4.2 Present Problems and Necessity for Improvements

4.2.1 Harvesting

(1) Recognition for postharvest operation improvements

According to the survey, losses by threshing show the highest values among the various operations in paddy fields with 2.9 to 4.2% in beating threshing and with 5.7% in threshing with bullocks. Urgent improvements in threshing work are desired. This has also been pointed out in the FAO report.

When threshing losses are analyzed, losses by unthreshing account for the bulk of the losses, and the introduction of threshers should be able to substantially reduce these losses.

The farmers will be able to obtain paddy by using threshers with a cleaning function, and paddy can be sold at a higher price than at present.

Efficient harvesting operations will greatly reduce losses. This and other surveys have shown that quantitative and qualitative losses of rice increase if the reaping time is delayed.

At present, a long time is needed in Pakistan for harvesting. In Sind Province particularly, reaping alone requires a long time, approximately two months. The harvesting operation should be made to be efficient to allow reaping at a suitable time and quick threshing and cleaning thereafter in order to reduce quantitative and qualitative losses. A supply of high quality paddy thus obtained on the market leads to an increase in high quality milled rice which would benefit not only farmers, but also rice millers and Pakistan.

A combine harvest method combining a reaper and thresher can be considered in mechanizing reaping and threshing, and the introduction of these machines is currently being studied by various government, public, and private organization.

The actual conditions and future trends will be described in detail later.

As mentioned earlier, paddy distributed in the market is sold by farmers almost completely unprocessed. To better prevent quality deterioration of paddy afterward is easier the nearer drying and cleaning are performed close to the farmer stage, and extra work in subsequent processes can be eliminated. By building a market system which allows appropriate evaluation in accordance with paddy quality will arouse the will of farmers to produce, and a system allowing higher quality paddy to be supplied to the market should be established.

Losses during postharvest operations are not due only to improper postharvest operations, but are strongly affected by factors before harvesting. It is to be remembered that reaping particularly affects losses.

Basmati grown in Punjab Province is tall, but has a low resistance to lodging. As mentioned earlier, there were many paddy fields in Punjab Province that had lodged rice plants during the harvest season, and reaping losses were large. Lodging not only reduces the yield, but also increase reaping losses. Further lodging greatly restricts mechanization. It will be very important to develop varieties that do not lodge as well as to penetrate a cultivation method that prevents lodging in order to reduce reaping losses in the future.

Losses during reaping can be expressed by a percentage of the absolute amount of losses relative to the yield. However, the absolute amount of losses does not increase proportionate to the yield increase. General examples are that the loss absolute amount does not increase corresponding to an increase in the yield. An increase in yield directly reduces losses.

There are many cultivation problems which can be immediately improved to increase the yield; such as damage by rice borers on Basmati and by plant hopper in Sind Province, and rough planting density. Improvements of these problems are necessary and indispensable to reduce losses along with improvements of postharvest operations.

(2) Problems with harvesting machines

1) Reapers

Reapers are high efficiency and relatively low cost harvesting equipment. The machine construction is not too complex, and they can be operated easily. However, it is difficult to reap lodged and diseased infested rice plants. Reaping in water ill-drained rice fields is possible by using squirrel cage wheels. However, efficiency is low, and sometimes the wheels sink into the fields and are unable to move. Further improvements are necessary.

2) Locally-manufactured threshers

Stalk paddy with ears are thrown into threshers, and high horsepower is needed. Scattering by the No. 3 outlet is slightly large in the quantitative loss, but its total is less than the 2% allowable range. Cracked kernel generation ratio showed as much as 7.6% in qualitative losses. This is due to dry sample rice plants, to thresher rotation speed, to profile of thresher teeth, and to other factors. The low work efficiency can be explained by throwing in low-reaped rice plants to recover rice straws as livestock fodder, and this is more prominent with Basmati which has a large amount of straws. A test was made by cutting rice plants with ears to 60 cm. A high efficiency of 1.78 t/h could be obtained with IR-6. However, a high level of scattering loss occurred at the straw outlet. The low efficiency was also caused due to improper position, profile, and size of the supply inlet, making stable and continuous supply difficult. With IR-6, straws are not discharged smoothly, and an assistant operator is needed at the outlet. However, generally, there are too many workers. Engines of 20 to 25 HP are difficult to procure, and threshers are driven using 45 or 62 HP tractors, further increasing costs. The mechanical construction is simple, but appropriate parts are not used, and problems frequently occur. Raw material

threshing is not possible as rice straws stick to the drum. Rice straws are dusty, but can be used as a fodder. As mentioned, there are many problems, and improvements are needed with an emphasis on improving efficiency.

Locally-manufactured axial-flow threshers require the following improvements:

a) Change the power source from a tractor PTO to a diesel engine of 20 to 25 HP.

b) Concerning thresher teeth, the present tooth type can be used. However, the tooth diameter should be slightly reduced, and the material should be replaced by a stronger one. The concave clearance must be wide in front and narrow in back and should be adjustable in accordance with rice plant conditions.

c) The feed inlet must be low or a step should be provided. Feed rolls or a conveyor should be installed to allow stable and continuous feeding.

d) A safety pin or safety cratch should be installed to assure safety.

e) The straw outlet construction should be improved to allow straws to be ejected without operator assistance.

f) Use parts with sufficient strength where strength is necessary.

g) Reduce the sieve size to prevent mixing paddy so branches and stems do not mix in the product and have it drop at the second outlet. Unhulled rice with branches and stems is rethreshed after work is finished by reducing the rotation speed.

h) Paddy with a moisture contents of about 16 to 18% so that it does not become too dry.

3) Auto-feed thresher

Both IR-6 and Basmati 370 have many delayed ears and are not inform in height. There are differences of 20 to 35 cm in height. If ear positions slip due to carelessness during gathering and transportation, ears do not completely enter the threshing chamber, causing some ears to be unthreshed. Unthreshed ears as loss reach as high as 1.8% in amount. Short-stalked rice plants due to a late transplantation season have larger losses, and threshing becomes impossible. The cracked kernel generation rate is 4.1% and is slightly high. The high rate of cracked kernels is due to the augers and throwers. When raw material is not enough dried, threshing is also possible, and straws can be used without problems and at a relatively low cost. Improvements are needed to simplify the construction and to improve efficiency.

The auto-feed threshers require the following improvements:

a) Reaping should be performed without changing the ear position, and care should be exercised during gathering, transportation, and heaping not to change the ear position.

b) Thresher drum width and feeding method should be improved to raise efficiency.

c) The drum diameter should be slightly increased to allow threshing of ears with large vertical ear position dispersions.

d) Provide two or three feed chain speed to allow work depending on crop conditions.

e) Do not use augers and throwers only when it is needed.

f) Install safety devices.

4) Auto combine

Reaping losses due to the impacts from raising tines are slightly high. Reapable stalk lengths are 60 to 120 cm

reaping Basmati 370 or wheat which have short stalks increases losses and is difficult to thresh. Through lodged rice plants can be reaped, work accuracy lowers when completely-lodged Basmati 370 is reaped. Due to high unthreshing and cracked kernel generation rate, losses are higher than that of other type of combine. The drive section is a crawler and the grounding pressure is low. Therefore, it can work even on the soft ground. Straws reaped by auto combines can be used without problems. However, it's efficiency is low, and construction is complex, therefore auto combines are not necessarily suitable for Pakistani farmers at present.

5) Ordinary combines

Combines were originally developed to harvest wheat. Many improvements are necessary in order to use them as rice harvesting machines. Hulled kernels generation ratio as qualitative losses is 2.2%. This rate is higher if adjustment of the drum rotation by the operator is poor. The generation of hulled kernels results in cracked kernels during drying, and this is one of the reasons for the low popularity of combines. However, these losses can be offset by low quantitative losses.

The construction of combines is so complex and difficult to operate that operators are required to have considerable skill to reap the rice stalk when the combine work on soft ground or to reap the lodged rice stalk. Severe checks are needed in routine checks and maintenance. The efficiency of large combines is generally very high. However, size of one plot of rice field are from 0.5 to 1.0 acre in Pakistan, therefore it's efficiency is extremely low in Pakistan. Combines of the present wheel type cannot be used in soft paddy fields. Rice straws are cut and are bent violently by work of combine. Therefore, the value of rice straws as fodder is rather low, but can be used as fodder after recovering them. The ratio of cracked kernels generation is rather low due to high moisture contents of raw material, so that no problems are

anticipated when operators become experienced. A large number of combines will be used in the future. Judging from various conditions of Pakistan, medium-type crawler combines, which are suitable for soft rice fields, will be used in some regions.

