CHAPTER IV ACTUAL CONDITION OF POSTHARVEST HANDLING

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1 Condition of Rice Fields

1-1 Special Province of Aceh

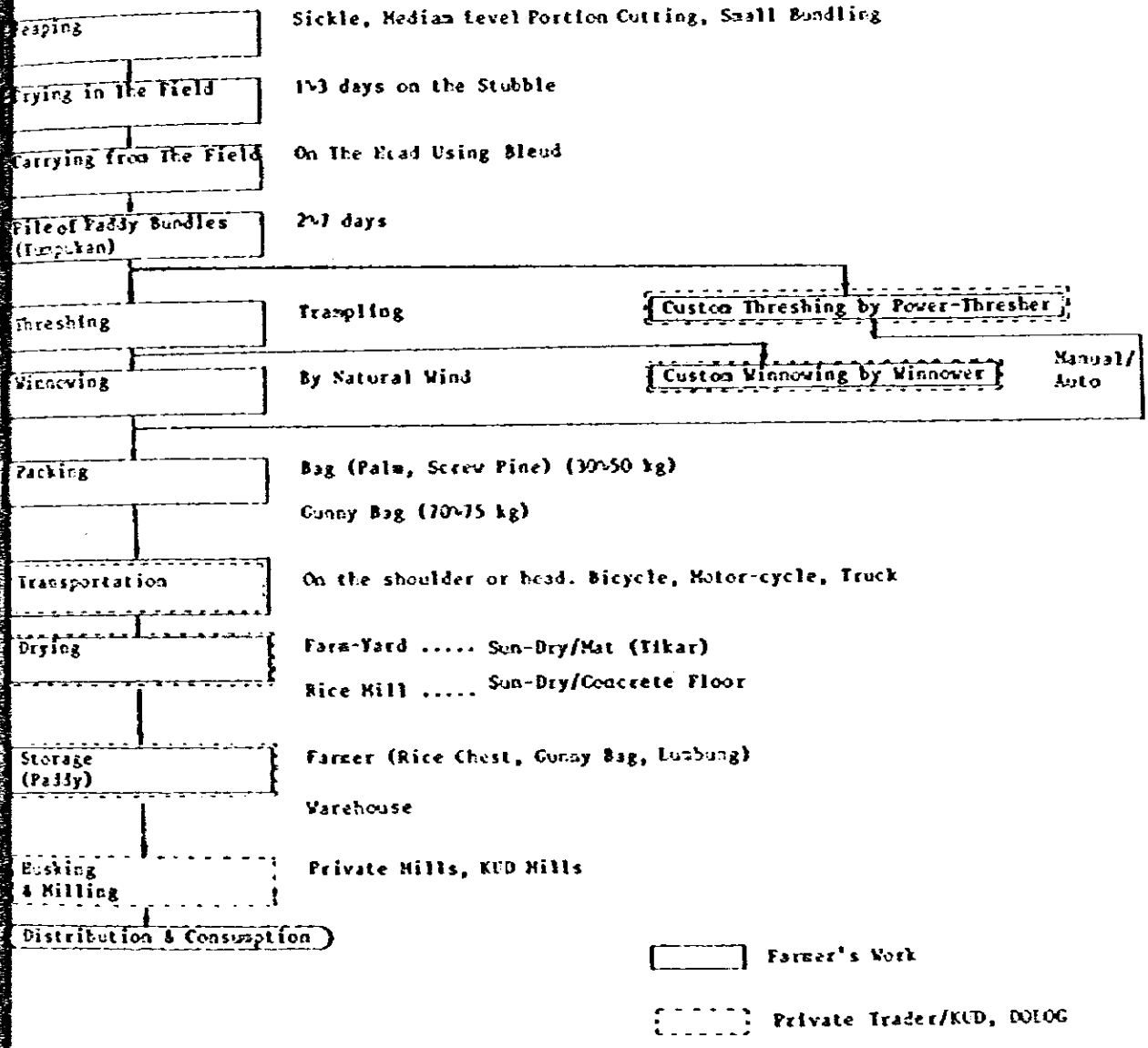


Fig. 4-1 Major Rice Practices in District of Pidie and Aceh Utara Province of Aceh

(1) Harvester and His Wage

There is a custom similar to "Yui" in old Japan which was a mutual system in rural community without any payment in cash or kind. Now in Indonesia, such traditional system still exists and is called Gotonroyong But it is declining as the modernization of rural village proceeds with than such mutual relief, there is a Bawon system.

Such a mutual aid system in Indonesia mostly remains in a neighbor and a group of relatives, and reaping, carrying, threshing and winnowing executed in mutual aid of the members of such group.

Costs of postharvest works are shown as below.

1) Gotonroyong

No payment in cash or kind.

2) Bawon

Reaping and bundling	:	450 - 500 kg paddy/ha
Carrying bundles	:	200 - 300 kg paddy/ha
Threshing (human power)	:	450 - 500 kg paddy/ha
(mechanical)	:	10% of the amount of paddy processed
Winnowing (with wind)	:	200 - 300 kg paddy/ha
(with winnower)	:	3.5 - 5.0% of paddy processed
Milling	:	10% of milled rice (1 kg milled rice/ 20 kg paddy; part over 60% of milling recovery
Drying in the sun	:	Rp 2 - 4/kg/day

3) Employment

Reaping and bundling	:	20 - 25 kg paddy/day/man
Carrying bundles (by woman)	:	Rp 1,500/day/man (or paddy equivalent
Threshing (by man)	:	Rp 1,500 - 2,000/day/man (same as abo
Drying in the sun	:	Rp 1,500 - 2,000/day/man

(2) Works on The Field

1) Reaping, Bundling and Drying Stalks Paddy

In the area studied by the Team, there was not observed reaping with traditional ani-ani. Sickles were used there in both dry and wet fields. In a standing posture farmers applied sickles 35 to 45 cm high from the base of each hill of rice plants though the height may change according to the length of the hill. The length of rice bundles thus reaped is usually fixed at about 50 cm so that it may be convenient for handlings especially in piling sheaves up in the form of domed cylinder.

A bundle (700 - 800 g in weight after drying) is made up with 10 to 30 hills depending upon the number of tillers, and the bundle is tied with several raw stalks with panicles. On some of wet fields in District of Samalanga, stalks paddy are hung on simple drying racks, but on dry fields sheaves are dried on stubbles on the field for a few days.

Field conditions at the time of harvest are as follows. In that District, transplanting is generally performed but regular planting has not been applied yet in most fields. Eye-measurement is usually taken up for planting. The sinkage of a man's foot in the soil of field is about 0 - 5 cm deep at the harvest time either in dry or wet season while the depth of plowsole is the same as in wet field because the field is of sandy soil and plowed shallow.

A sickle used for reaping has the straight blade 20 cm long, not serrated. As it is made by a smith in village, its shape and quality is not uniform. Its top is not put an edge for several centimeters, and this part finished like a straight drill. The drill part plays a role of finger in piercing several straws through a lock of stalks to make a sheaf. When a sheaf is made, stalks with panicle are often twisted and cause to shatter kernels. Therefore, a sickle now in use should be improved. Namely, its shape should be suitable for middle level cutting of a hill of the plants standing with their tops unfolded and forging and welding of steel used for sickles also be technically advanced.

2) Tumpukan (sheaves piled up in the form of domed cylindrical heap)

Rice sheaves dried on stubbles for a few days are collected and carried to a place of Tumpukan. Transport is all made with Bleud, a specific carrying tool put on the head. (4-1-7, refer to "Farm implements") Women usually engage in this kind of labor to carry 20 - 30 kg sheaves one way. The sheaver thus carried are immediately built up to a Tunpukan irrespective of season. A yard for the heap is chosen at a place which has dry ground, is located at the least possible distance from the filed (mostly 200 m at maximum) and has a space for threshing. The yard is often set at some part of the field or on roadside. But if a suitable one is not available, land preparation such as drainage and ground level raising is made on a part of the field.

The Tumpukan type piling is as shown in Fig. 4-2 the top of cylindrical heap is domed and this domed heap is 2 to 4 m in diameter and 1 to 2.5 m high. If it is threshed, the amount of paddy available is 0.5 to 2.0 tons (150 - 170 kg paddy/m^3 of a domed heap.) They are averaged respectively as 3 m in diameter, 1.5 m high and 1.1 tons of paddy.

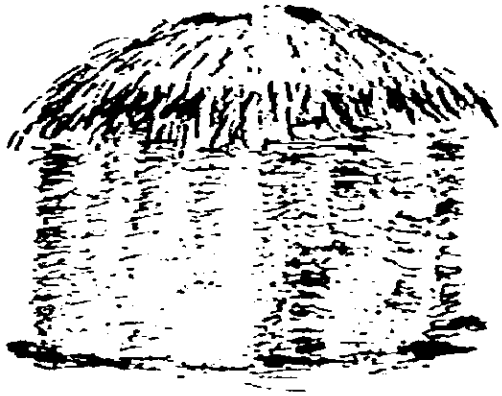


Fig. 4-2 Tumpukan

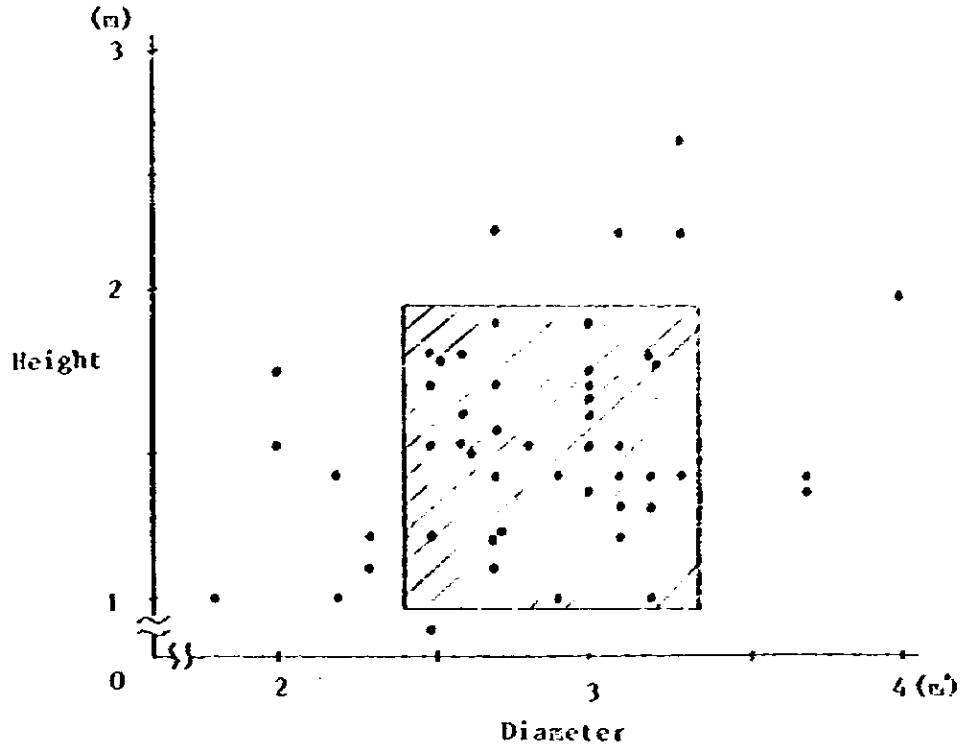


Fig. 4-3 Diameter and Hights of 51 Domed Heaps of Stalk Paddy (Tumpukan)
(A square with oblique lines occupies 70% of the total)

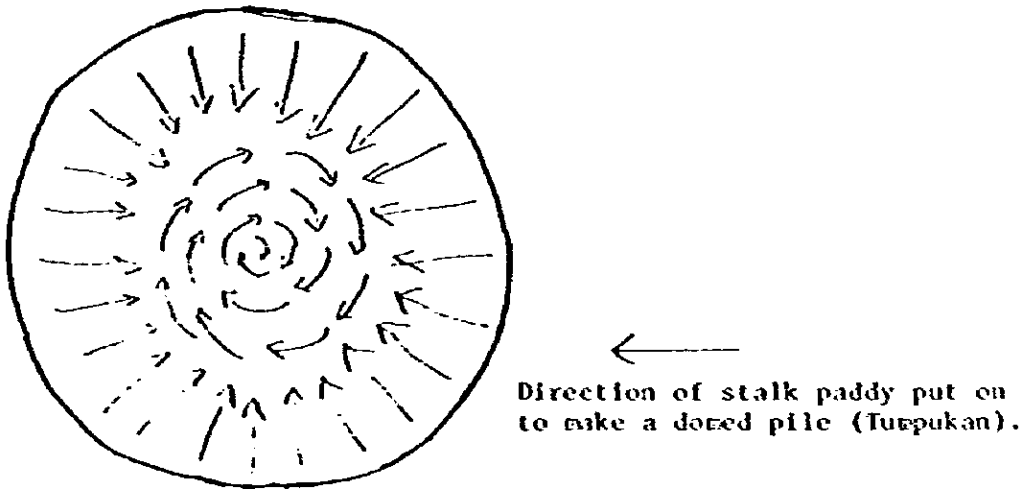


Fig. 4-4 Piling Way of Tumpukan

Sheaves with panicle at the top are more or less leaned against each other at the center and arranged spirally to form a d... heap. If they are placed with their panicles headed toward the ce... their ends of roots form the circumference of the base of the cyli... heap (Fig. 4-4). This procedure is repeated again and again to fo... a cylinder. This to make the dome, sheaves are put with their pa... headed toward the circumference with a slight slope. And finally s... waste straws are placed on the top to cover the whole heap. Durin... the construction of domed heap, sheaves are stamped down from tim... to time to keep the heap in good shape. In this way, a domed hea... (Tumpukan) is made up so as to protect the sheaves from rain and r... and other.

Building a domed heap is usually started when transport of st... paddy commences. Both this transport of stalks paddy and the con-struction of a domed heap of sheaves will take about 6 hours for 5 ... 6 laborers, the landowner usually engages in heaping up sheaves wh... others work as carriers.

The domed heap is left for 2 to 7 days until threshing is tak... up. Sometimes a heavy rain attacks the heap, when only one to two layers of sheaves as a part of the roof get wet. A domed heap is usually built up with stalks paddy with excessive moisture because ... adverse weather and wrong arrangement of works. This seems to be th... most serious problem in the area where the team made the study. It ... is considered to be the cause of discolored grains.

The highest temperature of 61.7°C was observed at the center inside the domed heap and it is usually recorded in the middle and ... 60% high from the base of the whole heap. The team observed change... in temperature on time series and other relation with the number of ... days between heaping and threshing of paddy as shown in Fig. 4-5. Rise of temperature is very rapid. Therefore it is important to st... the relation between the occurrence of discolored kernel and dryness of rice sheaver, size and shape of domed heap, rise of temperature ... its cause, duration of domed heap occurrence of fungi and physiolo... change of rice.

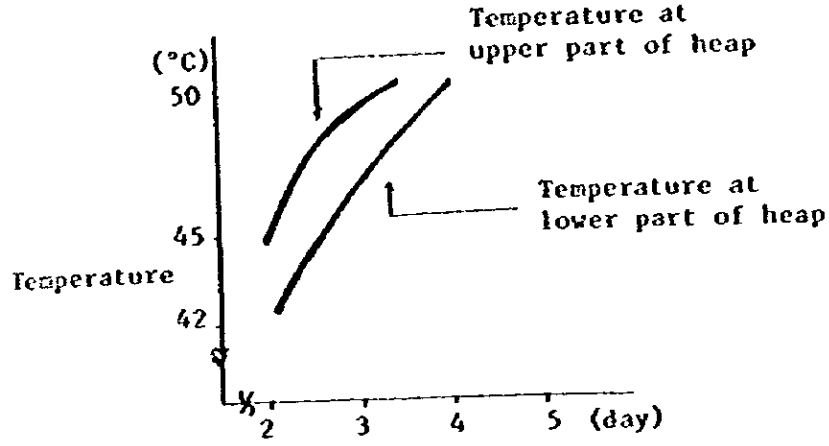


Fig. 4-5 Relations between Duration of Domed Heap of Sheaves, Temperature Inside The Heap

3) Threshing

Trampling threshing (Injak-Injak) is done by men near a domed heap of sheaves. In this case, several sheaves at a time are stamped down by a male worker on a mat made of fiber of coryph palm (Corypha elata) leaves. He has sticks to keep balance of his posture, and uses it sometimes to soften stalks and separate them. The working efficiency of trampling is estimated at 30 to 40 kg of paddy per man-hour though it may change by shattering habit quality and dryness of paddy. This threshing method do not seem to give rise to a large losses. (Fig. 4-16)

On the other hand, mechanical threshing has recently become popular. It has spread to improve rice quality deteriorating due to the shortage of farm labor and slow practice in works. Threshing machines are now mostly used on hire. Their owners are private persons, KUDs or the DOLOG. As the harvest time shifts from place to place, the thresher is also moved accordingly in the district achieving quite a high rate of effective operation. Although there may be still some defects of the machine, if they are improved, the mechanical threshing may spread all over the area.

Regarding this matter, "5-4-1 The Study on Actual State of Custom Threshing Work" describes in detail.

4) Cleaning

Cleaning of paddy is most carefully done either for home use or for market in this province if compared with others.

Paddy foot-threshed are winnowed with wind or winnowers on the spot.

Wind winnowing has been carried out exclusively by women. Pad subdivided and put in sack (Empang) or Winnow (Nyiru) are raised up to their head and dropped down. Then chaffs are fanned by wind to fly to all directions. (Fig. 4-31)

As a whole, the amount of paddy cleaned with winnowers is much less than that with wind winnowing. But the winnower will easily take the place of wind winnowing because it doesn't require much change in process, and besides provide much higher efficiency as seen in Table 4-1. Contrary to wind winnowing, the winnower is mainly operated by man. The division of labor has been introduced as far as the cleaning is concerned.

Individual farmers are in possession of a winnower and the owner lets it out on hire to a farmer on request. In this case he employs an operator or assistant to run it at the client's and receives 3.5 to 5.0% of the total paddy cleaned as custom charge. It is not common to hire out only the winnower. The wage paid to the assistant or operator is almost the same as in the case of wind winnowing but as the amount of yield is larger than winnowing, the contractor and his employees get more returns. For the client, cleaning is finished sooner and paddy of better quality are available, which are of course sold without much loss of time.

