

MINIMIZING FERTILIZER DISTRIBUTION COST IN THREE
SELECTED REGIONS IN THE PHILIPPINES

by

ELGIE LUCES NAMIA

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Albay, Philippines

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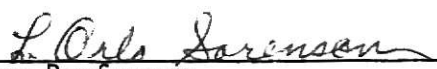
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CHAPTER I

INTRODUCTION

Fertilizer consumption in the Philippines has shown an upward trend in the past decade. This is due mostly to the active roles of both the government and the private sector in the national food programs. The annual growth rate of fertilizer consumption during the years 1975-1980 was 7.4 percent. Urea consumption had a mean annual increase of 18.5 percent while use of complete fertilizer increased at an annual rate of 9.4 percent (Table 1). In the six year period urea accounted for 33.0 percent of total consumption; complete fertilizer 18.2 percent; and ammonium sulfate 24 percent (Table 2). Although urea is currently the most widely used fertilizer a more balanced ratio of the three nutrients (nitrogen, phosphorous, and potassium) will be needed in the near future because of more frequent cropping and the wise use of high yielding varieties which cause depletion of all nutrients in the soil.

Despite increased use, the consumption of fertilizer among Filipino farmers still remains below the recommended level. The estimated quantity of 100 to 110 kg. of fertilizer per hectare of rice in 1978 is far below the recommended levels fixed for Masagana 99.¹ Recommendations for different regions range from 150 to 350 kg. of fertilizer per hectare for the wet season and from 200 to 350 kg. for the dry season. Consumption per hectare is highest in Central Luzon, Southern Tagalog and Bicol Region.

¹MASAGANA 99 is a Tagalog word meaning bountiful and 99 quantifies the goal of the program to increase rice production up to 99 sacks per hectare or 4.4 tons of unmilled rice or paddy.

Table 1
FERTILIZER USAGE AND TRENDS, PHILIPPINES, 1975-1980
(Thousand Metric Tons)

	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>ANNUAL AVE. GROWTH (%)</u>
Total Volume	577.8	644.0	686.6	791.6	849.3	819.6	7.4
Urea	143.8	174.8	228.4	287.1	320.4	329.2	18.5
Am. Sulfate/ other N	167.5	185.5	177.7	171.2	175.4	143.6	(3.4)
P/MAP/DAP	105.5	116.0	106.2	125.3	124.2	131.8	4.8
NPK	102.1	108.0	124.1	147.2	159.5	158.2	9.4
Potash	58.9	59.7	49.2	60.8	69.8	56.8	0.9

Source: Fertilizer and Pesticide Authority (Unpublished).

Table 2

CONSUMPTION PATTERN OF VARIOUS FERTILIZER
GRADES, PHILIPPINES, 1975-1980
(Percent of Total Consumption)

<u>GRADE</u>	<u>1975</u>	<u>1976</u>	<u>1977</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>Mean</u>
Urea	24.9	27.1	33.4	36.3	37.7	40.2	33.3
Am. Sulfate/ other N	29.0	28.8	25.9	21.6	20.7	17.5	23.9
P/MAP/DAP	18.3	18.0	15.5	15.8	14.6	16.1	16.4
NPK	17.7	16.8	18.1	18.6	18.8	19.3	18.2
Potash	10.2	9.3	7.2	7.7	8.2	6.9	8.3

Source: Fertilizer and Pesticide Authority (Unpublished).

Consumption figures varied between 90 to 130 kg. per hectare in 1977.² This means that there is still opportunity for increased use of fertilizers in the country and a likelihood that there will be more and more dependence on fertilizer to meet food needs. Fertilizer is a critical input in increasing food production.

A key barrier to increasing fertilizer consumption is high-cost distribution and marketing. Severe physical barriers to low cost distribution include geographical separation of provinces by mountain ranges and seas requiring frequent changes in mode of transport. Roads, although improving, are inadequate in some areas. Seasonal demands for fertilizers increase storage requirements, and hence storage costs, in the distribution system. Regardless of these difficulties, it is important to minimize distribution costs to make available to small farmers (the majority of the country's end-users of fertilizer) the appropriate types and amounts of fertilizer at the lowest possible costs. This study is concerned with fertilizer distribution costs.

²Fertilizer Advisory Development Information Network for Asia and Pacific Report, Marketing, Distribution and Use of Fertilizer in the Philippines, Economic and Social Commission for Asia and Pacific (Bangkok, January, 1980), p. 39.

CHAPTER II

STUDY OBJECTIVES

The overall goal of this study is to demonstrate the application of a mathematical linear programming technique to determine least-cost distribution for a segment of the Philippine fertilizer distribution system. Least cost distribution is determined within the constraints of the existing storage and transportation facilities and equipment. The analytical problem focuses on distribution of complete fertilizer from a major origin (Planters Products Incorporated production plant at Limay, Bataan) through eight major demand-area warehouse locations to destinations in twenty-three provincial capitals in Central Luzon, Southern Tagalog and Bicol Region.

Specific objectives are:

- 1) to demonstrate the use of the analytical technique in:
 - a. identifying least-cost transportation methods and routes in serving the warehouses and final demand points,
 - b. determining optimum warehousing of fertilizer for coordinating production schedules and seasonal demands by provinces, and
 - c. determining costs of transportation, warehousing and handling in an optimized distribution system with present cost rates and facilities and
- 2) to identify other applications of the analytical model for improvement of the fertilizer distribution system in the Philippines.

CHAPTER III

STUDY SETTINGS

A. Philippine Physical Characteristics

The Philippines is an archipelago of 7,100 islands of which only 2,773 are named and about a thousand are inhabited. Eleven islands constitute 95 percent of the total land area of approximately 115,800 square miles. The economy is predominantly agricultural, 54 percent of its total labor force is in the rural labor force and 47.6 percent of this rural labor force is engaged in agricultural production.

The country is subdivided into twelve regions (Figure 1) and has a variety of topographical features from the low swamps, a foot or two above high water to the mountain ranges culminating in Mindanao in Mt. Apo which is 9690 ft. above sea level.

The climate is basically tropical and has two seasons: the wet season and the dry season. The four traditional climate types, illustrated in Figure 2 are:³

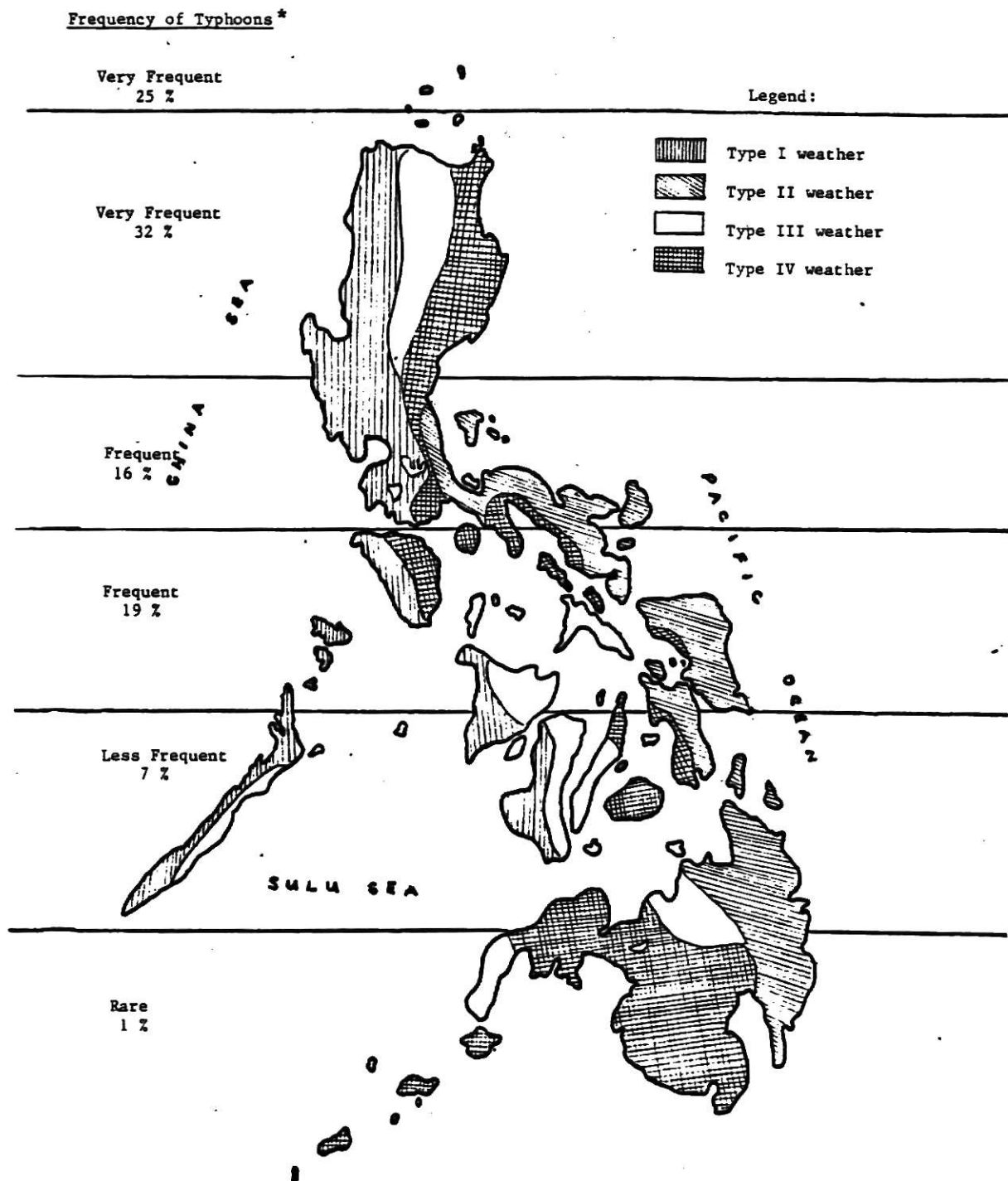
Type I. two pronounced seasons: dry from November to April; wet from May to October;

Type II. no dry season with very pronounced rainfall from November to January;

Type III. seasons not very pronounced; relatively dry from November to April but wet throughout the remainder of the year;

³Philippine Almanac and Handbook of Facts, ed. Efren Yambot (Manila, Philippine Almanac Printers, Inc., 1975), p. 34.

Figure 2. Climatic Map of the Philippines



* Frequency percentages reflect the proportion of total annual typhoons affecting specified regions.

Source : Philippine Almanac of Handbook and Facts for 1975.

Type IV. rainfall more or less evenly distributed throughout the year.

However, a new climate classification recognizes seven categories instead of four. The new classification tends to be more descriptive and precise.

Because of the predominance of Type I climate on the western half of Luzon island, seasonal crops must be planted at about the beginning of the pronounced wet season, especially where irrigation facilities are lacking. The traditional peak months for planting activity (especially for rice and corn) are late May, June and the first half of July. Since, every region and every province has different climatic conditions and irrigation facilities fertilizer consumption varies in every area for a particular period.

The country, especially the northern portion, lies in the typhoon belt. Thus typhoon season also affects the nation's economy.⁴

Various means of transportation are available--railways, roads, waterways and airways. But transportation networks are particularly difficult to establish because of the physical characteristics of the country. In addition to infrastructure for land transport, transport services require many ports and ferries and complex networks of shipping and air services. Although the government has made considerable progress in improving the major highway systems, particularly on the islands of Luzon and Mindanao, access to markets in rural areas is severely hampered by poor inter-island transportation, inadequate farm-to-market and feeder

⁴Typhoon period lasts from June to October.

roads, capable of accommodating motorized traffic, and the lack of all-weather facilities.⁵

Roads. The poor quality of roads increases the transport cost and freight rates, although set by the Board of Transport, are not followed closely in practice. In relatively inaccessible areas inputs such as fertilizers, insecticides, and seeds are not economical to purchase because of high transport costs, and marketing of output is difficult.

To aid food production programs, the government stresses the improvement of farm-to-market and feeder roads to aid food production programs. The long term goal is to establish one kilometer of effective feeder roads for every 100 hectares of cultivated land; this would require about 75,000 kilometers of feeder roads for the presently cultivated area. The government intended to maintain and upgrade some 7,500 kilometers of feeder roads at a cost of about P130 million in 1974-75 and to sustain improvements at this level in future years. The World Bank is helping to finance the upgrading of 700 kilometers of minor roads, and the Asian Development Bank is considering a loan application for funds to be used to upgrade 800 kilometers of minor roads in Mindanao.

As of April 1976, the Department of Public Highways currently maintains 23,837 kilometers of national roads; 20,762 kilometers of feeder roads and 7,578 national bridges with a total of 196,685 lineal meters.⁶

Ports and Shipping. Coastal transport is frequently a logical alternative where cross-island road construction is made difficult by

⁵A World Bank Country Economic Report (1976), "The Philippines: Priorities and Prospects of Development."

⁶Based on 1977 Survey Report Transportation prepared by the National Census and Statistics Office and on the DPH Reports for FY 1973-74 and FY 1974-75.

mountainous terrain, and numerous roadsteads and shallow water ports have been developed where land access is severely limited. Small watercraft (bancas, batels, and kumpits) provide low-cost short-haul transport of agricultural products for local as well as inter-island markets, and barges are used extensively to move raw and refined sugar, rice, and other produce. Despite their importance, the potential of inter-island and coastal shipping has not yet been fully realized, partly because of inadequate port facilities for local shipping.

The present marine port networks are classified into public ports and private ports. Public ports, owned and operated by the government are further classified into: a) national ports and b) municipal ports. In 1974, the Philippine port system consisted of 589 public ports and 161 private ports. Of the public ports, 93 were classified as national ports while 496 were classified as municipal ports.⁷

In the past few years the government with assistance from the World Bank and the Asian Development Bank, has improved the port facilities of Cagayan de Oro, General Santos, Davao, and Cotabato. The majority of ports however, still suffer from the inadequate work areas and transit sheds and antiquated cargo-handling facilities, disorganized port operations, and poor maintenance. An estimated 40 percent of inter-island vessels are over 24 years old, a high proportion of the smaller ships are converted naval or military vessels and overloading and prolonged journeys are characteristic.⁸

⁷ Ibid.

⁸ A World Bank Country Report Economic Report (1976), "The Philippines: Priorities and Prospects of Development."

Rail Transport. There are two railway systems in the country, namely; the Philippine National Railways (PNR) and the Philippine Railway Company (PRC). PNR network is a single track system with the main line of 740 kilometers and branch lines of 321 kilometers and 81 railway stations. The main line is divided into north line and south line with a common terminal located within Metro Manila. The north line is about 266 kilometers extending from Manila to San Fernando, La Union in Northwestern coast of Luzon and the south line is 474 kilometers reaching far south to Legaspi, Albay. Philippine Railway Company consists of a line of 116 kilometers running from Iloilo City to Roxas City. It has thirteen railway stations.

Philippine National Railways has 68 trains, 16 of which are for daily trips to the north, 24 to the south, and 28 for the commuters in Metro Manila area. Out of those 68 trains, PNR has 1,054 freight cars.

Air Transport. As of June 30, 1974, the Civil Aeronautics Administration (CAA) maintained 77 national airports. Of these 77 airports, 49 were served by Philippine Airlines (PAL) and the rest by the General Aviation Sector. There were also 68 private airports supervised by CAA. To intensify the growth of the cargo traffic, it is imperative that bigger type of purely domestic cargo aircraft that will propel a bigger stream of cargo distribution to be introduced. The introduction of DC-3 cargo and the air freight forwarders operation is geared to enhance the expansion of cargo distribution that will encourage more production and stabilize prices of food commodities at reasonable level.⁹

⁹Based on 1977 Survey Report on Transportation prepared by the National Census and Statistics Office and on the DPH Reports for FY 1973-74 and FY 1974-75.

B. Fertilizer Production

Domestic fertilizer production consists mainly of ammonium sulfate and complete fertilizers. Urea production, which was always limited, ceased in 1976 because domestic production costs became excessive compared with the cost of imported urea. Potash is not produced in the Philippines.

Domestic production by different manufacturers in 1978 is shown in Table 3. The two major fertilizer manufacturers in the Philippines are Planters Products Incorporated (PPI) (about 62 percent of production) and Atlas Fertilizer Company (AFC) (about 38 percent). Ammosul production of Chemical Industries of the Philippines, Incorporated (Chemphil) was a negligible 424 metric tons.¹⁰

Fertilizer production capabilities of each manufacturer is shown in Table 4. Maria Christina Fertilizer Company (MCFC) located in Northern Mindanao and Chemphil at Malabon, Rizal (just outside Manila) have small facilities to produce ammonium sulfate for 40,000 tons and 22,500 tons respectively. Production costs became too high compared to the costs of similar imported fertilizer. At present both MCFC and Chemphil are now mainly fertilizer importers.

PPI has a 50-ha plant at Limay, Bataan, on the southwest coast of Luzon, which uses refinery gas of the Bataan Refinery to produce ammonia.

In 1978, PPI produced 180.1 thousand metric tons of complete fertilizers; utilizing two-thirds of its maximum rated capacity for these fertilizers. Urea production capacity is no longer utilized.

¹⁰FADINAP, Marketing, Distribution and Use of Fertilizer in the Philippines, p. 12.

Table 3
 PRODUCTION OF FERTILIZERS, PHILIPPINES, 1978
 (Metric Tons)

	<u>21-0-0</u>	<u>16-20-0</u>	<u>0-20-0</u>	<u>12-12-12</u>	<u>14-14-14</u>
AFC (38%)	60,550	15,301	1,712	6,499	25,157
PPI (62%)	-	57,333	-	10,213	112,517
Chemphil	424	-	-	-	-
Total	69,974	72,634	1,712	16,712	137,674

Source: Fertilizer and Pesticide Authority (Unpublished).

Table 4
 PHILIPPINE FERTILIZER PRODUCTION CAPABILITY, 1981
 (Thousand Metric Tons)

<u>COMPANY</u>	<u>UREA</u> *	<u>AMMONIUM SULFATE</u>	<u>AMMONIUM PHOSPHATE</u>	<u>COMPLETE (NPKs)</u>	<u>TOTAL PRODUCTION</u>
Planters Products	40	-	100	125	265
Atlas Fertilizer Corp.	-	72	20	35	127
Phil. Phosphate Fert. Corporation **	-	153	731	115	999
Total	40	225	851	275	1,391
%	2.9	16.2	61.2	19.8	100.1

* PPI will start to produce urea in 1984.

** Phil. Phos. starts operation in August 1983.

Source: Fertilizer and Pesticide Authority (Unpublished).

Atlas Fertilizer Corporation has the second largest plant located at Sangi, Toledo on the island of Cebu. This company has facilities to produce ammonium sulfate, as well as complex fertilizer.

In 1978, AFC produced 60.6 thousand metric tons of ammonium sulfate, utilizing 84 percent of its production capacity. It utilized half of its production capacity for complex fertilizers.

By 1983, the Philippine Phosphate Fertilizer Corporation (PPFC) plant will be in operation. It is a joint venture of the Philippine government and foreign partners. The plant will be producing 72 percent of the total domestic fertilizer production and will export ammonium phosphates. Production capability of complete fertilizer will be 115,000 metric tons annually.¹¹

C. Philippine Fertilizer Distribution System

The marketing of fertilizer in the Philippines is under the control of the government through the Fertilizer and Pesticide Authority (FPA). FPA was formerly the Fertilizer Industry Authority established in 1973, and has the power to regulate supply, distribution, and pricing.¹²

¹¹Jorge G. Davide, "Fertilizer Distribution in the Decades to 1990 and 2000: The Philippines," presented at the FAO/FIAC ad Hoc Working Party on Fertilizer Marketing and Credit. FAO, Rome, March 10, 1981.

¹²FADINAP, Marketing, Distribution, and Use of Fertilizer in the Philippines, p. 22, enumerates FPA's responsibilities as follows:

- (i) To make a continuous assessment of the fertilizer supply and demand situation, both domestic and worldwide;
- (ii) To establish and enforce sales quotas, production schedules, distribution areas and such other marketing regulations as may be necessary to assure market stability and viable operations in the industry;
- (iii) To determine and set the volume and prices, both wholesale and retail, of fertilizer and fertilizer inputs;

Apart from the legal position of FPA, the fertilizer market is characterized by the fact that almost 70 percent of total fertilizer demand is met by only one company, Planters Products Incorporated. As

- (iv) To negotiate and enter into contracts for all imports and exports of fertilizer and fertilizer inputs;
- (v) To import fertilizer and fertilizer inputs exempt from customs duties, and sales taxes and all other taxes and to sell or convey such fertilizer or fertilizer input to any individual association, partnership or corporation likewise exempt from the payment of custom duties and all other taxes;
- (vi) To control and regulate all marketing companies whether importer, indentor, wholesaler or retailer;
- (vii) To regulate and control the quality of the different grades of fertilizer and to set new grades when necessary;
- (viii) To compel the utilization of unused or underutilized capacities of fertilizer companies and to direct any improvements, modifications or repairs as may be necessary to accomplish this;
- (ix) To approve or reject the establishment of new fertilizer or fertilizer input plants and the expansion or contraction of existing capacities;
- (x) To promote and coordinate all fertilizer research;
- (xi) To obtain complete access to all pertinent information on the operations of the industry, including audited and/or unaudited financial statements, marketing, production and inventory data;
- (xii) To call upon anyone in the fertilizer industry or in industries related to the fertilizer industry or any other government agency to assist the Authority in carrying out its functions;
- (xiii) To establish and impose appropriate penalties in the fertilizer manufacturers, distributors, dealers, wholesalers, retailers and raw materials suppliers for violations of any rule, quota, or guidelines established by the Authority; and
- (xiv) To do any and all acts not contrary to law or existing decrees and regulations as may be necessary to carry out the functions of the Authority.

this company is controlled by the Government, it is clear that the fertilizer market is centralized and largely under the direct control of the Government (Table 5).

Distribution System by Fertilizer Distributing Companies

The major channels for distribution, are the networks of the Philippines fertilizer producers. Each of the companies has its own distribution system. Some independent traders participate at the wholesale level, and at the retail level, a combination of exclusive-brand dealers, general stores, plantation owners and cooperatives sell directly to farmers. Fertilizer distribution cooperatives are concentrated in the sugar producing sector. Figure 3 shows the present fertilizer distribution channels.

Planters Products Incorporated, utilizes only three modes of transport, namely: barges or self-propelled vessels, trucks and on a limited scale, railcars. Out of the 600,000 metric tons of various fertilizers moved annually, about 55 percent is moved through marine transport and about 45 percent is moved through land transport. PPI does not maintain its own fleet of transport units. It relies mainly on private transport operators.

In order to meet fertilizer requirements even in remote areas PPI regionalized their warehousing operations into four districts. As of March 1981, warehouse capacity was 376,997 metric tons distributed over 24 base-point warehouses. Eleven of these warehouses have a combined capacity of 189,000 metric tons and are located in Luzon; thirteen are in the Visayas with a combined capacity of 124,550 metric tons and the other four are located in Mindanao with a combined capacity of 63,447 metric tons. Satellite warehouses are also used aside from the base-point warehouses. The warehousing facilities serving as the supply points

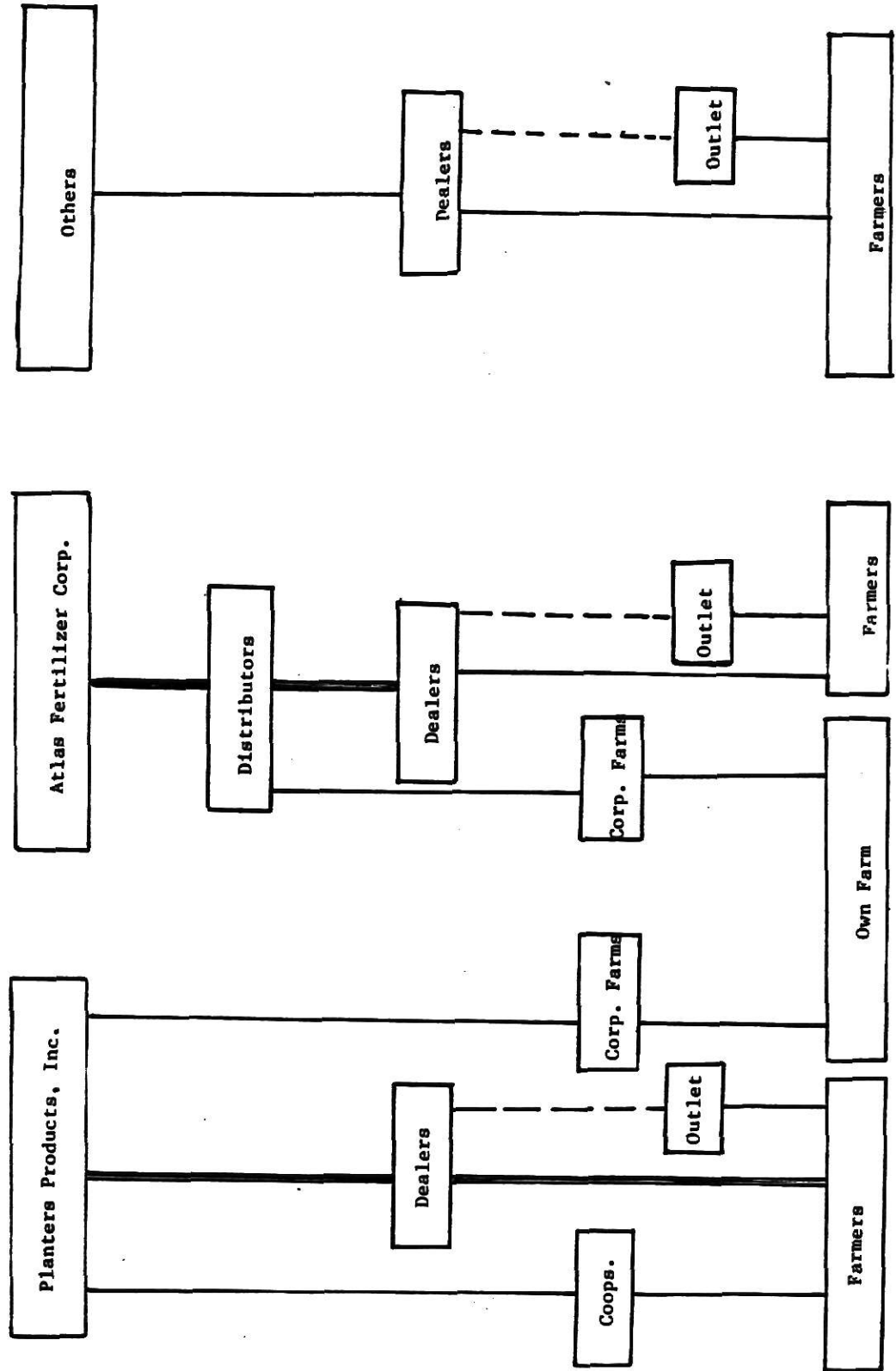
Table 5

SALES AND MARKET SHARES OF PHILIPPINE FERTILIZER
MARKETING COMPANIES, 1978-1980
(Thousand Metric Tons)

<u>COMPANY</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>% SHARE OF MARKET</u>		
				<u>1978</u>	<u>1979</u>	<u>1980</u>
Planters Products Inc. (PPI)	550.8	578.5	548.7	69.2	68.4	67.0
Atlas Fertilizer Corp. (AFC)	132.7	146.6	108.4	16.7	17.3	13.2
Sugar Producers Cooperative Marketing Assn. (SPCMA)	47.3	42.8	52.8	6.0	5.1	6.4
Maria Cristina Fertilizer Corp. (MCFC)	43.2	53.7	73.5	5.4	6.4	9.0
Others (Chemphil, Fermap)	21.6	27.1	36.2	2.7	2.8	4.4
Total	795.6	840.3	819.6	100.0	100.0	100.0

Source: Fertilizer and Pesticide Authority (Unpublished).

