CHAPTER IV STORAGE FACILITIES OF AGRICULTURAL PRODUCTS

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4-1 History of Storage

The followings are a brief history of the development of the storage facilities for agricultural products, with an emphasis on rice.

4-1-1 Storage Facilities During Canal Transportation

The Thai rice exports became active in the 1880s when approximately 200,000 tons of milled rice was exported to Singapore and Hong Kong markets. The exported rice was produced primarily in the Central Plain. Steam-powered rice mills were built along rivers and canals in the Central Plain, particularly in the Chao Phraya river flowing through Bangkok. Storage facilities were built adjacent to rice mills to conveniently receive paddy and ship the milled rice. Most storage facilities were built of wood, had low ceilings and no floors.

4-1-2 Storage Facilities During Railway Development

Since the turn of the century, railways have been constructed in the North and Northeast regions of Thailand. As railways developed, rice mills appeared in various rice-producing regions in the North and Northeast in addition to the Central Plain. In 1930, statistics indicate, that the paddy amounted to 1.2 million tons from the Central Plain, 500,000 tons from the Northeastern region and 150,000 tons from the Northern region were all transported to Bangkok.

In this period, most storage facilities were built as annexes to the rice mills along the water channels in the Central Plain or near the railway stations in the North and Northeastern regions. These were primarily wooden structures with the capacities to hold approximately 500 tons of paddy.

Bangkok, then the center of trade with rivers, canals and railways, had warehouses for storing paddy, milled rice and other agricultural products with a total capacity of approximately 400,000 tons.

4-1-3 Storage Facilities During Road Construction

Several agricultural products in Thailand recorded rapid production increases for export to foreign markets. As examples, the maize production increased in the 1960s, sugar cane in the 1970s and cassava in the 1980s. While paddy and milled rice could be transported by rivers, canals or railways from the producing regions to Bangkok, upland crops such as maize, cassava and raw sugar had to be transported by land. Extensive road construction in Thailand from the 1960s stimulated the production of these products.

These upland crops are handled and stored in bulk from harvest to export shipment. This requires facilities such as driers for maize, pellet processing facilities for cassava, sugar extraction and refinery facilities for sugar cane. Therefore, the storage facilities for these products completely differ from those for rice in both the processing and handling areas. As to the facilities for other products, emphasis is placed on processing and handling functions rather than storage.

Private enterprises are eager to build larger facilities to meet the increasing production and to reduce processing and handling costs. In recent years, road improvements and the increasing number of trucks have contributed to rapid domestic transportation and reduced transportation costs. The use of trucks has become more common than that of canal, river and railway recently.

4-2 Warehouses of Major Agricultural Products

The existing marketing conditions and storage problems of individual products: rice, maize, cassava and other agricultural products are described in this chapter.

4-2-1 Rice

1) Storage by farmers

After harvest, rice is stored by farmers in the form of paddy for their own consumption and seeding.

Farmers have to store paddy until it is taken by middlemen. Most farmers store it under the floor or in other sections of their dwellings.

Specific data is not available so far, to assess the amount of paddy possessed by farmers. However, the average annual amount of paddy retained by farmers for their consumption as food, seed, sweets and feed can be estimated as follows:

Amount of paddy retained per farmer ..... 280 kg (seed included)
Number of farmer households 4,500,000
Number of household members 6
The amount of paddy stored is estimated as
280 kg x 4,500,000 x 6 = 7,560,000 tons

According to the Survey on Post-harvest Practices in Thailand conducted by the Ministry of Agriculture and Cooperatives, the followings are the percentages of paddy sold immediately after harvest.

Northern area:	42%	
Northeastern area:	57.7%	
Central area:	in the rainy season:	67.25%
	in the dry season:	31.44%

Farmers are assumed to retain about 7.5 million tons of paddy for their own consumption and seeding out of the 17.5 million tons harvested throughout the entire country. They sell 7 million tons immediately after harvest and gradually sell about 3 million tons within 3 to 4 months after harvest.

If farmers were able to store their products, they could sell at a time when prices were more favorable. Farm storage facilities could help boost up prices.

2) Storage by middlemen

The role of the middlemen in purchasing paddy from farmers and selling it to rice mills is a major feature in the marketing of rice in Thailand. Many middlemen are local merchants or own grocery stores in towns or

villages. A middleman often possesses several tons of paddy in anticipation of price increases during the off-season. It is assumed that the amount of paddy possessed by middlemen is at the most 10% of all marketable paddy. Thus approximately 1 million tons of paddy is stored by middlemen throughout the country. This stock of paddy is piled in coarse and defective storage places together with other commodities.

3) Storage by millers

Rice millers possess the largest capacity in the rice producing area in terms of paddy/rice stockpiles. Since rice milling is a simple processing industry, the returns from processing is rather small in general. If a rice miller wants to make profits, he must purchase paddy at a lower price and sell his milled rice at a higher price by watching the market situation. Consequently, he needs to have his own rice storage facilities nearby his rice mill to hold his paddy and/or milled rice.

According to a survey on warehouse, godown and silo distribution nationwide conducted by the Bank of Thailand, the total capacity of storage of millers is 3,926,797 tons in terms of paddy. Although they have the largest capacity, storages in this level are simply places to pile paddy and milled rice. In most warehouses technical requirements for storing paddy and milled rice are not met, and the necessary storage control is not properly provided.

The average number of days for rice milling is 170. Although there are differences depending on the mill size, the peak mill operation season usually comes within 3 to 4 months of harvest. After the peak, mill operation mostly depends on the demand for milled rice for export.

The stockpiling of milled rice increases when the milled rice exports decrease. The storage capacity of Bangkok warehouses is limited. Therefore, a substantial volume of milled rice must be stored for a long period of time in the warehouses in the producing regions under unfavorable storage environments and control.

Inadequacy of most existing warehouses in resisting heat and humidity under the tropical conditions and their poor management cause rapid deterioration and damage of the stored rice. This deterioration is largely due to the propagation of harmful insects. The longer the milled rice is stored the greater its loss and waste become.

4) Farmers' cooperatives paddy storage

Farmers' cooperatives are not yet operating at maximum efficiency in this country. According to the Cooperative Promotion Department, the Ministry of Agriculture and Cooperatives, the capacity of warehouses owned by the cooperatives was merely 251,065 tons with 510 units in 1981.

These warehouses were managed and operated by 358 farmers' cooperatives throughout the country. Most of these were built for storing paddy with a 500-ton capacity under BAAC's long-term credits since 1977.

Although 37 of the above 358 farmers' cooperatives have rice mills with total capacities of 1,528 tons per day, most of the others provided merely storage spaces for farmers and are not properly equipped with post-harvest facilities such as dryers, cleaners and grading machines. As a result, these warehouses were not utilized by farmers at maximum efficiency.

5) Rice storage in Bangkok

According to a survey by Bank of Thailand, the total capacity of warehouses for rice storage in Bangkok was 826,732 tons in 1979. Of this, space for about 600,000 tons is used for handling of overseas shipments. There are two types of warehouses: old warehouses, called "godowns", belonging to ex-rice mills, most of which have moved to rice-producing areas and are located mostly in Satupradit and Rasburna, and the others are relatively new warehouses constructed in Prapradaeng by rice exporters to facilitate rice leading at their annexed. These warehouses provide space and functions for receiving milled rice from producing areas, and mixing in accordance with the export standards and, then loading it for export.

The warehousing operations are done generally by manual labor. For example, the grading of milled rice to export standards depends primarily on manual operation which is an outdated system.

As most of the rice mills were moved to the producing regions, rice sent to Bangkok has come to include the deteriorating or damaged ones. Such deteriorated milled rice must be regraded and sometimes milled again at the port godowns before shipping to domestic or foreign markets. Losses that occur in the remilling process are observed between 4 to 8%.

4-2-2 Maize

Maize, one of the major exporting agricultural products in Thailand, exceeded the 3 million ton level in 1982/83. The export volume reached 2,550,000 tons in 1981.

Before pier silos with drying facilities were built in and around Bangkok, maize was stored in bags in warehouses. The cutting bag system was adopted for maize exports.

For the first time in Thailand, a bulk handling silo was built in 1964 and since then, the number has increased steadily. Today bulk loading facilities for maize are operated in eight locations with a total capacity of about 600,000 tons in Bangkok Port.

Tarua Port has recently been developed as the center of collection and shipment with a total of about 400,000 tons in maize silos is located 85 km up the Chao Phraya River from Bangkok. In recent years, the amount of maize handled by these silos has been increasing sharply as following table shows:

Maize Export Ratio in Various Locations

	1977/78	1979/80	1980/81	1981/82
Bangkok Silos	67.0%	74.8%	58.0%	49.5%
Bangkok Warehouses	22.8%	8.5%	15.5%	7.5%
Tarua Silos	10.2%	16.7%	26.5%	43.0%

Maize silos are designed to handle large volume of bulk goods economically, and equipped with drying facilities. Silo's functions are different from those of the storage facilities for paddy and milled rice from a technical viewpoint.

After harvest, a large amount of non-dried maize is transported by trucks and barges from the producing areas to the silos. The progress of transportation by trucks now makes it possible to transport quickly from the producing regions directly to the port silos in and around Bangkok.

There are several problems with the maize storage facilities.

1) Most maize is sold by farmers mostly to middlemen immediately after the harvest. Middlemen deliver the maize as soon as possible to a silo equipped with drying facilities. Non-dried maize is likely to deteriorate. As it is harvested during the rainy season, maize is often exposed to rain while being dried. Fungus which produces mycotoxin, particularly afratoxin, tends to propagate rapidly under these conditions.

2) Six 2,000 M/T silos are owned by the Marketing Organization for Farmers. They are mostly located in the Central Region, the major maize-producing area. These silos have been used for maize collecting and drying. Today they are operated by the agricultural cooperatives and private companies instead of MOF and are used to raise chickens and ducks.

3) Maize production has increased to meet the growing demand in foreign countries. Recently, however, many countries have imposed severe restrictions on quality, particularly on the infestation of mycotoxin. It is difficult to maintain the existing markets and to develop new foreign markets until this problem is solved.

4) There are 16 port silos in and around Bangkok and Tarua that are operated by private companies. The total capacity of the silos is over one million tons. The present capacity of existing silos is considered sufficient to meet the demand from foreign countries. Therefore, it probably does not need any further expansion, unless there is a rapid increase in production in future.

4-2-3 Cassava Pellets

Cassava pellet exports from Thailand have increased at a remarkable pace, and this is accompanied by changes in the processing and storage systems.

Before 1970, cassava pellets had been shipped by about 20,000 DWT vessels. The vessels took a portion of the cargo from the Chao Phraya river around Bangkok Port and the remainder at Kohsichang. At that time the pellets were handled mostly in bags, and were loaded into the vessels using the cutting bag system.

Cassava pellet exports exceeded 3 million tons around 1975 and vessels over 50,000 DWT were chartered to carry the pellets to mainly EC countries. Most shipments were done at Kohsichang and large warehouses for bulk handling of the pellets appeared at Bangprakong, Bansen and Sriracha.

In 1978, a floating transshipment station was built by European traders with the participation of Thai enterprises. Most chartered vessels exceeded 100,000 DWT and shipping required faster operations. The size of facilities handling cassava products is much larger than those for other agricultural products.

The following problems exist with storage facilities for cassava products.

1) Most cassava products in Thailand are exported to foreign countries as starch feed in the form of pellets, and domestic consumption is limited. Cassava is harvested as roots, processed into chips by slicing and drying, and processed into pellets. Storage facilities are required for the large amount of chips and pellets. In 1970's, there used to be small chip and pellet factories that produce cassava products for export. Recently, however, huge factories have be constructed that can process chips and pellets systematically and at reduced costs.

2) Cassava pellets produced in Thailand are exported to EC countries where the import tariff is low. EC import tariffs would have a significant impact on exports of cassava pellets from Thailand.

3) Quality improvement is an important factor for the development of foreign markets. The reduction of foreign materials (particularly sand) and fibers (from the root skin, etc.), the presence of which is often a source of complaint by foreign buyers, would upgrade the

feed efficiency of cassava pellets and increase the possibility of its use as a material for alcohol and other purposes. This is one important topic for the export promotion of Thailand's agricultural products.

4) Storage facilities for cassava products cannot be operated effectively unless they are supported systematically by processing facilities for chip and pellet. The storage function should not be separated from the functions of transportation, processing and shipping of cassava pellet.

Cassava pellet exports amounted to over 7 million tons in 1983, and many modern large facilities for processing, storing and transporting as well as shipping to vessels or barges were built in the prefectures of Chonburi, Ayutthaya.

4-2-4 Storage of Other Agricultural Products

There are a variety of other agricultural products in Thailand, including sorghum, mung beans, peanuts, kenaf, jute, coffee and cocoa.

The production volume of these products is rather limited, and as no significant problems occur in their marketing, no detailed description will be given here.

4-3 Brief Description of Privately Owned Warehouses

Storage is required at each phase of the production and consumption, particularly in the marketing. In Thailand, storage of agricultural products has not yet matured as an independent service division, for the following reasons.

1) For the product control it is advantageous to have a warehouse in the proximity of the factory when the transportation infrastructures is inadequate.

2) Agricultural product prices are generally low and these commodities do not permit storage to become an independent economic service.

3) The merits of mechanized systems inherent in a modern warehouse do not necessarily lead to lower labor costs.

4) Capital investment has focused on processing facilities, but warehouses are usually deemed non-production facilities.

5) There is no guarantee against the deterioration of quality, especially in the high temperature and humidity of a harsh tropical environment. Warehouses are also vulnerable to insect damage, and for this reason traders deter to pay expensive storage fees.

Recently, however, activities in the warehousing business by the private sector appeared to meet the requirements of industrial development. For agricultural products, the team observed such warehousing activities only in the trade of cassava pellets.

4-4 Existing Storage Facilities

The Bank of Thailand made a detailed survey on regional storage facilities for agricultural products in cooperation with the Board of Investment in 1978 and 1979. According to the data, the total storage capacity for agricultural products in such facilities as barns, godowns, warehouses and silos in all provinces was 14,456,286 metric tons, and can be regionally summarized as follows:

Unit: metric tons

Region	Public Sector	Private Sector	Total
Central	193,120	8,637,227	8,830,347
North	89,400	1,215,121	1,304,521
Northeast	161,243	4,087,737	4,248,980
South	-	72,438	72,438
Total	443,763	14,012,523	14,456,286

The above figures indicate that the total storage capacity of the existing barns, godowns, warehouses and silos is about 37% of the annual gross production of the main agricultural products, such as rice, maize, kenaf and cassava which have a total annual production of 39,469,000 metric tons.

Most of the existing storage facilities belong to the private sector. Only 3% of the total storage capacity belongs to public agencies such as cooperatives, PWO, MOF and other governmental agencies. The Government still lacks storage facilities as an instrument for use in the market intervention to enable farmers to sell their products at fair prices. In the past, the PWO had to rent warehouses from private sectors for storing agricultural products during the market intervention programs. This did not stimulate the private sector to buy agricultural products during the same period because of the lack of storage which had already been rented to the PWO.

Almost all warehouses listed above are substandard. Originally they were built for storing paddy or kenaf and the quality of the buildings is poor. These substandard warehouses do not fit to store milled rice for longer periods under the severe conditions of the tropics. Moreover, the lack of proper quality control has resulted in a drop in both the quality and the price of stored rice.

Details of the above are mentioned by each classification of ownership, region and commodity in the Appendix K.

In 1982, the PWO owned warehouses in Bangkok and other regions with a total capacity of 124,713 metric tons. However, in order to meet the target capacity the PWO had to rent additional warehouses with a total capacity of 1,629,753 metric tons. Therefore, the PWO depended on rented warehouses for 92.89% of its total space requirements. Details of warehouse capacity operated by the PWO are shown in the following table.

Warehouse Locations	Warehouse Capacity (metric tons)		
	PWO owned Warehouses	Rented Warehouses	Total
Bangkok area	78,200	399,092	477,292
Northern Region	3,250	178,132	181,382
Northeastern Region	42,763	559,226	601,989
Central Plains Region	500	444,303	444,803
Southern Region	-	49,000	49,000
Total	124,713	1,629,753	1,754,466

The PWO have its own warehouses with a total capacity of 160,540 metric tons in Bangkok and other regions in 1984 as follow:

Bangkok area	
Bukkalo	51,270*
Rajburana	58,450*
Bangkrasor	21,670
	131,390
Other regions	
Saraburi	750
Nakhon Ratchasima	10,000*
(Bua Yai)	3,400
Khon Kaen	10,000*
(Ban Pai)	2,500
Sukhhothai	3,250
	29,900

* being suitable for storing milled rice

Out of the total 161,290 tons capacity of the PWO owned existing warehouses, warehouses located Bukkalo, Rajburana, Bua Yai and Ban Pai with total capacity of about 129,720 are regarded to be suitable for storing milled rice.

4-5 Actual Situation of Rice Storage

4-5-1 Actual Situation of Storage

1) Significance of storage

The main purposes for storing rice in the temperate zones such as in the U.S. and Japan are to maintain their viability of dormant seed and prevent their quantitative and qualitative losses like deterioration under the appropriate temperature and humidity conditions. Keeping the freshness and viability of rice is the most important factor of storage in Japan, where the fresh taste of rice is preferred. However, it is doubtful whether maintenance of viability is the most important factor in storing rice, except that for seed, in the Southeast Asian countries where the taste of the old rice is preferred.

In the Southeast Asian countries, a primary objective in storing rice is to prevent damage and losses under the tropical conditions with year-round high temperature, and high humidity in the rainy season. This is a fact in Southeast Asian countries, and Thailand is no exception. It is necessary, however, for Thailand to prepare fresh milled rice that some countries require to import.

2) Paddy storage

Generally, paddy is stored in bulk in the rice producing areas of Thailand. It is originated from a traditional practice that rice is handled in bulk from the farmers' sales (though sold by volume before,) through milling stage. Paddy is stored primarily in local warehouses annexed to rice mills. In addition to that, the second middle men store paddy in agricultural products warehouses in the dealing process. The way in which paddy is stored in these warehouses is outdated.

A number of small mounds of paddy are made, moved as required for aeration and provided quality control in the warehouse. The interior of the warehouse looks too spacious, but it is designed to allow movements of the mounds and provide insulation for radiant heat from the roof.

The small mounds are usually detached from the side wall and separated from each other by bagged paddy or bamboo mats to protect the side walls from the horizontal pressure of paddy.

3) Milled rice storage

Milled rice, unlike paddy, is always kept in bags. Storage of milled rice takes place in the course of distribution after the milling process, mainly in the warehouses on wharves.

Rice exporters' warehouses on the wharves are generally not in good condition. These warehouses have the function and sometimes the building itself of the former raw material warehouses located next to the rice mills.

It is as if milled rice is stored in warehouses for paddy. These warehouses' function are like that of cargo handling and processing facilities rather than storage facilities. The storage period of milled rice in these warehouses is limited.

As a rule, rice is milled to meet the demand. It might be unavoidably stored for a long time if the actual runs counter to the projection or the selling price sharply declines contrary to the expectation. It is known from experiences that rice should not to store longer than three months so that it may preserve better quality.

It is said that there used to be substantial stock of milled rice and a large volume of paddy in and around the port of Bangkok in earlier times when many rice mills were in operation. However, this should be attributed in part to the slow physical distribution rate in those times.

At the time when Japan imported milled rice from Thailand, only rice with period less than 40 days after milling is permitted for shipment. This is caused on such reason as a shorter storage period results in less development of micro-organism.

Apart from technical discussions concerning the propriety of milled rice storage, there are some other factors calling for milled rice storage in Thailand. These are as follows:

a) In the international markets, an efficient delivery system which supports prompt actions to meet the customers' timetables increases competitiveness of the products. This is true for rice exporters at the private level and for the Thai Government who export rice at the national level.

b) As the domestic market price of paddy increases with the conclusion of export contracts, it is necessary for rice exporters to prepare a substantial volume of milled rice in advance to secure profitable sales.

4-5-2 Storage Losses

1) Factors of losses

There are a variety of factors that cause losses during storage. Among these are environmental conditions such as physical factors (temperature; humidity), chemical factors (moisture content; enzyme action; oxidization), physiological factors (respiration; heating) and biological factors (insects; microorganisms; rats; birds). There are also material conditions such as soundness of rice kernel at the initial storage stage, material form (panicle reaped paddy; threshed paddy; brown rice; milled rice), extent of processing (raw or parboiled, bran attached to milled rice).

Rice storage is affected by combination of these factors, any of which may result in the deterioration of the quality or a reduction in the quantity. Insects and microorganisms cause losses in both the quality and the quantity. Moisture content and temperature are the most important of all the factors mentioned above.

i) Moisture content of rice

Rice with a low moisture content can remain sound for a long period of storage even though other storage condition are inadequate. Humidity of the tropical area during rainy seasons is another important factor. Humidity is correlated to the moisture content of rice by the natural equilibrium.

The moisture is constantly exchanged between the storing rice and the surrounding air by absorption and desorption. This exchange maintains the equibrium between rice kernel moisture content and humidity in the air. Refer to Fig. IV-1 and Table IV-1.

