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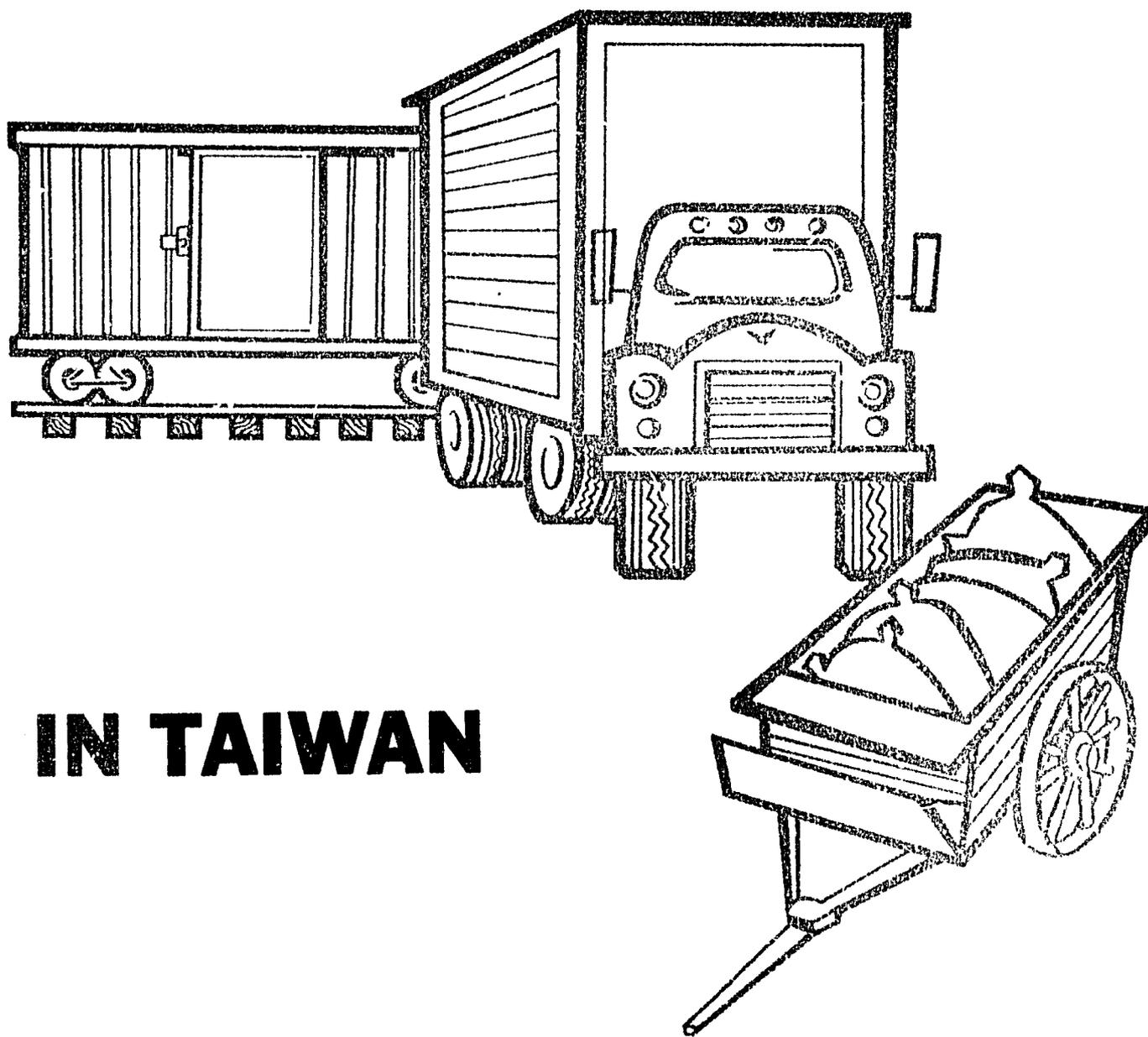
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the fertilizer marketing system



IN TAIWAN

*No. 1 in series of reports
analyzing marketing systems
potentially useful in
developing nations.*

Prepared for

AGENCY FOR INTERNATIONAL DEVELOPMENT

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by

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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 Taiwan and conducted a survey of fertilizer distribution firms. This work was accomplished in cooperation and with the assistance of Mr. James C. C. Lee and Mr. Wu Shu-Shun of the Taiwan Fertilizer Company.

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THE FERTILIZER MARKETING SYSTEM IN TAIWAN

Taiwan is a densely populated island where land is a serious limiting factor of agricultural production. Its agricultural development depends heavily upon efficient land utilization and the proper complements of production requisites and management. Crop production accounts for more than 70% of the total value of agricultural production; therefore, it is important to understand clearly Taiwan's land resources and the use of these resources.

The total land area of Taiwan, including the nearby small islands, is approximately 36,000 square kilometers or 13,885 square miles. Medium to high mountains together with hilly lands stretch from north to south, covering nearly all of the eastern and much of the central regions of the islands. Over 60% of the land is mountainous and hilly and of little agricultural value. Forests occupy about 212 million hectares (ha) or 55% of the total land area (1). Only the western regions are relatively level and endowed with considerable fertile soils.

In 1970, there was 905,000 ha (25% of total area) under cultivation. Fifty-eight percent of this land was irrigated and 336,000 ha had sufficient water for two rice crops. Paddy fields devoted mainly to rice production account for nearly 529,000 ha (58%). Dry land farming (upland) represents over 41% (376,000 ha) of the cultivated land. An important statistic is that the cultivated land produces an average of 1.8 crops per year. On some farms, the land may be subjected to four or five crops annually; thus, multiple cropping schemes are well developed in Taiwan. When one considers the average size farm is only 1.03 ha (2.5 acres) and the population density on cultivated land is nearly 1,600 persons per square kilometer, such schemes are likely to be continued and even intensified.

Taiwan is endowed with favorable rainfall and temperatures throughout the year. In the lowland farming regions, the average temperature is above 60°F and average rainfall exceeds 84 inches. Such conditions provide sufficient heat and moisture which make multiple cropping possible during all seasons. In addition, irrigation is highly developed and is expanding as new reservoirs and water projects are developed.

Taiwan's population is estimated at 15 million persons. The farm population is composed of 880,000 farm families averaging seven persons per household. Thirty-four percent of the total labor force is employed in agriculture. Most of the farm labor is family labor. Average farm family net income is approximately \$1,200, including approximately \$350 nonfarm income.

Agricultural productivity on Taiwan farms is among the highest in Asia. The record of expansion in agricultural output dates back to 1945. The annual growth rate for farm production averaged 4.9% during 1965-69.

The Taiwanese have long recognized that technological innovations that increase unit production are essential for agricultural progress. Christensen (2) has pointed out that Taiwan has well-developed systems for employing and implementing agricultural research, education, and extension activities. Since technological inputs appear large compared to most developing countries, emphasis in recent years has been on finding practical solutions to problems of farm production and marketing that increase agricultural productivity.

The contribution of farm production inputs, especially fertilizer, in improving farm output in Taiwan is well known and adequately described elsewhere (2, 3, 4). For example, Christensen's work (2) showed that on the average, rice yield per hectare increased nearly 4 kilograms (kg) per kg of fertilizer materials used. Using a N-P₂O₅-K₂O content of 30% he estimated that under Taiwan conditions each additional kilogram of plant nutrients added 13 kg of rice/ha under optimum rates of nitrogen application on different soils.

STRUCTURE OF THE FERTILIZER INDUSTRY

Fertilizer production in Taiwan began in the late 1930's and early 1940's when four small plants were built to produce some 50,000 metric tons (mt) of calcium cyanamide and calcium superphosphate. In 1946 the government established the Taiwan Fertilizer Company (TFC). Over the years, the initial four facilities were rehabilitated and expanded and additional plants have been built. In 1950, another government facility, the Kaohsiung Ammonium Sulfate Corporation (KASC) began production and with periodic expansions its capacity now exceeds 34,000 mt of N. Currently, there are two major companies in Taiwan, TFC and KASC, operating altogether seven fertilizer factories with an annual production capacity of nearly 305,000 mt of N; 61,000 mt of P₂O₅; and 23,500 mt of K₂O (table A-1). With the 1971 acquisition of the Mobil Chemical Allied facility, TFC now has over 85% of the nitrogen capacity in Taiwan. Of all these factories, four are located at the seaports of Keelung, Hualien, and Kaohsiung, only one near the natural gas field at Miaoli and another one in the vicinity of a coal mine (figure 1). Some 60 small private plants are now producing mixed fertilizers.