Figure 3. Fertilizer Distribution Systems by Fertilizer Distributing Companies



in the various demand areas of the country are shown in Table 6 and Figure 4.

PPI has a more extensive dealer network throughout the country than the other firms (Table 7). PPI aims at appointing one dealer in each of the main municipalities. The dealers are supplied from PPI's regional warehouses. The dealers serve sub-dealers and retailers, estates and haciendas but these dealers, sub-dealers and retailers are required to handle PPI products exclusively. Every PPI dealer is required to set up a demonstration farm.

Atlas Fertilizer Corporation (AFC) does not directly distribute fertilizer to dealers and outlets, but deals through 30 big independent distributors, equally spread over the country who in turn appoint and maintain their respective outlets. Each distributor maintains his own network.

The company does not maintain a warehouse system. This is done by distributors themselves. However, it has three small warehouses, one in Luzon and two in Visayas, with a total capacity of 9,000 metric tons.

Maria Christina Fertilizer Corporation (MCFC) is the only company which has made sizeable investments in transportation. It owns a 30,000-bag capacity cargo ship (about 1360 metric tons) and a tanker for up to 200 metric tons of liquid ammonia. The problems of high cost of barging and of being dependent on the crowded schedules of inter-island shipping lines were the primary factors in the investment decision and this was also necessitated by the long distance from their Mindanao plant to bigger markets of Luzon and Visayas.¹³

¹³Eric O. de Guia, Fertilizer Distribution in the Philippines, Development Centre of the Organization for Economic Cooperation and Development (Paris, 1970), p. 47.

Table 6

PPI WAREHOUSE LOCATIONS AND CAPACITIES IN METRIC TONS

<u>LOCATION</u>	<u>CAPACITY</u>
PHILIPPINES, Total	376,997
LUZON WAREHOUSES	189,000
Northern Luzon:	
Poro Point, La Union	17,000
Santiago, Isabela	10,600
Central Luzon:	
Balagtas, Bulacan	16,000
San Simon, Pampanga	7,500
Cabanatuan, Nueva Ecija	33,500
Tarlac, Tarlac	11,300
Urdaneta, Pangasinan	8,000
Pilar, Bataan	3,000
Metro Manila:	
Southern Luzon:	
Bauan, Batangas	8,000
Tabaco, Albay	8,000
VISAYAN ISLANDS WAREHOUSES	124,550
Eastern Visayas:	
Cebu	13,300
Ormoc Leyte	5,300
Western Visayas:	
Iloilo	22,100
Roxas	4,200
Negros	79,650
MINDANAO WAREHOUSES	63,447
Northern Mindanao:	
Cagayan de Oro	6,740
Ozamis	3,800
Southern Mindanao:	
Davao	38,317
General Santos	9,590
Western Mindanao:	
Iligan	5,000

Figure 4. PPI Warehousing Facilities

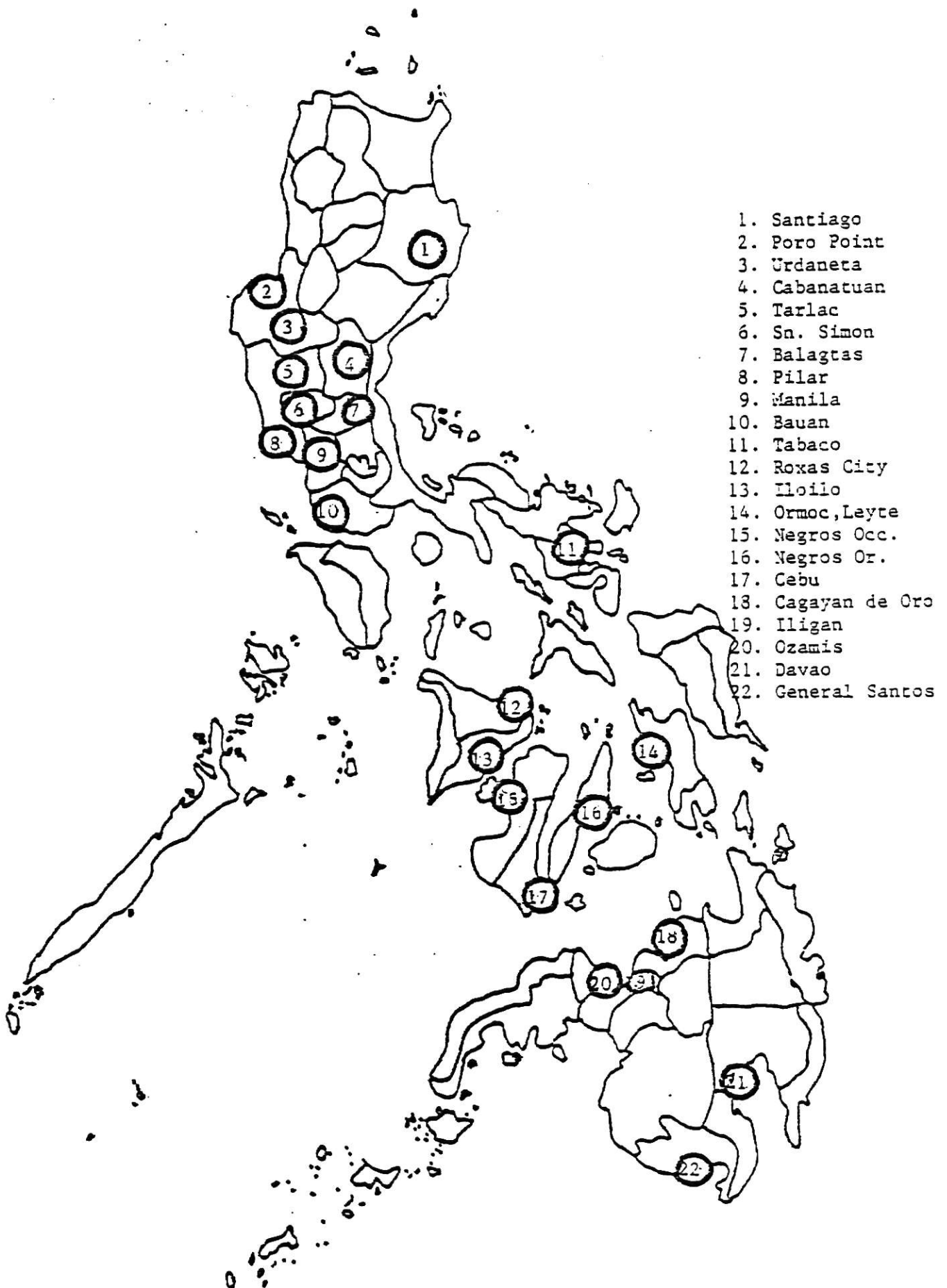


Table 7
REGIONAL DISPERSAL OF DEALER/OUTLET BY COMPANY
(May 31, 1980)

<u>REGIONS</u>	<u>COMPANY</u>						<u>TOTAL</u>
	<u>PPI</u>	<u>AFC</u>	<u>MCPC</u>	<u>CHEMPHIL</u>	<u>FERMAP</u>	<u>SPCMA</u>	
LUZON:	779	606	124	42	81	13	1,645
Ilocos	152	89	9	2	9	-	261
Cagayan	77	83	1	-	12	1	174
Central Luzon	243	197	22	19	38	5	524
Southern Tagalog	214	142	69	18	14	4	461
Bicol	93	95	23	3	8	3	225
VISAYAS:	426	239	15	1	23	28	732
Western Visayas	255	133	12	1	1	27	429
Central Visayas	131	77	3	-	4	-	215
Eastern Visayas	40	29	-	-	18	1	88
MINDANAO:	409	261	74	-	92	-	836
Western Mindanao	52	-	-	-	3	-	86
Northern Mindanao	122	88	7	-	22	-	239
Eastern Mindanao	105	85	33	-	44	-	267
Southern Mindanao	130	57	34	-	23	-	244

Source: Fertilizer and Pesticide Authority (Unpublished).

MCFC maintains six main warehouses with a total capacity of 52,500 metric tons: one is located in Luzon, three in Visayas and two in Mindanao.

The company subcontracts with its sister company, Polaris Marketing Corporation, for the sale and distribution of its own brand ammonium sulfate and other fertilizers. However, MCFC also handles direct sales to its distributors and outlets. It combines the two approaches of utilizing big distributors and its own exclusive retail outlets.

Chemical Industries of the Philippines, Incorporated (CHEMPHIL) concentrates its efforts on the markets of Luzon, using what it calls a "most-favored-distributor" approach. As many outlets as possible are sought in a given area and on the basis of sales performance, a chosen distributor is offered special concessions in exchange for taking responsibility for local market development. It limits its distribution activities mainly in Luzon.

Sumitomo Shoji Kaisha, Ltd., the country's sole supplier of imported ammonium chloride, is relatively new in the market. After its quite successful entry in Central Luzon market, it has started to penetrate the Visayas market. It has its own distributors to take care of its outlets.

Sugar Producers Cooperative Marketing Association (SPCMA) distributes its imported fertilizer through a network of sugar cooperatives in the country.

Fifty percent of the total fertilizer warehouse capacity is in Luzon, 30 percent in Visayas and 20 percent in Mindanao. Of the total

capacity, PPI has 61 percent, MCFC 16 percent, SPCMA 12 percent, Atlas two percent, and the others nine percent.¹⁴

Physical Movement of Fertilizers

The intricate Philippine geography and the poor road network has caused fertilizer movement to be a critical problem. Fertilizer movement, as described by E. O. de Guia in Fertilizer Distribution in the Philippines is still true today.¹⁵

A bag of fertilizer leaving the plant will probably be loaded on a truck, hauled to a port where it is unloaded, then reloaded on a seagoing vessel. The same bag, upon reaching a designated port-of-call, will again be unloaded to the pier, perhaps to be reloaded upon a barge for towing to an adjoining island which has no deep-water bays for ocean liners to dock. Unloaded from the barge, it is once again loaded onto trucks to be hauled to a warehouse to be unloaded and piled. Beyond these could be many more changes before the bag is found on the farmer's carabao-drawn cart.

As mentioned earlier, each company has its own marketing network covering the entire country. PPI's marketing network requires considerable transshipment from plant-site warehouses to the company's various base-point warehouses.

Distribution of fertilizer, from plant site or port of landing to major company warehouse and then to distributors and/or dealers is carried out by different modes of sea and land transportation.

A recent survey revealed that 45 percent of all fertilizer grades were moved by trucks and other land transportation and 55 percent by means of barges and other sea transportation.¹⁶

¹⁴Miguel M. Zosa, Administrator, Fertilizer and Pesticide Authority, "The Philippine Domestic Fertilizer Marketing Situation," 1981.

¹⁵de Guia, Fertilizer Distribution in the Philippines, p. 81.

¹⁶Zosa, "The Philippine Domestic Fertilizer Marketing Situation."

Inter-island movement of fertilizer uses three modes of transport:

- a) commercial inter-island vessel
- b) barge
- c) combinations of commercial inter-island vessels and barges.

Large fertilizer shipments are usually transported by barges, while small fertilizer shipments are transported by commercial inter-island vessels.

In May, 1974, the Fertilizer Industry Authority calculated the number of barges (with corresponding tugboats) needed to support the movement of fertilizers from the plant-site warehouses or pier warehouses to the industry warehouses. Based on an assumption of an annual requirement of one million metric tons, of which around eight hundred thousand are to be barged to various supply points, it was estimated that 27 to 58 barges are required monthly, depending on the seasonality of fertilizer demand (Table 8).¹⁷

Inland movement of fertilizer is mainly by cargo trucks. The fertilizer firms enter into hauling contracts with trucking companies and the trucking rates vary from area to area depending on road conditions, hauling distance, opportunity for backhaul arrangements and competition among trucking firms.

Fertilizer movement of PPI is handled by a large number of barge contractors and trucking companies. Movement from the plant site and in Luzon is usually completed within 24 hours. Transport to Visayas takes

¹⁷"The Philippine Fertilizer Industry Situation, Historical and Projected," April, 1975.

Table 8

ESTIMATED BARGING REQUIREMENTS
Tonnage to be Barged to Supply Points
(Thousand Metric Tons)
1974

MONTH	NORTHERN AND CENTRAL LUZON S. TAGALOG	EASTERN VISAYAS/ N. MINDANAO		WESTERN VISAYAS	SOUTHERN MINDANAO	TOTAL	NO. OF BARGES REQUIRED*
		BICOL	N. MINDANAO				
January	43.8	5.3	7.0	40.0	5.2	101.3	58
February	13.1	2.1	5.1	46.8	5.3	72.4	42
March	29.1	1.9	3.3	43.3	9.5	87.1	50
April	5.7	3.1	8.2	50.0	2.7	69.7	40
May	15.6	5.5	10.2	30.8	3.7	65.8	38
June	12.3	5.4	7.2	18.1	5.3	48.3	28
July	12.7	5.3	15.0	36.7	6.3	76.0	44
August	22.6	4.9	12.4	36.6	5.7	82.2	47
September	0.5	3.1	8.8	21.0	4.4	37.8	22
October	21.5	2.6	6.2	17.2	5.2	52.7	30
November	25.1	4.9	7.1	20.7	6.7	64.5	37
December	10.0	5.9	8.4	16.8	5.7	46.5	27
Total	212.0	50.0	98.9	378.0	65.7	804.6	

* Average unit load = 700 MT.

Source: FPA (Unpublished).

two days for a self-propelled vessel, whereas the transport time to Mindanao is three days for a similar vessel.¹⁸

¹⁸FADINAP, Marketing, Distribution, and Use of Fertilizer in the Philippines, p. 25.

CHAPTER IV

THE ANALYTICAL MODEL

This study uses a transportation linear programming model for computerized determination of least cost transportation routes and use of storage sites for distribution of complete fertilizer from Planters Products Incorporated supply point at Limay to market distribution points in 23 provinces. A routing and storage plan is determined within existing facility and data constraints. Additional uses and limitations of the model are both identified through the demonstration of the use of the model.

The transportation linear programming model is designed for more general purposes but in this case it is adapted to solving shipping routes and distribution patterns for complete fertilizer in the study setting already described. The model utilizes a mathematical linear programming technique. The distribution costs are minimized mathematically, subject to a set of constraints regarding transportation networks and storage facilities.

The inputs required for the transportation linear program are: (1) supply quantities, (2) demand quantities, and (3) the cost network connecting the supply points with the demand points. Supply quantities are the complete fertilizer produced by PPI and the available stock in the PPI warehouses. Demand quantities are the prorated complete fertilizer consumption requirements by each of 23 provinces prorated among suppliers and the inventory by the warehouses. The optimum routing

networks connecting the PPI plant with the base-point warehouses and the provinces include highway and water networks.

The cost and requirement table for the transportation problem appear like this:

D E S T I N A T I O N S							
O R I G I N	i j	1	2	3	. . .	n	S _i
	1	C ₁₁	C ₁₂	C ₁₃	. . .	C _{1n}	S ₁
	2	C ₂₁	C ₂₂	C ₂₃	. . .	C _{2n}	S ₂
	3	C ₃₁	C ₃₂	C ₃₃	. . .	C _{3n}	S ₃
	.						
	:						
	:						
m	C _{m1}	C _{m2}	C _{m3}	. . .	C _{mn}	S _m	
	d _j	d ₁	d ₂	d ₃	. . .	d _n	

Where:

$i = 1, 2, 3, \dots, m$ is the number of origins

$j = 1, 2, 3, \dots, n$ is the number of destinations

In the problem $i = 10$, namely, the PPI plant, Philippine Phosphatic plant and the eight PPI base-point warehouses and $j = 33$; the plant's storage demand points and the 23 provincial capitals of the provinces in the selected three regions.

The problem requires shipping the surplus of complete fertilizer $s_1, s_2, s_3, \dots, s_m$ from the supply points to satisfy the demand requirements $d_1, d_2, d_3, \dots, d_n$ of the destination points at minimum transportation cost. The objective function can be written as follows:

$$\text{Minimize } S = C_{11}X_{11} + C_{12}X_{12} + \dots + C_{21}X_{21} + C_{22}X_{22} + \dots \\ \dots + C_{mn}X_{mn}$$

or

$$S = \sum_{i=1}^n \sum_{j=1}^m C_{ij}X_{ij}$$

S = represents the total distribution cost

C_{ij} = transportation cost of shipping one metric ton of complete fertilizer from origin i to destination j , identified by mode

X_{ij} = corresponds to metric tons of complete fertilizer shipped from plant i to destination j

s_i = shipping requirements at point $i = 1, 2, 3, \dots, m$ or the individual quantities available for shipping at each origin

d_j = receiving requirements at point $j = 1, 2, 3, \dots, n$ or the individual quantities required at each destination;

$j = 1, 2, 3, \dots, n$

The above function is subject to the following constraints which must be satisfied:

$$\sum_{j=1}^n X_{ij} = S_i \quad \text{for } i = 1, 2, 3, \dots, m$$

Fertilizer shipments of the plant and warehouses must equal the capacity of the supply points.

The second restriction is:

$$\sum_{i=1}^m X_{ij} = d_j \quad \text{for } j = 1, 2, 3, \dots, n$$

Total fertilizer shipments to each demand point must equal the requirements of the locality.

Lastly the problem solution requires that:

$$X_{ij} \geq 0 \text{ for all } i\text{'s and } j\text{'s}$$

since negative quantities have no meaning.

The variable in the linear programming analysis is the shipment pattern--quantities of complete fertilizer to be handled from the plant and warehouses to the 23 demand points and nine storage demand points. The model assumes that the demanded quantities and per unit distribution costs for the month are known at the beginning of the month, and the allocation is done accordingly. It allocates the surplus quantities from the multiple origin points among the deficit quantities of the multiple destination points so that requirements of all the destinations are satisfied at a minimum total cost for the system as a whole. Separate runs are done for each month to determine the optimum solution because consumption requirements vary each month.

The optimum solution for the transportation problem is achieved by the transportation simplex procedure. This procedure is characterized by repetitive steps or iterations which depends on the size of the problem. Procedures are:¹⁹

1. Start with an initial basic solution. A basic solution is a set of routes in which the number of routes used at positive levels is equal to the number of restraining equations, i.e., the number of origins plus destination less one.
2. The basic solution satisfies all the restrictions, but does not necessarily correspond to minimal transportation costs. Each

¹⁹Robert Dorfman, Paul Samuelson and Robert Solow, Linear Programming and Economic Analysis (New York, Toronto and London: McGraw Hill Inc., 1958).

route not used in the initial shipping plan will then be tested. For each of the routes, the cost of shipping a ton of fertilizer is inserted to determine whether it is cheaper than achieving the same result indirectly by means of the routes included in the initial solution.

3. If the direct cost of an excluded route is lower than the indirect cost of achieving the result, then total transportation cost can be reduced by introducing that route into the shipping plan and dropping one of the included routes.
4. If it still is not the optimal solution, another iteration is done until the optimal is found, wherein the distribution patterns are created that give the most efficient and least costly for the transfer of complete fertilizer.

CHAPTER V

DATE REQUIREMENTS OF THE MODEL AND DATA DEVELOPMENT

A. Data Requirements of the Model

The basic set of inputs required in the model are the a) transportation network requirement, b) supply requirement by origin, and c) demand requirements by destination.

Transportation Network Requirement. This input indicates the shortest route connecting a source (i) and a destination (j). A set of connections is chosen to provide a route between any two points of a network in such a way as to minimize the total length of these connections. The minimum transportation cost by mode of transferring one unit of a product from i to j is developed representing the least cost distribution network of alternative modes. The final requirement is itself the result of a series of substeps: a) mode identification and link measurement for different modes of transportation, b) basic network is constructed for all potential links, c) development of minimum distance routing network, d) finding the transportation cost function, e) development of least cost distribution network for each mode of transport, and f) combining the least cost distribution networks for both modes.

Supply Requirement. The plant and warehouses are the sources of the product. Supplies are the available production capacity at the plant and available stock inventory at warehouses.

Demand Requirements. The demands are the potential sales of the products at the destination points.

B. Data Development

The methodology used in developing the input requirements relied mostly on Volume I and II of User's Guide to Computerized System for Feasible Agribusiness Development.²⁰ It uses a series of subprograms to generate the required final inputs for the Transportation Linear Programming model. The complete system showing the individual computer programs, the step by step approach, intermediate, and final results are shown in Figure 5.

1. Node Identification and Link Measurement

An up-to-date map of the country was used to determine exactly the supply and demand points. Each supply or demand point was known as a node, and each node was connected to another via highways or waterways which are known as links.

Unique numbers to each location were assigned consecutively. Numbers 001-009 were provided for the supply points; 010-049 for the internodes; 050-099 warehouses; 100-199 demand points and 200-299 were assigned to ports. These are all listed in Table 9.

A road map was used in locating and identifying the nodes which were connected to each other by a highway or waterway. This was done by measuring all the alternative highway and other transport mode link distances between two adjacent nodes. The type and condition of roads were taken into account. The second class roads were adjusted to first class roads by multiplying the measured distance in a second class road by two. This figure was used considering the variable cost per mile in a second

²⁰Richard Phillips, Leonard Schruben, and Joe Tiao, User's Guide to Computerized System for Feasible Agribusiness Development, Food and Feed Grain Institute, Kansas State University, Manhattan, Kansas, May, 1975.

Figure 5. Schematic Diagram of Procedural Approach to Linear Transportation Analysis

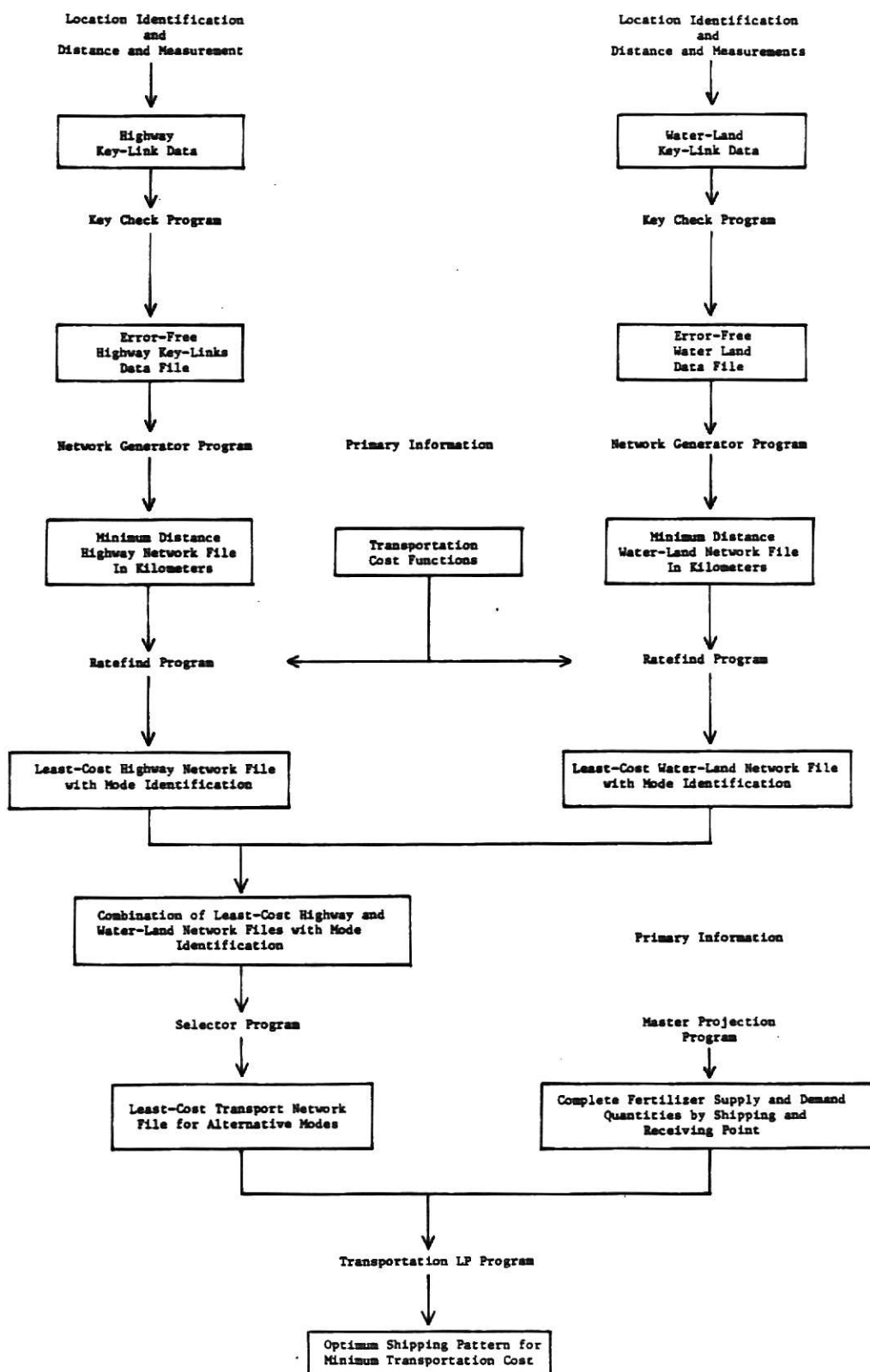


Table 9

TRANSPORT NETWORK LOCATION NAMES AND CODE NUMBERS

<u>LOCATION NAME</u>	<u>CODE NUMBER</u>
<u>Supply Points</u>	
A. Fertilizer Plants:	
Limay	001
Isabel	002
B. Fertilizer Warehouses:	
Pilar	050
Tarlac	051
Cabanatuan City	052
San Simon	053
Balagtas	054
Metro Manila	055
Bauan	056
Tabaco	057
<u>Demand Points</u>	
A. Provincial Capitals:	
Balanga	100
Iba	101
Tarlac	102
Cabanatuan City	103
Baler	104
San Fernando	105
Malolos	106
Pasig	107
Trece Martires	108
Batangas	109
Sta. Cruz	110
Lucena City	111
Daet	112

Table 9 (Continued)

<u>LOCATION NAME</u>	<u>CODE NUMBER</u>
Naga City	113
Legaspi City	114
Sorsogon	115
Puerto Princesa	116
Mamburao	117
Calapan	118
Boac	119
Romblon	120
Masbate	121
Virac	122
B. Storage Demand Points:	
Limay	123
Isabel	124
Pilar	150
Tarlac	151
Cabanatuan City	152
San Simon	153
Balagtas	154
Metro Manila	155
Bauan	156
Tabaco	157

class road. The distances between links in the road map were used in measuring the distance in the highway and a pair of dividers was used in measuring the distances in the waterway.