It is difficult to estimate the safety limit of moisture content of rice for storage, but should be kept below 14% to prevent the propagation of microorganism.

Moisture content of Thai rice when shipping is comparatively stable through out the year as shown in Table IV-2.

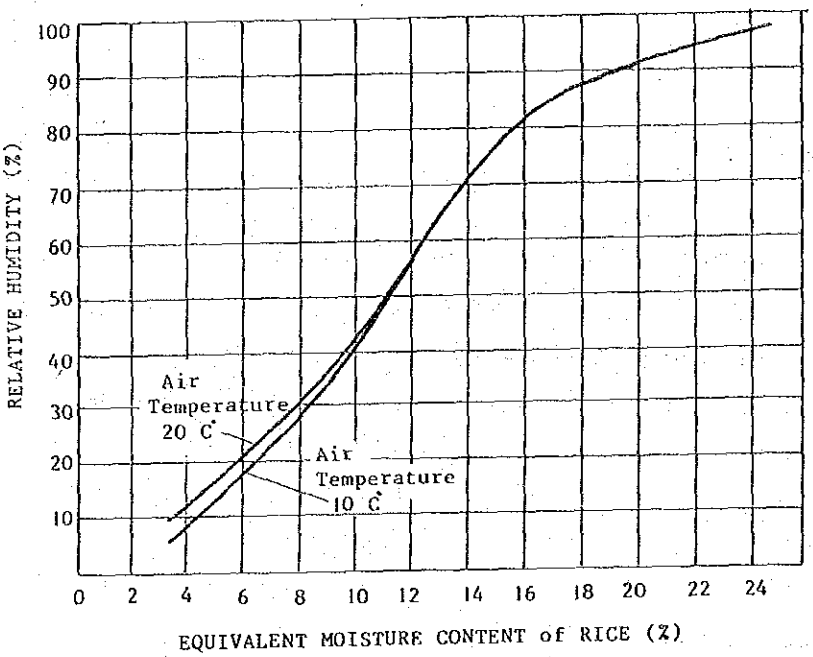


Fig. IV-1 Relative Humidity and Equivalent Moisture Content of Rice

Table IV-1 The Relation Between Relative Humidity and Moisture Content of Rice

30 °C		20 °C		10 °C	
Relative Humidity (%)	Moisture Content (%)	Relative Humidity (%)	Moisture Content (%)	Relative Humidity (%)	Moisture Content (%)
97.30	24.33	97.54	24.45	97.74	24.55
94.98	22.43	95.01	22.36	95.02	22.42
92.12	20.32	-	-	-	-
87.91	18.09	87.88	18.08	87.82	18.06
84.92	16.89	85.41	16.72	85.37	16.79
80.98	15.75	-	-	-	-
75.38	14.96	76.04	14.85	76.19	15.00
71.02	14.45	-	-	-	-
66.97	13.87	-	-	-	-
61.14	13.07	61.53	12.78	62.06	12.81
50.70	11.44	-	-	-	-
39.38	9.70	38.42	9.17	38.72	9.78
30.80	6.97	-	-	-	-
10.14	5.15	-	-	-	-
4.67	3.01	4.89	2.93	6.36	3.33

Table IV-2 Monthly Moisture Content of Thai Rice on Export Inspection

(Unit: %)

Kind of rice & year \ Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Ordinary Milled Rice												
1983	-	13.3	13.2	13.3	13.2	13.6	-	13.6	13.5	13.4	13.3	13.3
		(13.1-13.6)	(12.7-13.5)	(13.0-13.6)	(12.7-13.7)	(13.4-13.8)		(13.0-14.2)	(13.0-14.1)	(12.9-14.0)	(12.9-13.9)	(13.0-13.9)
1984	13.3	13.5	13.2	13.2	13.2	-	-	-	-	-	-	-
	(12.5-13.9)	(12.7-13.9)	(12.7-13.6)	(12.8-13.6)	(12.7-13.5)							
Parboiled Milled Rice												
1983	12.7	-	-	-	-	-	-	-	12.9	12.9	12.9	12.6
	(12.4-13.0)								(12.8-13.0)	(12.7-13.1)	(12.5-13.3)	(12.4-13.1)
1984	12.8	12.7	12.8	-	-	-	-	-	-	-	-	-
	(12.6-13.1)	(12.5-13.2)	(12.5-13.0)									

Source: OMIC Bangkok Branch

It should be less than 14% according to the export standard of Thai rice, but actually some rice comes to exceed the standard especially in the rainy season. The moisture content close 14% is not safe for a long term storage of rice. And parboiled rice has the moisture content of nearly 12%. This means not only parboiled rice has a stabilized fat content, but also it can be kept longer than the ordinary rice, due to its low moisture content.

ii) Temperature

Temperature is another important factor in the rice storage. It can affect the relative humidity which equilibrates the rice kernel moisture content to a certain extent. Low temperatures are favorable to the storage of rice, and the tropical temperature of Thailand is disadvantageous. Such high temperature encourage the respiration of rice and the action of enzyme or parasite microorganisms. The temperature of rice is affected primarily by the temperature of the air but can also be effected by the respiration fever of rice and the organic actions mentioned above.

If the temperature of rice exceeds 20°C, insects and microorganisms begin to propagate, and the rice begins to respire causing consumption to its components. Rice temperature is closely related to its moisture content. Although low temperatures are favorable to the storage of rice, rice with a low moisture content will be sound even under high temperature. It is recommended that the moisture content of rice be maintained at a low level in tropical areas.

Loss of rice during storage in tropical countries has been reported in various ways. In 1977, FAO reported on the storage loss in Thailand of 3.0-7.0% including on-farm store. It is difficult to compare simply with the loss rates each other because the methodology of loss assessment has not established and standardized yet. Quantitative losses of rice in developing countries is generally caused by rats, birds and insects in descending order. However, field surveys this time indicate that this order should be reversed. An extensive study should be made on this problem.

2) Losses caused by rats and birds

It is said that one rat consume approximately 9 kg of grain per year. It's rare, though, to recognize rats in warehouses in Thailand. As warehouses are usually with many openings, rats can easily enter there. It may be difficult to identify influence of rats in this condition. As paddy are normally stored in bulk, it is difficult to identify damage caused by rats, such as bag damage.

As a warehouse is designed to be open to the outside, birds can enter into it primarily from an upper window. The absence of preventive nets allows birds and other small animals to enter through an upper window. Sparrows are frequently seen in warehouses. Losses caused by birds are sometimes estimated to be less than those by rats, but there is no quantitative data available.

Losses caused by birds and rats have been considered negligible and unavoidable in Thailand. As experience tells, these losses are inevitable, however they should be avoided.

3) Insect under grain storage

i) Insect propagation

a) Each insect has its habitation limits under the environmental conditions such as temperature, humidity and grain moisture. In general insects are likely to increase at high temperature and humidity.

b) The presence of much broken rice and other foreign material provides favorable conditions for insects who don't make holes in grain such as almond moth, angoumois grain moth. They grow easily in grains with dust particles, fine broken kernels and mold, rather than in clean grain.

c) It is a rule to store raw materials and finished products separately to prevent losses by insects. Paddy is often stored close to milled rice in the rice mills of Thailand. This allows insects to move from the paddy to the milled rice. The warehouse for paddy should be separated from that for milled rice.

ii) Insects causing losses in Thailand

a) Insect fauna

The amount of insects depends on the meteorological conditions. They tend to actively propagate in the Southern region with high temperature and humidity. They are less in the North-eastern region where the climate is dry, compared with the Southern region.

b) Paddy insects

The angoumois grain moth is an overwhelmingly common insect to damage paddy. Rice weevil and lesser grain borer are also frequently recognized. In Japan, where brown rice is stored, the angoumois grain moth may damage wheat and barley but not rice. However, the angoumois grain moth is the most harmful insect in Thailand, where paddy is stored in bulk. When someone enters the warehouse, many angoumois grain moths will fly up and hit his face.

Few preventive measures against insects are actually taken at the mills storing a quantity of paddy. Probably, the damages caused by insects are considered to be relatively insignificant or to cause no effects on the quality of milled rice because the damaged rice kernels may be crushed away in milling process. The milling yield, however, particularly the ratio of whole grains, will certainly decline.

4) Insect control

Insect control measures currently available for practical use are quite limited. They are chemical products such as fumigants and contact insecticides, or physically keeping the storage temperature at a low level and sealing stored products. And CA (controlled atmosphere) methods to store rice with carbonic acid gas or nitrogen gas and high temperature treatment methods are now being developed.

i) Fumigation

Fumigants have played an important role as a insecticide used inside the warehouses. Although various kinds of fumigant were developed and introduced to the market in the past. The use of fumigants, except for methyl bromide and aluminium phosphide (phostoxin), has been gradually decreasing.

Chemical compounds used as fumigants are poisonous to the human body and their applications have been restricted because of the residual toxicity and the resulting air pollution. Moreover, it is reported some species of insects have become resistant to methyl bromide and aluminium phosphide. Residue of EDB used as a wheat fumigation insecticide has caused a problem in the U.S.A. recently.

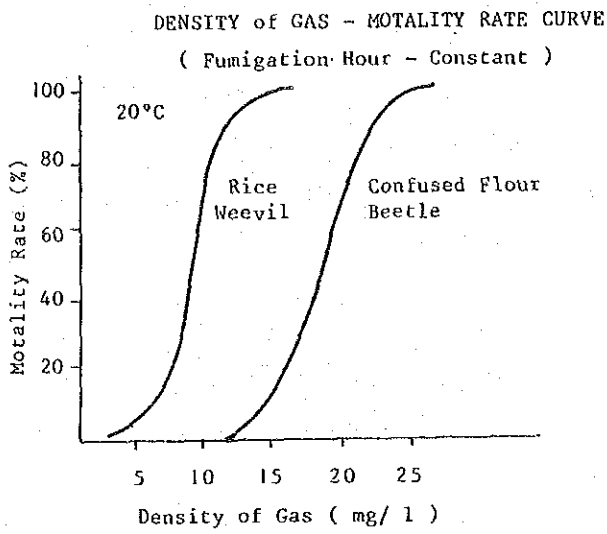
The following relationship is observed regarding fumigants. Refer to Fig. IV-2, as well.

Effect of fumigation = density of gas x fumigation time

Consequently, the emergence of fumigant-resistant insects may bring about a greater risk of residual toxics and air pollution caused by the fumigants, and ultimately even suspension of use.

In Japan, the current regulation of the Food Agency specifies that the warehouses to be designated by the Agency should be suitable for fumigation. Such designations remain effective for three years for concrete-built or steel-built warehouses, and one year for other warehouses. Gas detection devices are used to measure the density of gas, and smoke candle tests are conducted to check the degree of airtightness in the warehouses.

Methyl bromide is most commonly used is Thailand. Phostoxin is rarely used in Thailand, but is used extensively in the U.S.A. and Japan. Increase of insects is basically caused by late-timed fumigations, calling for the use of an instant and strong insecticides



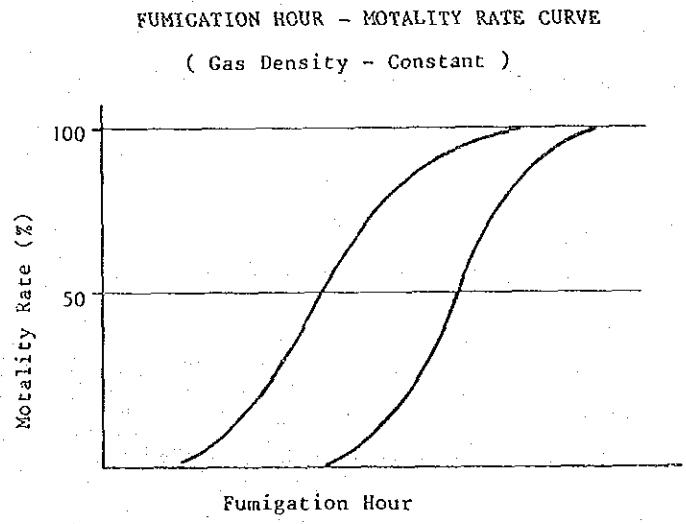


Fig. IV-2 The Relation Between Effect of Fumigation and Density of Gas & Fumigation Time

like methyl bromide. It is necessary to fumigate early enough in accordance with the mode of insect life to minimize residual toxity of fumigant.

In Thailand, air-tight warehouses suitable for fumigation is not common. Fumigation is done using a tent. Although this method has several advantages, insects outside the tent may survive and cause damage.

In Japan, fumigation, by agricultural chemicals is carried out for old crop once a year immediately after the rainy season. The purpose is to control rice weevil and other insects. These chemicals are methyl bromide, synthetic chemical of methyl bromide and ethyl oxide and aluminium phosphide.

Noxious substances of the fumigant gradually evaporate into the air after fumigation. However, the average fumigation interval is 2 to 3 months in Thailand, where insects propagate continuously. And noxious substance residues tend to increase cummulatively. A long-range plan for controlling insects should be set up because this issue could develope into a controversy, like maize afratoxin case, which would affect the evaluation and, eventually, export of Thai rice.

ii) Contact insecticides

Because contact insecticides work through a direct contact with the insects, they have to be applied uniformly and directly to cover the grain surface. The use of such agricultural chemicals is not suitable for general food.

However, a method to apply agricultural chemicals directly to paddy namely to the rice husk may be adopted in Thailand, where the storage of rice is primarily in bulk paddy. This is an effective

method that can be readily adopted in Thailand. Applying low-toxic and low-residual powder insecticides such as pyrethrin and malathion over paddy immediately after harvest would be effective enough to completely prevent damage caused by the angoumois grain moth. However, problem of residual toxicity should be considered carefully for the extension of toxic chemicals including contact insecticide.

iii) Sealed storage

Sealed storage is a traditional method of grain storage in the dry areas. A facility for sealed storage is built using concrete or steel. It is built underground with a low density of oxygen, and is provided with airtight and water-proof treatments. Insects can be killed in two weeks when the oxygen density becomes below 2%. However, they would still damage the rice during this two weeks. Grain with a high moisture content (more than 15%) is vulnerable to anaerobic fermentation. It is difficult to build underground sealed storage facilities in the lowlands like the central plain of Thailand.

iv) Refrigerated storage

Many insects grow and propagate actively in a temperature range from 25° to 35°C. They tend to be less active when the temperature drops low. They can therefore be controlled by maintaining the storage temperatuer at a low level. However, this would involve high costs related to the construction of insulated structures, refrigerator and an electricity to be consumed for the operation.

There are refrigerated warehouses with two temperature levels in Japan, one is refrigerated of "less than 15°C" and one is semi-refrigerated of "less than 20°C. While the temperature in Japan stays below 15°C for about six months out of the year under natural conditions, however, a large amount of electric power is required to maintain low temperatures within a warehouse in tropical areas throughout the year. More energy is required particularly in the

initial stage when grain with natural temperature is first brought inside. Moreover, a problem with this system is that the quality of rice may rapidly deteriorate by sweating immediately after it is brought out from the warehouse, because of the tropical temperature. It is therefore not advisable to build a refrigerated warehouse for rice in Thailand. The details about refrigerated warehouse in Japan are explained in Appendix P.

v) CA (Controlled Atmosphere) storage

Nitrogen(N_2) and carbonic acid(CO_2) gases are employed to alter atmospheric conditions to those unfavorable to the propagation of insects inside the warehouse. This can be done without a toxic problem, and is effective for controlling mold and free fatty acids, and reducing the consumption of carbohydrate. However, this method is difficult to apply except in the case of a steel welding silo which has gas-tight efficiency.

vi) High temperature treatment

High temperature will kill insects in a short period of time as shown in Table IV-3. In this method, the flow of grains is stratified and treated with compressed and heated air. Efforts for pratical use are now under way.

Table IV-3 Mortality Hours by High Temperature Treatment Method for Rice Weevil (Sit philus oryzae L.)

(Hrs)

Temp. (°C) / Mortality Percentage	40	43	45	47	50
50%	34.3	15.2	6.7	2.5	0.4
99%	47.1	21.0	10.1	3.4	0.5

Table IV-4 shows an evaluation of several methods described above. Fumigants, currently in extensive use, have a weakpoint in safety, which are however sufficiently made up with relatively low cost and efficiency. However, with the emergence of insects that resist fumigants, the conventional fumigation method shoud be reviewed now.

Possible method for extensive application in the future includes high temperature treatment method.

Table IV-4 Evaluation of Pestcontrol Effect by Methods

Method	Effect	Safety	Cost performance	Convenience of operation
Fumigants	Better	Normal	Higher	Good
Contact Insecticides	Good	Less (except paddy)	High	Normal
Refrigerated Storage	Normal	More	Normal	Normal
Sealed Storage	Normal	Much	Higher	Normal
CA Storage	Normal	Much	Normal	Good
High Temperature Treatment	Better	Much	High	Good

4-6 Actual Situation of Rice Marketing Facilities

4-6-1 Storage Shed for Farmers

Farmers grow, harvest and then sell paddy. Farmers who sell paddy before the harvest don't usually have a storage facility. Current conditions of storage facilities for paddy are described below.

1) North-eastern region

Crop production is unstable in the Northeastern region due to the hard natural conditions. Storage facilities are essential in these areas to meet their unstable rice production. According to a survey, about 92.4% of the farmers in the North-eastern areas own storage facilities. There are two types of storage facilities, "Yoong-Kao" which is a permanent shed, and "Kapong" which is a large container. "Yoong-Kao" is a shed with upheld-floor, 1 to 2 m above the ground. The pillars supporting the floor are made of reinforced concrete, or wood which supports the roof through the floor.

The floors are wooden plates, and the walls are wooden plates, galvanized iron sheet or bamboo wickerwork coated with clay mixing with cattle dung. Farmers say that insects are less likely to propagate in the storage shed for paddy coated with cattle dung, which may act as a repellent to insects. Roofs are made of galvanized iron sheet or thatch, structured in gable roof with wide eaves designed to prevent rain. The entrance is usually situated on the side of a shed, attached by a hinged door or a sliding-plate which is like the stop-plate at the water inlet for a paddy field. A sliding-plate door would be more effective for utilizing space within a shed storing paddy in bulk. A portable ladder is available for climbing from the ground to the upheld-floor. Wire nets may be set in the openings to prevent birds, rats and insects. Husks are scattered on the floor, over which bamboo wicker mats are laid. Paddy is stored on the bamboo mats. Seeds are packed in bags and stored in a corner of shed. The capacity of a shed is about 8 to 15 tons of paddy, which differs depending upon the farming scale. The sheds are built adjacent to the main house for the convenience of surveillance.

A "Kapong" is a large cylindrical bamboo container coated with clay mixing with cattle dung, like a "Yoong-Kao". It is placed on a wooden floor or crushed bamboo wicker coated with cattle dung, over low wooden stands. Paddy is put in from the upper outlet, and is covered by bags or cloth. They are taken out, through the small hole on the lower part of the side wall. The hole is usually pluged up with stopper. A "Kapong" can contain about 2 tons of paddy. It is also often installed under the floor of a upheld-floor house. When put outdoors, it is covered by a simple roof.

While "Yoong-Kao" is owned by relatively wealthy large farmers, "Kapong" is owned by small farmers.

2) Central region

Storage facilities are owned by 52.8% of all the farmers in the Central region of Thailand. They include "Young-Kao", "Kapong", and "Sham" which is a chamber with the wall of knitted split bamboo. "Sham" is either built independently near the house or linked to the house.

It has a crude roof for shunning rain and sunshine, and a floor sufficiently above the ground. The side walls are not made of clay, but of large bamboo sliced or small bamboo crushed, and knitted.

Nearly 50% of the farmers in the Central region do not possess their own facilities for storing paddy. They usually sell all paddy immediately after harvest, and then buy back milled rice for their own consumption.

3) Northern region

88.4% of the farmers in the Northern region of Thailand possess the facilities for storing paddy, mostly "Yoong-Kao" and "Kapong".

4) Southern region

In the Southern region of Thailand, paddy is stored in a partition or container within a house, or in a storage shed built beside a house. The sheds are structured more or less the same as those described above, but palm leaves may be used as roofing material. Some farmers in the Southern region of Thailand still keep the rice panicle picking and store in the form of dried panicles.

4-6-2 Brief Description of Existing Warehouses in Thailand

1) Outline

The warehouses of rice in Thailand may be considered as an specialization of the warehouses of paddy attached to the rice mill. The basic structure of warehouses on the wharf is almost the same as that of regional warehouse. Therefore there is no large structural difference between a warehouse storing paddy in bulk and a warehouse storing milled rice in bags.

Most existing warehouses are not suitable for storing milled rice for a long period of time. The temperature within warehouse becomes rather high. The warehouses have no humidity resistant floor.

Warehouses with upheld-floor are recommended for the control of humidity, heat, rats and insects, but the upheld-floored or multilayered warehouse has disadvantages for the high construction cost.