The most important fertilizers produced in Taiwan are ammonium sulfate, urea, single superphosphate, compound fertilizers and calcium ammonium nitrate. Of the total production 78% is N, 16% is P₂O₅, and 6% is K₂O (figure 2). Raw materials for manufacturing finished products are natural gas and liquid fuel, sulfur, phosphate rock and

FERTILIZER CONSUMPTION

Current estimates indicate that Taiwan farmers used approximately 257,000 mt of N, P₂O₅, and K₂O in 1970-71. Nitrogen accounted for nearly 60% of the total nutrients used while K₂O amounted to 23% and P₂O₅ 17% (figure 3). On a per hectare basis, Taiwan has one of the highest fertilizer application rates in Asia—second only to Japan. In 1970-71, nutrient use on rice averaged about 220 kg/ha. About 75% of all fertilizer used in Taiwan has been used for rice, 15% is used on sugarcane and 10% on all other crops (table A-2). The fertilizer use has been changing gradually, i.e., the consumption of fertilizer for rice and sugarcane is declining relative to the fertilizer used on other crops.

Ammonium sulfate, urea, calcium superphosphate, potassium chloride, potassium sulfate and compound fertilizers are the main sources of N, P₂O₅, and K₂O. Compound materials are the fastest growing fertilizer market in Taiwan. Because of the increased production of fruits and vegetables and emphasis on crops other than rice, these materials should continue to expand.

While Taiwan has a relatively high rate of fertilizer consumption per hectare there is still room for increased use. The acreages of major crops registered by farmers for fertilizer requirements lag behind the corresponding cultivated area, and production goals are being raised each year. For paddy rice, the cultivated area cannot be expected to increase but for other crops there is still room for expansion.

IMPORTS-EXPORTS

Taiwan is now considered self-sufficient in finished fertilizers for farm application with the exception of potash fertilizers. Prior to 1969 considerable quantities of ammonium sulfate were imported into Taiwan for use on the rice crop. Since 1969, imports have been limited to potassium chloride and potassium sulfate (table A-3).

Taiwan has been exporting fertilizer since 1960. The major exported materials have been nitrogenous-calcium cyanamide in earlier years and urea in the latter years. Small amounts of compound fertilizer and ammonium phosphate (16-20-0) are also exported. Additional nitrogen capacities now place Taiwan in a surplus urea situation for future trade considerations.

Recent developments in U.S. financing schemes of fertilizers for developing countries have strengthened Taiwan's position as a supplier to nitrogen-deficient Asian countries. Taiwan can now offer fertilizer under USAID-financed tenders.

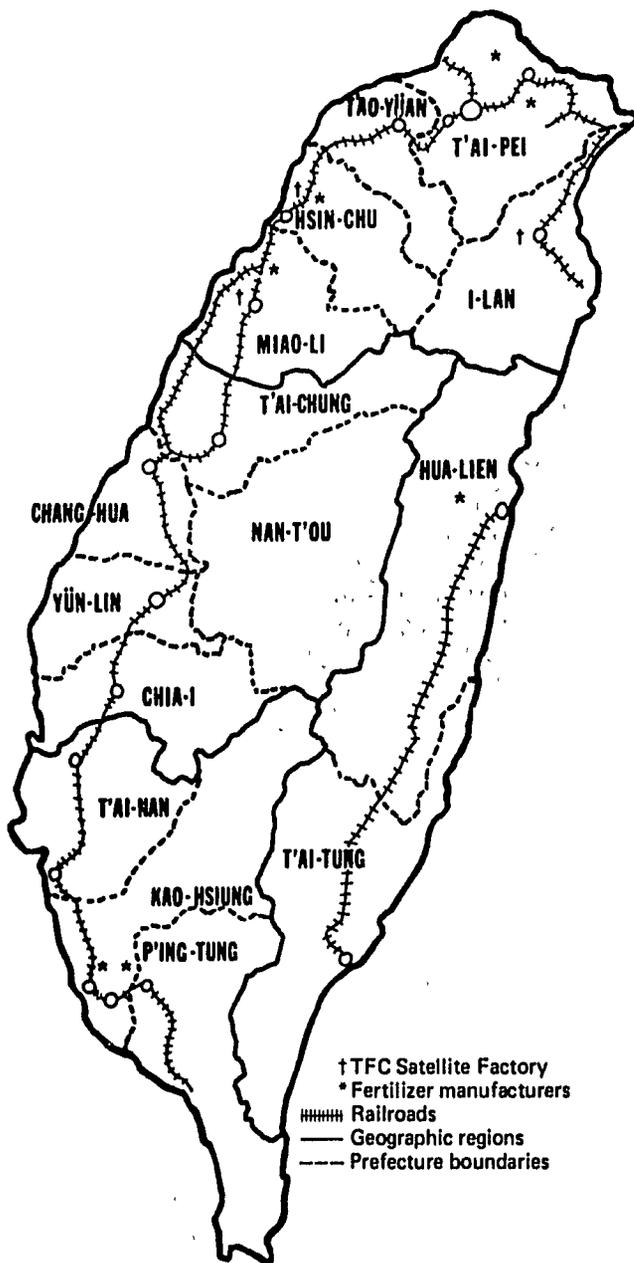


Figure 1. Map of Taiwan, showing regions, transportation system, and fertilizer production plants

potash. In 1970, gas and liquid fuel accounted for over 93% of the raw materials used in producing nitrogen fertilizers. Sulfur is supplied by local pyrite deposits plus imports from Canada, United States, and Mexico. Rock phosphate is imported, primarily from Morocco and the United States. Potash is imported in the form of KCl and K₂SO₄ which are allocated to the farmers by Taiwan Provincial Food Bureau and also used in the manufacture of compound fertilizers.

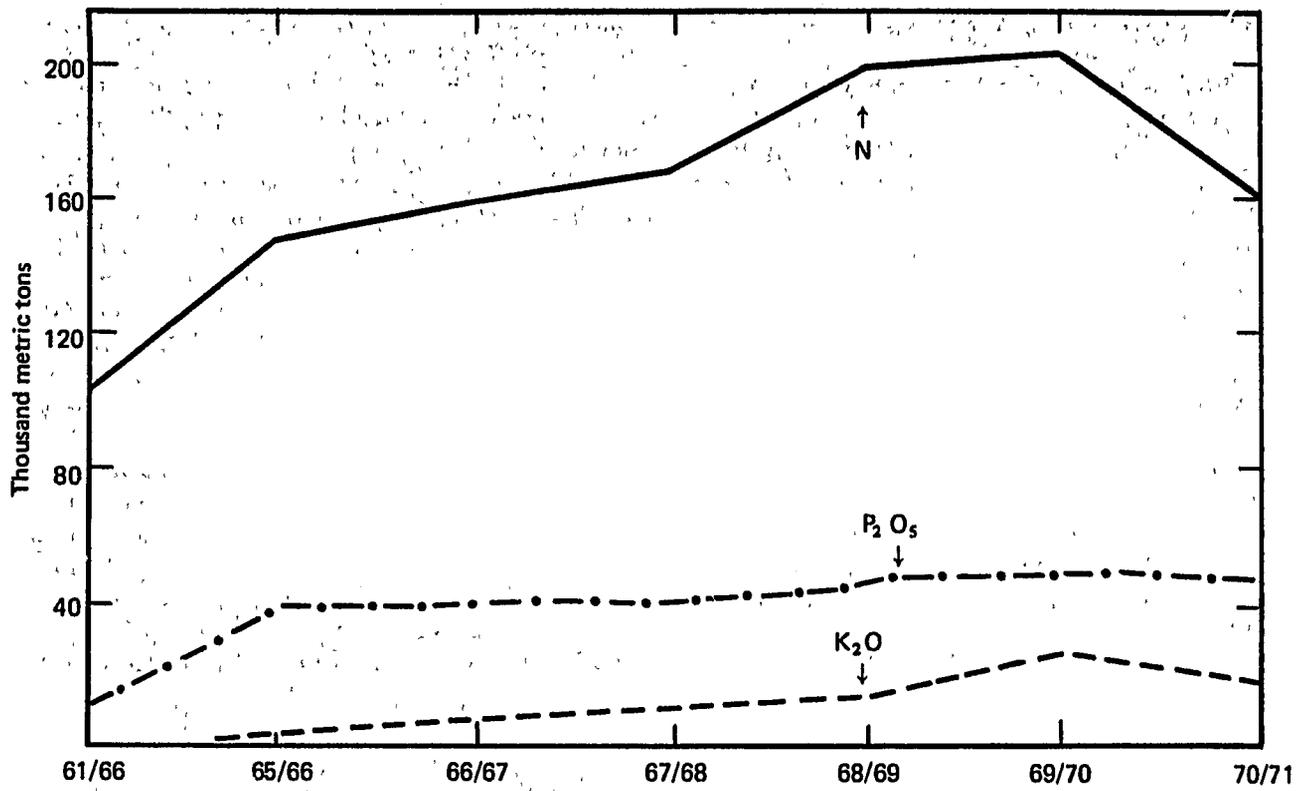


Figure 2. Fertilizer production in Taiwan, 1961-70 (000's mt of N, P₂O₅, K₂O) (5).