The provinces under study include several islands, and because of this geographical characteristic, a separate run for the land transport is needed for each island. To avoid this by running only one complete set of highway links for all the provinces a dummy distance was used to determine the highway distance between a node in one island and a node in another island. A distance of 1000 kilometers was used for each inter-island road distance so that these routes would not enter into the final solution.

After identifying the nodes and measuring the links, the key-link distance data were coded and punched to computer cards in preparation for the key check program run.

2. Basic Network

A Keycheck Program was used, which resulted in a basic network containing all potential links. This program checked the primary network input data for duplicate links and nodes, lack of connecting links, paired numbering of i's and j's and keypunch errors. After correcting the errors, final output contains 1) a listing of the original key-link data, 2) a listing of sorted key-link input, 3) a listing of all links serving each node, and 4) a summary table of links for each mode.

Both the highway and the waterway key-link data were analyzed for errors. The two separate runs resulted in two separate basic networks containing error-free highway and waterway links between the supply points: PPI plant and PPI warehouses and the demand point.

3. Minimum Distance Network

The corrected key-link deck from the Keycheck Program was used as the key data for the development of an optimum routing network for each mode. The minimum or the optimum distance routing network was developed from the basic network of each mode in which each link had an associated length and the Network Program found the shortest route from a specific node to each of the other nodes. The total minimum distances between each pair of nodes in the system were stored on magnetic tape.

The basic assumption here was that given no undue constraints, any commodity will travel the shortest distance between shipping point and receiving point.

4. Transportation Cost Functions

Transportation functions are represented by linear equations, expressed as $Y = A + BX$

Where:

Y = total cost of shipment per ton

A = constant (fixed cost per ton hauled)

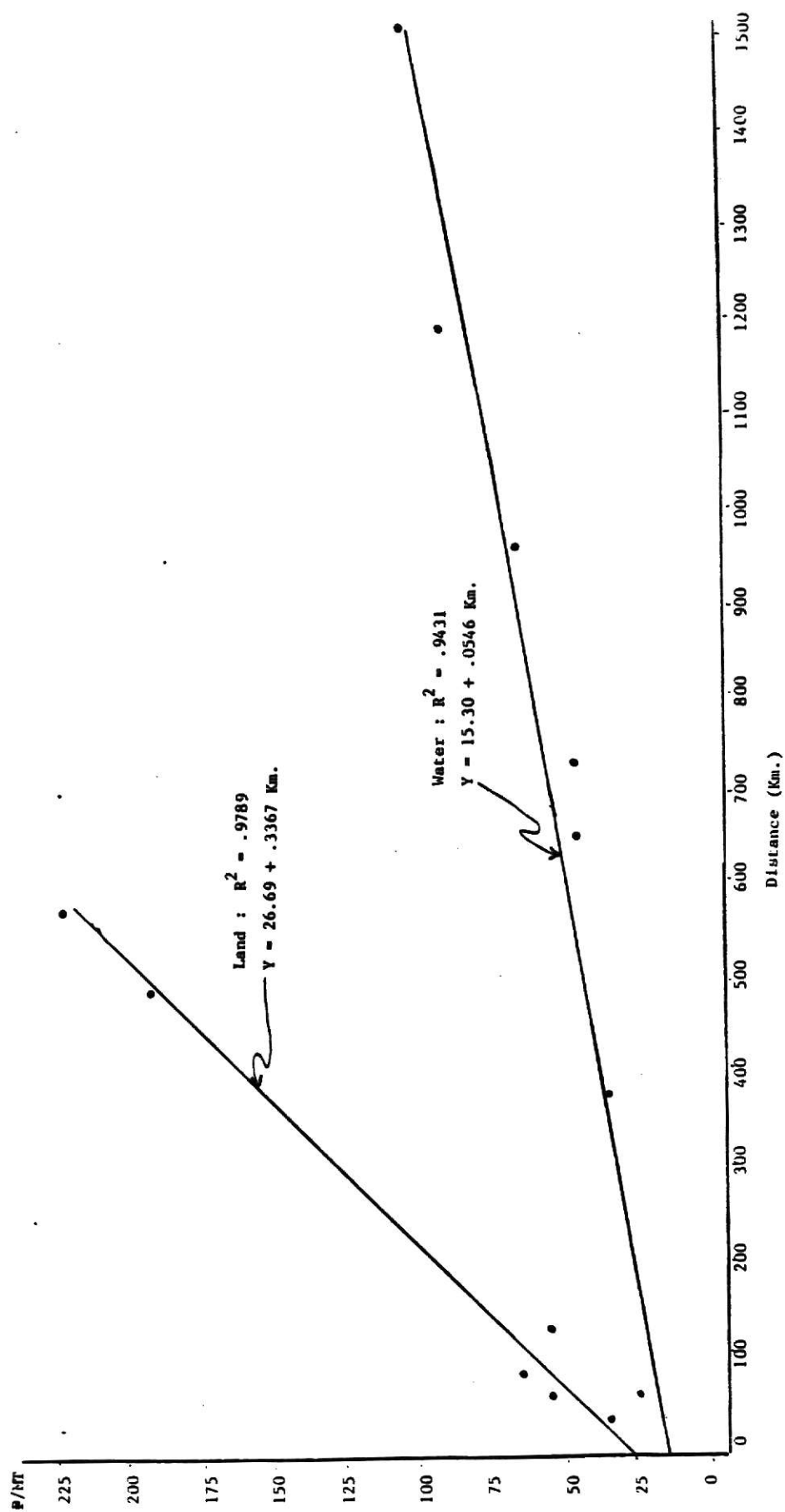
B = cost per kilometer

X = distance in kilometer

Truck Transportation Cost Function

The basic data for the development of the truck transportation cost function were obtained from the transportation rates in 1967 and adjusted to 1980 by using 14 percent inflation rate. Figure 6 represents the regressed rates against distance. The land transportation cost function ($Y = 26.69 + .3367 \text{ km.}$) does not include the handling cost. The fixed cost represents the minimum cost for a movement without taking into

Figure 6. Transportation Cost Functions for Land and Water



consideration the distance and the variable costs which are associated with the distance in the linear function.

Truck rates show that trucking charges per metric ton-kilometer decrease as distance becomes greater. Likewise, different rates for the fertilizer cargoes are charged in different areas. This could be attributed to the state of competition among truckers; frequency of trucking schedules, better road conditions and the like. Manila has relatively high rates, because of heavy demand for cargo space (Table 10).²¹

Truck operating costs consists of: 1) variable costs which are associated with distances, 2) fixed costs, and 3) transfer costs which consists of loading and unloading process.

Variable costs include fuel, tire cost, oil and lubrication cost, maintenance and repair cost. They are calculated as variable cost per kilometer of operation.

Certain truck costs remain the same regardless of kilometers driven. These costs are considered fixed. Fixed costs include interest, depreciation, license fees, insurance costs, administrative expense and drivers and helpers wages.

Drivers and helpers wages are considered fixed if they are paid a monthly salary but these wages could also be a variable cost if the driver and helper are employed and their wage costs increase according to the time spent on the road and the distance traveled. In the situation wherein wages are variable, wage costs are considered part of the operating costs.

²¹de Guia, Fertilizer Distribution System in the Philippines, p. 70.

Table 10

COMPARATIVE COSTS OF LAND TRANSPORT (1967)

ROUTE	MODE b	KM	P/MT	P/BAG	P PER MT/KM d
	1	2	3	4	
Luzon:					
More than 70 kms.					.097(Ave)
Manila-San Fernando	Tr	77	12.00(3.07)	.60	.155
Manila-Tuguegarao	Tr	482	35.00(8.97)	1.75	.072
Limay-Tarlac	Tr	130	10.00(2.56)	.50	.076
Limay-San Isidro	Tr	121	10.00(2.56)	.50	.082
Manila-Legaspi	RR	571	40.00(10.25)	2.00	.070
Less than 70 kms.					.21(Ave)
Manila-Canlubang	Tr	50	10.00(2.56)	.50	.20
Manila-Polo	Tr	30	6.60(1.69)	.30	.22
Visayas:					
More than 70 kms.					.144(Ave)
Iloilo-Roxas	Tr	120	22.00(5.64)	1.10	.183
Iloilo-Farthest Dealer	RR	100	5.00(1.28)	.25	.05
Bacolod-Sagay	Tr	200	30.00(7.69)	1.50	.15
Bacolod-Binalbagan	Tr	88	11.44(2.93)	.57	.13
Bacolod-Binalbagan	Tr	71	9.23(2.36)	.46	.13
Bacolod-Davao	Tr	75	9.75(2.49)	.49	.13
Less than 70 kms.					.157(Ave)
Iloilo-Ave. Dealer	Tr	50	12.00(3.07)	.60	.24
Pulupundan-Ave. Plantation	Tr	30	4.40(1.12)	.20	.146
Toledo-Cebu	Tr	50	6.60(1.69)	.30	.135

Table 10 (Continued)

ROUTE	MODE b	KM	P/MT		P/BAG	P PER MT/KM d
			1	2		
Bacolod-Silay	Tr	18	2.76(0.70)		.14	.153
Bacolod-Victorias	Tr	33	4.56(1.16)		.23	.136
Bacolod-La Carlota	Tr	46	6.12(1.56)		.30	.133
Mindanao:						
More than 70 kms.						
Davao-Cotabato	B	215	32.00(8.20)		1.60	.18(Ave)
Davao-Tinapauan	B	173	26.40(6.76)		1.20	.148
Davao-Bansalan	Tr	76	22.22(5.69)		1.01	.152
Cagayan de Oro-Iligan	Tr	100	13.00(3.33)		.65	.292
						.13
Less than 70 kms.						
Davao-Calina	Tr	30	8.80(2.25)		.40	.266(Ave)
Davao-Mintal	Tr	17	4.84(1.24)		.22	.293
Cotabato-Midsayap	B	50	10.00(2.56)		.50	.284
						.22

Note: a. Figures in parenthesis are dollar equivalents: ₱3.90 = \$1.00.

b. Symbols: RR = railroad TR = truck B = Bus

c. (3) : 20

d. (3) : (2)

e. Averages excluding railroad.

Source: Eric de Guia, Fertilizer Distribution in the Philippines, p. 137.

In this study, actual transportation rates per metric ton per specific trip were used and these data were regressed against distances.

Barge Transport Cost Function

The water transport cost function that was developed was:

$Y = 15.30 + .0546 \text{ km.}$ Handling cost was not included in this function and also as dictated by the geography of the country show that water transportation is a very promising route.

Fertilizer movement over water involves lower costs per ton kilometer compared to similar distances over land but then, if the cargo will move only from one seaport to another. Warehouses are situated inland and dealers are scattered close to the farmers. Therefore, a bag of fertilizer will be handled several times, transferring from truck to barge, then from barge to truck, and from truck to warehouse; thus raising the distribution costs.

As of 1975 transportation cost of fertilizer usually ranges from 10-20 percent of the retail price and 20-50 percent of the total marketing costs.²²

Handling Cost

The primary data used for calculating handling cost was the inflated rates reported for 1968 at major ports adjusted for price level changes as shown in Table 12. The data reflects that handling costs are not standardized in the Philippines, because in some areas stevedoring firms are in a position to dictate their prices. In areas where competition

²²Chong-Yeong Lee, "Fertilizer Marketing for Small Farmers in Asian Countries," Food and Agriculture Organization of the United Nations Regional Office for Asia and Far East (Bangkok, June, 1975), p. 14.

Table 11
SEA TRANSPORT COSTS, 1968

<u>ROUTE</u>	<u>MODE</u>	<u>DISTANCE (NAUTICAL UNITS)</u>	<u>PRICE PER MT (P)*</u>
I. Intra-Luzon			
Manila-Legaspi	barge	353	15.00 (3.84)
Manila-San Fernando (La Union)	barge	200	11.00 (2.82)
Manila-Manila Bay Area	barge	30	8.50 (1.79)
II. Luzon-Mindanao			
Manila-Iligan	barge	521	21.00 (5.38)
Manila-Cotabato	barge	650	28.00 (7.17)
Manila-Davao	barge	814	32.00 (8.20)
III. Luzon-Visayas			
Manila-Cebu	barge	390	14.00 (3.58)
Manila-Cebu	commercial	390	18.00 (4.61)
Manila-Bacolod	barge	348	14.00 (3.58)
IV. Visayas-Mindanao			
Cebu-Iligan	commercial	130	12.00 (3.07)
Cebu-Cagayan de Oro	commercial	130	10.00 (2.56)
Cebu-Cotabato	commercial	260	17.60* (4.51)
Cebu-Dadiangas	commercial	300	21.00* (5.38)
Cebu-Davao	commercial	424	19.36* (4.96)
Iligan-Cebu	owned	130	5.50 (1.41)
Iligan-Pulupundan	owned	130	
V. Intra-Visayas			
Bacolod-Iloilo	barge		8.00 (2.05)
Iloilo-Ormoc	barge		14.00 (3.58)
VI. Inland Waterways Lighterage			
Iloilo-inland	barge		4.00 (1.02)
Cotabato-in river	barge		4.40 (1.12)
Manila-Pasig in river	barge		5.95 (1.52)

*Based on average quotations of dealers located in respective areas.

Source: Eric de Guia, Fertilizer Distribution in the Philippines,
p. 64.

Table 12
DIFFERENCES IN HANDLING COSTS OF BAGGED FERTILIZERS
AT MAJOR PORTS, 1968

PORT	HANDLING CHARGES PER METRIC TONS		% OF COST 1 MT OF A.S.*	COST/50 KG. BAG (P)
	P	\$ US		
Luzon (average)	5.50	1.41		
Manila	7.00	1.79	2.6	0.32
Legaspi	4.00	1.02	1.5	0.20
Visayas (average)	4.50	1.15		
Bacolod	4.00	1.02	1.5	0.20
Iloilo	5.00	1.27	1.8	0.24
Mindanao (average)	8.00	2.05		
Davao	7.30	1.87	2.7	0.34
Cotabato	7.15	1.83	2.6	0.32
Dadiangas	9.60	2.46	3.5	0.48
Cagayan de Oro	12.00	3.07	4.5	0.60

* 1 metric ton of Ammonium Sulfate (AS) ex-factory = P 269.50.

Source: Eric de Guia, Fertilizer Distribution System in the Philip-
pines, p. 65.

prevails, loading and unloading charges are driven to lower levels.²³

In this study, the handling cost for truck transportation was calculated to be only ₱18.79 per metric ton. This includes the loading to the truck and unloading from the truck and stocking in a warehouse. While in the combined mode of transport, handling cost was quite high--three times higher than in land transport. The amount of ₱56.22 includes the loading to the truck and unloading from the truck, loading on a barge and unloading from the barge and reloading to a truck and unloading from the truck again and then stocking in a warehouse.

The weight of handling costs becomes even more burdensome to fertilizer consumers when one recognizes how many more times the cargo changes mode of transport enroute to the retail outlets scattered on other islands, and beyond the ports on the way to the farm. Transport savings from water transport tend to be offset by higher handling costs than for highway transport.

Rough handling at loading and unloading points at various ports and warehouses will result in weight loss in bagged fertilizer. The loss tends to be higher because almost no machinery, only human labor, is used in handling fertilizer.²⁴

Warehousing Costs

FPA requires all fertilizer producers and importers to hold a minimum stock level equivalent to a three-month supply. On January, 1979, this requirement was met for almost all fertilizer products (Table 13). The

²³de Guia, Fertilizer Distribution System in the Philippines, p. 65.

²⁴Lee, "Fertilizer Marketing for Small Farmers in Asian Countries," p. 15.

Table 13
FERTILIZER STOCKS, JANUARY 1979

<u>FERTILIZER PRODUCT</u>	<u>QUANTITY (IN THOUSAND MT)</u>	<u>EQUIVALENT MONTH SUPPLY</u>
Urea	106.8	4.5
Ammosul, Anchlor	41.9	2.9
P and NP	47.1	4.5
NPK	43.1	3.5
Potash	21.7	4.3
Total	260.6	4.0

Source: FPA (Unpublished).

average warehousing costs per metric ton in Luzon warehouses is reflected in Table 14. Warehousing costs include materials and supplies, contracted labor, pallets, security services, janitorial and messengerial, realty rental, electricity and water, depreciation, insurance, and other warehousing expenses.

The large inventories of complete fertilizer and the near self-sufficiency in these products led to the exports to Indonesia and Thailand of 22.3 and 10.0 thousand metric tons of phosphorous (P) and nitrogen and phosphorous (NP) fertilizer respectively in 1977 and 1978. However because production costs were much higher than the negotiated export prices, losses had to be compensated through government subsidies. These exports appear to have been merely a means to dispose of the excess supply of fertilizer grades. This had happened because of the high cost of fertilizer stockpiling in 1974.²⁵

5. Least Cost Distribution Network

The least cost distribution network for complete fertilizer reflects the minimum distance routing network for a particular mode and the appropriate mode transportation function of the same commodity. Therefore, the least cost distribution network was developed by multiplying each link in the minimum distance network by the appropriate mode transportation cost function for the complete fertilizer. The program used is called the Ratefind Program. The least cost distribution network from the complete fertilizer plants (001 and 002) and eight base-point warehouse (050-057) to twenty-three provincial capitals (100-122), the plant

²⁵FADINAP, Marketing Distribution and Use of Fertilizer in the Philippines, p. 21.

Table 14

AVERAGE WAREHOUSING COST PER METRIC TON
IN LUZON WAREHOUSES (1980)

	<u>AVE. WAREHOUSING COST PER MO. (P)</u>	<u>AVE. MONTHLY INVENTORY (MT)</u>	<u>AVE. MONTHLY WAREHOUSING COST PER/MT (P)</u>
Poro Point	109,634	10,615	10.33
Urdaneta	58,915	4,363	13.50
Tarlac	66,132	5,780	11.44
Santiago	67,374	7,072	9.53
Pilar	24,363	1,459	16.70
Cabanatuan	164,327	18,194	9.03
Inviernes	197,860	16,156	12.25
Tabaco	29,232	2,118	13.80
San Simon	44,831	3,235	13.86
Balagtas	109,828	7,733	14.20
Bauan	45,636	3,605	12.66

Source: FPA (Unpublished).

storage demand point (123) and the storage demand points (150-157) were developed.

The distribution cost from the warehouse to the same warehouse, serving as the storage demand is the average warehousing cost for one month.

The computer output of the first three programs: the Keycheck Program, the Network Program and the Ratefind Program were not reproduced herein.

6. Combined Least Cost Distribution Networks for Both Modes

A Selector Program was used to have a single least-cost transportation network file. The least-cost highway and waterway network files were combined in such a manner that all points (or any pair of supply and demand points) were connected by the least cost transportation mode.

Extra transfer costs involved in changing from one mode to another was included. The results were then stored on tape. Each rate chosen from one node to another was identified with the corresponding mode associated with the rate.

The final output of the Selector Program is shown in Table 15. It combines the two transportation cost files with different modes in the master file and shows which mode either the truck alone with a code number of 11 or the truck-barge-truck combination with a code of 33 represents the least-cost means of transport from the supply points to demand points.

The following summarizes the distribution route from the origin utilizing the two sets of modes of transportation. The data was taken from Table 15.

Table 15

LISTING TRANSPORTATION COST FROM RATEFILE										PAGE 1	
ORIGIN	DESTIN	RATES	MODE	ORIGIN	DESTIN	RATES	MUDE	OPTIOIN	DESTIN	RATES	MUDE
1	103	50.817	11	1	101	88.864	11	1	102	88.191	11
1	103	89.874	11	1	104	154.521	11	1	105	66.642	11
1	106	75.396	11	1	107	74.250	33	1	108	100.349	33
1	109	102.970	33	1	110	83.368	33	1	111	135.666	11
1	112	150.989	33	1	113	121.807	33	1	114	130.816	33
1	115	128.795	33	1	116	140.098	33	1	117	103.516	33
1	118	104.608	33	1	119	110.777	33	1	120	112.088	33
1	121	120.005	33	1	122	131.962	33	1	123	62.265	11
1	124	157.624	33	1	150	66.642	11	1	151	99.302	11
1	152	98.629	11	1	153	84.824	11	1	154	93.241	11
1	155	86.098	33	1	156	116.347	33	1	157	147.141	33
2	100	142.282	33	2	101	156.641	33	2	162	134.146	33
2	103	134.638	33	2	104	176.680	33	2	165	127.649	33
2	106	125.928	33	2	107	137.914	33	2	168	125.137	33
2	109	199.194	33	2	110	128.795	33	2	111	130.324	33
2	112	121.315	33	2	113	102.642	33	2	114	97.892	33
2	115	95.872	33	2	116	157.242	33	2	117	120.660	33
2	118	107.556	33	2	119	108.976	33	2	120	100.076	33
2	121	92.159	33	2	122	94.288	33	2	123	157.351	33
2	124	62.612	11	2	150	158.662	33	2	151	145.448	33
2	152	143.756	33	2	153	142.828	33	2	154	140.516	33
2	155	150.526	33	2	156	122.571	33	2	157	114.217	33
50	100	46.440	11	50	101	84.487	11	50	102	83.814	11
50	103	85.497	11	50	104	150.144	11	50	105	62.265	11
50	106	71.019	11	50	107	75.560	33	50	108	101.522	11
50	109	104.280	33	50	110	84.679	33	50	111	131.288	11
50	112	160.307	33	50	113	123.117	33	50	114	132.126	33
50	115	130.106	33	50	116	141.408	33	50	117	104.826	33
50	118	105.918	33	50	119	112.088	33	50	120	113.398	33
50	121	121.315	33	50	122	133.273	33	50	123	66.642	11
50	124	158.935	33	50	153	80.447	11	50	154	88.864	11
50	152	94.251	11	50	153	80.447	11	50	154	88.864	11
50	155	87.409	33	50	156	117.657	33	50	157	148.451	33
51	100	82.467	11	51	101	112.770	11	51	162	45.767	11
51	103	68.326	11	51	104	132.972	11	51	105	66.642	11
51	106	75.396	11	51	107	93.241	11	51	108	93.742	11
51	109	96.363	33	51	110	97.400	33	51	111	135.666	11
51	112	152.383	33	51	113	115.200	33	51	114	124.209	33
51	115	122.189	33	51	116	133.491	33	51	117	96.909	33
51	118	98.001	33	51	119	104.171	33	51	120	105.481	33
51	121	113.398	33	51	122	125.356	33	51	123	104.689	11
51	124	151.018	33	51	150	100.312	11	51	151	56.878	11
51	152	77.080	11	51	153	84.824	11	51	154	93.241	11
51	155	105.026	11	51	156	109.740	33	51	157	140.534	33
52	100	84.157	11	52	101	114.453	11	52	102	67.652	11
52	103	45.767	11	52	104	110.413	11	52	105	68.326	11
52	106	77.080	11	52	107	94.925	11	52	108	94.452	33
52	109	97.073	33	52	110	98.110	33	52	111	137.349	11
52	112	153.392	33	52	113	115.910	33	52	114	124.919	33
52	115	122.899	33	52	116	134.701	33	52	117	97.619	33
52	118	99.711	33	52	119	104.881	33	52	120	106.191	33
52	121	114.108	33	52	122	126.065	33	52	123	106.373	11
52	124	151.727	33	52	150	101.996	11	52	151	79.437	11
52	152	54.521	11	52	153	84.824	11	52	154	94.925	11
52	155	106.709	11	52	156	110.450	33	52	157	141.244	33
53	100	65.632	11	53	101	95.935	11	53	102	71.356	11
53	103	71.356	11	53	104	136.002	11	53	105	49.807	11
53	106	51.491	11	53	107	69.336	11	53	108	81.794	11

Table 15 (cont'n)

ORIGIN	DESTIN	RATES	MODE	TRANSPORTATION COST	ORIGIN	DESTIN	RATES	MODE	ORIGIN	DESTIN	RATES	MODE
53	109	91.285	33	53	110	92.323	33	53	111	111.760	11	11
53	112	147.305	33	53	113	110.122	33	53	114	119.131	33	33
53	115	117.111	33	53	116	128.413	33	53	117	91.831	33	33
53	118	92.923	33	53	119	99.093	33	53	120	109.403	33	33
53	121	108.320	33	53	122	120.278	33	53	123	87.854	11	11
53	124	145.940	33	53	150	83.477	11	53	151	82.467	11	11
53	152	89.110	11	53	153	59.235	11	53	154	69.336	11	11
53	155	81.120	11	53	156	104.662	33	53	157	135.457	33	33
54	100	73.713	11	54	101	104.016	11	54	102	79.437	11	11
54	103	81.120	11	54	104	145.767	11	54	105	57.888	11	11
54	106	49.134	11	54	107	61.255	11	54	108	73.713	11	11
54	109	88.446	33	54	110	88.864	11	54	111	103.679	11	11
54	112	144.466	33	54	113	107.283	33	54	114	116.292	33	33
54	115	114.272	33	54	116	125.574	33	54	117	88.992	33	33
54	118	90.084	33	54	119	96.254	33	54	120	97.564	33	33
54	121	105.481	33	54	122	117.439	33	54	123	95.935	11	11
54	124	143.101	33	54	150	91.558	11	54	151	90.548	11	11
54	152	89.874	11	54	153	68.999	11	54	154	59.571	11	11
54	155	73.039	11	54	156	101.823	33	54	157	132.617	33	33
55	100	75.506	33	55	101	89.866	33	55	102	93.241	11	11
55	103	94.925	11	55	104	159.571	11	55	105	71.693	11	11
55	106	62.938	11	55	107	46.777	11	55	108	64.285	11	11
55	109	86.171	11	55	110	77.080	11	55	111	94.251	11	11
55	112	156.641	33	55	113	119.459	33	55	114	128.468	33	33
55	115	126.448	33	55	116	137.750	33	55	117	101.168	33	33
55	118	102.260	33	55	119	108.430	33	55	120	109.740	33	33
55	121	117.657	33	55	122	129.614	33	55	123	90.575	33	33
55	124	155.276	33	55	150	91.886	33	55	151	104.352	11	11
55	152	103.679	11	55	153	82.804	11	55	154	75.060	11	11
55	155	57.551	11	55	156	100.985	11	55	157	144.793	33	33
56	100	105.317	33	56	101	119.677	33	56	102	97.182	33	33
56	103	97.673	33	56	104	183.614	33	56	105	90.685	33	33
56	106	88.964	33	56	107	89.538	11	56	108	88.173	33	33
56	109	47.787	11	56	110	79.773	11	56	111	77.753	11	11
56	112	128.249	33	56	113	91.067	33	56	114	100.076	33	33
56	115	98.056	33	56	116	120.278	33	56	117	83.696	33	33
56	118	73.868	33	56	119	80.038	33	56	120	81.348	33	33
56	121	89.265	33	56	122	101.222	33	56	123	120.387	33	33
56	124	126.884	33	56	150	121.697	33	56	151	108.484	33	33
56	152	106.792	33	56	153	105.863	33	56	154	103.352	33	33
56	155	100.312	11	56	156	58.225	11	56	157	116.401	33	33
57	100	134.965	33	57	101	149.325	33	57	102	126.830	33	33
57	103	127.321	33	57	104	160.300	33	57	105	120.332	33	33
57	106	117.712	33	57	107	130.597	33	57	108	117.821	33	33
57	109	101.878	33	57	110	121.479	33	57	111	113.944	33	33
57	112	104.935	33	57	113	84.824	33	57	114	51.491	11	11
57	115	74.386	11	57	116	149.926	33	57	117	113.344	33	33
57	118	103.240	33	57	119	100.840	33	57	120	92.759	33	33
57	121	84.842	33	57	122	81.239	33	57	123	150.035	33	33
57	124	117.384	33	57	150	151.345	33	57	151	138.132	33	33
57	152	136.439	33	57	153	135.511	33	57	154	133.000	33	33
57	155	143.210	33	57	156	115.255	33	57	157	59.235	11	11

Origin	Truck (11) %	Truck-Barge-Truck (33) %
1	42	58
2	0	100
50	45	55
51	48	52
52	48	52
53	42	58
54	55	45
55	48	52
56	18	82
57	12	88

Source: Computer Print Out (Table 15)

Supply and Demand Development

Supply requirement was developed from the 1980 production of complete fertilizer of the PPI plant and the available complete fertilizer stocks from the base-point warehouses. These represent the supply quantities available for shipping at each source in the cost and requirement of the model.