Table 4-1 Winnowing Ability of Natural Wind and Winnower

Items \ Winnowing	By natural wind	Winnower
Capacity	0.4 - 0.5 ton/day/man	2 - 4 ton/day/winnower (Operator + Helper: 2 persons)
Remarks	Work is discontinued in a calm condition	More than 5 ton/day/winnower (Engine driving)

Specification of Winnower

A skillful farmer can make it by himself. Generally local carpenter or joiner who has much experience makes it on the order. Parts of bicycles are usually used instead of the original ones which are short of demand. A specification is shown in Table 4-2 for example. Its feature is that feeding roller is attached to prevent irregular flow of paddy.

Table 4-2 Specification of Winnower

Sample Unit	①	②	③	④	⑤	⑥
[illegible]		130x50x98	145x55x100		20.5x45.5x96	212x50x128
[illegible] ine)	40	30	30		30	
[illegible] ine)	Yes	Yes	No	Yes	Yes	Yes
[illegible] et for [illegible] grain	Yes	Yes	No	Yes	Yes	Yes
[illegible] wer	Human Power	Air-cooled Engine	Human Power	Engine	Air-cooled Engine	Human Power
[illegible] fg.	80,000 (1982)	60,000 (1979)	Materials 25,000 (1979)	Used 35,000 (1982)		60,000 (1982)
[illegible]	Anticlock-wise rotation		No 2nd Outlet	Manufactured by Maker, but Not Clarified	Bearings set in for Power	2 Wheels Fixed for Easy Transfer

5) Drying After Threshing

There are two stages of drying paddy; the first stage is the dr made by the farmers and the second by a private rice mill or KUD.

a) Paddy Drying by Farmers

As paddy for farmer's home use have to be stored till the next harvest, they are dried fully in the sun. They are spread a few to several centimeters thick over a mat of palm leaf fibe (ex. 3.2 x 2.4 m in size) and mixed by stirring with hands or a simple tool (Fig. 4-29).

Paddy right after the threshing have usually been dried naturally to an extent of 17 to 18% moisture. Therefore, the drying in the sun for a day is usually enough to achieve the desirable moisture of 14 to 15%.

In the case of paddy for sale, those with the moisture of as much as 17 to 18% are customarily put on transaction.

b) Paddy Drying Through Marketing

Paddy purchased are dried again by private rice mills or KUD. As small merchants usually do not have their own drying facilities, they often consign this process to rice mills. The rate of drying is considered as equivalent to the result of one day operation of drying facilities and the fee paid to the mill is at a level from Rp 2 to 4 per kg. Drying time a day of course changes according to the sunshine and degree of moisture content.

A rice mill usually has a drying floor of concrete which is slightly slanted for better drain (Fig. 4-6). The area of platform is 200^2m to $1,000^2$m , depending on the size of mill.

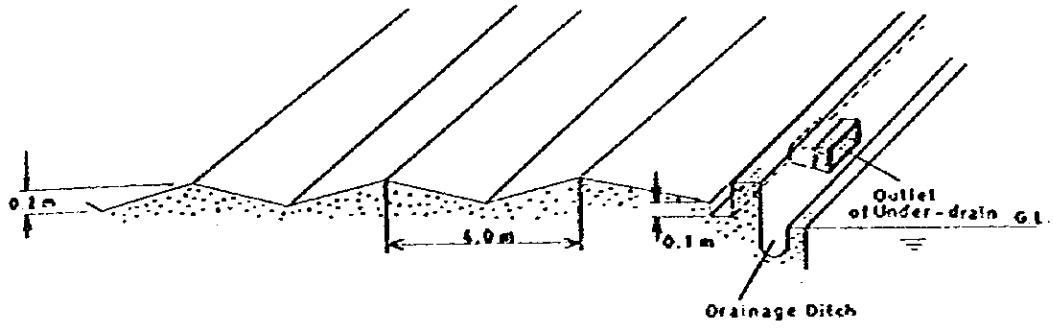


Fig. 4-6 Drying Floor

Table 4-3 One of Instance of Drying Condition in Aceh

Time	Climate	Temperature	Relative Humidity	Turning over	Transition of moisture content
9:30	Fine	30°C	72%	Start	17.9%
10:30	"	30	72	1st	17.2
11:30	"	33	62	2nd	16.3
12:30	"	33.5	60		15.5
13:30	Slightly Cloudy	32	65	3rd	14.8
14:30	"	32	66		14.2
15:30	Cloudy	29.5	75	(Finish)	13.7

Average Thickness of Paddy: 6.1 cm
Average Drying Rate: 0.6%/hr.

V.R.B. Udjong Rim BA Rice Mill
Kec. Jeunieb, Aceh Utara

April 17, 1982

4-1-2 Province of West Jawa

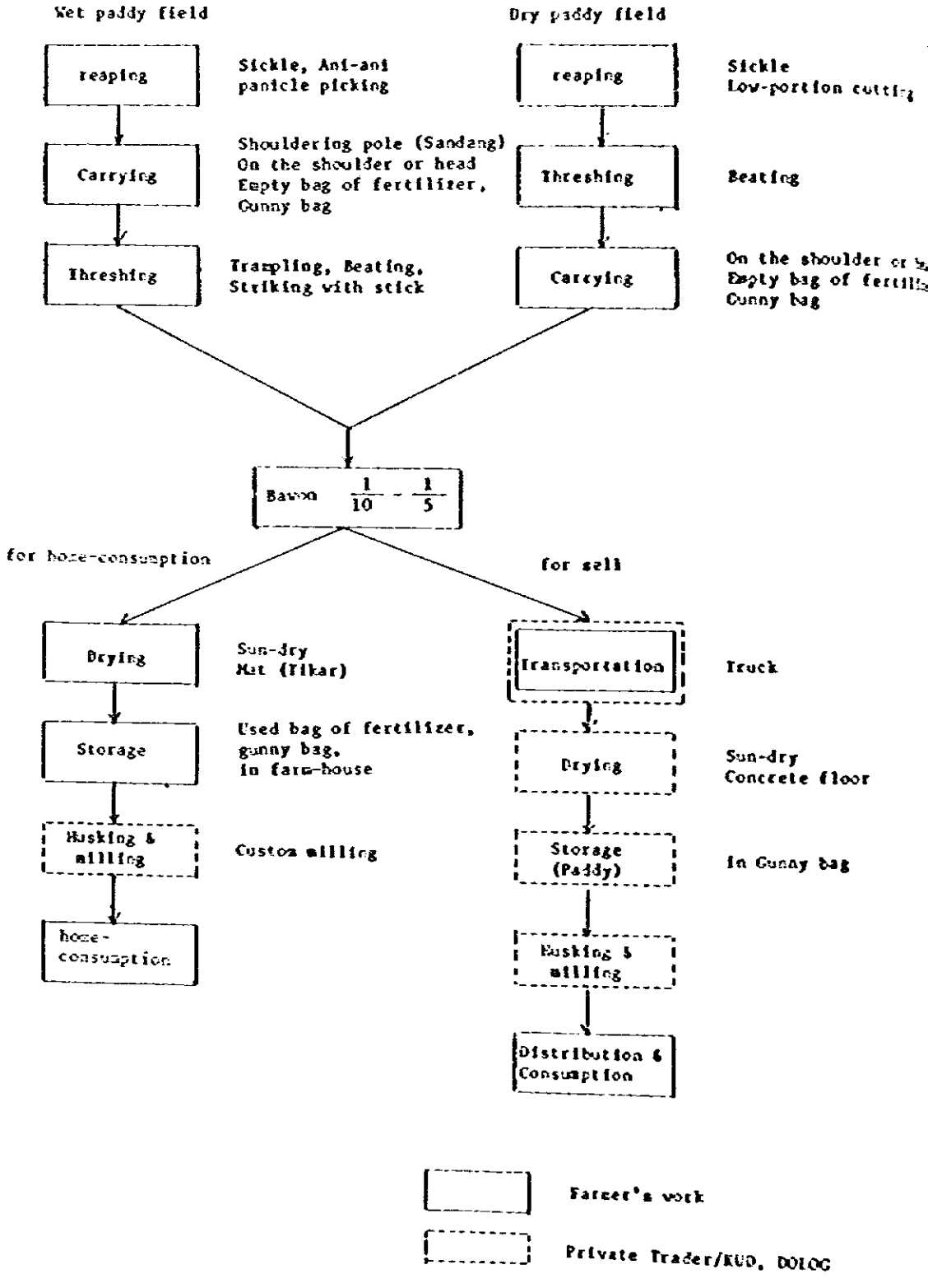


Fig. 4-7 Major Postharvest Practices in Karawang, Bekasi, Bogor of West Jawa

(1) Harvesting System

Reaping is mostly done under the Bawon system with the exception of the mountaneous region where it is sometimes performed under the Nyeblok.

Under both systems, reaping, threshing and transport are carried out through a complete works and only workers who participate in all these stages can get their remuneration.

Payment under the Bawon system is generally 1/7 of all the harvest in paddy. As a whole it is in a range from 1/10 to 1/5 depending on local customs and labor conditions in various areas.

Under the Bawon system, any one who wishes can participate in reaping. Therefore, a group of 50 to 100 workers move in Districts of major rice producing centers, from other districts and villages on buses and trucks. Sometimes, therefore, more than 200 persons join in reaping rice for one hectare. As a result, the harvest per head per allotted work employment is as little as 40 to 50 kg of paddy. It is natural they compete hard with each other to make their harvest more than others'. It looks like a contest of quick reaping.

(2) Works on The Field

1) Reaping

Ani-ani is used most widely to reap panicles in mountain areas while sickle and ani-ani are rised at random according to reapers' choice. Roughly speaking, sickle is applied to cut the plants at the base when the field is dry, while ani-ani or sickle is used for higher portion cutting. When the field is wet or muddy.

As it requires quite a skill to handle ani-ani efficiently, younger people prefer sickle to ani-ani and help it become popular.

In the working efficiency, the use of sickle is higher for low level cutting. It is followed by the sickle for high level cutting and then by ani-ani also for high level cutting. Ani-ani's inefficiency is attributed to the fact that it leaves many plants standing unmatured. Consequently, the second cutting must be done mainly by family labor several days after the first cutting. The second work is called Ngasak.

In Western Jawa, the regular planting of rice has now become
and the density of plants is generally rated at one hill per 25 x
In the northern plains, irrigation canals have developed well but
in parallel with drainage. Most of the soil there is clayish and
adverse effects on the field such as wet and muddy at the harvest

2) Transport

Right after the stalk paddy have been reaped at the bottom, th
threshing is done in the field. Then the paddy in the Jute bag, us
or the sheet used to the threshing are carried by the harvester to
farmer's yard where the share of work will be given.
As mentioned earlier, the share of work per person is not much but
40 - 50 kg.

Panicles cut or those with short stalk are generally put in th
shouldering pole (Fig. 4-21), though some put in used sacks of fer
and gunny bags, and carried to a threshing place (mainly farmers' k
garden).

When the shouldering pole is used for carrying, sheaves are
put in and exposed from the loading space in the form of upside-do
triangle. But the shouldering pole is so shaky at each time when
carrier takes a step forward that paddy shed along the way to make
a loss.

This study took up total 9 farmers from 3 farm households in
Karawang area and examined a loss made by shouldering pole. The r
stated in the section of 5-4-3.

3) Threshing

There are various ways of threshing such as trampling, beating, and striking with sticks, of which the first two are most popular.

Rice plants cut with sickle are threshed as soon as possible. In case that the field is dry, a square mat may be used for threshing. Each corner of the mat is tied respectively with 4 squarely standing sticks at a height of 30 to 40 cm from the ground and threshing is performed on the mat. A small board made by wood is put on the mat and panicles are beated on it. (Fig. 4-17).

On the other hand, stalks cut at high level are mainly threshed with trampling or striking with a stick. In case of trampling, it is sometimes done twice and the second one by family members. In the mountain area where the traditional rice cultivation is performed on local varieties, panicles cut are bundled and sheaves thus made are dried and stored.

Efficiency of the above two methods is estimated as follows: the beating; 60 - 70 kg/hr /head and trampling; 25 - 35 kg/hr /head. Striking with stick method is said to be less efficient than the foot threshing.

4) Drying

In the province of West Java paddy for home consumption are usually dried by farmers themselves while those for sale are not, and directly sold to KUD, private rice mill or village merchants in the neighborhood immediately after the threshing has been finished.

Drying by farmers is usually done in the sun on a mat or used bags of fertilizer in their home garden or road-side. Private rice mill or KUD which have bought paddy from farmers have their own drying floor made of concrete where the paddy are dried in the sun. The area of concrete platform varies with the size of warehouse and the capacity of milling machine. When farmers dry paddy, they usually do not replace surface layer with the subsurface. But when paddy are dried in private mills, their surface layer is replaced with the subsurface several times a day, therefore it can be said that the drying by the mill is quite carefully performed.

5) Cleaning

In West Java, cleaning paddy is not customarily carried ; only large rubbishes and impurities such as waste straws are up and removed with hand.

4-1-3 Province of South Sulawesi

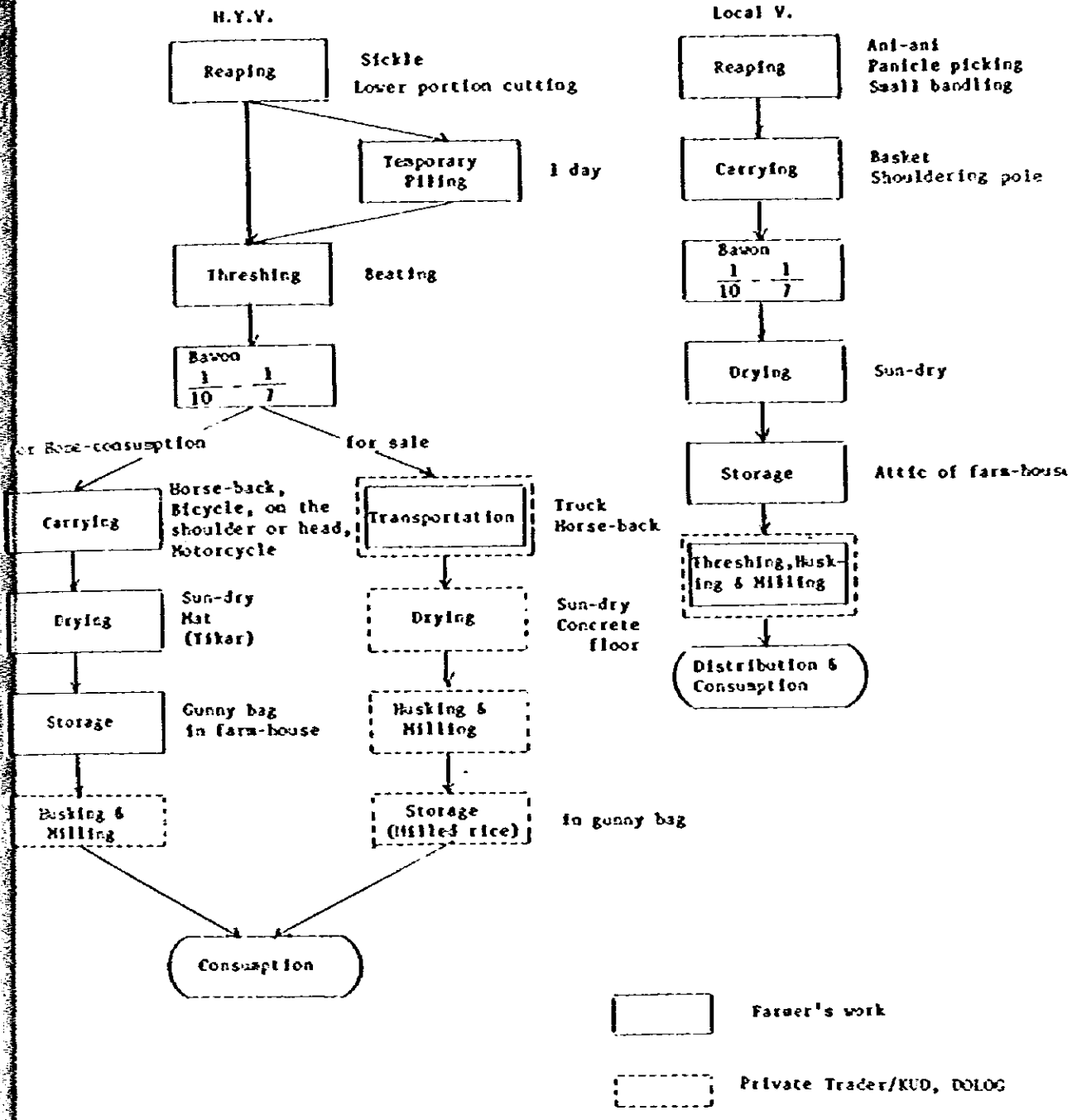


Fig. 4-8 Major Postharvest Practices in Districts of Pinrang, Luwu, and Polmas Province of South Sulawesi

(1) Harvesting System

Harvesting rice in South Sulawesi is mostly performed under the Ba... system, in which renumeration of workers is paid on a level of 1/10 of t... harvest in paddy after the threshing process.

Contrary to West Jawa, the distribution of renumeration is made mos... at the paddy field or roadside near the field. Under the Bawon system, transport is not included in the works consigned to the laborers.

Reaping is done by workers as a piece-work and a certain area for re... ing seems to be tacitly allotted for each worker depending on the numbe... of workers and the size of area to be harvested. Therefore, the reapin... process is quite orderly performed in this province compared with West J...

(2) Farm Practices on The Field

1) Reaping

In the province of South Sulawesi, about 75% of total area is planted to the H.Y.Vs while about 25% to the local varieties. Post-harvest practices of rice is different between the H.Y.Vs and the local ones. In other words, the local varieties are done with the traditional method while the H.Y.Vs are with a new one.

As the local varieties are rather high and come to the full maturity irregularly, ani-ani is used to pick panicles, which are h... in a lock at the neck of spike. On the other hand, as the H.Y.Vs a... short, a high tillering capacity and have a uniform maturity, sickl... is used for cutting panicles instead of ani-ani which is inefficie... in this case.

2) Transport

Plants cut at the base are carried to the place where they were threshed. For transport, the paddy is wrapped with the mat or put ... used bags of fertilizer.

After the payment was finished, paddy is carried by the field owner to his home.

The merchant often goes to the place where the reapers receive their pay and purchases the produce there.

In such a case, paddy is put in gunny bags. With a capacity o... 70 - 80 kg and carried on the horseback or with bicycle, autobicycl... or small truck.