Some of existing warehouses are designed to adapt to the natural environment, but most have several drawbacks to be amended. While old traditional warehouses were built with more considerations to the climate of Thailand, traditional technique has not been fully incorporated in new warehouses.

For example, some new warehouses with new materials are designed to be semi-closed which may be suitable for the temperate areas but not for the tropical areas. The traditional concept of natural ventilation is forgotten here. If new considerations are added to traditional knowledge, it would be possible to develop a structural mode suitable for warehouses in tropical areas.

It is quite important to keep warehouses and their surroundings clean for the prevention of insect and small animal damage in terms of the warehouse maintenance management. Various problems such as grain spill, dust and dirt accumulation are observed in many warehouses. Much accumulation of them is seen on the flat part of framework holding wall-slate plate, and corners, where difficult to clean. Moreover, a lot of spider web on the steel truss as beams is not only the problems for cleaning but also the problems originated in designing.

Plan of the size of a stack is not reflected in the design of warehouses. The building width and the position of doors of many warehouses are not proper for cargo handling. Design of a warehouse should be affected in compliance with the result of cargo handling analysis.

2) Structure

a) Most of existing warehouses are of common one-storied structure.

b) Traditional warehouses are one-storied upheld-floored, wooden and open type in which air may be ventilated naturally. Wide windows are open on the upper section, not on the lower section.

c) New warehouses are also structured to be open type, but their floors are low as the ground level, reflecting the change in cargo handling low-floor structure enables trucks to come in.

d) Iron frame truss (pillar, beam), concrete block (side wall) and slate plate (roofing) have come to be used as building materials, instead of wood in traditional buildings.

Table IV-5 Tidal Data of Chao Phraya Estuary (1940 - 1983)

LOCATION (Distances)	HYDRO-GRAPHIC DEPT	SATHU PRADIT	BANGKOK PORT (27 km)	PHRA PRADAENG (18 km)	PAK NAM (7 km)	FORT PHRACHUL (1 km)	BANGKOK BAR (0 km)
HIGHEST HIGH WATER	+ 2.42	+ 2.01 (1983)	+ 2.10 (1983)	+ 2.06 (1983)	+ 2.10 (1983)	+ 2.23 (1983)	+ 2.28 (1970)
MEAN HIGH WATER SPRING			+ 1.28	+ 1.31	+ 1.35	+ 1.39	+ 1.41
MEAN HIGHER HIGH WATER			+ 1.11	+ 1.10	+ 1.10	+ 1.16	+ 1.18
MEAN HIGH WATER NEAP			+ 0.95	+ 0.95	+ 0.97	+ 0.94	+ 0.95
MEAN HIGH WATER			+ 0.89	+ 0.94	+ 0.91	+ 0.95	+ 0.94
MEAN TIDE LEVEL			+ 0.23	+ 0.17	+ 0.11	+ 0.13	+ 0.09
MEAN SEA LEVEL (KO LAK STANDARD)			± 0.00	± 0.00	± 0.00	± 0.00	± 0.00
MEAN LOW WATER			- 0.48	- 0.54	- 0.65	- 0.63	- 0.78
MEAN LOW WATER NEAP			- 0.71	- 0.72	- 0.75	- 0.83	- 0.88
MEAN LOWER LOW WATER			- 0.88	- 0.94	- 1.07	- 1.12	- 1.26
MEAN LOW WATER SPRING			- 1.04	- 1.15	- 1.22	- 1.29	- 1.48
LOWEST LOW WATER	- 1.74 (1964)	- 1.25 (1983)	- 1.72 (1968)	- 1.78 (1967)	- 1.90 (1968)	- 1.79 (1956)	- 2.42 (1956)
MEAN SPRING RANGE			2.34	2.45	2.57	2.67	2.90
MEAN NEAP RANGE			1.66	1.66	1.71	1.76	1.83
MEAN RANGE			1.99	2.04	2.18	2.24	2.44

Source: Port Authority of Thailand

Table IV-6 Details of Standard and Rental Rate of Warehouse by PWO

1. "A" grade
   - Concrete floor
   - Concrete wall
   - Steel structure
   - Asbestos slate roof

   Maximum = 1.60 Baht/Bag/Month, 40 Baht/m^2/month
   Minimum = 0.90 Baht/Bag/Month, 18 Baht/m^2/month
   Average = 1.25 Baht/Bag/Month, 29 Baht/m^2/month

2. "B" grade
   - Concrete floor
   - Concrete wall
   - Wood structure
   - Zinc galvanizing plate roof

   Maximum = 1.11 Baht/Bag/Month, 29.99 Baht/m^2/month
   Minimum = 0.85 Baht/Bag/Month, 13.59 Baht/m^2/month
   Average = 0.98 Baht/Bag/Month, 21.79 Baht/m^2/month

3. "C" grade
   - Concrete Floor
   - Zinc galvanizing plate or wood wall
   - Wood structure
   - Zinc galvanizing plate roof

   Maximum = 1.11 Baht/Bag/Month, 34.09 Baht/m^2/month
   Minimum = 0.68 Baht/Bag/Month, 10.04 Baht/m^2/month
   Average = 0.90 Baht/Bag/Month, 22.07 Baht/m^2/month

4. "D" grade
   - Wood floor
   - Wood wall
   - Wood structure
   - Zinc galvanizing plate roof

   Maximum = 0.80 Baht/Bag/month, 20.37 Baht/m^2/month
   Minimum = 0.75 Baht/Bag/Month, 15.43 Baht/m^2/month
   Average = 0.78 Baht/Bag/Month, 17.90 Baht/m^2/month

Source: PWO, Mar., 1984

Table IV-7 Quantity of Rice Mills and Production Capacity per Scale in Each Region of THAILAND in 1982

RICE MILL SCALE	CENTRAL REGION		NORTHERN REGION		EASTERN REGION		SOUTHERN REGION		TOTAL	
	Q'TY	CAPACITY T/D	Q'TY	CAPACITY T/D	Q'TY	CAPACITY T/D	Q'TY	CAPACITY T/D	Q'TY	CAPACITY T/D
BIG	38	7,803	8	1,580	15	1,724	1	100	62	11,207
MEDIUM	863	19,037	378	16,486	297	11,362	44	1,083	1,582	47,968
SMALL	864	10,861	683	7,902	396	4,529	103	1,199	2,046	24,491
TOTAL	1,765	37,701	1,069	25,968	708	17,615	148	2,382	3,690	83,666

SOURCE: DEPARTMENT OF INDUSTRIAL WORKS, MINISTRY OF INDUSTRY.

REMARKS: BIG RICE MILL - PRODUCTION CAPACITY FROM 100 TONS/DAY (RAW MATERIAL)
MEDIUM RICE MILL - " 17-99 " AND UP
SMALL RICE MILL - " 10-16 " "

PRELIMINARY STATISTICS EXCLUDING SMALL RICE MILLS WITH LOWER THAN PRODUCTION CAPACITY OF 10 TONS/DAY

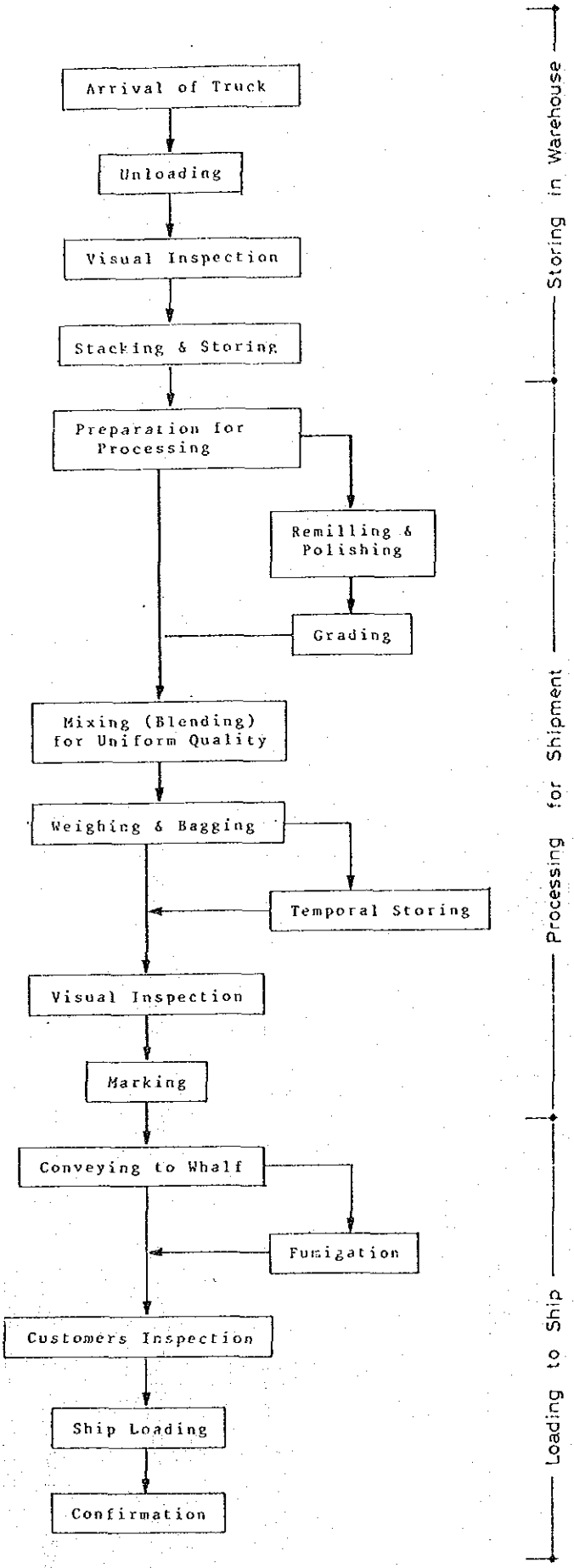


Fig. IV-3 Flow Chart of Existing Rice Handling Procedure at Shipping Facilities

3) Roof

The materials for the roof are corrugated slates or zinc corrugated plate. No roofs are a dual structured and heat insulated. The temperature rising in the warehouse is partly attributed to the roof light for lighting. A louver at the apex of the roof may be made for ventilation, however, much can not be expected without lower windows from which ambient air comes in.

Steep inclination of roof and wide space under the roof above rice stacks are effective for preventing the rise of temperature within the warehouse caused by sunshine.

On the other hand, in many warehouses, eaves are too short and some of them don't have any covering against rain at the end of the roof or in the upper section of the door. Cargo handling in the rain is very difficult in such conditions.

4) Side wall

Consideration has not been sufficiently given to the prevention of rising temperature due to the sun radiation. Galvanized iron sheet, wood and blocks are used as materials of walls. Blocks are found in relatively new warehouses, but they are not effective on heat insulation. Double-block walls are seen in a few warehouses to compensate for the absence of insulation but none of them use heat insulator to block walls.

No warehouses have wooden guards to prevent the damage to the wall. It cannot be expected that the walls of the warehouses are strong enough to resist the pressure of collapsing cargoes. In fact, some walls have been broken by the collapse of rice stack.

Protection net against bird are installed on some of the upper windows, but they are still vulnerable to insects.

5) Entrance

In most cases, an entrance is provided on only one side of a warehouse for the protection against thieves. The entrance plays the important role not only in going in and out in cargo handling but also in ventilation, consideration has not been given to the role of ventilation.

The absence of rat guard should also be questioned, as well as the entrance and floor lower than the road level, which have probably been sunk by the load of cargo.

6) Floor

The floor of a warehouses are varied from the ground level to as high as 30 cm from the ground. It is observed that small sandbags are piled up around entrance inside warehouse.

The floor should be elevated by 30 cm at least from the ground to prevent the rain invasion. It is also necessary to make slope from the road to the entrance to enable the truck to come in for cargo handling.

PWO's warehouses in Rajburana, Bukkalo and Bangkrasor along the river of Chao Phraya have never been inundated by a river so far. Table IV-5 shows the maximum water level of the Chao Phraya river in the period of 1940 to 1983. According to this, the ground more than 2.0 m above the average sea level may not be inundated by the rising tide.

7) Foundation

Piles foundation is taken for construction of grain warehouses in Thailand. As far as the survey team observed, the rainforced square concrete piles are mainly used for the warehouses along the Chao Phraya river. In the rural areas, bearing piles are used only for the lower

section of heavy loaded post, because the soil resistance is solid enough. However, as it was observed the uneven subsidence of the ground even in areas with a solid soil, investigation should be conducted carefully for the design of warehouses to recognize the conditions of subsoil, bearing capacity of soil, etc.

The crack of a floor caused by the uneven subsidence of the ground may raise humidity question, thus making the conditions of storage worse significantly. Sufficient consideration should be given to the foundation work against the load, and in case of fill-up ground the water proof floor should be made carefully to prevent the rise of humidity.

8) Site

Transportation means include trucks, railway and barges. Trucks are normally used for transportation with the exception of barges in the Central region and railway in the Southern region. Warehouses are located along highways (with the breadth of about 7.0 m) or have access roads to highway with the breadth of 4 to 6 m.

9) Standard of PWO entrusted warehouses

PWO has specified the grades for entrusted warehouses. The contents of grade are very simple as shown in Table IV-6. It would be necessary to make detailed standards in the entrusted warehouses. They should include the requirements for warehouses (area, structure, fumigation) and their equipment (cargo handling machines, appliances and equipment required for storage management).

10) Warehouses for survey

The warehouses surveyed by the study team are listed in Appendix E.

4-6-3 Actual Situation of Milling Facilities

Rice mills mostly locate rice producing areas. Milling capacity are shown in the amount (metric tons) of paddy processed in a day. It has a wide range from less than 10 tons to more than 100 tons. As shown in Table IV-7, small-scale rice mills predominate in number. Medium scale account for major proportion in total processing amount. Large scale rice mill process mainly export rice. Yearly operating days for them have been reported as 100 - 150 days after harvesting, however in central region rice mills have come to operate more due to the introduction of double crop of rice.

Facilities of a rice mill for exporting rice consist of warehouses for paddy, rice milling equipment with steam engine, paddy parboiling equipment and drying floor, and river wharves depending on its location.

Some of large scale rice mills have expanded facilities such as warehouse, and business of drying and storage for cassava chips under their management.

Machines are usually manufactured locally except that a few complicate ones are imported. A very advanced Rice Processing Complex has recently appeared for the purposes not only to produce quality of rice with high added value but also bran oil extraction, further utilization of paddy husk (burning-gas power generator, carbonized husk production). This kind of rice complex is putting more emphasis on rice processing than on rice trading which was ever main profitable business for rice mills.

New parboiling method (hot water soaking) and labour-saved paddy handling method (cargo handling machines) have newly been introduced in many rice mills.

For trading, quality of paddy must be grasped correctly. Since the end of last year, every rice facility is obliged to be equipped with the inspection instrument (moisture metre, test whitening and grading machine) instead of primitive devices.

4-6-4 Milled Rice Packing

Milled rice is packed in bags for distribution. As milled rice is the final product, it will be rarely sold without being packed in future. On the contrary, pre-packing is getting diversified. 50 kg chemical fiber bags are already in market in addition to 100 kg jute bags and 1 kg plastic film bags are also used to fulfill the customer's requirements.

Buyers usually prefer packed milled rice. This is also true with maize and beans because of the lack of facilities for receiving unpacked products in importing countries, and the difficulty with transportation of unpacked products to the inland areas. The ability to export packed products will make Thailand more competitive in export market.

4-6-5 Rice Transportation and Equipment for Transportation

Current transportation in Thailand is briefly explained below.

a) National wide road network has been developed rapidly in recent years, and accelerated motorization.

b) River and canal transportation which had long history in central region has declined recently.

c) The Bangkok Port is the only one shipping port for rice export in spite of various restrictions because of river side location. It is always congested since most of exports are gathered here.

Under these conditions, trucks nowadays transport rice much, and trains, barges follow as transportation equipment. Trains are utilized especially for the transportation from the North-eastern and North regions to the South, and for the export to Malaysia.

As stated separately, paddy is handled and transported in bulk. Trucks with specially designed high side plate for cargo table are operating, for

increasing loading capacity. The cloth net and bags full with paddy on the cargo table are used to prevent paddy spillage. Trailer-trucks are not used for rice transportation in Thailand. Large trucks have the time restriction to go in/out of Bangkok, and are checked the loading weight at the check points locating just before entering Bangkok.

In spite of the low cost, barge transportation has declined. There are some restraints for barges such as irrigation water gate, floating plants in water, longer transportation time. But some opinions to re-consider barge transportation are heard in view of energy saving. Steel made and larger barges are being developed recently though wooden and small barges are still working.

Wooden barges operate more in the river Chao Phraya and main canals, but from the warehouses in wharf to vessel, steel barges with the capacity of more than 500 tons are used.

4-6-6 Actual Situation of Cargo Handling Procedures

1) Paddy handling

The form and cargo handling system for paddy differ from those of milled rice. Paddy is normally stored and sold in bulk. Each grade of bulk paddy, piled in a warehouse separately is shipped as required. This operation used to depend on manual labour with basket, but has recently been substantially mechanized. Many tractor shovels (front-end type, with a bucket capacity of 1.6 tons) are used for moving paddy, particularly paddy feeding into the milling facilities. A large scale mill often has two or three tractor shovels.

Belt conveyors have been used only experimentally in Thailand, though they are most common in other countries for the bulk transportation of paddy. A tractor shovel can carry 20 to 30 tons of paddy per hour depending upon the transportation distance. A tractor shovel capability is almost equal to a belt conveyor of 20-inch width.

Tractor shovels, which are excellent in mobility are used extensively in the spacious facilities of Thailand.

Unloading of paddy in bulk from a truck depends on manual labour or sometimes using large board drawn by portable power winch.

2) Milled rice cargowork

Milled rice is packed in a jute bag after milling. A bag may contain 50 kg or 100 kg of milled rice with tare. A 100 kg bag is most commonly used. The unloading/loading of milled rice, and its handling and stacking are usually done by workers. The rice is carried on the workers' shoulder.

Stacker and belt-conveyor for bags are used in some warehouses. Most of the milled rice for export is shipped from the port of Bangkok. It is directly loaded into a vessel alongside the wharf or indirectly by a barge off the wharf. A recent survey indicates that 70 to 75% of the exported volume is loaded directly into a vessel, while its remaining 25 to 30% is loaded from a barge. The vessel can not be fully loaded because of sand bars at the estuary of the river.

The procedures of loading including export inspections have not changed basically in this 20 or 30 years. Fig. IV-3 indicates the flow of this loading which relies primarily on manual labor. A deck crane is used to load a slinged unit of 16 to 20 bags, weighing 100 kg each, directly into a vessel alongside a wharf.

Some attempts have recently been made to rationalize the cargo handling method. These attempts include the utilization of bag barrows and ceiling cranes in a warehouse, and truck cranes on the wharf. Labour can be saved by using a bag barrow, but it takes approximately the same length of time as conventional shouldering. A truck crane can handle about 500 tons of milled rice per day. The first model of a bag spiral chute for bag loading is being installed in Thanakit Warehouse.

It is technically difficult to improve the efficiency of bag handling. Although many other agricultural products are increasingly being handled in bulk, the idea of bulk handling of milled rice still faces opposition except for special cases. Therefore, milled rice will be packed and handled in various types of bags for the moment. The most efficient practical method is to handle as many bags as possible, as one unit.

4-6-7 Mixing and Operations

Rice normally undergoes re-milling, grading, mixing and packing by exporters, and inspection, in a warehouse at a wharf, before shipped for export from their own wharf. The warehouse at a wharf partly has function of cargo handling.

Rice merchants in Thailand export various grades of rice which are often mixed to meet the customers' requirements. This is recognized as a series of economic transactions. In 1982, as many as 22 grades of rice were exported. In the future, milled rice that has been packed by rice mills in accordance with scientifically standardized and quantified data will be distributed probably. Milled rice however will continue to be blended before export like other food items because it is the final product.

The present rice mixing process in the flow of rice marketing is positioned as shown in Fig. IV-3. The mixing method described below and illustrated (Fig. IV-4) has been in use for many years.

° 100 kg milled rice bags are piled up to form a square with the height of 5 to 6 m. The bags are then opened beginning from the top of the pile to make a heap of rice. The rice is mixed by crumbling the heap with a bucket.

° Mixed rice is fed with basket on workers' shoulder by about 30 kg, to the sieve with inclination, and weighed and packed again in new jute bags.

° The method of mixing is unique to each godown manager. The repacked bags are carried on the workers' shoulders and loaded into a barge beside the wharf.

° The operation is smoothly carried out by teams (20 to 30 workers each) under the instruction of a foreman.

