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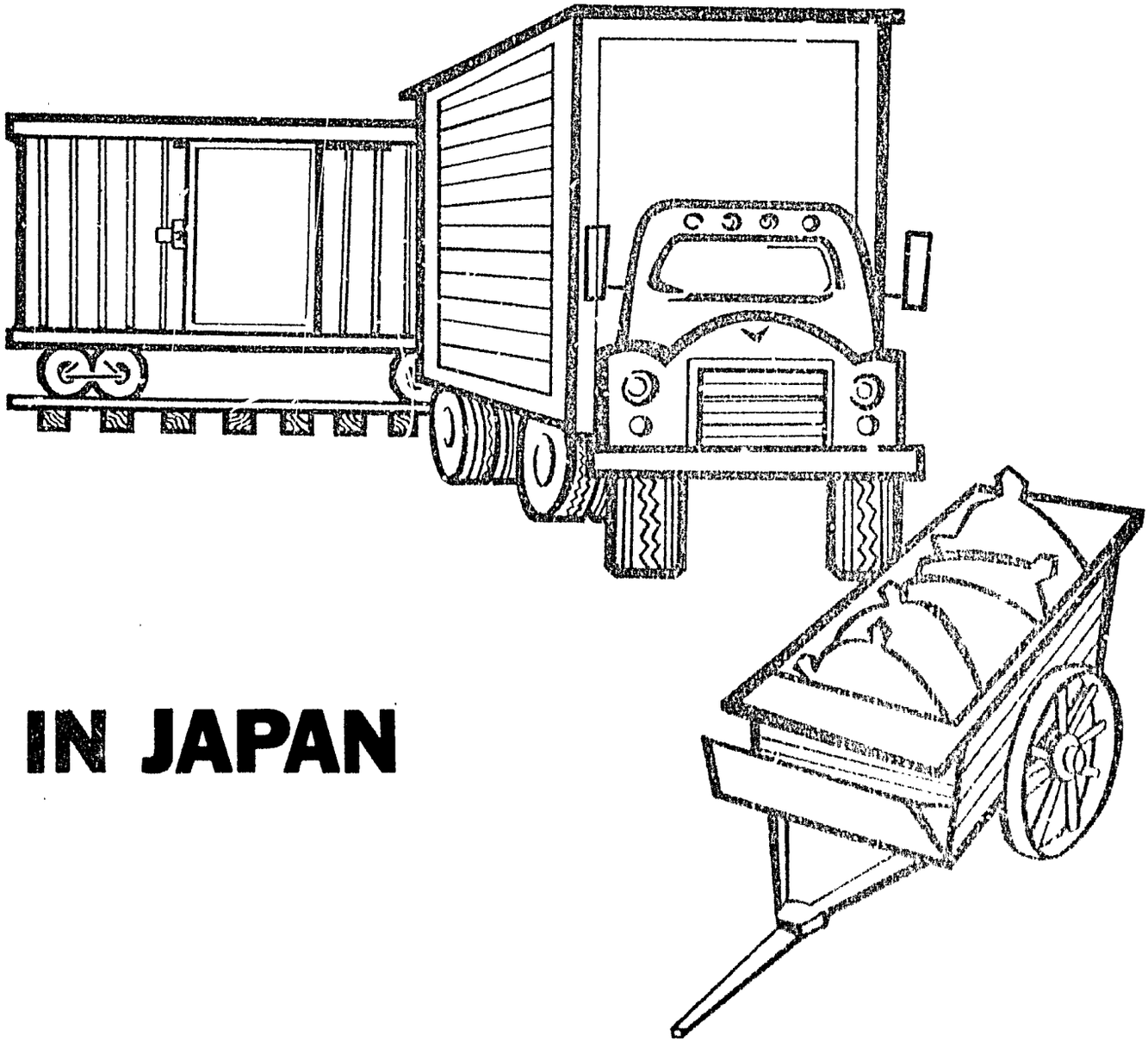

IN JAPAN

No. 2 in series of reports analyzing marketing systems potentially useful in developing nations. (No. 1 was on Taiwan.)

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TA(DA)6-69

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PREFACE

This report is part of the work undertaken by the Tennessee Valley Authority (TVA) under the Participating Agency Service Agreement (PASA) with the U.S. Agency for International Development (AID) for technical assistance concerned with the improvement of fertilizer production, marketing, and utilization in developing countries. Under the plan of work, a TVA team visited Japan and interviewed selected fertilizer distribution firms. This work was accomplished in cooperation and with the assistance of Zen-Noh, Japan Urea and Ammonium Sulphate Industry Association, Japan Phosphatic and Compound Fertilizer Manufacturers' Association, and other fertilizer industries.

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The Fertilizer Marketing System in Japan

BACKGROUND

Japan is one of the world's leading industrial and trading countries. Its economy has sustained one of the highest growth rates, averaging about 10% a year in real terms since 1955. Gross national product (GNP) in constant 1965 prices increased from US$36.5 billion in 1955 to US$157.0 billion in 1970. At current prices Japan's GNP totaled US$196.2 billion in 1970 (1).

Since Japan lacks most of the material resources necessary for its expanding industries, it is heavily dependent on foreign trade. Japan has in recent years managed to overcome its balance of payment difficulties through a vigorous export expansion program, and now enjoys a substantial surplus position with ample foreign exchange reserves. Exports account for approximately 10% of GNP, totaling US$19.3 billion in 1970. Imports, on the other hand, totaled US$18.9 billion in 1970 (2).

These statistics are presented here to set the stage for discussing the Japanese fertilizer industry and its heavy dependence on foreign trade. From the import side, all of the phosphate and potash needs must be met by shipments from other countries, either as raw materials or finished products. For the other side of the picture, exports in 1970-71 were equivalent to 41% of the total domestic consumption of N-P-K fertilizer and the export ratio of nitrogen fertilizer in the same period was 69. Obviously, then, the Japanese fertilizer industry is heavily oriented toward the international market.

Natural Conditions

Japan is a chain of islands off the eastern coast of Asia. The country consists of four major islands Honshu, Shikoku, Kyushu, and Hokkaido and more than 3,000 smaller ones, with a total area of 147,000 square miles [37 million hectares (ha)].

The terrain is rugged, with mountain ranges rising precipitously from narrow coastal plains. Each of the four main islands is traversed by north-south mountain chains. Twenty-five percent of the land area is level enough for cultivation, but sandy soils, lack of adequate drainage, and erosion reduce this area to less than 16%. Cultivated land totaled 5.9 million ha in 1969, of which 59% was classed as paddy land and 41% as upland (2).

The climate of Japan is mild and humid and largely determined by monsoons. Despite regional differences, all of Japan has an abundance of precipitation throughout the year, with maximum rainfall in the summer. Frost-free seasons in most areas last for 200 days or more. Overall, climatic conditions are generally favorable to agriculture.

Unfortunately, an outstanding feature of Japan's geographic and climatic setting is the constant threat of destruction and loss of life from natural disasters. Floods, earthquakes, and typhoons are fairly common occurrences in many parts of the country.

Agriculture

Agriculture is dominated by the relatively small proportion of arable land and the inherently low fertility of the soil. Double cropping, reclamation of marshland, terracing, and irrigation are practices used to add to cultivated land. Intensive cultivation, irrigation, heavy fertilization, and improved crop varieties have helped overcome the fertility problem, resulting in Japan having some of the highest crop yields in the world (14).

Although Japanese agriculture is still able to meet a large part of the domestic demand for foodstuffs, the level of self-sufficiency in farm production has been declining. From a 1961-65 base of 100 the index of total agricultural production increased to 119 in 1968 but dropped to 115 in 1969, 111 in 1970, and 105 in 1971 (3). Part of this decline is due to bad weather and part is due to a deliberate effort of the government to cut rice production to reduce surpluses. The drop in crop production has been even more rapid, but it has been partially offset by increased output of livestock. The net result has been a trend to greater imports of agricultural products.

In 1970 approximately 5.1 million households farmed 5.9 million ha of cultivated land. Like most developed countries, large numbers of people are migrating from farms to cities, and those remaining on farms are supplementing their incomes with off-farm sources. Full-time farms accounted for only 16% of all farms and the farm labor force represented 16.5% of the total working population in 1970 (2).

STRUCTURE OF THE FERTILIZER INDUSTRY

The Japanese fertilizer industry is privately owned. In total, more than 400 companies are engaged in the production and importation of fertilizer and fertilizer raw materials; however, a large share (65%) of the fertilizer production capacity is concentrated in about 15 firms (see appendix). Of the 21 firms having ammonia capacity on April 1, 1971, 6 companies accounted for 63% of the total capacity. Likewise, 5 out of 13 firms with urea capacity accounted for 67% of the total (5).

Production capacity for major fertilizers and fertilizer intermediates is presented in table 1. Table A-2 (appendix) presents a more detailed picture of productive capacity over recent years. Changes in the overall industry capacity reflect the general reorganization of the industry in Japan, particularly the nitrogen sector. In order to compete in the world nitrogen market, Japan has undertaken a program of rationalization and expansion, largely aimed at reducing the number of companies in the nitrogen industry and installing larger, more economic production units.

Ammonia and urea capacities have essentially doubled since 1965, while other nitrogen product capacities have either declined or remained fairly stable. Phosphate capacities have followed similar trends with higher grade product capacities increasing and lower grades, such as single superphosphate, declining.

Prior to World War II the production capacity of the Japanese fertilizer industry was only sufficient to cover domestic needs and products were largely limited to ammonium sulfate, calcium cyanamide, and single superphosphate (10). Today, Japan ranks third in the world in the production of nitrogen fertilizer and first in its export. And, as mentioned earlier, the quantity of fertilizer exported (in terms of nutrients) during fertilizer year 1970-71 totaled 1,453 million tons as compared to 2,104 million tons consumed domestically.

FERTILIZER PRODUCTION AND CONSUMPTION

Production and Imports

Total production of fertilizer nutrients during fertilizer year 1970-71 was over 1.5 million tons (8). Production by major fertilizer nutrients was as follows: nitrogen, 2,105,057 tons, phosphate, 665,190 tons, and potash, 764,674 tons.[1] The level of production during 1970-71 represents an increase of 57% (1,286,500 tons) over the 1960-61 level. (Appendix table A-3 shows production trends by major grades.) Production of individual fertilizers, however, differs substantially from the overall total. For example, urea increased by 253% during the period under study, ammonium chloride by 139%, and the nitrogen portion of high-analysis compound fertilizers rose by 359%. On the other hand, ammonium sulfate production declined by 16%, ammonium nitrate dropped 3%, and calcium cyanamide was down 11%. In total, nitrogen fertilizer production nearly doubled during the 10-year period (table 2).

Phosphate fertilizer nutrient production, likewise, varied considerably during this period. Single superphosphate production decreased 63%, while concentrated superphosphate rose 703% and high-analysis compound fertilizer (P_2O_5 portion) increased 513%. Fused magnesium phosphate production rose to a peak in 1968-69 and has since declined to a level only slightly above the 1960-61 level. Overall, phosphate fertilizer production has increased only moderately, 23%.

Production of potash fertilizer, most of which is imported, has not experienced the change undergone in nitrogen or phosphate fertilizers. Both potassium chloride and potassium sulfate have increased during the period cited, but neither have enjoyed substantial gains.

Japan is heavily dependent upon imports to meet its essential mineral needs, particularly with respect to fertilizer. Mineral deposits in wide variety are found in the

Table 1. Fertilizer production capacity (5, 9, 15, 25)

Type of fertilizer or intermediate	April 1, 1971	April 1, 1972
	thousand mt of product	
Ammonia	3,808.3	4,690.4
Urea	3,597.4	3,914.4
Ammonium chloride	943.2	943.2
Ammonium sulfate	4,562.7	3,933.0
Ammonium nitrate	155.5	161.5
Calcium cyanamide	306.2	306.2
Single superphosphate	3,792.9	3,158.8
Fused phosphate	1,099.4	1,070.0

Table 2. Fertilizer production (8, 17)

	Fertilizer year			10 year change	
	1960-61	1965-66	1970-71	Actual	Percent
	thousand mt of nutrient[a]				
Nitrogen	1,064.9	1,615.1	2,105.1	1,040.2	98
Phosphate	540.6	637.7	665.2	124.6	23
Potash[b]	641.0	690.1	764.7	121.7	19
Total	2,246.5	2,943.1	3,535.0	1,286.5	57

[a] Nutrients are in the forms of N, P_2O_5, and K_2O.
[b] Includes imports of potassium sulfate and potassium chloride.