(3) Improvements

1) Cultivation methods and rice field structures must be improved to implement mechanization of harvesting. Following improvements are required for future mechanization: prevention of lodging, early drainage of residual water, drying wet fields, improvements in the water supply and drainage canals, improvements in farm roads, unification of maturing season, collective use of varieties, extermination of diseases and insect pests, levelling of paddy fields, expansion and consolidation of plot or rice field and planting varieties which suitable to mechanization.

2) Mechanization in accordance with farmer's size of farming
For example:

Small and medium farmers —— Reaper + thresher
Large farmers —— Combine

3) Introduction and development of machines suiting actual conditions in Pakistan

Simple construction, rugged, easy operation, low cost, high efficiency, high versatility

4) Strong economic assistance and technical guidance by the Government to farmers will be needed to realize mechanization.

5) Recognition of losses by farmers, labor saving by mechanization, expanded scale, intensification, and diversification - these require strong activities to promote wider implementation.

6) Stronger technical and economic support to Pakistani agricultural machinery manufacturers for the development and local manufacture of suitable machines.

7) Conditions of paddy for Sind and Punjab Provinces differ, and mechanization should be pushed independently for these two provinces.

8) Cleaning can be improved by using winnowers, etc. which are very versatile.

9) Machine sizes and machine types should be selected depending on local conditions, and a large variety of machine sizes and types will be required. The present status of agriculture in individual regions should be analyzed, and a mechanization work system most suitable for management improvement should be introduced as part of the regional agriculture based on future management improvement goals for farmer groups and on improvement plans.

The methods to improve the above-mentioned situations can be summarized as follows:

Mechanization of reaping by reapers, mechanization of threshing by threshers and mechanization of cleaning, a high cleaning work efficiency by winnowers, mechanization of reaping, threshing, and cleaning by combines, improved natural drying of paddy by farmers, efficient transportation of harvests by farmers, promotion of use of agricultural equipment by farmers by establishing farming equipment lease centers, improvements and development of harvesting machines, and building facilities to educate and train equipment operators.

4.2.2 Cleaning and drying

(1) Cleaning by the farmer

Except for paddy for own consumption, wind cleaning is almost never performed after harvesting. This is because the farmers want to sell their crop as soon as possible after harvesting. Cleaning is not included in contracted labor for harvesting operations, and the farmers do not have suitable cleaning equipment. Wind cleaning is common in other rice growing countries.

Therefore, normally, 2 to 3% foreign matter is mixed in paddy. This is used as a reason for price reduction during bargaining to sell paddy. Paddy can be cleaned by introducing threshers or combines. Until these machines are introduced, cleaning by winnowers is desired.

(2) Drying by the farmer

After reaping, stalk paddy is dried in paddy fields for 1 to 3 days in Punjab Province and for 7 to 10 days in Sind Province. Sheeting should be used to dry paddy for farmers' consumption after threshing.

Normally, paddy to be sold is not dried, and the price for it is reduced in nearly all cases because the moisture content is approximately 18 to 20% at the time of sale compared with the procurement standard of 14%. Whether the farmers or rice millers should dry is a question involving labor and drying locations or facilities, and a decision is difficult to make.

Compared with other rice growing countries of Southeast Asia, Pakistan has better weather conditions during the harvesting season, and paddy does not deteriorate even if it is not dried immediately after harvesting. In the future, paddy should be dried by farmers, and it should be sold without a price reduction. Nevertheless, the farmers are not accustomed to drying paddy to be sold. Presently the farmers have neither suitable drying places nor sheeting. Therefore, there seems to be no alternative for the farmers than to sell paddy as it is and to let the rice millers dry it.

However, guidance should be given to the farmers for checking the moisture content of paddy by using a moisture meter and help should be given in selling paddy with proper price reductions.

(3) Cleaning and drying at the marketing stage

Paragraph 4-2-3 Milled rice describes this matter.

4.2.3 Rice milling

There are two methods for decreasing losses occurring in the rice milling process. One is to upgrade paddy quality in pre-processing and the other is to modernize rice milling equipment, and to improve on rice milling technology.

(1) To upgrade quality paddy

Paddy purchased by mills is upgraded mainly by drying it to adjust moisture contents and by removing forein matter.

When paddy is sun dried, it produces more cracked kernels than machine-drying, and is more vulnerable to mixing with dirt, sand and brick pieces. This may lead to the deterioration of the quality of the milled rice. In general, it is difficult to immediately enforce machine-drying from an economical viewpoint. Instead, it is recommended to turn over the paddy repeatedly and to use cover at night to prevent damage by dew. In connection with this, caution must be taken to avoid over-drying, for the moisture contents of 14% is required in the milled rice standards.

At present, paddy is winnowed by a sloped sieve at the time of drying, but it is recommended to add the two-staged winnowing process prior to the husking process.

(2) The modernization of rice milling facilities

As a result of observation and experimentation conducted by the study team, it is recommended to introduce to the husking process a rubber-roll husker instead of a conventional disk sheller. Although most millers are aware of the effect of the rubber-roll huller, they seem to be hesitant to actually introduce it owing to various reasons. They show a strong resistance to the necessity of frequently replacing a rubber-roll which is more vulnerable to wear than disk sheller parts, and are anxious about using a new machine to which they are not accustomed. They are not fully aware of the fact that the milling recovery increases and the cracked kernels occurrence rate decreases with the use of the new machine. These are the

main reasons for the delay in the introduction of the rubber-roll husker.

Therefore, to introduce the rubber-roll husker, it is necessary to fully instill the effect of the machine into millers in addition to providing them with suitable technical guidance. For this purpose, it is necessary for the government organizations to establish a leasing system at the initial stage of introduction and to enlighten the millers on the necessity of the new machine.

4.2.4 Storage

Major losses in the storage of paddy/milled rice occur during open-space storage at rice mills and RECP.

(1) Abolition of open-space storage

It is clear that the main reason for losses is due to open-space storage; however, construction of permanent storage buildings would be impractical because the maximum storage period is no more than 6 months and the losses are often not noticed by paddy/milled rice owners.

(2) Introduction of temporary godowns is recommended. These godowns can be quickly assembled and disassembled. The dimension of the godown is 8m in width, 10m in length and 3.8m in height with polyester coverings and iron frames.

Details are further discussed in Appendix D.

4.2.5 Transportation

Transportation losses of paddy and rice occured mainly at stages of loading, unloading, measuring and rebaging. However these losses can be reduced by careful recovery of leaks

Based on the study team's study, qualitative losses are serious if milled rice is stored in open air at the railway station, and there or delays in railway wagon arrangements. Broken kernels was not measured by the study team, but it is believed that broken kernels remarkably increases if is stored outside for more than 6 days. Countermeasures for this loss include moderization of the railway wagon assignment system and truck transportation is an alternative.

For reducing quantitative losses during transportation, mechanization of handling and careful recovery of leakage is suggested.

4.2.6 Grading and inspection

(1) Paddy inspection

Quality of paddy is examined only visually. In markets and rice mills, quality evaluation is not objective but subjective. This is a disadvantage for rice producers.

The Government sets a support price. However, the quality of paddy corresponding to the support price is not clear, and verification of whether or not the support price is adhered to is not presently possible. This situation is prominent particularly with IR-6 whose market price for paddy is extremely close to the support price.

To improve this situation, moisture meters should at least be used. Dockage sieves should be used to measure foreign matter. However, the lots of inspection are generally small, and sampling is possible with bags by prickling them with a sampling pier. When paddy is traded in bulk in the market, sampling is not easy, and the use of dockage sieves with bags is recommended.

(2) Inspection of milled rice

1) Samples are reduced by a quartering method, and uniform reduction is not performed regarding broken kernels and foreign matter. In the final process of reduction, the weight is adjusted by hand to obtain 10 g of sample. After all these efforts are made, reduction is not uniform. Instead of adhering to exactly 10 g, the weight should be "approximately" 10 g.

2) At least 1 kg samples should be analyzed for kernels of other varieties, foreign matter, and paddy.

3) Paddy quality standards

The present inspection standards are too detailed when quality inspection is performed without using inspection instruments, that is, by visual. In fact, numerical values cannot be judged for each item. Therefore, it is not practical to negotiate price reductions based on such numerical values. Inspection items should be reduced only to those that allow a decision by visual assessment. Those items that cannot be decided by visual assessment, that is, red kernels, heated damaged kernels, and cracked kernels which are not included as an item, but are important inspection items, should be studied to decide if they should be continuously inspected.

