Executive summary of the study on planning manual for rice postharvest processing improvement

EXECUTIVE SUMMARY

OF

THE STUDY ON PLANNING MANUAL

FOR

RICE POSTHARVEST PROCESSING IMPROVEMENT

MARCH 1989

JAPAN INTERNATIONAL COOPERATION AGENCY

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OBJECTIVE OF THE STUDY

The Kingdom of Thailand, as the largest rice exporting country in the world, has placed the priority in agricultural development on the increasement of rice production. In recent years, however, it is now important to improve postharvest practices and also rationalize the rice marketing system in order to improve farmers' income and to expand international rice markets. In this relation, the Government of Japan send a JICA Study Team to Thailand in order to find out the possibility of technical cooperation in the field of rice postharvest processing improvement.

The Objective of the Study is to grasp the actual conditions and to clarify the subjects in question on rice postharvest processing and marketing systems, and finally to draw up a planning manual of technical and financial cooperation expected for the improvement of various kinds of postharvest practices and marketing system of rice. The assigned areas of the Study are (1) Harvest, drying and storage, (2) Rice milling and processing, (3) Quality control, and (4) Farmers' institutions and rice marketing. The Study contents are mentioned below;

1. To discuss the postharvest subjects in the Sixth National Economic and Social Development Plan and in the agricultural policies of the Thailand Government,

2. To clarify the current problems in the postharvest of rice and to recommend improvements,

3. To study the economic and social conditions surrounding postharvest problems together with the system of marketing and to recommend improvements,

4. To study the activities of farmers institutions in respect to the improvement of postharvest problems and marketing systems of rice,

5. To analyze and evaluate the actual results of foreign assistance and to indicate the correct direction of technical cooperation on rice postharvest improvement.

MEMBER OF STUDY TEAM

NAME	ASSISGNMENT	POSITION
Dr. Akira HOSOKAWA	Team Leader	Senior Advisor, Japan Grain Inspection Association Agency
Mr. Isamu YAMAZAKI	Rice Harvesting, Drying & Storage	Manager, Consultant Dept. Overseas Merchandise Inspection Co., Ltd. (OMIC)
Mr. Osamu TOKUMOTO	Rice Milling	Sub-manager, Consultant Dept. OMIC
Mr. Satoshi ITO	Rice Quality Control	General Manager, Planning & Coordinating Dept. OMIC
Mr. Makoto YAMADA	Institution & Rice Marketing	General Manager, Consultant Dept. OMIC
Mr. Toshiaki FURUYA	Technical Cooperation & Coordinator	Agriculture, Forestory & Fisheries Planning & Survey Dept. Japan International Cooperation Agency (JICA)

STUDY ITINERARY

Days	Date	Day of the Week	Contents of Study	Place
1	Jan. 18	Wed.	(Tokyo - Bangkok : BKK), JICA BKK Office	BKK
2	19	Thu.	Embassy of Japan, Ministry of Agriculture & Cooperatives, Department of Agriculture, Division of Agriculture Engineering	BKK
3	20	Fri.	Dept of Agriculture Extension, Ministry of Commerce Dept of Internal Trade, Division of Agriculture Engineering, DTEC, Dept of Cooperatives	BKK
4	21	Sat.	Rice Exporter's Facilities, Rice Exporters' Association	BKK
5	22	Sun.	Data Arrangement	BKK
6	23	Mon.	Kesetsart Univ. (KU) BKK, Maize Quality Improvement Project Rice Research Institute	BKK
7	24	Tue.	KU Project (Kampansen), Dept of Cooperative Promotion, Division of Agricultural Toxic Substances, Division of Entomology & Zoology, North-east Thai Agricultural Development Project	BKK
8	25	Wed.	(BKK - Nakhon Ratchasima : NR) NR Agro-extension Service Office, Rice Mill of NR Cooperatives Federation, Pimai Agricultural Cooperative	NR
9	26	Thu.	NR Agro-coop Federation, Divisional Agro-coop Training Center, (NR - Khon Kaen : KK) Paddy Market, KK Agro-extension Service Office, Rice Mill of Buri Ram Agro-coop Federation, Village Type Rice Mills, Farmers, North-east Thai Agricultural Development Project	KK
10	27	Fri.	(KK - Phitsanulok : PSN) PSN Agro-extension Service Office Paddy Marketing Center, Seed Processing Center, Middle Size Rice Mill	PSN

- continued -

Days	Date	Day of the Week	Contents of Study	Place
11	28	Sat.	(PSN - Chaing Mai : CM) Large size Rice Mill, Farmer's Croup, Farmers	CM
12	29	Sun.	CM - BKK	BKK
13	30	Mon.	Agro-machinery Manufacturer, Rice Processing Machine Manufacturer, BAAC, PWO, FAO	BKK
14	31	Tue.	Dept of Cooperatives, Division of Agricultural Chemistry	BKK
15	Feb. 1	Wed.	ASEAN Grain Postharvest Programme Office, Dept of Agricultural Extension	
16	2	Thu.	Dept of Internal Trade, (BKK - Hatyai, Hatyai - Songkula : SK), Prince of SK Univ.	BKK SK
17	3	Fri.	BKK : (BKK - Nakhon Sawan - BKK) Chai Nat Agricultural Office NS Agro-coop Federation Mill, Kam Nang Song Paddy Marketing Center, BAAC Paddy Marketing Center SK : (SK-Phatthalung-SK) SK Agro-extenstion Office, Thachaid Experiment Station, Small Size Rice Mills, Farmers (Phattalung)	BKK SK
18	4	Sat.	BKK : BAAC Suphan Buri Paddy Marketing Center, Ramchalong Rice Mill SK : Hatyai - BKK	BKK
19	5	Sun.	Data Arrangement	
20	6	Mon.	JICA BKK Office : Report, Embassy of Japan : Report	BKK
21	7	Tue.	BKK - Tokyo	-

Executive Summary of the Study

on

Planning Manual for Rice Postharvest Processing Improvement

1. Agriculture in the Thai Economy

Agriculture is the most important sector in Thailand's economy, absorbing nearly the two thirds of the total labour force in the nation. The Thai economy has remarkably developed since World War II, owing to the increased production of various upland crops such as maize, cassava, kenaf and sugar cane etc. These crops not only contributed to the increase of farmers' income but also brought about the diversification of the nation's foreign trade structure for the earning of foreign currencies.

Thailand has, as she is often called a model of NAIC (New Agricultural Industry Country), achieved a success in economic development by diversifying the industrial structure, keeping balanced developments between urban and rural areas and creating employment opportunities based upon the agricultural development. In the 1950's, its' per capita G.D.P. was only US$80 but presently it is over $1,000. Recently, economic ties with the Asian NIES (Newly Industrializing Economies) have been strengthening. It is already the attainable and optional target for Thailand to join the NIES as a new member.