Eighty-one percent of the total demand quantities in the three regions were estimated to have been supplied by the PPI for the year 1980 and the rest was supplied by Atlas Fertilizer Corporation. The data estimates, utilized statistical surveys of the Bureau of Agricultural Economics.

The actual NPK production of PPI in 1980 was 158,000 metric tons. In this study it was assumed that there would be an equal production of

the said fertilizer for each month of the year. For each month the production was 3708 metric tons of complete fertilizer to be consumed by the twenty-three final demand points and nine storage demand points (includes the plant's storage demand points). As indicated in the assumptions used, there was a year-end carry over of stocks equal to a three month demand in the consuming regions. The beginning inventory was the current supply quantities at each of the base-point warehouses for the first month, and the requirement for the coming demand quantities (January of 1981) was provided in the solution for the twelfth, as the storage demand at the base-point warehouses.

The demand quantities are the individual quantities required at each destination within the cost and requirement table of the transportation linear programming model. These quantities were developed from the quantities demanded of each of the three regions and prorated by using the effective crop area in each of the 23 provinces of the three regions, for the year 1978-79 and adjusted by a growth rate of 3.2 percent to update the data. The process of proration used the Master Projection model. The output of this model was the monthly demand by destination for the year 1980 for complete fertilizer from PPI used in the linear transportation analysis (Table 16, 17, and 18).

Region III accounted for 74 percent of the total demand of the three regions; region IV, 17 percent; and 9 percent for region V.

In region III, Cabanatuan, Tarlac and San Fernando had the highest demand, 38 percent; 21 percent and 18 percent respectively of the total demand of the region. Batangas (40%), Sta. Cruz (22%) and Trece Martires (18%) took the highest three of region IV's total demand and likewise,

Table 16

DEMAND QUANTITIES OF COMPLETE FERTILIZER BY PROVINCE BY MONTH IN REGION III
UNIT IS IN METRIC TONS

PERIOD	BALANGA	IBA	TARLAC	CABANATUANS.	FERNANDO	MALULOS	TOTAL REGION 3
1 8001	201	111	730	1360	634	522	3558
2 8002	230	126	834	1554	724	597	4065
3 8003	57	32	208	388	181	149	1015
4 8004	115	63	417	777	362	298	2032
5 8005	57	32	208	388	181	149	1015
6 8006	258	142	938	1748	814	671	4571
7 8007	316	174	1147	2137	996	821	5591
8 8008	632	348	2293	4274	1991	1641	11179
9 8009	201	111	730	1360	634	522	3558
10 8010	258	142	938	1748	814	671	4571
11 8011	115	63	417	777	362	298	2032
12 8012	431	237	1564	2914	1358	1119	7623

SOURCE:

PHILIPPINE ALMANAC AND HANDBOOK OF FACTS
BUREAU OF AGRICULTURAL ECONOMICS

Table 17

DEMAND QUANTITIES OF COMPLETE FERTILIZER BY PROVINCE BY MONTH IN REGION IV
UNIT IS IN METRIC TONS

PERIOD	BALER	PASIG	TRECE MAR- TIRES	NATANGAS	STA CRUZ	LUCENA CITY	PUERTO PRINCESA	MAMBURAC	CALAPAN	BOAC	KOMBLON	TOTAL REGION 4
1 8001	28	28	136	403	223	56	8	49	58	6	7	1002
2 8002	39	39	187	554	307	77	10	68	80	8	10	1379
3 8003	11	11	51	151	84	21	3	19	22	2	3	378
4 8004	53	53	255	755	419	105	14	93	109	11	13	1883
5 8005	17	18	85	251	140	35	5	31	36	4	4	626
6 8006	35	35	170	503	279	70	10	62	73	7	9	1253
7 8007	25	25	119	352	195	49	7	43	51	5	6	877
8 8008	42	42	204	604	335	84	11	74	88	9	10	1503
9 8009	14	14	68	201	112	28	4	25	29	3	3	501
10 8010	21	21	102	302	168	42	6	37	44	4	5	752
11 8011	17	18	85	251	140	35	5	31	36	4	4	626
12 8012	49	49	238	705	391	98	13	87	102	10	12	1754

SOURCE:

PHILIPPINE ALMANAC AND HANDBOOK OF FACTS
BUREAU OF AGRICULTURAL ECONOMICS

Table 18

DEMAND QUANTITIES OF COMPLETE FERTILIZER BY PROVINCE BY MONTH IN REGION V
UNIT IS IN METRIC TONS

PERIOD	DAET	NAGA CITY	LEGASPI CITY	SURSIGON	MASBATE	VIRAC	TOTAL REGION 5
1 8031	14	268	101	47	6	3	439
2 8002	6	115	43	20	3	1	188
3 8033	2	38	14	7	1	0	62
4 8004	20	382	143	68	9	4	626
5 8005	4	76	29	13	2	1	125
6 8006	58	1110	416	196	26	11	1817
7 8037	8	153	58	27	4	2	252
8 8008	34	651	244	115	15	6	1065
9 8039	4	76	29	13	2	1	125
10 8010	14	268	101	47	6	3	439
11 8011	8	153	58	27	4	2	252
12 8012	28	536	201	95	12	5	877

SOURCE:

PHILIPPINE ALMANAC AND HANDBOOK OF FACTS
BUREAU OF AGRICULTURAL ECONOMICS

Naga (61%) and Legaspi (22%) of region V had the biggest demand for complete fertilizer for the region.

The month of August had the biggest demand followed by December for the marketing year of 1980.

The storage demand quantities of the base-point warehouses were equivalent to a three month stock inventory to meet the consumption needs of its service areas.

Demand requirements were reduced to PPI's market share in the three regions. It was estimated from the available data gathered by the Bureau of Agricultural Economics (BAECON), that of the total demand of complete fertilizer, 12, 22, and 23 percent were the market share of AFC in the regions III, IV and V respectively. The bulk of the demand (81%) was satisfied by PPI.

Assumptions Used:

1. Monthly demand quantities were the monthly consumption of complete fertilizer in each of the 23 provinces.
2. Provincial capitals are the chosen demand points of the provinces.
3. Storage demand quantities of the producers warehouses was the FPA required minimum stock level, equivalent to a three-month supply.
4. Storage demand quantities of the warehouse were the FPA requirement that each warehouse should have three-to-four-month stock inventory to meet the needs of its service areas.
5. Supply quantities were the 1980 annual production and divided equally among the twelve months.
6. The total supply will equal the total demand quantity.
7. The number of plants and warehouses were given.

8. The analysis was done for the supply and demand quantities for the marketing year 1980.

9. There was a carry-over stock inventory in each of the warehouses.

C. Application of the Model

The model was used in this study to demonstrate the transportation linear programming analysis for optimum distribution patterns of complete fertilizer from the Planters Products Incorporated and the eight PPI warehouses to the twenty-three provincial capitals and nine storage demand points for the marketing year 1980.

Some of the data requirements for this program were read from computer files generated by previous programs in the total system. Only the control card information were supplied. The supply and demand quantities were read from the cards. The total least-cost transfer costs in space, time and form were read from the computer file produced by the network combining program.

The least cost distribution pattern for the complete fertilizer was reflected in the model by considering the transportation network, and supply and demand quantities.

Separate solutions were obtained for each month of 1980. For a given month, the alternative destinations include 1) current consumption at the origin point, 2) current consumption at the destination points, 3) storage at the origin point for later consumption, and 4) storage demand of the warehouses. The transfer cost for each of the origin-destination links entered to the transportation model represents the least-cost method of transfer via that link. The quantities available at plant and warehouse in the period are allocated among the alternative

destinations in space, time and form so as to minimize total marketing costs of distribution for complete fertilizer.²⁶

The second month of the year represented a new linear programming with new current volumes of demand at each location and new volumes of demand for storage to serve future requirements at these locations. The model was a recursive one, in the sense that the available supply quantities for the second month at each location were the current supply quantities plus the accumulated quantities in storage from prior periods. The same process was repeated month by month in sequence through the marketing year.

²⁶Phillips, Vol. 1, Sec. 7-4.

CHAPTER VI

ANALYSIS

A. Results

The final output for each month of the linear programming solution for optimum distribution patterns of complete fertilizer from the fertilizer plant, and warehouses to the provincial capitals and storage demand points for 1980 in regions III, IV and V of the Philippines are shown in Table 19.

B. Interpretation of Results

The output was used to define the optimum solution for the least cost distribution pattern for the complete fertilizer.

In January for example, all the nine warehouses satisfied their own stock requirement from the current supply and/or from the available fertilizer stock. Pilar and Tarlac warehouses filled up their demand both from the two sources. Metro Manila satisfied its own demand and served two more demand points (Trece Martires and Lucena). Cabanatuan was supplied directly from the PPI plant and San Simon warehouse. Zambales, Baler, San Fernando were served by the PPI plant at Limay, Bataan. The southern part of Luzon met their requirement by shipping directly from the plant through the land/water network. About 92 percent of the total supply was transferred by land and only eight percent by the combined water and land transport (Table 20). The big amount of stock available during the month especially at the PPI's plant warehouse made it possible for a direct shipment from plant to demand points. The total cost for the optimum solution for the month of January was ₱2,795,751.14.

Table 19

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 180

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IRA, ZAMBALES	11 STA. CRUZ, LAGUNA	58.00	86.864	8708.67
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	802.00	85.874	79268.81
1 LIMAY, BATAAN	104 BALER, AUKORA	11 STA. CRUZ, LAGUNA	22.00	154.521	3399.46
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	558.00	66.642	37186.23
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	595.00	66.642	39918.49
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1066.00	99.302	105855.87
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	177.00	46.440	8219.83
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	330.00	62.265	20547.51
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	642.00	45.767	29382.41
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1633.00	56.878	92881.75
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	288.00	45.767	13180.85
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	6661.00	54.521	363164.31
53 SAN SIMON	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	27.00	71.356	1926.61
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	332.00	51.491	17095.01
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1052.00	55.235	62315.22
54 BALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	127.00	45.134	6240.02
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	2908.00	55.571	173232.44
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	106.00	64.285	6814.21
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	44.00	94.251	4147.04
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	8372.00	57.551	481816.87
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1441.00	58.225	83902.19
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1133.00	55.235	67113.25
		SUBTOTAL	39622.00		2398952.91
1 LIMAY, BATAAN	107 PASIG, RIZAL	33 TABACO, ALBAY-2	22.00	74.250	1633.50
1 LIMAY, BATAAN	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	314.00	102.970	32332.58
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	174.00	83.368	14506.03
1 LIMAY, BATAAN	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	11.00	158.589	1748.72
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACO, ALBAY-2	206.00	121.807	25092.24
1 LIMAY, BATAAN	114 LEGASPI CITY	33 TABACO, ALBAY-2	78.00	130.816	10203.64
1 LIMAY, BATAAN	115 SURSOGON, SORSOGON	33 TABACO, ALBAY-2	36.00	128.795	4636.62
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	6.00	140.098	840.59
1 LIMAY, BATAAN	117 MAMBURAD, OCC. MIN	33 TABACO, ALBAY-2	38.00	103.516	3933.61
1 LIMAY, BATAAN	118 CALAPAN, UR. MIND.	33 TABACO, ALBAY-2	45.00	104.608	4707.36
1 LIMAY, BATAAN	119 BOAC, MARINDUQUE	33 TABACO, ALBAY-2	5.00	110.777	553.88
1 LIMAY, BATAAN	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	5.00	112.088	560.44
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	5.00	120.005	600.02
1 LIMAY, BATAAN	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	2.00	131.962	263.92
1 LIMAY, BATAAN	155 METRO MANILA-2	33 TABACO, ALBAY-2	875.00	86.098	75335.75
1 LIMAY, BATAAN	156 BAYAN, BATANGAS-2	33 TABACO, ALBAY-2	1213.00	116.347	141128.87
1 LIMAY, BATAAN	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	535.00	147.141	78720.44
		SUBTOTAL	3570.00		396758.22
		TOTAL	43192.00		2795751.14

ITERATION = 5

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MUDE FOR PROJECTED PERIOD 280

ORIGIN	DESTINATION	MUDE	QUANTITY	UNIT_COST	TOTAL_COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	102.00	88.664	9064.04
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	578.00	85.874	51947.16
1 LIMAY, BATAAN	104 BALER, AURORA	11 STA. CRUZ, LAGUNA	30.00	154.521	4635.63
1 LIMAY, BATAAN	105 SN. FERNANDU	11 STA. CRUZ, LAGUNA	637.00	66.442	42450.95
1 LIMAY, BATAAN	106 MALOLO, BULACAN	11 STA. CRUZ, LAGUNA	250.00	75.396	18849.00
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	269.00	95.372	26712.24
1 LIMAY, BATAAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	579.00	84.824	49113.10
50 PILAR, BATAAN	100 DALANGA, DATAAN	11 STA. CRUZ, LAGUNA	202.00	46.440	9380.83
50 PILAR, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	9.00	84.487	760.47
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	718.00	62.265	44706.27
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	734.00	45.767	33592.98
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1965.00	56.878	111765.25
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	790.00	45.767	36155.93
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	5871.00	54.521	320392.75
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1052.00	55.235	62315.22
54 BALAGTAS, BULACAN	106 MALOLO, BULACAN	11 STA. CRUZ, LAGUNA	275.00	45.134	13511.85
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	2633.00	55.571	156850.44
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	146.00	64.285	9385.61
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	60.00	94.251	5655.06
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	9041.00	57.551	523318.50
56 RAUAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	283.00	47.787	13523.72
56 RAUAN, BATANGAS	156 RAUAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	2371.00	58.225	138051.44
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1668.00	55.235	98803.94
		SUBTOTAL	41387.00		2470278.16
1 LIMAY, BATAAN	107 PASIG, RIZAL	33 TABACO, ALBAY-2	30.00	74.250	2227.50
1 LIMAY, BATAAN	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	149.00	102.570	15342.53
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	239.00	82.368	19924.95
1 LIMAY, BATAAN	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	5.00	158.989	794.79
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACO, ALBAY-2	89.00	121.807	10843.82
1 LIMAY, BATAAN	114 LEGASPI CITY	33 TABACO, ALBAY-2	33.00	130.816	4316.93
1 LIMAY, BATAAN	115 SORSOGON, SORSOGON	33 TABACO, ALBAY-2	15.00	128.795	1931.92
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	8.00	140.098	1120.78
1 LIMAY, BATAAN	117 MAMBURAO, OCC. MEN	33 TABACO, ALBAY-2	53.00	103.516	5486.35
1 LIMAY, BATAAN	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	62.00	104.608	6485.70
1 LIMAY, BATAAN	119 BOAC, MARINUQUE	33 TABACO, ALBAY-2	6.00	110.777	664.66
1 LIMAY, BATAAN	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	8.00	112.088	896.70
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	2.00	120.005	240.01
1 LIMAY, BATAAN	122 VIPAC, CATANDUANE	33 TABACO, ALBAY-2	1.00	131.562	131.56
1 LIMAY, BATAAN	155 METRO MANILA-2	33 TABACO, ALBAY-2	550.00	66.098	47353.90
1 LIMAY, BATAAN	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	13.00	147.141	1912.83
		SUBTOTAL	1263.00		119672.33
		ICTAL	42650.00		2589950.49

ITERATION - 3

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 380							
ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	INITIAL COST		
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	28.00	88.864	2488.19		
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	341.00	85.874	30647.03		
1 LIMAY, BATAAN	104 BALER, AURORA	11 STA. CRUZ, LAGUNA	9.00	154.521	1350.69		
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	159.00	66.842	10596.67		
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81		
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	695.00	66.642	46316.12		
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	626.00	95.302	62163.05		
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	626.00	98.629	61741.75		
50 PILAR, BATAAN	100 BALANG, BATAAN	11 STA. CRUZ, LAGUNA	50.00	46.440	2321.95		
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	243.00	62.265	15130.45		
50 PILAR, BATAAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	425.00	80.447	34189.98		
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	183.00	45.767	8375.36		
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	2051.00	56.878	116656.75		
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	5871.00	54.521	320092.75		
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1631.00	55.235	96612.25		
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	2633.00	59.571	156850.44		
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	131.00	62.538	8244.87		
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	9.00	46.777	420.99		
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	40.00	64.285	2571.40		
55 METRO MANILA	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	118.00	86.171	10168.18		
55 METRO MANILA	110 STA. CRUZ, LAGUNA	11 STA. CRUZ, LAGUNA	66.00	77.080	5087.28		
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	16.00	94.251	1508.02		
55 METRO MANILA	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	180.00	75.060	13510.80		
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	8698.00	57.551	500578.50		
55 METRO MANILA	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	260.00	100.585	26256.10		
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	2371.00	58.225	138051.44		
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1681.00	59.235	99574.00		
SUBTOTAL			40265.00		2464180.22		
1 LIMAY, BATAAN	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	2.00	156.589	317.82		
1 LIMAY, BATAAN	114 LEGASPI CITY	33 TABACO, ALBAY-2	4.00	130.816	523.26		
1 LIMAY, BATAAN	115 SORSOGON, SORSOGON	33 TABACO, ALBAY-2	5.00	128.795	643.57		
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	2.00	140.098	280.20		
1 LIMAY, BATAAN	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	1211.00	147.141	178187.75		
55 METRO MANILA	113 NAGA CITY	33 TABACO, ALBAY-2	29.00	115.459	3464.31		
55 METRO MANILA	114 LEGASPI CITY	33 TABACO, ALBAY-2	7.00	128.468	899.23		
55 METRO MANILA	117 MAMBURAO, ILOCOS MIN	33 TABACO, ALBAY-2	15.00	101.168	1517.52		
55 METRO MANILA	118 CALAPAN, UK. MIND.	33 TABACO, ALBAY-2	17.00	102.260	1738.42		
55 METRO MANILA	119 BOAC, MARINUQUE	33 TABACO, ALBAY-2	2.00	108.430	216.86		
55 METRO MANILA	120 RUMBLON, RUMBLON	33 TABACO, ALBAY-2	2.00	105.740	219.48		
55 METRO MANILA	121 MASRATE, MASRATE	33 TABACO, ALBAY-2	1.00	117.657	117.66		
SUBTOTAL			1297.00		188126.53		
TOTAL			41562.00		2652306.75		

ITERATION = 10

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MUDE FOR PROJECTED PERIOD 480

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT_COST	TOTAL_COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	55.00	88.864	4887.52
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	684.00	85.874	61473.81
1 LIMAY, BATAAN	104 BALEN, AURORA	11 STA. CRUZ, LAGUNA	41.00	154.521	6335.36
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	319.00	66.642	21258.89
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	789.00	66.642	52580.47
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	854.00	95.302	84803.87
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	718.00	98.429	70815.56
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	101.00	46.440	4690.39
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	382.00	62.265	23785.29
50 PILAR, BATAAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	455.00	80.447	36603.39
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	367.00	45.767	16756.49
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	2310.00	56.878	131388.19
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	6497.00	54.521	354222.87
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	2056.00	55.235	121767.12
54 DALAGTAS, BULACAN	154 DALAGTAS-2	11 STA. CRUZ, LAGUNA	2813.00	59.571	167573.19
55 METRO MANILA	106 MALULOS, BULACAN	11 STA. CRUZ, LAGUNA	262.00	62.538	16489.75
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	41.00	46.777	1917.86
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	199.00	64.285	12792.71
55 METRO MANILA	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	22.00	86.171	1895.76
55 METRO MANILA	110 STA. CRUZ, LAGUNA	11 STA. CRUZ, LAGUNA	327.00	77.680	25295.16
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	82.00	94.251	7728.58
55 METRO MANILA	154 DALAGTAS-2	11 STA. CRUZ, LAGUNA	242.00	75.060	18164.52
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	7497.00	57.551	431459.75
56 HAUAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	567.00	47.787	27095.23
56 HAUAN, BATANGAS	156 HAUAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	2064.00	58.225	120176.37
57 TABACO, ALBAY	113 NAGA CITY	11 STA. CRUZ, LAGUNA	215.00	84.824	18237.24
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	110.00	51.491	5664.01
57 TABACO, ALBAY	115 SORSOGON, SORSOGON	11 STA. CRUZ, LAGUNA	52.00	74.386	3868.07
57 TABACC, ALDAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	2497.00	59.235	147909.75
	SUBTOTAL		43742.00		2690242.50
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACO, ALBAY-2	79.00	121.837	9622.63
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	11.00	140.058	1541.08
1 LIMAY, BATAAN	117 MAMBURAO, OCC. MIN.	33 TABACO, ALBAY-2	47.00	103.516	4865.25
1 LIMAY, BATAAN	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	85.00	104.638	8851.63
1 LIMAY, BATAAN	119 RUAC, MARINDUQUE	33 TABACO, ALBAY-2	9.00	110.777	956.59
1 LIMAY, BATAAN	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	10.00	112.688	1120.88
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	7.00	120.005	840.03
55 METRO MANILA	117 MAMBURAO, OCC. MIN.	33 TABACO, ALBAY-2	26.00	101.168	2632.37
57 TABACO, ALBAY	112 UAET, CAMARINES N.	33 TABACO, ALBAY-2	15.00	104.535	1573.92
57 TABACO, ALDAY	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	3.00	81.239	243.72
	SUBTOTAL		292.00		32326.55
	TOTAL		44034.00		2722569.45

