portion of the alumina by raising the changing the pH values to about 6 by the application of limestone and to plow-under husk or straw.

1.2.8 Potash (K_2O)

The potash content is nearly zero whereas the desirable content should range from 8 to 15 PPM. More green manure should be applied or the ash of burned plants and foliage, husks and straw.

1.2.9 Manganese Oxide (MnO)

More than 50 PPM of manganese oxide was recorded in the tests. This is nearly an ideal content. The manganese is stable when the soil is acid or when the manganese is deoxidated. When the soil is dried out, or when the pH value is above 7 (i.e. the soil is alkaline, the manganese oxide becomes unstable and makes it difficult for plants to absorb.

1.2.10 Phosphorous and its Absorption Coefficient

We found that the absorption coefficient of phosphorous ranged from 1,000 to 2,000. This measurement indicates the capacity of the soil to absorp phosphorous, and a measurement of 1,200 is the dividing line between good and poor absorption. The higher the measurement, the worse for growing plants. Much of the Delta Soils have too high a coefficient for ideal agriculture, and thus the soil supplies too little phosphorous as a plant nutrition.

1.2.11 Humus Content

The 3 to 9% humus content found is excellent for agriculture.

2.0 Characterics of the Mekong River Water

2.1 Introductory Comment

Among the elements contained in the water, those that affect agriculture are: mitrogen, phosphorous, potash, limestone, slilicic acid, iron, etc. The content of nitrogen, phosphorous, and iron are negligible if any. Therefore the water properties can generally be determined by analyzing the pH, and the content of other elements such as potash, silicic acid, calcium and chlorine. These elements in the water decline during the rainy season, rise in the dry season.

2.2 Location of Water Samples Tested

The water was sampled near the junction of the Cantho River and the Mekong River on October 25, 1974.

2.3 Acidity (Ph)

A pH value of 7.3 was recorded which is just above neutural and there therefore slightly alkaline. This pH level is good for vegetables plants and animals.

2.4 Potash (K_2O)

A finding of 6 PPM of K_2O was made. This content is rather high considering that the tests were taken shortly after the rainy season in October.

2.5 Chlorine

A finding of 15 PPM was recorded; this is a negligible quantity and there is no fear of salt water injury to vegetation in the Cantho vicinity (although salinity is a problem in the lower Delta where tidal actions contaminate the soil).

2.6 Calcium ($CaCO_3$)

The tests showed 65 PPM of $CaCO_3$ which indicates a high calcium content which is beneficial to vegetation and helps offset the soil acidity mentioned earlier.

2.7 Silicic Acid (SiO_3)

The finding was 16 PPM of silicic acid which is barely sufficient for vegetation.

Conclusions

Although the period of sampling was brief and the number of samples limited to 6, the tests were made with the FHK method (Fuji Hira Simplified Test Procedure) and are believed to have given us valid conclusions regarding the properties of soil and water.

The soil in the Delta has a number of shortcomings, the most serious being that it is too dense, sticky, clayey, and does not permit adequate root ventilation for plants and trees.

Vegetation requires a soil containing substantial bacteria; the bacteria in turn require air. Coconut trees, banana and papaya appear stunted and the large trees usually found in tropical areas are not seen in the Delta. This is a further indicator of the lack of bacteria and air in the soil.

Given the existing soil structure, the Delta is generally not suitable for growing vegetables, fruits, legumes and corn. On the other hand, the Delta is one of the best suited areas for paddy cultivation in the world. The productivity of paddy in the Delta is higher than the average of Southeast Asian countries and the local famers have developed tillage methods ideally suited to the conditions of the Delta.

The high productivity of the Delta, in spite of some shortcomings of in soil, should be credited largely to the properties of water from the Mekong River. As mentioned, the Mekong River water has properties making it nearly ideal for irrigation and capable of compensating for shortcomings in the soil.

We believe that the water, in combination with the diligence and skill of local farmers, have made it possible to attain high productivity in the Delta paddy land.