2. Rice Production in Thailand

Before 1950, Thai agriculture had been characterized as monoculture centering on rice production. Although a variety of agricultural products appeared on the market along the development of commercialization, still rice was the mainstay of Thai agriculture and the core in the marketing of agricultural products. Rice was and is the staple food of Thai people and the largest single export item occupying about 15% of total Thai export. The growth rate of agricultural production since the 1950's has been quite satisfactory in terms of both the quantity and diversification of output. This is resulted from the government endeavor for its diversification programs reducing the traditionally high dependence on rice. It is expected that 20.8 million tons of paddy (of which 17.3 million tons are major crop and 3.5 million tons are second crop) are produced in 1988/89. Four million seventy five thousand tons of milled rice were exported in 1988. In the Sixth National Economic and Social Development Plan (1987 - 1991), rice export is expected to expand to about 6 million tons in 1991, if growing rate of agricultural sector is surely achieved. However, such expectation is too optimistic, if it is considered that rice is one of the international commodities exposed to the sever competitivity and the production system of rice in Thailand is not necessarily rationalized but rather old fashioned relying on manual labour and animal power in principle. Thus it may be justly said that the export competitiveness of Thai rice is supported by natural favour of tropical climate that suites the cultivation of rice and also by low wages of rural labour. Recently a restraining tendency in agricultural production is appearing despite of inceased productivity, derived from the international market

situation. It is sure that the time has come for Thai agriculture to confront an evolution.

3. Basic Strategy for Agricultural Development in Sixth National Economic and Social Development Plan

The Sixth National Economic and Social Development Plan sets its basic policy targets on; 1) maintaining high level of economic growth, 2) efficient management of economy, 3) increase of employment opportunities and 4) adjustment of local differences. Strategically, these targets are to be achieved through the diversification program in the agricultural development which is called "Thai style NAIC". As the concrete measures to execute the above policies, followings are specified.

(1) Utilization of new technology in processing to increase the market value of produce

(2) Provision of sufficient production credits with reasonable rate of interests to reduce costs of production

(3) Promotion of basic administrative services

(4) Emphasis on co-ordination among government agencies and between the state and the private sectors

(5) Strengthening rural people's institutions so that they will play more important roles in economic and social development.

4. Loss Occurring in Postharvest Processing

The loss occurs in various stages of such processes between the time of harvest and consumption, as harvesting, drying, transportation, threshing, cleaning, parboiling, husking, whitening, packing, storing, retailing and cooking. The total loss of rice in the developing countries is estimated amounting to 25 - 30%, although in Thailand there were no extensive survey yet conducted on actual conditions. Moreover, as technique and methods of loss assessment have not yet been established, reliable data are not available. The Extraordinary General Assembly of the United Nations in 1975 resolved to make efforts to reduce the postharvest losses in developing countries by a half within 10 years until 1985. But the evaluation of the resolution after 10 years has not been known to us yet. In order to reduce the loss, it is necessary to know what are the causes and how much is the loss. Further, we must have a clear views on the possibility of extension of various techniques for improvement, on its economic efficiency, on its influence on social custom and so forth.

5. Significance of Improvement of Postharvest Processing

Thailand is a country of surplus rice. They export rice throughout the world, filling about 1/3 of the annual trade in the international rice market. Therefore, people are not so keen as those who are in rice deficient countries about making improvement on postharvest losses. However, the improvement on postharvest processes of rice began to be discussed more seriously, owing to the recent change in their production system, marketing system, socioeconomic conditions centering on employment and along with the improvement of rural infrastructure such as

roads and electricity, and increase of income from sources other than agriculture. In such a setting, topics for the improvement on post-harvest processes in Thailand are followings:

(1) Saving labour in farming practices ... mechanization of farming

(2) Increase of farmers' income ... endowment of farmers' bargaining power

(3) Improvement of commercial value ... stable expansion of outlet for Thai rice

6. Socioeconomic Background Related to the Improvement of Postharvest Processing

Actual situations of postharvest processes vary with the socioeconomic background wherein rural villages exist. Socioeconomic conditions of Thai villages are rapidly modernizing recently. They are affecting farmers' practices of postharvest processes. The main factors are as follows:

(1) Farmers' attitudes toward farm management have been changing, followed by the recently developed double cropping practice and the diversification of cropping. Furthermore livestock industries such as piggery and poultry etc, and cultivation of profitable cash crops are becoming more popular. Farmers began considering better usage of their labour which was up to now mainly devoted to rice growing.

(2) Agricultural population is moving to rapidly growing second and third industries in large number. It is said that about one million people have moved to other industries in 1987. In the Sixth National Economic and Social Development Plan, the employment target for agricultural sector is set at 13 million (its industrywise share is 33.8%). In order to cope with such a change of socioeconomic

surroundings, labour saving mechanization of agriculture is inevitable.

(3) As school education proceeds in villages, young generations find it easy for them to adopt high technologies in agriculture.

(4) Increase of income from sources other than agriculture is conspicuous. Farmers' non-agricultural income has, on the national average, reached 43.7% in their total income in 1986/87, and is still increasing. As the weight of agricultural income becomes less in their household expenditure, their urgent need to sell rice immediately after harvest is reducing and they began storing their paddy for the more beneficial selling.

(5) Not only has the marketing become easy by the network of better transportation in rural areas but also it is now possible for farmers to carry their crops to the market by their trailers and to sell them there rather than to sell them at their yards to middlemen.

(6) Price information on agricultural produce has become readily available at any time. Farmers are now more market conscious in their economic activities

(7) Diversification of personal food consumption is conspicuous. The meal of urban type is prevailing to rural areas, causing a change in cooking method (for instand wide use of electric rice cookers). Changes in the preference to the tastes of rice may be anticipated.

7. Prevailing Practices of Postharvest Processing

From the time when rice plant matures and is harvested until the time it is consumed, rice goes through various processes and many hands. Postharvest processes are related not only to their harvesting practices or rice processing technologies but also deeply related to rice growing conditions, trade practices, dietary culture and further to various natural and human activities such as food marketing policies. Therefore, the postharvest processes are very much varied depending on the stages of agricultural development and local conditions.

Postharvest practices for paddy done by farmers are harvesting, drying, threshing, cleaning, transportation, storage and milling. Each practice is not a common procedure but varies by many factors. By nature, they are of local characteristics and cannot be discussed as one form applicable throughout the country. Yet it can not be denied that there is a tendency that uniform practices are brought about rapidly by the introduction of new technologies.