If only visual assessment is to be made, inspection items that will remain will be only kernels of other varieties, rough moisture content, foreign matter, luster by external appearance, such as color and shape of kernels.

An alternative will be to continuously maintain the present standards by using moisture meter, dockage sieves, and simple huskers.

4) Milled rice inspection standards

a) First, the allowable limit for moisture is 14% maximum. In Pakistan's present situation, a lower limit for moisture should be established in order to prevent cracked kernels due to over drying and to

maintain taste and flavor of milled rice. In this case, research of average balanced moisture content by regions will be necessary.

b) Milling degree is expressed vaguely as "well milled." Therefore, buyers tend to frequently request over hulling. In fact, the survey team observed over milling by approximately 1.5 to 2.0%. It is best to use color meters in order to compare the milling degree, however, the color meter may be used to the comparison of milling degree to the same rice. On the other hand, when milling degree is not enough, the milling degree may be measured using a new MG reagent.

The inspection items include red kernels and under-milled kernels. Under-milled kernels are those kernels that are called "jumped in" kernels and should be treated whether or not milling is proper because of their character. It is not correct to treat them in the same group as red kernels.

c) Mixing paddy is treated as foreign matter. However, it should not be treated in the same category at that for ordinary foreign matter in terms of consumer quality value evaluations in and outside Pakistan. A more sever allowable low limit should be provided. This will necessitate the use of rubber-roll huskils and high-performance paddy separators.

d) The rule that red kernels, under-milled kernels, chalky kernels, white belly kernels, damaged kernels, discolored kernels, irregular shape kernels and also they are broken kernels that should be treated as broken kernels is acceptable in that no double counting is made. However, they all should not be treated as broken kernels. Originally, defective kernels affect the commodity value differently, and counting should be made in the order of the seriousness of the defect. Internationally and domestically there should be more items that have more serious defectiveness than broken kernels.

The order rankings of item in rice inspection standards of Japan, the United States and other countries are summarized below as a reference:

Paddy, small broken kernels, discolored kernels, damaged kernels other than discolored kernels, red streaked kernels, broken kernels, chalky kernels, large broken kernels, and kernels of other varieties

Kernels that are applicable to more than two items are applicable only to the first item that applies in this application order in applying these rules.

Red kernels originally exist during the process of paddy or brown rice and should be called red streaked kernels in milled rice. The degree of red stripes should be regulated by definition.

e) All inspection items should preferably be defined. This minimizes analytical errors due to different graders or places.

f) Grades and discount rates

At present, this situation is tolerable, but allowable limits, rejection limits, and discount rates for intermediate grades are provided. The application of these requires much time and labor. Instead of maintaining them, a grade system should be used to classify into first, second, and third grades. One example is given in Table 4-33.

Table 4.33 Recommendable Specification of Punjab Rice, Basmati

Grade	No.1	No.2	No.3
Item of Inspection	71%	71%	71%
1. Fully Healthy Kernels			
a) Permal, Mushkan, Hansraj (Bara) and Sathi, PK-177-178 and PK-196	5%	10%	15%
b) IRRI-6, KS-282, IRRI-8 Jhona and IRRI-9	5%	5%	5%
2. Broken Kernels			
a) over 1/4 to 3/4 of Basmati	10%	15%	20%
b) 1/4 and below	1%	2%	5%
3. Red Streaked Kernels	1%	1.5%	2%
4. Chalky Kernels	1%	4%	4%
5. Damaged Kernels	4%	1.5%	2%
(Discolored)	1%	0.5%	0.5%
6. Foreign Matter	0.5%	0.5%	1%
7. Paddy	0.2%	0.2%	0.5%

It will be rational in all respects to provide price differences corresponding to intergrade differences for first, second, and third grades.

(3) Quality and support prices for paddy and milled rice

The following support prices were applied during 1985 and 1986:

Table 4.34 The Support Price of Pady and Milled Rice

In RP/40 kg

	Basmati		IR-6 and others	
Paddy	92		57	
Milled Rice	Special	F.A.Q.	Special	F.A.Q.
	181	175	95	86.5

In deciding support prices, production costs should be used as a factor for paddy, while costs for milling rice, transportation and distribution costs, etc. should be factors for milled rice. As long as Pakistan remains an exporter of milled rice, the international rice price and political considerations are incorporated. This report has no intention of discussing the rice price level.

However, smooth marketing of rice may be hampered unless grade and price differences between special and F.A.Q. and between Basmati and IR-6 and other varieties are reasonable.

1) Price and quality of paddy

As mentioned earlier, quality of paddy in applying support prices is decided. However, in implementation of inspection, quality of paddy in applying support prices is not necessarily clear. It is, therefore, difficult to judge whether or not support prices are adhered to.

It will take time, but inspection methods should be changed from one that is based on visual assessment to one that is based on instruments and equipment in order to get objective inspection results. A grade system should be introduced in the future to divide grades into first and second grades, or into first, second, and third grades, instead of maintaining the tolerance of limit, scale of deduction, and rejection limit. These limits may be set for each grade to make clear the relationship between paddy quality and support prices.

Under the present paddy specifications, quality higher than tolerance of limit equals the support price. This contradicts the principle that the support price is the minimum price guarantee.

To some extent, this is tolerable judging from the actual condition of paddy transactions. However, this practice should be changed as soon as feasible.

2) Quality and support price of milled rice

a) Quality and support price

The same problem that exists with paddy also exists between the support price and specifications of milled rice. The support price, which should be the minimum price, is applied to the highest grades of milled rice purchased by the Government (Special and F.A.Q.) at present.

b) Grades and support prices

Therefore, as in paddy, the present tolerance of limit, scale of deduction, and rejection limit should be changed to first and second grades, or to first, second, and third grades. If necessary, a higher grade should be added to the IR-6 variety.

c) Differences among varieties

Differences among Basmati and other varieties should be set taking into consideration production costs and transaction conditions. However, the fact that production of the Basmati variety is decreasing year after year (1,035 K tons in 1981-1982, 987 K tons in 1982-1983, 926 K tons in 1983-1984, and 855 K tons in 1984-1985, down 4.7, 6,2, and 7.7% over the previous year) should be taken into consideration. The actual conditions of the market price should also be considered. The Basmati variety is traded in the market at a price far higher than the support price immediately after harvest. The IR-6 variety is traded particularly in Sind Province at a price which is probably below the support price. It goes without saying that the Basmati support price should be decided after taking into consideration the production, distribution, and processing costs, as well as the international rice price as a rice exporting country.

(4) Proposed improvements on grading and inspection

1) To reinforce paddy grading and inspection by instruments, equipment and technology improvements. The present inspection by visual assessment lacks objectivity and tends to be subjective. However, inspection that uses instruments requires large purchases of instruments and equipment, which is difficult to comply with. More time will be needed for inspection if instruments and equipment are to be used. Further, transaction units are small, and sampling is difficult to perform. For these reasons, inspection by instruments and equipment is difficult to be executed.

However, to safeguard producer interests regarding the interconnection between the support price and paddy quality, and to make paddy marketing smooth, a change should be made sooner or later from visual inspection to instrument and equipment inspection. Therefore, instruments and equipment should be introduced gradually.

As the first step, simple moisture meters should be introduced when government rice mills purchase paddy.

Next, decisions on paddy quality are technically difficult to make, and an item "test weight" should be used in the standard.

The test weight is a combination of apparent specific gravity and a high correlation with kernel solidness, that is, milling recovery. This is the most important item for expressing paddy quality among inspection items. Therefore, studies are needed to set a test weight standard and to decide inspection standard numerical values.

Test weights differ depending on paddy varieties and types, and studies of each test weight level will be necessary. Measurement of the test weight is difficult with paddy of covered varieties.

2) To study milled rice grading and inspection standards based on international standards and to rationalize it

As an exporting country of milled rice, an export standard should be announced. With this, customers outside of Pakistan can be assured of quality, cases for purchasing by special specifications will be minimized and rice mills in Pakistan will be able to use this as a reference. For this purpose, milled rice purchases for the State in purchasing milled rice in Pakistan should be changed to prices which reflect different grades.

3) Grading and prices of paddy and milled rice should be matched to contribute to improve quality of paddy and milled rice

Existing inspection methods for paddy and milled rice should be changed, and inspection standards should be amended to reflect different grades. Support prices should be changed in the near future to match quality differences and support price levels.