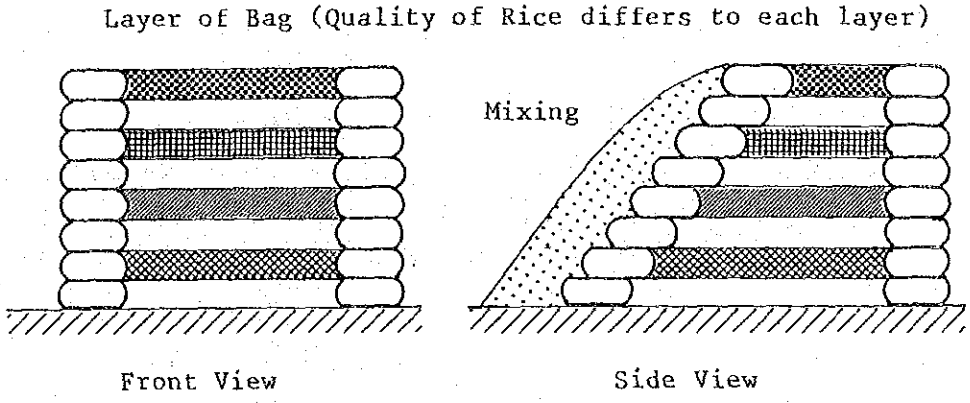


Fig. IV-4 Traditional Mixing Method in Thailand

A new mixing method has been adopted by some warehouses at the wharf. Milled and broken rice of different grades are put into steel tanks or concrete square bins. A certain volume of each rice is discharged and mixed to achieve a predetermined rice quality. A sliding shutter or a rotary valve is used to discharge the rice. The operation is controlled not by weight, but by volume.

4-6-8 Actual Situation of Re-Milling Procedures

There is no statistics available regarding the ratio of rice that is re-milled in the warehouse at the wharf. Through the survey as much as one third of all rice is estimated to be re-milled before exports.

The re-milling process, if necessary, usually precedes the mixing process as it may produce some broken rice. It is desirable to make less broken rice in the re-milling process.

The purpose of re-milling is as follows:

- The re-milling of milled rice, which can be stored for long time, enhances the milling degree of rice by removing the deteriorated browned aleurone layer. Re-milling would normally cause yield losses of 2 to 3%.

- The bran attached to on ordinarily milled rice is removed by re-milling and polishing to give it a smoother surface. This increases the commercial value of milled rice.

Recently rice is re-milled mainly for the latter purpose rather than the former one. Yet, concerning yield losses, the rise of added-value by re-milling can compensate it.

CHAPTER V FUNCTIONS AND ORGANIZATION OF THE PUBLIC WAREHOUSE ORGANIZATION

CHAPTER V FUNCTIONS AND ORGANIZATION OF THE PUBLIC WAREHOUSE ORGANIZATION

5-1 History

The Public Warehouse Organization (hereafter called the PWO) was established as state organization under the Ministry of Commerce in 1955 by the "Royal Decree Establishing a Public Warehouse Organization".

The history of organization similar to the PWO date back to the period immediately after the end of the war when the Division of Central Public Warehouse was established with the main objective of supplying basic commodities which were imported by the Government for sale to the farmers and the public at a cheap price to stabilize the prices of those commodities.

The Division's role was expanded later, by setting up rice storage facilities and warehouses in the countryside, to purchase rice and serve as a temporary storage for agricultural products.

In 1954 it was proposed that the Division's status be elevated to a state enterprise. On April 20, 1955, a Royal Decree was issued to create "The Public Warehouse Organization" and all the properties, assets, rights, liabilities and business of the Warehouse Division, as well as the officials under the Warehouse Division, were transferred to the PWO.

5-2 The Objectives of the PWO

Section 6 of the Royal Decree describes the objectives of the PWO as follows: "The objectives of the Organization shall be to carry out proper activities related to rice, agricultural and other products to ensure that their quantity, quality and prices are appropriate and that the supply is sufficient to meet the demand of the State and the Public.

5-3 Roles and Activities of the PWO

The authority of the PWO to carry out its objectives covers a rather wide range as stipulated in section 7 of the Royal Decree.

However, its actual activities in the past have mainly comprised price support and stabilization operations for various agricultural and consumer products.

The main past activities in which PWO has been involved are as follows:

1) Participation in a rice price support and stabilization program in which the PWO purchased milled rice to create a demand for paddy and help raise ex-farm paddy prices. Also, release of this milled rice on the local market when consumer prices showed signs of excessive increase.

2) Export of rice either under Government-to-Government contracts or under directly negotiated contracts.

3) Supply of rice for local consumption under normal commercial terms.

4) Storage and distribution of rice under the low-cost rice program.

5) Temporary storage of paddy and other agricultural commodities for farmers until prices rise, and in the interim provide farmers with credits to cover their expenses.

6) Procurement of consumer goods (locally or imported) essential for public welfare to sell at nominal prices to stabilize market prices at reasonable levels.

5-4 Past Performance of the PWO Activities

1) Activities listed in items 5-3, 1), 2) and 3) are mainly concerned with the market intervention program under the paddy price support and stabilization policy of the Government. This is the most important program the PWO has conducted over the last three consecutive years.

The objectives, systems, performance and problems of the market intervention program conducted by the PWO are described in the next chapter.

2) Activities other than those mentioned above for the market intervention program are called the PWO's private business.

The performance of this private business over the past six years is shown in Table V-I. The systems and purchasing channels of this business are shown in Table V-II.

3) The activities of item 5-3, 4) above are shown in the first column of table A as economy rice. The purchasing system for this economy rice including purchasing sources and procedures and setting procedures for purchase prices are shown in the first column of the Table B. This system was known as the "Rice Reserve Fund". It was started in 1966 and was in operation until 1982 when it was abolished because of opposition from the farmers' groups that this system brought on lower paddy prices.

Under this system exporters had to reserve about 60% of their exports and sell it to the PWO at a low price, about half of the prevailing market price. The PWO could, therefore, resell this rice to the public at nominal prices through the small stores under government support and provincial companies for the benefit of the low-income population. An example of rice sold under this system was the so-called "Ocha-Rice".

4) The PWO activities in item 5-3, 5) in the previous section are the most significant from the viewpoint of helping farmers increase their bargaining power to command higher prices when dealing with middlemen and private traders.

These activities are called temporary storage and pawning activities. The PWO had not been very active in these activities but is now trying to popularize this system among farmers by closely cooperating with the Bank for Agriculture and Agricultural Cooperatives (hereinafter called BAAC).

Table V-1 Operation of PWO in the Past 6 Years

Value Unit: Million Bahts

Own business of PWO		Quantity Unit	1978		1979		1980		1981		1982		1983	
			Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1. Economy Rice	Purchase	1,000 tons	367.3	1,158.8	501.9	1,167.1	562.6	1,784.9	665.9	1,903.9	382.8	1,122.2	172.3	681.9
	Sale		367.6	1,281.8	536.9	1,820.7	553.8	1,863.7	355.4	1,762.4	399.3	1,390.8	195.0	783.2
2. Exported Rice	Purchase	1,000 tons	63.9	256.5	16.7	69.7	54.7	251.0			63.7	277.4	11.8	62.3
	Sale		61.6	262.5	16.7	72.5	54.7	253.0			63.7	341.6	49.5	241.08
3. Maize	Purchase	1,000 tons	8.4	16.3	8.9	19.9	4.2	10.9	2.1	7.1	21.0	75.2	15.0	40.9
	Sale		8.4	14.8	8.9	18.3	4.1	11.9	1.8	6.4	21.5	78	14.9	45.2
4. Juce	Purchase	1,000 tons	3.9	18.8	1.0	3.6	6.5	32.8	5.8	31.5	-	-		
	Sale		0.03	0.06	4.5	21.7	4.2	26.1	3.1	14.0	4.5	30.9		
5. White Sugar	Purchase	1,000 tons					101.5	710.2	6.9	80.1	0.05	0.6	-	-
	Sale						100.6	702.0	3.8	37.1	6.6	63.6	0.4	2.6
6. Exchange Sugar	Purchase	1,000 tons							90.2	582.1				
	Sale								136.9	1,827.3				
7. Consumer Goods	Purchase			12.6		24.3		95.1				21.5		
	Sale			16.6		25.5		96.9				23.5		
8. Bean	Purchase	tons			123.1	0.6								
	Sale				123.1	0.8								
9. Potato Seed	Purchase	tons	15.0	0.24	33	0.55	116	2.19	80.0	1.32	71.0	0.9	107.2	1.1
	Sale		15.0	0.27	32	0.59	116	0.36	73.0	1.47	64.5	1.3	99.8	1.9
10. Dry Coconut	Purchase	tons											11.0	0.083
	Sale												11.0	0.08
11. Black Pepper	Purchase	tons											276.2	6.9
	Sale												-	-
12. Garlic	Purchase	tons											366.8	16.18
	Sale												281.2	13.12
Total	Purchase			1,463.24		1,737.75		2,887.09		2,606.02		1,497.8		825.67
	Sale			1,576.03		1,960.09		2,954.16		3,648.67		1,929.8		1,103.36

Source: Business Planning and Policy Division

Table V-2 System and Channel of Goods Purchase of PWO's Own Business

Description	Buying System			Distribution		
	Source of Buying	Means of buying	Price	Channel of Distribution	Means of Distribution	Price
1. Rice for domestic consumption	- Exporter's rice reserved as government policy - Rice traders	- Ministry of Commerce fixed price and types of rice - Bidding - Fixed price	- Ministry of Commerce fixed the price - Market price (Wholesale) "	- Small store under government support, government official, Province Company and low income people	- Retailing - Wholesaling	Lower than market price
2. Exported rice	- Rice traders	- Bidding - Fixed price	" "	Foreign government	G to G contract with quota allocated by DFT	DFT, fixed price
3. Maize	- Regional traders	- Price investigation	"	overseas market	quota allocated by DFT	"
4. Kenaf	- Farmers and traders	- Buying at farm gate	- Farm gate price	Jute Mill Factory	Wholesaling	Market
5. Sugar	- Sugar Factory	- Price investigation	Market price	Same Channel of Rice Sale	Wholesaling and Retailing	Government fixed price
6. Exchange Sugar	- Overseas	- Approved by the Government to exchange brown sugar for refined sugar from overseas company	-	Same Channel of Rice Sale	-	Government fixed price
7. Consumer Goods	- Factories and Companies	- Investigated price and concluded buying at large quantity to get price reduction	- Market price less reduction	Same Channel of Rice Sale	Retailing Wholesaling	Lower the market price
8. Bean	- Farmers	- Buying at farm gate where market price was low	- Ministry of Commerce fixed price	General traders	Bidding	
9. Potato seed	- Netherlands and Australia	- Price investigation	- Market price	Farmers in Northern area	Through province Company	PWO fixed price
10. Dried coconut	- Farmers	- Buying at farm gate where market	- Ministry of Commerce fixed price	Extraction Vegetable Oil Factory	Directly contact factories	Price Agreement
11. Black pepper	- Farmers	- Buying at farm gate where market	"	General traders	Bidding	Highest bidprice
12. Garlic	- Imported	- Price investigation	- Market price	Traders and general people	- Retailing - Wholesaling - Preserved food Organization	Lower than Market Price

Source: Business Planning and Policy Division

In this project, farmers will bring their paddy for storage in the PWO warehouses and the PWO will issue the receipt for the received paddy.

Farmers can, by using this receipt, borrow money from BAAC up to about 80% of the value of the paddy. The project would help farmers store their paddy until market prices become favorable.

On June 7, 1984, the PWO and BAAC announced a joint plan for this temporary storage and pawning program to provide short-term loans to farmers of 4 billion Baht for postponement of paddy sales in 15 provinces late this year.

The scheme enables farmers to pledge their paddy to warehouses provided by the PWO for 80% of the total value of the crop. They can sell their paddy when prices are favorable.

The program will begin in November, coinciding with the annual harvest when paddy prices are generally low. Farmers can deliver their paddy to 16 locations in 15 provinces.

In the northeastern region, warehouses will be provided in Nakhon Ratchasim, Khon Kaen, Udon Thani, Ubon Ratchathani and Surin. In the northern region, facilities will be provided in Sukhothai, Phitsanulok, Chiang Mai, Chiang Rai and Phayas, and in the central region in Ayutthaya, Ang Thong, Prachin Buri, Nakhon Nayok and Suphan Buri. In each province, warehouses will have at least a 20,000 ton storage capacity, and some may have up to 50,000 tons.

The PWO picked only 15 provinces due to a lack of warehouses. Most warehouses to be used in this scheme must be rented from private firms.

When farmers deliver paddy to warehouses they can use the warehouse receipts to obtain short-term loans amounting to 80% of the paddy value. Initially, the bank will set aside 1 billion Baht for the scheme. Farmers will pay a 14% interest on pledges not exceeding six months.

There is a problem with paddy that has over 14% moisture because it cannot be stored for long periods.

If farmers default, their paddy will be sold to the central market by BAAC to recover the payment. Farmers who use this service are expected to be mainly BAAC clients and number about one million.

5-5 The Organization of the PWO

1) The PWO is divided into various departments which are sub-divided into divisions and sections. Each unit is administered by a chief or head. These administrators report to deputy managing directors, assistant managing directors and managing directors. Overall management is supervised by the Board of Directors. The PWO organization chart is shown in Figure V-1.

2) The members of the PWO Board of Directors are chosen from experienced and qualified Government personnel. The term of office is four years. The board members consist of a chairman, vice-chairman and the managing directors as ex-official members, and no fewer than four but no more than eight members including a representative from the Finance Ministry. The board is authorized to set policy and supervise the overall management of the PWO and to set regulations dealing with business and personnel management.

   At present, the PWO Board of Directors consists of 11 members, with the Minister of Commerce acting as chairman.

3) The PWO Managing Director is authorized to manage and administer the PWO affairs in accordance with policy, rules and regulations laid down by the board acting under Thai Government rules and regulations that govern state enterprise activities. He is authorized to give rewards, annual promotions and administer the code of conduct, etc., in a manner that does not deviate from the policy set by the Board.

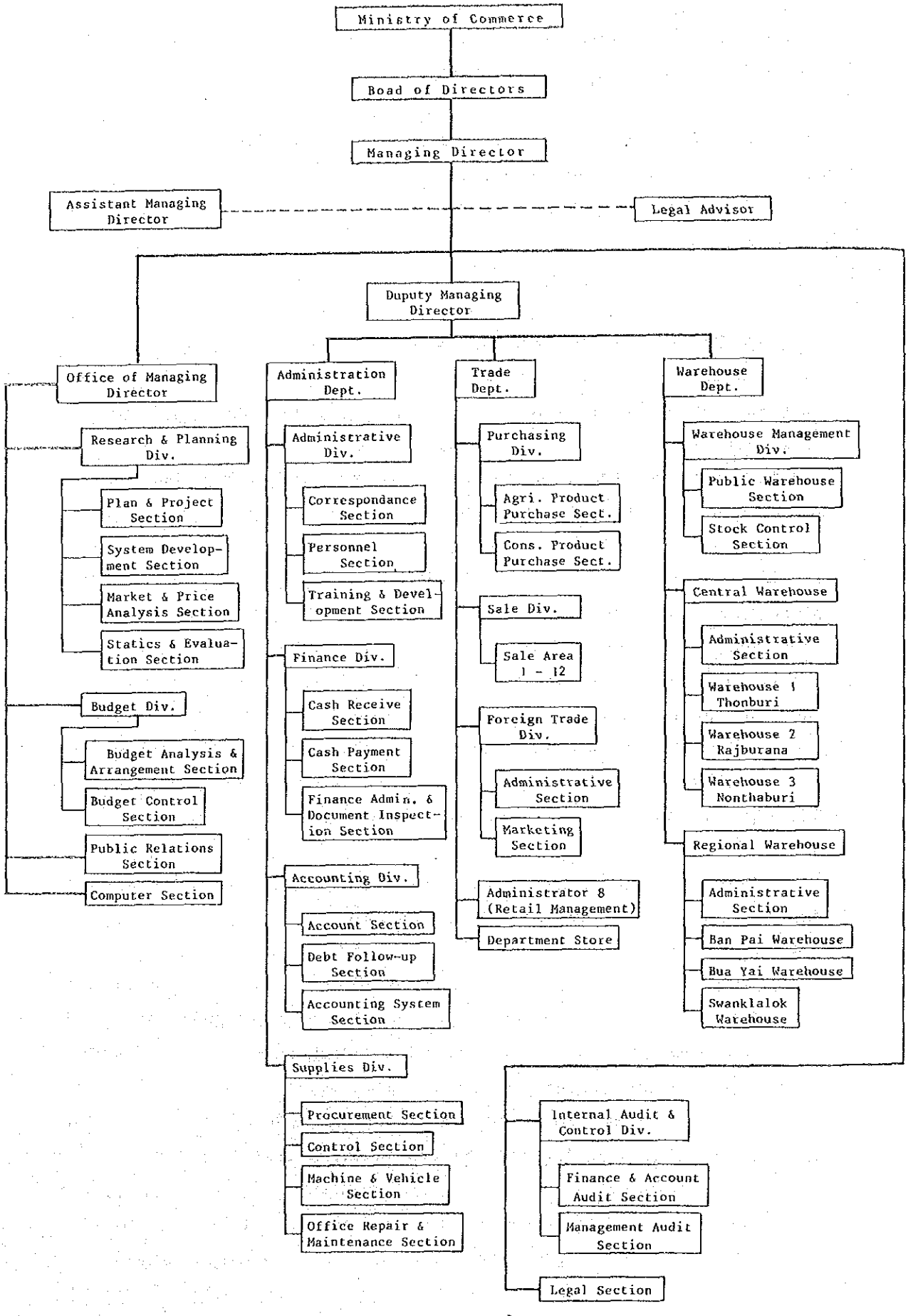


Fig. V-1 Chart of the PWO's Organization

4) The organization of Departments and Divisions is as follows:

Administration Department
General Warehouse Department
Agricultural and Consumer Products Department
Export-Import Department
Internal Audit and Control Department
Office of the Managing Director
Business Policy and Planning Division

5) The Administrative Department is responsible for general business management including other responsibilities not specifically assigned to any other department or division. Its main duties include legal and financial matters, accounting, personnel, storage and property maintenance. The Department is further divided into:

Administrative Division
Finance Division
Accounting Division
Budget Division
Supplies Division

6) The General Warehouse Department is responsible for various storage and warehouse services such as temporary storage, bonded warehousing, inventory record keeping and quality control with particular reference to agricultural products. It is divided into:

Control Area Warehouse Division
Regional Warehouse Division

7) The Agricultural and Consumer Products Department is responsible for procurement and sale of domestic products such as rice, field crops and other consumer products to maintain and stabilize prices for the benefit of domestic producers and to help create prices which consumers can afford to pay. It is further divided into:

Rice Division
Field Crops and Fibers Division
Consumer Products Division

8) The Export-Import Department is responsible for procurement and customs processes with regard to export and import of various commodities. It consists of:

Export Division
Import Division

9) The Internal Audit and Control Department is responsible for various aspects of internal auditing relating to the performance of the general warehouse operations, procurement and sale of products, financial matters, accounting and other assigned tasks including development and improvement of the PWO management system. It consists of:

System Development Division
Audit and Control Operating Division

10) The office of the Managing Director is responsible for all secretarial work, coordination within and outside the PWO, public relations and proposal of technical data and information duly assigned. The office consists of:

Secretary Division
Coordination Division

11) The Business Policy and Planning Division is responsible for general survey, study, and analysis of economic conditions and marketing situations in order to formulate basic criteria and parameters for policy-making decisions in accordance with the National Economic and Social Development Plan.

CHAPTER VI PWO MARKET INTERVENTION ACTIVITIES

CHAPTER VI PWO MARKET INTERVENTION ACTIVITIES

6-1 Objectives and Problems in Agricultural Product Market Intervention by the Government

The marketing system of agricultural products and their prices are unfair to farmers since prices of most agricultural products are determined by wholesale markets in Bangkok and middlemen who have better information on market movements and price fluctuations than farmers. This results in relatively weak bargaining power for the farmers.

Trade through the cooperative system or farmers' organizations has been underdeveloped, and therefore the majority of the farmers still trade through local middlemen.

Thus, the government had to increase its intervention in the marketing and agricultural pricing system at the export, wholesale, retail and farm levels.

However, these measures have not progressed, while the private sector's marketing system has expanded. Further, many market intervention measures of the Government have caused many problems that need to be seriously reviewed. For example, there is a policy to slow down agricultural price increases to protect domestic consumers that conflicts with a policy to raise farm-gate prices.

Other problems of the marketing and agricultural commodity pricing policies which need to be reviewed and improved during the Fifth Plan period are described in the Plan Document as follows.

1) The Government's intervention in the export market increases exporters' costs and results in lowering farm gate prices.

2) Local farm trade lacks basic infrastructural services, for example warehouses, godowns, silos and transportation services causing farmers to rely on middleman at various levels. Furthermore, middlemen have a monopoly over marketing and agricultural pricing information resulting in lower bargaining power for farmers.

3) Government intervention at local levels, such as the price support program, is not extensive enough and not operating as efficiently as it should be due to very limited resources.

4) The formulation of farmers' groups for trading purposes is still limited.

All these factors constitute existing agricultural marketing and pricing problems which place farmers in a disadvantageous position and prevent them from gaining the full benefits of agricultural prices.

6-2 Market Intervention

Thailand had attempted to introduce a price guarantee system for agricultural products but did not implement the system in a true sense. Setting price guarantees for any crop implies that farmers can obtain a guaranteed price for that crop from either merchants or the Government. When the Government sets a price guarantee, it must be prepared to purchase all guaranteed crops at the guaranteed price.