The harvesting time generally falls between December and January for the rainy season crop (the major crop), and between May and August for the dry season crop. It is widely different by the planting time which is restricted by the availability of irrigation water. The harvesting of the major crop is to be carried out within one month and so the labour cost for harvesting is apt to be high. It is said that the harvesting cost amounts to about a half of all production cost of rice. This shows that harvesting is very labour insentive and that there are large rooms for improvement. Labour wages are now mostly paid by cash. A traditional custom of paying in kind (paddy) or exchange of labour without compensation (longkheek) is less common nowadays than before.

There are many variations in the practice of postharvest processes according to various local conditions. Variations are seen even in the same area, but their outline is as follows:

(1) Harvesting

In many areas, stems are cut by sickle, leaving lower 1/3 - 1/4 part in the field. In other words, it is middle cut or high cut. Reaping method is different by locality because it is closely related with the field condition. Generally, the Northeastern region has little rain when the major crop is harvested, and the field is well dry. The Northeastern region where drainage is possible, the paddy field is dried in harvesting season because water is drained in the ripening period. In those places, harvesting work is rather easy. About a half or two third of stems, which are normally 1.2 m high, is cut off by serrated sickle, leaving their near root pact to the ground. Paddy, then, is gathered and tied with straw or bamboo stripes into bundles, the size of which is abot 25 cm in diameter. The bundles are stacked in the field to a height of about 1m and left there for 2 - 3 days to dry. In the northern region, where the second rice crop is well grown, paddy are reaped by cutting their stems near the ground. The stems or straw are often used as mulching material for horticultural crops. Remaining stubs are mostly burned by fire. In the central region, water stays in many paddy fields even in harvesting season of the major crop. In this area, long stem varieties are planted. Since water stays in the field throughout growing period, the paddy plant lodges often in random directions in harvesting season, reducing the efficiency of harvesting practice. Usually, stems are cut at 50 - 60cm from the top of the ear, made into small bundles and then

sun-dried on the studs for a couple of days to 10 days. In case there is still water in the field, some farmers dry their paddy on the racks. In the Southern region, the paddy fields are dry in harvesting season as in the Northeastern region. Traditionally ear cutters were used in harvesting, but they were nowdays replaced by the sickle.

(2) Drying

Drying at farms can be divided into two stages. In the first stage (primary drying), reaped paddy is dried on the ground/rack/straw/mat, so that transportation, threshing and further separation of impurities will be easy. Moisture contents of the paddy are usually 20 - 25% at the time of harvesting but if the weather is favourable and temperature is high, they go down to 15 - 16% within 2 or 3 days after cutting. In the second stage (secondary drying), it is further dried to about 14%. This reduction of moisture is necessary for farmers not only to store the paddy safely for their own consumption but also for milling. When harvesting is done in the dry season, the moisture content of paddy comes down to about 14% easily while paddy is standing in the field and also during threshing and cleaning in the field. Therefore almost no problem exists in drying. Harvesting in the rainy season, however, often bears problems particularly in drying. In August and September, it often rains continuously and farmers can not sufficiently dry their harvested paddy. If paddy is wet, it often get rotten due to high temperature caused by the respiration of paddy as well as activities of micro-organisms, resulting in serious losses for farmers. Farmers have no practical means of drying high moisture paddy harvested in rainy

season. Neverthless, they do not feel the necessity of having drying facilities seriously, because they can sell the high moisture paddy immediately after harvest. It can not be denied, however, that such high moisture paddy gives middlemen a good reason to reduce the purchasing price to the disadvantage of farmers.

(3) Threshing

Among various postharvest processes in Thailand, threshing have rapidly been mechanized. Traditional and common threshing methods were buffalo treading and beating of panicles against wood or a bamboo basket on the threshing yard in hardened plot of their paddy fields. However, since new varieties of short growing period and of less photosensitivity were introduced, double cropping cultivation became possible, thereby farmers were extremely busy at the time of interval between the two crops. Thus at first, hand tractors or four wheel tractors were introduced for treading in order to hasten up the job, then throw-in type threshers which were developed by the IRRI, Philippines, were brought to Thailand. The mechanization of threshing started in about 1980 on the full scale and now more than 40,000 units are estimated to be in operation.

(4) Storage of Paddy

According to "Survey on Postharvest Practices in Thailand" (1976) published by the Ministry of Agriculture and Cooperatives, the portion of paddy sold by farmers immediately after harvest was 42% in Northern region, 7.7% in Northastern region, 67.25% (rainy season crop) and 31.4% (dry season crop) in Central region respectively. In the Northeastern region, 57.7% of crop was sold without

storing or after short storing, 26.9% after storing 2 - 3 months and 7.7% after storing 4 - 5 months respectively at the time of the survey conducted. At the peak period, it was estimated that 10 to 15 million tons of paddy were stored by farmers in Thailand including either for seed or for farmers own consumption. This paper further reports that the quantity stored by one farm household was 1 - 3 tons, although it differed from place to place and by its number of family members. (It says that per capita annual consumption of paddy was 280kg including seed, food, feed and the loss during storage). In Thailand, farmers usually store paddy in bulk. The warehouse for storage is typically of high floor wooden house (average storage capacity is about 5 tons of paddy) built separately from their main house. It is called "yugkaau" and there are some local varieties. Besides, enclosures by bamboo woven mat placed under the warehouse floor or large bamboo baskets plastered with cow dung on their surface are also used for storage of paddy.

(5) Transportation

There are two categories of transportation. One is in the field and the other on the farm road. Within the field, man power (head-shoulder-balance pole), trailer (baffalo, bull or hand tractor driven trailer), sledge and boat are used. Because farm roads are not yet developed and the foot path between the fields functions more as the weir than as the road, it is common that hand tractors and trailers go over the foot path into and out of the rice field to carry harvested paddy as they are increasingly used. Hand tractors have almost replaced bull carts and bicycle rear cars as the means of transportation of paddy to the market. Prominent farmers of villages own trucks, and they serve as transportation companies on

demand. Recently, so called "Farmers' car" which is made of a second-hand chassie loaded with a general purpose engine is coming popular.

(6) Cleaning

For the purpose of cleaning harvested paddy after threshing, simple aspiration (winnow, natural wind, fan, winnower), sieve and hand separation of impurities were traditionally used depending on the case.

Today, due to the wide use of mechanical threshers, the threshing and cleaning are done simultaneously by threshers.