[1] Production of potash fertilizer includes imports of 641,816 tons of potassium chloride and 59,174 tons of potassium sulfate. Fertilizer year begins on July 1 and ends on June 30.

country, but they are generally of low quality, inaccessible, or too scanty to be adequate for the country's needs. To meet these needs with the least outlay of foreign exchange, Japan's policy has been to adopt tariff and other import control measures to encourage imports of raw materials rather than finished products (2).

The most significant fertilizer imports are potash products and phosphate rock. Of the finished materials imported, potash fertilizers account for by far the greatest portion, 92% to 94%. The remaining imports of finished fertilizers are compound fertilizers (ammonium phosphate) and small portions of concentrated superphosphate and other nitrogenous fertilizers not defined (table A-4).

Most potassium is imported as potassium chloride. During 1970-71, potassium chloride imports were equal to 641,800 tons of K_2O, or 92% of all potash imports. Potassium sulfate imports totaled 59,200 tons. Approximately 64,000 tons of imported potassium chloride was converted to potassium sulfate.

Canada has been the major supplier of potash materials in recent years, followed by the United States, the Soviet Union, Israel, France, and the Congo. During 1970-71, Canada supplied more than 40% of the potash fertilizer imports and the United States furnished about 16%.

Phosphate rock imports totaled slightly over 3 million tons in 1970 (table 4), an increase of nearly 50% over the level of imports during 1960. Major suppliers of phosphate rock in 1970-71 were the United States, Morocco, Nauru, Togo, and Taiba. About 65% of all imports came from the United States, with Florida rock accounting for practically the entire quantity.[2]

[2]Data for calendar year 1970 indicate that U.S. sources of phosphate rock accounted for about 58% of the total, while Morocco supplied about 21%.

Table 3. Imports of plant nutrients (8, 17, 19)

	Fertilizer year		
	1960-61	1965-66	1970-71
	thousand mt		
Nitrogen	9.3	2.0	5.0
Phosphate	0	5.0	13.0
Potash	602.7	622.2	701.0

Table 4. Phosphate rock imports[a] (15, 25)

	Calendar year			10 year change	
	1960	1965	1970[b]	Actual	Percent
	thousand mt				
Phosphate rock	2,023.0	2,996.6	3,188.4	955.4	49

[a]See table A-4 for more complete data.
[b]Imports for fertilizer year 1970-71 total 3,945,550 mt.

Utilization of Plant Capacity

The Japanese fertilizer industry, in recent years, has experienced difficulties in utilizing plant capacity. While this situation is not unique to Japan, it is especially critical for an industry that depends heavily on international market outlets. Part of the problem stems from the stagnation of the domestic market due to an oversupply of rice and partly from revaluation of the Japanese yen. It would also appear that the fertilizer industry over-anticipated the world demand for fertilizer and expanded capacity too rapidly, particularly nitrogen capacity.

Although data are not available concerning the utilization rate of the entire fertilizer industry, current estimates indicate that it is operating at less than 80% capacity (10). Utilization data for selected materials in 1971 as compared to earlier years are presented in table 5.

Domestic Consumption and Exports

Domestic demand for all fertilizer nutrients during 1970-71 totaled 2,104,012 tons. This level of use represents an increase of 21% over the 1960-61 level but is a decline of 7% from a peak of 2,271,701 tons in 1968-69. Of the total quantity consumed in 1970-71, nitrogen fertilizer accounted for 41% (865,672 tons), phosphate fertilizer made up 30% (632,208 tons), and potash fertilizer 29% (606,132 tons).

Table 5. Utilization of fertilizer production capacity

	Calendar year			
	1968	1969	1970	1971
	percent			
Ammonia	93.6	96.5	89.1	75.9
Urea	90.0	90.9	73.7	62.9
Ammonium sulfate	NA	NA	NA	40.3
Ammonium nitrate	NA	NA	NA	70.4
Ammonium chloride	NA	NA	NA	91.9
Calcium cyanamide	NA	NA	NA	85.4
Single superphosphate	NA	NA	NA	21.0
Fused phosphate	NA	NA	NA	17.9

Source: (4) for ammonia and urea utilization. Data for other materials were obtained from various issues of *Japan Chemical Week* through 1971 and 1972.

Table 6. Domestic fertilizer consumption (8, 15, 17)

	Fertilizer year			10 year change	
	1960-61	1965-66	1970-71	Actual	Percent
	thousand mt of nutrient				
Nitrogen	693.3	769.3	865.7	172.4	24.9
Phosphate	493.2	574.3	632.2	139.0	28.2
Potash	553.0	601.1	606.1	53.1	9.6
Total	1,739.5	1,944.7	2,104.0	364.5	21.0

Consumption of ammonium sulfate dropped from 338,638 tons in 1960-61 to 197,483 tons in 1970-71, while urea increased from 160,307 tons to 268,880 tons and high-analysis compound fertilizer (N portion) rose from 52,713 tons to 275,293 tons during the same period. In 1960-61 ammonium sulfate ranked first among domestically consumed nitrogen fertilizer, followed by urea and calcium cyanamide. Most recent consumption patterns indicate that high-analysis compound fertilizer now ranks first followed by urea and ammonium sulfate. (See table A-5 for consumption by fertilizer grades.) The greatest growth occurred in the consumption of compound fertilizer, which increased by over 400% during the period under study.

Consumption of single superphosphate followed a pattern similar to that of ammonium sulfate, dropping from 342,600 tons to 135,431 tons. In the earlier period, single superphosphate was the most popular phosphate material, followed by fused magnesium phosphate and high-analysis compounds. In 1970-71 compound fertilizer was by far the most predominant phosphate fertilizer. Single superphosphate ranked second and fused phosphate was third.

From a quantity standpoint, potassic fertilizer consumption did not change substantially between 1960-61 and 1970-71. Changes did occur, however, at the final use level. Since the early 1960's there has been an accelerating trend toward using potassium chloride and potassium sulfate as feedstock in the manufacture of high-analysis fertilizer rather than for direct application. For example, in 1963, 35% of the potassium chloride and 54% of the potassium sulfate were used for direct application. By 1970-71 the portions used for direct application had declined to 10% for potassium chloride and 20% for potassium sulfate.

In summary, high-analysis compound fertilizer was the most common form of fertilizer used in Japan in 1970-71. Although data sources vary somewhat, a number indicate that nearly 80% of the fertilizer consumed is now in the form of compound fertilizer. By nutrients, 73% of the nitrogen, 78% of the phosphate, and 83% of the potash are consumed in the form of compound fertilizer (11, 15)

Distribution of total plant food consumed in 1970-71, regardless of the type of fertilizer, was as follows: N, 41.2%, P_2O_5, 30.0%, and K_2O, 28.8%

Exports of fertilizer nutrients totaled 1,452,160 tons during 1970-71 compared to slightly less than 125,000 tons in 1960-61. Urea exports alone accounted for two thirds of all plant food exported. Other important materials exported include ammonium sulfate, ammonium chloride, and high-analysis compound fertilizers. In the earlier period, ammonium sulfate exports made up 54% and urea 35% of all fertilizer exports (see table A-6)

As mentioned earlier, 41% of the plant food produced in 1970-71 was exported. For nitrogen fertilizer, the portion is much higher—69% (6)

China is Japan's most important outlet for its fertilizer products, taking about 52% of the country's exports. Other countries importing significant quantities include Indonesia, the Philippines, Thailand, Cuba, and India (10).

In order to summarize the current supply-demand situation of the Japanese fertilizer industry, table 8 is presented.

One item worthy of note concerns the level of inventories at the end of 1970-71, which was equivalent to about 22% of the total demand during the same period. This situation was obviously a reflection of the depressed domestic fertilizer market in 1970-71. However, in 1972 Japan entered into several large contracts including China. These contracts have changed the supply-demand situation, and the Japanese nitrogen industry has recovered from the slump of 1969-71.

FERTILIZER DISTRIBUTION

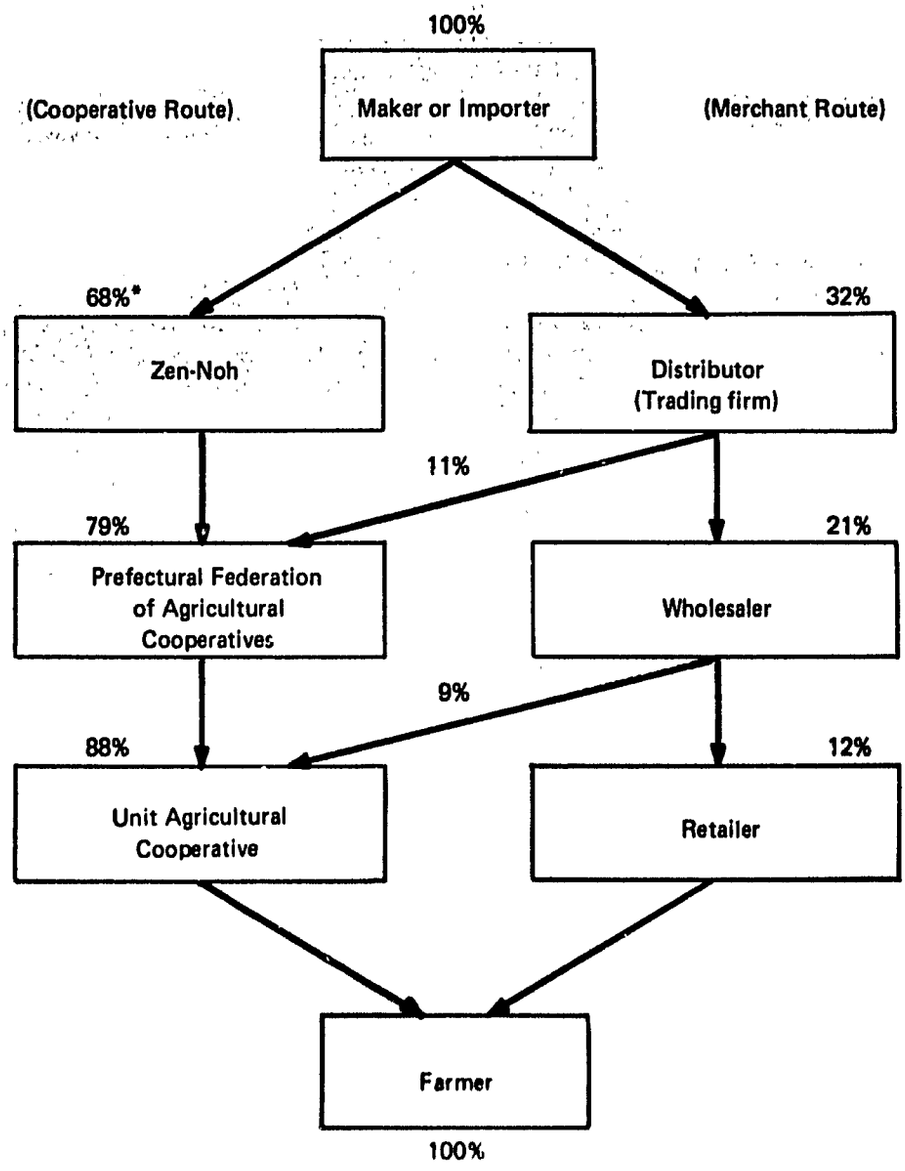
There are two major fertilizer distribution channels in Japan—agricultural cooperatives and private merchants or dealers. The private merchant line (made up of 13 prime wholesalers or trading firms, about 800 combined wholesaler-retailers, and between 5,200 and 6,000 retailers) accounted for only 12% of the final distribution of fertilizer to the farmer in 1970-71 (see figure 1) (12). At

Table 7. Fertilizer exports (8, 15, 17)

	Fertilizer year			10-year change	
	1960-61	1965-66	1970-71	Actual	Percent
	thousand mt of nutrient				
Nitrogen	297.4	775.5	1,410.5	1,113.1	374.3
Phosphate	27.5	54.5	27.9	0.4	1.4
Potash	-	11.8	13.8	13.8	-
Total	324.9	841.8	1,452.2	1,127.3	347.0

Table 8. Plant nutrient supply and demand 1970-71

	Nitrogen	Phosphate	Potash	Total
	thousand mt of nutrient			
Supply				
Production	2,105.1	665.2	63.7	2,834.0
Imports	5.0	33.0	701.0	739.0
Total	2,110.1	698.2	764.7	3,573.0
Demand				
Domestic	865.7	632.2	606.1	2,104.0
Export	1,410.5	27.9	13.8	1,452.2
Total	2,276.2	660.1	619.9	3,556.2
Year end inventory	512.9	149.6	110.6	773.1



*Percentages are the portions of fertilizer handled by the various organizations at each level of distribution for the 1970-71 fertilizer year.