Improved, continuing, and stabilized policies will be necessary, however, to maintain and increase the rice potential of the Delta. One such policy relates to calcium. In acid soils, bacteria do not form readily and the decay of organic material is retarded. In acid soils, the structure of soils is adversely affected which means that the ventilation and water permeability of the soil is inadequate and the downward thrust of growing roots is inhibited. When the soil is acid, the activated aluminum and iron combine with phosphorous to form insoluable phosphorous which means vegetation cannot absorb the necessary phosphorous.

The absence of air in the soil also means that leguminous plants cannot grow well in the Delta soils and, of course, leguminous plant cannot perform their usual function of conveying nitrogen from the air to the soil.

The calcium deficit makes the soil acid and destroys the balance of elements usually absorbed by vegetation and causes various plant diseases and thus places a limit on the productivity of certain vegetables. Legumes, vegetables and corn require more calcium than paddy (some species require 20 times more calcium than paddy).

The most suitable amount of powdered limestone for given crops can only be determined after a very throughgoing and detailed study. But on the basis of assumptions valid elsewhere, we believe that 300 to 500 kg. of powdered limestone is needed per hectare per year. This means a very substantial volume of limestone is needed for the Delta's paddy land. (16 provinces of the Delta have 2,039,000 hectares of paddy x 500 kg/year = 1,018,500 tons annually if optimum quantities of limestone were applied.) (*)

A second policy required to improve productivity is to increase the supply of green manure for the soil. This means a return to the soil of husk, straw and other organic materials. This will make better use of chemical fertilizers and thus save paddy production costs.

The improvement of animal husbandry and poultry raising is an important objective to increase the production of manure of high quality. Fortunately hog raising is widespread, but the cost of feed remains a basic deterent to hog raising. Fatty rice bran is being fed to hogs, but the residual cake from defatted bran would be a substantially better feed for hogs. This oil cake can be mixed with fish meal and other ingredients as a mixed feed. This will be necessary for the effective increase in hog and poltry raising and fish culture. Therefore a plan to make mixed feeds is an important goal.

Industry can play a role in achieving a interchange of plant and soil nutrients. It is important that industry be planned to support agriculture.

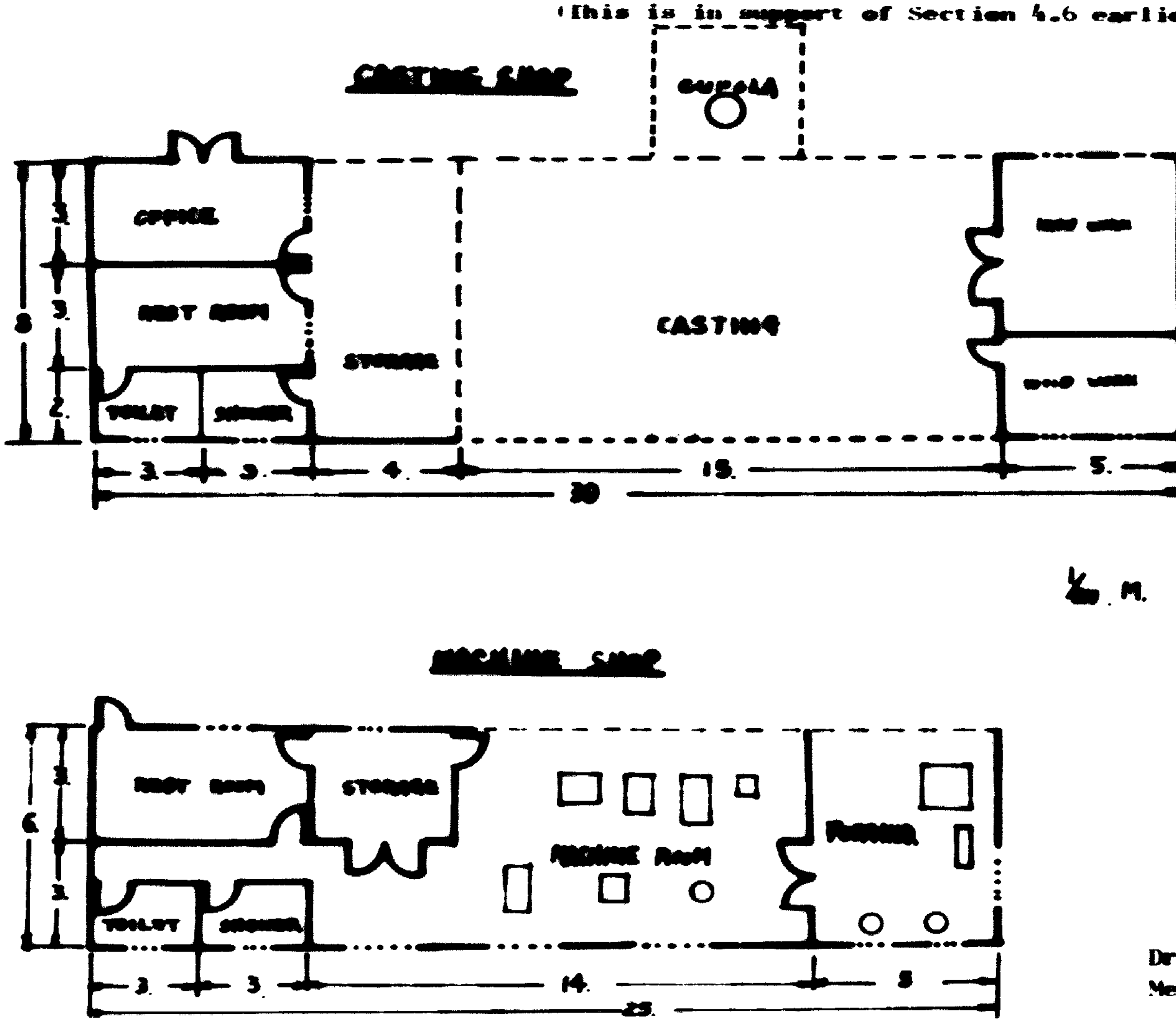
(Appendix C ends here)