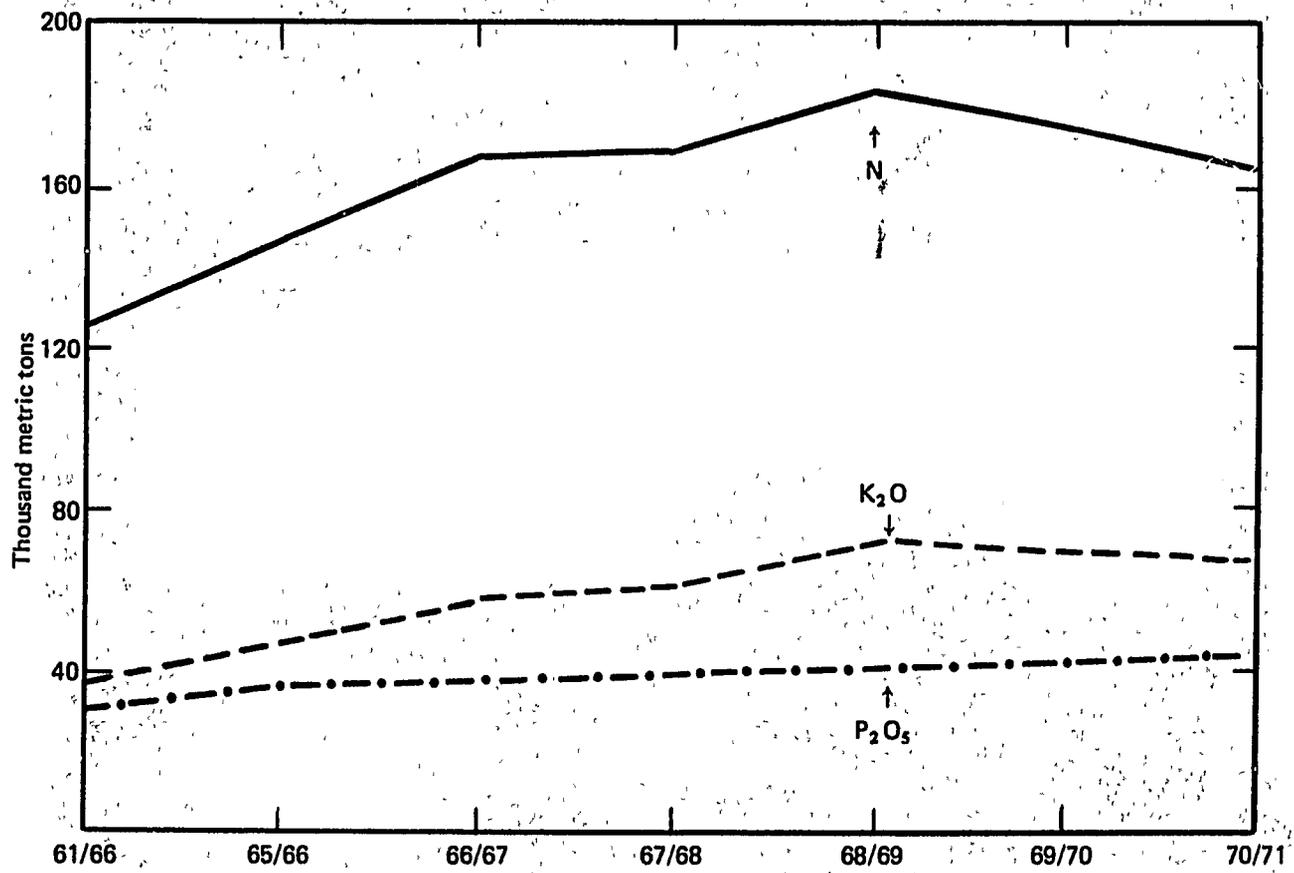


Figure 3. Fertilizer consumption in Taiwan, 1961-70 (000's mt N, P₂O₅, K₂O) (5).

FERTILIZER DISTRIBUTION CHANNELS

Fertilizer distribution in Taiwan is primarily the responsibility of the provincial government. However, fertilizer sales are made through several channels within both the government and private sectors. This tight public control of fertilizer marketing is an outgrowth of Taiwan's post-war food policy of producing enough rice to feed its rapidly expanding population. A major element in this policy has been the fertilizer-paddy barter system whereby farmers submit paddy rice in exchange for fertilizers. Management of the program has been entrusted with the Fertilizer Sales and Transportation Department of the Food Bureau. The fertilizer distribution process in Taiwan is schematically illustrated in figure 4.

In essence, the Food Bureau serves as the wholesaler and the farmer associations perform retail functions. Approximately 65% of all 1971 fertilizer sales were distributed under the supervision of the Food Bureau through farmer associations to farmers. Further, the associations operate as multipurpose agricultural cooperative organizations of

farmers. In 1971 there were over 300 farmer associations with nearly 875,000 members.

A second important channel of distribution is through various promotional groups such as the Taiwan Sugar Corporation, Taiwan Pineapple Corporation, Taiwan Tea Corporation, etc. (figure 5). About 25% of all Taiwan fertilizers are distributed through these organizations to their respective growers. Like the farmer associations, they obtain their straight fertilizer materials from the Food Bureau and compound fertilizers directly from the TFC. Exception to this procedure is the Taiwan Sugar Corporation. It allocates fertilizers to growers through the sugar mills. Each of the 27 sugar factories serves as a fertilizer distribution outlet.

The third distribution channel is strictly in and through the private sector. It accounts for 10% of total fertilizer sales. TFC markets part of its compound fertilizers through registered private retailers. Among the private fertilizer producers are three larger ones who are authorized to buy their raw material (chiefly aqueous ammonia) from TFC and sell their product (ammonium sulfate) back to TFC.

A retail fertilizer dealer near Taichung.



The annual output of these plants amounts to about 40,000 mt of ammonium sulfate. Some 60 very small registered producers are chiefly mixers and blenders. They use urea, phosphatic and potash fertilizers and also organic materials to produce different forms of mixed fertilizers. These

products find their way into the partially free market, accessible to end-users, through local retail dealers.

Fertilizer distribution is based primarily on crop production plans. Therefore, the process of distributing fertilizers involves a very intricate and closely coordinated procedure.