Figure 1. Japanese fertilizer distribution channels (13)

the first stage of the distribution route, the private sector handled about 32% of the fertilizer. However, as fertilizer moves through various levels of the distribution channel, portions of fertilizer are sold to the cooperative sector, reducing the portion eventually sold to farmers by the merchant group.

Cooperative Organizations and Evaluation of Their Fertilizer Policy[3]

The cooperative route has three stages: (1) The National Federation of Agricultural Cooperative Associations (*Zen-Noh*), (2) Prefectural Economic Federation of Agricultural Cooperative Associations, and (3) Unit Agricultural Cooperatives (13).

[3] *Zen-Noh*, formerly known as *Zenhoren*, was formed by merger of *Zenhoren* and *Zenhanren* on March 30, 1972. The new organization has, for the time being, taken over all the supply business for the National Purchasing Federation (*Zenhanren*) and the marketing of agricultural and livestock products formerly handled by the National Marketing Federation (*Zenhoren*). This cooperative is one of about 20 national level cooperatives that make up the overall cooperative organization in Japan. The Prefectural Economic Federation of Agricultural Cooperatives is the "state" level and functions as a secondary wholesaler while the unit cooperatives, the local level organizations, function as a retailer.

In 1970 the Zenkoren and Zenhanren organizations consisted of approximately 50 prefectural economic federations and 6,500 unit cooperatives.[4] Presumably, the recent merger has not affected the number of "state" and local units. The organizational structure of Zen-Noh, however, is obviously changed from that existing in the original setup. Unfortunately, organizational data are not available for Zen-Noh at the time of this writing. (See figure A-1 for organizational chart of Zenkoren.)

During 1970-71 the national cooperative organization distributed 68% of all domestic fertilizer materials at the wholesale level (88% at the unit cooperative level), while estimates for 1971-72 are placed at 72%. Similarly, the national cooperative distributes about 60% of all agricultural chemicals, 43% of all feedstuffs, 37% of all farm machinery, and between 60% and 70% of all the petroleum products used on farms.

Moreover, the national cooperative has played an important role in importing fertilizer raw materials, handling about 60% of the total imported potash and 40% of the phosphate rock. These raw materials are consigned to private fertilizer manufacturers for processing, and most are eventually returned to the national cooperative for distribution as finished goods.

Zen-Noh's postwar fertilizer policy began with what is commonly referred to as the "joint discount" movement. According to this method, Zen-Noh procured fertilizer on the basis of a national aggregate demand. The fertilizers were ordered in advance by farmers and pooled regionally for short periods of time.

This method was intended to help Zen-Noh take the initiative in stablizing the fertilizer market and gradually lower prices according to four general principles:

1. *Average price* This usually became the "settlement price." However, before the final "average price" was determined, fertilizer was sold to farmers at less than the expected settlement price.
2. *Cost price* Under this system, the cost of fertilizer was the purchase price plus transportation and handling costs
3. *No change in amount* In essence, this precluded any changes in the farmer's original order Among other things, farmers were unable to modify their orders in response to price fluctuations.
4. *Pyramidal* This simply meant that Zen Noh determined the size of its orders by the magnitude of individual advance orders by farmers

In short, the "joint account" system based on the advance order system was intended to cope with fertilizer price fluctuations due to supply demand differentials

[4] Numbers of prefectural federations vary from 47 to 53 and unit cooperatives vary from 6,470 to 7,300 depending upon the source of information (13, 31, 33)

Since 1964, fertilizer distribution by the cooperatives has been based on a contract system where farmers establish fertilizer application plans prior to planting and enter into a contract with the unit cooperatives for purchases of specified quantities and kinds of fertilizer. These contracts or orders are pooled four times a year by the unit cooperatives. Subsequently, the orders are submitted to the prefectural federations which in turn send them to Zen-Noh. The advance orders, accumulated in this pyramidal fashion, are then used by Zen-Noh to negotiate prices with the fertilizer manufacturers (12, 20, 22).

The advance ordering system is closely linked to the farm advisory service provided jointly by the cooperative organizations and the agricultural extension offices. Farmer members are given guidance on effective use and application of fertilizers, taking into account soil types and crops. Technical services are also provided.

After price negotiations are completed, Zen-Noh informs the prefectural federations of the established prices and gives shipping instructions to the manufacturers.

Fertilizer shipments are made direct from the manufacturer to the railroad station nearest the unit cooperative (see figure 2) (13). Invoicing is from the manufacturer to Zen-Noh, which, in turn, sends the bill to the local cooperative through the prefectural federation. Upon delivery of the fertilizer to the farmer, payment is made to

Local cooperative dealer distributing fertilizer to member farmer.

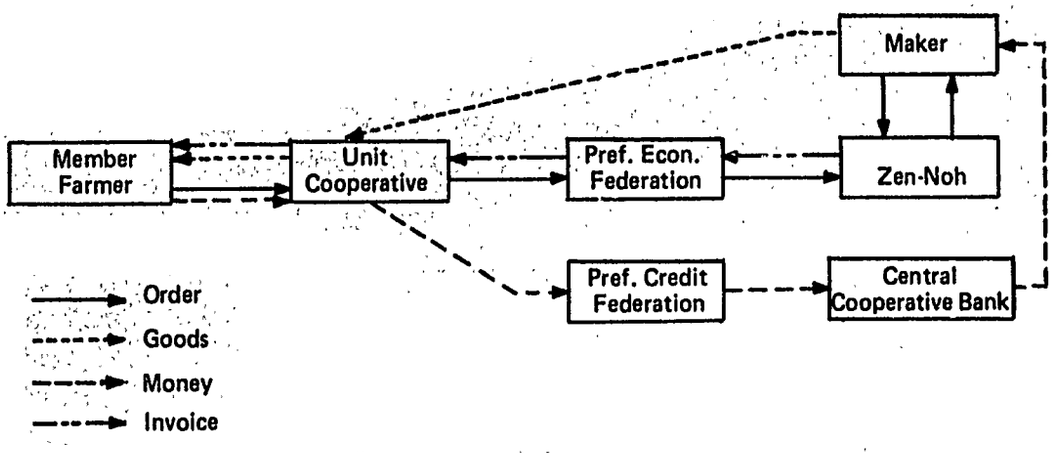


Figure 2. Mechanism of cooperative supply business (13)

the local cooperative (sometimes by withdrawal from the farmer's account at the prefectural credit federation). The prefectural federation then transfers the collected bill to the account of Zen-Noh at the Central Cooperative Bank, which, in turn, pays the manufacturer.

Private Merchant Organizations

The structure of the private merchant system is very similar to the national cooperative organization in that there are two levels of wholesalers–primary and secondary–corresponding to Zen-Noh and the prefectural economic federations, respectively. The final step in the distribution structure is the private retailer who performs functions similar to the unit or local cooperative (12).

The prime wholesale firms purchase most fertilizers direct from the manufacturers and sell through special contracted regional (secondary) wholesalers who in turn sell to retailers. Ammonium sulfate and urea purchases are handled differently in that these materials are purchased jointly through the Central Federation of Prime Wholesalers, Ltd. This common purchasing organization was established by stockholders of eight prime wltolesalers for the purpose of securing more favorable and stable prices.

The secondary wholesalers actually serve as the first step in the distribution process. In addition to transmitting orders, they accept shipment of fertilizer from the manufacturers, provide storage, and tend to diversify the commodities offered for sale to the retail outlets. Generally speaking, the average secondary wholesaler has nearly 12 employees and ¥59,000,000 (US$190,000) turnover.

As previously mentioned, the private merchant system handled about 32% of all domestic fertilizer sales during 1970-71 at the prime wholesale level. The secondary wholesaler, however, handled only 21% of all sales, the difference resulting from fertilizer sales by the prime wholesalers to the prefectural federations. Private retailers accounted for only 12% of the final sales to farmers due to further sales to the unit cooperatives by the secondary wholesalers (figure 1). The average private retailer has 3.5 employees and nearly ¥25,000,000 (US$80,000) annual turnover.

Based on 1969 shipment data from the manufacturers to the wholesalers, the private merchant line held a greater share of the market for ordinary grade compound fertilizers, mixed fertilizers, and ammonium nitrate than for all fertilizers in general (12). This is attributed to brand popularity and to specialization. While the cooperatives concentrate most efforts on the traditional crops, the merchant group has directed its activities toward the horticultural and truck farming areas. Because of the current rice surplus situation, the merchant line may be in a good position to capture a larger share of the fertilizer market in the future.

LOGISTICS

Within the cooperative system, fertilizer shipments are generally made direct from the manufacturer to the unit cooperative. However, there appears to be a trend under way whereby shipments are first made to federation storage facilities with later movement to the unit cooperatives. Presumably, this is a result of inadequate storage at the local level. It may also be a means to provide more prompt delivery of fertilizer.

Movement of fertilizer within the private merchant system is from the manufacturer to the secondary wholesaler and on to the retailer. The primary wholesalers are similar to Zen-Noh in that they are a common purchase organization and neither accept nor make shipments of fertilizer.

Bagged fertilizer loaded onto truck at a private retail store for delivery to farmers.

Transportation

Motor vehicles (trucks) are by far the predominant means of transport for fertilizer in Japan, accounting for about three-fourths of the total volume shipped (16, 23). Railroads carry 16% with the balance going by ocean vessel. However, when distance is taken into consideration, railroads are the most important means, followed by ocean vessel.

The average distance of fertilizer movement in kilometers (km) is as follows: truck, 10; railroad, 311; and ocean vessel, 480. The overall average for all means of transport is slightly more than 90 km.

Table 9. Means of domestic fertilizer transport (23)

	Truck	Railroads	Ocean vessel
Volume (% of total tons)	77	16	7
Volume-distance (% of total ton-km)	8	57	35

Storage

In the past, most fertilizer stocks were kept at the manufacturers' warehouses or in storage facilities at the retail (local) outlets. Due to shortage of storage space, resulting in part from the rice surplus, fertilizer is now being stored at the secondary wholesale as well as the local level.

Storage capacities for the private and the cooperative systems are presented in table 10. These data indicate that fertilizer storage is quite limited, particularly at the retail level. It would appear that practically no storage exists at the private retailer and, in the case of the unit cooperative, the situation is not much different when the portion of space used for fertilizer is taken into account.

Packaging

Practically all of the fertilizer distributed in Japan is handled in bags. Plastic bags of one form or another

Bagged fertilizer being loaded into railroad cars at fertilizer plant.

Bagged fertilizer loaded onto truck from a typical retail storage center.