(*) On p. 115 of the report, we are recommending that a start be made by focussing on the high acid zones of the Delta. This would mean a minimum requirement in the range of 210,000 to 350,000 tons per year.

APPENDIX D

LAYOUT OF MACHINE AND CASTING SHOPS ON TAY DO INDUSTRIAL PARK (PRELIMINARY PLAN)

(This is in support of Section 4.6 earlier herein.)



Drawing courtesy T. Aoike,
Member of Cantho Survey Team

Appendix D-1

MACHINERY SUGGESTED FOR ENGINE REPAIR, MACHINE AND CASTING SHOPS (See Section 4.6 of Report)

I. Engine Repair Shop (Total cost of this equipment would be about $41,000 C.&F. Cantho)

I-1 Testing Equipment

Diesel fuel injection pump tester
Nozzle tester
Diesel injection timing tester
Diesel compression gauge
Valve and clutch spring tester
Con-rod aligner
Sound-scope
Compression and vacuum gauge
Cylinder gauge
Exhaust tester (for carbon monoxide testing)
Universal electrical tester
Timing light
Megar
Circuit tester
Engine scope analyzer
Wheel aliginment tester set
Torque wrench
Thermometer
Vernier caliper
Outside, inside micrometer sets
Engine dynamometer
Prinnel hardness tester
Tachometer
Thickness, radius and pitch gauges
Other tools

I-2 Machining Equipment for Engines

Cylinder boring machine
Cylinder honing machine
Fast charger
Valve seat grinder
Valve refacer
Brake reliner
Tire remover
Push-pull master
Air compressor
Plain trolley chain block
Parts cleaner
High pressure car washer
Portable electric disc grinders
Bench grinders
Sanders
Other tools

I-3 Lubricaters, Fuel, Oil Servicing Equipment
Pumps for oil drums
Chassis lubricaters
Gear lubricaters
Bucket pumps
Other tools

I-4 Plyers, hand tools, jacks, etc.