3) Threshing

As the local varieties are dried and stored in form of stalk paddy they are threshed with a wooden hand mill or thresher of a rice mill immediately before milling. On the contrary, the H.Y.Vs are threshed with beating at the field immediately or a day after the harvesting.

When reapers participate in harvest, they use their own sickle, board for thrashing and floorcloth which is to prevent paddy from scattering. Such floorcloth is about 5 m^2 in size and of poor quality and can hardly work well, that is, it produces quite a big loss.

4) Drying

In this province the same as in West Java, all paddy except for home consumption are not dried and those raw ones for sale are purchased by KUD, rice mill and merchants. In this case the state of dryness of paddy is almost the same as in West Java.

5) Cleaning

In this province the cleaning of paddy is not generally performed as same as in West Java.

4-1-4 Province of South Kalimantan

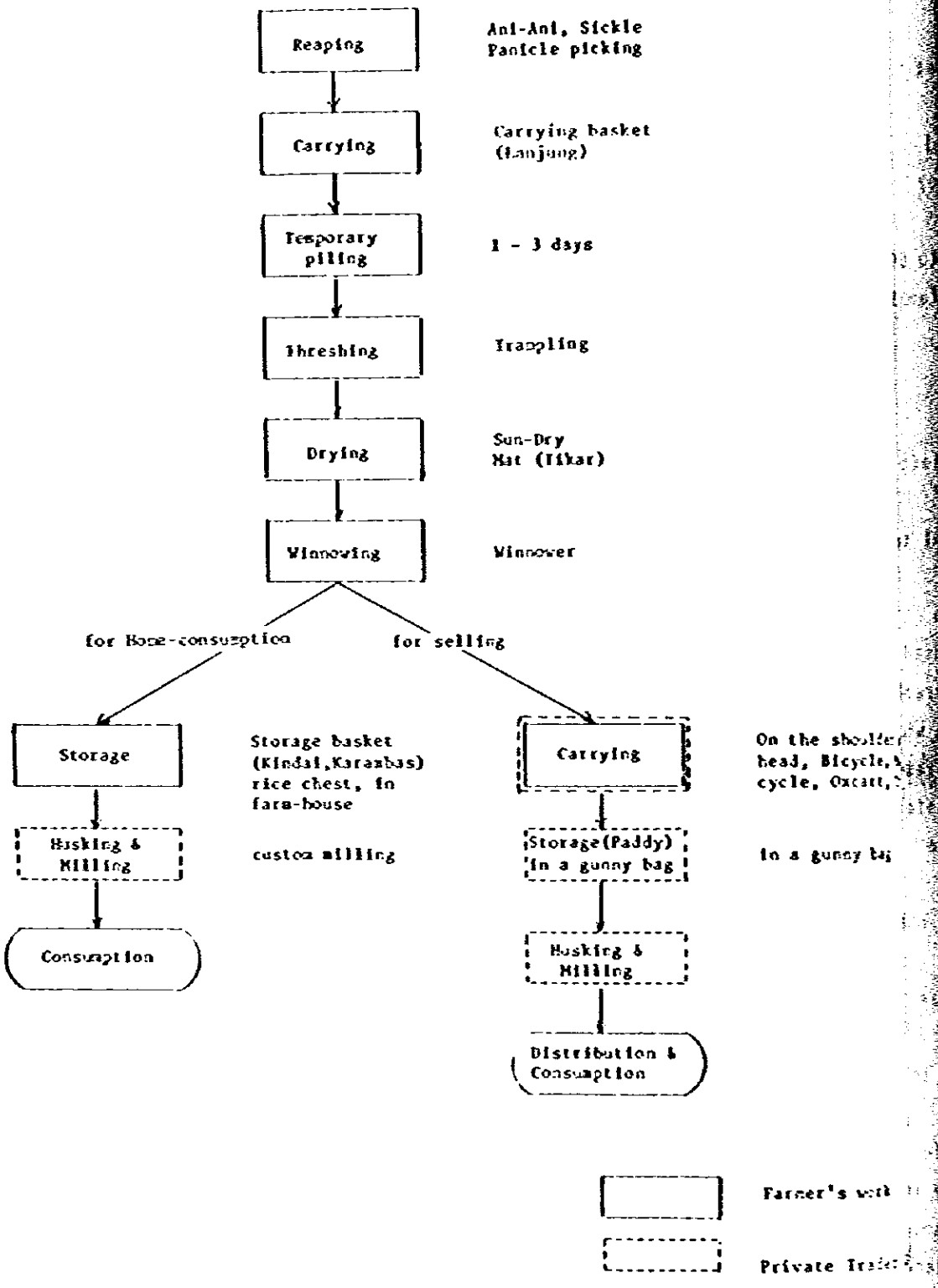


Fig. 4-9 Major Postharvest Practices in Districts of Banjar, Tapin and Hulu Sungai Tengah, Province of South Kalimantan

(1) Harvesting System

Rice is harvested generally by hired women. The hired workers are mostly living in the neighborhood. Their wage is mainly paid in cash although it is sometimes in kind at a piece-work rate similar to the Bawon system. The wage is usually in a range from Rp 700 to Rp 1,000, depending on working hours and capacity of workers and meals and refreshments provided by the employer.

Transport of paddy is mainly carried out by farmers or their adult male. Few workers are employed for this purpose.

Threshing is also mainly executed the same as above and when some workers are hired, their wage is paid at a piece-work rate usually amounting to Rp 50 per 10 kg.

Cleaning paddy is performed mostly by family labor with winnower. All farmers do not always have a winnower, which is therefore hired at the rate of 1% of total cleaned paddy.

(2) Farming Practices on The Field

1) Reaping

In this province, as most of rice is cultivated in swamp area and its periphery in river valleys, the water management has been hardly established. As a result, most of the fields are planted to the rice of local varieties. Accordingly farmers generally employ the traditional method of rice culture.

Reaping process is no exception. Ani-ani is used for it widely. Recently, however, as the H.Y.Vs have been spreading gradually in some areas, where middle portion cutting is implemented with sickles. As the H.Y.Vs generally have a short culm and high tillering capacity, it seems to make the use of ani-ani difficult.

When the ani-ani is used for picking panicles, farmers do not reap immature plants, which are later reaped when they have matured. But the second haryest is so little that busy farmers often leave it out. According to some farmers, it is common to take about 60 man-days per ha. for the first harvesting.

As the paddy fields are located over and around swamp area many of them are commonly very wet and muddy at the time of harvest.

2) Transport

Rice panicles cut with sickle or ani-ani are put in a bas
fixed at the waist of a reaper. When rice is carried from th
field to farm house, it is transferred in a bigger basket call
Lanjung at the farm house it is stored in bulk in a barn or u
the eaves of the main house.

The amount of panicles carried in one Lanjung is about 5
kg. This transport is performed by the farm owner or his mal
members.

3) Threshing

Most of panicles carried to farm house garden are usuall
there for a few days without threshing until the reaping of al
field has finished through sometimes they are threshed on arri
the garden.

An armful of panicles is usually threshed at a time thro
rubbing and pressing out with both feet of a worker. A mat is
for a floor-cloth. In some villages it was observed that the
ing was done on a square like a sieve made of fine split bamb
is laid over the mat. As this sieve is so hard as to make the
sure from the above much heavier and as to make the threshing
In addition paddy are passed through the sieve while larger wi
straws stay on it and easily removed.

Such simple tool should have been easily available to ev
in each locality at a cheap price and already been popular am
farmers in the Province. But it isn't. In fact, only a few
are now enjoying that simple and convenient tool.

Panicles once threshed are usually trampled again later
leave any unthreshed paddy.

In most cases, threshing is done by farm owners or their
family members. But some owners employ daily laborers. The w
this case is usually paid at a piece-work rate, which generall
to about Rp 50 per 10 kg of threshed paddy. The threshing eff
is about 30 kg per man-hour on an average.

4) Drying

After threshing, paddy both for consumption and for sale are sun-dried by farmers on a mat to reduce this moisture content to about 17%. Then they are winnowed and stored for short time. After that farmers repeat drying to make the moisture content down to 14 to 15%.

A mat used for drying paddy is 1.5 by 1 m in size. A farmer usually owns about 10 mats of this kind. About 20 to 30 kg of paddy are dried on one mat at a time. As the amount of paddy is so small as easy to put away even in sudden rainfall.

5) Cleaning

Most of farmers in this province use winnower for cleaning paddy. The shape and type of a winnower is illustrated in Fig. 5-28 and it is mainly operated by a male adult. The cleaning with winnower is usually performed after paddy has been dried to a certain moisture contents as mentioned above.

There are many craftsmen producing winnowers throughout the Province and this implement is usually priced at Rp 15,000 to 30,000 and is durable for 10 to 15 years, which will make the price cheap in the long-run.

As present, however, the winnower has not been adopted by all farmers. About 20 to 30% of them seems to have it. Those who hire it at the rate of 1% of total amount of paddy cleaned. The capacity of winnower is usually 500 kg per hour.

The sorting process made with winnower in this Province will be mentioned in detail in "Cleaning impurities and immature kernels with winnower".

4-1-5 Characteristics of Postharvest Practices in Survey Areas

(1)

Table 4-4 Existing Method of Postharvest Practices in the Surv

Kabupaten (Province)			Pidie Aceh Utara (Aceh)	Bekasi Karawang Bogor (W. Java)	Pinrang Luwu Polmas (S.Sulawesi)	Bagi- Hulu S (S. U
Reaping	Sickle	Lower portion cutting		o	◎	
		Middle "	◎			
		High "		o		
	Ani-Ani		x	o	o	
Bunding	do	Large				
		Small	◎		o	
	don't			◎	◎	
Carrying	Bleud		◎			
	Shouldering poll			◎	o	
	Back carrying basket					
	Bag			o	o	
Drying	Before threshing (in the field)	do	◎			
		don't		◎	◎	
	After threshing	Farmer	◎	◎	◎	
		Trader	◎	◎	◎	
	Dryer					
Tumpukan			◎			
Threshing	Treading		◎	o		
	Beating			o	◎	
	Striking with stick					
	Power thresher	Pedal				
		Power	o			
Winnowing	do	Natural wind	◎	△		
		Winnower	o			
	don't			◎	◎	
Storage	Farmer	Lusbung	x	x	x	
		Bag	△	o	o	
		Rice chest	o		△	
	Trader	Rice mill	◎	◎	o	
		Ware house	◎	◎	o	
Husking, Milling	Farmer	Manual	x	x	x	
		Auto				
	Trader	Rubber-roll type huller	◎	◎	o	
		Engelberg type huller	o	△	◎	
		Blowing friction type whitener	△	◎	△	

◎ Well extended
o Extended
△ Somewhat extended
x Existed only previously and mostly disappeared in current practice

------ Combination of works

(1) Aceh Province (Pidie District, Aceh Utarah District)

1) Laborers for Agriculture are Highly Paid Compared with Other Provinces

In the listed districts, the payment is 1,500 ∿ 2,000 rupia/man/day. In South Kalimantan, however, it is 700 ∿ 1,000. The reason is less population density in these districts. In addition, the labor force is absorbed by large neighboring industrial projects (LPG, fertilizer). Therefore, there is less agricultural labor density per rice growing unit area, causing a steady labor shortage. It is understandable that the wage level of industrial projects is pushing the agricultural wages up.

2) Piling (Tumpukan) is Always Done

After reaping and semi-drying in the field, a piling is carried out without exception. This may be to prevent against rain-wetting. However, even in the harvest during the dry season, the piling is done. Accordingly, the actual reason will be temporary piling up for threshing, caused by a labor shortage. But, questions may be raised. Why a column or dome type? And is there any other simple layout?

3) Agriculture is Promptly being Mechanized

In the trends in (1) above, mechanical means are progressively introduced; contract farming by tractors (5 rupia/m^2), contract threshing (10% by piecework payment), rental winnowers (3.5 ∿ 5% by piecework payment) and so on.

4) Paddy for Selling has already been Dried Considerably at the Farm Level (17 - 18%). In Addition, It is Completely Cleaned (Drying and Cleaning have a Close Relationship).

Unlike West Jawa and South Sulawesi, the paddy is not raw or uncleaned. If the reason for this is clarified, it will be very helpful for the improvement of practice in other provinces.

(2) West Java (Karawang, Bekasi, Bogor District)

1) Many Workers Participate in Bawon Reaping

Reaping work in Karawang and Bekasi Districts in the province mainly performed with Bawon. In this work, a lot of agricultural laborers come together to participate. The number of reaping work reaches more than 100 persons per ha or occasionally even 200 ∿ 3

In Bawon reaping, remuneration is based on a piecework payment system. Therefore, workers try to reap as large a volume as possi As a result, the work naturally becomes rough. The more people employed, the rougher the quality of the work. From the workers' standpoint, it is not a problem even if there are slight amounts of non-reaped paddy in field. It is one of reason of a large amount occurrence.

As long as reaping is done with Bawon, workers will not be compensated even if they attempt to reduce losses only by 1 ∿ 2%. Therefore, it is very difficult to persuade them to reduce losses.

For instance, if it is assumed that the harvesting amount is 6 tons per ha and that there are 100 people participating in the reaping work, the harvest per capita amounts to 60 kg. If the remuneration ratio is 1/7, a reaping worker can receive some 8.5 k Taking 1 ∿ 2% of this results is as small as 85 ∿ 170 g. In these circumstances, a loss reducing effort would be meaningless to the workers. Rather, they want to complete reaping work as fast as possible to move to another farming field, to make their own profit Reaping workers often work in two fields a day; in one in the morn and the other in the afternoon.

As described above, as long as Bawon is used for reaping work, will be impossible to avoid the losses. However, in districts in Java, farmers are completely separated into two groups; large landholders owning a majority of a village, etc. and a lot of agricultu laborers and small tenant farmers who could not live only on agriculture. Accordingly, if the Bawon system is immediately terminate serious social trouble would result.

2) There is Versatility in the Postharvest Handling

In 3 other provinces out of those surveyed, each work was readily set as one line and the method was universal. However, in the listed province, there often appeared cases where two attitudes were used for a work process.

In reaping work, lower-portion-reaping and high-reaping methods are taken respectively in dry and wet fields. Such practice will be reasonable as already described in the section on work status. Nevertheless, in Aceh and South Kalimantan, head-chipping and mid-reaping are employed even in dry fields. In South Sulawesi, HYV is lower-portion-reaped with sickles even in water-covered fields. The attitude toward reaping never changes depending on field conditions, unlike in the listed province.

Also in the listed province, both Ani-ani, sickles are used when high-reaping rice in wet fields, in the same fields. For threshing, not only trampling but also the beating methods are used. As such, postharvest practice is diversified in the fields of the province, compared with other provinces.

3) No Drying and Cleaning is Done

As described earlier, farmers sell paddy without drying in the province. In addition, no cleaning work is carried out. Cleaning is also not conducted for household use paddy, in normal cases.

The reason why paddy is not dried or cleaned in the province is not known but might be estimated as follows:

a) There are many 2-croping in a year popularly using HYV, so that farmers do not have sufficient time available for drying and cleaning. In addition, there is no significant price difference between dried and cleaned paddy and raw paddy for selling (actually there is no transaction of dried paddy). Even with small amounts of paddy treated by each farmer, farmers can sell raw paddy without material loss of money even when they sell raw paddy, in consideration of drying and cleaning labor costs. Accordingly, farmers seem to consider that, rather than using the labor force for drying and cleaning, promptly proceeding with the next crop would be more profitable.

b) According to the traditional method of agriculture, paddy reaped by Ani-ani are dried and stored. Then, using a wooden mortar and pestle, threshing, husking and milling are performed in a series. Consequently, there has been no practice of cleaning paddy, up to the time of modern agriculture.

(3) South Sulawesi (Pinran, Luwu, Polmas District)

1) Lower portion-reaping and Beat-threshing are Popular and are Widely Used

In the other 3 surveyed provinces, there are remaining traces of traditional practice of postharvest in many forms in the field. In the listed province, however, new agricultural methods are completely spread and rooted in HYV growing areas; namely lower portion-reaping by sickles, beat-threshing in the field which might have been introduced simultaneously with the adoption of HYV.

A series of this agricultural work of lower portion-reaping and beat-threshing has the best labor efficiency in harvesting in Indonesia at present, disregarding loss. In the listed province, there are relatively many fields having good drainage conditions, where fields are dry at harvesting, so that it is expected that the new method will be widely accepted and spread promptly. However, also in the province, paddy is not dried or cleaned as in West Java.

2) Horses are Used for Transportation

In an area in Pinran District and Polmas District in the province horses are widely used for paddy transportation from fields. Paddy is packed in gunny bags and 2 - 3 bags (80 - 100 kg per bag) are loaded on a horse to transport.

Horses are hired and their rental fees are dependent on the transportion distance (normally 1 - 3 km), and other factors, but the ordinary charge is about 500 rupia per a trip.

(4) South Kalimantan (Banjar, Tapin,Hulusungai Tenga District)

1) Spread of Winnowers

In the province, winnowers are introduced and widely used for cleaning. It was the listed province only out of the 4 surveyed provinces in which sold paddy was completely dried and cleaned by farmers.

In the province, mostly one crop a year is harvested with a local rice variety. Accordingly, there is less volume for work, which affords considerable time for the postharvest work. In addition, farmers consider that drying and separation should be done by themselves. It may be directly connected to their efforts to improve labor efficiency, e.g. introduction of winnowers in the cleaning process, etc.