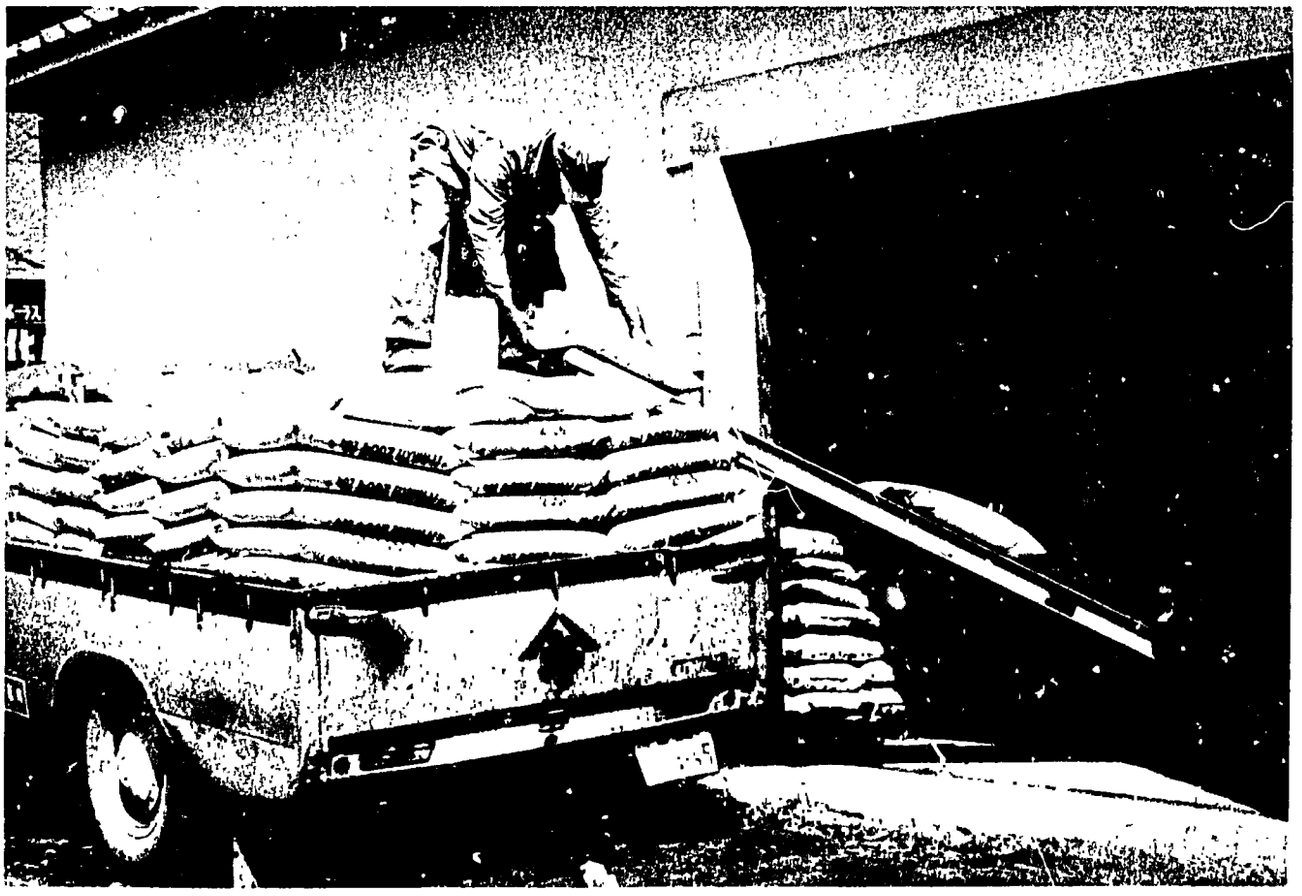


Table 10. Fertilizer storage capacity (23)

	Total storage space	Portion used for fertilizer
	thousand square meters	%
Wholesale–Private	499	50
–Cooperative	322	34
Retail–Private	37	52
–Cooperative	390	38
Total–Private	536	50
–Cooperative	712	36

Table 11. Estimated number of fertilizer brands available at wholesale and retail levels

Distribution level	Sector	Number of brands per enterprise	Total number of brands
Wholesale (secondary)	Private	32 to 67	294 to 2,034
	Cooperative (federation)	80 to 133	320 to 1,200
Retail	Private	17 to 24	124 to 923
	Cooperative societies	17 to 36	277 to 1,368

account for about 70-75% of the bags, paper bags account for about 20%, while the remainder are jute or straw bags. Use of plastic bags, particularly polyethylene, is increasing rapidly (20, 23).

The national cooperative organization is attempting to standardize the unit weight of packaged fertilizer to 20 kilograms (kg) which is considered the most reasonable weight to be handled by the average farmer. To date, urea, ammonium chloride, ammonium nitrate, concentrated superphosphate, and high-analysis compound fertilizers are packaged in 20-kg bags.

In addition, the cooperatives have set standards for colors and designs of plastic bags according to nitrogen content and for type of application (initial and followup) (20).

Bulk handling was introduced about 4 years ago by the cooperative federations in northern Japan. It is estimated that approximately 40,000 tons per year is currently handled by this means (26). As labor becomes scarcer and labor costs rise, continued and accelerated growth in bulk handling is anticipated.

Brands

The number of fertilizer brands poses a major problem in both production and distribution. For example, in 1968 Japan's total production of high-analysis compound fertilizer was represented by 2,800 brands, averaging less than 1,500 tons per brand (20). The fertilizer handled by Zen-Noh has the "Kumiai" mark on all bags regardless of the manufacturer, but it may also have other brand names. More recent data indicate that the number of brands is declining but still presents a problem. Private wholesalers handled about 2,000 different brands while the prefectural federations handled 1,200 brands. At the retail level, private merchants handled more than 900 brands and the unit cooperatives, nearly 1,400 (table 11). For this reason, Zen-Noh is promoting the use of "popular" brands in an attempt to reduce the total number of brands.

CREDIT

Credit for the purchase of fertilizer by farmers is provided within the cooperative organization. Zen-Noh, however, is only the supply and marketing arm of the cooperative setup and does not furnish credit. Credit is made available through the national cooperative credit organization: the Central Cooperative Bank for Agriculture and Forestry at the national level, the Prefectural Credit Federation at the "state" level, and the unit cooperative at the local level (13).

The terms of sale for fertilizer to the farmer are "cash at delivery." If the farmer is unable to pay cash he may have the amount of the bill withdrawn from his savings and loan account at the unit cooperative.[5] Presumably, a necessary prerequisite for obtaining credit involves establishing an account with the cooperative credit society prior to the purchase of fertilizer or other inputs. Interest rates for loans at the unit cooperatives average between 9% and 10% per year.

Credit is also made available through the private merchant sector. Unfortunately, data on terms, interest rates, etc., are lacking.

Table 12 presents information on payment for fertilizer by the various organizations. Overall, the private distributors (both wholesalers and retailers) make much more use of long-term credit than the cooperatives. The portion of cash payment at the wholesale level is nearly twice as great for the cooperatives as for private distributors. However, at the retail level the differences are not nearly so great. The higher percentage of cooperative sales for cash is no doubt a reflection of Zen-Noh's "cash at delivery" policy.

SEASONAL DISTRIBUTION

Because only limited data were available on the seasonal consumption of fertilizer, this portion of the analysis is

[5]The unit cooperative, the final link with the farmer, provides a number of services including: inputs for agricultural and family living, marketing outlet for agricultural products, banking services in the form of savings and credit, insurance, and welfare services.

based on calendar years 1968 and 1969. Moreover, these data appear to be based on shipments from manufacturers rather than on sales to farmers. Only very limited data were found on the distribution of retail sales (17).

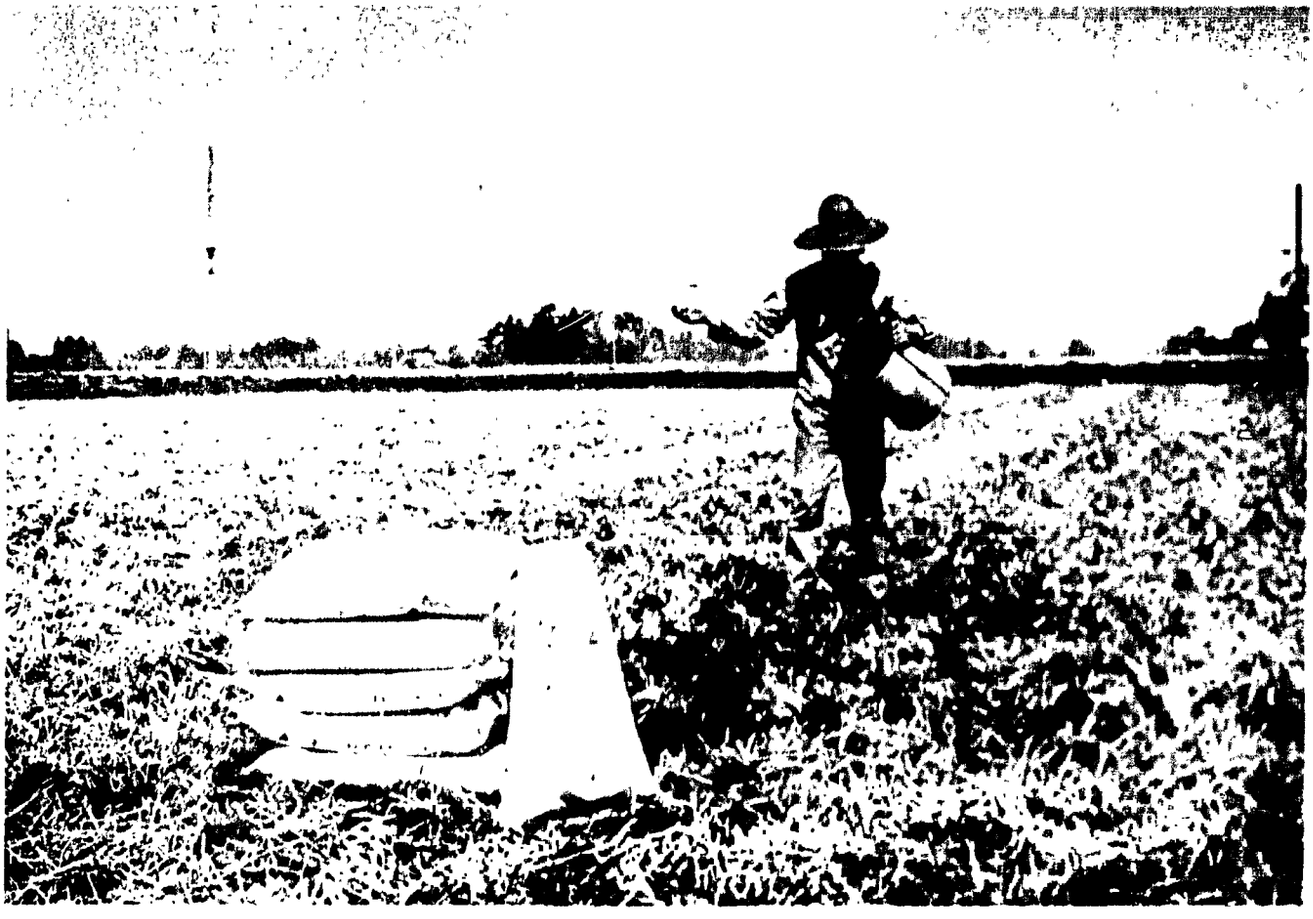
Based on the 1968-69 data, domestic consumption of all N-P-K plant food had a peak in March followed by a low in July (see figure 3 and table A-7). The curve does not exhibit wide divergence and, because of the reduced production of rice, the curve may be even flatter now than in 1968-69. With more emphasis on horticultural and vegetable crops, forages for livestock, urea for livestock feeds, forest fertilization, etc., fertilizer use will tend to be spread more evenly throughout the year.