4.2.7 High utilization of by-products

(1) Present utilization status

1) Rice straws

As mentioned in 3.1.8 above, rice cultivation in Pakistan is agriculture with livestock raising as a major side line, and most rice straws generated after harvesting are used as raw fodder for livestock. The utilization condition of rice straws was observed to be as follows:

Table 4.35 Utilization of Rice Straws by Province (%)

Province, Rice Variety \ Utilization Status		Utilization		Unused (Mostly burnt)
		Green Fodder	Dried Straws	
Punjab	Basmati	5	90	5
	IR	10	15 (Pulp material)	75
Sind	IR	25	65	10

The rice straw price in both provinces was within the price range of Rs100 to 200/acre depending on paddy field location, rice type, season, and quality.

The rice straw yield with Basmati is 2 to 2.5 times the harvested weight of paddy and 1.5 to 2.0 times with IR. Approximately 10 million tons of rice straws are produced from rice harvest throughout Pakistan per year.

2) Husk

Husk is mostly used in Pakistan as a fuel in brick factories. However, husk is bulky and are not convenient for transportation. Therefore, the husk utilization ratio differs depending on the location between the rice mill and brick factory. The husk utilization state in both provinces during the survey was estimated as Table 4.36.

Table 4.36 Husk Utilization Status (%)

	Utilization Ratio as Fuel in Brick Manufacture	Burnt
Punjab	75	25
Sind	65	35

As the location between the rice mill and brick factory affects the husk utilization ratio, the husk price is also greatly affected by such location relationship. The husk price is generally as follows:

Punjab Rs100 - 150/ton
Sind Rs50 - 150/ton

Approximately 20 to 22% husk are generated relative to the paddy weight depending on the variety of paddy. Rice mills on a commercial level throughout Pakistan produce approximately 800,000 tons of husk per year.

3) Rice bran

Rice bran produced in Pakistan can be classified as by-products of two types of rice mills - huller type

(small rice mills in villages) and sheller type or modern mills (large and medium rice mills on a commercial basis).

Rice bran by the former type leaves husk and rice bran unseparated. Most of it is consumed as fodder for livestock (donkeys, chicken, cows and oxen) in villages and is not sold on the market. Rice bran of the latter type is produced as a by-product of rice mills on a commercial basis. Husk and rice bran are separated. Rice bran of this type is shipped to the market as fodder and as a raw material for industrial oil. Sometimes, rice bran is hold by grade - white rice bran for chicken and red rice bran for cows and oxen. However, in most cases, white and red rice bran is sold as mixed rice bran. The price differs very much between Rs30 and 50/kg depending on rice bran quality, season, and region.

Rice bran is generally produced as follows per year:

- Huller mills ..... Approx. 350,000 tons
  (Approx. one million tons of paddy is processed throughout Pakistan. An admixture of approximately 60% husk and the balance, rice bran)
- Sheller and modern mills .... Approx. 320,000 tons
  (Approx. 4 million tons of paddy is processed throughout Pakistan. Approx. 25% is white rice bran, balance, red rice bran)

If the entire amount of red rice bran is used to produce edible oil, the following calculations are possible:

320,000 tons	x	0.75	=	240,000 tons
(Rice bran)		(Red rice bran generation ratio)		(Rice bran suitable for oil cake oil)
240,000 tons	x	0.15	=	36,000 tons
		(Oil content rate)		(Edible oil)

Assuming a domestic market price of Rs16/kg, 36,000 tons of edible oil obtained from rice bran is equivalent to 576 million rupees.

The actual condition of an edible oil shortage facing Pakistan today is briefly introduced below:

In 1983/1984, the following oil seeds were produced as a raw material for edible oil and vegetable butter (ghee) in Pakistan broken down by provinces in Table 4.37.

Table 4.37 Oil Seed Production Quantity (1983/1984)

Punjab Province	274,964 tons
Sind Province	165,334
Baluchistan Province	80,547
Total	529,800 tons

Nearly all oil seed production is consumed at the farmer stage in spite of such a high production level. Of edible oil that can be obtained from oil seeds, only 40,944 tons (cotton seeds 38,095 tons, other oil seeds 2,849 tons) are sold in the market.

Most oil seeds produced in Pakistan are cotton seeds, mustards, and rapeseeds. The Pakistani Government is strongly appealing to the nation to increase production of new oil seeds that contain much oil in order to meet the edible oil shortage - such as peanuts, sunflower seeds, and soybeans.

Generally, Pakistani cookery uses much oil, and oil consumption in Pakistan is extremely high. For this reason, Pakistan spends a large amount of foreign currency to import edible oil every year as shown in Table 4.38.

Table 4.38 Import of Edible Oil and Foreign Exchange Payment (1983/1984)

Soybean oil	369,789 tons	$255 million
Palm oil	336,442	226
	706,231 tons	$481 million

4) Broken rice

Broken rice sold in the market is classified roughly into two types. They are ordinary broken mainly for eating (rice flour) and fine broken for chicken and industrial use.

One characteristic of rice cultivation considerably in Pakistan is that chapati, using rice flour obtained from low-cost broken rice as a raw material, is consumed in large amounts. The same time is true of chapati which uses wheat as a raw material.

This is why broken rice is sold at a price relatively higher compared with other rice-producing countries. Approximately more than 100,000 tons of broken rice is estimated to be consumed for such purposes.

(2) High utilization of by-products

Taking the actual utilization conditions as mentioned above into consideration, the utilization of by-products that can be translated into practical applications are described below:

1) Rice straws

a) Livestock fodder

Rice straws are already used effectively as green fodder and dried rice straws. However, if post-harvesting work can be mechanized by using harvesting machines, fermented fodder which is richer in nutrition value, can be produced by mixing molasses, which would be produced in Pakistan in a large volume, with raw straws before drying. This will be an effective utilization method for Pakistan which has a large amount of cattle.

b) Pulp raw materials

There are large pulp mills in Punjab Province producing pulp from rice straws. However, the quality of cellulose obtained from rice straws is not very high, and much cannot be expected in the production of high-quality paper from rice straws.

c) Kraft paper manufacture

There are small Kraft paper mills in the rice growing areas. However, their manufacturing methods are rough, and bleaching paper is not performed. The market can be expanded considerably if improvements are made.

d) Rice straw processed articles

Processed articles made of rice straws include straw ware, straw mattresses, and straw rope can be made. Taking to consideration the demand for them and processing skill of the farmers, rice straw rope processing will be suitable. Simple straw rope making machines may be installed to produce thin, medium, and thick ropes for use during harvest of various agricultural products.

2) Husk

The utilization range for husk is wide including small round briquettes, briquettes, husk board and other fuels. As practical utilization methods, the manufacture of small round briquettes and briquettes can be considered. Large demand for husk can be expected as a house fuel in Pakistan which has a scarce supply of wood.

3) Rice bran

a) Industrial oil raw materials

Oil is extracted in six mills throughout Pakistan using rice bran of a high acid value and low quality as raw materials for soap, etc.

b) Edible oil

Oil is extracted at present many days after rice bran is produced, and oxidized rice bran with high acidity value is used as the raw material. Furthermore, the oil extraction technology and equipment are not sufficient. Therefore, only industrial raw materials are produced as products. As by-products, only

low-quality strained less and produced as fodder. Compared with them, the new system proposed by the study team allows fresh rice bran to be gathered organically and high-quality edible oil to be obtained using high-standard technology and modern equipment. As a by-product, high-protein fodder, high in nutrition value, can be obtained.

Based on the supply-demand quality of this product and the facts that the consumption of raw material rice bran is existing oil extraction mills is limited and because rice bran generally used as fodder can be used as fodder with a higher nutrition value after extracting oil in the new system, severe competition will not result for raw-material rice bran quantity, prices for other mills or to present fodder utilization methods by the new system.

4) Broken rice

High utilization of broken rice includes the manufacture of industrial alcohol, isomerized sugar, and glucose. The demand for them in Pakistan and in foreign countries is small at present, and commercialization is hardly feasible judging from the investment size. The price for broken rice is high in Pakistan compared with other countries, and commercialization is less feasible as long as this high standard of broken rice price continues.

(3) High utilization method of by-products

As a result of the foregoing studies, the following four high utilization methods of by-products are proposed:

1) To produce fermented fodder using rice straws.

2) To manufacture ropes from rice straws.

3) To manufacture small round briquettes and briquettes using husked.