4-1-6 Characteristics of Leading Rice Varieties in Indonesia

(1)	Designation	PB.5 (IR.5)
	Released Year	1967
	Parent	Peta/Tangkai Rotan
	Type	Cere
	Growing Period	130 - 145 days
	Plant Height	110 - 130 cm
	Tiller	Many
	Head (Panicle) Type	Short, Many kernels
	Grain Shape	Large
	Shattering Habit	Moderately easy
	Lodging Resistance	Moderately resistant
	Taste	Poor
	Yield	High

(2)	Designation	SIAMPAT (C4-63gb)
	Released Year	1969
	Parent	Peta/BPI-76
	Type	Cere
	Growing Period	125 - 130 days
	Plant Height	105 - 112 cm
	Tiller	Moderate
	Head (Panicle) Type	Short, Many kernels
	Grain Shape	Long & Thin
	Shattering Habit	Easy
	Lodging Resistance	Resistant
	Taste	Good
	Yield	High

(3)	Designation	PB.26 (IR.26)
	Released Year	1975
	Parent	IR.24/TKM6
	Type	Cere
	Growing Period	123 days
	Plant Height	85 - 90 cm
	Tiller	many
	Head (Panicle) Type	Many kernels

	Grain Shape	Median & thin
	Shattering Habit	Easy
	Lodging Resistance	Resistant
	Taste	No Good
	Yield	Moderately high
(4)	Designation	PB.32 (IR.32)
	Released Year	1977
	Parent	IR20[2]/Oryza nivara/CR94-13
	Type	Cere
	Growing Period	140 - 145 days
	Plant Height	88 cm
	Tiller	Many (30 tillers)
	Head (Panicle) Type	-
	Grain Shape	Thin
	Shattering Habit	Easy
	Lodging Resistance	Resistance
	Taste	Medial
	Yield	3 - 4 ton/ha. in dry paddy base
(5)	Designation	PB.36 (IR.36)
	Released Year	1978
	Parent	IR-1561-228//IR24[4]/Oryza nivara///CR94-13
	Type	Cere
	Growing Period	110 - 120 days
	Plant Height	70 - 80 cm
	Tiller	Medium (14 - 19 tillers)
	Head (Panicle) Type	-
	Grain Shape	Moderately long & thin
	Shattering Habit	Easy
	Lodging Resistance	Resistant
	Taste	Poor
	Yield	4.0 - 4.5 ton/ha in dry paddy base
(6)	Designation	SEMERU
	Released Year	1980
	Parent	CR-B/IR1561-228-3-3
	Type	Cere

	Growing Period	122 - 132 days (0 - 500m above the sea level), 140 - 150 days (500 - 900m above the sea level)
	Plant Height	75 - 85 cm (0 - 500m above the sea), 70 - 80 cm (500 - 900m above the sea)
	Tiller	Medium (16 - 24 tillers)
	Head (Panicle) Type	-
	Grain Shape	Thin
	Shattering Habit	Easy
	Lodging Resistance	-
	Taste	No Good
	Yield	4.5 - 5.5 ton/ha in dry paddy base
(7)	Designation	CISADANE
	Released Year	1980
	Parent	Pelita I-1/B2388
	Type	Cere
	Growing Period	135 - 145 days
	Plant Height	105 - 120 cm
	Tiller	Medium(15 - 20 tillers)
	Head (Panicle) Type	-
	Grain Shape	Thick
	Shattering Habit	Medium
	Lodging Resistance	Moderately Resistant
	Taste	Good
	Yield	4.5 - 5.5 ton/ha in dry paddy base
(8)	Designation	CIMANDIRI
	Released Year	1980
	Parent	Pelita I-1/B2709
	Type	Cere
	Growing Period	135 - 145 days
	Plant Height	100 - 115 cm
	Tiller	Medium(15 - 20 tillers)
	Head (Panicle) type	-
	Grain Shape	Thin
	Shattering Habit	Medium

	Lodging Resistance	Medium
	Taste	Good
	Yield	3.5 - 4.5 ton/ha in dry paddy base
(9)	Designation	AYUNG
	Released Year	1980
	Parent	Pelita I-1/82388
	Type	Cere
	Growing Period	135 - 145 days
	Plant Height	105 - 120 cm
	Tiller	Medium(15 - 20 tillers)
	Head (Panicle) type	-
	Grain Shape	Long & Thick
	Shattering Habit	Medium
	Lodging Resistance	Moderately Resistant
	Taste	Good
	Yield	4.5 - 5.5 ton/ha in dry paddy base
(10)	Designation	PB.42 (IR.42)
	Released Year	1980
	Parent	IR2042/CR94-13
	Type	Cere
	Growing Period	135 - 145 days
	Plant Height	90 - 105 cm
	Tiller	Many (20 - 25 tillers)
	Head (Panicle) type	-
	Grain Shape	Thin
	Shattering Habit	Medium
	Lodging Resistance	Resistant
	Taste	No Good
	Yield	4.5 - 5.5 ton/ha in dry paddy base

4-1-7 Farming Implements in Postharvest Handling and Their Usage

(1) Ani-ani

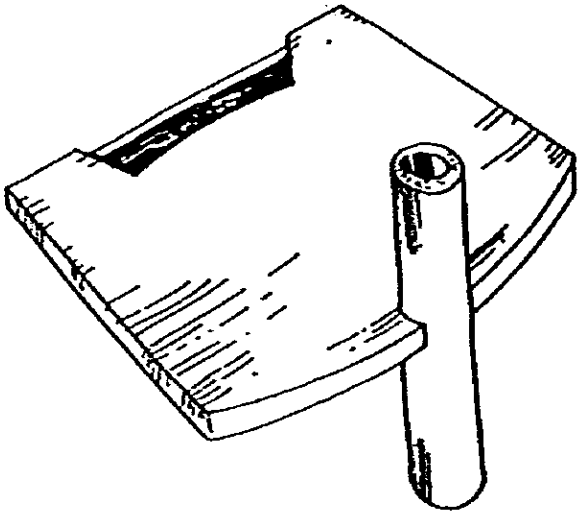


Fig. 4-10

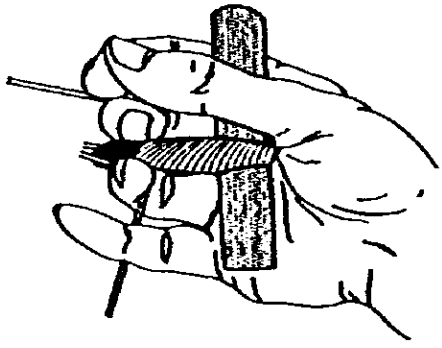


Fig. 4-11

Fig. 4-12

Ani-ani (See Fig. 4-10) is a traditional implement for picking pa... especially used for local variety. The way of using ani-ani is as follo... Hold ani-ani in one hand (See Fig. 4-11), and then draw panicle base wit... middle and ring finger, in the same instant picking panicle like pushin... out ani-ani with palm. The shape and material of ani-ani are little bit... different by the region. Usually womenfolks use ani-ani for picking panicle.

(2) Sickle

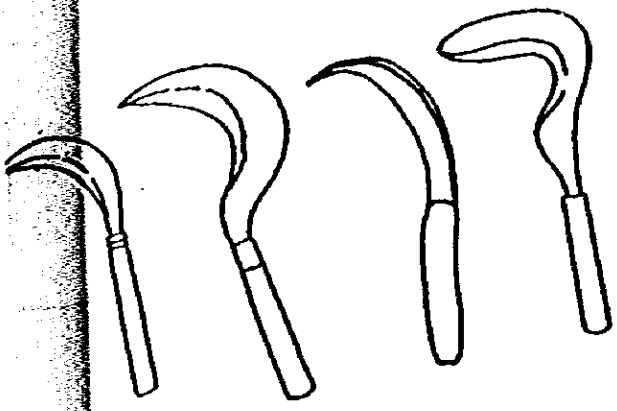


Fig. 4-13

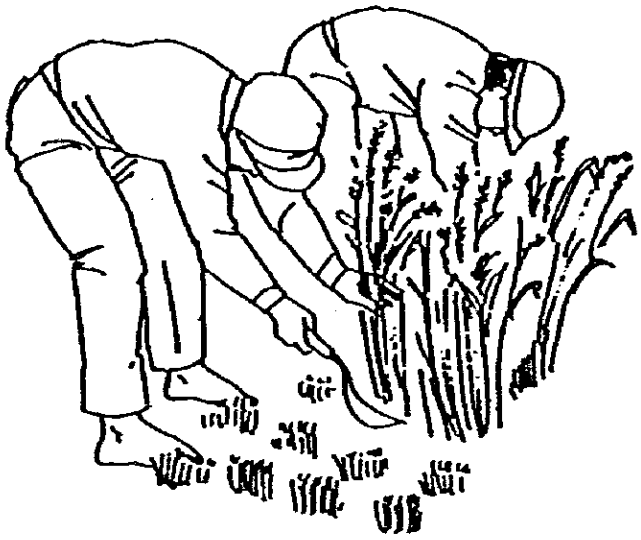


Fig. 4-14

Sickle (See Fig. 4-13) has spread out rapidly since H.Y.Vs introduced into this country. It is a popular working style reaping lower portion of paddy (See Fig. 4-14) with sickle in the well-drained paddy field. In the bad-drained paddy field, usually farmer cut higher or middle portion of paddy. Also, sickle is well used for cutting stalks and stubbles after harvesting and used for mowing grass. The blade, size and shape of sickle has various in form for the purpose of using and field.

(3) Trampling

Fig. 4-15

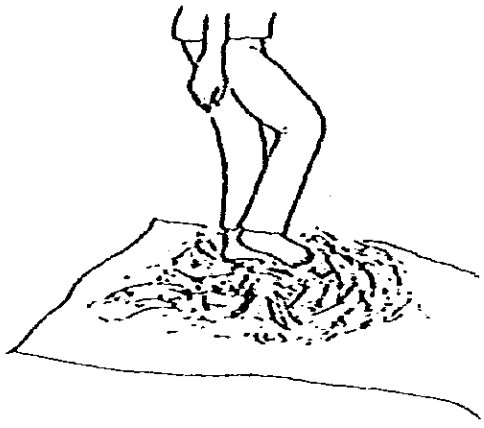


Fig. 4-16

Trampling (See Fig. 4-15,16) is the way of threshing when the pa picked panicle or reaped upper as well as middle portion of paddy. Fa thresh the panicle of paddy by trampling as squeezing it. They use sti for keeping balance and also to loosen the straw.

(4) Beating

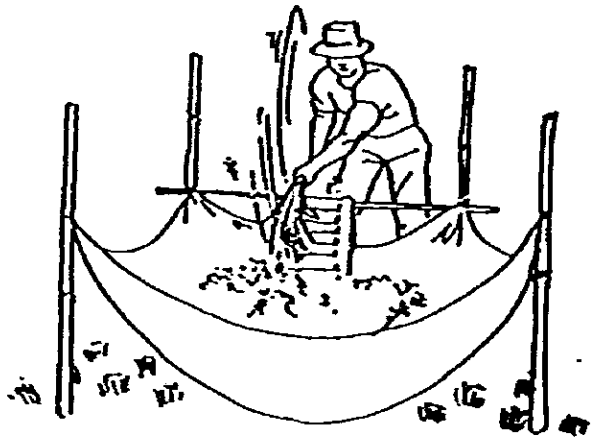


Fig. 4-17

Beating (See Fig. 4-17) is the way of threshing when Farmer cut lower portion of paddy of sickle. In this way work efficiency is good but it occurs much loss by scattering. The stand where to beat the panicle is made of wood, bamboo and other materials. It's size is also many kinds.

(5) Striking with stick

Fig. 4-18

Striking with stick (See Fig. 4-18) is the way of threshing when farmer picking panicle and lower portion cutting. Stick is usually wood, bamboo and sometimes palm petiole. In some places, they work standing with quite long stick.

(6) Pedal Thresher

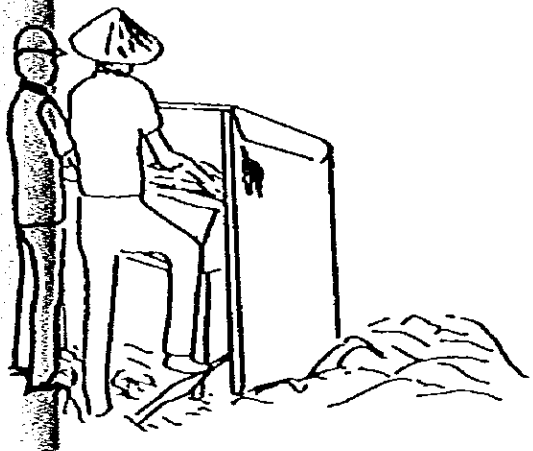


Fig. 4-19

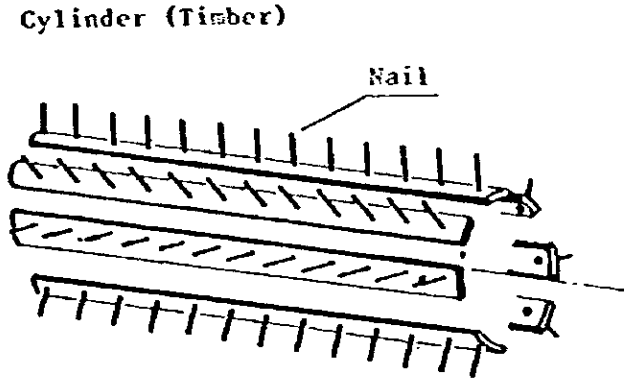


Fig. 4-20

Pedal thresher (See Fig. 4-20) is spread in Kudus, Central Java. This local made thresher's tooth is drove the nail up-side-down. To prevent scattering of paddy, farmer make a crate and cover pedal thresher with cloth.

(7) Shouldering Pole (Sandang)

Fig. 4-21

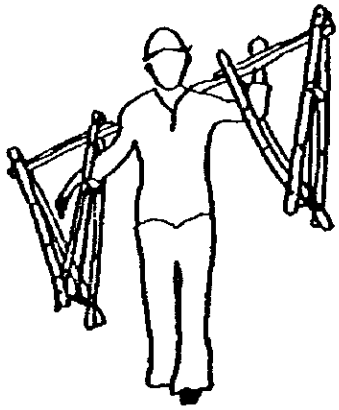


Fig. 4-22

Sandang (See Fig. 4-21, 4-22) is made of bamboo. Farmer use Sandang when they cut the paddy in middle portion or panicle picking. They carry the paddy with Sandang. In Jawa Island, Sandang is popular. They use Sandang not only for transporting paddy but also other goods.

(8) Back Carrying Basket (Lanjung)

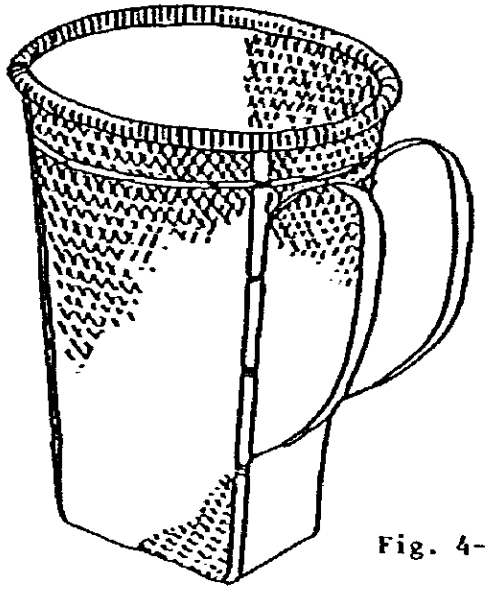


Fig. 4-23

This Lanjung (See Fig. 4-23) can be seen in South Kalimantan. It is usually used for transportation paddy from field to farmer's house. Lanjung's material is rattan. Its size is 1 m high, about 0.5 m upper diameter.

(9) Bleud

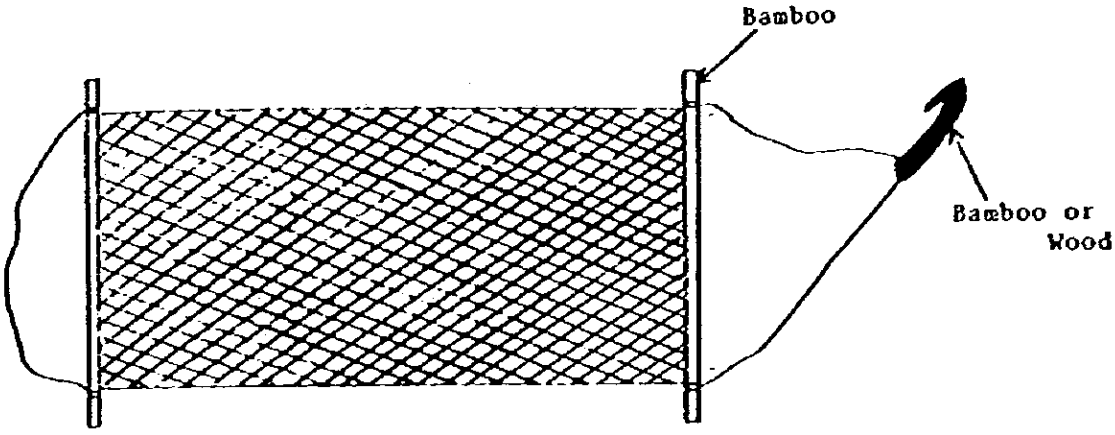


Fig. 4-24

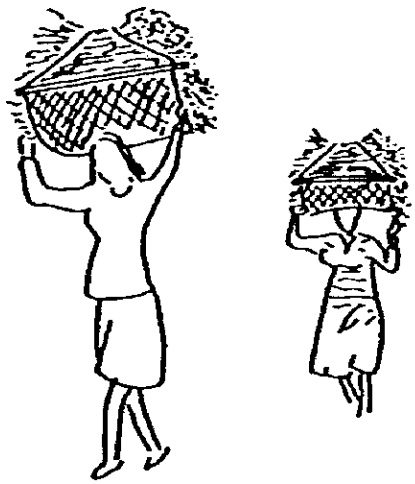


Fig. 4-25

Bleud (See Fig. 4-24) is a implement for carrying paddy. It is made out of plaited palm and popular in Aceh. Carrying capacity is 20 - 30 kg.

(10) Bicycle, Gunny Bag

Fig. 4-26

Fig. 4-27

Bicycle is an important transportation implement in farm village in Indonesia because the road condition is not good. Many things is transported with bicycle. Gunny bag and second handed bag of fertilizer, etc. are generally used in the village to sack and carry paddy and other crop

(11) Tikar

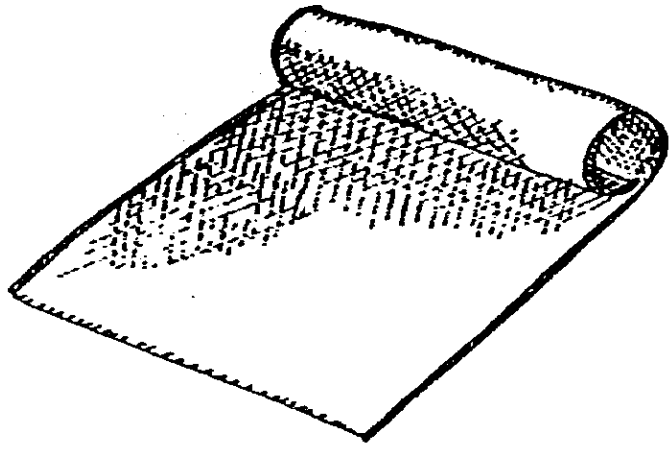


Fig. 4-28

Fig. 4-29

Farmer underlays the Tikar (See Fig. 4-28) to work drying, threshing, etc. It is necessaries for the farmer. Tikar's material is palm, bamboo, ratan, rush, etc. The size is various.