(7) Rice Milling

Rice mills in Thailand run mostly on speculative profits, viz., how cheaply they can buy raw paddy and how highly they can sell their milled rice. Millers do not pay as much attention to their rice milling processes as other manufacturers do to their manufacturing processes. As of 1982 the number of rice mills was reported to be 30,000. The small rice mills were 52% in number (while milling capacity was 11% of total national milling capacity), medium size rice mills, 34% (capacity 27%) and large rice mills 14% (capacity 62%) respectively. In recent years, the numbers of large mills have been increasing, whereas the middle and small mills have been ing. Regardless of the scale, the equipment in those rice mills now in operation is comparatively old fashioned. Even newly built ones are also old fashioned. Head rice yield is comperatively smaller than those of other ASEAN countries. In particular, the husking and whitening efficiencies of the medium and small sized rice mills which are found mostly in villages, are low, and their processing capacity per hour per h.p. is less than a half of those

in Indonesia and Philippines etc. In other words, in Thailand, it takes more than twice the power to process the same quantity of paddy. The milling charge at villege mills is paid in kind (rice bran and broken rice). Due to good price of rice bran, there is scarece incentive for rice millers to improve their milling technology. The larger rice mills also are not so willing to improve their facilities, attaching much importance to speculative deals. There are, even in local markets, needs for rice of better appearance, better taste and good cooking quality in compliance with the improved living standard of Thai people. The by-product of rice milling, both coarse and fine brans are traded at comparatively high prices as feed for their raising of pigs. In the present condition, there seems no incentive to promote edible oil extraction from rice bran or further utilization of rice husk.

8. Quality Control

Present situations and problems on quality control of rice (paddy and milled rice) were studied from the following points of view;

- Quality control in each stages; farmers - middlemen - rice millers - rice exporters
- Inspection and grading of paddy and milled rice for domestic market and milled rice for export
- Physical and chemical properties of rice of which major parts are exported
- Residue of agricultural chemicals in rice

Among the items mentioned above, the problems and the points to be improved were noticed as follows:

(1) Quality Control of Paddy and Milled Rice

Methods of quality control of paddy and milled rice presently practiced in various marketing stages differ by the season, local practices and marketing situations, but main points to be improved are as follows:

- Improvement of paddy storage practice at farmers level
- Prevention of rice from breaking and cracking during paddy drying which is done by middlemen or rice millers.
- Sufficient drying of second crop paddy (drying down to safe storage moisture level)
- Removal of immature kernels especially in parboiling mills
- Improvement of rice exporters' storage facilities where milled rice, which is most susceptible to damage, is stored for a long period

Generally speaking, the quantity of paddy to be handled will become larger as the marketing stage proceeds from farmers to middlemen or to rice millers. If the quantity becomes larger, handling and processing such as drying and cleaning will become more difficult. Therefore, it is desirable to clean and dry at farmers' level as much as possible, while its quantity is still small. Presently, the Department of Internal Trade, Ministry of Commerce and the Bank of Agriculture and Agricultural Cooperatives (BAAC) are encouraging farmers not to sell their paddy immediately after harvesting but to watch market conditions and to sell it at an optimum time. Especially, BAAC, in their Paddy Pledging Scheme, sends officers to inspect farmers storage facilities and only if they find them satisfactory, they approve the mortgage for the paddy kept by farmers in that approved facility.

(2) Grading and Inspection System

1) Paddy

When the paddy is traded in local market, buyers, middlemen and/or rice millers extract some sample paddy by themselves and prepare samples to be examined in such a way as puting it on a thick wooden board with grooves, then turning a long wooden roll over the paddy to rub it against the board to remove husk off the paddy. Then they examine the samples if how much it yields broken rice and how much it contains red rice, before setting prices on the paddy. Thus marketing of paddy is, in a way, sample transactions. The grading standard and inspection system for paddy have not been established yet. In order to secure a dominant Thai position in the international market, quality improvement of export rice is indispensable. For this purpose, quality of the paddy of export rice should be inspected properly. The establishment of quality standard and inspection system of paddy grain is, therefore, highly desired.

2) Milled Rice

The quality standard and inspection system for the rice to domestic consumption have not yet been established. All transactions between whole-salers and retailers and between rice millers and exporters are based on samples.

On the other hand, regarding export rice, "Thai Rice Standard" is issued by the Ministry of Commerce for the purpose of maintaining good reputation of Thai rice in the world market. In this standard, 27 grades in all are set to be employed to various varieties and qualities. There are 11 grades for non-glutinous milled rice, 7 grades for non-glutinous broken rice, 5 grades for parboiled rice and 4 grades for glutinous rice. Export inspec-

tions based on those standards are carried out by private inspection institutions. Further, Rice Inspection Committee in BOT is charged with supervision on an orderly observance of the export standard.

Although this export standard is widely recognized by buyers throughout the world, it does not always give full satisfaction to the buyer. Various complaints are received by the authority. Buyers' dissatisfactions on the quality are as follows:

. Broken rice percentage is higher than that of Standard
. Moisture content is high and quality deterioration by sweating often observed at destination
. Cooking quality is not uniform

Buyers' complaints about broken rice percentage seem to have been caused by insufficient communication between exporters and importers. The Department of Foreign Trade, Ministry of Commerce changed the definition of the broken rice and declared it on 16th September 1985. However, this has not been properly informed to every buyer throughout the world.

Since September 1985, in case of 100% B rice, Thai side regards only those grains of less than 5.2mm as brokens, whereas the buyer regards the ones whose length is less than 8/10 of the average grain length, viz., about 5.6mm, as broken rice.

Occurrence of sweat damage during voyage and the uneven cooking quality are the signs of defective rice blending. By mixing high moisture second crop rice with the low moisture first crop rice, total moisture content may be less than 14.0% which is defined in the export standard. However, individual rice kernels greatly vary in their moisture content. This is considered to be one of the main causes of sweat damage. Therefore, the

second crop rice also needs to be dried below 14%. Uneven cooking quality is supposed to be caused by the mixing of many varieties whose amylose contents substantially differ.

(3) Physical and Chemical Propeties of Export Rice

The milled rice, which is to be exported from Thailand, is subject to strict quality inspection according to the "Thai Rice Standard". As the sales competition of rice as an international commodity is becoming keen, several requests for quality related with physical and chemical properties are sent from the buyers. Some of them are as follows:

1) Grain length is short

Basic idea in the export standard is that the longer grains are ranked in the higher grade. Therefore, the higher is the grade, the more long grains must be contained. In case of 100% B rice, over 45% of the gains must be more than 7mm long. The buyers of 100%B often send complaints saying that the quantity of Extra Long Grain of over 7.0mm is in short. These complaints are often on the shipments made after May, when the second crop rice starts to appear on the market.

Varieties grown in the second crop are belonging to RD series developed and bred from IRRI-8. The grain length of RD series is somewhat shorter than the varieties selectively bred from the superior local varieties. IRRI categorizes brown rice over 7.0mm as long grains. If milled rice of over 7.0mm is required, the brown rice must be over 7.4mm. While all RD series are shorter than 7.3mm except RD-3 and RD-11, the length seldom reaches 7.0mm after milling.