4) To extract and refine edible oil from rice bran.

Of these utilization methods, extraction and refining edible oil from rice bran reduces imports of edible oil to Pakistan and develops the agricultural product industry. Therefore, this recommendation is significant and should preferably be implemented as soon as it is feasible.

4.3 Future Constraints

4.3.1 Future production of rice

In the Sixth Five-Year Plan, it is projected that the rice cultivation area will increase by 146,000 ha or 11.4% from the benchmark of 131,000 ha by developing new irrigation water resources. Furthermore, increase in rice yield, through affected by various factors, is necessary for increasing rice production. In the plan, a contribution rate of each of these factors is estimated to be 0.27 for irrigation water supply, 0.19 for fertilizer application, 0.14 for pest and disease control, 0.05 for qualified seed distribution, 0.17 for replacing local varieties to high-yielding varieties and 0.18 for improvement of farming practices. The Plan anticipates that the rice production will be able to attain the target of 4.20 million tons in the final year, 1987/88, with an annual growth rate of 4.9% during the Plan period. For this, however, it is needed to improve the above-mentioned factors as planned to get the desired effects of the improvement.

No long-term development plan and forecast for the rice production covering the period after the Sixth Five-Year Plan are available. Taking into account a conservative estimate of the future progress of irrigation water resource development, it can be considered that the above growth rate of rice production will decrease. Hence, the growth rate from 1988/89 onward is assumed to be 3.0% per annum on the average. The anticipated rice production in 2000/01 is estimated to be around 6.00 million tons.

4.3.2 Future consumption of rice

In the Sixth Five-Year Plan, the projected growth rate of rice exports will be 3% per annum throughout the Plan period and the target of rice exports in 1987/88 will be 870,000 tons. From the viewpoint of

maintaining an earning source of foreign currency, the assumption is made that the growth rate of rice exports projected in the Plan will have to be kept after the Plan period. Thus, rice exports in 2000/01 are estimated to be 1.25 million tons.

The total population projected in 1987/88 in the Six Five-Year Plan is 101 million. Therefore, per capita consumption of rice is calculated to be 33 kg a year under such assumption that 3.33 million tons as the balance of rice production and exports are wholly consumed by 101 million people. This estimate indicates that the per capita consumption of rice during the Plan period deceases by 4 kg from the benchmark of 37 kg a year. With an assumed population growth rate of 2.5% per annum on average after the Plan, the per capita consumption of rice in 2000/01 is estimated to be 35 kg a year.

4.3.3 Future demand and supply balance

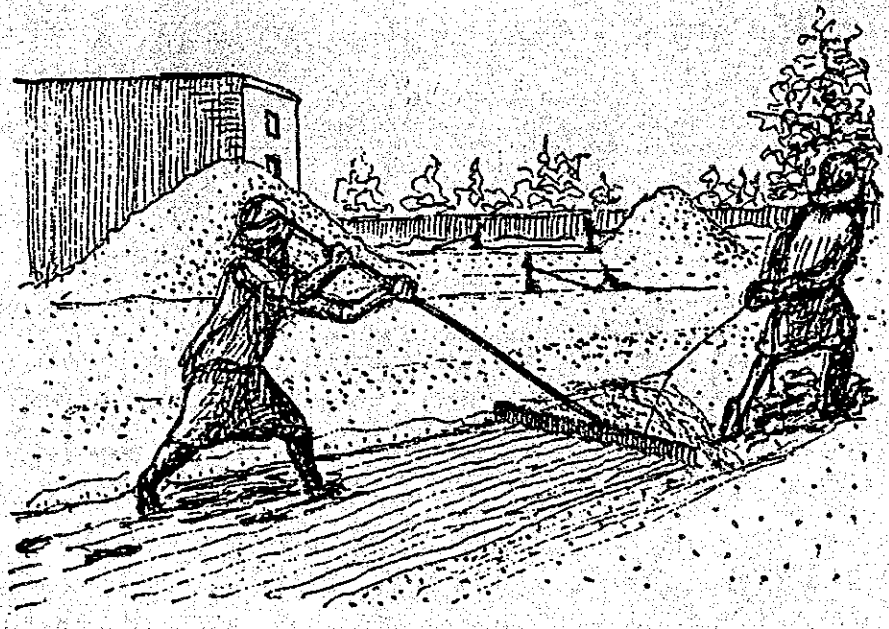
As described before, the total consumption rice for domestic use, including home consumption by rice growers, is estimated to be 3.33 million tons in 1987/88 and 4.75 million tons in 2000/01 under the condition that, in the future, there is no change in the present role of rice in being the staple food on the domestic market and earning foreign currency from exports. Furthermore, if the population growth rate in rice growing areas is higher than the current level followed by an increase in home consumption by rice growers, marketable rice to the domestic consuming areas is expected to be lower in comparison with the above estimate. Taking this into account, however, the marketable rice will increase by two times after 15 years.

According to the World Bank's forecast as of the end of 1985 on the rice marketing situation in the international market, India, Indonesia and South Korea, being former importers, have become rice exporters. China has also emerged as a major rice exporter and its strong export performance places China as the world's third-largest rice exporter behind Thailand and the United States. Coupled with foreign exchange constraints in many developing and oil producing countries as major rice importers, large supplies of rice are expected to keep world rice trade sluggish. In order to achieve the target of larger foreign currency receipts by rice exports under such a background, more efforts will have to be made for improving the quality and increasing the quantity of exportable rice.

4.3.4 Prospective constraints

In addition to the prevailing constraints of the traditional postharvest practices in rice growing areas of Pakistan, another serious problem in the future will be (1) to boost handling quantity of paddy at harvesting time by the anticipated increase of paddy yield and (2) additional capacities of transportation means and storage facilities by increasing marketable rice. To establish countermeasures for solving such prospective constraints, studies from the short-term and long-term viewpoints are required, paying particular attention to breaking bottlenecks in not only quantitative capacity but also qualitative capability of postharvest operation of paddy/rice.

CHAPTER 5 BASIC CONCEPTS FOR IMPROVEMENT OF POSTHARVEST OPERATIONS



CHAPTER 5 BASIC CONCEPTS FOR IMPROVEMENT OF POSTHARVEST OPERATIONS

5.1 Basic Concepts

(1) Plans for improving postharvest operations are made with the following basic concepts:

1) Minimizing the qualitative and quantitative losses of rice which occur in each stage of postharvest operation,

2) Supplying higher quality rice with low cost to both domestic and foreign markets, and

3) Increasing the income of farmers through rationalizing their farming practices.

(2) The formation of implementation plans are based on the following four stages of postharvesting operations giving due consideration to each function:

1) Harvesting,
2) Rice milling,
3) Marketing, and
4) Utilization of by-products

5.2 The Concept of Improvement in Each Stage of Postharvest Operation

5.2.1 Harvesting

It is necessary to minimize harvesting losses to increase farmers' income by rationalization of harvesting operations and to get more national revenue by rice exports. It is also necessary to have a consistent mechanization system, and the final effect of mechanization must be brought to small farmers.

5.2.2 Rice milling

It is necessary to minimize quantitative and qualitative losses which occur mainly due to outdated facilities and equipment of rice mills through introducing modern facilities and technology in order to produce

high quality rice. Improvements should be firstly extended to commercial mills and finally to "Chakkies", which engage in rice milling at the village level.

5.2.3 Marketing

It is necessary to promote sound marketing arrangements of paddy/rice by strengthening facilities and equipment such as drying, cleaning, grading, weighing, packing, storing and transportation in order to ensure smooth handling and fair trading and to eliminate the losses which occur in each stage of the marketing process.

5.2.4 Utilization of by-products

It is necessary to foster an agricultural industry by effectively utilizing by-products such as straw, husk, rice bran and broken rice. An efficient use of unutilized resources performs a role of minimizing losses.

5.3 Perspective into Improvements

5.3.1 Technical perspectives

(1) Harvesting

1) Each harvesting machine must be operated to the greatest extent, that is, it should be utilized for harvesting other crops such as wheat and so on.

2) Machines should be able to be easily operated, maintained and managed, and they must be highly durable.

3) It is necessary to select and introduce machines which are the most suitable for local conditions in Pakistan. These machines should be chosen out of machines which have been effectively utilized in other countries.

4) These machines must be further improved so that they fit local conditions of the country.

(2) Rice milling

1) Improvements must be basically focused on the upgrading of milling recovery and yield of whole kernels.