(12) Ayakan

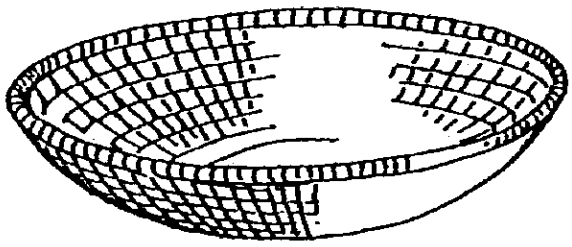


Fig. 4-30

Ayakan (See Fig. 4-30) is circular, oval and square, and its use is varied in the region. Frequently is made of bamboo.

(13) Winnowing by Wind (Dihembus Angin)

Fig. 4-31

(14) Winnowing with Winnow and Sieve (Tampi, Ayak)

Fig. 4-32

(15) Winnower (Gumbaan)

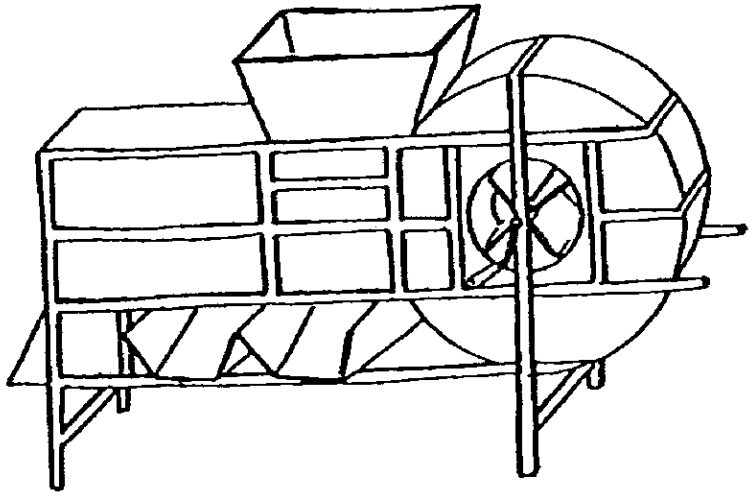


Fig. 4-33

Winnower (See Fig. 4-33) have now found anywhere in South Kalimantan and also rapidly spreading in Aceh province. It is made of wood.

(16) Basket

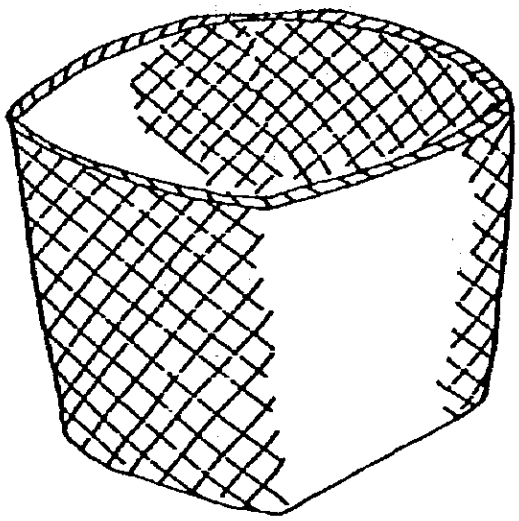


Fig. 4-34

This is necessaries for the farmers to handle the paddy. Material is rattan, rush, etc. Size and shape are varied.

(17) Lumbung

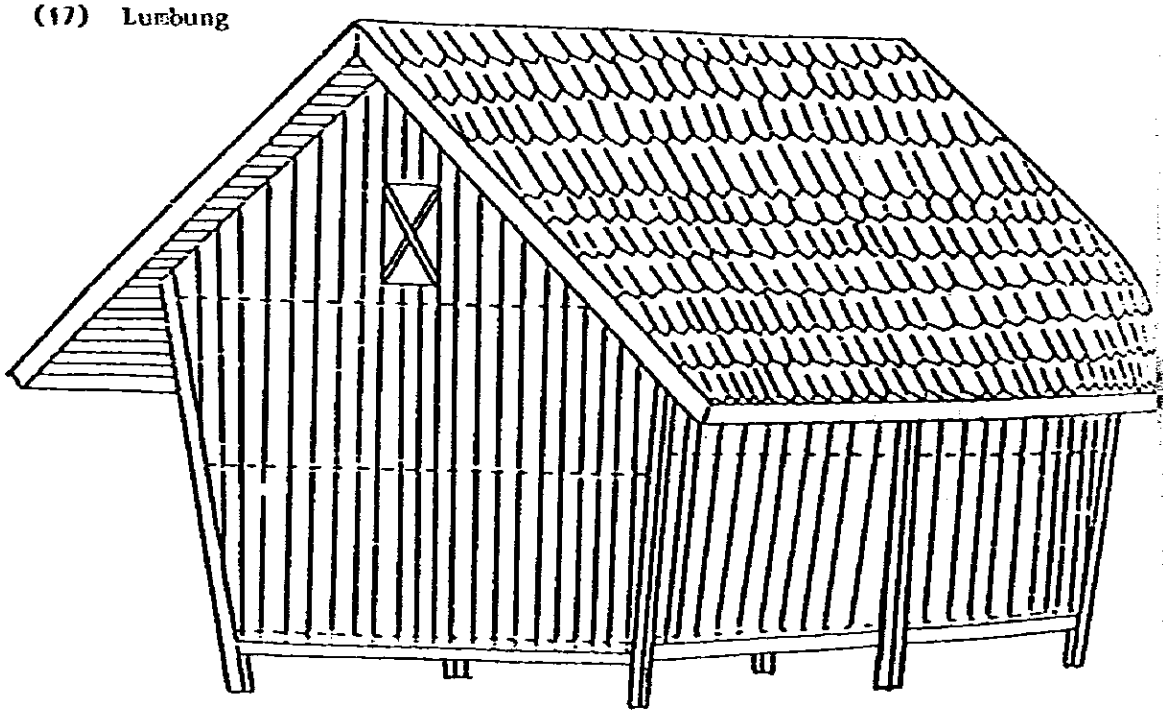


Fig. 4-35

We can see everywhere this Lumbung (See Fig. 4-35) to storage bundle of stalk paddy. The shape of roof and floor height is various in the re The entrance is elevated near the roof and use the ladder to take it in and out. Inside the Lumbung is one room and storage a pile of stalk pad

In these days the storage style is changed from stalk paddy to unhulled rice so that utilization of Lumbung is decreasing gradually.

(18) Storage Container of Paddy

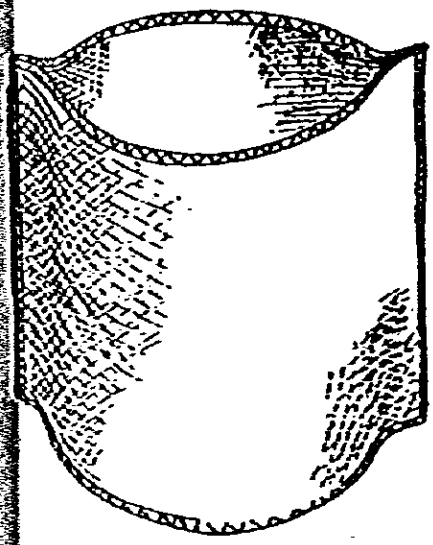


Fig. 4-36

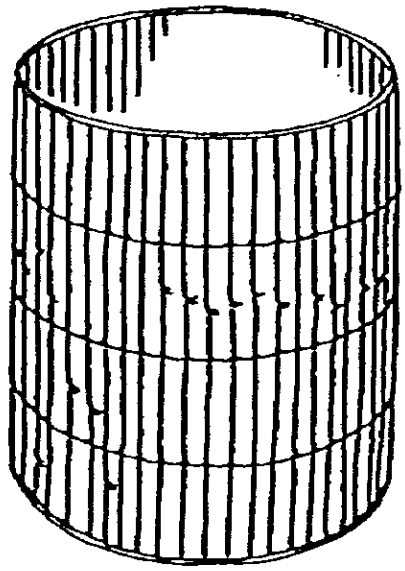


Fig. 4-37

Unhulled rice storage is common nowadays among numbers of farmers and they use these containers (See Fig. 4-36 and 37) in the home to store. Materials of these containers are wood, bamboo, petiole, rush etc. Farmer use gunny bags to stock paddy frequently. The shape, style and name of containers are varied is region.

(19) Wooden Handy Mill (Lesung)

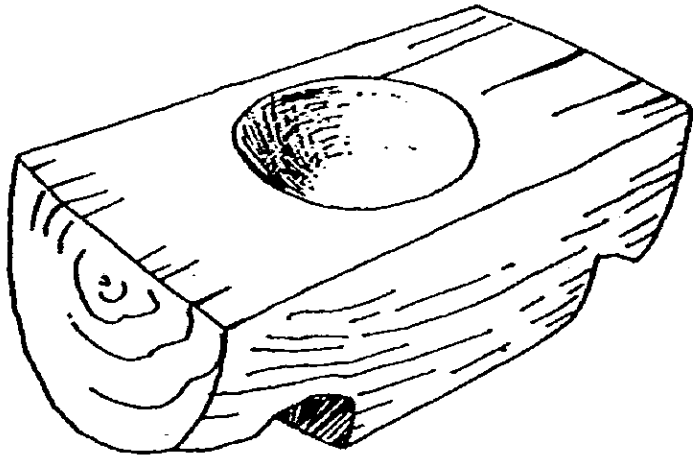


Fig. 4-38

Old days, wooden mill (See Fig. 4-38) was used for threshing, husking and whitening the dried stalk paddy. There were many kinds of types. Frequently, the hole of mill is separated for husking and whitening.

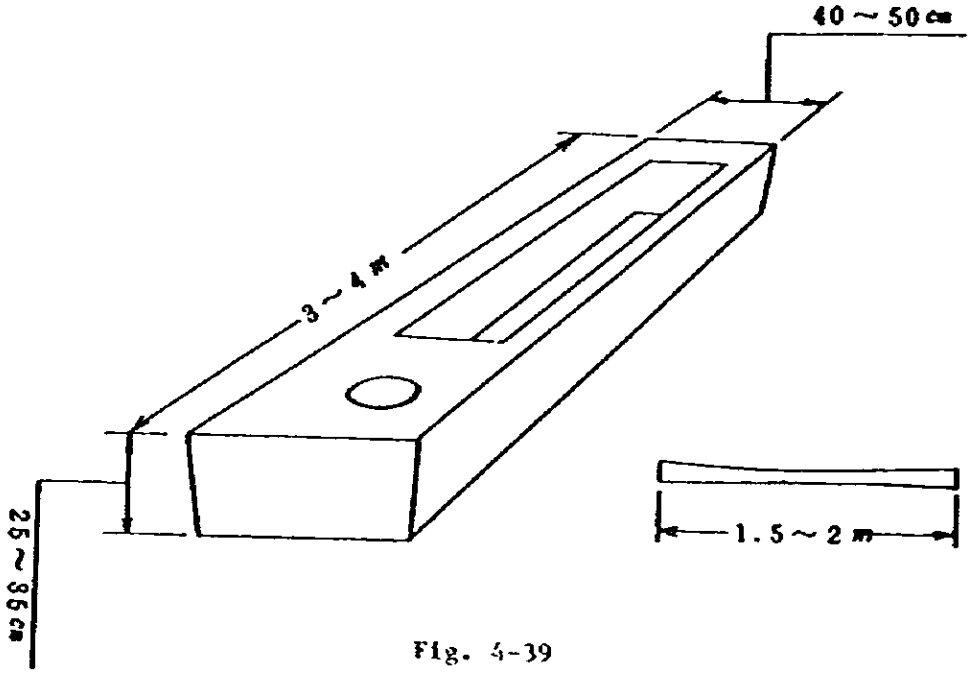


Fig. 4-39

(20) Kiseran

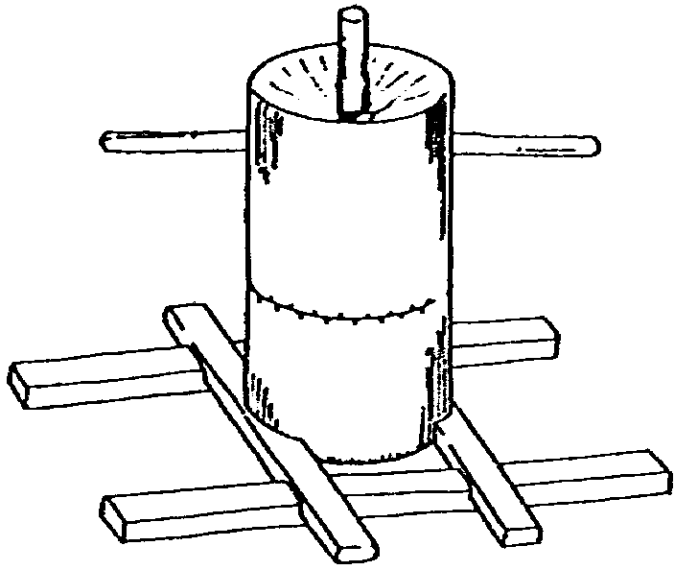


Fig. 4-40

Kiseran can be seen everywhere in Indonesia and it is made of palm or hard wood.

It was used for husking in old days but nowadays with the spread of rice mill, very few farmers use.

4-2 Storage

4-2-1 Introduction

(1) The quantity to be stored in Aceh Province is as follows.

The paddy production in 1980/81 in this province was 812,000 tons. Of the total population of 2,611,000 in this province, the rice farming population is estimated at 1,669,000 (number of households 334,000) and non-rice farming population is estimated at 942,000. The estimated paddy consumption is 494,000 tons, and the excess milled rice quantity is estimated at 185,000 tons. The majority is stored at the farm level.

In 1981/82, DOLOG made a purchase of about 47,000 tons on a milled rice base. Rice of this quantity is stored as entrusted at KUD and private warehouses besides DOLOG warehouses. The current storage capacity of existing warehouses in this province is about 81,000 tons. Paddy of about 11,000 tons in total is always kept stored in these warehouses for military forces and government employees and for market control and emergency release.

(2) The quantity to be stored in West Jawa Province is as follows.

The paddy production in 1980/81 in this province was about 7,126,000 tons. Of the total population of 28,115,000 in this province, the rice farming population is estimated as 7,887,000 (number of households 1,578,000) and the non-rice farming population is estimated as 20,228,000. The estimated paddy consumption is 5,406,000 tons, and the excess milled rice quantity is estimated as 1,082,000 tons.

The capacity of warehouses located throughout this province is 153,[illegible] tons for DOLOG warehouses, 69,300 tons for private warehouses stored and managed by DOLOG, 63,700 tons for warehouses either possessed or managed by KUDs/PUSKUD and 117,500 tons for private warehouses. The total is [illegible] tons. The quantity purchased by DOLOG in 1981/82 was 191,299 tons.

Private commercial warehouses in Indonesia are small in both number and capacity at all places of production, places of transit and places of consumption. The following factors can be raised as the reasons for it.

1) Construction costs for new commercial warehouses are high and these warehouses hardly pay for themselves.

2) As harvest of paddy is made twice a year in many areas of the nation, the possibility of long-term storage of over six months is extremely small for private warehouses.

3) As the deterioration of paddy is very high in general for storage in a tropical area, storage losses are high in commercial warehouses.

4) The level of warehouse charges of private commercial warehouses is not known because there does not exist any private commercial warehouses. But the warehouse charge paid by BULOG for renting a whole warehouse is as low as 300 rupiah per ton per month. As the warehouse charge is considered to be of this level if professional private warehouses are in existence, the business hardly pays for professional private warehouses.

(3) The quantity to be stored in South Sulawesi Province is as follows.

The paddy production in 1980/81 in this province was about 2,566,000 tons. Of the total population of 6,059,000 in this province, the rice farming population is estimated as 2,356,000 (number of households 471,000) and the non-rice farming population is estimated as 3,703,000. The estimated paddy consumption is 1,258,000 tons, and the excess milled rice quantity is estimated as 849,000 tons.

The quantity purchased by DOLOG was about 118,000 tons in 1980/81 and about 180,000 tons in 1981/82. Besides paddy of about 80,000 tons transferred to outside of the province, the majority of the excess paddy is stored at the farm level.

The storage capacity, on the other hand, is 121,300 tons for warehouses possessed by DOLOG and 26,950 tons for leased warehouses; 148,250 tons in total. The quantity of rice that is stored for controlling the market price or for emergency release is small compared to other provinces.

(4) The quantity to be stored in South Kalimantan Province is as follo

The paddy production in 1980/81 in this province was about 866,000 tons. Of the total population of 2,070,000 in this province, t rice farming population is estimated at 235,000 (number of households 47,000) and the non-rice farming population is estimated at 1,835,000. The estimated paddy consumption is 446,000 tons, and the excess quantity estimated at 266,000 tons.

The milled rice quantity increased accompanying a gradual increas of paddy production in the past few years. The majority of the excess besides 20,000 tons purchased by DOLOG in fiscal 1980/81 is stored in t form of paddy or milled rice at the farm or commercial level at places production or places of consumption, and is transferred to markets in t province or in other provinces where production of paddy is not sufficie The storage capacity in this province is 19,500 tons for warehouses possessed by DOLOG and 18,300 tons for warehouses leased by DOLOG; 37,8 tons in total.

It appears that rice is stored in the form of paddy after harvest b farms in the South Kalimantan Province and is sold when it is necessary cash it or as matched with a rise in the market price. The market price for paddy and milled rice does not drop lower than the minimum supported price level (floor price) even in the harvest season due to such economi reasons as the nature of a local variety of rice with high selling prices, a rise in the market price which can be expected through storage, and the fact that there are many rice producing areas which have slow me of transportation depending on trucks and river transportation, which co even more than truck transportation. It can be said that this shows a p of the distribution picture for rice in this province.