The various price-guarantee schemes undertaken by the Government since 1975 have always been conducted under severe financial and personnel limits. The Government has intervened only in some areas and has paid those few lucky farmers the guaranteed prices. The vast majority of farmers have had to sell privately in the open market, below the guaranteed price. The two-price system that has emerged has caused some problems.

In the price support system, the Government purchases crops on the basis of the prevailing market price. As long as the Government does not want to destroy the existing market system, it should respect the principle of the market mechanism for successful price support based on clear understanding of market operations.

One popular theory which shows the effectiveness of market intervention activities is that the government purchase of crops creates an artificial demand which raises prices.

However, if the Government sells the products immediately after purchase, the measure is useless. Any artificial demand created by the Government is cancelled by an artificial supply from the sale of the products. The purchased commodities must be held in storage to make the created demand last as long as possible.

Generally, the prices of agricultural commodities drop immediately after harvest when the marketable surplus of the commodities floods the market. Their prices increase especially in urban areas at the end of crop year when the marketable surplus is almost sold out.

The objectives of market intervention by the Government is, as stated above, to support the prices of agricultural commodities, especially at the beginning of the crop year, to raise farmers' income and living standard, then to stabilize the prices of commodities for the sake of consumers during the end of the crop year when the farmers' stocks are low and prices increase.

For this purpose, the purchased commodities must be kept at least six months between the harvest season and the pre-harvest season.

It is for this reason that basic infrastructural services such as warehouses, godowns, silos and transportation are essential, and that the lack of these services is a crucial problem to be solved for the successful implementation of marketing and agricultural pricing policies.

When the Government wants to support prices through market intervention, it must take proper steps at the export level because domestic prices are more effectively adjusted by export premiums or taxes.

6-3 Market Intervention Activities by the PWO: Procedure and Performance Over the Last Three Years

1) The Thai Government realized the need to increase the income level and living standard of farmers by intervening in the market to keep agricultural commodity prices at a reasonable level. For the first time in its history of agricultural pricing policies, the Government announced a policy to support and stabilize the paddy price on September 1, 1980.

A Price Policy Committee under the chairmanship of the Prime Minister General Prem Tinasulanonda was also set up to stipulate the policy and implementation procedures.

In addition to the primary objectives stated above, this policy also has the following objectives which can be attained simultaneously:

a) Stabilization of consumer rice prices
b) Increase of national revenues through exports

The first priority among these three objectives is that of increasing the income level and living standard of farmers.

Measures under this policy were slightly changed under the new title of the policy, termed as Market Intervention and Paddy Price Stabilization.

The PWO, as a state enterprise under the supervision of the Ministry of Commerce, has been assigned to carry out the necessary measures under this policy.

Market intervention under this policy is the most important function of the PWO activities over the last three years.

2) Market intervention procedures

Market intervention procedures involve purchasing rice as buffer stock at the beginning of the crop year and releasing it to the market at a later period when farmers' paddy stocks are low or when paddy and rice prices increase to a level creating a burden on consumers. Purchase of rice by the PWO is expected to create an additional artificial demand at the beginning of the harvesting season and increase paddy prices above or near the target price fixed by the Government. This enables farmers to sell their products at these prices.

There are two systems for the PWO rice purchases for market intervention: by bidding and/or at fixed prices.

In typical bidding, rice traders, millers, exporters and farmers' organizations are all entitled to submit bids. However, in some specific cases only farmers' organizations are entitled to submit bids to give them a more favorable position.

The fixed price system means direct negotiation and contracts with the specific supplier and is applied to purchases from the Agricultural Cooperatives Federation of Thailand, Accelerated Rural Development and the farmers' organizations.

Since the announcement of the Paddy Price Support and Stabilization Policy in September 1980, the Thai Government has fixed and announced the prices of paddy for each crop year. The prices of paddy fixed by the Government in the 1980/81 and 1981/82 crop years were "target prices", but in the 1982/83 crop year was the "floor price."

The target price was higher than the market price when it was set. The Government, after the announcing the target price, took every possible measure including market intervention and export mechanism operation to bring the market price of paddy up to the fixed target price. The PWO was in charge of market intervention and temporary storage for pawning.

The floor price was set by the Government as the criteria for market intervention. The Government intervenes in the market when the market paddy price is lower than the floor price.

The PWO is entitled to purchase milled rice from millers, rice traders and farmers' organizations in the market intervention activities. The Market Organization for Farmers under the jurisdiction of the Ministry of Agriculture and Cooperatives is assigned to purchase paddy from farmers, farmers' organizations and/or middlemen to intervene into the market under the Paddy Price Support and Stabilization Program of the Government.

In the 1980/81 crop year starting from October 1980 and lasting to September 1981, the government set the target price for paddy for milling to 5% rice at 3,500 Baht per metric ton. The market price of paddy for the same grade was 3,000 Baht at that time.

In the next crop year of 1981/82 (from October 1981 to September 1982), the target price of paddy was increased to 3,750 Baht for the same grade of paddy to intensify the market intervention activities.

However, from July 1981, the price of rice in the domestic market of Thailand followed the declining tendencies in the world market and fell to 3,100 to 3,200 Baht.

In the 1982/83 crop year (October 1982 to September 1983) the government found the target price at 3,750 Baht impractical and changed its pricing procedure from the target price to the floor price. The floor price set by the government in the 1983 crop year was 3,300 Baht.

3) Market intervention activities by the PWO: performance over the last three years

The performance of the PWO operations under the Government's Paddy Price Support and Stabilization Program is shown in Table C. The system and channel of rice purchases by the PWO under the program are shown in Table D.

Table C shows that the quantity of rice purchased by the PWO to intervene in the market was 1.16 million tons, 1.33 million tons and 0.55 million tons, respectively, in the crop years of 1980/81, 1981/82 and 1982/83.

Buffer stock accumulated over the last three years which was originally for export and local consumption, could not be entirely released to the local market during the early period of the each crop year because it would have effected a paddy price decrease.

The PWO, therefore, had to store this huge amount of rice for a long period to export it. But unfortunately the price of rice in the international market fell in the latter stages of the operation.

The prices of rice purchased by the PWO were in fact higher than the market price, and international rice prices during that time were much lower than the purchased prices, thus causing a huge loss to the PWO.

In the implementation of the Paddy Price Support and Stabilization Program, the Agricultural Cooperatives Federation of Thailand (hereafter called ACFT) has also been assigned by the Government to purchase paddy from its members at the Government target price for rice milling. The target price of paddy fixed by the Government was higher than the actual market price and thus caused higher costs to ACFT. ACFT would be faced with losses if it sold the rice stock on the market. The PWO was, therefore, assigned to buy milled rice from ACFT at a price calculated from the target price of paddy with the addition of other operating costs. The prices of these purchases were therefore much higher than actual market prices, thus were another cause of the huge losses incurred by the PWO.

The cabinet has approved an agreement for the Government to compensate the PWO for all losses during the past three years.

For the 1983/84 crop year, the government used the export mechanism by reducing the export premium and export tax, instead of using market intervention to support the paddy price.

Floor prices of paddy have also been announced for this crop year by the Government, but the purchase of rice by the PWO and other agencies to intervene in the market has so far been suspended.

4) Constraints on the PWO activity in the market intervention program and countermeasures.

Several constraints on PWO's performance in market intervention operations were the main causes for the huge loss incurred over the last three years. They can be grouped, however, into the following four factors.

i) Financial factor

To smoothly purchase a fairly large amount of rice during the short period immediately after the harvest, the PWO required large funds. In the rice market intervention activities over the last three years, these funds were financed by a commercial bank loan with rather high interest.

The financing for these operating funds which can be turned over by the selling and buying operation should be made available from governmental financial sources without interest or at a low rate of interest.

ii) Facility factor

The PWO owns warehouses which met only 7% of its capacity requirements for the operation in the 1980/81 and 1981/82 crop years. The balance had to be rented from the private sector. Renting private warehouses gives rise to various problems. These include:

a) Warehouses of substandard quality allow the stored agricultural commodities to deteriorate rapidly.

b) Warehouses are of small capacity requiring the PWO to rent a large number. They are also scattered over a wide area which makes it difficult to keep them under proper management.

c) Rented warehouses are often located far from loading and port facilities, causing transportation problems.

d) Rental fees are high because of limited available space.

e) Lack of necessary warehouse facilities.

In order to serve the Government policy in such a program, the PWO should be ready to intervene in the market with its own warehouses and facilities.

iii) Marketing factor

The huge amount of rice purchased by the PWO to support the prices for the benefit of the farmers must be either released to the local market to stabilize consumer prices or exported to foreign countries. However, during the program, the PWO was not given top priority in government-to-government export for its rice stock.

Marketing is very important not only for its price stabilizing function but also for fulfilling the PWO's role to support the price for farmers.

When it is difficult to release the buffer stock to the local market because of the prevailing market situation, these stocks in the PWO warehouses should be given priority in meeting the export quota of the government-to-government sales contracts.

iv) Personnel factor

The assignment of market intervention has caused the PWO to increase its personnel sharply from 500 to 800 persons during the program. It is thus quite natural that the PWO had to recruit a large number of inexperienced personnel to perform the job. It is necessary for the PWO to establish the Grain Storage Technology Development Facility (tentative) to improve inventory management and conduct applied research work and training.

The four constraints on the PWO mentioned above should be dealt with in a systematic, integrated manner with the cooperation of all organizations concerned in the PWO's financial, purchasing and marketing operations.

To attain the goal of market intervention, it is necessary for the Thai Government to establish long-term policy, so that the organizations in charge of and concerned with the operation can be sustained on a firm foundation and managed effectively.

In spite of efforts to remedy the situation, market intervention is still subject to losses because of its function in supporting prices for farmers and stabilizing prices for consumers.

These losses, when occurred, can be compensated by the Government as for the loss incurred in the last three years.

5) Effective rice market intervention by the PWO to support paddy prices

i) It has been clearly stated by Mr. Kosol, the Minister for Commerce, during a courtesy visit of the survey team that the Ministry intends to intervene in the market by purchasing and selling about 10% of the marketable surplus of agricultural products.

The marketing of agricultural commodities in Thailand is mainly handled by numerous merchants, millers, and traders which have formed efficient groups of business circles.

Under these circumstances, the PWO must take special and specific measures to make market intervention activities successful, effective and efficient.

ii) Raising the income level and living standard of farmers is the most important of the three objectives of the rice market intervention activities assigned to the PWO under the Paddy Price Support and Stabilization Policy of the Thai Government.

A market mechanism has been used for market intervention with the expectation that additional demand at the beginning of the harvesting season will help increase the paddy price above or near the target price fixed by the Government and enable farmers to sell their products at a higher price. The purchase of milled rice by the PWO is expected to produce this additional demand.

The PWO purchased milled rice in the last three years from various groups, including millers, private traders and agricultural cooperatives and farmers' groups. But the most effective channel to assure that farmers can sell their products above or near the target price is direct purchase from agricultural cooperatives.

iii) To stabilize this system, it is advisable that the PWO co-operates or enters a joint program with the Agricultural Cooperative Organizations and Bank for Agriculture and Agricultural Cooperatives (BAAC).

Agricultural Cooperative Organizations (including primary cooperatives at the Amphoe level, federation of cooperatives at Changwat level and Agricultural Cooperatives Federation of Thailand at national level) are conducting marketing business to attain reasonable prices of agricultural products, especially for paddy, for the benefit of farmers against the profits of private traders.

BAAC is in a position to provide the agricultural cooperative organizations with the necessary funds for purchasing and marketing agricultural products of members.

This type of joint program has already been in operation from 1980, titled "Production Credit and Marketing Linkage Program for Rice of Agricultural Cooperatives in Thailand" (hereafter called "Linkage Program") under the support of the Cooperatives Promotion Department of the Ministry of Agriculture and Agricultural Cooperatives to implement the program.

The PWO has been purchasing milled rice from the ACFT and/or farmers' organizations under this "Linkage Program". These purchases have been about 20% of milled rice purchased by PWO in 1981 and 1982 and more than half in 1983.

A joint program such as this "Linkage Program" should be continued and expanded to serve as the basic set-up of rice market intervention by the Government of Thailand, as this type of joint program is most conducive to effective market intervention activities to support paddy prices for farmers.

CHAPTER VII OTHER ORGANIZATIONS CONCERNED WITH THE ACTIVITIES OF THE PWO

CHAPTER VII OTHER ORGANIZATIONS CONCERNED WITH THE ACTIVITIES OF THE PWO

7-1 Agricultural Cooperatives

7-1-1 Brief History of Agricultural Cooperatives in Thailand

1) The agricultural producer's associations in Thailand dated back to 1916 when the first rural village credit cooperatives was formed at the initiative of the government.

Between 1959 and 1972, the land improvement cooperatives were formed and expanded to the irrigation system at the "tumbol" level.

Recognizing the fact that most of the cooperatives were small in size and narrow in scope to satisfactorily meet the increasing demand of member farmers, the government in late 1959, set up a programme under which limited liability production credit co-operatives were organized in some provinces with share capital, and consisted of groups of farmers at the district level to enable greater number of members to join.

As membership increased and the business functions expanded, the cooperatives generated surplus. The successful operation of these credit cooperatives proved that with proper size and expanded business activities, they can meet the greater needs of members and have a better chance to succeed than a small single-purpose credit society. This supports the idea of merging a number of small credit societies into a large size and more viable unit.

2) In 1968, the Cooperatives Societies Act was promulgated, repealing the Cooperatives Societies Act of 1928, in order to facilitate the expansion and improvement of the cooperatives. The first government programme of cooperatives amalgamation was then designed for a three

year operation from 1969 to 1972, combining several village-level credit societies into a district level cooperative. They performed the same activities as production credit cooperative but are officially called agricultural cooperatives.

3) In 1972, the government's organization in charge of administration for cooperatives including the Land Cooperatives Department finally merged into a unified Department which is the present Cooperatives Promotion Department. This means that the agricultural cooperatives have evolved from the amalgamation of village credit societies, land improvement cooperatives and production credit cooperatives into co-operatives of larger size covering an entire district and capable of doing a multi-purpose function.

7-1-2 Present Situation of Agricultural Cooperatives

1) At the end of September, 1981, there are 714 agricultural cooperatives established in various districts of the country. Their activities include agricultural credit service, purchasing, land improvement, processing (small rice mill) and marketing of farm products and extension service.

2) These agricultural cooperatives are the primary societies at the local or district level which consist of individual farmers. At the level above this level, there are 27 secondary or provincial cooperative federations which undertake joint activities on behalf of their primary affiliates, including the processing of agricultural products. Their members are not only agricultural cooperatives but also consumers' and thrift and credit cooperatives.

3) At the national level, the Agricultural Cooperative Federation of Thailand is the apex society of the agricultural cooperatives. The

members are the agricultural cooperatives and the provincial agricultural cooperative federations. The Cooperative League of Thailand, established under the Cooperative Societies Act of 1968, is regarded as the apex organization of the cooperative movement at the national level.

7-1-3 Marketing Activities of Agricultural Cooperatives and its Problems

1) Cooperative marketing system for rice

The marketing of paddy or rice is the biggest business line of the agricultural cooperatives. In 1977 the government provided long-term loans to agricultural cooperatives to establish 500 warehouses for paddy and other products. At the end of September, 1981, 714 agricultural cooperatives with 711 thousands members, in total, own and operate 664 warehouses with a total capacity of 315,425 mt and 19 rice mills with a total capacity of 448 mt/day.

In addition to these, there are 27 provincial cooperatives federations operating 23 rice mills with a total capacity of 1,450 mt/day. These federations also obtains marketing loans from the Cooperative Promotion Department and other sources for purchasing paddy or other products from the primary societies as well as farmers. They process these products and resell them to the Agricultural Cooperatives Federation of Thailand (hereafter called as the ACFT), cooperative stores, traders and others.

At the national level, the ACFT is engaged in importing farming materials and exporting farm products. The most important imported product is fertilizer as it is the agent that distributes this input to the primary societies. Rice is the most important export which is purchased from the provincial federations and primary societies.

The ACFT is financed by the Cooperative Promotion Department.

2) Major problems of cooperative marketing

Members of primary cooperatives account for only 14 percent of total number of farmers in the country, hence their bargaining power is weak. The primary cooperatives have, on average, the member of only 1,000 families. Their volume of business is too small to support the price of paddy for farmers and are not able to compete with private traders of farm products.

As a matter of fact, under the current set-up and practices, the marketing system of agricultural cooperatives as a whole is widely distributed and manifold. It starts from the farm gate of member farmers, through the second points of primary societies for collection of paddy and the third point of the provincial federation for processing, finally goes through the fourth point of distribution center at national level organization. Consequently, the price of the products which go through these channel and are disposed of finally by the national level organization is usually much higher than those dealt with by the private traders.

7-1-4 Production Credit and Marketing Linkage Programme for Rice

1) In view of the weakness of the marketing system discussed above, the Cooperative Promotion Department decided to stop the old marketing system in 1981 and promoted instead a new programme called Production Credit and Marketing Linkage Programme for Rice.

Under this programme, cooperatives at all levels will work together as one integrated cooperative organization. Their bargaining power will be strengthened, the marketing costs will be reduced, and a

reasonable price support scheme will be applied.

The ACFT, 19 provincial cooperative federations and 339 primary agricultural cooperatives, with their facilities of 37 rice mills and 510 warehouses were selected to cooperate. The government agencies provided the financial and marketing support and supervision.

2) The operation of the programme is as follows.

The Agricultural Cooperatives Rice Marketing Promotion Centre was set up under the Cooperatives Promotion Department (hereafter called as the CPD) of the Ministry for Agriculture and Agricultural Cooperatives to operate and control the activities of the movement such as the paddy collection, grading, storing, transportation, processing and distribution. After a few years or as soon as the programme gains a headway, the ACFT will take over the responsibilities gradually.

The Bank for Agriculture and Agricultural Cooperatives (BAAC) and the CPD are the main sources of funds to finance the primary societies for paddy collection.

The primary societies are only authorised to collect and grade paddy. The farmer members who deliver the paddy receive the way bill from their societies and collect the proceeds themselves from the bank. The societies deliver the paddy to the nearest rice mill of any primary societies or provincial cooperatives federation.

The rice mill of the provincial federation will undertake only the processing of paddy and deliver the milled rice to the PWO warehouses or to the ACFT warehouses without purchasing or/and selling.

ACFT is responsible for the whole operation as follows. It does not purchase paddy or rice, as it is only distribution of rice. It enters into an agreement with the PWO and offers to make delivery contract. It collects the proceeds from the buyer and deposits the same to the BAAC or CPD for clearing of loans borrowed for paddy purchasing.

3) The initial results of the new programme in fiscal 1981 have been encouraging. The value of paddy delivered by the farmer-members was 397.4 million Baht, of which 293.6 million was turned to loan repayment representing 74 percent repayment rate.

The primary cooperatives collected paddy from member at high prices according to the new price support system. The operation cost of the primary societies was only 10 Baht/mt of paddy.

7-2 Bank for Agriculture and Agricultural Cooperatives

1) Bank for Agriculture and Agricultural Cooperatives(hereafter called as BAAC), as a government-owned bank, is extending its credit services to more than 2 million agricultural households which represent nearly 40% of the total number of agricultural households in Thailand.

2) There are three types of clients of BAAC loans, individual registered client farmers, agricultural cooperatives and farmers' associations.

3) Loans which are provided to individual registered client farmers are divided into three kinds of loans, short term loans, medium-term loans and long term loans. These loans represent about 70 - 80 percent of the total amount of loans disbursed annually by BAAC. About 25 percent of the total loans are provided to Agricultural Cooperatives and the remaining 1 - 2 percent to Farmers' Associations.

4) Loans to registered client farmers are provided on both a group lending and individual lending basis. Since by far the majority of the Bank's clientele are small and middle-income farmers, the group lending delivery system is the more important of the two. Under this system each farmer is required to join an informal, joint liability client group of at least 5 farmers before applying for a short and/or medium term loan.

5) BAAC makes four types of loans available to agricultural cooperatives. These consist of loans for lending to member farmers, loans for purchasing agricultural inputs and equipment for resale to members, loans for purchasing and marketing members' agricultural products and long term loans for investment in fixed assets. In 1982, cooperatives availed themselves of loans for purchasing and marketing members' agricultural products to the amount of 243 million Baht which accounted for 9 percent of the Bank's total disbursement to cooperatives.

6) Farmers' association are the second type of farmers' cooperative institution existing in Thailand, and are basically organized along the same lines as agricultural cooperatives. Current government policy clearly favours agricultural cooperatives rather than farmers' associations with the result that the number of farmers' associations in existence is gradually diminishing.