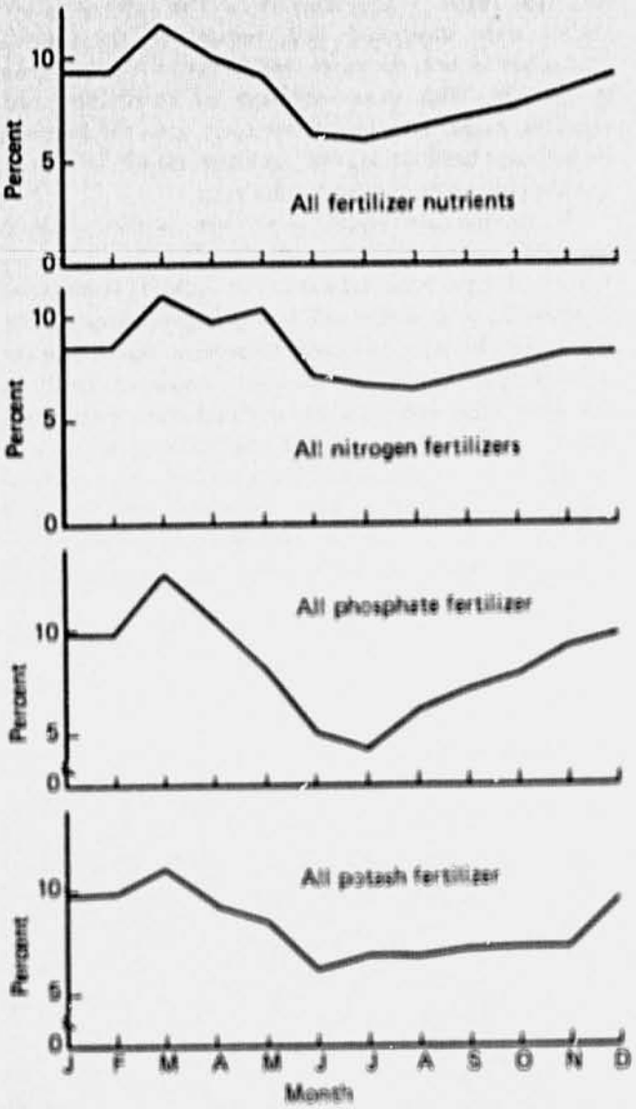
Table 12. Payment of fertilizer purchases (23)

	Method of payment		
		Credit	
	Cash at delivery	Payment within 3 months	Payment after 3 months
	Percent of total sales value		
Secondary wholesale–Private	14.7	41.8	43.5
–Cooperative	25.9	58.6	15.5
Retail–Private	24.3	32.6	43.1
–Cooperative	27.8	39.3	32.9

The greatest consumption of nitrogen nutrients occurred during the period March through May, dropping to a low in July and August. Urea had a relatively smooth consumption curve with a peak in May and lows in August and December (figure 4). On the other hand, ammonium sulfate and the nitrogen portion of high-analysis compound fertilizers exhibited rather wide variations in distribution. Ammonium sulfate had peaks in March and May followed by a low in August, while compound fertilizers reached a high in March and fell to a low in July. Since compound fertilizers make up such a large part of the fertilizers used in Japan, their distribution throughout the year strongly affects the overall curve for nitrogen.

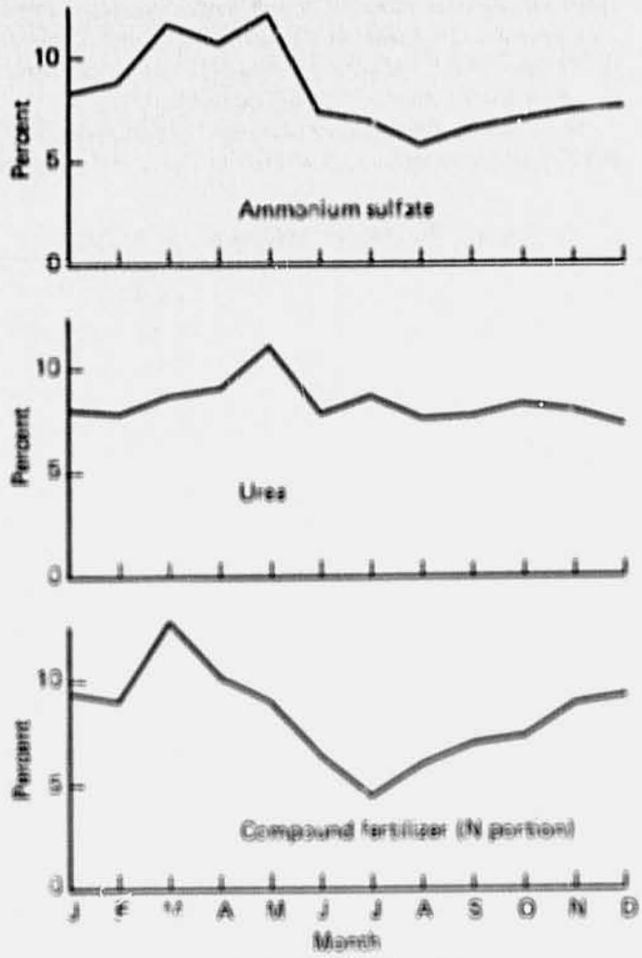
Farmer applying a mixed fertilizer to field.





Source: *Japan Fertilizer Pocketbook*, 1971, pp. 51, 55, 59.

Figure 3. Seasonal fertilizer distribution patterns by major nutrients, 1968-69



Source: *Japan Fertilizer Pocketbook*, 1971, p. 51.

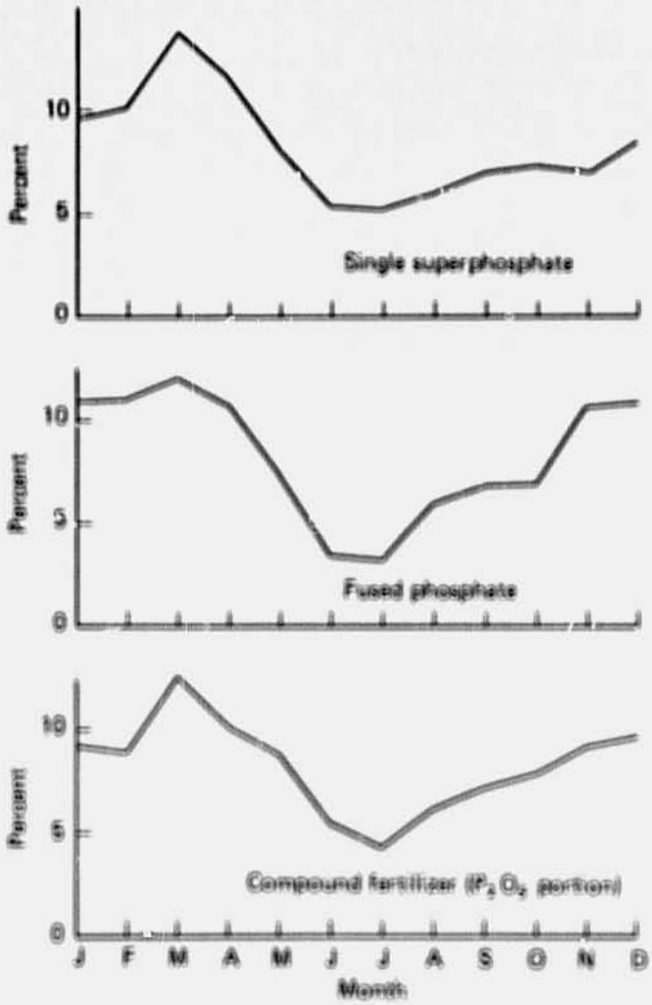
Figure 4. Seasonal distribution patterns for major nitrogen fertilizers, 1968-69

The overall consumption of phosphate exhibited more divergence than nitrogen (figure 3). Use reached a peak in March, then dropped sharply to a low in July. Consumption of fused phosphate had rather erratic movements (figure 5). Most of the consumption took place during the period November through April. June and July were the months with lowest use. Compound fertilizer (P_2O_5 portion) and single superphosphate distribution curves were nearly identical, both peaking in March and falling to a low in July.

The consumption pattern was less erratic for potash than for the other two materials (figure 3). As was the case in the other two major nutrients, peak use occurred in March with most consumption taking place during the period December through April. Lowest consumption occurred in the period June through November with June having the least use.

The limited data on sales to farmers indicated that peak uses occurred during the period March through May, based on sales by cooperative societies. Sales by the private retailers were greatest during April and May. This slight difference in sales patterns is undoubtedly a reflection of the differences in the types of materials handled by each group. It should be recalled that the private retailers have a larger share of the fertilizer market for specialized crop production (horticultural and vegetable).

Sales were lowest during July with only slight increases during the fall months, followed by another low in January.



Source: *Japan Fertilizer Pocketbook*, 1971, p. 56.

Figure 5. Seasonal distribution patterns for major phosphate fertilizers, 1968-69

PRICING AND PRICES

Under existing laws, fertilizer prices are established by negotiation between buyers and sellers at the national level (12, 20, 22). The laws further provide that participants in price fixing must have at least a 50% share of the market. Consequently, negotiations are conducted between Zen-Noh and the Japan Urea and Ammonium Sulphate Industry Association since these organizations are the only ones meeting this requirement. Prices for the private merchant line follow those set by the negotiations between Zen-Noh and the producers. The government no longer takes an active role in price negotiation. The government is notified of the negotiated sales price and generally acts only in a supervisory capacity.

Ammonium sulfate and urea are the fertilizers used in price fixing. Prices for other fertilizers are designated by administrative ordinance, based on the prices for ammonium sulfate and urea.

Prior to the start of each fertilizer year, representatives of the manufacturers' association and Zen-Noh meet for price negotiations. Further, notification of the negotiations must be made 15 days prior to settlement on prices. Monthly prices, based on the average negotiated price for the year, are also determined. All fertilizer prices are based on delivery at the railway station of destination, packed in bags. The price paid by farmers includes a commission charge for the unit cooperative, handling charges at the retail level, interest, and storage.

Wholesale and retail prices for major fertilizer materials are presented in table 13 and table A-8. Fertilizer prices generally declined during the period 1965-66 and 1969-70. Exceptions were calcium cyanamide, single superphosphate, and fused phosphate. This general price decline is in line with the overall objectives of Zen-Noh in stabilizing or reducing prices of farmer inputs. Wholesale price declines ranged from about 4% on high-analysis compound fertilizers to nearly 10% on urea. Retail price declines were considerably smaller, ranging from 2% on high-analysis materials to slightly more than 6% on urea.

Table A-8 presents monthly fertilizer prices for the period July 1968 through June 1970. It is interesting to note that fertilizer prices were generally highest during the heavy use periods of each year, i.e., peak fertilizer prices occurred during the period March through July (See figures 3, 4, and 5 for consumption patterns.) Conversely, lowest prices were normally recorded during the low-use period of August through December.

Another item worthy of note concerns the extent of price variation during the fertilizer year (table 14). Although fertilizer prices, at both the wholesale and retail levels, are predetermined, they are not set at one point for the entire year. Presumably, a portion of the variation is planned in order to encourage purchasing during the off-season. Storage at various times during the year, handling, and interest charges may also account for some of the price variation.

COSTS AND MARGINS

Costs

The various cost components for selected fertilizers are presented in table 15. Using a 20-kg bag of 15-15-15 as an example, plant food material and mixing costs totaled ¥414 or 52% of average farmer cost during 1971-72. Packaging costs totaled ¥48 (6%) while freight and handling charges added ¥177 (22%). Total manufacturer's cost

Table 13. Wholesale and retail fertilizer prices[a] (17)

Type of fertilizer and size of package	Wholesale or retail	Fertilizer year 1965-66	1966-67	1967-68	1968-69	1969-70	4-year change	
Ammonium sulfate–40 kg	W	¥ 738	¥ 729	¥ 707	¥ 690	¥ 681	¥ -57	-7.7%
	R	800	790	771	758	759	-41	-5.1
Urea–20 kg	W	710	703	675	656	641	-69	-9.7
	R	772	768	743	729	724	-48	-6.2
Ammonium chloride–30 kg	W	552	546	532	518	511	-41	-7.4
	R	608	605	595	587	578	-30	-4.9
Calcium cyanamide–25 kg	W	615	611	618	624	630	15	2.4
	R	671	666	671	677	682	11	1.6
Single superphosphate–40 kg	W	525	532	533	539	536	11	2.1
	R	569	579	586	593	595	26	4.6
Fused phosphate–30 kg	W	448	456	465	472	473	25	5.6
	R	491	502	517	524	534	43	8.8
Potassium sulfate–30 kg	W	735	704	678	679	693	-42	-5.7
	R	791	770	749	751	769	-22	-2.8
Potassium chloride–30 kg	W	NA	575	556	549	548	-27	-4.7
	R	NA	643	632	623	626	-17	-2.6
Compound, 8-8-5–30 kg	W	NA	548	536	532	524	-24	-4.4
	R	NA	616	610	600	598	-18	-2.9
Compound, 14-14-14–20 kg	W	608	609	599	585	583	-25	-4.1
	R	666	673	666	646	653	-13	-2.0

[a]Wholesale prices are average annual prices for fertilizer delivered to nearest railway station. Retail prices are based on average annual price of fertilizer delivered to the retail outlet.