Basic data on the amount of rice related to storage and transportation

Item \ Province	Aceh	West Jawa	S. Sulawesi	S. Kalimantan
Paddy Production (x1,000 ton)	812	7,126	2,586	866
Seed consumption (x1,000 ton)	34	56	21	10
Total population (x1,000)	2,611	28,115	6,059	2,070
Total household of farmer (x1,000)	370	3,246	735	277
Total household of rice cropping farmer (x1,000)	334	1,578	471	47
Total population of rice cropping farmer (x1,000)	1,669	7,887	2,356	235
Total population excepting rice cropping farmer (x1,000)	942	20,228	3,703	1,835
Milled rice consumption per capita in a year (kg)	123	125	135	140
Milled rice consumption per capita in a year (rice cropping farmer) (x 1,000 ton)	205	986	318	33
Milled rice consumption per capita in a year (excepting rice cropping farmer) (x 1,000 ton)	116	2,529	500	257
Total paddy consumption (x1,000 ton)	494	5,406	1,258	446
Total milled rice consumption (x1,000 ton)	321	3,514	818	290
Total purchased milled rice by Dolog (x1,000 ton)	47	191	179	20
Total capacity of warehouse in Province (x1,000 ton)	81	403	148	38
Total capacity of Dolog warehouse in Province (x1,000 ton)	16	133	123	20
Surplus (milled rice x 1,000)	185	1,082	849	266

Note) No. 6 - 12, 16 are estimated values

Table 4-6 Handing of Rice by DOLOG in Aceh Province

Year			1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
Demand	Domestic procurement	Paddy	2,096	13,666	7,190	7,191	12,530	16,016	68,198
		Rice	-	-	-	-	50	-	1,186
	Move from other province		22,325	4,739	5,750	4,400	3,488	8,850	1,944
	Import from other country		5,140	-	11,000	19,677		-	-
	Total input equal to rice		28,827	13,622	21,424	28,751	11,682	19,261	47,459
Supply equal to rice			29,574	13,356	19,208	24,610	16,636	20,876	19,360*

Note 1) Paddy milling recovery is 65%

2) *: Preliminary data

3) -: None or no activity

4-2-2 Farm Level

(1) Aceh Province

As the method for storage, paddy is contained in robust containers called lumbungs made of bamboo and these lumbungs are located in corners of main farmhouse buildings or in adjacent sheds. Paddy may also be stored in bulk form in wooden boxes located in main buildings or living rooms or in gunny sacks or in bags made of coconut or pandanuses leaves.

It is considered that the quantity of rice possessed at the farm level in this province is about 80% of the crop. The period of storage of paddy is about five months in the double cropping area and is about eleven months in the single cropping area. The storage quantity is around 1.5 to 2.0 tons on an average per farm except for large-scale farms. Storage is made in the form of paddy in this province instead of storage in the form of stalk paddy. Although storage is made in various configurations, countermeasures which are considered to be suitable for prevention of damage caused by insects, humidity and rats have not been established in general. However, wooden boxes, the use of which is increasing these days, are most suitable for prevention of damage caused by insects and rats out of those used at the present time.

(2) West Java Province

For storage of rice at the farm level, paddy is put in second handed bags for fertilizer made of polyethylene and is stored in corners of main buildings or in adjacent simple warehouses. Also storage is made in bulk form in simple stores called "lumbungs" which have been used for a long time in this area. The period of storage for home consumption is five months at maximum in the double cropping area, and one year in the single cropping area. In reality, however, the situation is entirely different from that. Particularly among farms on the periphery of large cities there are those who consider sales in expectation of price rises caused by fluctuation of market prices. There are farms who sell all paddy of both crops as it is in the distribution stage. Thus an outstanding contrast is observed according to their financial condition. Thus an outstanding contrast is observed.

(3) South Sulawesi Province

In the surveyed area, harvested paddy is placed in bags and stored in sheds and lofts of main buildings or in simple warehouses made of wooden plates located under the floors of main buildings. In the case of local varieties, stalk cutting is mostly done using small finger knives to cut the rice stalk. The stalk paddy is bundled and stored as it is air drying. It is stored in lofts at farms in the Luwu District. There also are cases where storage is made in containers made from the stems of sago palms. They have a log house structure with a width of about 1 m and a length of about 1.5 m. The height corresponds to the storage quantity. As the floor is located at a level of 30 - 50 cm above the ground, consideration is made for ventilation and to protect against humidity, but they are defenseless against insects and rats.

Private lumbungs for rice are available in the Tanatoraja area and are used for storage of stalk paddy. Their floors are elevated 1 - 1.5 m above the ground using trunks of coconut trees as columns. As they provide good ventilation, it can be said that their structure is suitable for wet tropical areas.

Almost no drying or cleaning is made in for paddy of selling general at farms after harvest. The rice to be consumed by the farm is dried and then stored.

Storage facilities having a structure to prevent damage caused by rats, insects and humidity and considered to be suitable in quality cannot be seen at the farm level.

The paddy for distributed rice delivered to KUD/BUUD is usually stored at the farm level for 2 to 3 weeks. The former distribution channel with large size rice mills as the nuclei made a change in the past few years due to the penetration of small size rice mills at the farm level. Accordingly, the milling cost decreased and the situation changed to such a state that farms are directly concerned in the milling market.

Such changes in the realities of distribution will probably progress in the direction of gradually increasing both the quantity and duration of storage of paddy at the farm level in the future.

(4) South Kalimantan Province

Until HYVs were recently introduced, farms in this province in general were using small knives to cut the rice stalk, drying stalk paddy under the sun and were storing stalk paddy as it is piled in lofts of main buildings or in buildings constructed as sheds. After introduction of HYVs, however, they stored the rice in the form of paddy, and usually it is stored in houses while contained in containers called kaindai (Fig. 4-37) or karabas (Fig. 4-36) made by weaving bamboo or coconut stems. The container capacity varies by the family size and crop, but many are of a capacity of 500 kg to 2,000 kg.

Farms in South Kalimantan do not have the custom of cashing paddy immediately after harvest, which is observed at farms in other provinces. Accordingly, the amount of stored paddy at the farm level is naturally large compared to other provinces. The stored paddy is dried twice (sun drying method using mats) and is cleaned (using winnowers). Its mean moisture content is 15 - 16% and mean foreign matter content is around 5%. The countermeasures for protection against damage caused by insects and rats are not taken during storage, and when the disadvantages of high temperatures and high humidity are taken into account it is estimated that the loss in this stage is quite large.

In order to reduce the loss during storage at the farm level, it is necessary to promote improvements in the method for storage at the farm level through activities of PPLs.

4-2-3 KUD Level

(1) Aceh Province

Warehouses are single-story wooden buildings with a capacity of 300 to 500 tons, and floors are made of concrete. Side walls are made of bricks and are finished with mortar or are lined with steel sheets or wooden plates, and roofs are finished with steel sheets. Although floors of newly constructed warehouses are elevated 90 cm, the floors of old warehouses are not elevated. Considerations for preventing the entry of rats, birds, etc. are not sufficiently made. For example, warehouses were seen in which the nets for preventing the entry of birds were broken, the roofs leaked and/or there were gaps in the plates along the side wall. The majority of KUD warehouses have insufficient storage functions and are not managed well.

The paddy purchased by KUD from farms is milled at relatively early times and is sold to DOLOG or in the general market. Therefore, the usual storage period is as short as 2 to 4 months.

(2) West Java Province

The number of warehouses owned by the KUD organization in West Java Province is 432 buildings, and the capacity per building is 100 to 200 t. Warehouses of KUD scattered mainly in rice producing areas are largely diversified. Presently some of them are of a simple wooden structure with slate roofs and some of them are modern warehouses of prefabricated steel structure.

Roofs of buildings are finished with steel sheets and broad windows are provided in general under the eaves. All of these windows have wire nets for protection against birds, but many are broken. There are many leaky places in some warehouse and leakage is a problem in storage in the rainy season. When the storage functions of all warehouses are observed, as little as about 20% of all warehouses are regarded as relatively good warehouses.

One of the functions of KUD is to process the paddy purchased from farms into a product which matches with the standard for delivery to DOLOG. KUD warehouses, therefore, are places where purchased paddy is dried and cleaned. The period of storage in these warehouses therefore is relatively short.

Dryers made by R.A. Lister of U.K. have been installed at some KUD/PUSKUD warehouses. The number of these dryers installed by this time is not large because drying costs with these dryers are high compared to sun-drying. However these dryers are used to prevent losses to raw paddy during emergencies when the rains continue and sun-drying cannot be done in the rainy season.

Warehouses owned by PUSKUD are mainly made of wood or steel. Roofs are finished with steel sheets, floors are finished with concrete, and plates, bricks, steel sheets, etc. are used for the walls. The capacity per warehouse ranges from 500 tons to 4,000 tons and there are relatively many large-scale warehouses.

Warehouse functions begin in February with incoming crops when harvest in the rainy seasons begins. The period up to July is the storage period. The shipping period begins in October and the storage quantity gradually decreases afterward. This is the storage pattern in a

ear. The period of storage of paddy in private warehouses leased by DOLOG is between 4 and 8 months, and paddy is stored entirely in bags. Storage management in terms of warehouse functions and management is relatively good in general.

(3) South Sulawesi Province

The number of KUD warehouses located in South Sulawesi Province is 369 in 1982 as shown below. The majority of them have a small capacity of 100 to 200 tons. The majority of them are made of wood, the roofs are finished with steel sheets or slates and the walls are finished with steel sheets, blocks or bricks, and floors are finished with concrete or bricks. Ventilation windows are provided under the eaves and these windows have wire nets for preventing entry of birds.

KUD warehouses provide intermediate processing functions as undried and uncleaned paddy purchased from farms is prepared or milled at these warehouses before delivery to DOLOG. Accordingly, many KUD warehouses are equipped with drying yards made of concrete as well as rice mills. Warehouses equipped with dryers made mostly by R.A. Lister of U.K. were occasionally observed, but these dryers are not fully utilized in practice because the drying cost is high compared to sun-drying.

(4) South Kalimantan Province

The number of warehouses owned by the KUD organization in South Kalimantan Province in 1980 was 45 as shown below, and when the 41 under construction and being planned are added to them, KUD will have 86 warehouses in the future. (See Table 4-7)

Table 4-7 Total KUD Warehouses in South Kalimantan

Kabupatan	Existing	Under Construction
Banjarmasin	1	3
Banjar	5	2
Tapin	7	3
H.S. Selatan	5	11
H.S. Tengah	9	7
H.S. Utara	4	1
Tabalong	3	3
Barito Kuala	5	6
Tanah Lalt	5	4
Kota Barn	1	1
Total	45	41

The majority of these warehouses owned by KUD have a small storage capa of 100 to 200 tons on a paddy base. All of them are wooden structures w roofs finished with steel sheets or slates, with walls finished with ste sheets, wood, blocks or bricks and with floors finished with bricks or concrete. Ventilation windows covered with wire nets for preventing ent of birds are located under the eaves for ventilation of the lofts. The temperature rises due to direct sunlight in the day time. No warehouses have been designed for storage under conditions of high temperatures and high humidity in terms of their structure, as the preliminary purpose of these warehouses is not storage but a place for performing an intermedia function in the process of distribution (drying and cleaning for deliver to DOLOG). KUD warehouses equipped as ancillary equipment with rice mill sun-drying yards (usually of a scale of 3 to 4 tons per day) and rarely dryers (mainly those made by R.A. Lister of U.K.; almost unused at the p time). The functions of KUD are, as seen in activities in other provinc to purchase paddy at the floor price, dry and clean the quality level th matches with the purchase standard of DOLOG and to deliver it to DOLOG.

In reality, however, KUD is not very active because the transportation and machinery are not well equipped while personnel required for upkeeping the operations is not sufficient. Under these circumstances there are many cases where processing (transportation, cleaning, drying, milling) is entrusted to commercial rice mills, who are members of KUD, or to PUSKUD. The number of cases in which KUD itself processes products delivered to DOLOG is small. Naturally, therefore, it is difficult to say that warehouse owned by KUD are used for performing their original storage functions in the process of distribution.

However, cases were observed where DOLOG paddy was temporarily stored (about 6 months to 1 year) to compensate for the shortage of capacity of DOLOG's warehouses.

4-2-4 DOLOG Level

(1) Aceh Province

The capacity per building for DOLOG warehouses varies greatly in the range of 400 to 2,000 tons. Warehouses are usually single-storied wooden buildings having rooves finished with steel sheets and side walls finished with steel sheets, wooden plates or bricks. Floors finished with mortar are elevated about 90 cm off the ground. Warehouses of steel structure having relatively modern facilities were also observed. The storage period is 6 to 7 months in the case of paddy and 4 to 10 months in the case of milled rice in general.

DOLOG warehouses, compared to warehouses at other levels, are suitably provided with countermeasures against damage caused by insects and rats in the aspect of storage. They also play the role as the nuclei of the distribution mechanism, and control the market prices while serving as terminals in the market.

Rice mills are usually equipped, as ancillary equipment, with single-storied wooden warehouses in general. Foundations and floors are made of concrete, rooves are finished with steel sheets and side walls are finished with steel sheets or wooden plates. Ventilation windows are provided under the eaves and are covered with wire nets, but they are broken and are useless in many places. These warehouses are partially leased to DOLOG, and paddy in these warehouses are milled and shipped in accordance with instructions given by DOLOG. The storage period is around 4 to 8 months.

(2) West Jawa Province

Warehouses owned by DOLOG are large and made of modern prefabricate steel or wood. Floor levels are elevated 90 cm above the ground. Roofs are finished with steel sheets, floors are made of concrete, walls are finished with steel sheets, wood plates, bricks or mortar. The capacity per unit of building is 1,000, 2,000 and 3,500 tons.

These warehouses play roles as the nuclei of distribution in both the production area and consumption area. That is, storage of paddy and milled rice delivered from KUD and large scale rice mills are the main functions in the production area, and acceptance of milled rice from the production area and its storage are the main functions in the consumption area. The usual storage period is 4 to 10 months for milled rice and 6 to 7 months for paddy.

DOLOG warehouses function to control market prices as located in the distribution mechanism as described earlier, and at the same time, they also serve as terminals and their storage operations are favorable at the present time. If special comment is required, cleanliness of the interior of warehouses and suitable implementation of countermeasures against damage caused by insects and rats compared to storage at other levels can be pointed out.

Warehouses leased to DOLOG/SUB DOLOG at the present time are wooden, steel, and the capacity is around 1,000 1,500 tons per building. These buildings have rooves finished with steel sheets, concrete floors and walls finished with wooden plates, bricks, steel sheets of the like, and broad windows for ventilation are usually located under the eaves and covered wire nets.

Storage of paddy is entirely done in bags. The storage period is usually 4 to 6 months for paddy, and it is relatively short for milled rice. Insecticides and rodenticides is used, and storage management is done in accordance with instructions given by DOLOG.

(3) South Sulawesi Province

Warehouses in this province owned by DOLOG, owned by KUD and leased from private sector under the management of DOLOG and the program for construction of warehouses in 1982 are as follows.

Table 4-8 Storage Capacity and Location of Warehouses in South Sulawesi Province

(ton)

Location	Dolog Own			Contracted	Total
	PPGR	GBB	SP		
1. Panaikang	-	21,000	-	5,000	26,000
2. Polmas	2,000	7,000	-	-	9,000
3. Pare-Pare	18,300	14,000	-	6,700	39,000
4. Sidrap	4,450	16,000	-	8,400	28,850
5. Wajo	3,800	10,500	3,200	2,250	19,750
6. Bulukumba	2,800	4,000	1,000	2,200	10,000
7. Palopo	2,600	4,500	-	-	7,100
8. U. Pandang	6,150	-	-	2,400	8,550
Total	40,100	77,000	4,200	26,950	148,250

Note: PPGR : Old godown
GBB : Permanent godown
SP : Semi permanent godown (Temporary)

Source: DOLOG, S. Sulawesi

Table 4-9 Programs of Warehouse, 1982 (South Sulawesi Province)

Location	Level II		Level III	
	GBB	SP	GBB	SP
1. Panaikang	-	-	-	-
2. Polmas	-	2,000	-	3,000
3. Pare-Pare	4,000	2,000	10,500	20,000
4. Sidrap	-	14,000	7,000	14,000
5. Wajo	2,000	9,000	-	7,000
6. Bulukumba	1,000	5,000	-	-
7. Palopo	1,000	1,000	-	5,000
8. U. Pandang	-	3,000	1,000	3,000
Total	8,000	36,000	18,500	52,000

Source: DOLOG, S. Sulawesi

Storage capacity is at four levels, i.e., 1,000 tons, 2,000 tons, 3,500 tons and 5,000 tons. The storage capacity and number of buildings for each warehouse are matched with the required storage quantity in the route of distribution. The structure of a new warehouse recently built is prefabricated steel. Construction work for this warehouse was executed by an Indonesian contractor. The building is of a gable structure, the roof is finished with steel sheets, the lower part of walls is made of laid bricks and mortar finish and the upper part of the walls is finished with steel sheets. The floor is made of reinforced concrete and is elevated about 90 cm from the ground. Usually louver type panels are mounted on the gable side as ventilation holes, and the roof is not equipped with ventilators. No heat insulation materials are used on the back side of the roof, but the protected sections under the eaves are covered with wire nets for bird protection and entry of fresh air into the loft section is permitted. Doors for warehousing and shipment are made of iron and are a double opening type. Screen doors are provided inside of the iron doors.

As the storage standard of DOLOG, paddy is packed in 70 kg bags and milled rice is packed in 100 kg bags. It is usual that these bags are stacked in 20 to 25 layers in Tsugaru Method (5 bag make one layer) arrangement.

The storage period of milled rice is 4 to 6 months. Facilities and management of warehouses owned by DOLOG are relatively good. The principle of "first-in, frist-out" is relatively well observed, and chemical spraying and fumigation are periodically conducted.

As a result of large increases in production under the Lappo-Ase Project implemented in three districts including the Bone District, the product quantity far exceeded the storage capacity of DOLOG warehouses. Farms could not sell paddy to DOLOG and they temporally stacked paddy in the open yard covered with poly sheets. The total storage capacity in three districts in which the Lappo-Ase Project was implemented was 4 buildings, 3,000 tons before the project, but it is said that 6 warehouses, 6,000 tons (4,000 tons of which are temporary warehouses) were constructed after implementation of the project. As there is a possibility of crop increases again in the future, expansion of warehouse facilities will become necessary.

(4) South Kalimantan Province

Warehouses in South Kalimantan Province managed by DOLOG are divided into those owned by DOLOG and those leased from private companies and KUD. The storage capacity is as follows.

DOLOG Warehouse	19,500 ton
KUD and leased from private companies	17,100 ton
Total:	36,600 ton

Among these warehouses, four buildings are located in the port of Banjarmasin, which is a large consumer area in this province, and one building is located in Barabai. Medium size warehouses with two buildings are located in Barabai. Besides these buildings, four warehouses (storage capacity: 1,200 tons) leased from KUD and 23 warehouses (storage capacity: 15,900 tons) leased from private companies are used. Most of the KUD warehouses and private warehouses are old and the facilities and their locations are generally not good. Accordingly, DOLOG planned 24 warehouses and the following four buildings in Project has already started.