2) Cooking quality is uneven

Compared with selected rice varieties produced in U.S.A., the cooking quality and palatability of Thai rice are not uniform.

There are about 1,000 kinds of non-glutinous varieties grown in Thailand and their amylose contents spread widely from 14% to 32%. Such rice is mixed and blended and made into Thai export rice. It should therefore be easily imagined that the cooking quality and palatability of such rice is not uniform. IRRI disclosed the values of amylose content, gelatinization temperature and gel consistency of many varieties. But regrettably they are not utilized in Thailand as the basis of blending.

(4) Residue of agricultural chemicals

According to the "Insecticide in Thailand 1987" issued by the Ministry of Agriculture and Cooperatives, agricultural chemicals registered presently reach 306 different compounds. It also reports that 8,229 tons of insecticides, 3,010 of fungicides and 4,801 tons of herbicides were used in 1986. The agricultural chemicals are used mostly for vegetables and fruits. There is a report that in 1981 about 30% of the rice field was treated with some kind of chemicals. Division of Agricultural Toxic Substance, Department of Agriculture, Ministry of Agriculture and Cooperatives is charged with the control and supervision on the use of chemicals and also residue of them in foods. They temporarily use "CODEX Maximum Limits for Pesticide Resides" based on the CODEX Alimentarius Commission, FAO/WHO Food Standards Programme as their standard. In their laboratory, necessary analysis based on the above mentioned CODEX are conducted also on export rice. There are many problems such as that some analysis takes 10 days when items to be examined are accumulated and so forth. In future, it may be necessary to improve analysis techniques, to develop skills, to have equipment that will enable quick analysis and to install more complete equipment.

9. Institutions

Following government offices, public corporations and farmers organizations are functioning in improving the rice postharvest process, rice marketing and distribution.

(1) Government Administrative Offices

1) Ministry of Agriculture and Coopertives

Improvements on postharvest processes are promoted by the followings:

a) Rice Research Institute, Department of Agriculture

. Breeding to produce paddy that will suite mechanized farming.

b) Agricultural Engineering Division, Deaprtment of Agriculture

. Development of various agricultural machinery

. Paddy storage technology at farm level

. Improvement of rice milling machines at village level

c) Agricultural Chemistry Division, Department of Agriculture

. Effective utilization of by-products (rice bran and husks)

d) Agricultural Chemicals Toxic Substances Division, Department of Agriculture

. Control on residues of agricultural chemicals

e) Crop Promotion Division, Department of Agricultural Extension

. Promotion of rice cultivation technology

. Guidance to rationalized farming practices by improving farm management

f) Agricultural Administrative Development Division, Department of Agricultural Extension

. Extension on agricultural machinery and improvement technique centering on the activities of "Farm Mechanization Promotion Centre"

g) Training Division, Engineering Division, Department of Cooperative Promotion

. Training on operation, maintenance and repairing techniques of various machines

h) Planning Division, Department of Cooperative Promotion

. Introduction of rice mills for village level use and their rational management

2) Ministry of Commerce

a) Department of Internal Trade

. Promotion of paddy/milled rice marketing by market-running system

. Promotion of paddy/milled rice marketing by opening temporary markets

. Market price information services through mass media

b) Department of Foreign Trade

. Development of foreign market for Thai rice and collecting information regarding international rice markets

. Quality inspection and supervision on export rice

3) Ministry of Industry

. Promotion of manufacturing domestic rice milling machines and agricultural tools

4) Ministry of Science, Technology and Engergy

. Promotion of processing technology for agricultural produce

. Development and introduction of packaging technology

5) Ministry of Interior

. Fostering rural development works (activities related to post harvest processes and rice marketing) by the local autonomous bodies

(2) Public Corporations

Basically a majority of the marketing of agricultural produce in Thailand is carried out by the hands of private sector. The government, however, has been taking various measures to protect farmers' interest. The following three are the measures taken, which will directly intervene in the market for agricultural produce:

a) When the paddy market price lowers, the government procures rice at support prices.

b) To improve farmers' bargaining power by temporarily setting up paddy markets near the villages.

c) To give farmers financial assistance so that they are not obliged to sell their paddy in the harvesting season, when the market price drops sharply.

In order to enforce these measures following organizations are actively engaged in their duties:

1) Market Organization for Farmers (MOF)

MOF is a governmental organization which was established in 1974 under the supervision of Department of Agricultural Extension, Ministry of Agriculture and Cooperatives for the purpose of improving farmers' position in marketing of agricultural produce and in procuring their input materials and consumption goods.

2) Public Warehouse Organization (PWO)

PWO is a governmental organization established under the supervision of the Ministry of Commerce for the purpose of maintaining fair price of produce for farmers and also of securing low priced consumption goods for low income groups of consumers.

3) Bank of Agriculture and Agricultural Cooperatives (BAAC)

BAAC is a government financial organization established in 1966 under the supervision of the Ministry of Finance for the purpose of providing low interest financial assistance when the government policies for agricultural promotion are carried out by farmers, agricultural cooperatives and farmers groups.

(3) Farmers Organizations

In the rural areas of Thailand, there are three kinds of farmers organizations. They are organized by government as is the case with most developing countries but participation is not compulsory and left to farmers' free will.

1) Agricultural cooperatives

Number of cooperatives	: 1,157 units (as of 1987)
Number of members	: 883,694 persons
Member ratio to total farmers	: About 20%
Controlled by	: Dept. of Cooperative Promotion, Minisry of Agriculture and Cooperatives

2) Farmers Groups

Number of societies	: 3,923 units (as of 1987)
Number of members	: 487,194 persons
Members ratio to total farmers	: About 10%
Controlled by	: Dept. of Agricultural Extension, Ministry of Agriculture and Cooperatives

3) BAAC Group

Members	: 1,576,261 persons (as of 1987)
Member ratio to total farmers	: About 30%
Controlled by	: Ministry of Finance and Bank of Agriculture and Agricultural Cooperatives

10. Marketing of Rice

Major players of rice marketing are in private sector. They are brokers, rice merchants and exporters. Their activities are seen in many stages such as village, regional and terminal markets. Farmers, after harvest, sell their surplus rice to middlemen or to rice mills nearby. Farmers in the Central region sell most of their paddy in bulk immediately after harvest to the middlemen without retaining any even for their own consumption. Farmers in the northern region, on the other hand, sell about 2/3 of their produce, retaining 1/3 either for their consumption or for seed/feed. The monthly price of paddy and milled rice generally declines gradually from November when newly harvested rice starts to appear on the market. This declining tendency continues until April. After April the price turns to go up and continues to do so until October. The price fluctuation is directly related with the quantity of paddy sold by farmers. The excess supply at the peak of harvesting season causes sharp drop of rice price. Recently, however, farmers began to store more rice by themselves than before as a result of government's scheme, giving farmers the market information through mass media. In order to improve marketing practices of farmers further, it is imperative for the government to arrange markets near the farms and to give farmers the bargaining power.