2. Machine Shop (Total cost of this equipment would be about $51,000 C.&F. Cantho)

(Note: The abbreviation, w/a, means, with accessories)

Lathe (7 feet) w/a
Lathe (5 feet) w/a
Universal milling machine w/a
Shaping machine w/a
Vertical drilling machine w/a
Abrasive cut-off machine w/a
Bench grinder w/a
Bench drill w/a
Air compressor w/a
A.C are welder w/a
Oxy-hydrogen welder, cutter w/a
Belt hammer w/a
Blower, surface plate, anvil, swage block, others black smith's forging tools
Vice, wrench, hammer, taps, dies, others hand tools
Dial gauge, micrometer, vernier calipers, steel V block, calipers, others measuring equipment
Other tools

3. Casting Shop (Total cost of this equipment would be about $9,000 C.&F. Cantho)

(Note: The abbreviation, w/a, means, with accessories.)

Small cupola w/a
Blower w/a
Compressor w/a
Sand mill mixer w/a
Chipping hammer w/a
Jet chisel w/a
Grinder w/cyclone
Light thermometer
Electric hand, planes, groover, mortiser, circular and jig saws, others carpenter's hand tools
Platform scale
Chain block

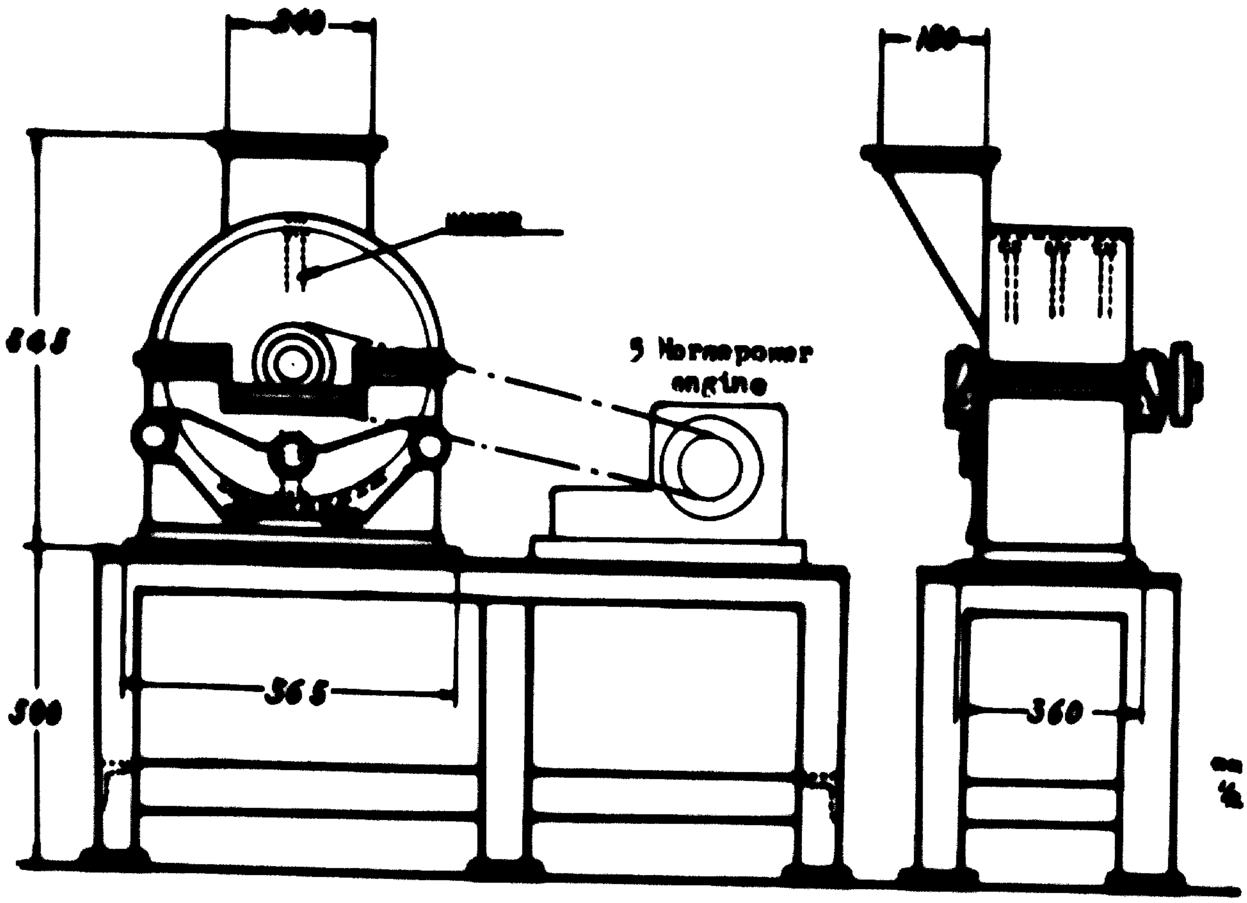
Hand and measuring tools
Materials (gray iron, ingot, sand, wood for patterns etc.)
Other tools