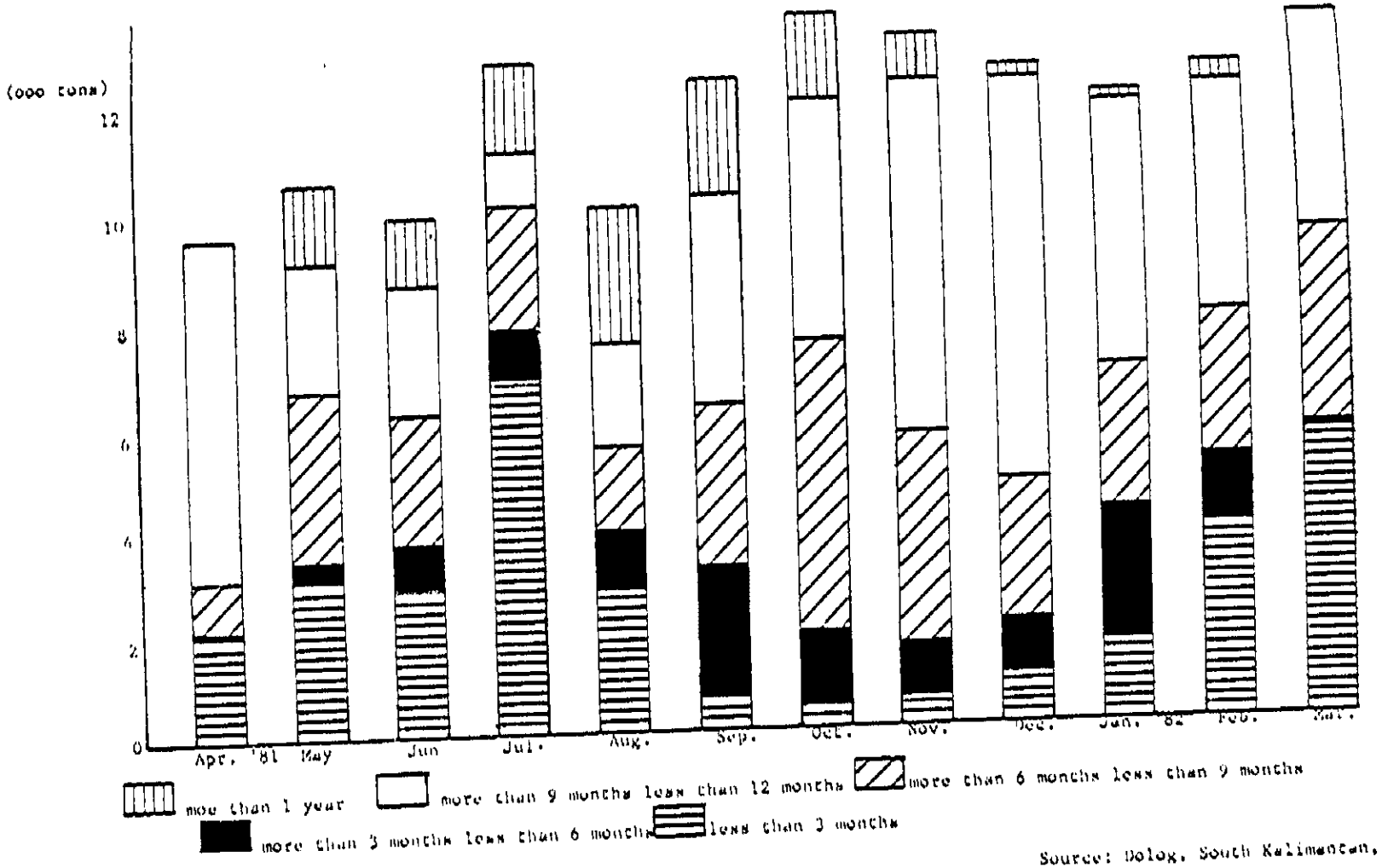
Banjarmasin	3,500 ton
Martarura	3,500 ton
Rantau	2,000 ton
Barabai	2,000 ton
Total:	11,000 ton

Warehouses owned by DOLOG are large in general. Moreover, piling is neatly done at these warehouses. Insect control activities (inspection and extermination) are also done periodically. Thus, storage management is generally good. What is mainly stored in these warehouses is paddy, and its mean storage period is relatively short, that is, 3 to 4 months. Monthly storage condition of milled rice is shown in Fig. 4-40-1.
period is relatively short, that is, 3 to 4 months. Monthly storage cond
of milled rice is shown in Fig.4-40-1.

As a point that requires attention in the building structure, floors of warehouses (BGG ANTASARI, 3,500 tons x 4 buildings) adjacent to part of Banjarmasin settled by 30~40 cm in the period of five years after construction due to low soil support. Some buildings are dangerous, and this settlement of floors has reached a stage that cannot be overlooked. There a fear that such settlement of soft ground may continue in the future at a rate of around 5 cm per year, and countermeasures are required as soon as possible.

The majority of warehouses of the commercial sector level were built as ancillary facilities for rice mills, and they are scattered in places of consumption and places of collection and distribution such as Banjarmasin and Barabai. Many of the warehouses in Banjarmasin are located along rivers.

These warehouses are old fashioned and the buildings are not more than temporary structures. Furthermore, storage management is insufficient, as the storage capacity is as small as around 300 tons on an average except for some warehouses belonging to big rice mills.



Source: Dolog, South Kalimantan, April 1982

Fig.4-41 Monthly Milled Rice Stock Condition in South Kalimantan

4-3 Transportation

Each one of the working processes which begins with reaping after harvest requires a logical means of transportation matched with the handling scale. That is, the object of transportation begins with stalk paddy cut on the field and terminates with rice milling for consumers in the final stage. The means of transportation selected for these varied stages are diversified from human power to trucks as matched with the transportation quantity.

4-3-1 Introduction

(1) Aceh Province

The estimated quantity of paddy and milled rice sold to the market from farms in this province is 116,000 tons, and a quantity that is equivalent to about 1.65 times this quantity, that is, about 191,000 tons, transported as paddy and milled rice. (See Table 4-5)

When this province is observed as classified by district, transportation is done from production districts such as Aceh Pidie District, Aceh Utara District and Aceh Selatan District to Aceh Tengah District, Aceh Besar District and Sabang District in the form of paddy or milled rice. The majority is done with trucks, and it appears that there is no problem in particular in terms of the number of trucks required for transportation of paddy and milled rice. It is packaged in gunny sacks and also because consolidation of trunk roads has made considerable progress, the loss during transportation is extremely small according to our observation.

(2) West Jawa Provicne

The estimated quantity of paddy and milled rice sold to the market from farms in this province is 2,529,000 tons, and a quantity that is equivalent to about 1.65 times this quantity, that is, about 4,173,000 tons, is transported as paddy and milled rice. (See Table 4-5)

Six districts (Bekasi, Karawang, Subang, Indramayu, Cirebon, Majalenka) in the northern plateau consitute a huge granary that produces about 60 ~ 70% or even more of the total production of rice in this province. Milled rice of about 2,000 tons is transported daily to Djakarta from this area. The total quantity is about 730,000 tons per year, and it is said that the annual consumption per capita of milled rice in Djakarta is about 112 kg.

Besides, over 200,000 tons per year in milled rice base is transported mainly as milled rice from the Bandung Plateau to three places of consumption, that is, Bandung, Bogar and Sukabumi.

The majority of the transportation described above in West Jawa Province also depends on trucks. Consolidation of trunk roads has made considerable progress in recent years and losses were extremely minor according to our observation.

(3) South Sulawesi Province

The estimated quantity of paddy and milled rice sold to the market from farms in this province is 500,000 tons, and the quantity that is equivalent to about 1.65 times this quantity, that is, 825,000 tons is transported as milled rice. (See Table 4-5)

Rice production in this province is the largest among outer Jawa, and excess rice is transferred from this province to other Sulawesi provinces in which production is insufficient and to large places of consumption on Jawa Island every year. As it is expected that the BIMAS/INMAS project will make further expansion in the future and that production increasing projects such as the Lappo Ase Project which was successful in the Bone area will be implemented in the future, it is anticipated that there will be further increases in the surplus of rice in the future.

There is a possibility of increases in excess rice by about 100,000 tons each in the future. Serious shortages of warehouses and problems in transportation occurred as a result of a rapid increase in production by implementation of the Lappo Ase Project. Inter-island tranportation from this province will be discussed elsewhere.

For transportation at the present time, only the trunk road between Ujunpandang and Parepare is relatively well consolidated, and it is considered that the loss caused by truck transportation is relatively minor.

(4) South Kalimantan Province

The estimated quantity of paddy and milled rice sold to the market from farms in this province is 257,000 tons, and a quantity that is equivalent to about 1.65 times this quantity, that is, 424,000 tons, is transported as paddy and milled rice. (See Table 4-5)

It is said that an area of over 500,000 ha which can be converted

into paddy fields are located in this province with a large swamp zone that extends to the basins of the Barito River and Negara River which run on the west side of this province toward the north. If development of these areas is undertaken in the future, handling of excess rice produced as a result will be greatly magnified as problems in storage and transportation.

Transportation at the present time is mainly dependent on rivers except for some areas in which trucks may be used, as this province extends with river zones as the nuclei. Accordingly, small size boats, which are inconvenient and cost more than trucks, are used for transportation, which is a large handicap due to geographical conditions. Even for land transport there are no good roads except for a national highway of over 200 km, which spans the provincial capital of Banjarmasin and Tanjung, and runs inland in a north - south direction along hilly ground.

The national highway that leads to the adjacent East Kalimantan Province along the coastline is also not completed, and it should be said that consolidation of roads for inland transportation is slow.

When the problem of transportation in this province is considered in the future, how to functionally combine river transportation with land transportation will be a major subject that will naturally require examination for this province in relation to the development of other industries, in order to reduce the cost of transportation.

4-3-2 KUD Level

(1) Aceh Province

Transportation from farms to KUD warehouses, rice mills and so forth is done by means of bicycles, motorcycles, small size trucks, etc. with paddy contained in bags made of coconut leaves, gunny sacks and so forth. The forms of transportation in 1972 were 51% by carrying poles, 43% by bicycles, 4% by hand carts and 2% by trucks. (I BRAHIM HASAN, RICE MARKETING IN ACEH

Transportation of paddy in gunny sacks (content: about 70 kg) and bags made of coconut leaves placed on bicycles and motorcycles was often observed. As these sacks and bags are well maintained, spillage of paddy was rarely observed. However, a load of 70 kg appeared to be too large and too heavy for a bicycle. Even when paddy is transported using trucks, it was observed that the maximum payload is exceeded to a considerable extent.

It is considered that the quantity of paddy sold by farms to KUD and

and KUD registered rice mills is over 61,000 tons. However, because there are situations where merchants purchase paddy from farms and sell it to KUD and where merchants purchase milled rice from KUD, it is considered that the actual quantity is larger.

The quantity of paddy purchased from farms by village collectors or small traders is estimated to be several times as much as the quantity of paddy supplied to people other than farms. The scale of these dealings can be estimated from the fact that ultra-small farms sell rice in their possession to merchants and buy milled rice as required from merchants again.

When merchants make direct purchase from farms, they usually use bicycles or small size trucks. The gunny sacks used on these occasions are well maintained second-hand gunny sacks, but cargo handling done by merchants is not as careful as that by farmers. Spillage of paddy due to breakage of mouth straps is occasionally observed and collapse of bags on trucks is also observed, but it is used to carefully recovered on each occasion by workers.

(2) West Java Province

Farms generally transport paddy by their own means to have paddy milled for their own consumption and for delivery to KUD. Second handed bags of fertilizers made of plastic sheets are used for such transportation, and bicycles and motorcycles are used as the means of transportation. Particularly for delivery of a crop in the rainy season, because of the fact that the harvest is in the January-February period of the heaviest rainfall, the paddy is put in bags made of plastic sheets in the state where foreign matter is mixed in without any processing such as drying and cleaning by the farms themselves, and in many cases where the entire quantity is sold to small traders and village collectors at pricess less than the government supported price. The paddy sold to these traders is brought into commercial rice mills where cleaning, drying and milling are done.

The quantity of paddy which is put into distribution channels by these commercial traders in the entire West Java Province at the present time is estimated as about 3,700,000 tons.

Transportation in this stage is done by bicycles, motorcycles and small size trucks and the crop is put in 70 kg plastic bags as already described. Cargo handling is done carefully in this stage, and losses are minor.

(3) South Sulawesi Province

Village merchants visit farms and directly purchase paddy immediately after threshing in most cases. There also are cases where farms bring paddy to traders using horses, small size trucks, etc. The transportation charges are 5 ∿ 10 PR/kg (within sub-districts), and horse rental is around 500 RP each way, which is rather high. Consolidations of the foudations for fields and roads are inferior in general and a suitable means of transportation is not available. Therefore, the transported quantity is minor and the cost is high.

Many of the KUDs do not have a means of transportation such as trucks and they even do not have subcontractors in some areas. Accordingly, KUD activities are limited by a lack of a proper means of transportation.

(4) South Kalimantan Province

The distribution channel from farms is about the same as that in other provinces with not much difference. 124 KUDs are in this province at the present time, and 102 of them are organized by rice production farms. There are many rivers in this province as already described and development of another means of transportation has been delayed. We had an impression that regional KUD activities are also resticed to a major extent by the presence of many rivers. Paddy prices at farms do not fall lower than the government's floor price throughout the year. It means that the the majority of distributed paddy is mainly local varieties with high marketability and the paddy shipped out of the farms is well dried and selected which gives it high added value. Therefore, the reality of the situation is that farms sell paddy to commercial traders at high prices rather than KUDs.

There also are cases, on the other hand, in which member commercial traders of KUDs purchase paddy from farms on behalf of KUDs, mill the paddy and sell milled rice to DOLOG.

In this case, the majority of the paddy was a HYV series sold at low prices. Distribution at the village level is such that village gathering traders purchase paddy, this paddy is gathereed by brokers having transportation means on both rivers and land, and is then delivered to rice traders

or rice mills located in places of consumption in towns.

The quantity transported at one time in this stage is small, cargo handling is done carefully and it was observed that the loss during transportation was minor.

4-3-3 DOLOG Level

(1) Aceh Province

KUDs supply all paddy or milled rice purchased by DOLOG. New bags are used for transportation between KUDs and DOLOG. Paddy is packed in 70 kg bags and milled rice is packed in 100 kg bags. As new bags are used, the loss caused by breakage of bags is minor compared to that at the farm level. The quantity of paddy or milled rice released for emergencies for budget groups such as military forces and government employees and for stabilization of market prices in the past ten years was about 20,000 tons at maximum per year. Milled rice of about 10,000 tons at maximum per year was supplied to government concerns including military forces.

Large size trucks of 5 tons to 10 tons are used for transportation at this level.

(2) West Jawa Province

New bags are used for transportation at this level like in other provinces, and the frequency of damage to bags is less compared to transportation at other levels. Trucks with a 5-ton capacity and 10-ton capacity are used for transportation. Although transportation is done with the maximum payload far exceeded, traders who specialize in transportation of rice participate in the transportation operations. Truck marshalling during cargo handling at warehouses requires time that is beyond expectations. A long waiting time at warehouses will probably become a transportation bottleneck in the future.

(3) South Sulawesi Province

The handling quantity of DOLOG in 1981/82 in this province was 179,620 tons in milled rice base (paddy 50,849 tons, milled rice 146,568 tons). Release of rice by DOLOG was 30,226 tons to military forces and government concerns, 220 tons for controlling the market and 150,742 tons

to be transferred outside of the privince; 181,188 tons in total. (Fiscal 1981/82) (See Table 4-10, 11)

Table 4-10 Procurement of Rice in Last 5 Years (South Sulawesi province)

Year	Paddy (ton)	Milled Rice (ton)	Equivalent Rice (ton)
1977/78	44.635	32.513	61.525
1978/79	11.815	78.075	85.755
1979/80	5.614	58.292	61.941
1980/81	14.263	108.961	118.232
1981/82	50.849	146.568	179.620

Source: DOLOG, S. Sulawesi

Table 4-11 Distribution of Rice in Last 5 Years (South Sulawesi province)

Year	Army/Officials (ton)	Market Operation (ton)	Inter-Province (ton)	Total (ton)
1977/78	19.603	3.073	66.701	89.467
1978/79	23.287	76	52.293	75.656
1979/80	17.925	16.925	60.455	94.830
1980/81	18.237	573	106.430	125.240
1981/82	30.226	220	150.742	181.188

Source: DOLOG, S. Sulawesi

It is estimated that the quantity of rice being surplus in this province is 988,000 tons or more of paddy. The range of distribution is limited due to the influence of self-sustaining agriculture, and the majority of paddy is milled at private rice mills. Retailing is made through gathering traders and brokers at local markets held a number of times per week. In town areas, rice (local varieties, improved varieties, imported rice, glutinous rice, etc.) is sold by retailers. Traders also perform shipping operations for milled rice to neighboring islands and even to remote areas such as Irian using small boats (around 5 - 20 tons).

Paddy and milled rice gathered by KUDs and some commercial traders carry milled rice to DOLOG warehouses using 2 - 5 ton trucks or larger vehicles. Transportation to DOLOG warehouses is sequentially made as the end of the harvest season draws near. Over 50 trucks form a line not only on the premises but also on the road to the warehouse. There are cases where trucks must wait two or three days before warehousing can be done and troubles occur between the warehouse and the truck drivers. It is considered that there are problems in the method of inspection of rice and also in the method of inspection of rice and also in the methods of warehousing and shipping. Efforts should be made to reduce such losses in transportation time through introduction of machines such as belt conveyors for stacking.

The gunny sacks used are new sacks supplied by BULOG. Packaging is firm enough, as guidance is made from DOLOG to sew the opening at least nine times using double gunny straps (seven times for small sacks). However, the weight of 100 kg per bag is too heavy, for manual handling.

(4) South Kalimantan Province

The quantity of rice distributed in this province is estimated at about 365,000 tons (dried paddy base), and excess rice of about 196,000 tons is transferred to other Kalimantan provinces mainly by small boats of 50 tons. These other Kalimantan provinces are a lot of undeveloped areas of mainly swamps and virgin forests, and only local varieties of low productivity are cultivated. As supply of rice is insufficient in these provinces, and these provinces are dependent on supply from many places in the country.