The government has embarked on various policies for different agricultural commodities. The agricultural products have been subjected to government intervention to various degrees depending on their "local importance". Thus, rice which is consumed up to 70% domestically is the most subjected to government control; while maize, of which only 20% is locally consumed, is subject to relatively less control.

The government's price policy for rice is outlined as follows:

The government has been carrying out various price controls in order to prevent soaring of consumer price at the time of high market price, and to safeguard farmers' interest at the time of low market price. In other words, when the international price is high, they charged export levy and export tax, and gave a quota on the quantity of stocks and export, thereby lowering the price of rice. When the international price is low, the government acts on the price support system (government procures at a guaranteed price). But in January 1986, when the international price stayed low, Thai government abolished the price control system mentioned above. After this, Thai government is stabilizing the price by removing various taxes which has been actually detrimental to rice export, and also by giving low interest loans to farmers, rice millers and rice exporters, and procuring rice from small farmers at a higher price or releasing government stocks.

11. Direction of Improvement in Postharvest Processing

The postharvest process of rice is being done by 4.9 million agricultural households of 34 million farmers. The works differ locally due to their backgrounds such as farming practices, socioeconomic conditions, incomes from other sources than agriculture, infrastructure such as road, electricity, technical level of the farmers and so forth. But

regardless of their many differences, farmers in Thailand are to keep pace with the times and to adopt new technologies in their agricultural practices. Actually we can say that they have started moving toward that direction. Proposed items of improvement in main processes are as follows:

(1) Harvesting

Although mechanization of harvesting is necessary due to labour shortage in harvesting seasons, development of suitable machines to local conditions is slow and so harvesters like paddy reapers may be tried for the time being.

(2) Threshing

Threshers are mostly owned by those who do the threshing on contract basis. The custom threshing is likely to continue and develop for a while. The manufacturers of threshers should make efforts to improve them, especially paying attention to safety factors. In future, as the income of farmers increases, demands for small threshers by individual farmers are anticipated. Development for small, light weight threshers therefore should be started. Further, head combing type threshers should also be developed so that rice straw can be utilized.

(3) Drying

Drying is of fundamental importance to improve the quality of paddy harvested during rainy season. But farmers has no effective means of drying and they sell high moisture paddy without drying, suffering from losses of their income due to the low price of paddy. However, under the present paddy price, it is impossible for farmers to bear

any more cost of drying. For the agricultural produce harvested in the rainy season, there remains the same problem of aflatoxin contamination as in maize. Therefore, drying of paddy needs some drastic technical and economic measures to be taken.

(4) Paddy Storage

Because of the farmers' stronger interests and orientation in paddy market for their higher income, storage facilities are a must to support their strategy. Therefore, it is required to develop and to spread widely storage facilities with structure size suitable to the local climate and production system so that they can prevent damages from birds, rats and insects.

(5) Transportation

Recently, a transportation vehicle called "Farmers car", which runs by a general purpose engine mounted on the second-hand truck chassie, is coming popular among Thai farmers. When the road in rural areas is further improved, more farmers' may have more interest to use them in their daily work.

(6) Rice Milling

The head rice yield and efficiency in milling are low, even though Thailand is the world's top rice exporter. They need improvement. Firstly a survey on miller's skills, on supplies of spare parts, on millers' special needs and on social effects that come from improvement should be conducted, and then effective plans to improve husking and milling should be proposed.

(7) By-product

1) Husks

Husks except for those used as fuel for making bricks, are mostly burnt. If 20 million tons of paddy are produced in whole Thailand, about 4 million tons of husks will be made available in theory as a source of bio-mass. The effective utilization of them would be significant.

2) Rice bran

Piggery and poultry are very popular among farmers. For this reason, rice bran is traded at good price as feed. Although some progressive rice mills are extracting oil from rice bran to produce edible oil but it is not yet a common practice. This is one of areas where Japanese technical assistance will effectively contribute to its development.

(8) Food Processing

The manufacturing of rice crackers and instant foods, and also rice wine(sake) brewery have naturally bright prospects in future not only for Thai market but also for export.

(9) Improvement of Agricultural Machine Manufacturing Technology

The manufacturing factories of threshers and rice milling machines in Thailand are still technically primitive and their manufacturing processes are not arranged in good order yet. Therefore, their quality control in manufacturing is poor and the interchangeability of machine parts is not yet expected. If the manufacturing technology of agricultural machinery is not improved, farmers are troubled with machines of poor quality. It causes not only economic losses but also safety problems. Although direct assistance to the improvement of the technology may be difficult, it is important to modernize the manufacturing system and engineering technique.

(10) Direction of Improvement of Technology in the Postharvest Processes of Other Agricultural Produce

This survey mainly focused on rice but the development of processing technology which is common to agricultural produce in general is expected in the following fields:

1) Drying of agricultural produce (specially maize) harvested in rainy season and the economical management of drying system.
2) Storage of vegetables and fruits
3) Food processing in general

12. Direction of Improvment in Rice Marketing

Before agricultural products finally reaches the site of human consumption or export markets, they go through various marketing channels. The main part is played by middlemen who initiate each stage of procurement. In other words, agricultural products in Thailand are apt to be placed in highly speculative commercial transactions. The government in this circumstance takes various undermentioned measures for the purpose of protecting farmers' interest, promoting fair commercial transactions and maintaining fair quality of produce.

- To procure at support prices when market prices are low
- To provide farmers with a temporary paddy market near them to strengthen the farmers' bargaining power. Nationwide "Temporary Paddy Market Scheme" has been carried out by Department of Internal Trade, Ministry of Commerce.
- To give farmers financial assistance through BAAC so that they are not obliged to sell their paddy even when the market price is extremely low at the time of harvest.

13. Problems and Their Improvement Measures of Rice Marketing

The private sector plays a main role in rice marketing. In this background, some of the problems hindering improvements are outlined as follows:

(1) Incapable government agencies

- The government agencies such as MOF and PWO are mostly incapable to perform their duties due to lack of facilities and also due to repeated failures in their past operations.
- BAAC lacks facilities to carry out their operations and also most farmers have no good storage houses without warehouses for rice, therefore, the project cannot be performed smoothly as scheduled.
- Ministry of Commerce has started to run the "Temporary Paddy Market Scheme". However, most markets lack equipment to run the business.

(2) Old-fashioned Paddy Grading Practice

Grading are indespensable for fair paddy transactions, but methods in practice are out of date. Lack of fairness for both the buyer and the seller often prevents smooth transactions of rice.