(Appendix D-1 ends here)

Appendix E

Hammer Mill with 350 Kg./hour Capacity

(This appendix relates to 4.7.2)



Note: The mounting tables, covered with sheet steel, can be made locally.

This is a multi-purpose mill to grind limestone, casava (i.e. manioc), animal bones, sorghum.

Drawing courtesy of Mr. T. Amike, Member, Cantho Agro-industry Survey

APPENDIX F

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APPENDIX G

FEASIBILITY STUDY OUTLINE

Chapter 9 of this report starting or page p. 192 refers to the sections of the following "Technical Notes" published as a preface to Extracts of Industrial Studies, Industrial Planning and Programming Series, No. 7, United Nations Industrial Development Organization, Vienna, Volume I, United Nations, New York, 1973.

The text of the "Technical Notes" is reproduced here to facilitate readers in finding sections of the Notes referred to in the text of Chapter 9.

(Terms of Reference for Future Feasibility Studies page,192.)

TECHNICAL NOTES

The standard form used in this volume consists of 13 sections of which one (XII) is reserved for any supplementary information that does not readily fit into the rest of the form. The major points to be considered in filling in the form are noted section by section and item by item.

I. ORIGIN OF THE STUDY

1. *This study was prepared by*
   Indicate only the type of the institution that prepared the original feasibility study from which this extract is derived, such as an independent consultant, a private consultant firm, a machine supplier, the staff of a governmental development institution, or of an international technical-assistance agency.
   This study was prepared for
   Indicate only the type of the institution that requested the original study, such as an individual private investor, a ministry of industry, or an investment bank.
2. *The study was intended to*
   Specify the main investment opportunity that motivated the feasibility study: an investment priorities plan, preliminary sectoral studies, etc. Important factors underlying the opportunity may be mentioned.
3. *Size of the economy considered*
   — *Other information*
   List the main established industries and point out the particular resources with which they are favourably endowed. The geographical region in which the economy is located may or may not be mentioned. If the economy involves more than one country, this should be mentioned.

II. GENERAL DESCRIPTION

1. *Products*
   Describe briefly the technical specifications of the products: e.g., chemical purity, mechanical properties, quality standards, composition. Quantities and product-mix are to be indicated elsewhere.
2. *Major input materials*
   Give the qualitative specifications of major raw materials from local origins and any important features of their supply; and indicate important production materials, if any, that are needed but not locally available.
3. *Alternative technologies available and technology adopted for the study*
   Indicate the type of process, such as single-product process, multi-product process, single-train or multi-train production;
   Describe briefly the technology, mentioning any special name popularly used by experts in the field. Give details in section XII ("Supplement") as deemed appropriate;
   State the degree of mechanization and automation. Special advanced features may be described in section XII ("Supplement").
4. *Locational factors*
   — *Particularly important factors*
   Specify the key parameters for transport requirements: quantities of main input materials and output products in terms of gross weights and/or volumes;
   Indicate means of transport and transport tariffs applicable;
   State the desired degree of proximity to electricity, water and basic infrastructure, including the location of other industries with which the project is to be closely linked;
   Indicate crucial regional policy measures recommended for the project feasibility, if any.
   — *Actually proposed locality*
   Describe simply the proposed locality in terms of differential priorities given to important factors.