2) To improve rice milling facilities which exist in large numbers in many parts of the country, it is necessary to take certain measures for removing the defects which were commonly observed in existing facilities.

3) High quality par-boiled rice must be prepared to expand markets both at home and abroad.

(3) Marketing

1) The improvement of storage and transportation must be planned based on a mutual relationship, and the best location and storage capacity must be determined in accordance with the actual state of rice production and marketing.

2) Effective ways of paddy cleaning and drying should be developed at the level of farmers and markets.

3) To improve grading paddy, it is required to provide necessary equipment for testing the moisture contents and foreign materials.

(4) Utilization of by-products

1) It is necessary to study how by-products are developed in other rice producing countries, and practicable methods must be introduced.

2) It is necessary to fully study the quality of the by-products as raw materials.

3) Appropriate technology and facilities for local conditions in rice producing areas must be introduced.

5.3.2 Social and economical perspectives

(1) Harvesting

1) In rice producing areas where production innovation is under way, there is a great need for harvesting more effectively by means of mechanization.

2) In Pakistan the income of average farmers is not high; they cannot afford expensive machines by themselves.

3) The effects of investment should be upgraded through applications of a work system on a group or contract basis.

4) It is also effective to utilize the land-owning system and the sub-contract work system existing in rice producing areas.

(2) Rice milling

1) The rice milling industry in this country is mostly composed of privately owned rice mills except for RECP-related millers. Necessary measures must be taken to encourage the private sectors.

2) It is of special importance for the country to exploit new export markets as well as to maintain present export markets by supplying high quality rice.

(3) Marketing

1) For improving storage and transportation, it is necessary to give due consideration not only to the marketing of paddy and rice but to marketing other agricultural products, particularly wheat.

2) Sellers and buyers' benefits must be regarded, and a fair and reliable transaction system must be promoted.

3) Fair and smooth transactions could be effectively ensured for farmers, millers, dealers if a reliable grading system is executed in paddy/rice markets.

(4) Utilization of by-products

1) This must contribute to the promotion of industry at the village level.

2) This is also effective in expanding rural employment by promoting a private activity force.

3) Existing usage of by-products should be fully studied in order to avoid business competition.

5.3.3 Institutional perspectives

(1) Harvesting

Although most farmers are aware of the advantages of mechanization, they are still conservative in adopting, and not able to afford, mechanized systems. At the initial stage of introducing machines, it is necessary for official organizations to take the following measures to support farmers.

1) To help farmers realize the effectiveness and economy of using machines.

2) To show actual measures for utilizing machines by groups.

3) To facilitate operation/management of machinery, parts supply, repairing and to establish training system.

4) To promote low-interest financing for farmers.

(2) Rice milling

Sheller type millers (about 1,000 on a nationwide scale) are directly related to processing export rice and contribute to obtaining foreign currency for this country. From the standpoint of expanding exports supply by processing high quality rice, it is urgently necessary to improve the facilities.

1) In improving facilities, financial and technical assistance should be officially provided as one of the important policies of exporting rice.

2) To encourage improvement of privately owned rice mills, it is effective to demonstrate model facilities owned by official organizations.

3) To promote processing high quality rice, it is necessary to provide incentives through pricing of paddy and milled rice according to its quality.

(3) Marketing

1) Warehouses must be effectively utilized as much as possible, irrespective of the kind of crop.

2) Official grading systems for paddy should be introduced in the public markets.

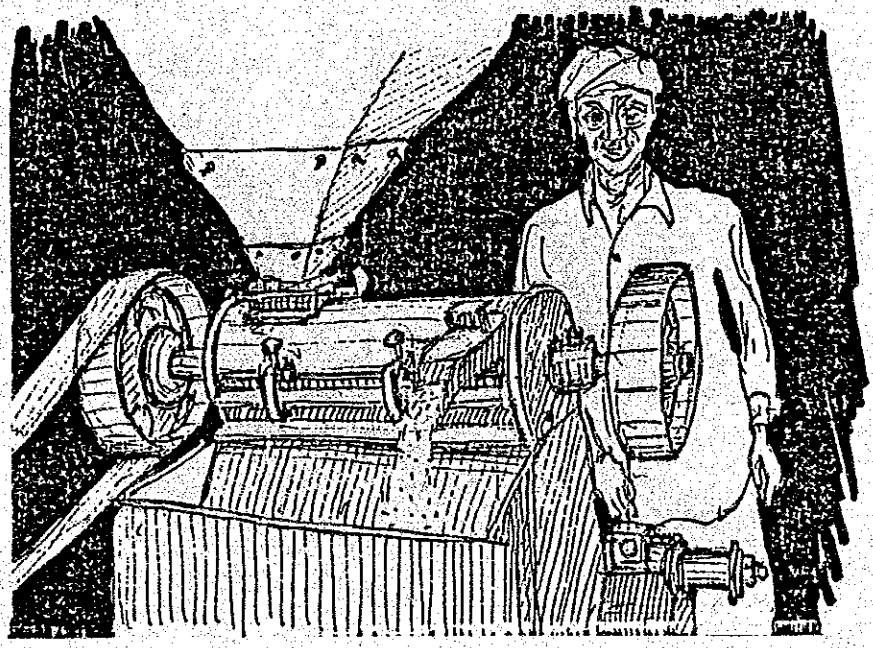
3) The quality standards of milled rice should be examined in accordance with international specifications.

(4) Utilization of by-products

1) Introduction of new technology and appropriate facilities by an official organization, in order to promote cottage industries, are necessary.

2) An effective system for securing raw materials and selling by-products should be created.

CHAPTER 6 FORMATION OF PLAN



CHAPTER 6 FORMATION OF PLAN

6.1 Improvement Items

Based on the concepts and perspectives mentioned in Chapter 5, the following total 34 items for improving postharvest operations are identified and listed in each process of postharvest operations:

6.1.1 Improvement items for harvesting

Improvement item 1

To mechanize reaping by reaping machines

Improvement item 2

To mechanize threshing and cleaning by threshing machines

Improvement item 3

To make farmers' cleaning work more efficient by winnowers

Improvement item 4

To mechanize reaping, threshing and cleaning work by combine harvesters

Improvement item 5

To improve farmers' sun-drying methods of paddy

Improvement item 6

To make farmers' transportation work more efficiently

Improvement item 7

To establish a rental system of harvesting machines to promote farmers' use of them

Improvement item 8

To set up facilities for development and extension of machines, and also training operators and farmers

6.1.2 Improvement items for rice milling

Improvement item 9

To improve cleaning and drying of paddy at sheller type rice mills

Improvement item 10

To improve husking at sheller type mills

Improvement item 11

To improve polishing at sheller type mills

Improvement item 12

To innovate whole lines of rice milling process by introducing modern facilities and equipment

Improvement item 13

To improve the grading process (separation of broken kernels) at sheller type rice mills

Improvement item 14

To make the work more efficient by introducing an automated handling system (weighing and packing)

Improvement item 15

To produce high quality par-boiled rice

Improvement item 16

To improve rice milling facilities at sheller type rice mills through demonstrations of the facilities of modern mills, up dated technology and management

Improvement item 17

To improve mills in villages ("chakkies")

6.1.3 Improvement items for marketing

Improvement item 18

To increase warehouse capacity for paddy in rice producing areas

Improvement item 19

To increase warehouse capacity for milled rice in rice producing areas

Improvement item 20

To improve farmers' storing practices for paddy/milled rice

Improvement item 21

To promote bulk storage and bulk transportation of paddy

Improvement item 22

To improve warehouse management for paddy/milled rice

Improvement item 23

To strengthen transportation capacity of milled rice

Improvement item 24

To improve paddy markets through innovation of facilities (cleaning, drying, grading, weighing and auction)

Improvement item 25

To improve paddy grading and inspection methods by providing proper equipment and technology

Improvement item 26

To rationalize grading and inspection standards for milled rice in accordance with international specifications

Improvement item 27

To match the quality of paddy and milled rice with prices in order to encourage upgrading quality

6.1.4 Improvement items for utilization of by-products

Improvement item 28

To manufacture straw-processed products such as various kinds of ropes and mats

Improvement item 29

To produce high quality bulk feed from rice straw

Improvement item 30

To manufacture charcoal lumps and briquettes from rice husk

Improvement item 31

To produce edible oil from rice bran

Improvement item 32

To produce high quality feed from defatted rice bran

Improvement item 33

To produce various kinds of products from broken rice

Improvement item 34

To provide demonstration facilities for utilization of by-products

6.2 Selection of Improvement Items

The above-mentioned 34 items have been evaluated based on the following factors as criteria for selection.