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 580					
ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	INITIAL COST
1 LIMAY, BATAAN	105 SN, FERNANDO	11 STA-CRUZ, LAGUNA	159.00	66.642	10596.67
1 LIMAY, BATAAN	123 LIMAY, DATAAN-2	11 STA-CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA-CRUZ, LAGUNA	671.00	66.642	44716.71
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA-CRUZ, LAGUNA	1417.00	98.302	140710.87
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA-CRUZ, LAGUNA	1461.00	98.629	144057.00
50 PILAR, BATAAN	100 DALANGA, BATAAN	11 STA-CRUZ, LAGUNA	50.00	46.440	2321.55
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA-CRUZ, LAGUNA	1121.00	62.265	69795.12
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA-CRUZ, LAGUNA	183.00	45.767	8375.36
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA-CRUZ, LAGUNA	2981.00	56.878	169553.31
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA-CRUZ, LAGUNA	7215.00	54.521	393368.94
53 SAN SIMON	153 SN, SIMON-2	11 STA-CRUZ, LAGUNA	2511.00	59.235	148739.06
54 RALAGTAS, BULACAN	154 DALAGTAS-2	11 STA-CRUZ, LAGUNA	3055.00	55.571	181989.37
55 METRO MANILA	103 CABANATUAN CITY	11 STA-CRUZ, LAGUNA	341.00	94.925	32369.43
55 METRO MANILA	104 BALER, AURORA	11 STA-CRUZ, LAGUNA	13.00	155.571	2074.42
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA-CRUZ, LAGUNA	131.00	62.938	8244.87
55 METRO MANILA	107 PASIG, RIZAL	11 STA-CRUZ, LAGUNA	14.00	46.777	654.88
55 METRO MANILA	108 TRECE MARTIRES	11 STA-CRUZ, LAGUNA	66.00	64.285	4242.81
55 METRO MANILA	109 BATANGAS, BATANGA	11 STA-CRUZ, LAGUNA	180.00	86.171	15510.78
55 METRO MANILA	110 STA-CRUZ, LAGUNA	11 STA-CRUZ, LAGUNA	109.00	77.080	8401.72
55 METRO MANILA	111 LUCENA CITY	11 STA-CRUZ, LAGUNA	27.00	94.251	2544.78
55 METRO MANILA	152 CABANATUAN-2	11 STA-CRUZ, LAGUNA	195.00	103.679	20632.02
55 METRO MANILA	153 SN, SIMON-2	11 STA-CRUZ, LAGUNA	1194.00	82.804	98867.94
55 METRO MANILA	154 RALAGTAS-2	11 STA-CRUZ, LAGUNA	468.00	75.060	35128.08
55 METRO MANILA	155 METRO MANILA-2	11 STA-CRUZ, LAGUNA	4267.00	57.551	245570.06
56 BAYAN, BATANGAS	109 BATANGAS, BATANGA	11 STA-CRUZ, LAGUNA	16.00	47.787	764.59
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA-CRUZ, LAGUNA	2048.00	55.225	119244.81
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA-CRUZ, LAGUNA	2497.00	55.235	147909.75
		SUBTOTAL	43518.00		2749064.54
55 METRO MANILA	101 IBA, ZAMBALES	33 TABACO, ALBAY-2	28.00	89.866	2516.25
55 METRO MANILA	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	3.00	156.641	469.77
55 METRO MANILA	113 NAGA CITY	33 TABACO, ALBAY-2	59.00	119.459	7048.08
55 METRO MANILA	114 LEGASPI CITY	33 TABACO, ALBAY-2	22.00	128.468	2826.30
55 METRO MANILA	115 SORSOGON, SORSOGON	33 TABACO, ALBAY-2	10.00	126.448	1264.48
55 METRO MANILA	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	4.00	137.750	551.00
55 METRO MANILA	117 MABURAO, OCC. MIN	33 TABACO, ALBAY-2	24.00	101.168	2428.03
55 METRO MANILA	118 CALAPAN, UR. MIND.	33 TABACO, ALBAY-2	28.00	102.260	2863.28
55 METRO MANILA	119 BUAC, MARINDUQUE	33 TABACO, ALBAY-2	3.00	108.430	325.29
55 METRO MANILA	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	3.00	109.740	329.22
55 METRO MANILA	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	2.00	117.657	235.31
55 METRO MANILA	122 VIKAC, CATANDUANE	33 TABACO, ALBAY-2	1.00	125.614	125.61
55 METRO MANILA	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	301.00	144.793	43582.69
		SUBTOTAL	488.00		64569.31
		TOTAL	44006.00		2813633.65

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 680

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	INITIAL COST
1 LIMAY, BATAAN	101 IHA, ZAMBALES	11 STA. CRUZ, LAGUNA	125.00	88.864	11108.00
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	1200.00	89.874	107849.12
1 LIMAY, BATAAN	104 BALER, AURORA	11 STA. CRUZ, LAGUNA	27.00	154.521	4171.46
1 LIMAY, BATAAN	105 SN-FERMANDO	11 STA. CRUZ, LAGUNA	716.00	66.642	47715.67
1 LIMAY, BATAAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	315.00	75.396	23749.74
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	152.00	66.642	10129.52
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	648.00	99.302	64347.70
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	227.00	46.440	10541.83
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	1565.00	62.265	97444.75
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	825.00	45.767	37757.77
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	3573.00	56.878	203225.06
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	338.00	45.767	15469.07
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	8537.00	54.921	465445.69
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	153.00	51.491	7878.12
53 SAN SIMON	153 SN-SIMON-2	11 STA. CRUZ, LAGUNA	3552.00	55.235	210402.69
54 BALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	122.00	45.134	5544.35
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	3401.00	55.571	202600.94
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	133.00	64.285	8549.90
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	55.00	94.251	5183.80
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	4079.00	57.551	234750.52
56 BAYAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	342.00	47.787	16343.15
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1706.00	58.225	99331.81
57 TABACCO, ALBAY	113 NAGA CITY	11 STA. CRUZ, LAGUNA	773.00	84.824	65565.00
57 TABACCO, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	320.00	51.491	16477.12
57 TABACCO, ALBAY	115 SORSOGON, SORSOGON	11 STA. CRUZ, LAGUNA	151.00	74.386	11232.29
57 TABACCO, ALBAY	157 TABACCO, ALBAY-2	11 STA. CRUZ, LAGUNA	1501.00	59.235	88911.69
	SUBTOTAL		45660.00		2764816.54
1 LIMAY, BATAAN	107 PASIG, RIZAL	33 TABACCO, ALBAY-2	27.00	74.250	2004.75
1 LIMAY, BATAAN	109 BATANGAS, BATANGA	33 TABACCO, ALBAY-2	50.00	102.570	5148.50
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACCO, ALBAY-2	218.00	83.368	18174.22
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACCO, ALBAY-2	82.00	121.897	9988.05
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACCO, ALBAY-2	8.00	140.098	1120.78
1 LIMAY, BATAAN	117 MAMBURAO, OCC. MIN	33 TABACCO, ALBAY-2	48.00	103.316	4968.77
1 LIMAY, BATAAN	118 CALAPAN, UR. MIND.	33 TABACCO, ALBAY-2	57.00	104.608	5962.65
1 LIMAY, BATAAN	119 BOAC, MAR INDUQUE	33 TABACCO, ALBAY-2	5.00	110.777	553.88
1 LIMAY, BATAAN	120 RMBLON, RMBLON	33 TABACCO, ALBAY-2	7.00	112.088	784.62
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACCO, ALBAY-2	20.00	120.005	2400.33
1 LIMAY, BATAAN	155 METRO MANILA-2	33 TABACCO, ALBAY-2	2.00	86.058	258.29
57 TABACCO, ALBAY	112 DAET, CAMARINES N	33 TABACCO, ALBAY-2	45.00	104.935	4721.57
57 TABACCO, ALBAY	122 VIRAC, CATANDUANE	33 TABACCO, ALBAY-2	8.00	81.239	649.91
	SUBTOTAL		578.00		56736.74
99999 NCT RECEIVED	104 BALER, AURORA	99	0.00	C.0	0.0
	SUBTOTAL		0.00		0.0
	TOTAL		46238.00		2821553.28

ITERATION = 7

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 780

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IHA, ZAMBALES	11 STA. CRUZ, LAGUNA	153.00	86.664	13556.19
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	1239.00	85.874	111353.87
1 LIMAY, BATAAN	104 BALER, AURORA	11 STA. CRUZ, LAGUNA	20.00	154.521	3050.42
1 LIMAY, BATAAN	105 SN-FERNANDO	11 STA. CRUZ, LAGUNA	876.00	66.642	58378.39
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	174.00	66.642	11555.62
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	733.00	55.302	72788.31
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	278.00	46.440	12910.26
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	1439.00	62.265	89559.37
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	1005.00	45.767	46178.90
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	3212.00	56.878	182692.12
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	619.00	45.767	28329.77
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	7918.00	54.521	431697.19
53 SAN SIMON	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	23.00	71.356	1641.19
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	198.00	51.491	10155.21
53 SAN SIMON	153 SN-SIMON-2	11 STA. CRUZ, LAGUNA	3331.00	59.235	197311.75
54 HALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	261.00	49.134	12823.57
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	3140.00	59.971	187052.87
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	263.00	62.538	16552.69
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	20.00	46.777	935.54
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	93.00	64.285	5978.50
55 METRO MANILA	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	153.00	86.171	13184.16
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	38.00	94.251	3581.54
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	3515.00	57.951	202251.69
56 BAHUAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	122.00	47.787	5830.01
56 BAHUAN, BATANGAS	156 BAHUAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1584.00	58.225	92228.37
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1501.00	59.235	88911.69
SUBTOTAL			43336.00		2593365.44
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	152.00	83.368	12671.93
1 LIMAY, BATAAN	112 DALT, CAMARINES N	33 TABACO, ALBAY-2	6.00	156.989	953.77
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACO, ALBAY-2	118.00	121.807	14373.23
1 LIMAY, BATAAN	114 LEGASPI CITY	33 TABACO, ALBAY-2	45.00	130.816	5886.72
1 LIMAY, BATAAN	115 SORSOGON, SORSOGON	33 TABACO, ALBAY-2	21.00	128.795	2704.69
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	5.00	140.698	703.49
1 LIMAY, BATAAN	117 MAMBURAO, ILOC. MIN.	33 TABACO, ALBAY-2	34.00	102.516	3519.54
1 LIMAY, BATAAN	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	40.00	104.608	4184.32
1 LIMAY, BATAAN	119 ROAC, MAR INDUQUE	33 TABACO, ALBAY-2	4.00	110.777	443.11
1 LIMAY, BATAAN	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	5.00	112.688	560.44
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	3.00	120.005	363.01
1 LIMAY, BATAAN	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	2.00	131.962	263.92
1 LIMAY, BATAAN	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	78.00	147.141	11477.00
SUBTOTAL			513.00		58059.18
TOTAL			43545.00		2651464.62

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 880

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	181.00	88.864	16084.27
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	1738.00	66.442	115823.75
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	459.00	95.302	45579.62
50 PILAR, BATAAN	100 BALANUA, BATAAN	11 STA. CRUZ, LAGUNA	556.00	46.440	25820.58
50 PILAR, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	125.00	84.487	10560.98
50 PILAR, BATAAN	157 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	932.00	62.265	58030.58
51 TARLAC, TARLAC	107 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	2018.00	45.767	92357.75
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1927.00	56.878	109603.87
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	2793.00	45.767	127827.19
52 CABANATUAN CITY	104 BALER, AURORA	11 STA. CRUZ, LAGUNA	33.00	110.413	3663.63
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	5092.00	54.521	277620.87
53 SAN SIMON	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	968.00	71.356	69072.56
53 SAN SIMON	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	14.00	45.807	657.30
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	391.00	51.491	20132.58
54 BALAGTAS, BULACAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1958.00	55.235	115982.12
54 HALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	1053.00	45.134	51738.10
55 METRO MANILA	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	2087.00	55.571	124324.62
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	159.00	64.285	10221.31
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	66.00	94.251	6220.57
56 BAYAN, BATANGAS	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	3290.00	57.551	189342.75
56 BAYAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	338.00	47.787	16152.00
57 TABACO, ALBAY	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1246.00	58.225	72548.31
57 TABACO, ALBAY	113 NAGA CITY	11 STA. CRUZ, LAGUNA	253.00	84.824	21460.55
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	188.00	51.491	9680.33
57 TABACO, ALBAY	115 SORSOGON, SORSOGON	11 STA. CRUZ, LAGUNA	89.00	74.386	6620.35
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1018.00	55.235	60301.23
		SUBTOTAL	40096.00		2350054.38
1 LIMAY, BATAAN	107 PASIG, RIZAL	33 TABACO, ALBAY-2	33.00	74.250	2450.25
1 LIMAY, BATAAN	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	133.00	102.570	13695.01
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	261.00	83.368	21759.05
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACO, ALBAY-2	248.00	121.807	30208.02
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	9.00	140.098	1260.88
1 LIMAY, BATAAN	117 MAMBURAO, OCC. MIN.	33 TABACO, ALBAY-2	58.00	132.516	6903.93
1 LIMAY, BATAAN	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	69.00	104.698	7217.95
1 LIMAY, BATAAN	119 BUAC, MAR INDUQUE	33 TABACO, ALBAY-2	7.00	110.777	775.44
1 LIMAY, BATAAN	120 RORLON, RORLON	33 TABACO, ALBAY-2	8.00	112.088	896.70
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	12.00	120.005	1440.06
1 LIMAY, BATAAN	155 METRO MANILA-2	33 TABACO, ALBAY-2	492.00	86.098	42360.22
57 TABACO, ALBAY	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	26.00	104.935	2728.20
57 TABACO, ALBAY	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	5.00	81.239	406.19
		SUBTOTAL	1361.00		131201.90
		TOTAL	41457.00		2481286.28

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MUDE FOR PROJECTED PERIOD 980					QUANTITY	UNIT COST	TOTAL COST
ORIGIN	DESTINATION	MUDE	PERIOD	PERIOD			
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	98.00	88.664	8738.67		
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	1197.00	85.874	107579.12		
1 LIMAY, BATAAN	104 BALER, AURORA	11 STA. CRUZ, LAGUNA	11.00	154.521	1659.23		
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	558.00	66.642	37186.23		
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81		
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	551.00	64.642	36719.74		
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1003.00	99.302	99555.87		
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	290.00	56.629	28622.41		
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	177.00	46.440	8219.83		
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	593.00	62.265	36923.14		
50 PILAR, BATAAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	162.00	80.447	13032.49		
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	642.00	45.767	29382.41		
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1744.00	56.878	99195.14		
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	5092.00	54.521	277620.87		
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1958.00	55.235	115982.12		
54 BALAGTAS, RULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	2087.00	59.571	124324.62		
55 METRO MANILA	106 MALDLOS, BULACAN	11 STA. CRUZ, LAGUNA	459.00	62.538	28688.54		
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	14.00	46.777	654.88		
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	53.00	64.285	3407.13		
55 METRO MANILA	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	157.00	86.171	13528.55		
55 METRO MANILA	110 STA. CRUZ, LAGUNA	11 STA. CRUZ, LAGUNA	87.00	77.080	6735.96		
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	22.00	94.251	2073.52		
55 METRO MANILA	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	228.00	82.804	18879.23		
55 METRO MANILA	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	1.00	75.060	75.06		
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	1989.00	57.551	114468.87		
55 METRO MANILA	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	309.00	100.985	31204.36		
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1246.00	58.225	72548.31		
57 TABAGO, ALBAY	157 TABAGO, ALBAY-2	11 STA. CRUZ, LAGUNA	1018.00	55.235	63301.23		
		SUBTOTAL	32870.00		2070148.21		
55 METRO MANILA	112 DAET, CAMARINES N	33 TABAGO, ALBAY-2	3.00	156.641	469.77		
55 METRO MANILA	113 NAGA CITY	33 TABAGO, ALBAY-2	59.00	119.459	7048.08		
55 METRO MANILA	114 LEGASPI CITY	33 TABAGO, ALBAY-2	22.00	128.468	2826.30		
55 METRO MANILA	115 SORSOGON, SORSOGON	33 TABAGO, ALBAY-2	10.00	126.448	1264.48		
55 METRO MANILA	116 PUERTO PRINCESA	33 TABAGO, ALBAY-2	3.00	137.750	413.25		
55 METRO MANILA	117 MABURAO, OCC. MIN.	33 TABAGO, ALBAY-2	20.00	101.168	2023.36		
55 METRO MANILA	118 CALAPAN, UR. MIND.	33 TABAGO, ALBAY-2	23.00	102.260	2351.98		
55 METRO MANILA	119 BOAC, MARINDUQUE	33 TABAGO, ALBAY-2	2.00	108.430	216.86		
55 METRO MANILA	120 ROMBLON, ROMBLON	33 TABAGO, ALBAY-2	2.00	105.740	219.48		
55 METRO MANILA	121 MASBATE, MASBATE	33 TABAGO, ALBAY-2	2.00	117.657	235.31		
55 METRO MANILA	122 VIRAC, CATANDUANE	33 TABAGO, ALBAY-2	1.00	125.614	129.61		
55 METRO MANILA	157 TABAGO, ALBAY-2	33 TABAGO, ALBAY-2	316.00	144.793	45754.87		
		SUBTOTAL	463.00		62953.34		
		TOTAL	33333.00		2133101.55		

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 1080

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 INA, ZAMBALES	11 STA. CRUZ, LAGUNA	125.00	88.664	11108.03
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	1117.03	89.874	100389.25
1 LIMAY, BATAAN	104 DALER, AURORA	11 STA. CRUZ, LAGUNA	16.00	154.521	2472.34
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	716.00	66.642	47715.67
1 LIMAY, BATAAN	106 MALLOS, BULACAN	11 STA. CRUZ, LAGUNA	258.03	75.396	19452.16
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	157.03	66.642	10462.73
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	634.00	95.302	62957.47
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	227.00	46.440	13541.83
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	917.00	62.265	57057.06
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	825.00	45.767	37757.77
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1922.00	56.878	109319.59
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	421.00	45.767	19267.91
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	4961.00	54.521	270478.62
53 SAN SIMUN	106 MALLOS, BULACAN	11 STA. CRUZ, LAGUNA	151.00	51.491	7775.14
53 SAN SIMUN	153 SN. SIMUN-2	11 STA. CRUZ, LAGUNA	2197.00	55.235	130139.25
54 BALAGTAS, BULACAN	106 MALLOS, BULACAN	11 STA. CRUZ, LAGUNA	181.00	45.134	8893.23
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	1907.00	54.571	113601.87
55 METRO MANILA	107 PASTIG, KIZAL	11 STA. CRUZ, LAGUNA	21.00	46.777	982.32
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	80.00	64.285	5142.80
55 METRO MANILA	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	152.00	86.171	13097.99
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	33.00	54.251	3110.28
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	1703.00	57.551	98055.31
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1555.00	56.225	90539.87
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	16.00	51.491	823.96
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1318.00	59.235	78071.69
	SUBTOTAL		32734.00		2901843.86
1 LIMAY, BATAAN	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	84.00	102.970	8649.48
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	131.00	83.368	10921.21
1 LIMAY, BATAAN	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	11.00	158.989	1748.72
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACO, ALBAY-2	206.00	121.807	25092.24
1 LIMAY, BATAAN	114 LEGASPI CITY	33 TABACO, ALBAY-2	62.00	130.816	8110.34
1 LIMAY, BATAAN	115 SORSOGON, SORSOGON	33 TABACO, ALBAY-2	36.00	128.795	4636.62
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	5.00	140.098	700.49
1 LIMAY, BATAAN	117 MAMBURAU, OCC. MIND.	33 TABACO, ALBAY-2	29.00	103.516	3001.56
1 LIMAY, BATAAN	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	34.00	104.608	3556.67
1 LIMAY, BATAAN	119 BUAC, MARINDUQUE	33 TABACO, ALBAY-2	3.00	110.777	332.33
1 LIMAY, BATAAN	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	4.00	112.088	448.35
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	5.00	120.005	600.02
1 LIMAY, BATAAN	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	2.00	131.562	263.92
1 LIMAY, BATAAN	156 BAYAN, BATANGAS-2	33 TABACO, ALBAY-2	73.00	116.347	8493.33
	SUBTOTAL		685.00		76555.68
1 LIMAY, BATAAN	99999 NOT SHIPPED	99	0.00	0.0	0.0
	SUBTOTAL		0.00		0.0
	TOTAL		33419.00		2078355.54

Table 19 (cont'n)
OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 1180

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IBA, ZARBALES	11 STA. CRUZ, LAGUNA	55.00	85.644	4867.52
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	604.00	89.874	61473.81
1 LIMAY, BATAAN	104 JALER, AURORA	11 STA. CRUZ, LAGUNA	13.00	154.521	2008.77
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	319.00	66.642	21258.80
1 LIMAY, BATAAN	106 MALOS, BULACAN	11 STA. CRUZ, LAGUNA	262.00	75.396	19753.75
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	257.00	66.642	17126.53
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	687.00	95.302	68223.44
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	494.00	98.629	48722.72
1 LIMAY, BATAAN	153 SN. SIMUN-2	11 STA. CRUZ, LAGUNA	300.00	84.624	25447.20
50 PILAR, BATAAN	100 BALANGA, RATAAN	11 STA. CRUZ, LAGUNA	101.00	46.440	4650.34
50 PILAR, BATAAN	109 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	973.00	62.265	60583.90
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	367.00	45.767	16796.49
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	2189.00	56.878	124505.94
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	4981.00	54.521	270478.62
53 SAN SIMON	153 SN. SIMUN-2	11 STA. CRUZ, LAGUNA	2197.00	55.235	130139.25
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	1907.00	55.571	111601.87
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	14.00	46.777	654.88
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	66.00	64.285	4242.81
55 METRO MANILA	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	132.00	86.171	11374.57
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	27.00	94.251	2546.78
55 METRO MANILA	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	152.00	75.660	11409.12
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	1312.00	57.551	75506.87
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1628.00	58.225	94790.25
57 TABACO, ALBAY	113 NAGA CITY	11 STA. CRUZ, LAGUNA	43.00	84.824	3647.52
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	45.00	51.491	2317.09
57 TABACO, ALBAY	115 SORSOGON, SORSOGON	11 STA. CRUZ, LAGUNA	21.00	74.386	1562.11
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1201.00	55.235	71141.19
	SUBTOTAL		31531.00		1961523.39
1 LIMAY, BATAAN	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	64.00	102.570	6590.08
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	109.00	83.368	9087.11
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACO, ALBAY-2	75.00	121.807	9135.43
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	4.00	140.098	560.39
1 LIMAY, BATAAN	117 MAMBURAO, OCC. MIN	33 TABACO, ALBAY-2	24.00	103.516	2484.38
1 LIMAY, BATAAN	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	28.00	104.608	2929.02
1 LIMAY, BATAAN	119 BOAC, MAR INDIQUE	33 TABACO, ALBAY-2	3.00	110.777	332.33
1 LIMAY, BATAAN	120 RUMBLON, RUMBLON	33 TABACO, ALBAY-2	3.00	112.088	336.26
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	3.00	120.005	360.01
1 LIMAY, BATAAN	156 BAYAN, BATANGAS-2	33 TABACO, ALBAY-2	324.00	116.347	37656.43
57 TABACO, ALBAY	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	6.00	104.535	629.50
57 TABACO, ALBAY	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	2.00	81.239	162.48
	SUBTOTAL		645.00		70303.41
	TOTAL		32176.00		2031826.80

Table 19 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 1200

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	122.00	88.864	10841.30
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	133.00	85.874	11953.24
1 LIMAY, BATAAN	104 DALER, AURORA	11 STA. CRUZ, LAGUNA	38.00	154.521	5871.80
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	1195.00	66.642	79637.19
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	11124.00	62.265	692635.81
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	333.00	99.302	33067.57
50 PILAR, BATAAN	103 BALAGU, BATAAN	11 STA. CRUZ, LAGUNA	379.00	46.449	17600.70
50 PILAR, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	87.00	84.487	7350.47
50 PILAR, BATAAN	153 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	764.00	62.265	47570.46
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	1376.00	45.767	62975.39
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1500.00	56.878	85317.00
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	1827.00	45.767	83616.25
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	3628.00	54.521	197802.12
53 SAN SIMON	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	634.00	71.356	43055.02
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	330.00	51.491	16992.03
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1563.00	55.235	92584.25
54 HALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	655.00	45.134	32182.77
54 HALAGTAS, BULACAN	154 HALAGTAS-2	11 STA. CRUZ, LAGUNA	1404.00	55.571	83637.62
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	186.00	64.285	11957.01
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	76.00	94.251	7163.07
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	1050.00	57.551	63428.54
56 BAYAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	520.00	47.787	24849.24
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1432.00	55.225	83378.19
57 TABACOG, ALBAY	113 NAGA CITY	11 STA. CRUZ, LAGUNA	276.00	84.824	23411.51
57 TABACOG, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	155.00	51.491	7981.10
57 TABACOG, ALBAY	115 SORSOGON, SORSOGON	11 STA. CRUZ, LAGUNA	73.00	74.386	5430.18
57 TABACOG, ALBAY	157 TABACOG, ALBAY-2	11 STA. CRUZ, LAGUNA	671.00	55.235	39746.68
	SUBTOTAL		31501.00		1869080.50
1 LIMAY, BATAAN	107 PASIG, RIZAL	33 TABACOG, ALBAY-2	38.00	74.250	2821.50
1 LIMAY, BATAAN	109 BATANGAS, BATANGA	33 TABACOG, ALBAY-2	30.00	102.570	3089.10
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACOG, ALBAY-2	305.00	83.368	25427.24
1 LIMAY, BATAAN	113 NAGA CITY	33 TABACOG, ALBAY-2	137.00	121.807	16687.44
1 LIMAY, BATAAN	116 PUERTO PRINCESA	33 TABACOG, ALBAY-2	10.00	140.098	1400.98
1 LIMAY, BATAAN	117 MAMBURAO, OCC. MIN.	33 TABACOG, ALBAY-2	68.00	103.516	7039.99
1 LIMAY, BATAAN	118 CALAPAN, OR. MIN.	33 TABACOG, ALBAY-2	80.00	104.608	8368.64
1 LIMAY, BATAAN	119 BUAC, MAR. NUQUE	33 TABACOG, ALBAY-2	8.00	110.777	886.22
1 LIMAY, BATAAN	120 RORBLON, RORBLON	33 TABACOG, ALBAY-2	5.00	112.088	1008.79
1 LIMAY, BATAAN	121 MASBATE, MASBATE	33 TABACOG, ALBAY-2	9.00	120.005	1080.04
1 LIMAY, BATAAN	155 METRO MANILA-2	33 TABACOG, ALBAY-2	1193.00	86.098	102714.87
57 TABACOG, ALBAY	112 DAET, CAMARINES N	33 TABACOG, ALBAY-2	22.00	104.935	2308.46
57 TABACOG, ALBAY	122 VIRAC, CATANDUANE	33 TABACOG, ALBAY-2	4.00	324.96	324.96
	SUBTOTAL		1913.00		173157.33
	TOTAL		33414.00		2042237.83

ITERATION = 5

Table 20
 PERCENTAGE UTILIZATION OF METRIC TONS TRANSPORTED
 BY MODE OF TRANSPORT

<u>MONTH</u>	<u>TRUCK %</u>	<u>TRUCK-BARGE-TRUCK %</u>
0180	92	8
0280	97	3
0380	97	3
0480	99	1
0580	99	1
0680	99	1
0780	99	1
0880	97	3
0980	99	1
1080	98	2
1180	98	2
1280	94	6
Average	97%	3%

For the succeeding month, the distribution pattern was almost the same, especially in the land/water movement and the total cost was only ₱2,589,950.49. The only difference in the land movement from that of January's solution was that Malolos was supplied by Limay and Balagtas unlike in the previous month in which Malolos was supplied by Balagtas and San Simon warehouses. Cabanatuan's requirement was filled out by Limay and Cabanatuan warehouse.