III. MARKET

1. *Tabulation of estimated demand on domestic and export markets*
   Tabulate separately for the domestic and the relevant export markets;
   Indicate any special characteristics, possible margins of error (between optimistic and pessimistic), etc.
2. *Notes on methodology*
   Indicate major determinant variables, demand elasticities and other key parameters for projections, and special consumer patterns;
   Give an indication of how crude or sophisticated the estimates are;
   Describe any special market surveys conducted in the field.

3. *Selection of product-mix*
Justify the selected product-mix from the standpoints of both the market and the production technology. Indicate potential additional products to be included in a future extension of the project.

IV. CAPACITY OF PROPOSED PLANT

1. *Nominal maximum capacity according to major process*
Give the time basis of calculation (operating time) and indicate specific groups of machines and equipment that determine the nominal maximum capacity of the major process or processes;
Indicate whether the proposed capacity represents the technologically acceptable minimum plant scale.

2. *Maximum feasible capacity of the plant*
Calculate the feasible capacity of the plant, taking into account normal stoppage, desired shift patterns, indivisibilities of major machines to be combined, etc.;
Indicate potential bottlenecks and selective extension possibilities.

3. *Expected maximum output of the plant*
Indicate expected maximum output, compatible with the expected markets, in percentage of the maximum feasible capacity. Efficiency of labour, demand irregularities, proportion of rejects, seasonal variations of raw material supplies etc. should be taken into account.

V. INVESTMENT

1.1. *Land, site development*
Indicate size of plot in parenthesis.

1.2. *Buildings*
Indicate floor space in parenthesis for each sub-item.
— *Others*
Describe water facilities, electricity works, reservoirs, waste-disposal systems, housing for employees, etc., separately if possible.

1.3. *Machinery and equipment*
Give total, including installation.
(Indicate in the foot-note here or in section XII ("Supplement") any extraordinarily high or low estimates of particular items that might be associated with special road and housing development schemes, power supply, leasing of equipment, special properties of inputs and outputs, time-phasing of a potentially larger integrated project, etc.)

2. *Working capital*
State in *ex ante* planning terms, referring to the normal level of operation expected after the completion of the plant and its start-up.

2.1. *Inventories*
Indicate in parenthesis the equivalent number of months.

2.2. *Accounts receivable*
Indicate average period of deferred payment allowed to customers, in parenthesis.

3. *Other investments*
Calculate expenditures prior to the start o production that are to be capitalized.
Major machinery and equipment (table)
List *(a)* production machinery and equipment and *(b)* auxiliary equipment (transport, laboratory, maintenance, power generation, office equipment, etc.) separately;
Production machinery should be listed preferably by departments or shops rather than item by item, with classification corresponding to the shop alignment as in section VI ("Manning table");
If space permits, indicate the capacity rating of the machinery and equipment by shop, or for predominantly important items. Use section XII ("Supplement") if necessary.

VI. MANNING TABLE

List of shops should preferably indicate the main processing stages involved. A process flow chart supporting the given shop alignment may be shown in section XII ("Supplement");
Seasonal workers should be so specified.

VII. ANNUAL PRODUCTION

1. *Total annual expected maximum output*
Tabulate by product and by destination. "Unit price ex factory" would include production and/or sales taxes, if any. Special subsidized export prices should be indicated.

2. *Expected sales and inventory build-up*
Give background information on the expected growth of turnover and capacity utilization during the first few years of production, as tabulated in section XIII ("Cash flow table").

3. *Pricing policy*
Compare the prices derived from direct costing with current import prices. The latter should be clarified in terms of the c.i.f. prices, free of import duties at the port of import, and the normal rates of surcharge including duties, sales taxes, trade and transport margins;

State any specifics regarding the proposed export prices;

Indicate the results of any sensitivity tests concerning the desired level of profitability and the pricing of products;

Indicate any necessary governmental protective measures (the justification for such measures should be given in section XI ("Data for evaluation").

4. *Planned sales organization*
Describe own distribution network via sales representatives and own retail stores or agents, wholesalers and other trading organizations; also the significance of own transport facilities in marketing.