(1) Criteria for evaluation

1) The degree to which the losses are minimized

a) The degree to which the qualitative loss is minimized

b) The degree to which the quantitative loss is minimized and quality can be improved

2) The Degree of increasing farmers' profits

   a) Cost reductions through rationalized harvesting

   b) Improvement in paddy quality

   c) Diversified crops through a shortened work time and laborers

   d) Stabilization of paddy prices through a rationalized marketing system

3) The Deduction of marketing costs

   a) To what extent costs have been decreased

   b) Economic effects due to smooth transactions

   c) Market expansion by cost deductions

4) The Degree of contribution to the expansion of exports

   a) Increase of export markets by cost deductions

   b) Stabilization and expansion of export markets through quality improvements

5) Effects on rural communities

   a) Whether or not employment opportunities have been increased

   b) Effects on rural society particularly on the economy

   c) The restrictive factors in rural societies

6) Effects on the private-sector activity force

   a) The degree of promoting private-sector activity force

   b) Effect on related industries

7) The degree of effectiveness of by-products

   a) Contribution to national economy

   b) Fostering village industry

   c) Increase in farmers' income

8) Technical difficulty

a) Operational ability

b) Capabilities for maintenance and repairing of machinery

9) Conformity with the governmental policies

a) Relation to the Sixth Five-year Plan

b) Contribution to the national economy

10) Administrative Problems

a) Relation to other ministries

b) Institutional restrictions

11) Technology Transfer

a) The quality of technology

b) The need of technology transfer

12) Relation to other governmental development plans and international cooperation development plans

(2) Selected items for improvement

9 items were selected from a total of 34 items for improving postharvest operations on the basis of criteria mentioned in 6.2.(1).

In this selection, both the advantages and restrictive factors for each item were also analyzed.

Selection 1

"Mechanization of reaping by reaping machines"

(Advantages)

1) Eliminates qualitative and quantitative losses by reaping at the optimum time

2) Farmers can prepare the soil earlier for next rabi crops and, as a result, they have a higher yield in next crop

3) Saves labor costs for reaping

Selection 2

"Mechanization of threshing and cleaning by threshing machines"

(Advantages)

1) Eliminates qualitative and quantitative losses by avoiding the practices of leaving stalk paddy in the field for a long time

2) Increases the paddy price by selling cleaned paddy

3) Threshing is done by a smaller number of workers

Selection 3

"Mechanization of reaping, threshing and cleaning by combine harvesters"

(Advantages)

1) Reaping, threshing and cleaning is done at one time

2) Eliminates qualitative and quantitative losses by smooth and consistent harvesting work

3) Farmers can prepare the soil earlier for the next rabi crops, thus increasing the yield of the rabi crops

Selection 4

"Establishment of rental systems of harvesting machines to promote farmers' use"

(Advantages)

1) More farmers could have access to machines and they will become familiar with the machines, especially among small farmers

2) The machines could be maintained by proper control and management

3) Promotes smooth extension of harvesting machines to farmers

Selection 5

"Establishment of facilities for development and extension of machines and training farmers and operators"

1) Promotes better application of harvesting machines and modifications to suit the local conditions of Pakistan

2) Machines could be kept under proper operation and maintenance by training operators

Selection 6

"Improvement of husking at sheller type mills"

1) Eliminates qualitative and quantitative losses occurring at existing sheller type huskers

2) High quality milled rice could be prepared for domestic and the export markets

3) Promotes modernization of rice milling facilities

Selection 7

"Improvement of rice milling facilities owned by the private sector through demonstrations of up-to-date modern facilities"

1) Encourages the private sector to improve their facilities

2) Promotes technology for milling a higher quality of rice, especially for exports

Selection 8

"Production of edible oil from rice bran"

1) Utilizes rice bran more efficiently for edible oil and animal feed

2) Saves foreign currency used for importing edible oil

3) Efficiently supports the production of oil seed in extraction

Selection 9

"Provision of demonstration facilities for utilization of by-products"

1) Encourages the development of cottage industry and increases rural employment

2) Promotes efficient utilization of by-products of rice, such as straw, husk, bran and broken rice

3) Increases farmers' income

Restrictive Factors and Suitable Time for Implementation

Number	Improvement Items	Restrictive Factors on Implementation	Suitable Time for Implementation		
			1st stage	2nd stage	3rd stage
1	To mechanize reaping by reapers		o		
2	To mechanize threshing and cleaning by threshers		o		
3	To make farmers' cleaning paddy more efficient by winnowers	Farmers do not show much interest. There is not much incentive on paddy prices		o	
4	To mechanize reaping, threshing and cleaning by combine harvesters		o		
5	To improve farmers' sun-drying methods of paddy	Farmers do not show much interest. Marketing price of paddy does not reflect the efforts of drying paddy by farmers		o	
6	To make farmers' transportation work more efficient	As farmers cannot presently afford to arrange suitable transporting means, it is difficult to make this work more efficient presently.		o	
7	To establish rental systems of harvesting machines to promote farmers' use of them		o		
8	To set up facilities for development and extension of machines and training operators and farmers		o		

Number	Improvement Items	Restrictive Factors on Implementation	Suitable Time for Implementation		
			1st stage	2nd stage	3rd stage
9	To improve cleaning and drying paddy at commercial mills	It is difficult to improve this process immediately. The costs are high for installing drying and operational machines, mainly for fuel.		o	
10	To improve husking process at sheller type mills		o		
11	To improve the polishing process at sheller type mills	The finance for the implement is great and it is more effective to do after improvements in the husking process are completed.			o
12	To innovate the all aspects of rice milling process by introducing modern facilities and equipment	This process will be improved when the improvements implemented in step 10) and 11) takes effect, and millers recognize this improvement.		o	
13	To improve the grading process in commercial mills	This process should be improved at the time when the differences in prices between whole rice and broken rice becomes reasonable.		o	
14	To make the work more effective by automating handling equipment (weighing and packing)	This improvement should be implemented after milling processes are fully improved			o
15	To improve the producing method of par-boiled rice and to make high quality par-boiled rice	Production of high quality par-boiled rice would be possible at the time technical research and development are accomplished through step 16).			o

Number	Improvement Items	Restrictive Factors on Implementation	Suitable Time for Implementation		
			1st stage	2nd stage	3rd stage
16	To improve private mills through facilities of modern facilities, up-to-date technology and operations.		o		
17	To improve mills in villages ("chakkies")	Owners of chakkies will object to an immediate improvement, even if qualitative and quantitative losses are observed.			o
18	To increase warehouse capacity for paddy in rice producing areas	Effects of investment will be small. Paddy would be stored for about six months and there are no other products to be stored during the period when paddy is not stored. In addition, fair weather usually continues during the storage of paddy and there is no big demand in these areas.			o
19	To increase warehouse capacity for milled rice in rice producing areas	Effects of investment will be small. Milled rice would be stored for about six months and there are no other products to be stored during the period when milled rice is not stored.		o	
20	To improve farmers' storing practices of paddy and milled rice	It is necessary to make farmers recognize the stupidity of causing losses, and it will take time to implement this improvement.		o	

Number	Improvement Items	Restrictive Factors on Implementation	Suitable Time for Implementation		
			1st stage	2nd stage	3rd stage
21	To promote bulk storage and bulk transportation of paddy	It is necessary to perform bulk storage and bulk transportation of paddy based on a consistent way of handling, but the time is not yet ripe to effectuate this condition.			o
22	To improve warehouse management of agricultural products	This improvement is possible only when parties concerned become aware of the stupidity of causing losses during the period paddy and milled rice are stored, and it will take time.		o	
23	To strengthen the transportation capacity of milled rice	It is necessary to strengthen the transportation capacity by freight cars or trucks so that cargoes can be transported intensively at the time rice is transacted. However, increase in freight cars and trucks involves institutional problems.			o
24	To improve paddy markets through innovation of facilities	These facilities would be utilized by many parties concerned and their real effect will be small until such time comes when the relation between the supported price of paddy and its quality becomes clear and farmers and traders become aware of the importance of these facilities.		o	