In this study, the month of August had the highest demand quantity excluding the storage demand. Limay supplied the consumption needs Iba, San Fernando, Tarlac and Tarlac's storage demand were met by means of truck and also satisfied the requirements of Pasig, Batangas, Sta. Cruz, Naga, Puerto Princesa, Mamburao, Calapan, Boac, Romblon, Masbate and Metro Manila by truck-barge-truck network. Tabaco warehouse filled out the requirements of Daet and Virac utilizing the truck-barge-truck route and also satisfied its own storage demand and it also supplied Naga, Legaspi and Sorsogon with its needed complete fertilizer. In the succeeding month, Metro Manila satisfied the demand of the following points and by land and water combination mode: Daet, Naga, Legaspi, Sorsogon, Puerto Princesa, Mamburao, Calapan, Boac, Romblon, Masbate, Virac and also the Tabaco warehouse. By truck, Metro Manila satisfied the demand needs of Malolos, Pasig, Trece Martires, Batangas, Sta. Cruz, Lucena, San Simon, Batangas, Bauan and Metro Manila warehouses. In this month 99 percent of the total quantity demanded of complete fertilizer was transferred by truck alone.

Minimum Monthly Distribution and Storage Costs

The minimum monthly marketing costs incurred for the distribution of complete fertilizer from the origin to its destination points is

Figure 7A. Complete Fertilizer Distribution Flow Pattern
(January, 1980) of Initial Solution

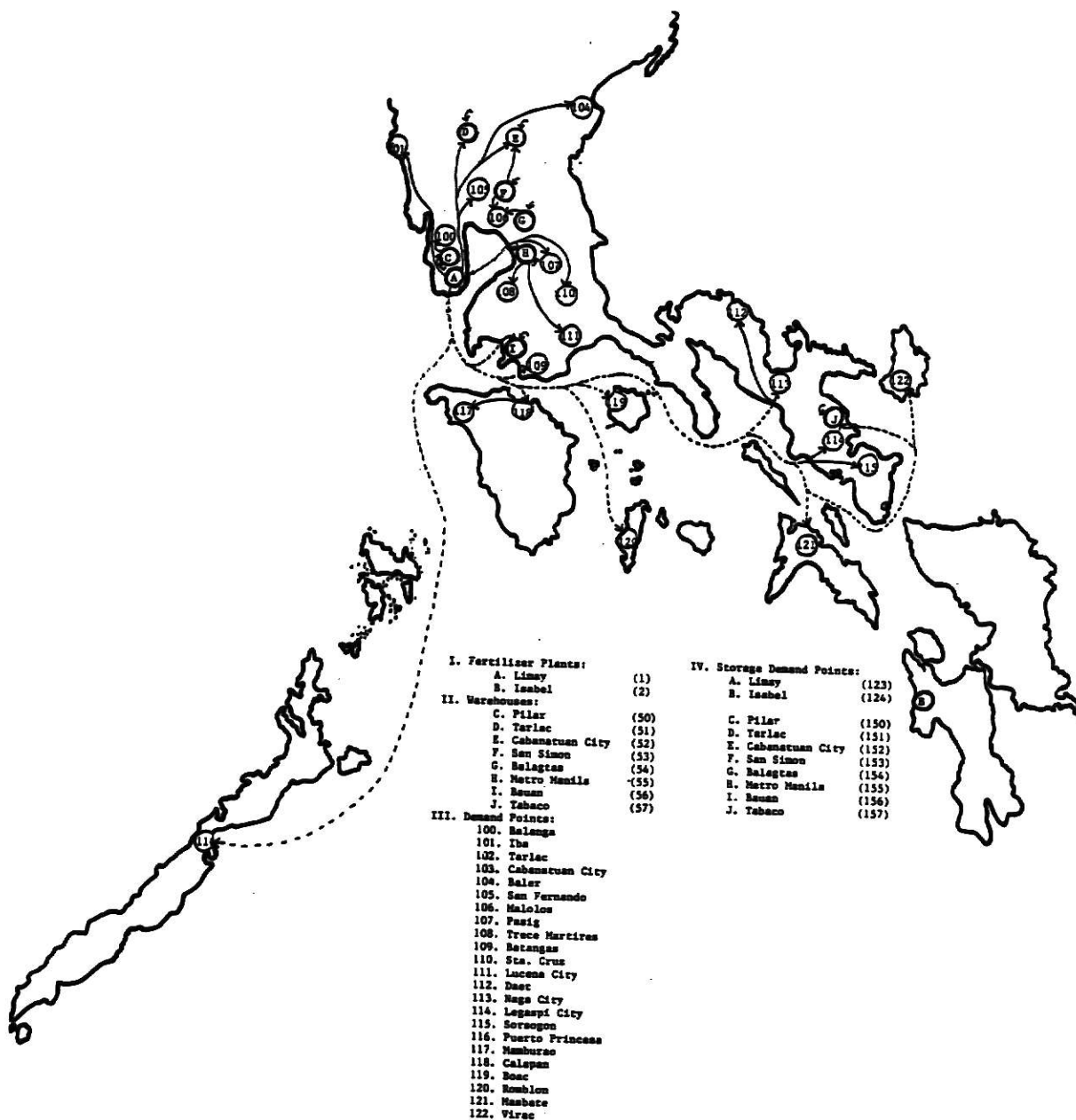


Figure 7B. Complete Fertilizer Distribution Flow Pattern
(February, 1980) of Initial Solution

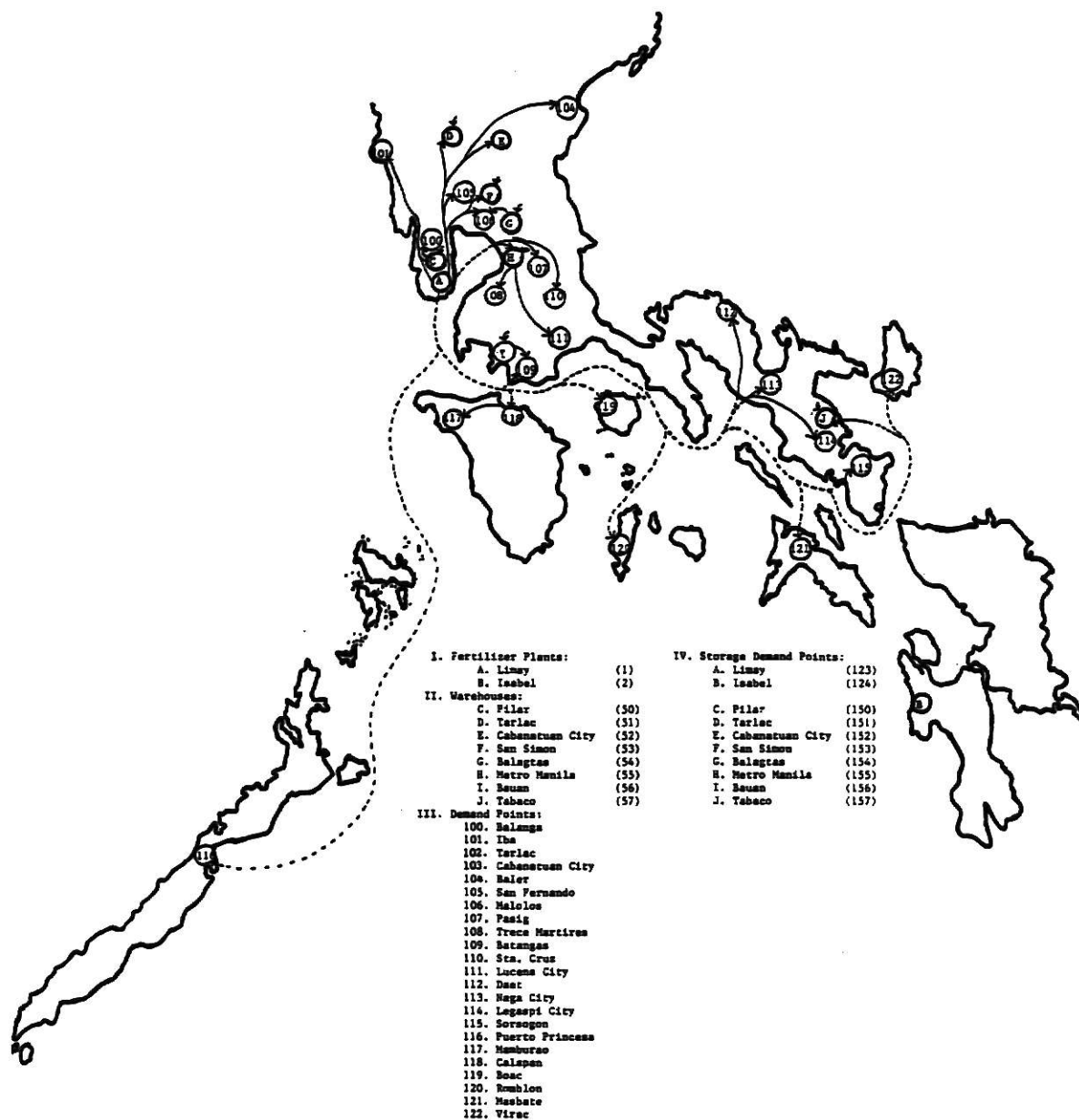


Figure 7C. Complete Fertilizer Distribution Flow Pattern
(August, 1980) of Initial Solution

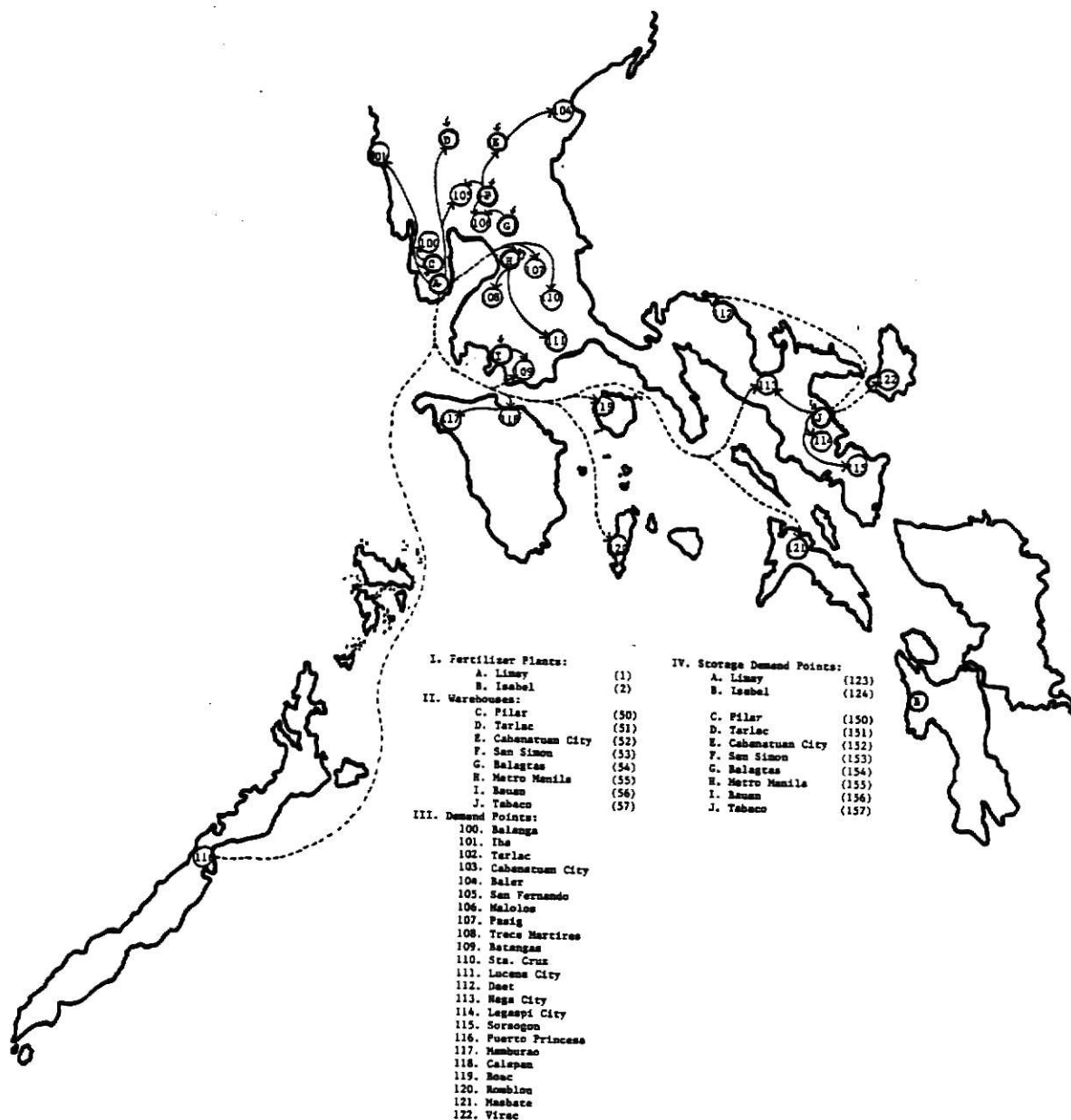
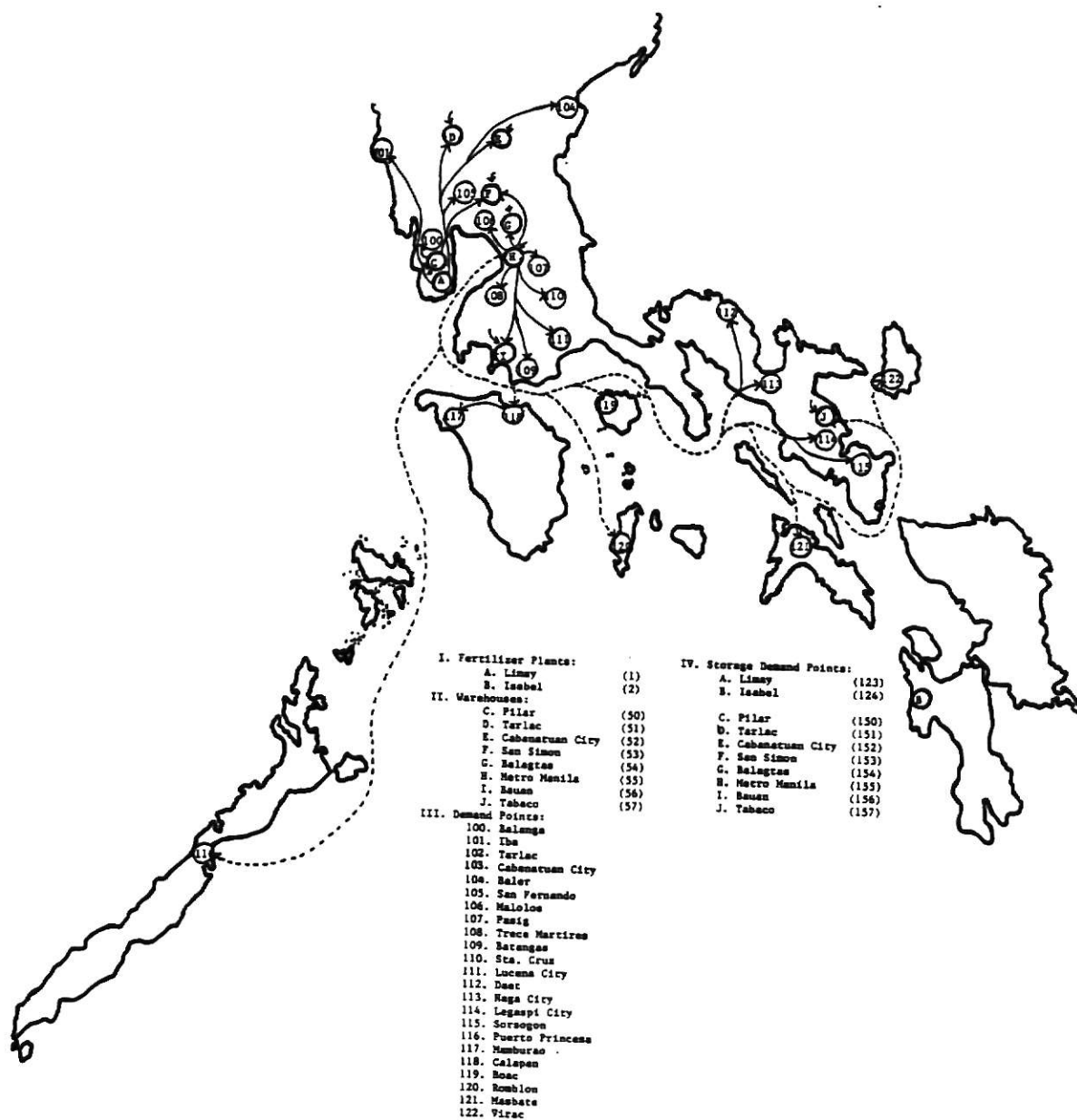


Figure 7D. Complete Fertilizer Distribution Flow Pattern
(September, 1980) of Initial Solution



summarized in Table 21. The figures were obtained by dividing the total costs incurred by the total supply quantities allocated for each month. The monthly average costs consist of transport and handling costs for the distribution of the complete fertilizer during the current month, and a combination of storage, transport and handling cost for allocation to the succeeding month. There is not much variation in the monthly total cost and average costs.

Modified Solution

A modified solution was made wherein the Philippine-Phosphate Fertilizer Corporation in Isabel, Leyte was assumed to be in operation in addition to PPI. Actually this fertilizer plant is envisioned to be in the fertilizer industry by 1983 and will have a production capability for NPK of 20 percent. The plant was also assumed to be also distributing to some parts of the three regions under study. For this study it was further assumed that it supplied one-third of the total demand of the areas under study.

During the month of January the plant had a total cost of ₱2,779,279.85 and incurred ₱16,471.2 savings if Leyte's plant was already in operation in 1980.

The Philippine-Phosphate Fertilizer Corporation supplied the following demand points by land and water route: Batangas, Daet, Naga, Legaspi, Sorsogon, Calapan, Boac, Romblon, Masbate, Virac, Bauan and Tabaco. Limay supplied Pasig, Sta. Cruz, Puerto Princesa, Mamburao, Metro Manila and Bauan by the combination of land and water route.

The distribution pattern in the succeeding month by the use of truck was almost the same aside from that Trece Martires and Lucena City were

Table 21
MINIMUM MONTHLY DISTRIBUTION AND STORAGE COSTS

<u>MONTH</u>	<u>TOTAL COST (P)</u>	<u>AVE. COST (P/MT)</u>
0180	2,795,751.43	64.73
0280	2,589,950.62	60.73
0380	2,652,306.90	63.82
0480	2,722,569.69	61.83
0580	2,813,634.07	63.94
0680	2,821,553.53	61.02
0780	2,651,464.94	60.88
0880	2,481,286.58	59.85
0980	2,133,101.81	63.99
1080	2,078,399.70	62.19
1180	2,031,827.04	63.15
1280	2,042,238.07	61.12
Annual	29,814,084	62.27

Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 280

ORIGIN	DESIGNATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	102.00	88.664	9064.12
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	34.00	85.874	3055.72
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	637.00	66.642	42453.55
1 LIMAY, BATAAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	250.00	75.396	18849.00
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	7452.00	62.265	463998.75
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	269.00	99.302	26712.24
1 LIMAY, BATAAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	579.00	84.824	49113.10
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA. CRUZ, LAGUNA	3672.00	62.602	229874.50
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	202.00	46.440	9380.88
50 PILAR, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	5.00	84.487	760.38
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	718.00	62.265	44706.27
51 TARLAC, TARLAC	102 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	734.00	45.767	33592.98
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1965.00	56.878	111765.25
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	790.00	45.767	36155.93
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	5871.00	54.521	320392.75
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1052.00	55.235	62315.22
54 BALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	275.00	45.134	13511.85
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	2633.00	55.571	156850.44
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	9247.00	57.551	532174.00
56 BAUAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	283.00	47.787	13523.72
56 BAUAN, BATANGAS	156 BAUAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	2371.00	58.225	138051.44
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1668.00	55.235	98803.94
	SUBTOTAL		40813.00		2414803.40
1 LIMAY, BATAAN	107 PASTIG, RIZAL	33 TABACO, ALBAY-2	30.00	74.250	2227.50
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	239.00	83.368	19924.95
1 LIMAY, BATAAN	155 METRO MANILA-2	33 TABACO, ALBAY-2	344.00	86.098	29617.71
2 ISABEL, LEYTE	103 CABANATUAN CITY	33 TABACO, ALBAY-2	544.00	134.638	73243.06
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACO, ALBAY-2	30.00	176.680	5300.40
2 ISABEL, LEYTE	108 TRECE MARTIRES	33 TABACO, ALBAY-2	146.00	125.137	18270.00
2 ISABEL, LEYTE	169 BATANGAS, BATANGA	33 TABACO, ALBAY-2	149.00	109.194	16269.90
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACO, ALBAY-2	60.00	130.324	7819.44
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	5.00	121.315	606.57
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACO, ALBAY-2	89.00	102.642	9135.14
2 ISABEL, LEYTE	114 LEGASPI CITY	33 TABACO, ALBAY-2	33.00	97.892	3230.44
2 ISABEL, LEYTE	115 SORSOGON, SORSOGON	33 TABACO, ALBAY-2	15.00	95.872	1438.08
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	8.00	157.242	1257.94
2 ISABEL, LEYTE	117 MAMBURAO, OCC. MIN	33 TABACO, ALBAY-2	53.00	120.660	6394.98
2 ISABEL, LEYTE	118 CALAPAN, DR. MIND.	33 TABACO, ALBAY-2	62.00	107.556	6668.47
2 ISABEL, LEYTE	119 BOAC, MAR. INDIQUE	33 TABACO, ALBAY-2	6.00	108.576	653.86
2 ISABEL, LEYTE	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	8.00	100.076	800.61
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	2.00	92.159	184.32
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	1.00	94.288	94.29
2 ISABEL, LEYTE	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	13.00	114.217	1484.82
	SUBTOTAL		1837.00		204622.46
	TOTAL		42650.00		2619425.86

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Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 300

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 TBA, ZAMBALES	11 STA. CRUZ, LAGUNA	28.00	88.864	2488.19
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	341.00	30647.03	30647.03
1 LIMAY, BATAAN	104 BALER, AURORA	11 STA. CRUZ, LAGUNA	5.00	154.521	1350.69
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	159.00	66.642	10596.67
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	7452.00	62.265	463958.75
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	695.00	66.642	46316.19
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	626.00	95.302	62163.05
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	626.00	98.629	61741.75
1 LIMAY, BATAAN	124 ISABEL, LEYTE-2	11 STA. CRUZ, LAGUNA	3672.00	62.602	229874.50
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	50.00	46.440	2322.00
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	243.00	62.265	15130.39
50 PILAR, BATAAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	425.00	80.447	34189.58
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	183.00	45.767	8375.36
52 CABANATUAN CITY	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	2051.00	56.878	116656.75
53 SAN SIMON	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	5871.00	54.521	320092.75
54 BALAGTAGAS, BULACAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1631.00	55.235	96612.25
55 METRO MANILA	154 BALAGTAGAS-2	11 STA. CRUZ, LAGUNA	2633.00	55.571	156850.44
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	131.00	62.538	8244.87
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	9.00	46.777	420.99
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	40.00	64.285	2571.40
55 METRO MANILA	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	118.00	86.171	10168.18
55 METRO MANILA	110 STA. CRUZ, LAGUNA	11 STA. CRUZ, LAGUNA	66.00	77.080	5087.28
55 METRO MANILA	111 LUCENA CITY	11 STA. CRUZ, LAGUNA	16.00	94.251	1508.02
55 METRO MANILA	154 BALAGTAGAS-2	11 STA. CRUZ, LAGUNA	180.00	75.060	13510.80
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	8698.00	57.551	500578.50
55 METRO MANILA	156 BAWAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	260.00	100.985	26256.10
55 METRO MANILA	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	2371.00	58.225	138051.44
57 TABACO, ALBAY	11 STA. CRUZ, LAGUNA	11 STA. CRUZ, LAGUNA	1681.00	55.235	99574.00
	SUBTOTAL		40265.00		2465417.71
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	2.00	121.315	242.63
2 ISABEL, LEYTE	114 LEGASPI CITY	33 TABACO, ALBAY-2	11.00	97.892	1076.81
55 METRO MANILA	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	1211.00	114.217	138316.75
55 METRO MANILA	113 NAGA CITY	33 TABACO, ALBAY-2	29.00	115.459	3464.31
55 METRO MANILA	115 SORSOGON, SORSOGO	33 TABACO, ALBAY-2	5.00	126.448	632.24
55 METRO MANILA	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	2.00	137.750	275.50
55 METRO MANILA	117 MAMBURAD, OCC. MIN	33 TABACO, ALBAY-2	15.00	101.168	1517.52
55 METRO MANILA	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	17.00	102.260	1738.42
55 METRO MANILA	119 BOAC, MARINDUQUE	33 TABACO, ALBAY-2	2.00	108.430	216.86
55 METRO MANILA	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	2.00	105.740	219.48
55 METRO MANILA	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	1.00	117.657	117.66
	SUBTOTAL		1297.00		147818.18
	TOTAL		41562.00		2613235.89

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Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 480