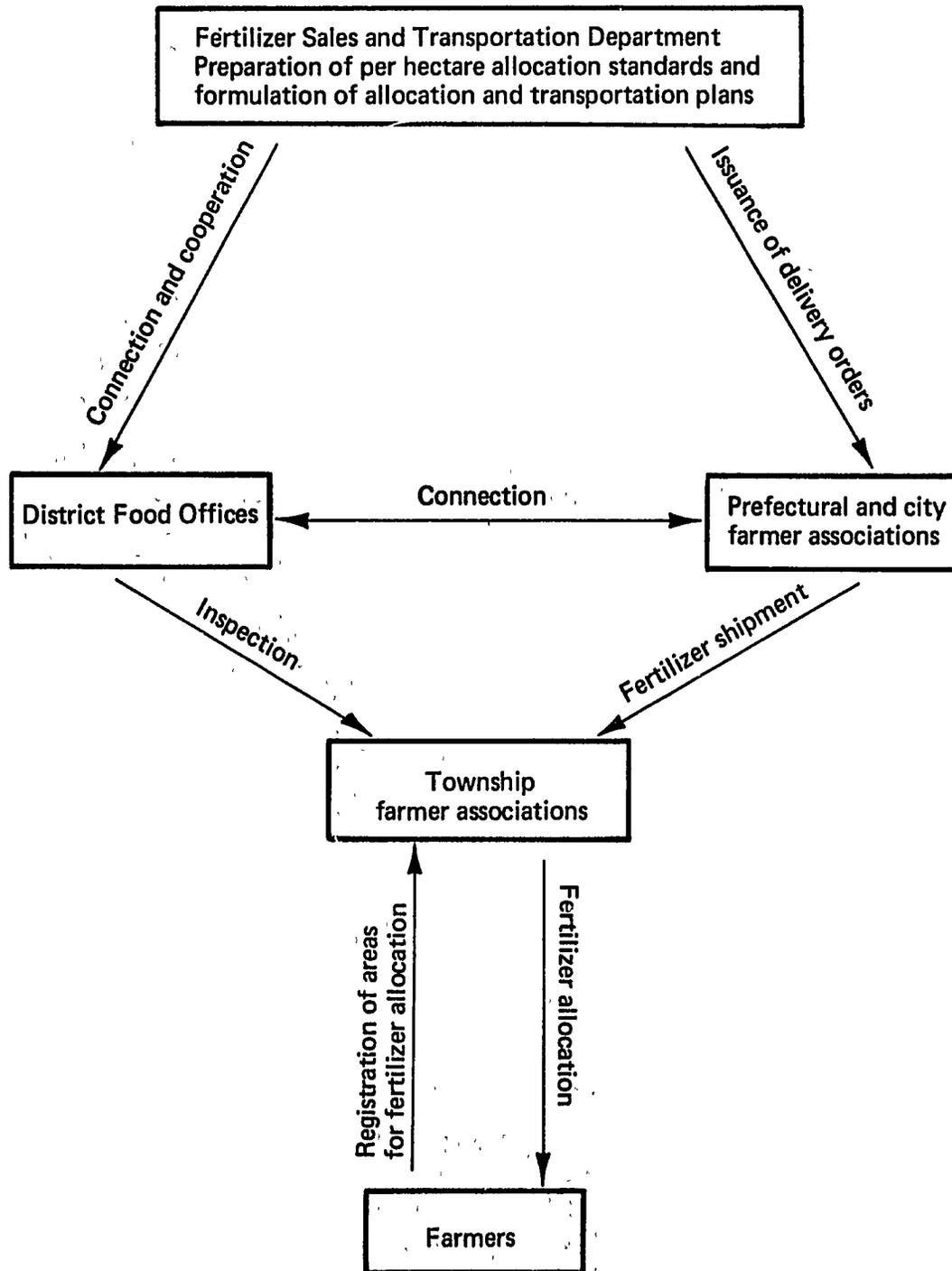


Figure 4. Fertilizer distribution processes of the Taiwan Provincial Food Bureau (6).

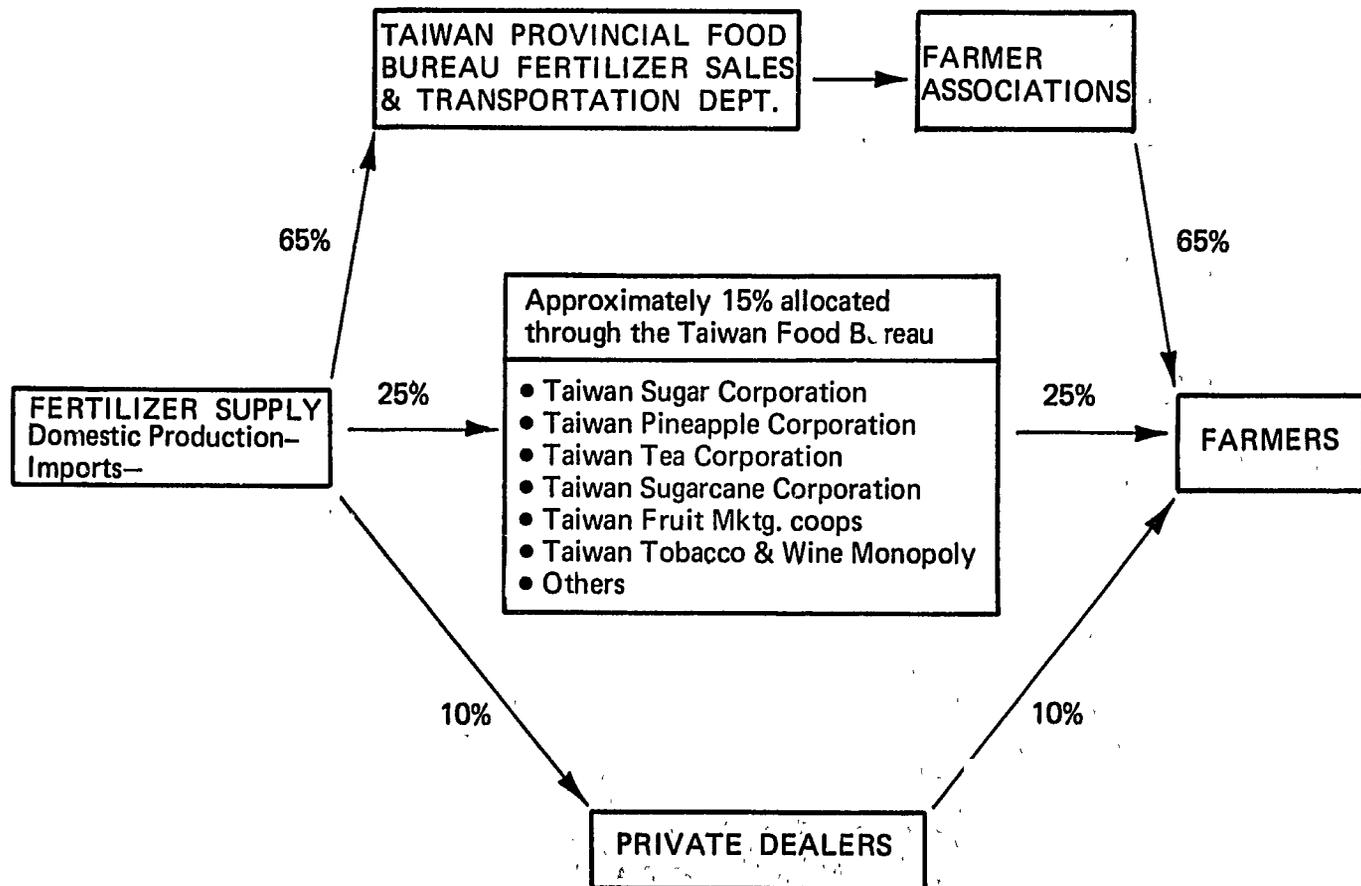
involving the Food Bureau and relevant organizations. Basically, the distribution process for fertilizer in Taiwan is best described by the following procedures.

1. The Food Bureau consults with the Joint Commission on Rural Reconstruction (JCRR), Department of Agriculture and Forestry, Taiwan Fertilizer Company, and the Provincial Agricultural Research Institute, etc., to determine the effective demand as supported by research, supply conditions, and farmer practices.
2. Meanwhile, farmers are required to report their prospective plantings and fertilizer requirements for crops to the farmer association. Their requests are screened and registered by the farmer association. At this time any request for additional allocations will be considered.
3. Distribution of fertilizers for rice is handled under the fertilizer-paddy barter system through the farmer associations.

4. Distribution of fertilizer for other crops is handled through farmer associations, the various promotional self-interest organizations and the TFC entirely on a cash basis.

TRANSPORTATION AND STORAGE OF FERTILIZERS

Fertilizer movement begins with the Fertilizer Sales and Transportation Department of the Food Bureau (6). Transportation plans are prepared according to logistical requirements, storage inventories and availabilities, freight chartering, and delivery schedules for farmer associations. Although a graphic illustration (figure 6) makes the transportation process look complicated, it is relatively simple. Imported fertilizers are, to the extent possible, directly transferred from the ports to the township farmer associations (retail level) for storage and distribution.



Source: Taiwan Fertilizer Company and Taiwan Provincial Food Bureau

Figure 5. Fertilizer marketing channels in Taiwan.

Excessive imports are transferred to intermediate storage areas.

Domestically produced fertilizers are shipped direct from the plants by the prefectural and city farmer associations to the township level associations according to transportation plans. The Taiwan Railway Administration and Harbour Bureaus undertake consignment of storage, transportation, loading and discharging of fertilizer alongside railway lines and in the harbors. Truck transportation is handled through open tenders in accordance with instructions of the provincial government.

Approximately 90% of the fertilizers in Taiwan is shipped by rail and/or truck. Nearly all of the fertilizer between the producer and intermediate warehouse storage and the prefectural and city farmer associations moves by rail. A combination of rail, truck, and oxcart moves the bulk of fertilizer through the township farmer associations on to the farmers.

The average distance of shipping fertilizers by rail is 200 kilometers (km) and the longest distance is about 300 km. Average freight rate is about U.S.\$3/mt. Truck rates are considerably higher than rail—NT\$40/ton/10 km.¹ Usually a 20% discount is given by truck companies for fertilizer consignments.

¹NT\$40 = US\$1.

In addition to the regular shipments of fertilizer, the Food Bureau allocates 0.55% of the total consignments to farmer associations as loss allowance during transportation and distribution. Of the 0.55%, 0.05% is given to prefectural and city farmer associations while the other 0.50% is given to township farmer associations.



Distribution of fertilizer by truck from an intermediate warehouse near a rail station.

Loading ammonium sulfate on rail car.