¥302 = US$1.

or price for this product was ¥639, or 80% of the farmer cost. Commission charges for margins and other retail costs were ¥161 (20%), making a grand total of ¥800 (27).

Averaging all costs for the seven materials examined indicates that production and material costs accounted for 56% of the farmer cost. Packaging, handling, and freight added 26% while commissions and other retail costs totaled 18%.[6]

Margins

Margins or handling commissions within the cooperative system are fixed as are prices. Each of the three levels of the cooperative organization receives a commission designed to cover all costs (12, 26). The fixed rates for 1970-71 were: Zen-Noh, 0.6%; prefectural federations, 2.0-2.2%; and unit cooperatives, 9.0%.[7] The percentages listed for the various levels are averages for all fertilizers and may actually vary by type fertilizer. The overall commission charge, then, totals slightly less than 12%.

If the commissions are actually in the vicinity of a 12% markup over manufacturer's prices as indicated by Zen-Noh, the difference must be accounted for in other marketing costs at the retail level. The percentage markups for Zen-Noh and the prefectural federations do not differ substantially from the published rates (see table 15). However, the markup at the farmer level for seven fertilizers examined was 18%—considerably larger than the 9% or 10% indicated above. The difference here is presumably explained by storage, interest, and handling charges at the final step in the distribution process.

While producer prices are common to both cooperatives and private merchants, the commission charges are not regulated in the private system. Total handling commission within the private merchant system in recent years has been estimated at about 10%.

Margins existing for major fertilizer materials during 1968-69 and 1969-70 are presented in table 14. In the earlier fertilizer year margins varied from 8.5% on calcium cyanamide to 13.5% on potassium chloride. In the latter year, margins were generally higher, although the pattern was similar to the earlier period.

Selected fertilizer prices for 1971-72 at each level of the cooperative distribution system are also presented in table

[6]The method of calculating margins or commissions here differs from that in table 13. In this analysis margins are treated as a portion of the total farmer cost, whereas in table 15 margins are calculated as the percentage markup over manufacturer's cost.

[7]Commission charges for 1968-69 were: Zen-Noh, 0.6%; prefectural federations, 2.1%; and unit cooperatives, 10.0%. In 1969-70 the charges were: Zen-Noh, 0.6%; prefectural federations, 2.3%; and unit cooperatives, 9.9%.

Table 14. Fertilizer price variations and margins

Type of fertilizer and size of package	Wholesale or retail	Seasonal price variation[a] 1968-69	Seasonal price variation[a] 1969-70	Margins[b] 1968-69		Margins[b] 1969-70	
Ammonium sulfate – 40 kg	W	¥ 16	¥ 21				
	R	15	12	¥ 68	9.9%	¥ 78	11.5%
Urea – 20 kg	W	16	26				
	R	16	11	73	11.1	83	13.0
Ammonium chloride – 30 kg	W	14	20				
	R	12	6	64	12.4	67	13.1
Calcium cyanamide – 25 kg	W	19	17				
	R	14	21	53	8.5	52	8.3
Single superphosphate – 40 kg	W	14	13				
	R	6	15	54	10.0	59	11.0
Fused phosphate – 30 kg	W	20	12				
	R	15	12	52	11.0	61	12.9
Potassium sulfate – 30 kg	W	37	13				
	R	26	22	72	10.6	76	11.0
Potassium chloride – 30 kg	W	12	17				
	R	13	8	74	13.5	79	14.2
Compound, 8-8-5 – 30 kg	W	16	12				
	R	20	12	67	12.6	74	14.1
Compound, 14-14-14 – 20 kg	W	14	9				
	R	20	19	61	10.4	70	12.0
Average Margin	=	=	=	68	10.9	70	12.0

[a]Seasonal price variation is the difference between the highest and lowest prices existing during each fertilizer year.
[b]Margins are the difference between average wholesale and retail prices existing for each fertilizer year. The percentage margin or markup is calculated using the wholesale price as the base.

¥302 = US$1.

Table 15. Selected fertilizer costs, prices, and margins, 1971-72 (27)

		Ammonium sulfate 40 kg	Urea 20 kg	Ammonium chloride 20 kg	Ammonium nitrate 20 kg	Single superphosphate 40 kg	Compound fertilizer 8-8-5 30 kg	Compound fertilizer 15-15-15 20 kg	Average[a] of seven materials
Production and material cost	(¥)	407.40	446.20	242.50	363.80	397.80	304.00	414.00	367.97
Packaging	(¥)						52.00	48.00	
	(¥)	226.60	137.80	87.50	149.20	162.20			178.19
Handling and freight	(¥)						179.00	177.00	
Manufacturer's price	(¥)	634.00	584.00	330.00	513.00	560.00	535.00	639.00	582.16
Zen Noh price	(¥)	639.00	591.00	334.00	519.00	565.00	540.00	646.00	587.57
Prefectural federation price	(¥)	649.00	607.00	342.00	528.00	575.00	555.00	664.00	560.00
Farmer's price	(¥)	736.00	710.00	440.00	622.00	660.00	683.00[b]	800.00	657.86
Margins									
Zen Noh	(¥)	5	7	4	5	5	5	7	5.41
	(%)	=	=	=	=	=	=	=	1.0
Prefectural federation	(¥)	10	16	8	10	10	15	18	12.43
	(%)	=	=	=	=	=	=	=	2.3
Farmer	(¥)	81	105	98	94	85	98[b]	134	97.86
	(%)	=	=	=	=	=	=	=	18.0
Total	(¥)	96	126	110	109	100	108	161	115.70
	(%)	15.1	21.6	33.3	21.2	17.6	20.2	25.2	21.3

[a]Average costs and margins were calculated as simple averages, i.e., quantities marketed were not considered. Margins reported in percentages were based on the manufacturer's price.
[b]Estimated.

¥302 = US$1.

15. Conversations with private merchant representatives indicate that prices for certain fertilizers sold by the private merchants are lower than those charged by the cooperative society. For example, the average price charged by the cooperatives for 15-15-15 in 1971-72 was ¥800 sold in a 20-kg bag. The private merchant price was in the vicinity of ¥730-740 (27).

TECHNICAL SERVICES

A highly organized program of technical guidance for farmers has been established by the cooperative societies. With the annual advance ordering system used, it would appear that a guidance program would be a necessary prerequisite if the system were to be successful. Moreover, from the share of the fertilizer market dominated by the cooperatives, it is apparent that the effort has been successful.

With the realization that it cannot confine its fertilizer business to simply distributing fertilizers to its members, the cooperative organization has developed a technical guidance program for member farmers regarding the effective use and application of fertilizer. Recent estimates indicate that agricultural cooperatives have about 14,500 technical guides involved in this activity (12). In addition, the cooperatives have formed liaison councils in cooperation with agricultural experiment stations, extension services, and other administrative organizations at the prefecture, municipal, township, and village levels to carry out promotion work on a larger, more systematic scale.

By utilizing this large-scale technical guidance program, a farmer has only to notify the local association of the area of his land under cultivation classified by cropping intentions and a complete fertilization plan is developed for his farm. This includes application rates, times of application, types of fertilizer, etc. Moreover, assistance in solving other production problems, such as diseases and pests, is available.

A major objective of Zen-Noh is to help Japanese farmers stabilize and increase agricultural production by eliminating output differentials among farmers and regions. And the annual advance ordering system along with technical guidance provides a unique tool for scheduling fertilizer production, plant investment, transport, storage, and distribution, not to mention the fact that it also provides a means for capturing an even larger share of the total fertilizer market.

Zen-Noh, in its endeavor to promote the application of modern farm technology, has an Agricultural Technical Center. Various experiments, inspection, and research are conducted on fertilizers, foodstuffs, farm machinery, chemicals, and other farm inputs, as well as training for technical guides in their guidance program and managers of the local cooperatives.

In order to compete with the powerful and well-planned cooperative system, the private merchants are emphasizing quick delivery, extensive promotion of new brands and types of fertilizer, farm delivery, and direct farmer consultation on fertilizer and other production and management problems. Private wholesalers are also providing training of managerial and technical staff at the retail level and loans for storage facilities. Some of the private firms are even promoting integration of marketing farm produce through production contracts at guaranteed prices.

In addition, the manufacturers conduct many activities such as seminars and distribution of educational material to promote fertilizer application techniques and sales. The manufacturers also provide sales training to workers at the retail level.

SUMMARY

The Japanese fertilizer marketing system has two major distribution channels: agricultural cooperatives (Zen-Noh) and private merchants. The system is largely dominated by the cooperative organization, accounting for about 88% to 90% of the total fertilizer market in recent years. Fertilizer sales by the cooperatives have continued to show growth both in volume and in the proportion of total market. However, their greatest advances are taking place in other farm inputs such as foodstuffs, chemicals, and machinery.

The fertilizer marketing system is unique in that distribution is entirely free of government controls and has been since August 1950. The government no longer participates in price fixing but does provide guidance and supervision in the annual price negotiations between Zen-Noh and the manufacturers' association. Moreover, there are no government subsidies on fertilizer.

The current rice surplus situation has created some uncertainties for the cooperative organization since its strong ties are with traditional agriculture. The private merchants feel that they are in a strong position to regain some of the lost fertilizer market because of their ties with the horticultural and specialty crop farmers. The private firms have promoted fertilizers for specialized uses as well as premium products. The highly organized technical guidance service of the cooperatives has forced the private sector to develop a similar organization which may even provide a higher degree of service than provided by the cooperatives.

A number of problems in fertilizer distribution have been cited. They include the shortage of low-cost labor, fertilizer logistics, and the small size of agricultural holdings. As in most developed countries, rising labor costs continue to create problems, especially when an industry experiences a depressed market which has been the case in fertilizer. Solving the labor problem will depend largely on

mechanization at all levels of distribution. This would obviously involve shifting from bagged movement of fertilizer to bulk handling, both to intermediate and final storage points. Direct shipments from manufacturer to the retail outlet would also reduce labor costs.

An equally pressing problem concerns the physical distribution of fertilizer throughout the country. Storage space appears to be in short supply, especially when needs are greatest and in remote areas. More storage is planned by the cooperative organization both at the prefectural and unit cooperative levels.

Other problems observed include the apparent lack of seasonal discounts. Although there are minor variations in fertilizer prices throughout the year, there does not appear to be a concerted effort to promote sales during off-seasons. The practice of ordering fertilizer in advance has certainly streamlined fertilizer production and distribution processes, but it does not allow for unexpected changes in farmer fertilization plans. In this respect the private firms are better able to meet the immediate needs of the farmer. And while credit for fertilizer purchases through the cooperative organization is highly developed, this is not the case for the private channel.

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APPENDIX

Table A-1. Major Japanese fertilizer producers (5, 7, 9, 10)

Ammonia

Asahi Chemical Industry Company, Ltd.
Asahi Glass Company, Ltd.
Chisso Asahi Fertilizer KK
Japan Gas-Chemical Company, Inc.
Kasei Mizushima Petrochemical Company, Ltd.
Kashima Ammonia Industry, Ltd.
Kyowa Hakko Kogyo Company, Ltd.
Mitsubishi Chemical Industries, Ltd.
Mitsubishi Gas-Chemical Company, Inc.
Mitsui Toatsu Chemicals, Inc.
Muroran Chemical Industry Company, Ltd.
Nihon Ammonia Company, Ltd.
Nippon Kasei Chemical Company, Ltd.
Nissan Chemical Industries, Ltd.
Nitto Chemical Industry Company, Ltd.
Sotetsu Kagaku Company, Ltd.
Showa Denko KK
Sumitomo Chemical Company, Ltd.
Tongosei Chemical Industry Company, Ltd.
Tokuyama Soda Company, Ltd.
Toyo Gas Chemical Industry, Ltd.
Toyo Soda Manufacturing Company, Ltd.
Ube Industries, Ltd.