VIII. ANNUAL OPERATING COSTS AND PROFITS

The data in this section should correspond to the "annual expected maximum output" as shown in section VII.

State separately and in detail: *(a)* raw materials and semi-processed materials, *(b)* packaging materials, *(c)* repair and maintenance supplies, *(d)* energy, and *(e)* water and other materials.

Note: Office supplies, advertisements, insurance fees, communication, staff travel and other business services to be purchased should be included in item 7 ("Administrative expenses and sales costs"). Item 7 should not include wages and salaries for the enterprise's employees.

3. *Interests*
Give average annual interest charges on borrowed capital as planned. Interest on foreign loans should not be included here.

5. *Indirect taxes*
List value added tax, production tax, turnover tax, employment tax, franchise tax, etc. Profit tax is to be shown in item 9.

6. *Depreciation*
Indicate rate and method of depreciation. Use space in section XII ("Supplement") if necessary.

7. *Administrative expenses*
See note above.

8. *Other costs*
Include work by outside firms on contract basis, if any; otherwise, "contingency allowances" would normally fit under this item.

IX. FINANCING PROPOSAL

2. *Long-term loans*
List separately loans of different terms.

3. *Other loans*
List separately short- and medium-term loans; indicate interest and repayment conditions for each.

4. *Suppliers' credits*
Indicate over-all repayment conditions.

5. *Remarks on the financing policy*
Indicate whether the financial proposal is only a crude, somewhat arbitrary assumption or whether it reflects the proposal from a potential investment institution. Also state local and foreign sources of capital. Describe briefly any peculiarities of the financing proposal.

X. IMPLEMENTATION

1. *Technical collaboration service*
Include projections or recommendations concerning further studies required, preparation of project blue-prints, contracting procedures and other major steps to be taken if the project proves acceptable for the purpose for which the original feasibility study was prepared.

2. *Project management*
Indicate, e.g., whether a turn-key contract is envisaged and any specific arrangements proposed for project management during the construction and/or initial operation period.

3. *Recruitment and training of personnel*
Describe any programmes for training abroad and/or locally. Also describe the proposed time schedule for recruitment of technical personnel, skilled workers, etc.

4. *Other items*
Describe any organizational problems, infrastructural requirements to be satisfied, crucial legislative actions required to ensure the viability of the industry considered, etc.

5. *Time schedule*
Give time schedule proposed for major implementation activities, covering contracting and other pre-construction activities, construction schedules start-up and extension phase. The schedule would underlie the calculations presented in section XIII ("Cash flow table").

XI. DATA FOR EVALUATION

Check the type of analysis included in the original feasibility study and summarize the main findings. Any incorrect or inadequate treatments involved in the original study may be pointed out, and an alternative analysis may be undertaken and presented by those who prepare this extract. The original feasibility study document used for this extract may or may not be complete in terms of project evaluation. Recommendations made in the original document may or may not be reasonable. A space in this section may well be spared for an expert evaluation pinpointing any notable weak points of the original project study.

XII. SUPPLEMENT

Use this space to provide additional information relating to any sections of the extract. Any further details or commentaries that require extra space or non-*pro forma* presentation should be given here, and reference made in each case to the relevant section and its sub-item.

XIII. CASH FLOW TABLE

Use this standard cash flow table to ensure comparability among different cases. When more than one cash flow table is available and/or a given cash flow table is in a special form that cannot be reorganized in this standard form, it should be presented in section XII ("Supplement").

Note that, in this tabulation, no. 4 ("Production expenditure") does not include interests on loans and depreciation (which are included in section VIII, sub-sections 3 and 6 respectively). Interests are entered in sub-section B.5.1 ("Interest on loans"). Instead of depreciation allowances, the anticipated replacement expenditures are to be entered in sub-section B.1.3 ("Machinery and equipment (replacement)"). This table is arranged in such a way that internally accumulated profits and depreciation funds are not so isolated, but are absorbed into sub-section C ("Surplus/Deficit"), after being adjusted for yearly expenditures on the capital account (replacement expenditures and repayments of loans and credits).

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