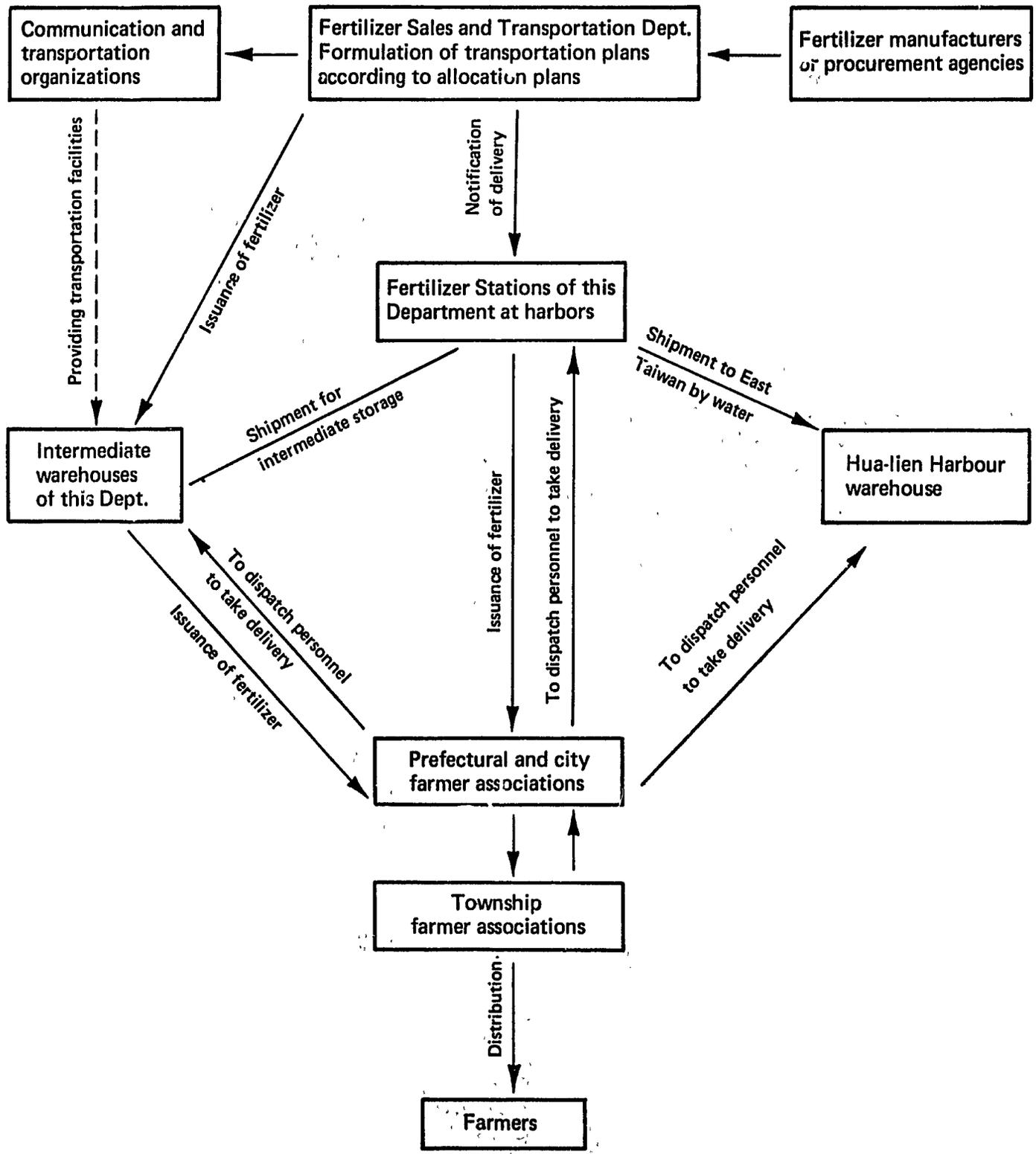


Figure 6. Transportation processes of fertilizer distribution.

The Food Bureau coordinates warehousing and storage activities at the various points in the distribution channel. The Food Bureau operates 11 intermediate warehouses having 110,000 mt of storage capacity. Farmer associations have an additional 220,000 tons of storage. The Food Bureau also rents additional warehouse space as needed from the Taiwan Railway Freight Service along railway lines.

The TFC maintains considerable storage capacity through its compound fertilizer dealers. This capacity is usually small unit-wise, and is managed by the individual dealer and subdealers. Compound fertilizers are also sold f.o.b. storage at 14 points throughout the country.

SEASONAL DISTRIBUTION

The movement of fertilizer through the respective marketing channels varies by type of fertilizer according to use. Generally speaking, fertilizer distribution will closely correspond to peak periods of the first and second rice crops which occur in February-March and July-August. Consequently, the primary movement of ammonium sulfate, superphosphate, and calcium ammonium nitrate is just prior to and during rice planting time.

With the exception of fertilizer use on rice, the seasonal curve for use on other crops is fairly uniform throughout the year. Urea and compound fertilizers are used extensively on fruits, vegetables, and tobacco. The practice of various multiple cropping schemes has reduced the cyclic effect of seasonal movement of fertilizer. As crop acreages other than rice expand, the fertilizer movement curve will become even flatter (figure 7).

Due to the increasing use of fertilizer on other crops, storage facilities are more efficiently utilized during the nonrice growing periods. This relatively stable movement of product minimizes peak "overloads" on transportation facilities.

PACKAGING

All fertilizer used in Taiwan is handled in bags. Woven straw bags (50 kg) with polyethylene lining are used for superphosphate. The woven straw bags have given considerable problems due to acid leaching which tends to destroy the outer bag. Normally 200-300 additional grams are added to the bag to compensate for the possible loss during transportation. Since these conditions have created a farmer acceptance problem, the straw bags will probably be discontinued in the future.

Urea is packaged in 25-kg, 4-ply kraft paper bags with 1-millimeter (mm) polyethylene liners. The 25-kg bags are popular in mountainous areas since they are easier to

handle. All other fertilizers are handled in 40-kg bags, some in woven polypropylene bags with polyethylene liners. In many cases, replacement bags at the Food Bureau intermediate storage points are cloth.

Product differentiation is handled by coding the bags with analysis and the plant producing the materials. Bag costs vary considerably according to type and size. These costs are shown in table 1.

Table 1. Type and cost of bags used for fertilizer in Taiwan.

Type bag	Size (kg)	NT\$/bag ^a
Kraft paper bags w/1 mm PE liner	40	7-8
Kraft paper bags w/1 mm PE liner	25	6-7
Woven PP w/1 mm PE liner	40	6-8
Woven straw bags w/1 mm PE liner	50	5-6

^aNT\$40 = US\$1.

PP = Polypropylene

PE = Polyethylene

PRICE DETERMINATION

The fertilizer-paddy barter system² has been the primary pricing instrument for marketing fertilizers in Taiwan for over 25 years. In the initial years of the barter system farmers could get 60% of their fertilizer on loan and the

²The barter system for pricing fertilizer was abolished January 1, 1973. However, it is expected that the effect of the barter system will continue to influence fertilizer/rice price ratios for the next several rice crops.



Polypropylene bags are becoming more popular.