7) Agricultural Cooperatives Restructuring Programme

i) Despite 65 years of sustained effort and the expenditure of considerable governmental resources, agricultural cooperatives in Thailand has not yet matured into efficient and self-reliant business enterprise serving the social and economic needs of their members.

ii) In the year of 1980 the Thai Government adopted in principle the NESDB's Five-Year Comprehensive Plan for the Development of Agricultural Cooperatives, one development from which is the Agricultural Cooperatives Restructuring Programme. This programme aims to strengthen and develop the multi-purpose business activities of about 400 weakest agricultural cooperatives in three years.

iii) Among many activities and tasks of the programme, BAAC is also assigned to initiate the Marketing Support Project for those cooperatives having the potential to provide a viable marketing service to their members.

iv) In its capacity as the most important source of operating funds for agricultural cooperatives at all levels, BAAC is highly desirous that the credit worthiness of these agricultural cooperative should be upgraded.

v) In addition to a credit service originally assigned to it by the Government, BAAC now thus offers advice and cooperation in a broad sphere of agricultural cooperatives activities, in a strong belief that the comprehensive five-year plan will meet its stated objectives and ultimately result in agricultural cooperatives maturing into economically viable, self-sufficient, business enterprises conducting credit, farm supply and marketing operations for the benefit of the Kingdom's farming population.

7-3 Market Organization for Farmers

1) Market Organization for Farmers (hereafter called MOF) was established as one of the state enterprises under the Royal Decree of Establishment in 1974 with the authorised capital of one billion baht (US$50 millions), of which 50 million baht has been invested by the Government.

2) The major objectives of MOF are

i) to provide farmers with their agricultural in-put including materials and equipments and their necessary consumers' goods.

ii) to establish the market for selling and purchasing of agricultural products to keep up the price of agricultural products.

iii) to assemble agricultural products from farmers for disposition, or processing for disposition both within and outside the Kingdom of Thailand.

3) The MOF's operation with regard to paddy

In accordance with the government's policy in helping farmers to get good selling price for paddy, MOF was assigned to purchase paddy from farmers, agricultural cooperatives and farmer's associations in order to support the price of paddy to the target level. This is the paddy market interventions activities by MOF under the paddy price support and stablization programme by the government.

This purchase by MOF has also the merit for MOF by giving the fund to farmers to clear up their debts of fertilizer provided them by MOF on credit.

The fund necessary for MOF to purchase paddy is financed by the loan from Farmers' Aid Fund administered by the Ministry of Agriculture and Agricultural Cooperatives.

CHAPTER VIII ANALYSIS OF PRODUCTION, MARKETING AND EXPORTS OF AGRICULTURAL PRODUCTS IN TERMS OF QUANTITY

CHAPTER VIII ANALYSIS OF PRODUCTION, MARKETING AND EXPORTS OF AGRICULTURAL PRODUCTS IN TERMS OF QUANTITY

8-1 Analysis of Current Situation in a Three Year Average, 1979 - 1981

Statistical analysis was made using economical formulas, employing parameters of individual statistical sectors.

8-1-1 Analysis of Rice Situation

1) Analysis procedure

Two basic formulas are employed to determine both the sales of paddy from rice-growing farming households and the export potential of milled rice in terms of quantity.

(i) $V = Y-D'$

where: V = Normal availability of sales from rice-growing households

Y = Production of paddy

D' = Normal demand in rice-growing households

(ii) $X = Y - D$

where: X = Normal availability of exports of milled rice

D = Normal demand in whole Kingdom

D' and D are aggregation derived from (i) seed requirement, (ii) normal estimated loss in harvesting, transportation and storage, (iii) normal requirement of food consumption and (iv) requirements other than food (for example, feed, processing sweets, etc.).

2) Results of analysis (See the following table.)

Analysis results summarized the marketing flow of paddy and milled rice at each stage in the marketing channel and also, at the same time, normal export potential both nation-wide and by region:

- Production is recorded at 16.967 million M/T.

- Normal demand in rice-growing households is estimated at 6.553 million M/T.

- Normal marketing availability from rice-growing households is estimated at 10.541 million M/T.

- Export availability in three year average during 1979 - 1981 is estimated at 2.939 million M/T.

3) Marketing analysis

Analysis procedures were applied to the Bangkok Metropolis area and 71 other Changwats. The result values were processed using the same formula as forementioned in 8-1-1. These figures of every Changwat, combined together with results of regional analysis, supply us with significant informational data regarding marketing rice in terms of quantity in Thailand.

General conclusions are:

i) Rice-growing households in the Central and Lower North have available to them a large amount of paddy sales (4.163 million M/T) (83% of paddy production) in the Central and 2.201 million M/T (73% of paddy production including second rice crop) in the Lower North, while in the Northeast, marketable availability from rice-growing households is a lesser percentage (45%) of paddy production (2.511 million M/T).

ii) Milled rice which may be distributed and consumed in non-rice-growing households is estimated at approximately 36% and 30% of the total estimate of rice milled within the regions, respectively in the Central (except the Bangkok area where estimated food consumption is about 0.65 million M/T milled rice basis) and the Lower North. In the Northeast, as compared with these figures in the two regions, the percentage

Table VIII-1 Analysis of Production, Marketing and Export of Rice in Terms of Quantity (1979 - 1981 Avg.)

(Unit: Paddy in 1,000 M/T
Milled rice in bracketed figures)

(Milling rate: 65%, except 60% in Northeast)

	Central	Lower North	Upper North	North East	South	Whole Kingdom
0. Population	15,464	5,066	4,521	16,090	5,823	46,961
1. Production of paddy						
Major rice crop	3,847	2,886	1,844	5,591	1,102	15,270
Second rice crop	1,458	105	64	41	29	1,697
Total	5,305	2,991	1,908	5,632	1,131	16,967
2. Demand in rice-growing households 1/						
Major rice crop	1,030	781	791	3,076	578	6,256
Second rice crop	112	9	5	4	2	132
Total	1,142	790	796	3,080	580	6,388
Population	2,806	2,199	2,726	9,381	2,369	19,491
3. Availability of sales from rice-growing households (1. - 2.)	4,163 (2,706)	2,201 (1,430)	1,112 (723)	2,552 (1,531)	551 (358)	10,579 (6,749)
4. Regional demand other than rice-growing households	2,492 (1,620)	668 (434)	453 (294)	1,753 (1,052)	634 (412)	6,000 (3,813)
5. Surplus above Regional demand	1,671 (1,086)	1,533 (996)	659 (428)	799 (479)	-83 (-54)	4,579 (2,939) 2/

Source of Data:

Production; Agricultural Statistics of Thailand, 1981/82

Population; Registered Population, Ministry of Interior, 1980

Population of rice-growing households; 1978 Agricultural Census Report, data adjusted to 1980

Remarks:

1/: Includes requirement for seed, uses other than food, harvest losses, transportation and storage by rice-growing households.

2/: Export potential in this analysis, 2.939 million tons is 2.19% over actual export of 2.876 million tons of a three year average 1979 - 1981.

Fig. VIII-1 AMOUNT of RICE PRODUCTION and MARKETING in THAILAND

(1979 - 1981 average)

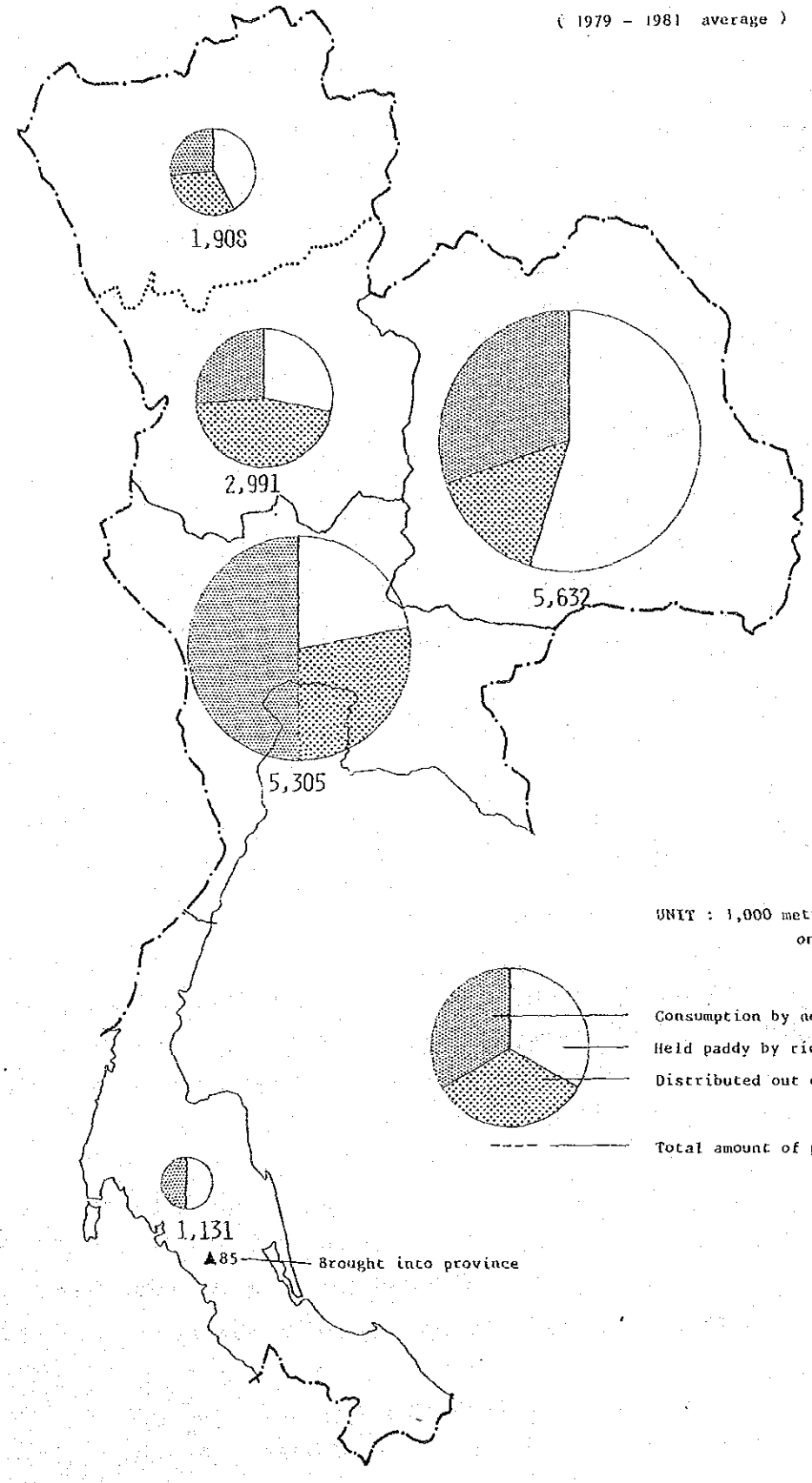
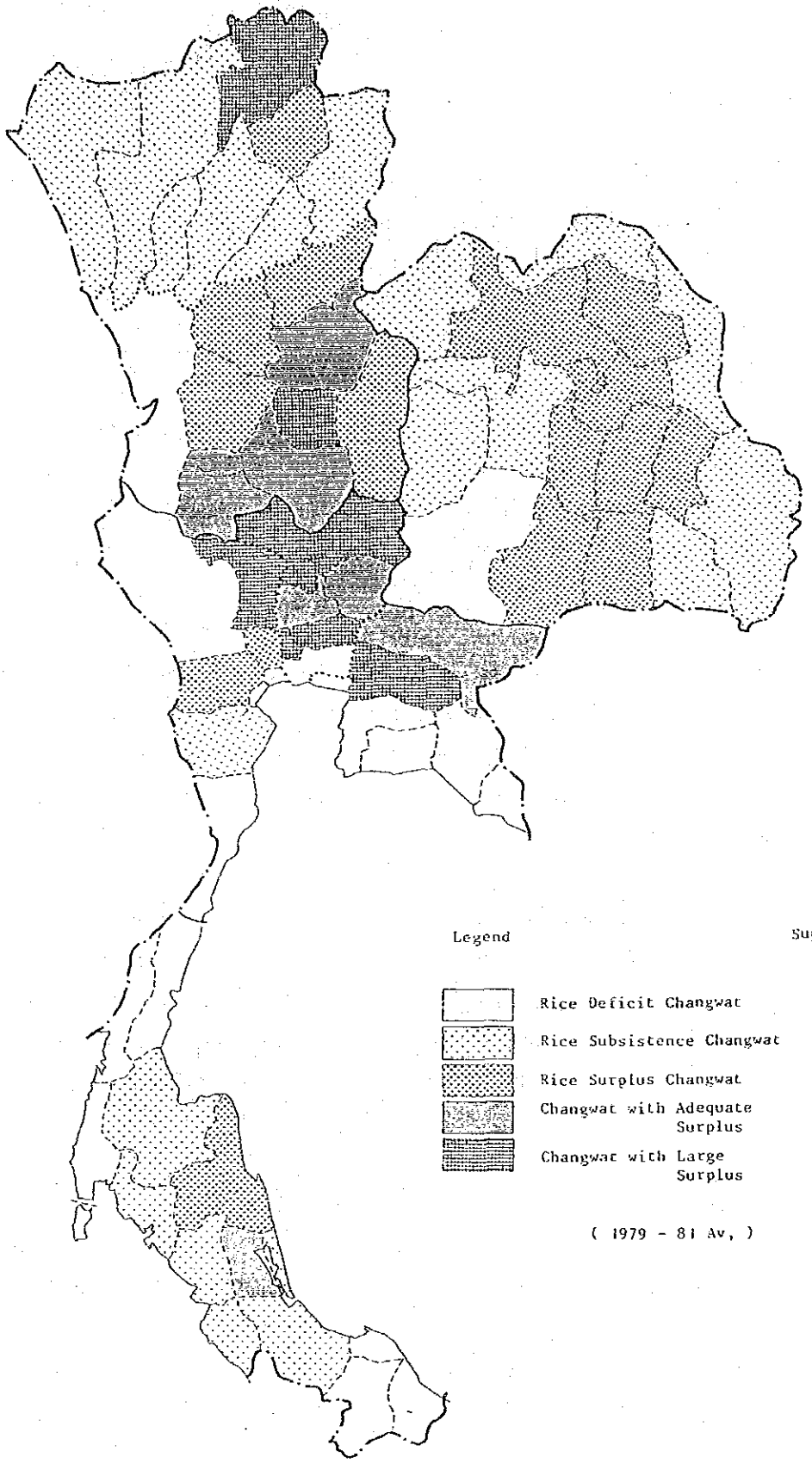


Fig. VIII-2

SURPLUS and DEFICIT of RICE by CHANGWAT

(detailed data in every Changwat; refer to Appendix 0-24)



of milled rice which will be redistributed and consumed in non-rice-growing households is much higher (68%), 1.207 million M/T).

iii) Bangkok is conceivably estimated to collect more than 2.7 million M/T of milled rice including normal food consumption in the Bangkok area (a little more than 0.65 million M/T) from only two regions, Central and Lower North, in addition to shipment from other regions.

Approximately 2.1 million M/T (more than 0.85 million MT may be second rice crop) of milled rice collected from the Central and Lower North is estimated to be sent into foreign trade channels from Bangkok, together with a little more than 0.9 million M/T of milled rice collected from other regions in a three year average, 1979 - 1981.

8-1-2 Analysis of Upland Crops and Products

Six major upland crops (maize, mung bean, cassava, sugar cane, kenaf and sorghum) have a share of the 87 - 89% of planted acreage among the total area under upland crops and vegetables, (Appendix O-27). Exports of six major upland crops and products amount to 9 million M/T in three year average, 1979 - 1981. (Appendix O-28)

Most of the production of upland crops is marketed from farming households with very little kept for home consumption. Export percentages for selected upland crops are estimated at 75 - 95% for maize, 35 - 40% for mung bean, 90 - 95% for cassava and about 70% (sugar and molasses included) for sugar cane in recent normal years. (Appendix O-29)

Eight major exports items (rice and six major upland crops and products --- sugar and molasses are processed from sugar cane.) --- amount to almost 90% (approximately 12 million M/T) of the total estimated export quantity (approximately 13.5 million M/T in a 3 year average 1979 - 1981) from Bangkok. Exports in terms of quantity of the six major upland crops and products (9 million M/T) almost equal 85% of

Fig. VIII-3 MAIZE PRODUCING CHANGWAT

(for detailed data, refer to Appendix 0-24)

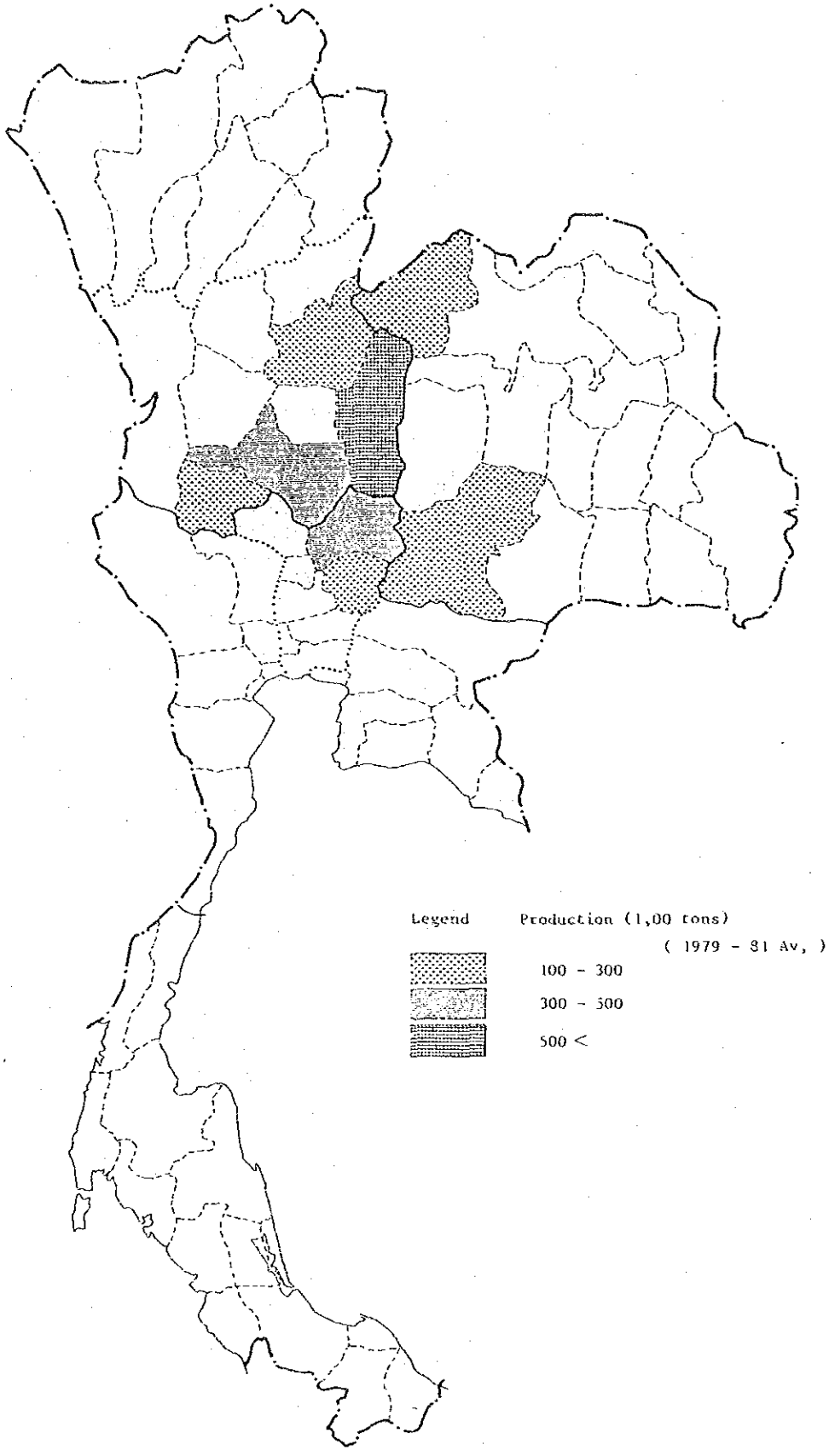


Fig. VIII-4 CASSAVA PRODUCING CHANGWAT

(for detailed data, refer to Appendix O-24)