Urea

Japan Gas-Chemical Company, Inc.
Kasei Mizushima Petrochemical Company, Ltd.
Kashima Ammonia Industry, Ltd.
Kyowa Hakko Kogyo Company, Ltd.
Mitsubishi Chemical Industries, Ltd.
Mitsubishi Gas-Chemical Company, Inc.
Mitsubishi Petrochemical Company, Ltd.
Mitsui Toatsu Chemicals, Inc.
Nihon Ammonia Company, Ltd.
Nippon Kasei Chemical Company, Ltd.
Nissan Chemical Industries, Ltd.
Nitto Chemical Industry Company, Ltd.
Sotetsu Kagaku Company, Ltd.
Showa Denko KK
Sumitomo Chemical Company, Ltd.
Tohoku Hiryo KK
Toyo Gas Chemical Industry, Ltd.
Ube Industries, Ltd.

Ammonium Sulfate

Chisso Corporation
Ishihara Sangyo Kaisha, Ltd.
Japan Gas-Chemical Company, Inc.
Katakura Chikkarin Company, Ltd.
Konoshima Chemical Company, Ltd.
Kyowa Hakko Kogyo Company, Ltd.
Kyowa Gas Chemical Industry Company, Ltd.
Kyushu Chemical Industry Company, Ltd.
Mitsubishi Chemical Industries, Ltd.
Mitsubishi Petrochemical Company, Ltd.
Mitsui Toatsu Chemicals, Inc.
Nissan Chemical Industries, Ltd.
Nitto Chemical Industry Company, Ltd.
Sotetsu Kagaku Company, Ltd.
Showa Denko KK
Sumitomo Chemical Company, Ltd.
Tongosei Chemical Industry Company, Ltd.
Toray Industries, Inc.
Ube Industries, Ltd.

Ammonium Chloride

Asahi Glass Company, Ltd.
Central Glass Company, Ltd.
Tokuyama Soda Company, Ltd.
Toyo Soda Manufacturing Company, Ltd.

Ammonium Nitrate

Asahi Chemical Industry Company, Ltd.
Mitsubishi Chemical Industries, Ltd.
Sumitomo Chemical Company, Ltd.
Ube Industries, Ltd.

Calcium Cyanamide

Denki Kagaku Kogyo KK
Togawa Electric Industry Company, Ltd.
Shinetsu Chemical Industry Company, Ltd.
Showa Denko KK
Tokuyama Soda Company, Ltd.
Toyo Soda Manufacturing Company, Ltd.

Single Superphosphate

Chisso Asahi Fertilizer KK
Ishihara Sangyo Kaisha, Ltd.

Table A-1. (continued)

Single Superphosphate (continued)

Konoshima Chemical Company, Ltd.
Kureha Chemical Industry Company, Ltd.
Mitsubishi Chemical Industries, Ltd.
Mitsui Toatsu Chemicals, Inc.
Nihon Suiso Kogyo Company, Ltd.
Nippon Kasei Chemical Company, Ltd.
Nippon Kokan KK
Nissan Chemical Industries, Ltd.
Nitto Chemical Industry Company, Ltd.
Onoda Chemical Industry Company, Ltd.
Ruse Industries, Ltd.
San Kagaku Company, Ltd.
Seibu Chemical Industry Company, Ltd.
Sumitomo Chemical Company, Ltd.
Taki Fertilizer Manufacturing Company, Ltd.

Fused Phosphate

Denki Kagaku Kogyo KK
Hinode Kagaku Kogyo Kasha, Ltd.
Ibigawa Electric Industry Company, Ltd.
Kanto Denko Company, Ltd.
Minami Kyushu Chemical Industry Company, Ltd.
Nippon Chemical Industry Company, Ltd.
San Kagaku Company, Ltd.
Seibu Chemical Industry Company, Ltd.
Shinetsu Chemical Industry Company, Ltd.
Tokkoshu Company, Ltd.

Ammoniated Phosphates

Chisso Corporation
Ishihara Sangyo Kasha, Ltd.
Japan Union Fertilizer Company, Ltd.
Kyushu Chemical Industry Company, Ltd.
Mitsubishi Chemical Industries, Ltd.
Mitsui Toatsu Chemicals, Inc.
Nihon Rinsan KK (Japan Phosphoric Acid Company, Ltd.)
Nippon Kokan KK
Nissan Chemical Industries, Ltd.
Nitto Chemical Industry Company, Ltd.
Ruse Industries, Inc.
San Kagaku Company, Ltd.
Showa Denko KK
Sumitomo Chemical Company, Ltd.
Taki Fertilizer Manufacturing Company, Ltd.
Tohoku Hiryo KK
Toyo Gas Chemical Industry, Ltd.
Ube Industries, Ltd.

Compound Mixed Fertilizers

Asahi Chemical Industry Company, Ltd.
Asahi Glass Company, Ltd.
Central Glass Company, Ltd.
Chisso Corporation
Ishihara Sangyo Kasha, Ltd.
Japan Union Fertilizer Company, Ltd.
Kanto Kasei Kogyo Company, Ltd.
Karakura Chikkarin Company, Ltd.
Konoshima Chemical Company, Ltd.
Kureha Chemical Industry Company, Ltd.
Kyushu Chemical Industry Company, Ltd.
Mitsubishi Chemical Industries, Ltd.
Mitsubishi Gas Chemical Company, Inc.
Mitsui Toatsu Chemicals, Inc.
Nippon Kasei Chemical Company, Ltd.
Nippon Kokan KK
Nippon Rinsan Company, Ltd.
Nissan Chemical Industries, Ltd.
Nitto Chemical Industry Company, Ltd.
Onoda Chemical Industry Company, Ltd.
Ruse Industries, Inc.
San Kagaku Company, Ltd.
Seibu Chemical Industry Company, Ltd.
Showa Denko KK
Sumitomo Chemical Company, Ltd.
Taki Fertilizer Manufacturing Company, Ltd.
Tohoku Hiryo KK
Toyo Gas Chemical Industry, Ltd.
Ube Industries, Ltd.

Table A-2. Fertilizer production capacity[a] (15, 17, 25)

Product	1965	1966	1967	1968	1969	1970	1971
	thousand mt of product						
Ammonia	2,313	2,503	2,685	3,079	3,142	3,362	3,808
Urea	1,462	1,599	2,160	2,603	2,639	2,988	3,597
Ammonium chloride	654	684	711	842	905	925	943
Ammonium nitrate	80	89	97	100	138	139	173
Calcium cyanamide	529	529	551	572	536	458	345
Single superphosphate	4,162	4,335	3,952	3,935	3,895	3,781	3,025
Fused phosphate	NA	945	906	920	1,099	1,099	1,048
Calcined phosphate	NA	95	95	95	95	95	155
Mono/diammonium phosphate	NA	292	346	393	482	632	657
High grade compounds	2,629	2,627	2,817	3,270	3,598	3,794	3,852
Sulfuric acid[b]	6,053	6,427	6,710	7,359	7,507	7,740	8,300
Liquid phosphoric acid	398	444	485	589	649	785	838

[a]Capacities are as of April 1.
[b]Include capacity for industrial uses.

Table A-3. Fertilizer production (8, 17)

Type of fertilizer	Fertilizer year										
	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
	thousand mt of nutrient										
Ammonium sulfate	525.9	542.0	490.4	469.4	495.7	562.6	535.6	544.6	506.9	480.3	442.3
Urea	308.9	320.1	391.0	464.4	498.8	622.9	756.5	958.7	1,010.1	1,067.9	1,091.0
Ammonium nitrate	7.8	7.0	6.8	5.8	6.2	6.4	6.7	6.4	7.9	6.7	7.6
Ammonium chloride	79.9	90.5	103.1	121.1	119.4	133.3	143.8	155.6	141.2	149.7	191.2
Calcium cyanamide	74.1	64.9	63.6	69.6	71.6	75.4	74.7	72.8	73.5	65.0	65.9
Compound fertilizer	65.7	93.4	117.4	164.4	197.9	231.0	263.6	291.2	314.3	315.9	301.8
Other N fertilizer	2.6	3.0	3.4	3.4	3.7	3.5	4.4	5.4	5.0	5.4	5.3
Total N fertilizer	**1,064.9**	**1,120.9**	**1,185.7**	**1,298.5**	**1,393.3**	**1,635.1**	**1,789.3**	**2,034.7**	**2,096.9**	**2,130.9**	**2,105.1**
Single superphosphate	358.6	319.7	303.8	292.4	291.4	252.9	248.5	241.3	190.4	166.7	132.4
Concentrated superphosphate	3.6	3.9	5.1	13.6	21.9	27.2	27.9	30.7	41.9	32.6	28.9
Fused phosphate	79.3	73.0	68.4	52.7	61.4	63.9	71.4	101.9	123.5	106.0	86.4
Compound fertilizer	62.3	90.8	120.9	172.3	211.7	256.2	298.5	339.9	378.1	399.4	391.6
Other P_2O_5 fertilizer	36.4	32.0	32.9	38.2	35.5	37.5	36.5	31.5	33.7	31.7	35.9
Total P_2O_5 fertilizer	**540.6**	**519.4**	**529.1**	**569.2**	**622.7**	**637.7**	**694.8**	**745.3**	**768.0**	**729.4**	**665.2**
Potassium sulfate[b]	NA	37.3	40.4	55.4	61.5	67.1	77.0	93.3	79.9	62.9	63.7

[b]Imported potassium chloride which was converted to potassium sulfate in domestic plants.

Table A-4. Imports of fertilizer and fertilizer raw materials (8, 17, 19)

Type of fertilizer or intermediate	Fertilizer year										
	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
	thousand mt of nutrient/product[a]										
Total N fertilizer	9.3	2.5	2.1	2.5	7.0	2.0	2.4	4.0	10.0	7.0	5.0
Total P_2O_5 fertilizer	0	0.4	0.2	0.4	0.4	5.0	5.0	16.0	22.0	29.0	33.0
Potassium sulfate	49.5	53.5	25.5	42.0	38.5	49.5	29.8	29.4	43.3	39.3	59.2
Potassium chloride	553.2	442.2	482.4	567.8	555.0	573.7	605.1	682.3	658.0	625.1	641.8
Total K_2O fertilizer	602.7	495.7	507.9	609.8	592.5	623.2	634.9	671.7	701.3	664.4	701.0
Phosphate rock	2,117.5	2,117.0	1,879.9	2,269.2	2,413.1	2,403.5	2,559.2	2,986.1	3,230.8	2,936.7	2,965.4

[a]Phosphate rock is in terms of product.