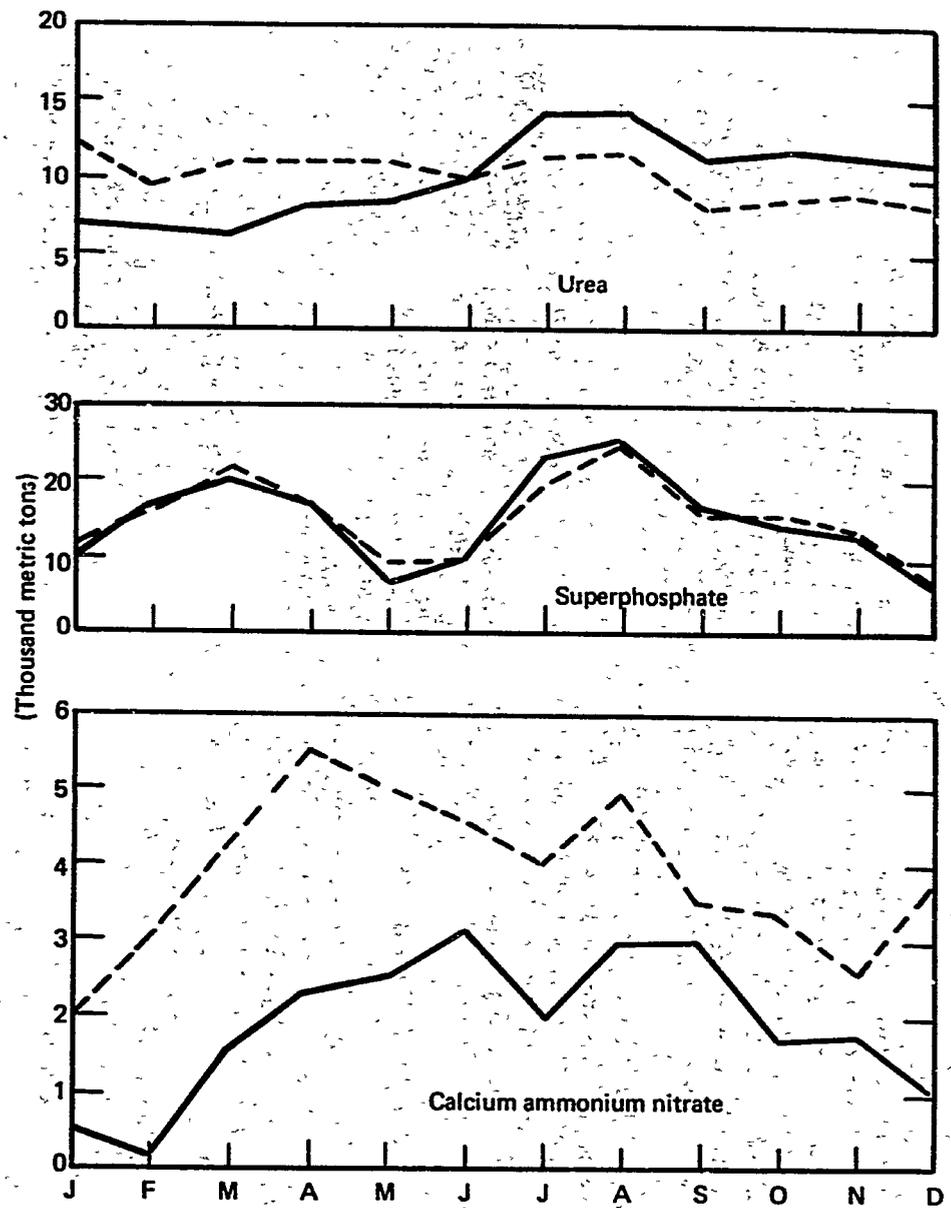
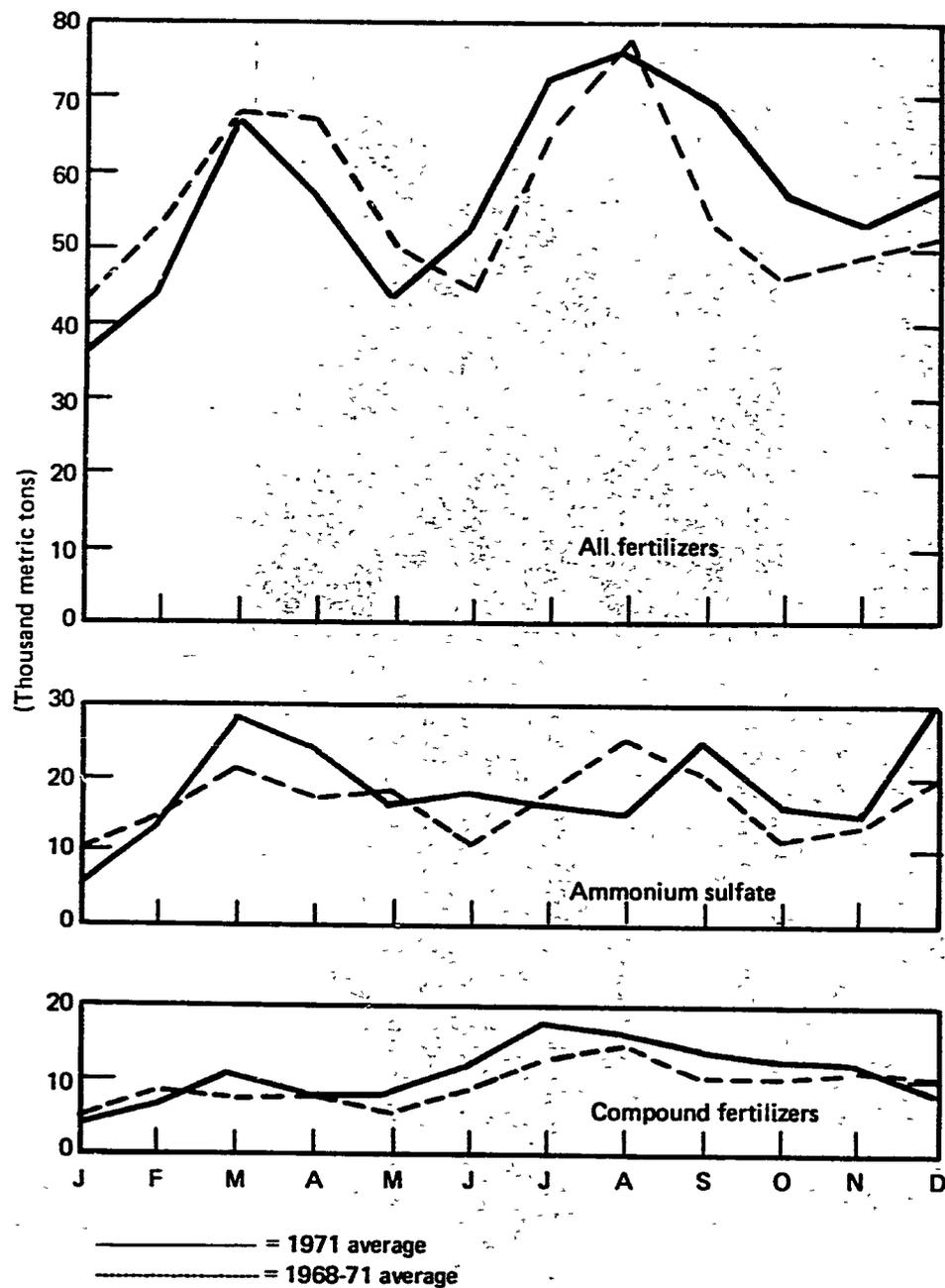


Figure 7. Seasonal distribution patterns for fertilizer movement in Taiwan by type of fertilizer.

loan had to be repaid with rice of the next harvest. The remaining 40% was paid by surrendering rice on the spot or paying in cash. Recently, the regulation has been lessened somewhat, farmers can either get all of the fertilizer on loan or pay for part of the fertilizer with cash. The present fertilizer-paddy barter ratios (unit of paddy rice in exchange for one unit of fertilizer) for the past 2 years for the major fertilizers are shown in table 2.

In principle, the barter ratios for various types of fertilizers are such that the yield increment of rice from the application of a particular fertilizer is always larger than the amount required for an exchange of the fertilizer. The fertilizer-paddy barter ratio calculations are based on data representing distribution cost, value:cost ratios from yield response data, and market price of paddy. Data in table 2 illustrate that conditions were such that in 1972 the ratios for urea and ammonium sulfate represented declines of 24 and 22%, respectively, from 1971. The ratios for the other fertilizers showed similar changes. Those who have studied the barter system from an economic point of view admit it has both advantages and disadvantages (6, 7, 8, 9). Some of the advantages of the barter system have been:

1. The government has been able to collect considerable quantities of rice thereby enabling the government to control the food supply.
2. It has made possible a wide distribution of fertilizer for rice.
3. It has prevented farmers from being cheated by unethical fertilizer dealers.
4. Farmers have been able to purchase fertilizer at a low interest rate.

The disadvantages of the system as expressed by some are:

1. The procedures for the barter system are rather complicated.

2. The barter exchange forces the farmer to grow only rice, thus, limiting the farmer's choice in his farm business.
3. Due to the rice-fertilizer price relationship, a change in the price of rice induces a corresponding change in the cost of fertilizer. Moreover, the variation in the rice price often makes the barter price of fertilizer higher than the official price.
4. There is little incentive for the farmer since the accrued profit goes to the government.

Fertilizers for all other crops in Taiwan are sold on a cash basis. Although other sales are for cash, the prices of fertilizers are maintained as near as possible to the corresponding cash equivalents converted from the barter ratios. Cash prices of the single nutrient fertilizers are shown in table 3. The three most important nitrogen fertilizers have decreased in price per ton since 1970.

Prices for the compound fertilizers sold in Taiwan are usually equal to or slightly higher than that of the particular fertilizer when calculated on the basis of the unit prices of the corresponding nutrient elements in straight fertilizers. Compound fertilizers are sold primarily for tobacco, fruit, and vegetable production. Wholesale prices of these materials are based on production cost plus a predetermined profit margin. The quoted wholesale price is either an exfactory or intermediate warehouse gate price. Compound fertilizer prices for 1972 are shown in table 4.