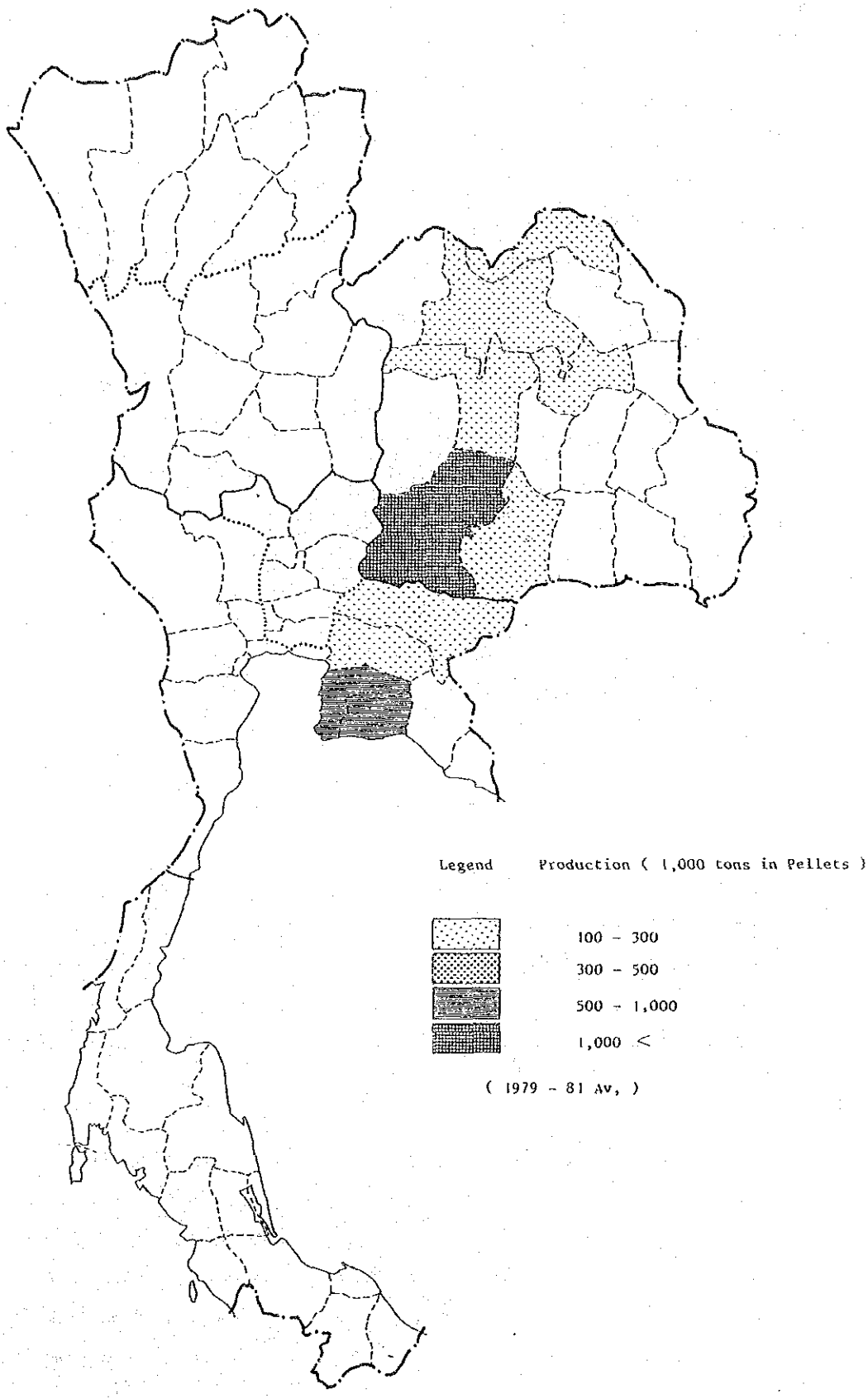


Table VIII-2 Changes of Major Factors Supporting Agriculture

	Population	Farm holding land	Area under rice	Area under upland crops	Exports of 8 major items 2/	Farm size per household	Yield per major rice crop/rai **
I. Data							
Mid-1950s	22,099	61,382	34,732	5,165	n.a.	27.79	196
1962	27,995	69,682	42,861	6,104	2,518	21.68	253
1973	39,375	109,406	52,270 (50,222) 1/	20,161	6,155*	27.97	266
1975-77 av.	42,419	113,112	53,029 (52,523) 1/	21,895	9,409*	27.24	255
1979-81 av.	46,455	118,999	59,684 (56,714) 1/	26,441	11,888*	26.63	269
II. Growth rates (%)							
Mid-1950s-1962	3.00	1.60	2.66	2.11		-2.05	2.15
1962-73 (av.)	3.15	4.19	1.82	11.79	8.48	2.34	0.46
1973-80 (av.)	2.37	1.20	2.02 (1.79) 1/	3.95	9.86	-0.70	0.16
1973-76 (av.)	2.51	1.12	0.48	2.79	11.19	-0.87	-1.39
1976-80 (av.)	2.29	1.28	3.00 (1.94) 1/	4.83	6.02	-0.56	1.34

Remarks: Mid-1950s (1954): All figures are from the Statistical Review of Thai agriculture, 1954.
Other data is from Agricultural statistics of Thailand series.

* : 3 year averages

**: 3 year average

1/ Major rice corp only

2/ Rice, Maize, Kenaf, Cassava Products, Mungbean, Sorghum, Sugar and Molasses

the total exports, excluding rice (13.5 - 3 = 10.5 million M/T). Six major upland crops play a large role in exports, in terms of quantity, from Bangkok. (Appendix O-28)

That 26 million rais of upland crops produce 9 million tons of exports may be a good basis for estimating future exports in quantity.

8-2 Projections of Production, Domestic Demand and the Export Potential of Agricultural Products in 1990 and 2000

8-2-1 Statistical Review of Major Factors Supporting Agricultural Development in the Past

1) Changing tendencies of major factors supporting agricultural development

The average annual growth rates of the major factors that have supported this country's agricultural development have changed during the 30 years from 1950 to 1980. They are summarized in the following table.

Development of Thai agriculture has been achieved primarily through the extension of the planted area with few agricultural inputs instead of an increase in productivity per rai during the same period. Population growth had played a considerable role in the extension of the planted area.

i) Population growth rates

High population growth rates of more than 3% per annum up to 1973, declined to an average annual growth rate of 2.37% between 1973 - 80.

ii) Growth rates of area of farm holding land

The average annual growth rate of area of farm holding land was above the average annual growth rate of population and was as high as 4.19% in the diversification of agriculture period of 1962 - 73. The competent rate declined to below the population growth rate from 1973 - 80, to a rate of only 1.20%.

iii) Growth rates of paddy planted area

The average annual growth rates of major rice crop planted areas which are always below the average annual growth rates of population was only 1.79% in the period from 1973 - 80.

iv) Growth rates of area under upland crops

The average annual growth rate of the area under upland crops was as high as 11.79% in 1962 - 73. This was significantly higher than the average annual growth rate of population, 3.15%. This rate fell to 3.95%, which is much lower than in the previous period, however, still over population growth rate.

v) Farm size per agricultural household

Farm size per agricultural household declined from 27.79 rais in the 1950s to 21.68 rais in 1962 when the Agricultural census was conducted. This was an annual rate of decline of -2.05%. From 1962 - 73, farm size per household increased to 27.97 rais, at the annual growth rate of 2.34%. However, farm size turned again to decline from 1973, and it was 26.63 rais in 1980. This was an annual rate of decline of -0.79% from 1973 - 80.

The declining farm size per agricultural household deserves special attention in foreseeing the capacity of development agriculture.

In reviewing changes in major factors which supported agricultural development, especially area of farm holding land and farm size per household, the year 1973, is important in studying the agricultural development of this country.

2) Review of major factors supporting production of major rice crop

Major rice corp has been and still is the most important crop in Thailand. Further examination will supply suggestions for a perspective analysis for future production capacity. Two main factors of production are planted area and average yield per rai.

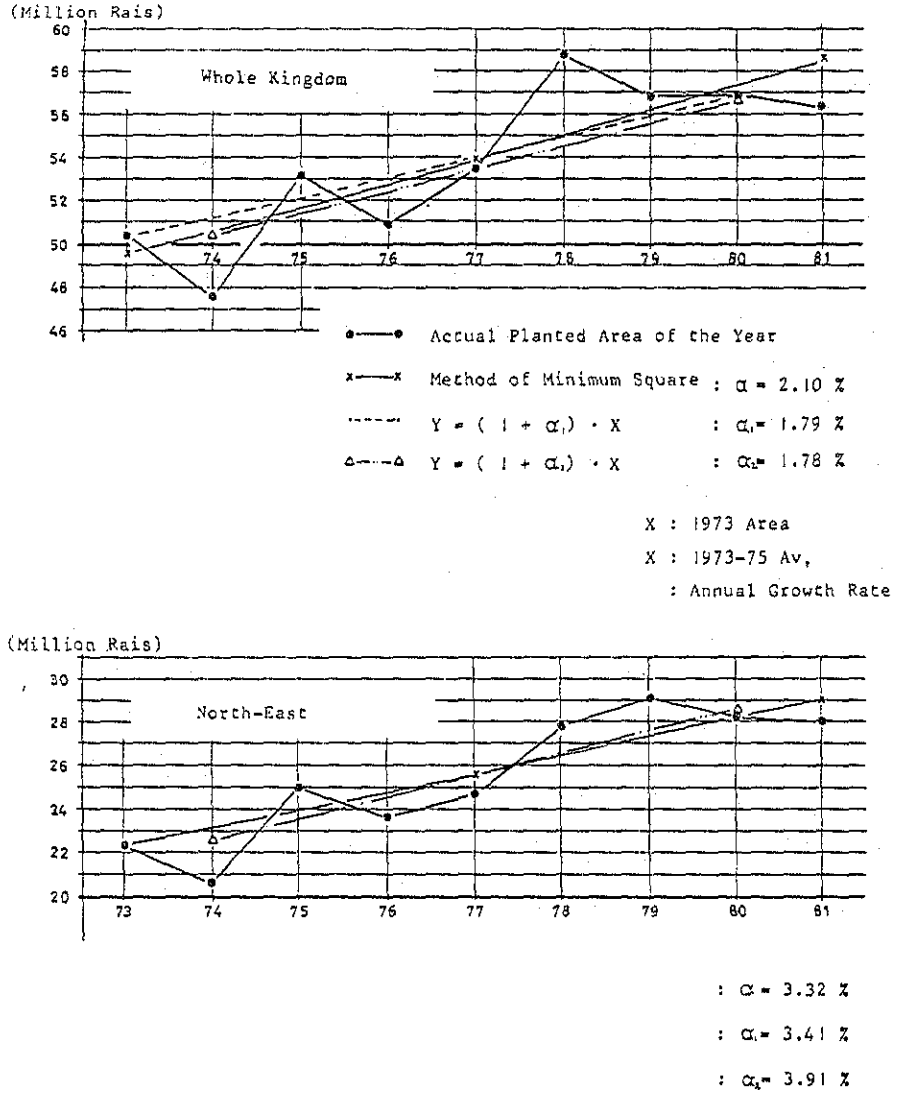
i) Growth rate of paddy planted areas by regions

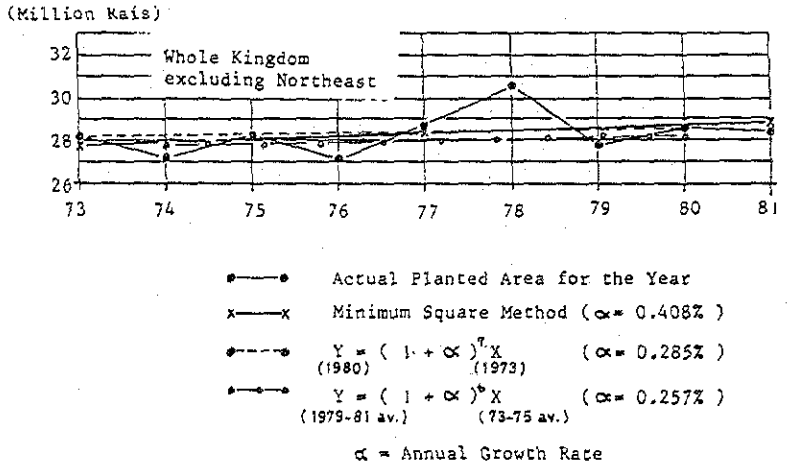
When a statistical review is centered on rice cultivation, the annual growth rate is recorded at 2.02% from 1973 - 80. However, 1.79% is marked for the major rice crop and 5.45% for the second rice crop.

Growth rates vary from region to region. The region with the highest growth rate is the Northeast. Major rice crop planted areas have declined in the Central region.

From 1973 to 1980, the planted areas for the major rice crop in all regions, except the Northeast, increased by only 0.433 million rais (from 27.844 million rais in 1973 - 75 av. to 28.277 million rais in 1979 - 81 av.) at an average annual growth rate of 0.25%. In the Central region, planted areas of the major rice crop declined at an average annual rate of about -1.8%.

The planted areas of the major rice crop in the Northeast increased by 5.849 million rais (from 22.588 million rais in 1973 - 75 av. to 28.437 million rais in 1979 - 81 av.) at a high annual growth rate of 3.91%.





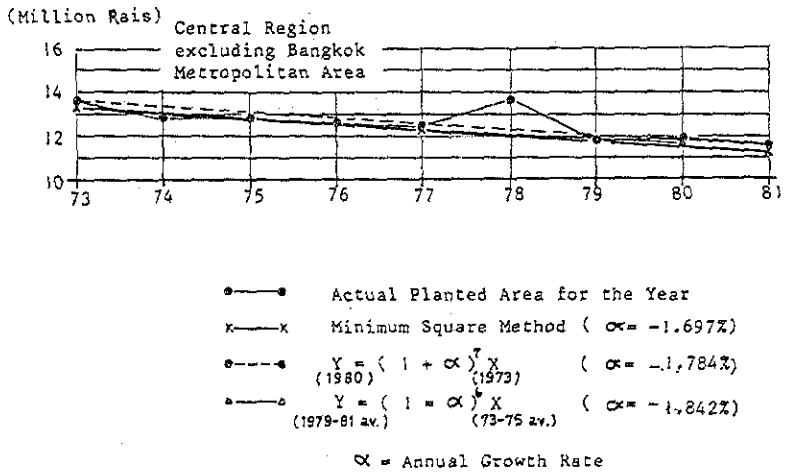


Fig. VIII-5 Average Annual Growth Rates of Planted Areas of the Major Rice Crop Under Different Methods of Analysis (1973-81)

In consideration of the fact that the planted area of the major rice crop increased by 6.282 million rais (from 50.432 million rais in 1973 - 75 av. to 56.714 million rais in 1979 - 81 av.) almost all of the increased planted areas of the whole Kingdom (93%) were in the Northeast Region.

ii) Growth of yield per rai of second rice crop

Yield per rai of the major rice crop has not improved much in the period from 1973 - 75 av. to 1979 - 81 av. Yield per rai increased from 267.1 Kg in 1973 - 75 av. to 269.2 Kg in 1979 - 81 av. at an average annual growth rate of only 0.13%.

However, in Northeast, yield per rai decreased unexpectedly from 201.7 Kg in 1973 - 75 av. to 196.6 Kg in 1979 - 81 av. Yield per rai in the Region decreased at an average annual rate of -0.393%.

All other areas excluding the Northeast showed an increased rate of 1.08%. This was because yield per rai improved from 319.7 Kg in 1973 - 75 av. to 341.2 Kg in 1979 - 81 av.

8-2-2 Projections of Rice Production

1) Population projections

Population data is important in making an examination of production, domestic requirements and export potential of rice. All projected perspectives on planted areas of rice and upland crops, domestic requirement and export potential in 1990 and 2000 are based upon the following projected population.

The Government of Thailand had made population projections under two assumptions of high fertility and low fertility. According to these projections, Thailand population will be:

Table VIII-3 Changes of Yield per rai by Regions
(1973-75 av./1979-81 av.)

(Unit: Kg)

	1973-75 av.	1979-81 av.	Average Annual (%) Growth Rate
0. Whole Kingdom	267.1	269.2	0.1306
1. Central	305.2	324.1	0.995
(i) Bangkok Metropolis area	340.2	417.1	3.488
(ii) excl. Bangkok area	304.3	322.1	0.952
11. Central	326.2	363.9	1.839
(ii) excl. Bangkok area	325.1	356.2	1.534
12. East	263.0	282.3	1.187
13. West	306.4	299.9	-0.356
2. North	356.7	378.6	0.998
21. Lower North	317.8	336.8	0.972
22. Upper North	459.0	469.1	0.363
3. Northeast	201.3	196.6	-0.393
4. South	258.8	281.7	1.423
5. Whole Kingdom excl. Northeast	319.9	341.2	1.080

Source: Derived from data in Agricultural Statistics of Thailand series

(Unit: 1,000)

	High fertility	Low fertility
1980	46,455	46,455
1985	51,571	51,301
1990	56,185	55,345
1995	61,113	59,580
2000	66,114	63,772

Average annual growth rate from 1980 to 1985 will be 2.11% in the case of high fertility and 2.00% in the case of low fertility. (Appendix O-30)

Recent annual population growth rates were 2.62% from 1970 - 75 and 2.34% from 1975 - 80. The annual population growth rate has been declining. Such declining trend is very close to the growth rate of low fertility in the Government projections. Population projections are, then, made based upon low fertility data from the Government projection.

Annual growth rate of population may be;

1.77% in 1980 - 90 and
1.43% in 1990 - 2000

Population growth rates were not the same in the different regions. The Bangkok metropolis area has experienced the highest growth rate. It is 1.62 times as high as the annual growth rate of the whole Kingdom's average. The averaged figure of the annual growth rate of the population in the whole Kingdom, excluding the Bangkok metropolis area, is 93% of that of the whole Kingdom. (Appendix O-31)

Population distribution by region shall be as follows, based upon different annual population growth rates computed by region.

(Unit: 1,000; Projections are in round figures)

	1980	1990	2000
Whole Kingdom	46,455	55,345	63,772
Bangkok metropolis	5,152	6,840	8,600
Central	14,601	17,800	20,900
Central excl. Bangkok area	9,449	10,960	12,300
North	9,667	11,160	12,540
Northeast	16,433	19,580	22,570
South	5,754	6,890	7,970

This population data by region is the basis on which the following projections of production, demand and export potential are made.

2) Projection of major rice crop

i) Projections of planted area of major rice crop

Projections of planted area of major rice crop are processed from relationships of growth rates of planted area and growth rates of population by region in the past 1973 - 1980 (elasticity of annual growth rate of planted area against annual growth rate of population). Projected planted area of major rice crop by region shall be summarized as follows:

(Unit: million rais)

	1979 - 1981 av.	1990	2000
Whole Kingdom	56.432	64.1	71.4
Central	11.924	11.1	10.8
North	12.478	13.9	15.1
Lower North	8.550	9.3	10.0
Upper North	3.929	4.6	5.1
Northeast	28.437	34.8	40.9
South	3.923	4.3	4.6

ii) Projections of major rice crop production

Projections of production in 1990 and 2000 are processed respectively from both the above projected planted area and the projected yield per rai by region, which is estimated by the different annual growth trends experienced in 1973 - 80, based upon the average yield per rai of 1979 - 81 av. by region.

Production projections of the major rice crop, by region, in 1990 and 2000:

(Unit: million tons)

	1979 - 1981 av.	1990	2000
Whole Kingdom	15.270	17.01	18.66
Central	3.847	3.91	4.12
North	4.733	5.27	5.75
Lower North	2.886	3.13	3.33
Upper North	1.847	2.14	2.42
Northeast	5.591	6.57	7.44
South	1.102	1.26	1.35

3) Production projections of the second rice crop

The second rice crop has been under regular cultivation in full scale, from the 1972/73 agricultural season, this was when Phasom Dam was completed, in 1972. Historical records in the following are not enough for statistical analysis. The second rice crop has developed significantly, under practical cultivation in both planted areas and also yield per rai. However, it may be said that it is not yet stabilized enough to make a projection based on past statistical records.

Table VIII-4 Records of second rice crop after 1972/73 agriculture season

	Planted area (1,000 rais)	Yield per rai (Kg)
1972/73	1,310	567
1973/74	2,038	495
1974/75	2,968	454
1975/76	2,358	512
1976/77	2,736	509
1977/78	2,979	532
1978/79	4,257	535
1979/80	2,103	528
1980/81	3,228	608
1981/82	3,578	564
1979/80 - 1981/82 av.	2,969	571

The planted area of the second rice crop was recorded at more than 4 million rais in the 1978/79 crop year. Yield per rai was also recorded at more than 600 Kg in 1980/81.

In consideration of the potential yield per rai of the new, improved RD variety series with 700 - 750 Kg, 600 and 630 Kg are to be employed for yield per rai in 1990 and 2000, respectively.

Estimated figures in projections of the second rice crop are as follows:

	1979-81 av.	1990	2000
Planted area (1,000 rai)	2,969	5,000	5,500
Yield per rai (Kg)	591	600	630
Production (1,000 tons)	1,696	3,000	3,465

Regional distribution of the production of the second rice crop is estimated as follows:

(Unit: 1,000 tons)

	1979-81 av.	1990	2000
Whole Kingdom	1,696	3,000	3,465
Central	1,418	2,520	2,910
Lower North	104	180	220
Other regions	174	300	335

Regarding the second rice crop, irrigation facilities are desperately needed. Estimated figures in the projections of the second rice crop in the above table are subject to further investment in irrigation facilities as in the past.

8-2-3 Projections of Supply, Domestic Demand and Export Potential of Major Agricultural Products in 1990 and 2000

1) Projection of supply, domestic demand and export potential of rice in 1990 and 2000

Projections of the demand for rice in 1990 and 2000 are computed by the same method as in the 1979 - 81 av., based on population projections in 1990 and 2000.