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	55.00	88.664	4877.22
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	319.00	66.642	21258.80
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	7452.00	62.265	463958.75
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	659.00	66.642	43917.07
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	854.00	95.302	84803.87
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	597.00	98.629	58801.51
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA. CRUZ, LAGUNA	3672.00	62.602	229874.50
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	101.00	46.440	4690.44
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	512.00	62.265	31879.68
50 PILAR, BATAAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	325.00	86.447	26145.27
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	367.00	45.767	16756.49
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	2310.00	56.878	131388.19
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	6497.00	54.521	354222.87
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	2056.00	55.235	121787.12
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	2813.00	59.571	167573.19
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	262.00	62.938	16489.75
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	41.00	46.777	1917.86
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	199.00	64.285	12792.71
55 METRO MANILA	110 STA. CRUZ, LAGUNA	11 STA. CRUZ, LAGUNA	327.00	77.680	25205.16
55 METRO MANILA	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	130.00	82.804	10764.52
55 METRO MANILA	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	242.00	75.060	18164.52
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	7497.00	57.551	431459.75
56 BAYAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	567.00	47.787	27055.23
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	2064.00	58.225	120176.37
57 TABACO, ALBAY	113 NAGA CITY	11 STA. CRUZ, LAGUNA	233.00	84.824	19763.99
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	52.00	51.491	564.01
57 TABACO, ALBAY	115 SORSOGON, SORSOGON	11 STA. CRUZ, LAGUNA	52.00	74.386	3868.07
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	2497.00	55.235	147909.75
	SUBTOTAL		42810.00		2603376.97
2 ISABEL, LEYTE	103 CABANATUAN CITY	33 TABACO, ALBAY-2	684.00	134.638	92092.37
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACO, ALBAY-2	41.00	172.680	7233.88
2 ISABEL, LEYTE	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	22.00	109.194	2402.27
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACO, ALBAY-2	82.00	130.324	10686.57
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	15.00	121.315	1819.72
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACO, ALBAY-2	61.00	102.642	6261.16
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	11.00	157.242	1729.66
2 ISABEL, LEYTE	117 MAMBURAO, OCC. MIN	33 TABACO, ALBAY-2	73.00	120.660	8808.18
2 ISABEL, LEYTE	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	85.00	107.556	9142.26
2 ISABEL, LEYTE	119 RDAC, MAR INDUQUE	33 TABACO, ALBAY-2	9.00	108.976	980.78
2 ISABEL, LEYTE	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	10.00	100.076	1000.76
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	7.00	92.159	645.11
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	3.00	94.288	282.86
2 ISABEL, LEYTE	152 CABANATUAN-2	33 TABACO, ALBAY-2	121.00	143.756	17354.47
	SUBTOTAL		1224.00		160490.07
	TOTAL		44034.00		2763867.04

Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 580

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT_COST	TOTAL_COST
1 LIMAY, BATAAN	105 SN-FERNANDO	11 STA-CRUZ, LAGUNA	159.00	66.642	10596.07
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA-CRUZ, LAGUNA	7452.00	62.265	463958.75
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA-CRUZ, LAGUNA	671.00	66.642	44716.78
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA-CRUZ, LAGUNA	1417.00	95.302	140710.87
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA-CRUZ, LAGUNA	237.00	96.629	23375.07
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA-CRUZ, LAGUNA	3672.00	62.602	229874.53
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA-CRUZ, LAGUNA	50.00	46.440	2322.00
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA-CRUZ, LAGUNA	1121.00	62.265	69755.06
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA-CRUZ, LAGUNA	183.00	45.767	8375.36
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA-CRUZ, LAGUNA	2981.00	56.878	169553.31
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA-CRUZ, LAGUNA	7215.00	54.521	393368.94
53 SAN SIMON	153 SN-SIMON-2	11 STA-CRUZ, LAGUNA	2511.00	55.235	148735.06
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA-CRUZ, LAGUNA	3055.00	59.571	181989.37
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA-CRUZ, LAGUNA	131.00	62.538	8244.87
55 METRO MANILA	107 PASIG, RIZAL	11 STA-CRUZ, LAGUNA	14.00	46.777	654.88
55 METRO MANILA	108 TRECE MARTIRES	11 STA-CRUZ, LAGUNA	66.00	64.285	4242.81
55 METRO MANILA	110 STA-CRUZ, LAGUNA	11 STA-CRUZ, LAGUNA	109.00	77.080	8401.72
55 METRO MANILA	152 CABANATUAN-2	11 STA-CRUZ, LAGUNA	1220.00	103.679	126488.37
55 METRO MANILA	153 SN-SIMON-2	11 STA-CRUZ, LAGUNA	1194.00	82.804	98867.94
55 METRO MANILA	154 BALAGTAS-2	11 STA-CRUZ, LAGUNA	468.00	75.060	35128.08
55 METRO MANILA	155 METRO MANILA-2	11 STA-CRUZ, LAGUNA	4267.00	57.551	245570.06
56 BAWAN, BATANGAS	109 BATANGAS, BATANGA	11 STA-CRUZ, LAGUNA	16.00	47.787	764.59
56 BAWAN, BATANGAS	156 BAWAN, BATANGAS-2	11 STA-CRUZ, LAGUNA	2048.00	58.225	119244.81
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA-CRUZ, LAGUNA	2497.00	55.235	147909.75
	SUBTOTAL		42754.00		2682937.04
2 ISABEL, LEYTE	103 CABANATUAN CITY	33 TABACO, ALBAY-2	341.00	134.638	45911.55
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACO, ALBAY-2	13.00	176.680	2296.84
2 ISABEL, LEYTE	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	180.00	105.194	19654.92
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACO, ALBAY-2	27.00	130.324	3518.75
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	3.00	121.315	363.94
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACO, ALBAY-2	59.00	102.642	6055.67
2 ISABEL, LEYTE	114 LEGASPI CITY	33 TABACO, ALBAY-2	22.00	57.892	2153.62
2 ISABEL, LEYTE	115 SORSOGON, SORSOGON	33 TABACO, ALBAY-2	10.00	95.672	958.72
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	4.00	157.242	628.57
2 ISABEL, LEYTE	117 MAMBURAO, OCC. MIN	33 TABACO, ALBAY-2	24.00	120.660	2895.84
2 ISABEL, LEYTE	118 CALAPAN, GR. MIND.	33 TABACO, ALBAY-2	28.00	107.556	3011.57
2 ISABEL, LEYTE	119 BOAC, MARINDUQUE	33 TABACO, ALBAY-2	3.00	106.576	326.93
2 ISABEL, LEYTE	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	3.00	100.076	300.23
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	2.00	92.159	184.32
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	1.00	94.288	94.29
2 ISABEL, LEYTE	152 CABANATUAN-2	33 TABACO, ALBAY-2	203.00	143.756	29182.46
2 ISABEL, LEYTE	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	301.00	114.217	34379.31
55 METRO MANILA	101 IBA, ZAMBALES	33 TABACO, ALBAY-2	28.00	85.666	2516.25
	SUBTOTAL		1252.00		154434.39
	TOTAL		44006.00		2837371.43

Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 680

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA-CRUZ, LAGUNA	125.00	88.864	11108.03
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA-CRUZ, LAGUNA	335.00	85.874	30107.79
1 LIMAY, BATAAN	105 SN.FERNANDO	11 STA-CRUZ, LAGUNA	716.00	66.642	47715.67
1 LIMAY, BATAAN	106 MALOLOS, BULACAN	11 STA-CRUZ, LAGUNA	290.00	75.396	21864.84
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA-CRUZ, LAGUNA	7452.00	63.265	463958.75
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA-CRUZ, LAGUNA	152.00	66.642	10129.58
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA-CRUZ, LAGUNA	648.00	95.302	64347.70
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA-CRUZ, LAGUNA	3672.00	62.602	229874.50
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA-CRUZ, LAGUNA	227.00	46.440	10541.88
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA-CRUZ, LAGUNA	1565.00	63.265	97444.69
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA-CRUZ, LAGUNA	825.00	45.767	37757.77
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA-CRUZ, LAGUNA	3573.00	56.678	203225.06
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA-CRUZ, LAGUNA	338.00	45.767	15469.24
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA-CRUZ, LAGUNA	8537.00	54.521	465445.69
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA-CRUZ, LAGUNA	153.00	51.491	7878.12
53 SAN SIMON	153 SN-SIMON-2	11 STA-CRUZ, LAGUNA	3552.00	55.235	210402.69
54 BALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA-CRUZ, LAGUNA	122.00	45.134	5944.35
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA-CRUZ, LAGUNA	3401.00	55.571	202600.94
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA-CRUZ, LAGUNA	25.00	63.538	1573.45
55 METRO MANILA	107 PASIG, RIZAL	11 STA-CRUZ, LAGUNA	27.00	46.777	1262.58
55 METRO MANILA	108 TRECE MARTIRES	11 STA-CRUZ, LAGUNA	133.00	64.285	8549.90
55 METRO MANILA	155 METRO MANILA-2	11 STA-CRUZ, LAGUNA	4082.00	57.551	234923.12
56 BAUAN, BATANGAS	109 BATANGAS, BATANGA	11 STA-CRUZ, LAGUNA	342.00	47.787	16343.15
56 BAUAN, BATANGAS	156 BAUAN, BATANGAS-2	11 STA-CRUZ, LAGUNA	1706.00	58.225	99331.81
57 TABACO, ALBAY	113 NAGA CITY	11 STA-CRUZ, LAGUNA	826.00	84.824	70064.62
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA-CRUZ, LAGUNA	320.00	51.491	16477.12
57 TABACO, ALBAY	115 SORSOGON, SORSOGON	11 STA-CRUZ, LAGUNA	151.00	74.386	11232.29
57 TABACC, ALBAY	157 TABACO, ALBAY-2	11 STA-CRUZ, LAGUNA	1501.00	55.235	88911.69
	SUBTOTAL		44796.00		2684577.37
1 LIMAY, BATAAN	110 STA-CRUZ, LAGUNA	33 TABACO, ALBAY-2	218.00	83.368	18174.22
2 ISABEL, LEYTE	103 CABANATUAN CITY	33 TABACO, ALBAY-2	865.00	134.638	116461.81
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACO, ALBAY-2	27.00	176.680	4773.36
2 ISABEL, LEYTE	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	50.00	105.194	5459.70
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACO, ALBAY-2	55.00	130.324	7167.82
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	45.00	121.315	5459.17
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACO, ALBAY-2	29.00	102.642	2976.62
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	8.00	151.242	1237.94
2 ISABEL, LEYTE	117 MAMBURAO, OCC. MIN	33 TABACO, ALBAY-2	48.00	120.660	5791.68
2 ISABEL, LEYTE	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	57.00	107.556	6130.69
2 ISABEL, LEYTE	119 BOAC, MARINDUQUE	33 TABACO, ALBAY-2	5.00	106.576	544.88
2 ISABEL, LEYTE	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	7.00	100.076	703.53
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	20.00	92.159	1843.18
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACC, ALBAY-2	8.00	94.288	754.30
	SUBTOTAL		1442.00		177492.93
	TOTAL		46238.00		2862070.28

Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 780				
ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST
1 LIMAY, BATAAN	101 18A, ZAMBALES	11 STA. CRUZ, LAGUNA	153.00	88.864
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	396.00	85.874
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	876.00	66.642
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	7452.00	62.265
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	174.00	66.642
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	733.00	95.302
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA. CRUZ, LAGUNA	3672.00	62.602
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	278.00	46.440
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	1435.00	62.265
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	1009.00	45.767
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	3212.00	56.878
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	619.00	45.767
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	7918.00	54.521
53 SAN SIMON	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	214.00	71.356
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	7.00	51.491
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	3331.00	55.235
54 BALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	261.00	45.134
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	3140.00	59.571
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	454.00	62.538
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	20.00	46.777
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	93.00	64.285
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	3515.00	57.551
56 BAYAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	122.00	47.787
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1584.00	58.225
57 TABACCO, ALBAY	157 TABACCO, ALBAY-2	11 STA. CRUZ, LAGUNA	1501.00	59.235
		SUBTOTAL	42173.00	2514758.43
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACCO, ALBAY-2	152.00	83.368
2 ISABEL, LEYTE	103 CABANATUAN CITY	33 TABACCO, ALBAY-2	652.00	134.638
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACCO, ALBAY-2	20.00	176.680
2 ISABEL, LEYTE	109 BATANGAS, BATANGA	33 TABACCO, ALBAY-2	153.00	105.194
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACCO, ALBAY-2	38.00	130.324
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACCO, ALBAY-2	6.00	121.315
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACCO, ALBAY-2	118.00	102.642
2 ISABEL, LEYTE	114 LEGASPI CITY	33 TABACCO, ALBAY-2	45.00	97.892
2 ISABEL, LEYTE	115 SORSOGON, SORSOGON	33 TABACCO, ALBAY-2	21.00	95.872
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACCO, ALBAY-2	5.00	157.242
2 ISABEL, LEYTE	117 MAMBURAO, OCC. MIN	33 TABACCO, ALBAY-2	34.00	120.660
2 ISABEL, LEYTE	118 CALAPAN, OR. MIND.	33 TABACCO, ALBAY-2	40.00	107.556
2 ISABEL, LEYTE	119 BUAC, MARINDUQUE	33 TABACCO, ALBAY-2	4.00	108.576
2 ISABEL, LEYTE	120 ROMBLON, ROMBLON	33 TABACCO, ALBAY-2	5.00	100.076
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACCO, ALBAY-2	3.00	92.159
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACCO, ALBAY-2	2.00	94.288
2 ISABEL, LEYTE	157 TABACCO, ALBAY-2	33 TABACCO, ALBAY-2	78.00	114.217
		SUBTOTAL	1376.00	164407.70
		TOTAL	43549.00	2679206.13

Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 880

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT_COST	TOTAL_COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA-CRUZ, LAGUNA	181.00	88.864	16084.38
1 LIMAY, BATAAN	105 SN-FERNANDO	11 STA-CRUZ, LAGUNA	1705.00	66.642	113624.56
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA-CRUZ, LAGUNA	7452.00	62.265	463958.75
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA-CRUZ, LAGUNA	298.00	99.302	29592.00
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA-CRUZ, LAGUNA	3672.00	62.602	229874.50
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA-CRUZ, LAGUNA	556.00	46.440	25820.64
50 PILAR, BATAAN	101 IBA, ZAMBALES	11 STA-CRUZ, LAGUNA	125.00	84.487	10560.87
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA-CRUZ, LAGUNA	932.00	62.265	58030.98
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA-CRUZ, LAGUNA	1857.00	45.767	84989.31
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA-CRUZ, LAGUNA	2088.00	56.878	118761.25
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA-CRUZ, LAGUNA	2826.00	45.767	129337.50
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA-CRUZ, LAGUNA	5092.00	54.521	277620.67
53 SAN SIMON	103 CABANATUAN CITY	11 STA-CRUZ, LAGUNA	935.00	71.356	66717.81
53 SAN SIMON	105 SN-FERNANDO	11 STA-CRUZ, LAGUNA	47.00	45.807	2340.93
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA-CRUZ, LAGUNA	391.00	51.491	20132.58
53 SAN SIMON	153 SN-SIMON-2	11 STA-CRUZ, LAGUNA	1958.00	55.235	115982.12
54 BALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA-CRUZ, LAGUNA	1053.00	45.134	51738.10
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA-CRUZ, LAGUNA	2087.00	55.571	124324.62
55 METRO MANILA	155 METRO MANILA-2	11 STA-CRUZ, LAGUNA	3515.00	57.551	202291.69
56 BAYAN, BATANGAS	109 BATANGAS, BATANGA	11 STA-CRUZ, LAGUNA	338.00	47.787	16152.00
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA-CRUZ, LAGUNA	1246.00	58.225	72548.31
57 TABACO, ALBAY	113 NAGA CITY	11 STA-CRUZ, LAGUNA	284.00	84.824	24090.02
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA-CRUZ, LAGUNA	188.00	51.491	9680.30
57 TABACO, ALBAY	115 SORSOGON, SORSOGON	11 STA-CRUZ, LAGUNA	89.00	74.386	6620.35
57 TABACC, ALBAY	157 TABACO, ALBAY-2	11 STA-CRUZ, LAGUNA	1018.00	55.235	60301.23
		SUBTOTAL	39933.00		2331216.09
1 LIMAY, BATAAN	107 PASIG, RIZAL	33 TABACO, ALBAY-2	33.00	74.250	2450.25
1 LIMAY, BATAAN	155 METRO MANILA-2	33 TABACO, ALBAY-2	267.00	86.098	22968.16
2 ISABEL, LEYTE	102 TARLAC, TARLAC	33 TABACO, ALBAY-2	161.00	134.146	21597.50
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACO, ALBAY-2	33.00	176.680	5830.44
2 ISABEL, LEYTE	108 TRECE MARTIRES	33 TABACO, ALBAY-2	159.00	125.137	19856.78
2 ISABEL, LEYTE	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	133.00	105.194	14522.80
2 ISABEL, LEYTE	110 STA-CRUZ, LAGUNA	33 TABACO, ALBAY-2	261.00	128.795	33615.49
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACO, ALBAY-2	66.00	130.324	8601.38
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	26.00	121.315	3154.19
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACO, ALBAY-2	217.00	102.642	22273.31
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	9.00	157.242	1415.18
2 ISABEL, LEYTE	117 MAMBURAO, OCC. MIN	33 TABACC, ALBAY-2	58.00	120.660	6958.28
2 ISABEL, LEYTE	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	65.00	107.556	7421.36
2 ISABEL, LEYTE	119 BOAC, MARINUQUE	33 TABACO, ALBAY-2	7.00	106.576	762.83
2 ISABEL, LEYTE	120 RORBLON, RORBLON	33 TABACO, ALBAY-2	8.00	100.676	800.61
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	12.00	92.159	1105.51
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	5.00	94.288	471.44
		SUBTOTAL	1524.00		173905.92
		TOTAL	41457.00		2505122.01

Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 980

ORIGIN	DESTINATION	MODE	QUANTITY	LMUL_COST	INITIAL_COST
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	244.00	89.874	21929.25
1 LIMAY, BATAAN	105 SN.FERNANDO	11 STA. CRUZ, LAGUNA	558.00	66.642	37186.23
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	7452.00	62.265	463558.75
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	389.00	66.642	25923.73
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1003.00	99.302	99559.67
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	29.00	98.629	28602.41
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA. CRUZ, LAGUNA	3672.00	62.602	229874.50
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	177.00	46.440	8215.88
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	755.00	62.265	47010.07
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	642.00	45.767	29382.41
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1744.00	56.078	99155.19
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	5092.00	54.521	277620.87
53 SAN SIMON	153 SN.SIMON-2	11 STA. CRUZ, LAGUNA	1958.00	59.235	115982.12
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	2087.00	55.571	124324.62
55 METRO MANILA	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	691.00	94.925	65593.12
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	459.00	62.538	28888.54
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	14.00	46.777	654.88
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	53.00	64.285	3407.13
55 METRO MANILA	110 STA. CRUZ, LAGUNA	11 STA. CRUZ, LAGUNA	87.00	77.080	6705.56
55 METRO MANILA	153 SN.SIMON-2	11 STA. CRUZ, LAGUNA	390.00	82.804	32293.56
55 METRO MANILA	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	1.00	75.660	75.06
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	1989.00	57.551	114468.87
56 BAWAN, BATANGAS	156 BAWAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1246.00	58.225	72548.31
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1018.00	55.235	60301.23
		SUBTOTAL	32011.00		1993786.57
2 ISABEL, LEYTE	103 CABANATUAN CITY	33 TABACO, ALBAY-2	262.00	134.638	35275.15
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACO, ALBAY-2	11.00	176.680	1943.48
2 ISABEL, LEYTE	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	157.00	105.194	17143.46
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACO, ALBAY-2	22.00	130.324	2867.13
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	2.00	121.315	363.94
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACC, ALBAY-2	59.00	102.642	6055.87
2 ISABEL, LEYTE	114 LEGASPI CITY	33 TABACO, ALBAY-2	22.00	97.892	2153.62
2 ISABEL, LEYTE	115 SORSOGON, SORSOGON	33 TABACO, ALBAY-2	10.00	95.872	958.72
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	3.00	157.242	471.73
2 ISABEL, LEYTE	117 MAMBURAO, OCC.MIN	33 TABACO, ALBAY-2	20.00	120.660	2413.20
2 ISABEL, LEYTE	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	23.00	107.556	2473.79
2 ISABEL, LEYTE	119 BOAC, MARINDUQUE	33 TABACO, ALBAY-2	2.00	108.576	217.95
2 ISABEL, LEYTE	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	2.00	100.076	200.15
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	2.00	92.159	184.32
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	1.00	94.288	54.29
2 ISABEL, LEYTE	156 BAWAN, BATANGAS-2	33 TABACC, ALBAY-2	309.00	122.571	37874.44
2 ISABEL, LEYTE	157 TABACO, ALBAY-2	33 TABACO, ALBAY-2	316.00	114.217	36052.57
55 METRO MANILA	101 IBA, ZAMBALES	33 TABACC, ALBAY-2	98.00	85.866	8606.67
		SUBTOTAL	1322.00		155590.68
		TOTAL	33333.00		2149377.25

ITERATION = 3

Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 1180

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT_COST	TOTAL_COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	55.00	88.864	4887.52
1 LIMAY, BATAAN	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	160.00	85.874	14375.44
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	319.00	66.642	21258.80
1 LIMAY, BATAAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	103.00	75.396	7765.79
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	7452.00	62.265	463558.75
1 LIMAY, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	257.00	66.642	17126.99
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	687.00	95.302	68220.44
1 LIMAY, BATAAN	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	494.00	98.629	48722.72
1 LIMAY, BATAAN	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	300.00	84.824	25447.23
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA. CRUZ, LAGUNA	3672.00	62.602	229874.50
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	101.00	46.440	4690.44
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	973.00	62.265	60583.84
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	367.00	45.767	16796.49
51 TARLAC, TARLAC	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	2189.00	56.878	124535.94
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	4961.00	54.521	270478.62
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	2197.00	55.235	130139.25
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	1907.00	59.571	113601.87
55 METRO MANILA	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	155.00	62.938	10307.14
55 METRO MANILA	107 PASIG, RIZAL	11 STA. CRUZ, LAGUNA	14.00	44.777	654.88
55 METRO MANILA	108 TRECE MARTIRES	11 STA. CRUZ, LAGUNA	66.00	64.285	4242.81
55 METRO MANILA	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	152.00	75.660	11409.12
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	1312.00	57.551	75506.87
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1628.00	58.225	94790.25
57 TABACO, ALBAY	113 NAGA CITY	11 STA. CRUZ, LAGUNA	51.00	84.824	4326.02
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	45.00	51.491	2317.09
57 TABACO, ALBAY	115 SORSOGON, SORSOGON	11 STA. CRUZ, LAGUNA	21.00	74.386	1562.11
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	1201.00	55.235	71141.19
		SUBTOTAL	30843.00		1898436.48
1 LIMAY, BATAAN	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	109.00	83.368	9087.11
2 ISABEL, LEYTE	103 CABANATUAN CITY	33 TABACO, ALBAY-2	524.00	134.638	70550.25
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACO, ALBAY-2	13.00	176.680	2296.84
2 ISABEL, LEYTE	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	196.00	105.194	21402.02
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACO, ALBAY-2	27.00	130.324	3518.75
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	6.00	121.315	727.89
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACO, ALBAY-2	67.00	102.642	6877.01
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	4.00	157.242	628.57
2 ISABEL, LEYTE	117 MAMBURAO, OCC. MIN	33 TABACO, ALBAY-2	24.00	120.660	2895.84
2 ISABEL, LEYTE	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	28.00	107.556	3011.57
2 ISABEL, LEYTE	119 BOAC, MARINDUQUE	33 TABACO, ALBAY-2	3.00	106.576	326.93
2 ISABEL, LEYTE	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	3.00	100.076	300.23
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	3.00	92.159	276.48
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	2.00	94.288	188.58
2 ISABEL, LEYTE	156 BAYAN, BATANGAS-2	33 TABACO, ALBAY-2	324.00	122.571	39713.09
		SUBTOTAL	1333.00		161801.46
		TOTAL	32176.00		2060237.93

Table 22 (cont'n)

OPTIMAL SOLUTION SORTED BY MODE FOR PROJECTED PERIOD 1280

ORIGIN	DESTINATION	MODE	QUANTITY	UNIT COST	TOTAL COST
1 LIMAY, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	122.00	88.864	10841.41
1 LIMAY, BATAAN	105 SN. FERNANDO	11 STA. CRUZ, LAGUNA	1195.00	66.642	79637.19
1 LIMAY, BATAAN	123 LIMAY, BATAAN-2	11 STA. CRUZ, LAGUNA	7452.00	62.265	463958.75
1 LIMAY, BATAAN	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	198.00	95.302	19661.79
2 ISABEL, LEYTE	124 ISABEL, LEYTE-2	11 STA. CRUZ, LAGUNA	3672.00	62.602	229874.50
50 PILAR, BATAAN	100 BALANGA, BATAAN	11 STA. CRUZ, LAGUNA	379.00	46.440	17600.76
50 PILAR, BATAAN	101 IBA, ZAMBALES	11 STA. CRUZ, LAGUNA	87.00	84.487	7350.37
50 PILAR, BATAAN	150 PILAR, BATAAN-2	11 STA. CRUZ, LAGUNA	764.00	47573.46	47573.46
51 TARLAC, TARLAC	102 TARLAC, TARLAC	11 STA. CRUZ, LAGUNA	1241.00	45.767	56796.84
52 CABANATUAN CITY	151 TARLAC, TARLAC-2	11 STA. CRUZ, LAGUNA	1635.00	56.878	92955.50
52 CABANATUAN CITY	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	1827.00	45.767	83616.25
52 CABANATUAN CITY	152 CABANATUAN-2	11 STA. CRUZ, LAGUNA	3628.00	54.521	197802.12
53 SAN SIMON	103 CABANATUAN CITY	11 STA. CRUZ, LAGUNA	604.00	71.356	43099.02
53 SAN SIMON	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	330.00	51.491	16952.03
53 SAN SIMON	153 SN. SIMON-2	11 STA. CRUZ, LAGUNA	1563.00	55.235	92584.25
54 BALAGTAS, BULACAN	106 MALOLOS, BULACAN	11 STA. CRUZ, LAGUNA	655.00	45.134	32182.77
54 BALAGTAS, BULACAN	154 BALAGTAS-2	11 STA. CRUZ, LAGUNA	1404.00	55.571	83637.62
55 METRO MANILA	155 METRO MANILA-2	11 STA. CRUZ, LAGUNA	1312.00	57.551	75506.87
56 BAYAN, BATANGAS	109 BATANGAS, BATANGA	11 STA. CRUZ, LAGUNA	520.00	47.787	24849.24
56 BAYAN, BATANGAS	156 BAYAN, BATANGAS-2	11 STA. CRUZ, LAGUNA	1432.00	58.225	83378.19
57 TABACO, ALBAY	113 NAGA CITY	11 STA. CRUZ, LAGUNA	302.00	84.824	25616.85
57 TABACO, ALBAY	114 LEGASPI CITY	11 STA. CRUZ, LAGUNA	155.00	51.491	7981.10
57 TABACO, ALBAY	115 SORSOGON, SORSOGON	11 STA. CRUZ, LAGUNA	73.00	74.386	5430.18
57 TABACO, ALBAY	157 TABACO, ALBAY-2	11 STA. CRUZ, LAGUNA	671.00	55.235	39746.68
	SUBTOTAL		31221.00		1838753.74
1 LIMAY, BATAAN	107 PASIG, RIZAL	33 TABACO, ALBAY-2	38.00	74.250	2821.50
1 LIMAY, BATAAN	155 METRO MANILA-2	33 TABACO, ALBAY-2	931.00	86.098	80157.19
2 ISABEL, LEYTE	102 TARLAC, TARLAC	33 TABACO, ALBAY-2	135.00	134.146	18155.71
2 ISABEL, LEYTE	103 CABANATUAN CITY	33 TABACO, ALBAY-2	133.00	134.638	17906.85
2 ISABEL, LEYTE	104 BALER, AURORA	33 TABACO, ALBAY-2	38.00	176.680	6713.84
2 ISABEL, LEYTE	108 TRECE MARTIRES	33 TABACO, ALBAY-2	186.00	125.137	23275.48
2 ISABEL, LEYTE	109 BATANGAS, BATANGA	33 TABACO, ALBAY-2	30.00	105.194	3275.82
2 ISABEL, LEYTE	110 STA. CRUZ, LAGUNA	33 TABACO, ALBAY-2	305.00	128.795	39282.47
2 ISABEL, LEYTE	111 LUCENA CITY	33 TABACO, ALBAY-2	76.00	130.324	9904.62
2 ISABEL, LEYTE	112 DAET, CAMARINES N	33 TABACO, ALBAY-2	22.00	121.315	2668.53
2 ISABEL, LEYTE	113 NAGA CITY	33 TABACO, ALBAY-2	111.00	102.642	11393.26
2 ISABEL, LEYTE	116 PUERTO PRINCESA	33 TABACO, ALBAY-2	10.00	157.242	1572.42
2 ISABEL, LEYTE	117 MAMBURAO, OCC. MIN	33 TABACO, ALBAY-2	68.00	120.600	8204.88
2 ISABEL, LEYTE	118 CALAPAN, OR. MIND.	33 TABACO, ALBAY-2	80.00	107.556	8604.48
2 ISABEL, LEYTE	119 BOAC, MARINDUQUE	33 TABACO, ALBAY-2	8.00	106.576	871.81
2 ISABEL, LEYTE	120 ROMBLON, ROMBLON	33 TABACO, ALBAY-2	9.00	100.076	900.68
2 ISABEL, LEYTE	121 MASBATE, MASBATE	33 TABACO, ALBAY-2	9.00	92.159	829.43
2 ISABEL, LEYTE	122 VIRAC, CATANDUANE	33 TABACO, ALBAY-2	4.00	94.288	377.15
	SUBTOTAL		2192.00		236870.52
	TOTAL		33414.00		2075621.26