Table A-5. Domestic consumption of fertilizer (8, 15, 17)

Type of fertilizer	Fertilizer year										
	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
	thousand mt of nutrient										
Ammonium sulfate	338.6	307.8	299.4	293.3	264.6	248.5	246.8	240.8	221.1	208.3	197.5
Urea	160.3	152.8	157.2	168.3	163.8	188.2	210.8	233.0	245.8	240.2	268.9
Ammonium nitrate	7.6	6.7	6.7	6.1	5.4	6.4	6.6	6.3	7.4	6.9	7.5
Ammonium chloride	61.7	57.4	57.8	58.4	53.5	53.5	59.9	65.1	67.9	61.2	45.2
Calcium cyanamide	69.6	61.7	65.7	66.0	63.7	65.4	74.5	73.4	73.0	71.4	65.8
Compound fertilizer	52.7	78.2	108.4	141.0	166.9	203.7	239.3	265.6	286.7	285.5	275.3
Other N fertilizer	2.8	3.0	3.3	3.8	3.5	3.6	4.2	5.2	4.9	5.4	5.5
Total N fertilizer	**693.3**	**667.6**	**698.5**	**736.9**	**721.4**	**769.3**	**842.1**	**889.4**	**906.8**	**879.9**	**865.7**
Single superphosphate	342.6	310.2	300.2	285.2	256.3	236.4	220.6	209.7	190.7	162.1	135.4
Concentrated superphosphate	2.5	2.7	3.2	9.3	15.0	20.7	25.6	29.8	32.1	30.6	30.9
Fused phosphate	69.2	54.7	52.9	53.7	56.3	64.6	75.9	97.2	109.5	102.5	93.0
Compound fertilizer	42.9	73.0	107.5	147.9	174.2	220.1	266.7	306.0	341.8	360.2	344.6
Other P_2O_5 fertilizer	36.0	29.7	29.6	36.1	32.9	32.4	31.1	28.0	27.6	28.2	28.3
Total P_2O_5 Fertilizer	**493.2**	**470.3**	**493.4**	**532.2**	**534.7**	**574.2**	**619.9**	**670.7**	**701.7**	**683.6**	**632.2**
Potassium chloride	NA	NA	456.7	484.0	482.2	497.6	507.4	543.0	540.3	548.0	481.5
Potassium sulfate	NA	NA	84.1	91.9	101.0	103.5	104.5	108.3	122.9	112.2	124.6
Total K_2O Fertilizer	**553.0**	**508.8**	**540.8**	**575.9**	**583.2**	**601.1**	**611.9**	**651.3**	**663.2**	**660.2**	**606.1**
Total consumption	1,739.5	1,646.7	1,732.7	1,845.0	1,839.3	1,944.6	2,073.9	2,211.4	2,271.7	2,222.7	2,104.0

Table A-6. Fertilizer exports (8, 15, 17)

Type of fertilizer	Fertilizer year										
	1960-61	1961-62	1962-63	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
	thousand mt of nutrient										
Ammonium sulfate	175.9	175.8	231.7	190.1	221.9	269.2	313.9	280.4	232.1	269.4	258.6
Urea	115.2	186.5	218.7	298.8	322.3	385.9	518.0	671.5	543.5	807.1	970.2
Ammonium chloride	0.7	25.6	47.8	73.8	68.3	85.9	74.7	80.6	102.5	128.2	164.7
Calcium cyanamide	0.1	0.1	0	4.2	8.2	9.0	3.1	0.1	0.7	0.1	0.1
Compound fertilizer	5.3	10.6	10.9	14.9	17.5	25.5	20.4	14.9	16.9	30.8	16.9
Other N fertilizer	0.2	0.1	0.3	0.1	0.2	*	0.5	*	0.3	*	*
Total N fertilizer	**297.4**	**398.7**	**508.9**	**581.9**	**638.4**	**775.5**	**930.6**	**1,051.5**	**896.0**	**1,235.6**	**1,410.5**
Single superphosphate	8.3	14.3	5.3	9.9	38.4	13.9	1.5	2.0	1.9	1.6	1.1
Concentrated superphosphate	0.3	1.1	2.1	2.4	3.5	4.2	2.4	2.8	5.8	3.9	1.7
Fused phosphate	9.1	17.7	11.9	5.9	4.3	0.6	0.5	0.1	*	*	0
Compound fertilizer	6.5	13.2	13.1	17.7	20.1	31.3	28.5	23.1	20.7	37.6	19.0
Other P_2O_5 fertilizer	3.3	2.8	2.4	2.0	2.9	4.5	5.1	3.2	4.0	3.4	6.1
Total P_2O_5 fertilizer	**27.5**	**49.1**	**34.7**	**37.9**	**69.2**	**54.5**	**34.0**	**31.2**	**32.4**	**46.5**	**27.9**
Potassium chloride	0	3.5	4.6	10.8	11.7	10.7	6.3	10.9	5.9	14.7	7.9
Potassium sulfate	0	1.1	*	2.8	0.1	1.1	3.6	7.0	0.7	12.2	5.9
Total K_2O fertilizer	**0**	**4.6**	**4.5**	**13.6**	**11.8**	**11.8**	**9.9**	**17.9**	**6.6**	**26.9**	**13.8**
Total exports	324.9	452.4	548.1	633.4	719.4	841.8	974.5	1,100.6	935.0	1,309.0	1,452.2

*Less than 50 tons.

Table A-7. Seasonal consumption of plant nutrients and selected products

Month	Ammonium sulfate	Urea	Compound fertilizer N	Total N	Single superphosphate	Fused phosphate	Compound fertilizer P_2O_5	Total P_2O_5	Total K_2O	Total, all nutrients
January	8.4%	8.0%	9.4%	8.6%	9.7%	10.9%	9.2%	9.8%	9.8%	9.3%
February	8.7	7.9	9.0	8.5	10.1	11.1	8.9	9.8	9.8	9.3
March	11.6	8.7	12.8	11.1	13.9	12.1	12.6	12.7	11.1	11.6
April	10.7	9.0	10.1	9.8	11.5	10.7	10.2	10.6	9.4	10.0
May	12.0	11.1	9.0	10.4	8.2	7.3	8.8	8.0	8.6	9.1
June	7.3	7.8	6.3	7.2	5.4	3.4	5.8	5.1	6.2	6.2
January-June	(58.7)	(52.5)	(56.6)	(55.6)	(58.8)	(55.5)	(55.5)	(56.0)	(54.9)	(55.5)
July	6.9	8.7	4.5	6.8	5.3	3.3	4.3	4.3	6.9	6.0
August	5.8	7.6	6.1	6.6	6.0	6.0	6.2	6.1	6.8	6.5
September	6.6	7.7	7.0	7.0	7.0	6.8	7.2	7.1	7.2	7.1
October	7.0	8.2	7.4	7.6	7.4	6.9	7.9	7.7	7.3	7.6
November	7.4	8.0	9.0	8.2	7.0	10.7	9.3	9.1	7.3	8.2
December	7.6	7.3	9.4	8.2	8.5	10.8	9.7	9.7	9.6	9.1
July-December	(41.3)	(47.5)	(43.4)	(44.4)	(41.2)	(44.5)	(44.5)	(44.0)	(45.1)	(44.5)
Total, tons[a]	452,464	483,547	562,720	1,801,823	381,330	218,534	677,171	1,397,275	1,314,738	4,513,836

[a]Average annual consumption in terms of product for the years 1968 and 1969.

Table A-3. Wholesale and retail fertilizer prices (17)

Month	Ammonium sulfate 40 kg		Urea 20 kg		Ammonium chloride 30 kg		Calcium cyanamide 25 kg		Single super-phosphate 40 kg		Fused phosphate 30 kg		Potassium sulfate 30 kg		Potassium chloride 30 kg		Compound: 8-8-5 30 kg		Compound: 14-14-14 20 kg	
	W	R	W	R	W	R	W	R	W	R	W	R	W	R	W	R	W	R	W	R
											yen									
July 1968	686	758	653	731	512	582	613	670	532	590	462	519	663	739	547	627	525	610	579	643
August	682	752	648	723	512	579	616	670	533	590	463	518	660	736	544	623	527	597	580	644
September	685	754	651	726	514	584	623	675	537	594	470	523	663	741	546	625	530	599	580	642
October	687	756	654	729	516	587	622	676	539	596	469	525	670	746	547	626	528	593	579	639
November	688	755	654	726	516	581	623	675	539	595	470	522	675	750	548	621	530	594	581	640
December	684	751	650	721	514	575	620	675	534	590	468	520	678	752	545	615	527	590	578	638
January 1969	687	754	653	724	516	576	622	676	536	590	471	520	684	755	546	618	530	594	584	642
February	691	758	657	728	520	581	626	681	541	594	475	524	686	758	549	621	535	598	587	646
March	695	760	661	731	524	583	630	684	544	596	479	526	690	761	552	624	538	602	592	650
April	697	766	663	737	526	585	631	682	545	595	480	531	697	760	553	628	539	603	592	658
May	698	762	663	734	526	583	632	680	545	594	480	531	692	757	553	625	539	603	592	658
June	698	764	664	733	526	583	631	679	546	596	482	533	694	762	556	628	541	604	592	658
Average	690	758	656	729	518	582	624	677	539	593	472	524	679	751	549	623	532	599	585	646
July 1969	694	759	658	728	523	582	628	676	542	592	477	529	692	761	553	623	531	597	582	645
August	678	751	639	717	510	576	625	676	529	588	468	527	694	768	547	624	523	[illegible]	581	642
September	677	754	636	721	509	579	626	679	533	592	471	531	694	763	544	623	522	593	584	652
October	675	759	632	726	504	579	623	676	531	592	467	534	685	765	540	627	520	597	578	652
November	676	759	633	724	505	578	624	676	531	593	469	532	686	765	541	627	519	595	579	652
December	673	757	632	724	503	576	622	675	531	592	467	530	690	767	541	626	518	591	578	652
January 1970	677	757	638	724	508	577	628	677	534	591	472	531	696	769	546	625	520	594	581	655
February	681	759	642	724	512	577	632	683	537	597	476	538	697	771	550	628	523	598	583	655
March	685	761	646	726	516	578	636	687	541	595	479	539	698	770	549	625	527	602	587	660
April	686	763	644	726	515	578	637	691	541	601	479	539	697	783	557	631	528	603	587	658
May	687	762	644	723	515	579	639	694	540	603	478	538	691	775	557	631	528	603	587	657
June	687	762	643	721	515	578	639	696	540	603	478	537	693	774	553	628	528	603	587	657
Average	681	759	641	724	511	578	630	682	536	595	473	534	693	769	548	626	524	598	583	653

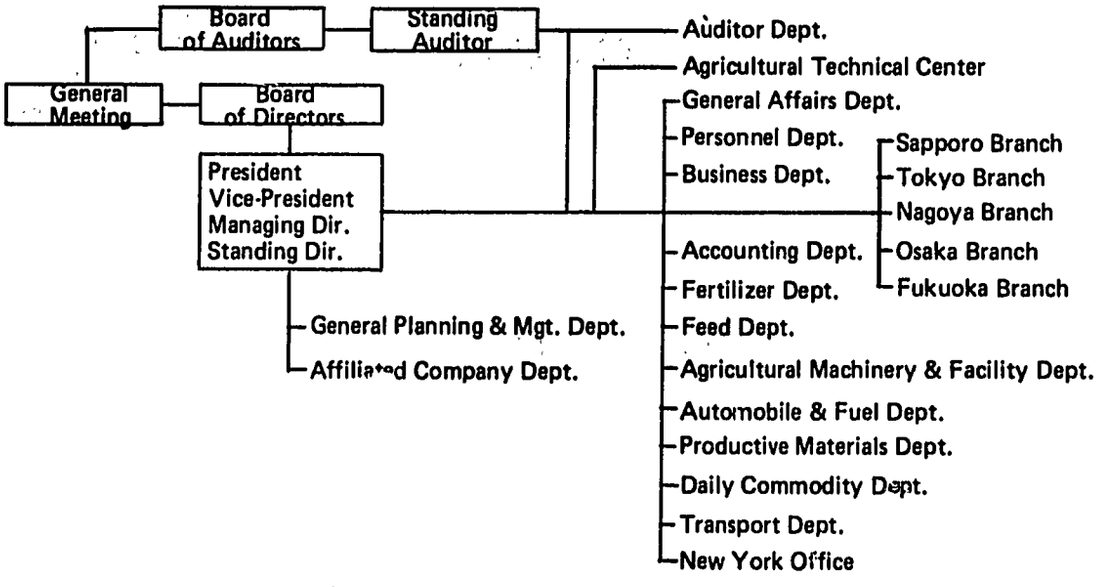

Figure A-1. Organizational structure of Zenkoren (13)

Bulletin Y-60 *June 1973*

NATIONAL FERTILIZER DEVELOPMENT CENTER TENNESSEE VALLEY AUTHORITY MUSCLE SHOALS, ALABAMA 35660