(3) Inefficient Export Facilities

The Sixth National Economic and Social Development Plan anticipates that rice export reaches 6 million tons by 1991, when the plan is to be terminated. At present, Rice is exported mainly from the age-worn port of Bangkok which is located at river banks. The port is very much congested because beside rice it ships maize, cassava, sugar and also it handles materials for various industries and their products. The government must take comprehensive measures for various improvements in port facilities along with the project by

which they plan to construct a sea port at Laem Chabang in the South-East coast.

Under these assumptions, the government's roles to play for the improvement are as follows:

- Strengthening the organization of the related agencies
  In supporting the agencies which execute various related policies, it is important to define clearly the roles and functions of the agencies, and especially to ascertain their capacility (facility and management ability) in performing their assigned duties.
- Introduction and Enforcement of Paddy Grading System
  The improvement measures for paddy grading should not only cover the technology, tools and equipments but also regulatory matters such as method and place of inspections, inspectors, etc. Department of Internal Trade, Ministry of Commerce showed that they had a strong intention to this effect.
- Promotion of private Sector Activities
  Rice marketing in Thailand is basically in the hands of private sector. Therefore, the government should avoid duplication of works between the two but rather support the private sector by extending technical and financial assistance to them.

14. Training and Development Concerning Postharvest Processing

(1) Main organizations in charge of development and training

1) Section of Processing and Storage, Division of Agricultural Engineering, Ministry of Agriculture and Cooperatives

a) Intiation of various developments in rice milling machines, threshers and cleaners for farmers.

b) Research and development of storage facilities for farmers and also of silo technology.

2) Farm Machinery Promotion Centres, Department of Agricultural Extension, Ministry of Agriculture and Cooperatives

a) Introduction and demonstration of various postharvest machines to be used by farmers, such as harvesters, dryers and rice milling machines

b) Training for operation, maintenance and repair of machinery related to harvesting

3) Engineering Division, Cooperative promotion Department, Ministry of Agriculture and Cooperatives

a) Training at the Engineering Centres (10 of them in whole nation) for operation and maintenance of tools, machinery and other materials used for farming by the members of cooperatives

b) Operation and management of medium scale rice milling machines

4) Division of Agricultural Chemistry, Department of Agriculture, Ministry of Agriculture and Cooperatives

a) The effective utilization of by-products such as rice husk and bran etc.

5) Department of Business Administration, Faculty of Economics and Business Administration, Kasetsart University.

a) Loss assessment during postharvest processes

b) Researches on socioeconomic aspects of postharvest processes

(2) International Cooperation Projects

There are following projects now going under way assisted by international aids concerning the improvements of postharvest processes.

1) "Intercountry Cooperation on Postharvest Technology" by the FAO, Regional Office for Asia and the Pacific

The projects concerned with improvement of postharvest practices are supervised by the Division of Agricultural Engineering and Prevention of Food Losses. The participating countries are Bangladesh, Burma, China, Indonesia, Korea, Malaysia, Nepal, Pakistan, Philippines, Sri Lanka, Thailand, and Viet Nam. The projects deal with problems in many stages of postharvest processes such as harvesting, drying, storage and marketing. The results and experiences are shared by the participating countries. They are hoping that they will establish an improved organizational system through which the exchange of information and extension works among them may be possible.

2) "Asian Grain Postharvest Programme"

This project is started by the aid from the Canadian IRDC (International Research and Development of Canada) in 1988. The Southeast Asia Cooperative Postharvest Research and Development Programme, was its predecessor and its former activities are mostly succeeded by this project. The main activities are; a training course under a specific theme which is set up every year and a workshop which is also held once a year in one of ASEAN member countries in turn.

3) Survey on Postharvest Processes in Thailand

This survey was conducted with the aid from Canadian IRDC in 1976. In this report, Thailand was divided into four regions, the Central plain, the Northeastern, Northern and Southern regions and the detailed results of the survey were reported together with many photographs. It presents the problems clearly and is a valuable reference to review the actually prevailing conditions in Thailand.

4) In 1981, Kasetsart University hosted the conference for the deans of the faculty of agriculture in Asian universities. At that time, a seminar was held on the education and research for postharvest processes. The seminar received the financial assistance from UNESCO and the German Foundation International Development. The seminar seemed to have aroused and stimulated the interest of young researchers in the field of postharvest processes who were in the universities and research organizations in Thailand.

(3) Projects cooperated by the Japanese Government

1) Maize Quality Improvement Research Centre

The purpose of the project is to make basic researches for technical development to prevent aflatoxin infestations. The mode of cooperation is the combination of despatch of specialists from Japan, acceptance of trainees in Japan and providing Thai side with materails/equipment to promote technical development in the following fields:

a) Cultivation; Improvement of cropping pattern to avoid harvesting in rainny season and selection of varieties resistant to diseases

b) Drying and Cleaning; Improvement of drying and storage practices after harvest and developments of threshers for high moisture grains and handy moisture meter etc

c) Microbes; Analysis of the ecology of the aflatoxin producing microbes etc, a grasp of the actual condition of infestation and developments of infestation preventing technology and a handy detection method of aflatoxin

2) Cooperation project to Rice Research Institute

Main activities of the Rice Research Institute are basically in breeding. However, for the field of postharvest, they have just started concrete works along with the national policy of the government. One Japanese specialist of insect infestations in grain storage is staying here.

3) Research Cooperation Programme for Kasetsart University (Phase II)

This is to contribute to the agricultural development of Thailand through the expansion of their research activities in Kasetsart University, the core agriculturel University in Thailand. For the postharvest processes, insect and disease control for the agricultural produce in relation with the quality guarantee technology, and improvement and development of threshing technology in agricultural mechanization are taken up as their research themes.

15. Requests from Thai Side for Aid from Japan

During the study tour, the mission had opportunities to visit various organizations which were working towards the improvement of postharvest processes. Many requests were made seeking various assistance from Japan for the purpose of the improvement of postharvest processes. The mission had the opportunity to be shown of their new requests. They are as follows. Among these, (1) and (2) have already been submitted to DTEC:

(1) Postharvest Technology Centre Project

Request from; Thailand Institute of Science and Technological Research, Ministry of Science Technology and Energy

Purpose; To establish a Postharvest Technology Centre for the purpose of comprehensive advancement of the study (especially packing technology) on postharvest processes of vegetables and fruits, in order to promote the plan of exporting horticultural crops which are mentioned in the 6th Plan

Items requested; The building and the basic machinery and equipment for the three main activities of research, training and management of various packing factories

(2) Improvement of the Quality Control on Pesticide Residue for Certification of Export Agricultural Products

Request from; Division of Agricultural Toxic Substances, Department of Agriculture, Ministry of Agriculture and Cooperatives

Purpose; To obtain necessary analytical equipment for detecting agricultural chemicals contained in export rice, vegetables and fruits etc

Items requested; Measuring equipment and technical guidance

(3) Postharvest Technology Centre at Kanchanaburi Agricultural College

Request from; Department of Vocational Education, Ministry of Education.