Number	Improvement Items	Restrictive Factors on Implementation	Suitable Time for Implementation		
			1st stage	2nd stage	3rd stage
25	To improve grading and inspecting methods of paddy/ rice by providing equipment and technology.	This improvement would be realized when parties concerned become more interested in quality in dealing with paddy.			o
26	To rationalize the grading and the inspection standards in compliance with international specification.	These improvements would be realized when it becomes possible to determined the prices of milled rice with more incentives to its		o	
27	To match the degree of quality of paddy and rice with their prices in order to upgrade quality	This improvement would be possible when an inspection method is rationalized, for there still remain institutional problems.		o	
28	To manufacture straw- processed products such as straw ropes and mats	These products would be able to be produced only when a full study is made on the quality of IRRI straw.		o	
29	To produce high quality bulk feed straw	This would be possible after research and development are made in step 34).		o	
30	To make husk into charcoal lumps and briquettes	This would be possible after research and development are made in step 34).		o	
31	To provide edible oil from rice bran		o		
32	To make feed from defatted rice bran	This would be possible when oil extracting work stated in step 31) is accomplished.		o	

Number	Improvement Items	Restrictive Factors on Implementation	Suitable Time for Implementation		
			1st stage	2nd stage	3rd stage
33	To make broken rice into various kinds of products	This would be possible after research and development are made as stated in step 34).		o	
34	To provide of demonstration facilities for utilization of by-products		o		

6.3 Proposed program for improvements

The selected nine items stated above can be arranged as the following four proposed programs for improvement:

I. "To mechanize harvesting works"

The mechanization of harvesting practices makes it possible to minimize losses, to save labor, to shorten time, and to diversify crops. (This includes the above-mentioned Selection 1, 2 and 3.)

II. "To modernize milling facilities"

Improvements in facilities and operation of husking operations make it possible to minimize losses which occur in existing equipment, and to produce higher quality milled rice for domestic and foreign markets. (This is the above-mentioned Selection 6.)

III. "To produce edible oil from rice bran"

The production of edible oil from rice bran means the effective use of rice bran which was not fully utilized, simultaneously saving a lot of foreign currency used for importing edible oil. (This is the above-mentioned Selection 8.)

IV. "To establish facilities for improving and developing post-harvesting technology"

To improve techniques and facilities regarding postharvest operations such as harvesting, paddy processing, rice milling, marketing and utilization of by-products, the necessary facilities must be established for conducting the required practical research/development and training. (This contains the above-mentioned Selections 4, 5, 7 and 9.)

6.4 Alternative plans

This section describes alternative plans for the four proposed programs stated in section 6.3, examining them to obtain the most practical plan.

6.4.1 Plans and study

(1) To mechanize harvesting works

Alternative plan 1-1

"To mechanize harvesting, it is the best way for farmers to have various machines such as a reaper, thresher and combine harvesters and to use them by themselves."

Study

The best method is for farmers themselves to buy and use these machines. It is difficult, however, to expect much even with some governmental support, when we consider the economic capability of small farmers, which are the majority of rice producing farmers.

Alternative plan 1-2

"To provide farmers with various machines by letting private sectors establish systems for leasing these machines to farmers"

Study

In Pakistan, some private companies employ big combine harvesters already. However, more technical improvements are required for paddy harvesting, and machines are very expensive. It is therefore necessary to remodel these combine harvesters to fit small-scaled farming operations and to use rice straw etc. This means that government assistance or support would be necessary for the development.

Alternative plan I-3

"To establish rental systems by governmental organizations so that farmers or private sectors can directly rent machines from these systems."

Study

Notwithstanding that needs are great for mechanization of harvesting, farmers are generally unaware of the efficiency acquired from utilizing machines in harvesting and their financial ability is also limited. Machines are not fully remodeled to adapt local Pakistani conditions. Under these circumstances, government support is a must at the initial stage of introducing machines.

(2) To modernize milling facilities

Alternative plan II-1

"To improve facilities and management of all the processes of the sheller type mills who supply milled rice to both domestic and foreign markets."

Study

More than two million tons of milled rice are processed by over 1,000 sheller type mills existing all over the country. Overall improvements on the rice milling processes of these mills would produce a great effect, but entail huge outlays. It would be therefore more practical to improve the processes with priority placed on the process which will produce the greatest effect, instead of improving all the processes at once.

Alternative plan II-2

"As the first step toward the modernization of mill, to improve the husking process of the sheller type mills"

Study

It is technically and financially easier than plan II-1 to improve the husking process, which causes the greatest loss, of existing mills.

(3) To produce edible oil from rice bran

Alternative plan III-1

"It is planned to install oil extraction equipment at the main millers in rice producing areas, and to set up an oil plant at port areas for producing exportable oil cake and edible oil."

Study

This plan not only aims at producing rice bran oil but encouraging the production of oil seeds (such as peanut seeds, sunflower seeds, mustard seeds, rapeseeds, etc.) which is strongly urged by the government. This means that great national benefit is expected from this plan. The plan would be willingly accepted by rice millers because they can diversify their business.

Alternative plan III-2

"It is planned to establish edible oil extracting and refining system in the rice producing areas."

Study

Most sheller type mills are located near towns in rice producing areas; therefore, this plan is effective in view of collection of fresh rice bran. Presently, however, it would be more effective to enforce this plan after the facilities of mills are improved to some extent, because

there are such problems as the uniform quality of bran supplied, mixing of husk and broken rice in rice bran and so on.

(4) To establish facilities for improving and developing post-harvest technology

Alternative plan IV-4

"It is planned to conduct practical development of harvesting machines, rice milling facilities and those necessary for utilizing by-products. It is also planned to train farmers and other workers concerned, on operation, repair, maintenance/management, etc."

Study

Most machines relating to postharvest operations are developed in foreign countries, and their performance and capability do not meet the various local conditions in rice producing areas in Pakistan. It is therefore necessary to actively remodel these machines so that they may meet the actual conditions. To achieve a smooth extension of these machines, it is also indispensable to give proper training to farmers concerning operation, repair, maintenance and management of these machines.

6.4.2 Schedule for application

It has been evaluated that it is practical to carry out each alternative plan described in section 6.4.1 according to the following schedule which consists of first, second and third stages.

The first, second and third stages referred to in the above schedule are to be interpreted as:

The first stage

Subjective conditions and objective situations of the plan have been arranged, and the plan can be initiated at any time.

The second stage

The first stage has progressed considerably, and the plan can be enforced when the subjective conditions and the objective situations have been arranged.

The third stage

Subjective conditions and objective situations of the plan have not been arranged and, the accomplishment of the first stage and the second stage is the prerequisite. It will take much time to materialize the plan.

Plans and Applicable Time

Plans	Time for application		
I. To mechanize harvesting work	The first stage	The second stage	The third stage
° To let farmers or private sectors use machines from rental systems operated by government organizations	———		
° To develop a rental business operated by private sectors so that farmers can use these machines.		———	
° Farmers have for themselves such various harvesting machines, reapers, threshers and combines.			———

Plans	Applicalbe time		
	The first stage	The second stage	The third stage
II. To modernize the millers			
° As the first step toward modernizing milling facilities it is planned to improve the husking process of sheller type mills.	———		
° To improve all processes of rice milling facilities of sheller type mills		———	
III. To produce edible oil from rice bran			
° To install oil extracting equipment at the main mills in rice producing areas, and to set up an oil plant at port areas for producing exportable oil cake and edible oil.	———		
° To establish an oil production system with extracting and refining facilities in rice producing areas.		———	

Plans	Applicable time		
	The first stage	The second stage	The third stage
IV. To establish facilities for improving and developing post-harvest technology			
° It is planned to conduct practical development of harvesting machines, rice milling facilities and those necessary for utilizing by-products. It is also planned to give education or training to farmers and workers concerned with operation, repair and maintenance/ management.			

6.4.3 Plans for implementation

The following four plans, which subjective conditions and objective situations of the plans have been arranged and the plans can be enforced at any time, are proposed for improving postharvest operations of rice.

I. Rental operation of harvesting machines

As the first step toward mechanizing harvesting, governmental organizations establish and manage rental systems of harvesting machines to promote utilization.

II. Rental operation of rubber-roll husker

As the first step toward modernizing rice mills, government organizations create systems for husking machines to sheller type mills.

III. Production of edible oil from rice bran

It is planned to install oil extraction equipment at the main mills in rice producing areas and to set up an oil plant at port areas for producing exportable oil cake and edible oil.

IV. Establishment of facilities for improving and developing postharvest technology

It is planned to conduct practical development of harvesting machines, facilities for processing rice and for utilizing by-products. It is also planned to give farmers and other workers concerned education and training on operation, repair and maintenance of machines or facilities.