COSTS AND MARGINS

Costs—As in many other countries, the cost of distributing fertilizers in Taiwan is influenced by many variables—type of fertilizers, packaging materials,

Table 2. Fertilizer-paddy barter ratios in Taiwan, 1971-72.

Year	Ammonium sulfate	Calcium ammonium nitrate	Urea	Calcium superphosphate	Potassium sulfate	Potassium chloride
1971	0.68	0.65	1.09	0.40	0.80	0.65
1972	0.53	0.49	0.82	0.37	0.65	0.60

Source: Taiwan Provincial Food Bureau

Table 3. Cash retail fertilizer prices to farmers, 1970-72, unit NT\$/mt.

Year	Ammonium sulfate	Calcium ammonium nitrate	Urea	Calcium superphosphate	Potassium sulfate	Potassium chloride
1970	2,900	2,800	4,650	1,700	3,000	2,800
1971	2,700	2,650	4,300	1,700	3,000	2,800
1972	2,460	2,260	3,800	1,700	3,000	2,800

Source: Taiwan Provincial Food Bureau

transportation facilities and distance to markets, intermediate handling, etc. In a public sector system, such as Taiwan, where fertilizer prices are administered, distribution costs are also subject to less fluctuation. Thus in most situations the cost of distributing fertilizer in Taiwan fluctuates according to transportation rate schedules for the various fertilizers.

Since the Food Bureau handles 65% of all fertilizer in Taiwan, the major costs of distributing fertilizers are the costs incurred by the Food Bureau in administering the fertilizer program. Under this program, the Food Bureau employs over 100 employees and operates 7 district food offices, 10 subdistrict food offices and 11 storage centers. The estimated cost components of distributing fertilizer by the Food Bureau are shown in table 5. These data indicate that the costs of distributing fertilizers are approximately 16% of the retail price (farmer price). As is usually the case transportation expenditures account for over 30% of the total cost, while interest accounts for nearly one-fourth of the cost. The miscellaneous cost is in the form of subsidies for construction of irrigation facilities, rice drying floors,

Table 4. Compound fertilizer prices, Taiwan, 1972.

Fertilizer	Prices paid by farmers (NT\$/mt)
20-5-10	3,150
11-9-18	2,700
11-5.5-22	2,420
16-8-12	2,820
21-0-17	3,700
4-12-12	2,650
16-20-0	3,200

Source: Taiwan Fertilizer Company

Table 5. Estimated costs of distributing fertilizer by the Taiwan Food Bureau—expressed as a % of retail price.

Cost items	Percent
Transportation—rail, truck, ship	5.41
Interest	3.92
Farmer association allowance	2.70
Administration	
Operation	.67
Salaries	.65
Storage rent	.60
Product loss	.46
Packaging	.27
Taxes	.03
Insurance	.02
Miscellaneous costs	1.32
Total	16.02

Source: Taiwan Provincial Food Bureau

compost structures, farm machinery, etc. This particular function is being transferred to the provincial government in 1971-72; therefore, the cost to the fertilizer program of the Food Bureau should be reduced to about 14% of the retail cost of the fertilizer.

The 16% marketing cost as expressed in table 5 appears low when compared with costs of marketing fertilizer in other countries. This 16% represents a "pure" distribution cost since some of the cost of administering the fertilizer program is evidently charged off to the food control program. The integration of costs of operating the barter program makes it impossible to allocate overhead (fixed costs) costs which are not accounted for in the total distribution costs.

Margins—Under the present pricing structure, the gross margins vary considerably among the products offered for sale to Taiwan farmers (table 6). The greatest margin appears to be in pricing ammonium sulfate—a 20% gross margin between factory and the farmer. The margin for urea is estimated at 15% between factory and retailer. The wholesaler's margin is about 6% while the retailer's margin is nearly 9%.

The pricing structure for compound fertilizers gives a gross margin of 5.2% for the retailer regardless of the analysis. Typical cost structure for marketing compound fertilizers through retailers is shown in table 7. Using 20-5-10 as an example, a metric ton sold in 40-kg bags nets NT\$83.40 (2.5% of retail value) to the wholesaler. Since very little, if any, intermediate storage is used in the case of compound fertilizers, storage costs are minimized.

TECHNICAL SERVICES

The Food Bureau and TFC are heavily involved in promotional and extension activities. The TFC conducts more than 300 fertilizer demonstrations annually. These demonstrations along with technical assistance are a joint activity between TFC and the farmer associations and the various promotional interests, i.e., sugar, tea, pineapple, and tobacco. Farmers participating in the demonstrations obtain free fertilizer and are paid for the use of the land and extra labor involved in conducting the demonstration.

The Food Bureau like the TFC is also engaged in technical assistance providing a wide range of services. The extension activities provided by the Food Bureau are listed below.

1. Conducts training classes in fertilizer application and extension work.
2. Establishes fertilizer demonstration farms.
3. Holds field days for fertilizer demonstrations.
4. Directly contacts and advises farmers.
5. Conducts discussion meetings on fertilizer distribution for and with small village leaders.

6. Promotes distribution of fertilizer use propaganda.
7. Uses fertilizer publicity extensively—radio, speakers, movies, slides, pamphlets, etc.

In addition to the efforts of the Food Bureau and the TFC, a number of other organizations assist farmers with technical advice concerning fertilizer use. The Taiwan Tea Corporation, Taiwan Sugar Corporation, the Tobacco and Wine Monopoly Bureau and others conduct fertilizer demonstrations and advise farmers on the proper application of nutrients. Services provided by different organizations involved in promoting fertilizer in Taiwan are shown in table A-6.

GENERAL COMMENTS

Taiwan's experience in marketing fertilizer is extensive and unique. It represents a rigid form of government

control on both the supply and demand side. It is difficult to appraise the effectiveness of the system because of the built-in character of the rice-fertilizer barter system, which in effect controls the market supply of rice. Certainly over the years the government has been successful in generating a strong demand for fertilizer even with relatively high fertilizer prices. Most experts contribute this success to a high return per dollar invested for fertilizer and a stable supply due to government-controlled production.

Although the distribution system is relatively the same as 20 years ago, the current conditions and the factors affecting the marketing system are changing. Rice supply is no longer a critical problem. Evidence of this can already be seen in the lowering of fertilizer prices by the government. Further, it is now possible for farmers to get more fertilizer either on loan or by cash payment.

Table 6. Average fertilizer prices and gross margins in Taiwan, 1971-72.

Types of fertilizer	Analysis	Packing		Exfactory price			Implied gross margin %
		Kg/bag	Materials	For Taiwan Food Bureau & Taiwan Sugar Corporation	Wholesale	Retail	
Ammonium sulfate	21-0-0	40	Kraft paper bags	2,040		2,460	20
Urea	40-0-0	25	Kraft paper bags	3,300	3,500	3,800	15
Calcium ammonium nitrate	20-0-0	40	PE woven bags		2,147	2,260	5.2
Calcium superphosphate	0-18-0	50	Straw woven bags	1,450		1,700	17
Complex fertilizer	20-5-10	40	PE woven bags		2,992.50	3,150	5.2
Complex fertilizer	11-9-18	40	PE woven bags		2,565	2,700	5.2
Complex fertilizer	11-5.5-22	40	PE woven bags		2,299	2,420	5.2
Complex fertilizer	16-8-12	40	PE woven bags		2,679	2,820	5.2
Complex fertilizer	21-0-17	40	PE woven bags		3,515	3,700	5.2
Complex fertilizer	4-12-12	40	PE woven bags		2,517	2,650	5.2
Complex fertilizer	16-20-0	40	PE woven bags		3,040	3,200	5.2

Source: Taiwan Fertilizer Company

Table 7. Average marketing cost and net profit for a typical compound fertilizer (20-5-10) in Taiwan, 1971-72.

Item	NT\$/mt
TFC: Retail price	3,150.00
Commission for wholesaler (5% discount of retail price + NT\$50 discount on cash basis)	207.50
Wholesaler: Exfactory or intermediate warehouse sales cost	2,942.50
Wholesaler's expenses:	
Tax: Stamp (4% of retail price)	126.00
Commission tax 207.50 x 4%	11.00
Profit (rate of 6%)	1.00
Retailer discount	50.00
Transportation cost	37.50
Personnel cost	10.00
Others	2.00
Total	124.10
Net profit for wholesaler (207.50 - 124.10)	83.40

Source: Taiwan Fertilizer Company



A field day at a pineapple plantation demonstrating the use of urea on pineapple.



Open discussion between farmers and extension personnel during field day activities.