Figure 8A. Complete Fertilizer Distribution Flow Pattern
(January, 1980) of Modified Solution

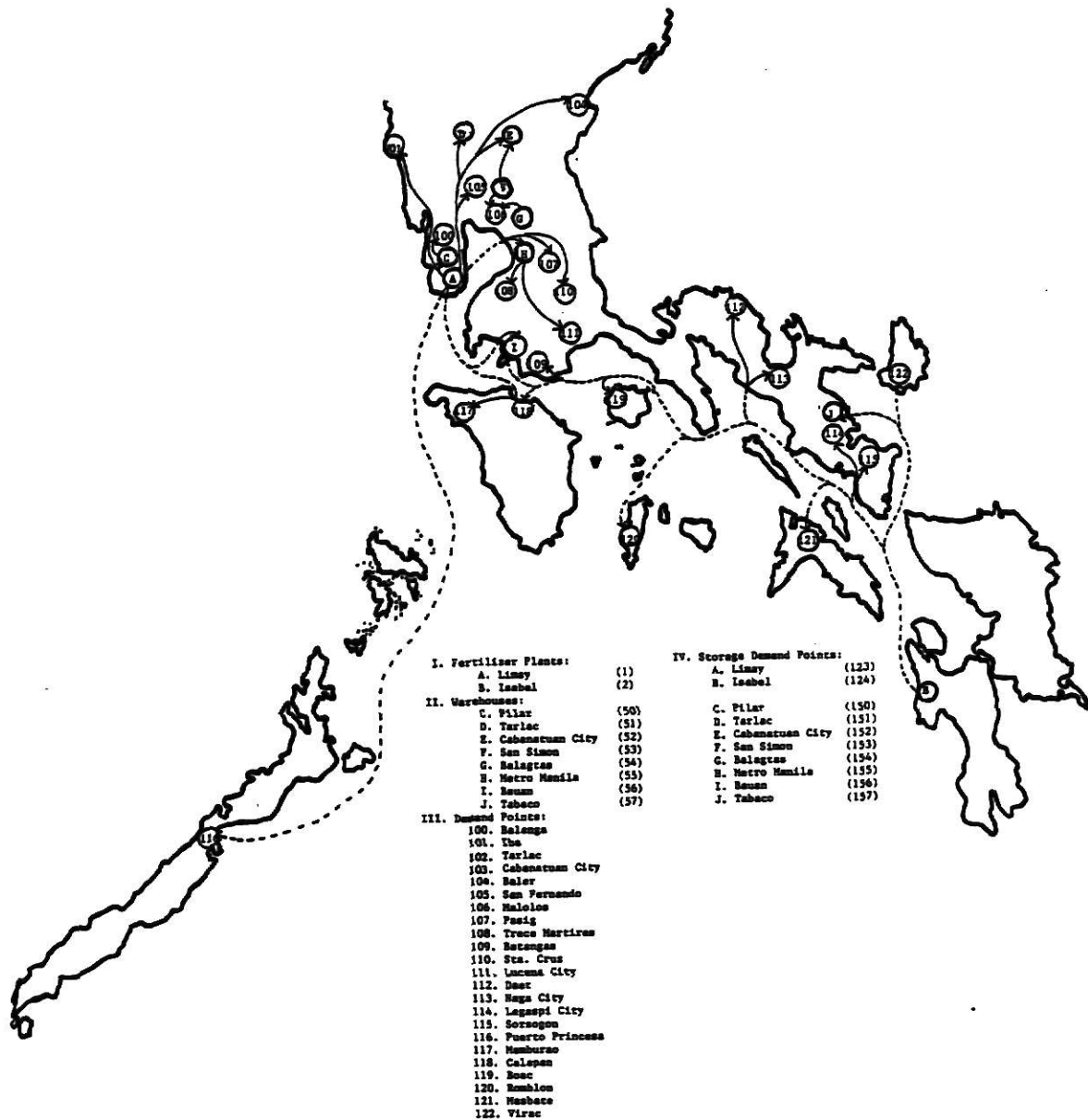


Figure 8B. Complete Fertilizer Distribution Flow Pattern
(February, 1980) of Modified Solution

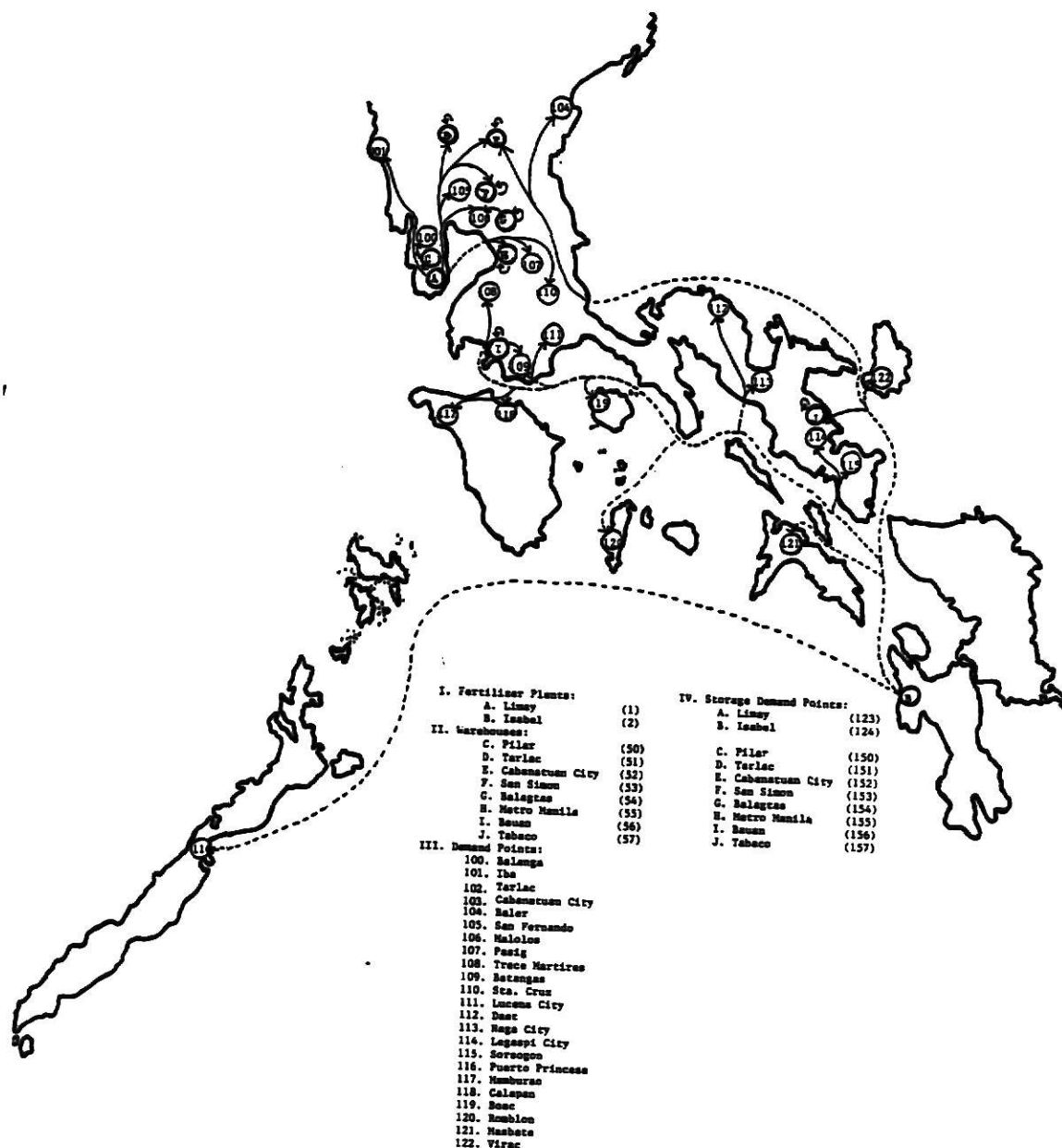


Figure 8C. Complete Fertilizer Distribution Flow Pattern
(August, 1980) of Modified Solution

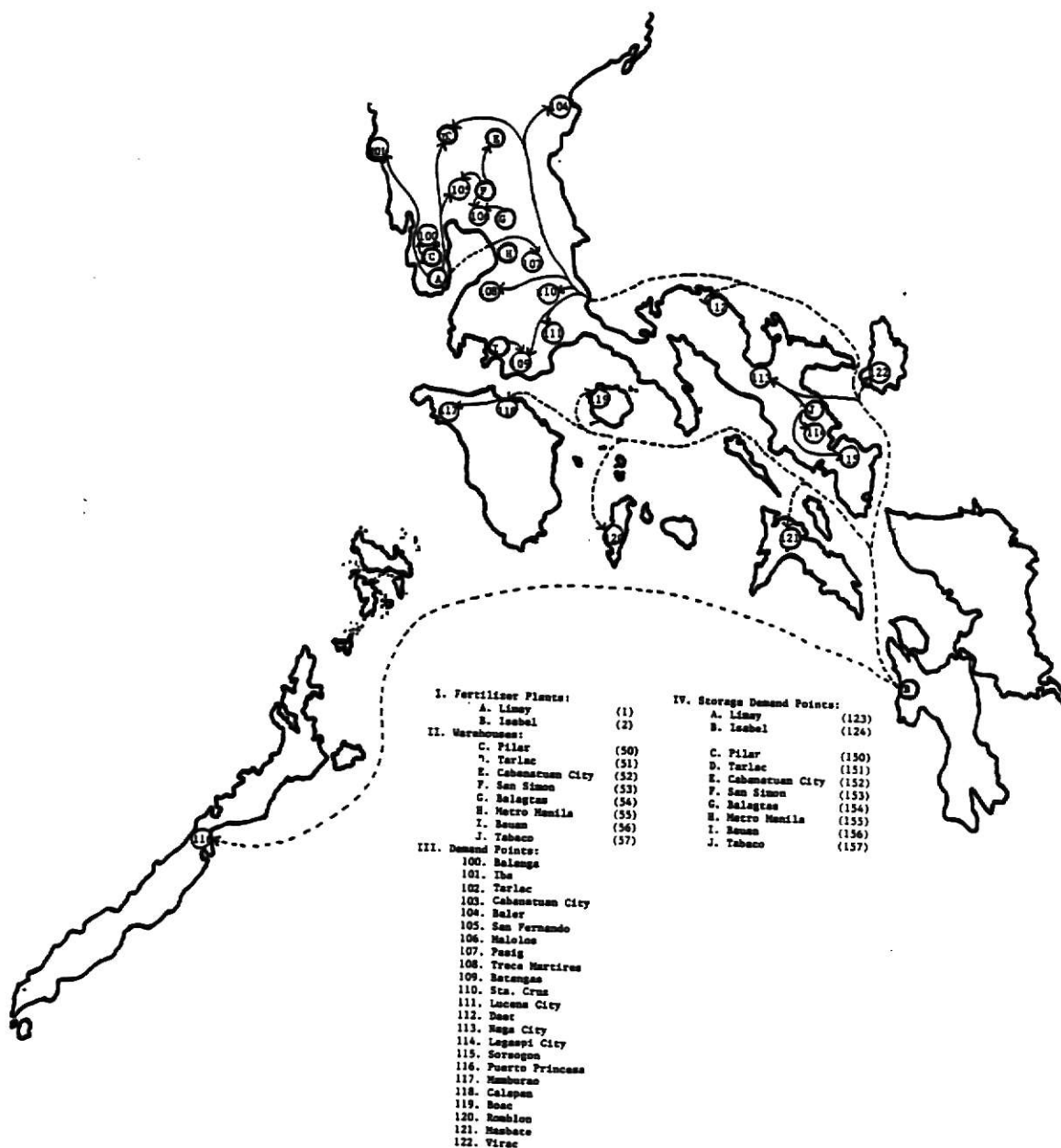
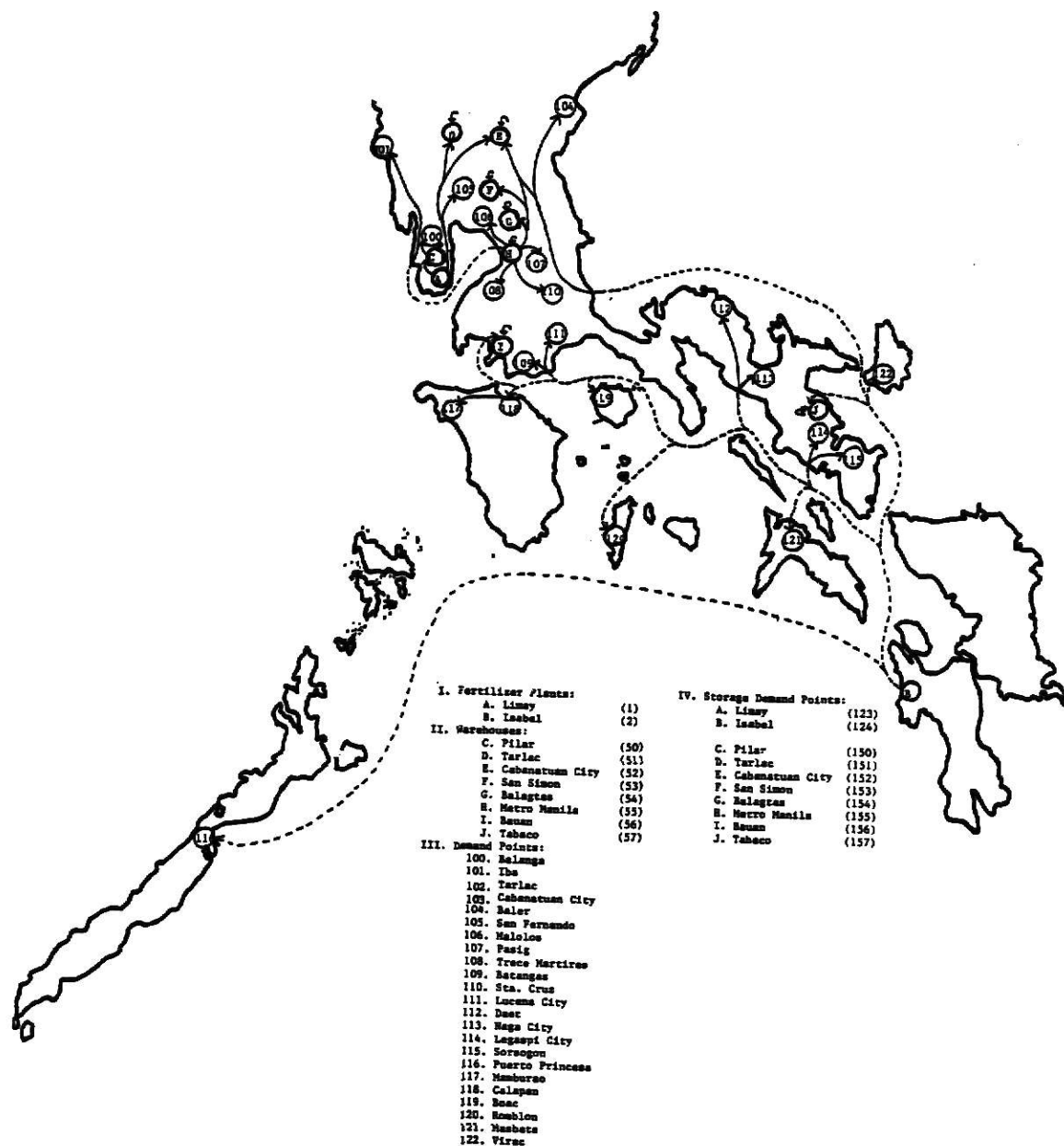


Figure 8D. Complete Fertilizer Distribution Flow Pattern
(September, 1980) of Modified Solution



supplied by Isabel rather than by Metro Manila through the combined route instead by truck only.

Limay supplied Pasig, Sta. Cruz, and Metro Manila while Isabel, Leyte met the demands of the following points: Cabanatuan, Baler, Trece Martires, Batangas, Lucena, Daet, Naga, Legaspi, Sorsogon, Puerto Princesa, Mamburao, Calapan, Boac, Romblon, Masbate, Virac and Tabaco, by means of land and water route. The total cost was ₱2,619,425.86. Earlier solution has a savings of ₱29,475.4 compared to this modified solution.

As indicated in the optimal solution for the modified case, the plant at Isabel, Leyte supplied some of the final demand points at Central Luzon which could be supplied by the Planters Products Incorporated at a lower cost. This distribution pattern was attributed to the quantity supplied by the plant at Isabel, Leyte. The Philippine-Phosphate Fertilizer Corporation was assumed to deliver one-third of the total demand of the provinces under study and from the analysis this figure is relatively high considering the higher total distribution costs incurred of the modified solution. The average cost per metric ton is higher by ₱0.49 than the initial solution.

Table 23
MINIMUM MONTHLY DISTRIBUTION AND STORAGE COSTS
OF THE MODIFIED SOLUTION

<u>MONTH</u>	<u>TOTAL COST (P)</u>	<u>AVE. COST (P/MT)</u>
0180	2,779,280.17	64.35
0280	2,619,426.00	61.42
0380	2,613,236.08	62.88
0480	2,763,867.22	62.77
0580	2,837,371.58	64.48
0680	2,862,070.54	61.90
0780	2,679,206.46	61.52
0880	2,505,122.29	60.43
0980	2,149,377.50	64.48
1080	2,097,174.87	62.75
1180	2,060,238.21	64.03
1280	2,075,621.57	62.12
Annual	30,041,992.49	62.76

CHAPTER VII

EVALUATION AND RECOMMENDATIONS

The analysis performed in this study demonstrate the use of an analytical tool that has powerful capability for decision making in very complex circumstances. The analytical system incorporates a large body of detail into the analysis. Detail can be specific to each alternative and brought to bear on the total solution.

The operational validity of the analysis undertaken in this report is limited only by the quality of the data that entered the model. Cost, demand and supply data were from secondary sources and in some cases were made current through statistical estimation procedures that may or may not have produced accurate data, although all available checks on the data lies in greater differentiation of costs at specific nodes and links based on different, localized cost conditions. Different rates for the fertilizer cargoes were charged in different areas. Likewise handling costs charged by stevedoring firms in major ports also differ. Additional costs, for example losses resulting from additional handling of bags of fertilizer in multimode combinations of transport, incorporated in the analysis would further define alternative costs and hence modify the solution.

The analysis performed here identifies and measures the very significant costs associated with fertilizer distribution under existing conditions in the Philippines.

Warehouse use patterns could have been identified and could be

further identified in a complete model to identify potential needs and sites for more storage.

Modified solutions could have been accomplished by holding supply and demand quantities constant while the distribution pattern is altered to test for potential improvement resulting in reduced costs in the distribution system. The optimum flow patterns may be quite different with and without the improvements even though both runs meet the total demand requirements during the marketing year. Such comparative runs were not performed because of data limitations and time constraint. System improvement that may be considered include refinement of the data in acquiring a desirable analysis.

The basic model could be modified reflecting the time required for production, transport and utilization. This could be reflected by considering the time dimension of both the quantities supplied and the quantities demanded, and treating storage as an alternative to transport in the optimum solution.

Capacity limits could be handled by this model, if structured to do so for the number of origins and destinations considered. Lack of sufficient storage capacity at the proper locations forces the use of routings which are different from those selected in the least-cost marketing network. Specific capacity restrictions can be very expensive or relatively inexpensive, depending upon 1) the magnitude of the unit savings forgone by having to select the next best routing and 2) the volume of marketing over the affected routings (as determined by the linear programming solution). By comparative solution with and without the capacity restrictions, the transportation linear programming model can give accurate measurement of

the costs of the restrictions (and the potential benefits from capital projects to remove them).²⁷

A national model can be used for developing optimum inter-provincial flow patterns. The regional model can be used for developing optimum inter-municipality flow pattern. The municipality model can be used for developing optimum rural and inter-village flow patterns. The three different level models can be used to measure the impacts and benefits of proposed transport improvements at the respective levels.

Shadow prices could also be provided by the transportation model used in the computer system for feasible agri-business development. In a capacity restricted solution of the model, shadow prices indicate the marginal cost of the last unit before restriction is encountered. Shadow prices provide an indication of the priority for the number, type, and location of new storage facilities for maximum benefit to the marketing system as a whole.

Complete fertilizer demand quantities could be projected by the use of the Master Projection Program for the marketing year 1990 and evaluate what the optimum solution of fertilizer distribution cost and flow pattern would be for that year.

²⁷ Ibid.

CHAPTER VIII

SUMMARY

Fertilizer is one of the most important inputs in food production. The increased and regular supply of water will make it possible to raise the productivity per hectare of both old and new land. In both cases more fertilizer will be needed.

Philippines is one of the developing countries in which the consumption of fertilizer is still very low. Nitrogeneous fertilizer is the most widely used among the fertilizers but the importance of complete fertilizer in the soil is now beginning to be recognized. To satisfy the growing fertilizer requirements, prices of fertilizer must be favorable enough to the small farmers. Basing on the previous studies transportation costs occupy a considerable percentage of the total marketing costs.

The increasing use of complete fertilizer for food production has a great influence on fertilizer distribution structure. Coordinated efforts between the government and the private sector are needed to make fertilizer available as cheaply as possible. Economic viability of the distribution system is very important in the fertilizer industry.

The main concern of this study is to demonstrate the application of a transportation linear programming so as to design the least cost distribution pattern of complete fertilizer from the Planters Products Incorporated plant at Limay, Bataan to the 23 provincial capitals of Regions III, IV, and V of the Philippines.

The process of finding out ways and means to effect economies in the distribution cost is a continuous one. It is the interest of the producer and the dealer to deliver the goods and services to the consumer at the minimum possible cost.²⁸

The recursive transportation linear programming model was used to evaluate the optimum solution of complete fertilizer distribution and its physical characteristics like the warehousing sites, changes in the mode of transportation and changes in the demand and supply quantities. This model is set to meet the constraints at the least cost.

²⁸R.T. Doshi, Mixed Fertilizer Industry (Bombay: G.R. Bahtkal for Popular Prakashan, 1969).

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MINIMIZING FERTILIZER DISTRIBUTION COST IN THREE
SELECTED REGIONS IN THE PHILIPPINES

by

ELGIE LUCES NAMIA

B.S., Bicol University College of Agriculture, 1977
Albay, Philippines

AN ABSTRACT OF A MASTER'S REPORT

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Agricultural Economics

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1982

ABSTRACT

Fertilizer is an important agricultural input. For the past five years fertilizer consumption increased each year at an average rate of 7.4 percent annually. Nitrogenous fertilizer is the most widely used among chemical fertilizers. At present, Filipino farmers are beginning to expand use of phosphate and potash as well as nitrogen in plant growth. Greater increase in use of complete fertilizer in the near future is a possibility.

The geographical structure of the Philippines dictates many features of the distribution system for fertilizer. Distribution pattern and transportation costs are vital to fertilizer prices.

The main concern of this study is to demonstrate the application of a mathematical linear programming technique to determine least-cost distribution of complete fertilizer from Planters Products Incorporated through eight major demand-area warehouses to the twenty-three provincial capitals in Central Luzon, Southern Tagalog and Bicol Region. The specific objectives are 1) to demonstrate the use of the analytical technique in a) identifying least-cost transportation methods and routes in serving the warehouses and final demand points, b) determining optimum warehousing of fertilizer for coordinating production schedules and seasonal demands by provinces and c) determining costs of transportation, and warehousing and handling in an optimized distribution system with present cost rates and facilities and 2) to identify other applications of the analytical model for improvement of the fertilizer distribution system in the Philippines.

All the data requirements for this study were from secondary sources and were made current through statistical estimates. The methodology used in developing the input requirements uses a series of subprograms to generate the required final inputs for the Transportation Linear Programming model. A recursive transportation linear programming model was used to evaluate the optimum solution for the least cost distribution pattern for the complete fertilizer. Monthly optimum solutions were derived for the marketing year 1980.