Export Potential is to be introduced by the reduction of demand from supply in the same manner as in the 1979 - 81 av. analysis.

Summarized figures for the whole Kingdom are as follows, and details by region are in the following tables.

(Unit: 1,000 tons)

	1979-81 av.	1990	2000
Supply (production)	16,967	20,010	22,125
Demand (domestic requirement)	10,414	14,810	17,100
Export potential (in terms of milled rice)	2,939	3,350 - 3,700	3,250 - 3,600

2) Projections of export potential of major upland crops and their processed products in 1990 and 2000

Estimates of area under upland crops are introduced by the relationship between average annual growth rates of an area under upland crops and average annual growth rate of the population in the whole Kingdom, excluding the Bangkok metropolis area (because there is no area under commercial upland crops in the Bangkok metropolis area) from 1973 - 1980 (elasticity of growth rate of upland crops area against growth rate of population is 1.563), on the basis of area under upland crops in 1979 - 81 average.

Estimated areas:

33.955 million rais in 1990
41.510 million rais in 2000

as compared with 26.443 million rais in 1979 - 81 av.

Table VIII-5 Projections of Production, Demand and Export Potential of Rice in 1990

(Unit: 1,000 tons)

	General	Lower North	Upper North	North East	South	Whole Kingdom
0. Population	17,800	5,900	5,250	19,580	6,890	55,345
1. Production						
11. Major rice crop	3,910	3,130	2,140	6,570	1,260	17,010
12. Second rice crop	2,520	180	ng.	300 ng.	ng.	3,000
13. Total	6,430	3,310	2,140	6,570	1,260	20,010
2. Demand 1/	4,350	1,710	1,450	5,870	1,430	14,810
3. Balance (13. - 2.)	2,080	1,600	690	700	-170	5,200
4. Supply-Demand Ratio (13. - 2.)	1.478	1.936	1.476	1.119	0.881	1.357
5. Export Potential and Regional Surplus (in terms of milled rice)	1,352	1,040	449	420	-111	3,350 (approx.) 2/

Remarks: 1/ Demand includes requirements of seed, food use, all other usage except of food; feed, processing, etc. and postharvest loss.

2/ This projection is about 0.4 million tons larger than actual export 2.940 million in 1979 - 81 av.

Projection shall be, in 1990, 3.35 million tons at low estimate and 3.7 million tons at high estimate.

Table VIII-6 Projections of Production, Demand and Export Potential of Rice in 2000

(Unit: 1,000 tons)

	General	Lower North	Upper North	North East	South	Whole Kingdom
0. Population	20,900	6,630	5,890	22,570	7,970	63,722
1. Production						
11. Major rice crop	4,120	3,330	2,420	7,440	1,350	18,660
12. Second rice crop	2,910	220	ng.	335 ng.	ng.	3,465
13. Total	7,030	3,550	2,420	7,440	1,450	22,125
2. Demand 1/	5,080	1,920	1,620	6,770	1,660	17,100
3. Balance (13. - 2.)	1,950	1,630	800	670	-310	5,025
4. Supply-Demand Ratio (13. - 2.)	1.384	2.178	1.494	1.099	0.813	1.294
5. Export Potential and Regional Surplus (in terms of milled rice)	1,268	1,060	520	402	-200	3,250 (approx.) 2/

Remarks: 1/ Demand includes requirements of seed, food use, all other usage except of food; feed, processing, etc. and postharvest loss.

2/ Projection shall be, in 2000, 3.250 million tons at low estimate and 3.600 million tons at high estimate.

This projection is 0.1 million tons below projected export in 1990.

Estimated export potential in 1990 and 2000 is also to be processed in proportion to the area under upland crops. Procedure of computation is based upon the export potential of major upland crops and products, 9 million tons from 26.443 million rais of upland crops planted area in 1979 - 81 av., with an adjustment of the average annual declining rate of yield per rai of upland crops from 1973 - 80, as shown in the following formula.

$$X^t = 9 \text{ million tons} \times A^t/A^o \times (1-0.0067)^t$$

where : X^t = Estimated export potential in 1990 and 2000

A^t = Estimated area under upland crops in 1990 and 2000

A^o = Area under upland crops in 1979 - 81 av.

0.0067 = average annual declining rate of yield per rai of upland crops from 1973 - 80

Estimated figure of export potential of upland crops and products shall be,

10.800 or approximately 11 million tons in 1990, and
12.350 or approximately 12.500 million tons in 2000.

3) Comments on exports potential

The export potential of rice and major upland crops and products may be summarized as in the following table.

(Unit: million tons, in round figures)

	1978-81 avg.	1990	2000
Rice	3	3.35 - 3.7	3.25 - 3.6
Major upland crops and products	9	11 ± 10%	12.5 ± 10%

The following three comments are not to be neglected in an understanding export potential.

i) The year of 1990, or 2000, does not indicate an individual year. Each is to be recognized as a three year av., with 1990 or 2000 at the middle. Because all estimated figures are constructed based on the figures of the 1979 - 81 av.

ii) Estimated figures do not mean export quantity in absolute scale in a individual year, because all factors supporting exports such as supply (production), domestic demand and demand of foreign markets are subject to both domestic climatic and economic conditions and also, at the same time, the requirements of foreign countries. Actual exports in terms of quantity in an individual year, 1990 or 2000, might deviate with appropriate variation as matter of course, from the estimated figures in the above-mentioned table.

Export potential means, then, a kind of standard export potential under normal conditions with tolerated statistical error.

iii) All estimations have been made by employing parameters in 1973 - 1980, based upon informational data of the 1979 - 81 average. It is, then, suggested that another examination is to be made, more closely focusing on the future potential of exports, by utilizing possible new parameters in 1980 - 85 based upon the 1984 - 86 average. In particular, population, area of farm holding land, farm size per agricultural household, development of second rice crop and yield per rai should be used.

8-3 Estimated Exports from Bangkok Port

8-3-1 Estimated Exports from Bangkok Port and Shipping Facilities Construction

Statistically estimated exports from Bangkok port based upon export potential analyzed in the aforementioned projections are summarized in round figures as listed in the following table.

Current exports of 13.5 million tons in 1979 - 81 av. is almost doubled as compared with 7.05 million tons in 1970 - 74 av. This dramatic growth was achieved in only less than ten years, at a rapid average annual growth rate of 8.5%.

Most increases in export quantity have been made by these export items for which bulk shipment are available such as maize, cassava pellets, sugar and molasses. Large investment has been made for facilities for storing and loading these increasing export commodities, along with development of exports in these years.

Well equipped modern facilities for storage and loading of these commodities in bulk were constructed in Bangkok Port and its vicinity in recent years. However, some of these facilities are deemed to be over capacity in terms of normal need of shipment of the specified cargoes for the moment.

In contrast to these large investments, facilities for commodities which must be shipped exclusively in bag are obviously inadequate, and it requires necessary investments for regular commodity outlets.

Table VIII-7 Estimated Exports from Bangkok Port by Type of Handling

(Unit: 1,000 tons)

	1970-74 average	1979-80 average	1990 estimate	2000 estimate
1. Export total	7,050	13,500	H 17,800 L 16,300	H 19,700 L 17,900
2. Rice export	1,330	3,000	H 3,700 L 3,350	H 3,600 L 3,250
3. Exports of major upland crops and products 3/	4,400	9,000	H 12,000 L 11,000	H 13,750 L 12,500
4. Exports of rice, major upland crops and products (2. + 3.)	5,730	12,000	H 15,700 L 14,350	H 17,350 L 15,750
5. Other exports 2/	1,320	1,500 2/	H 2,100 L 1,950	H 2,350 L 2,150
6. Exports by type of handling				
61. Potential bulk handling 1/	2,250	8,550	H 11,400 L 10,450	H 13,050 L 11,900
62. Shipment exclusively in bag	4,800	4,950	H 6,400 L 5,850	H 6,650 L 6,000

Remarks: H = Estimation at high level

L = Estimation at low level

1/ = Estimate based on loading facilities at the port

2/ = Selected major items included in other exports are listed in the following table. These items comprise about 60% of other export in terms of quantity in 1979 - 81 av.

3/ = Major upland crops and products are maize, kenaf, mung bean, cassava products, sugar, molasses and sorghum

Table VIII-8 Selected Export Farm Products from Bangkok

(Unit: 1,000 tons)

	1979	1980	1981	Av.
Rice products	51	46	70	56
Other sugar/products incl. refined sugar	99	1	32	44
Black matpe	69	114	62	82
Fiber crops and products excl. Kenaf	112	97	90	100
Animal feed	342	277	280	300
Animal product	67	52	56	58
Fruit and fruit product	187	197	242	209
Total	927	784	832	848

Source: Agricultural Statistics of Thailand, 1981/82

Existing warehouse capacity in Bangkok is estimated at about 1.3 million tons in the Bangkok area and more than 1.3 million tons in Prapradaeng area, except of warehouses in Chonburi area for cassava pellets.

Warehouses in the Prapradaeng area are mainly for purpose of storing and loading of maize, cassava pellets, sugar and molasses. The following is a breakdown of warehouse capacity by commodity:

approximately 0.470 million tons for maize
" 0.300 " " for cassava products
" 0.640 " " for sugar and molasses
" 0.120 " " exclusively for rice

The warehouse capacity of 1.3 million tons in the Bangkok area has the following breakdown.

About 0.35 million tons are owned and operated by commercial banks for general cargo with higher unit prices and may not be available for ordinary storage and handling of agricultural products.

Of the remaining capacity of about 0.95 million tons, warehouses with capacities of about 0.45 million tons are now generally used exclusively for storing and loading rice.

The combined capacities of warehouses regularly used for rice in the Bangkok area at 0.45 million tons and 0.12 million tons in the Prapradaeng area, totaling about 0.6 million tons.

8-3-2 Warehouse capacity for storing and loading agricultural products in bags

Bangkok port had warehouses with about 0.6 million ton capacities when approximately 1.5 million tons were exported from Bangkok in the beginning of the 1950s. Warehouse capacities which are regularly utilized for agricultural products are considered deficient for the following reasons.

i) From the viewpoint of volume handled in bags

It is rather difficult to conclude how many tons of goods are now handled in bags, however, handling activity must be much more conjested in the 1979 - 81 av. than in the 1970 - 74 av. as seen in the following measurement. In practice, commodities which can be handled in bulk are not always handled in bulk. On the assumption that 10% of such cargo should be handled in bag actually, bag handling would be 2.25 x 10% + 4.8 = 5.025 million tons in 1970 - 74 av., and 8.5 x 10% + 4.95 = 5.805 million tons in 1979 - 81 av. According to this estimation, shipment of cargo in bag will increase considerably.

Present capacity of storing and loading of commodities in bag at existing warehouse facilities are obviously insufficient, in comparison with the period, 1970 - 74.

ii) Rice storage and loading at Bangkok port

Bangkok has warehouse capacities of about 0.6 million tons, when 1.36 million tons (1950 - 1954 av.) of rice was exported in the early 1950s. Almost 90% of exports from Bangkok were, at that time, in bags, excluding export commodities such as teak (approximately 0.1 million m^3) and salt (2 million piculs = 0.12 million tons).

The export ratio of rice in terms of quantity against warehouse capacity was 2.27 : 1.

Warehouse capacity for bag handling was unchanged from 1950 at 0.6 million tons (verified by warehouse data in 1972) in the 1970 - 74 av. with 1.33 million tons of rice exported, and the ratio of export against warehouse capacity was also unchanged at 2.22 : 1.

The situation changed very much in the late 1970s. Rice export jumped up to 2.045 million tons in the 1975 - 79 av. and 2.876 million tons in the 1979 - 81 av., almost the 3 million tons level, despite warehouse capacity for rice remaining at approximately 0.6 million tons. The ratio of rice exports against capacity went up to 3.41 : 1 in the 1975 - 79 av. and 4.79 : 1 in the 1979 - 81 av.

Present warehouses for rice storage in Bangkok are confirmed to be short of capacity and are more conjested than the past up to the early 1970s.

iii) Existing warehouses for bag handling

During the period of rapidly expanding exports of agricultural products, especially upland crops and products which are handled in bulk in the 1970s, most of the investments were directed towards facilities for modern bulk storage and loading to meet the

requirement of large-scale handling, for example, automatic loading system with silos, automatic suction pontoon off Ko Sichang and/or Sugar terminal.

On the other hand, facilities for bagged commodities, especially for rice are the same as they were in the 1950s and have not been renovated. Most of these existing facilities are obsolete or too old-fashioned to meet the actual handling requirements of large-scale and proper services needed today.

CHAPTER IX THE COMPREHENSIVE STORAGE FACILITIES DEVELOPMENT PROJECT AND ITS OUTLINE, OBJECTIVES AND APPROACHES

CHAPTER IX THE COMPREHENSIVE STORAGE FACILITIES DEVELOPMENT PROJECT AND ITS OUTLINE, OBJECTIVES AND APPROACHES

9-1 Outline of the Proposed Comprehensive Storage Facilities

In proposing the recommendation to improve the storage facilities of the PWO, the objectives of the Thai Government's Fifth Five-Year National Economic and Social Development Plan in which the PWO acts as an important implementing organization have been duly taken into consideration.

To improve the marketing system of agricultural products is one of the top priority objectives, therefore the Thai Government has drawn up a plan to provide warehouses equipped with the necessary facilities to stabilize the prices of farm commodities as well as to promote their export.

In the past, the PWO had to rent a considerable amount of warehouses from the private sector to perform services on behalf of the Government. Most of these warehouses were substandard, mainly built to store commodities such as paddy, kenaf, etc. and were not suitable for the storage of milled rice. As a result the rice procured by the PWO deteriorated in the warehouses quickly.

The high initial amount of investment and slow profit turnover deters the private sector from investing in warehouse construction. It is therefore the Government's responsibility to build model warehouses which meet both quality and quantity requirements and are equipped with proper facilities to store milled rice.

Based on the findings of the Feasibility Study Phase I, it is recommended that the plan to improve the storage facilities of the PWO should be implemented as mentioned below in order to intensify its comprehensive storage system.

The project would consist of the following three components:

Increase of Regional Warehouses
Development of Central Shipping Complex
Establishment of Storage Technology Development Facilities

A brief explanation on the above components are described below and details of the each project component are proposed in Chapter X.

1) Increase of Regional Warehouses

As stated already, the existing warehouses are mostly far below the desired standard and the appropriate storage facilities are evidently short in number. To enhance the activities of the PWO and to ensure its aim to stabilize the price of agricultural products for farmers as well as for consumers, it would be necessary to increase the number and to modernize regional warehouses with the necessary equipment at the selected locations.

2) Development of Central Shipping Complex

In view of the urgent necessity for an efficient control of the stock in the regional warehouses, quality improvement of stored products, smooth handling of export shipments, the development of a Central Shipping Complex with the proper storage capacity, efficient grading equipment together with the modern loading facilities for both domestic and overseas shipments would be of great help for the PWO's entire activities.

3) Establishment of Storage Technology Development Facilities

It is obvious that the improvement of technology related to the stock control, the quality control of stored products, the storage and handling of cargoes are essential to advance the storage condition of agricultural products. It is also important to employ a systematic approach to achieve the primary objective in terms of the marketing functions of the PWO. In this connection, the relevant technology application facilities and sufficient staff training would be most appropriate for the purpose.

9-2 Objectives of the Project

The objectives of the Comprehensive Storage Facilities Development Project would be as follows:

1) Increase in farmers' income

Farmer's poverty problem is mainly because of the relatively low farms price compare to other commodities. In the Fifth Plan, the one of major objectives is to solve this problem. By enhancement of the ability of the PWO serving as a mechanism to ensure better prices for farmers by constructing warehouses, the PWO would be in a better position to control the market price in response to the market demand.

2) Export increase by improvement of agricultural product quality and shipping facilities

Export of agricultural products have always been the major source of foreign exchange earnings. However, strong competition in the world market requires Thailand to improve quality of exported agricultural products as well as to improve efficiency of shipping facilities. By establishing modernized warehouses as model for the country together with export shipping facilities, the PWO can play a leading role in the export business circle. It is also expected that more agricultural products can meet the foreign standards when processed through these modernized facilities which in turn will increase the export earnings and reduce trade deficit for Thailand.

3) Facilitation of government programs

Since the PWO has played a major role in government programs through various market interventions, it is essential for the government to strengthen the PWO's capability to implement various policies such as paddy price programs for farmers, cheap rice programs for consumers, welfare programs, etc.

4) Decrease in post-harvest losses

The post-harvest losses of agricultural products in Thailand are assumed to be substantial. This is due to primitive practices employed in the post-harvest works and insufficient marketing infrastructures including storage facilities. According to FAO's survey on post-harvest losses conducted in 1977, an assumption of losses during storage was reported at 7% including on-farm storage in Thailand. Decrease in qualitative and quantitative losses during storage is quite significant. To protect stored crops from damage or deterioration by building improved-designed warehouses and shipping complex, the PWO can ensure farmers of better prices as well as high income earned from foreign sales.

9-3 Approach to the Project

9-3-1 Regional Warehouses

The oversupply of agricultural products during the peak harvesting season reduces prices. This can be settled by providing the PWO with storage facilities in which the crop can be stored for longer period of time. Such facilities may serve several purposes: (1) To substantiate the Government programs to increase farmers' income and uplifting their living standard, (2) to reduce storage losses and protect the products from quality deterioration and insect damage, and (3) to function as a rice control instrument with adequate buffer stocks.

Practical approaches to achieve these purposes are described as follows.

1) The design of warehouses should ensure that milled rice can be stored safely and effectively for a long period of time (over 6 months) under the tropical conditions with high temperature and humidity.

2) Because loss caused by insect pest can be most serious compared with other ones, proper measures on pest control are necessary as well as rodent control.

3) Regional characteristics should be considered for the installation of various machinery and equipment in the warehouses. For example, warehouses in the Northern regions should have those for cleaning and grading various agricultural products that are produced in those areas, while warehouses in the Southern regions should be equipped with packing machines as they must act as regional distribution centers.

9-3-2 Central Shipping Complex

The central shipping complex should be a pilot plant designed to improve the quality of export rice not only to maintain the existing foreign markets but also to develop new markets by increasing its reputation abroad. It should be a model after which the private sector can follow to build their own facilities. And the complex should be considered as an instrument to carry out policies to stabilize the rice price for farmers and consumers, to support the Government welfare programs and to promote the rice export.

In order to implement such objectives, the following approaches would be recommended.

1) The complex shall have a capacity which ensures PWO's smooth handling of the domestic supplies and export shipments

2) The machinery and equipment attached to the complex shall be installed so as to improve the rice quality to meet the export requirements and domestic needs.

3) The complex shall include with necessary facilities to handle rice efficiently in such processes as receiving, mixing, regrading, remilling, packing, fumigating and shipping.

4) Machinery and equipment for existing warehouses in Bangkok port should be properly installed to expedite smooth and efficient shipping operations of the export rice taking account of the PWO's total operations and facilities in the port.

9-3-3 Storage Technology Development Facilities

It is quite clear that the efficient management of the warehouses, introduction of modern technology and adequate personnel training are essential for the rationalized operation of the PWO.

Since the PWO handles and stores various kinds of agricultural products in the warehouses across the nation, the improvement in stock control is extremely important.

At present, research and study on the post-harvest quality control, specially on storage techniques for the agricultural products in the tropical regions are still insufficient despite the increasing necessity and importance. Implementation of the necessary research and study and provision of an institute to carryout such works are required in the PWO.

The present major bottleneck of the PWO's total management is the shortage of properly trained personnel. The improvement of the skills of the PWO staff at all level through training program are necessary.

Therefore, the PWO is advised to take positive measures as follows to overcome the afore-mentioned problems and limitations.

1) Introduction of an advanced modern management system using computers and telecommunications will enable the PWO to handle a variety of cargoes of great volume smoothly and efficiently, and to reduce the substantial losses during the storage in line with the primary principle "First-in, First-out".

2) Various kinds of researches concerning post-harvest quality control and storage technology should be carried out in order to strengthen PWO's capability of its operations.

3) Proper size of laboratory equipment and simulation warehouses should be provided to perform chemical and physical analysis, and to carry out various kinds of research works.

4) A training institute shall conduct programs including the following items.

a. Warehouse control practices
b. Grading and inspection methods and practices of agricultural products
c. Pest control measures
d. Post-harvest processing techniques
e. Marketing and operating control

As the Government of Thailand realized the significant role of quality problem in the international market, standards of inspection of export products have been tightend and the Trade Training Centre was established recently to render various services to facilitate the activities of exporters.

Such research and development might includes what has already been or is currently being carried out by the Trade Training Center and other research institutions. In this facilities, however, it should deal with outstandinging problems related to the storage of agricultural products particularly the PWO's operational and managerial fields, and overlapping of the studies should be avoided when other institutions conduct similar researches.

Concerning the integrated research and development, the details are mentioned in the Chapter 10-6. However, it is advisable to establish a training course in the PWO to train primarily the storage experts and other necessary specialists. Further study should be made in this respect how to organize technical cooperation with foreign assistance in order to obtain an appropriate technical transfers.