A quasi-private fertilizer market is emerging in the distribution of compound material through TFC dealers. While not yet a major factor in production, the presence of the small private producers indicates that forces of a market economy are at play. These circumstances, whether the result of changing times or government planning or both, may be indicative of future events which could lead to the separation of fertilizer distribution from production control programs.

The fertilizer market in Taiwan will continue to expand with compound fertilizers leading the anticipated growth. Fertilizer prices are likely to decline to at least international levels. This is especially true for the single nutrient fertilizers, such as urea, which may decrease slightly in use.

Although the Taiwan marketing system may not be completely modeled by other Asian countries, certain elements of the system appear to have considerable

application to developing nations. Important to the system has been the planning and supervision in the early stages of development. Agricultural policies have created incentive for farmers to use fertilizers.

The government has developed the infrastructure whereby the marketing system can be responsive to changing cropping conditions. Effective railway and road systems have virtually eliminated transportation bottlenecks. Organizations involved in fertilizer distribution are heavily engaged in promoting fertilizer through research and technical assistance via direct contact with farmers. Thus, in the early stages the monetary and physical inputs have been available for the development of Taiwan's fertilizer marketing system. The principle of fertilizer in the right place, at the right time, and at a price the farmer can afford has apparently been successfully applied in Taiwan.

REFERENCES

1. Chang, Te Tsui, Professor, Director of the Research Project. "Long-Term Projections of Supply, Demand and Trade for Selected Agricultural Products in Taiwan," The Research Institute of Agricultural Economics College of Agriculture, National Taiwan University, Taipei, Republic of China, October 1970.
2. Christensen, Raymond P. Economic Research Service, U.S. Department of Agriculture. "Taiwan's Agricultural Development, Its Relevance for Developing Countries Today." Foreign Agricultural Economic Report No. 39, April 1968.
3. Cummings, Ralph W., and Ralph N. Gleason. "The Role of Fertilizer in Agricultural Development." IN *Fertilizer Technology & Use*, Second Edition, Soil Science Society of America, Inc., 677 South Segoe Road, Madison, Wisconsin 53711.
4. Economic Research Service U.S. Department of Agriculture. "Economic Progress of Agriculture in

Developing Nations 1950-68," Foreign Agricultural Economic Report No. 59, May 1970.

5. Annual Fertilizer Review 1971. Food and Agriculture Organization, Rome, Italy.
6. "A Brief Introduction of the Business of Fertilizer Sales & Transportation Department." Taiwan Provincial Food Bureau, the Republic of China, October 1970.
7. Kao, Y. H., Dr. "Agriculture Planning and Fertilizer Distribution In Taiwan," Rural Economics Division,

JCRR, 1972.

8. Mao, Y. K., Dr. *A Study on Taiwan Food Administration*, Department of Agricultural Economics, National Taiwan University, 1971.
9. Yu, Y. H., Dr. *The Demand for Fertilizer in Taiwan's Rice Production*. Department of Agricultural Economics, Chung Hsing University. 1971.
10. Hsung, M. H., Professor. *Some Discussion on the Exchange Rate Between Rice and Fertilizer*. The Institute of Economics, Academia Sinica, 1971.

Table A-2. Fertilizer consumption by major crop, Taiwan, 1969.

Crop	Sown land area (ha)	Fertilized area ^a (ha)		Fertilizer consumption by crop (N-P-K)		
			(%)			
Rice	786,592	631,342	(79.00)	90,482	17,488	20,679
Miscellaneous crops	817,566	144,395	(17.70)	21,664	11,380	22,914
Sugarcane	90,797	90,797	(100.00)	25,420	3,080	6,000
Others	26,345	2,117	(8.00)	39,893	8,278	10,379
Total	1,721,300	868,651	(50.50)	177,459	40,226	59,972

^aAccording to fertilizer allocation.

() = % of sown land fertilized.

Source: Taiwan Fertilizer Company

Table A-3. Import of chemical fertilizers to Taiwan, the Republic of China.

Calendar year	Ammonium sulfate	Ammonium phosphate	Ammoniated superphosphate	Calcium superphosphate	Triple superphosphate	Potassium sulfate	Potassium chloride	Potassium chloride	Others	Total
							(50% K ₂ O)	(60% K ₂ O)		
<i>metric tons</i>										
1947	31,177	29,072		15,870	9,528					85,647
1948	37,402	9,002								46,404
1949	66,330	17,896							2	84,228
1950	219,568	23,334	15,498				4,984		8	263,392
1951	156,497	14,734					22,813	4,663	1	198,708
1952	200,689	5,538	40,576	39,986		3,425	26,478		98	316,790
1953	154,662			64,752		2,434	47,995		680	270,523
1954	297,944	9,963		24,996		1,182	9,884			343,969
1955	312,934	31,079		41,807		2,589	17,337		21	405,769
1956	361,746			57,020		3,180	15,143	16,635	35	453,759
1957	352,419	14,995		50,000		3,500		38,189		459,103
1958	296,468	14,992		55,000		2,600		47,377		416,437
1959	303,938	25,650		40,002		2,800		47,608		419,998
1960	315,989	20,637		15,000		6,497		50,678		408,710
1961	342,562	20,004				5,250		53,492		421,308
1962	272,955	7,882				4,200		43,849	224	329,110
1963	299,975	9,667				6,097		48,415		364,154
1964		9,926				5,997		60,688		76,611
1965	300,000					5,950		69,778		375,728
1966	300,000					11,093		75,524		386,617
1967						3,500		90,934		94,434
1968	303,687					7,000		106,318		417,005
1969						14,000		112,000		126,000

Source: Taiwan Fertilizer Company

Table A-4. Taiwan fertilizer consumption, 1961-71.

Types of fertilizers	Fertilizer consumption in mt of nutrients							
	1961-66 ^a	1964-65	1965-66	1966-67	1967-68	1968-69	1969-70	1970-71
Total N	127,000	138,900	146,500	159,800	161,100	170,100	165,100	154,000
Total P ₂ O ₅	32,000	36,700	37,400	37,600	38,200	40,200	41,000	42,500
Total K ₂ O	37,000	36,200	46,300	52,000	57,000	63,500	62,000	60,100

^aAverage 1961-62 - 1965-66.

Source: Annual Fertilizer Review, FAO, 1970

Table A-5. Export of chemical fertilizers
from Taiwan, the Republic of China.

Calendar year	Country	Calcium cyanamide	Urea	Compound fertilizer
<i>metric tons</i>				
1960	Japan	20,000		
1961	Japan	15,200		
1962	Ryukyu	40		
	Republic of Korea		15,000	
	Vietnam		1,999	
1963	Ryukyu	95		
	Vietnam		18,000	
1964	Ryukyu	30		
	Republic of Korea	10,950		
	Vietnam		9,000	
1965	North Borneo	1	1	
	Philippines		5	
	Vietnam		31,692	
1966	Vietnam		36,300	
1967	Vietnam		49,548	
	Indonesia		16,963	
	India		16,677	
	Thailand		300	100
1968	Vietnam		47,250	
	Hongkong			20
	Thailand			100
1969	Vietnam		10,553	
	Indonesia		2,000	
	Hongkong			153
1970	Vietnam		93,053	
	Hongkong		110	
	Singapore			40
	Hongkong			24
Total		46,316	348,451	437

Source: Taiwan Fertilizer Company

Table A-6. Technical services provided to farmers by relevant organizations.

Services	TFB	TFC	TSC	TTC	IPC	TWM	FA	JCRB	Provincial Govt.
1. Conducts training classes:									
a. Sales	xx	xxx					xx		
b. Fertilizer application for farmers	xxx	xxx	xxx	xxx	x/xx	xxx	xxx	xx	xx
2. Fertilizer demonstration farms	xxx	xxx	xx	xx	xx	xx	xx	xx	xx
3. Hold field days	xx	x	x	x	x	x	x	x	x
4. Individual contact with farmers	xx	xx	x	x	x	x	xxx	x	xx
5. Village meetings	x	x	x	x	x	x	x	x	x
6. Communication publicity	x	xx	x	x	x	x	x	x	x
a. Radio and speakers	x	x	x	x	x	x	x	x	x
b. Movies and slides	x	x	x	x	x	x	x	x	x
c. Fertilizer publications	x	x	x	x	x	x	x	xx	xx
7. Conducts research	x	x	x	x	x	xx		xxx	xxx

xxx = very intensive

xx = intensive

x = not so intensive

TFB = Taiwan Provincial Food Bureau

TFC = Taiwan Fertilizer Company

TSC = Taiwan Sugar Corporation

TTC = Taiwan Tea Corporation

IPC = Taiwan Pineapple Corporation

TWM = Tobacco and Wine Monopoly

FA = Farmer Associations

JCRB = Joint Commission for Rural Reconstruction

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