Purpose; Establishing a technical training centre at the Kanchanaburi Agricultural College a) to reeducate teachers and government officers, b) to hold classes for farmers, c) to hold seminars, d) to promote research along with their regular college education

Items requested; Facilities for technical training, various machines and equipments relating to various processing of agricultural produce

(4) Establishment of Postharvest Service Stations

Request form; Department of agricultural Extension, Ministry of Agriculture and Cooperatives

Purpose; Reduction of losses, improvement of quality, extension of postharvest processing technology and machinery

Period; 1989/90 - 1991/92 (2 years), with extention as necessary

Related organizations;

Department of Agricultural Extension

- Division of Crop Promotion
- Division of Agricultural Management
- Division of Crop Protection

Department of Agriculture

- Rice Research Institute
- Division of Agricultural Engineering

Project style; A pilot project with cooperation by foreign experts

Project site; The proposed stations would be constructed at four sites as followings:

Chai Nat (Central region)

Brirum (Nontheastern region)

Chiang Mai (Northern region)

Patthalung (Southern region)

Concrete plan for operation;

To make plans to carry out the project in following three stages:

1st stage Study, Development and Introduction

2nd stage Operation tests for local application

3rd stage Extension

Request for cooperations;

a. Technical cooperations by foreign experts

b. To provide facilities at four project sites with threshers, harvesters, dryers and village type rice milling machines

c. Economic aid for training

Expenses shared by Thai side;

a. Some warehouses for machines and equipments

b. Technical staff as counter-parts

They expressed their strong intention to utilize the facilities as regional centres for Southeast Asia after the project proves to be successful in Thailand to certain degree. The largest reason for this is that the four experiment stations to be formed by this project represent each of the different topographical conditions of Southeast Asian countries. Namely, Chai Nat in the central region stands for the delta areas of Bangladesh and Burma, Brirum of the northeastern region for rainfed lowland paddy fields in Philippines, Chiang Mai of the northern region for the intensive farming areas and the southern region for the farming system of Malaysia and Indonesia respectively.

When the mission members met the Director of the Department of Internal Trade, Ministry of Commerce, he presented a strong request to get, by all means, the economic and technical assistance from Japan in order to establish inspection system of paddy and central institution for these activities in Thailand.

16. Planning Manual for Improvement of Postharvest Processing of Rice

The improvement of postharvest processes must be formed with the technology and system which can take roots in the local condition. It is needed to make a thorough study not only on management system for new technology and an incentives for improvement as well as on the technical level of the workers (farmers), but also on labour productivity, on economic effects, on acceptance to rural society and on secondary effects such as its possibility of application for other agricultural produce. Then, full scale extention works should be initiated. The planning manual for such improvement would include following items:

(1) Investigation on actual conditions of the postharvest processes

1) Survey on actual conditions by the types of work and area

2) Grasp and analysis of the actual conditions of losses and their causes

3) Necessary measures and the method of evaluating the effect of improvement

(2) Introduction and development of improvement technology

1) Selection of itemwise and areawise works for improvement

2) Analysis of economic efficiency and socioeconomical effects

3) Studies of management and running system of new technology to be introduced

(3) Verification of the new technology

1) Test of the new technology whether it fits the local conditions and whether it is accepted from the people there

2) Check of the factors which obstructs the introduction of new technology

(4) Extension of new technology

1) Workwise and areawise extension of the new technology

2) Evaluation of extension effects and their secondary effects

3) Possibility of giving incentives for extension

17. Selection and Priority of the Cooperation Project

Postharvest processes and marketing channels have broad and complicated features. We must evaluate properly the various projects which are proposed from developing countries for the purpose of solving their problems which lie in these field, and then establish a preference to the projects of their requests before we decide to take up, because it is not possible for us to accept all of them. The referential terms for preference may be as follows:

a) Urgency, b) Relation with the government's development plan, c) Sphere of influence (domestic and foreign), d) Propagation of effects, e) Contribution to other areas, f) Assistance given to past/present similar projects, g) Availability of knowledges and techniques in cooperating country, h) Level of economic independence, i) Extent of contribution to social welfare and j) Possibility of contribution to protecting natural environment

18. Evaluation of the Project

Evaluation is generally made to confirm the effect of cooperation. The first step of the evaluation is to review the contents of the project based on the objectives of the project, then, we must analyze the course of execution and finally must judge how much the goal has been achieved. If there are any problems, findings should be reported for the correction. Important points in the evaluation may be as follows:

- Whether the contents of the project (purpose, design and management plan etc.) are appropriate or not.
- Whether there were any problems in the execution and management of the project.
- What sort of benefits has been gained and what sort of problems was encountered.

In this evaluation, we must review not only the course of planning and the contents of the project but also the following items in detail:

Maintenance and Management (budget, personnel, line of responsibility, repair/maintenance, safety measures, fringe infrastructure), Extent of utilization and its' effects (operation record, spreading possibility), appropriateness (scale, function, site selection, time of construction, design of facilities, selection of machinery/equipments), level of contributions (PR effect, extension and extent of technology transfer)

19. Recommendation

The mission would like to recommend the followings to promote smooth and effective cooperation for improving postharvest technology in rice processing:

(1) The improved postharvest technology contributes not only to reduce various losses but also to promote the diversification of cropping which is made possible by distributing the farming labour rationally, and thereby contributes to improve farmers' standard of living. Based on this understanding, our activities of cooperation should be further strengthened.

(2) Postharvest process technology is a kind of new technology, and one not yet determinedly established. Although a standard/manual for improvement must be established in case by case for a time being, accumulating such experiences the general standard/manual should be made in future.

(3) Various improvement activities have been carried out to a certain extent in developing countries. The cooperation of Japan may not necessarily be of project type which requires massive time and fund. It would be more effective if we could extend cooperations flexible enough to be able to provide, with simple formalties, financial assistance for recipients activities when they need it.

(4) The planning and execution of the improvements may not totally be made by the ideas and technologies of the specialists sent by the donor country but the experiences and wisdom of the recipient country should be brought in and made full use of them.

(5) In planning the improvement, it should be taken into consideration that there be incentives for the farmers who put it into practice. Otherwise it would be difficult for the new technology or system to take root among the farmers.

(6) In planning an improvement, not only the new technology will be developed or introduced but also it must be verified for their adaptability to the local conditions so that they will take root in the farming operation of the farmers through extension service. For this purpose, various assistance either donation or loans or technical aids must be combined in a systematic way and the assistance should be extended for a certain period of time.