Rice from many places in the country is once unloaded at Banjarmasin, and is then transported over roads or on rivers.

Hand hooks are used for handling bags of rice transported over the sea from other provinces. As rough handling is made, spillage of a considerable amount is observed. It is necessary to introduce machinery for work requiring marshalling of a large quantity such as cargo handling at a port and to improve equipment and work for facilitating handling.

It is considered that the necessity for such improvement is particularly great for this province in which transportation by ships has a large share, as well as from the aspect of improvement of cargo handling efficiency.

The quantity purchased in 1979/80 remained at a low level of 255 tons of paddy because the government supported price was lower than the market price. In 1980/81, however, the accomplishment was 19,783 tons, which was close to the target value. Although the target value was 27,500 tons for 1981/82, the achievement was only 10,410 tons, as the market price was always above the government supported price as in 1979/80. (See Table 4-12)

Table 4-12 Actual Paddy Purchasing Record in Dolog, S. Kalimantan

Fiscal Year	K U D		NON-KUD		TOTAL
	ton	%	ton	%	(ton)
77/78	2,681.24	13.6	16,980.00	86.4	19,661.24
78/79	5,212.21	21.0	19,625.00	79.0	24,837.90
79/80	-	-	155.74	100.0	155.74
80/81	17,783.17	89.9	2,000.00	10.1	19,783.17
81/82	10,410.02	100.0	-	-	10,410.02

Source: DOLOG, S. Kalimantan

As seen in this table, the majority of rice distributed in the market is handled by the private sector, and a large quantity of milled rice is sold in markets of various areas with markets of major cities such as Banjarmasin, Martapura Amuntai, Kandangan, Barabai by numerous retailers on a small scale.

Although trucks are mainly used by DOLOG inside the province, problems occur for transportation particularly during the rainy seaosn because floods occur in swampy areas and the collapse and breakage of roads and bridges occur. Road conditions are not good in general with insufficient counter-measures against rain in the rainy season. Accordingly, use of large size trucks is difficult and trucks of 2 or 4 tons capacity are mainly used.

Small boats (10 ∿ 30 ton class) are used for transfer of rice from the basins of the Barito River and the Negara River for which no roads are available and also for transportation of rice to places of consumption in these basins from Banjarmasin. Infrastructure has not been consolidated for either land or ship transportation at the present time, and accordingly, the cost of ship transportation is high compared to land transportation. (See Tables 4-13, 14)

Table 4-13 Truck Fares in South Kalimantan

Distance	Fare (Rp/kg)
0 - 15 km	3
- 30	4
- 40	4.5
- 60	5
- 75	5.5
more than 75 km	6

Source: DOLOG, S. Kalimantan

Table 4-14 Fare of Shipping in South Kalimantan

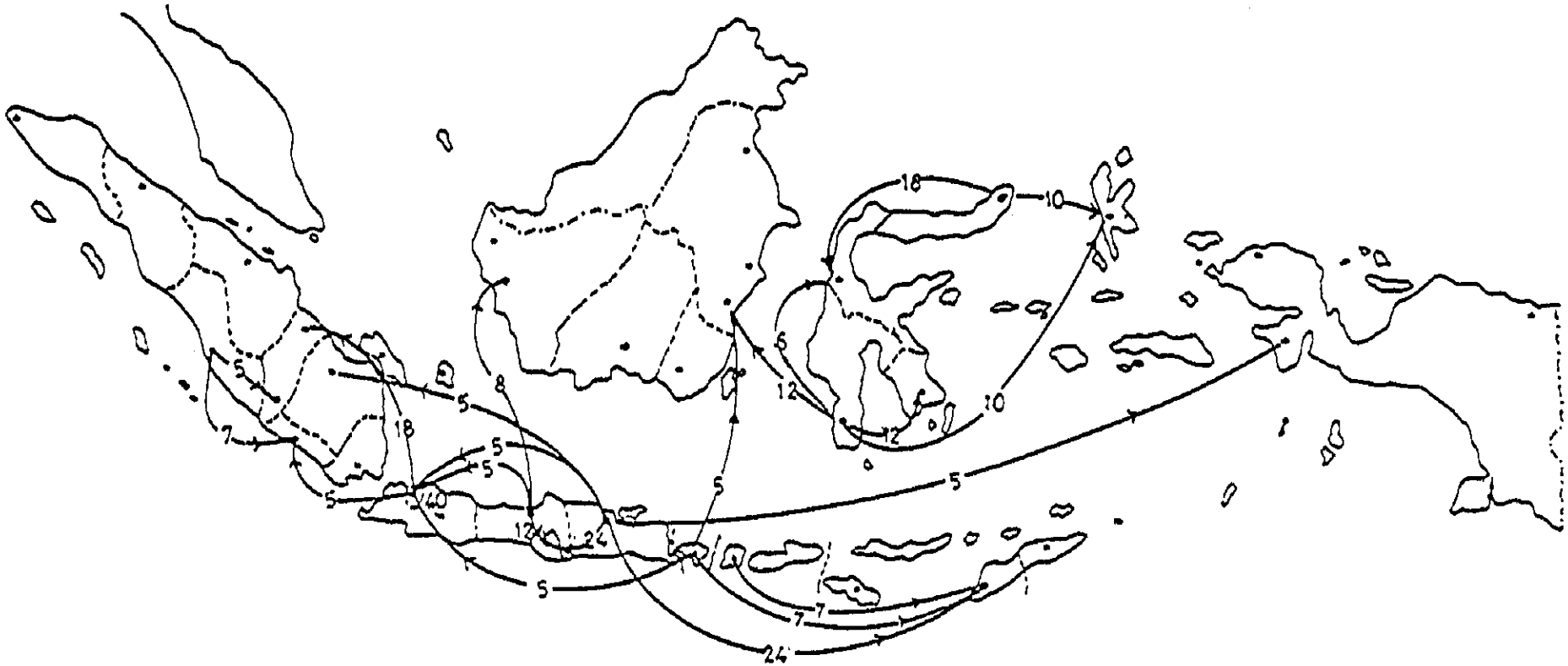
Destination		Distance	Fare (Rp/ton)
BANJARMASIN	⟶ Muarataweh	350 km	28,000
"	⟶ Buntok	220	28,000
"	⟶ Marabahan	40	13,200
"	⟶ Kualakapuas	40	13,200
"	⟶ Sanpai	500	35,000
"	⟶ Pangkalanbun	700	49,000

Source: DOLOG, S. Kalimantan

Penetration of imported trucks, which are excellent in durability and economy and the number of which is said to be over 3,000 in Banjarmasin alone, can be raised as a reason for these differences in the trucking.

4-3-4 Inter-Island Transportation

Inter-island transportation is mainly made for transfer of rice from the three major rice-producing areas - East Java Province, Bali Province and South Sulawesi Province - to provinces in which supply of rice is insufficient and for partial domestic transfer of imported rice. The transfer quantity was 750,000 - 800,000 tons in 1980/1981. Production at major producing areas largely grew in this year, and about 600,000 tons of rice from East Java Province, about 40,000 tons from Bali Province and about 80,000 tons from South Sulawesi Province were transferred to provinces in which supply of rice is insufficient. (See Tables 4-15, 16, 17, 18, 19; Fig. 4-10)



Source: Badan Urusan Logistik (BULOG)

- Figures on shipping lines refer to total annual shipment of rice in 000 tons.

Fig. 4-42 Major BULOG Inter-Provincial Shipment Channels, 1978

Table 4-15 BULOG Inter-Provincial Shipments, 1978

(ton)

From	To	Total
1. Jakarta	Jambi	18,075
	West Sumatera	3,200
	West Java	40,000
	West Kalimantan	2,950
	East Nusa Tenggara	500
	Bengkulu	5,000
2. Central Java	Yogyakarta	12,000
	West Kalimantan	7,550
	Jakarta	5,000
3. East Java	East Nusa Tenggara	24,025
	Jakarta	5,000
	East Timor	3,000
	Southeast Sulawesi	750
	Yogyakarta	24,000
	South Sumatera	5,000
	South Kalimantan	1,500
	Irian Java	5,400
	East Kalimantan	2,000
	Maluku	2,000
	West Nusa Tenggara	4,200
	Lampung	1,000
4. South Sumatera	Bengkulu	2,000
5. North Sumatera	Aceh	2,100
6. West Sumatera	Bengkulu	6,575
7. North Sulawesi	Maluku	10,500
	Central Sulawesi	18,500
8. South Sulawesi	West Kalimantan	3,000
	Southeast Sulawesi	12,435
	Central Sulawesi	6,000
	East Kalimantan	12,373
	Maluku	10,250
	East Nusa Tenggara	2,000
9. West Nusa Tenggara	East Nusa Tenggara	7,053
	East Timor	3,200
	East Kalimantan	2,500
10. Bali	West Nusa Tenggara	3,250
	East Nusa Tenggara	7,400
	East Timor	2,000
	South Sumatera	2,050
	East Kalimantan	4,863
	Jakarta	4,600
	Central Java	2,550
11. South Kalimantan	East Kalimantan	1,300
	Central Kalimantan	1,000

Source : Badan Urusan Logistik (BULOG)

Table 4-16 Private (Authorized by BULOG) Inter-Provincial Shipments, 1978

(ton)

Province of Origin	Provinces of Destination: North Sumatra	Riau	South Sumatra	West Kalimantan	South Kalimantan	East Kalimantan	East Jawa	North Sulawesi	South Sulawesi	Central Sulawesi	** N.T.B.	** N.T.T.	Maluku	* IRJA	Total
Jakarta		3,500	8,500	7,650									55	2	19,707
West Jawa		500	1,650	850											3,000
Cental Jawa		2,500	2,000	14,500				3,000							22,000
East Jawa	1,000		6,000	3,500	500	4,500		7,500	1,000	3,000	500	1,000	5,500	75	34,075
N.T.B.							1,000								1,000
Total	1,000	6,500	18,150	26,500	500	4,500	1,000	10,500	1,000	3,000	500	1,000	5,555	77	79,782

Notes : *) IRJA = Irian Jaya
**) N.T.B. = West Nusa Tenggara
**) N.T.T. = East Nusa Tenggara

Table 4-17 Estimated Quantity of Milled Rice Shipments by Various Modes 1978 (in 900 tons)

	Quantity	% of Production
1.Production (Q)	17,593	100
2. Estimate % not marketed (65% Q) 1)	11,439	65
3. Sea Transport - inter - island 2)	423	3
4. Rail Transport	93	3)
5. Other Land Transport	5,573	32
6. Imports	1,850	10.5

Sources : Production : CBS
Rail Transport : PJKA
Sea Transport : BULOG

1) Most of this was transported to the small mill for milling before consumption on the farm.

2) BULOG authorized shipments only. There also may have been some unauthorized shipments.

3) Less than 1%.

Table 4-18 Release Capacity of Some Ports for Food Logistic

Port	For inter islands	
	Average loading capacity/day (ton)	Average of shipment capacity (ton)
1. Aceh (Krueng Raya)	400	500 (to Meulaboh etc)
2. South Sumatra (Belawan)	600	1,000 (to Krueng Raya)
3. Riau (Dumai)	500	750 (to small islands)
4. West Sumatera (Teluk Bayur)	400	700 (to Bengkulu)
5. South Sumatera (Palembang)	500	750 (to Bengkulu, Bangka, Belitung)
6. Jakarta (Pasar Ikan)	6,000	1,000
7. Central Java (Semarang)	400	600
8. East Java (Surabaya)	600	2,000
(Meneng)	1,000	2,000
9. North Sulawesi (Bitung)	600	1,000
10. South Sulawesi (Pare-Pare)	1,000	1,500 (to Kendari, Ambon etc.)
(Ujung Pandang)	600	1,000 (to East Nusa Tenggara etc.)
11. Bali (Benoa)	750	1,000 (anywhere)
12. West Nusa Tenggara (Mataram)	500	500 (to islands East Nusa Tenggara)
13. East Nusa Tenggara (Kupang)	500	500 (- idem -)
14. Naluku (Ambon)	500	500 (to Tual etc.)
15. Irja (Jayapura)	200	500 (to Sorong etc.)

Source : BULOG.

The contracting condition for inter-island transportation is from DOLOG warehouses at points of loading to DOLOG warehouses at points of unloading. The tolerance is losses which occur during the transportation is 1.75%.

Consolidation and repletion of port facilities and cargo handling work are required for improving the efficiency of inter-island transportation. Transportation programs are planned so that extra month of stock is added to the minimum required stock volume at warehouses in places of insufficient supply on the unloading side, with delay of the transportation period usually taken into account. The result of investigation of actual conditions of transfer of rice at South Sulawesi Province and South Kalimantan Province to and from other provinces are described in the following.

(1) South Sulawesi Province

The excess rice which is the object of inter-island transportation in South Sulawesi Province was estimated at about 520,000 tons in 1980 and about 760,000 tons in 1981. There is a trend that the quantity of excess rice will increase in the future by promotion of food production increase projects such as the Lappo Ase Project. It is anticipated that the quantity of excess rice will reach a level of 1,000,000 tons in the near future, and it is considered that South Sulawesi Province will constantly become, together with East Java Province and Bali Province, a place that supplies rice to provinces with insufficient supply.

Accompanying such food production, consolidation and expansion of the distribution process, particularly road conditions in the province, storage facilities and cargo handling facilities at loading ports, will be required.

(2) South Kalimantan Province

The quantity of excess rice in South Kalimantan Province is estimated at about 140,000 tons in 1980 and about 120,000 tons in 1981, and this quantity of rice was transferred to provinces with insufficient supply.

Banjarmasin, the capital city of this province, is the place for gathering and transit. Four DOLOG warehouse buildings are located in Banjar port for this purpose, and their total storage capacity is 14,000 tons.

The quantity of import, transfer and loss of DOLOG in 1981/82 are as follows.

Table 4-19 Total Amount of Rice Shipping & Its Losses in S. Kalimantan 1981/82

Unit: ton

Paddy Production Area	Loading Wt.	Landing Wt.	Allowance	Losses
BALI	16,770,585	16,346,081	195,348 (1.2%)	229,156
EAST JAWA	7,134,791	7,004,889	67,963 (1.0%)	61,939

Note: Max. allowance is to be under 1.75%.

Source: DOLOG, S. Kalimantan

It is necessary to consolidate and expand rice distribution functions of South Kalimantan Province as in South Sulawesi Province.

4-4 Milling and Drying

4-4-1 Present Conditions

Situations related to rice milling made major changes in the economic and social environment which surrounds rice. These are the rapid growth of the economy, increase of population and rapid increase of food production by the introduction of high yield variety (HYV) in Indonesia in recent years.

To start from the introduction of small and high-efficient milling machineries Japan and other countries in early 1960, and under the support of the government, these machineries have been rapidly spread and increased. As a result, the hand pounding milling method at the farm level almost disappeared, and on the other hand, the functions of conventional large-scale mills were also hamstrung partially due to a change in the policy. Thus, penetration of rice milling machines played a revolutionary role in the distribution of the rice in Indonesia and also made a major contribution to reduction of milling losses.

Therefore, the interest on rice milling was raised in the all of Indonesia and rice milling machines of diversified kinds were imported from other countries over the past ten years and are used in the country. These machines are really diversified as they were introduced without clarification of criteria for selection. The situation is as if machines of this kind were gathered from all over the world and a historical display and demonstration were being made.

The present situation in Indonesia is that the most adequate rice milling machines and rice milling method are not yet determined, and it would not be exaggerating to say that in this transition a state of chaos in the stage of development is produced.

The approach to rice mills from the viewpoint of minimization of milling losses is known to a certain extent at the present time through surveys made by various agencies up to the present time.

Measures such as the prohibition of use of individual hullers of the ENGELBERG TYPE without rubber roller type huskers by Presidential Decree No. 122 were taken and major improvement was made by the enforcement of this decree. In reality, however, rice milling machines of this type still remain in a large quantity in the interior of Java Island and outside of Java.

For example, the fact that even when RUBBER ROLL TYPE HUSKERS are added, the basic defect of Engelberg type hullers as rice milling machines is not eliminated and losses in quantity and quality still remain is not necessarily well recognized.

Even if the loss occured by custom milling using Engelberg type whiteners is greatest at the farm level this most serious loss factor is not understood as a problem at the individual level. In the whole nation, however, because of the fact that 60 - 65% of all rice production is custom milled, prompt measures should be urgently taken from the viewpoint of reduction of losses caused by custom milling using Engelberg type whiteners.

Interest in improvement of rice quality has recently begun to grow in Indonesia, and quantities of paddy and milled rice are questioned at the present time when rice production is to a certain degree stable secured in quantity.

The tolerance in the broken rice content of milled rice of the highest rank purchased by the government agency BULOG is as high as 25%, and tolerances in contents of other defective grains are also high. The level is also low in the commercial value from the viewpoint of appearance of milled rice and differences from rice of other countries are large as international commodities, and conditions that permit competition in the international market do not exist.

In the free market in Indonesia, however, clear differences in price are established by rice quality, commercial value of milled rice and the percentage of broken rice and the quality level is higher in the free market compared to the government agency. However, in reality, quality standards or values are not yet established.

Even with low priced rice due to low quality, the quality can be improved through improvement of handling methods after harvest in most cases. This is a very important problem also from the viewpoint of minimization of quality losses.

As the milling stage is the final handling stage of rice after harvest, the means to be used for finishing rice as a commodity having higher commercial value determines the commercial value of rice. On the other hand, it is natural that methods of paddy handling before milling directly exert influence over the commercial value of milled rice. However, it can be said that the influence caused by inadequate drying and handling of paddy before milling is greater than the influence of the milling stage itself exerted over the commercial value of milled rice.

Regarding rice milling machines, a combination of single machines of rubber roll type huskers and blowing friction type whiteners, which appear to be almost fixed at the present time, is only a temporary measure for improvement and development of rice mills in Indonesia in the future.

4-4-2 General Condition on Rice Milling Machines

The system of rice milling in Indonesia before 1960 was classified into three kinds. One is manual pounding at the farm level, that is, paddy contained in a wooden mortar is pounded with a wooden pestle using hands or feet. The second is a huller type mill using a single Engelberg type huller at the local rice mill level. The third is a plant equipped with a European type multistage mill at the large-scale mill level for commercial milling. Small scale milling using Engelberg type hullers and large scale milling using European type multistage mills can also be observed in general in other South East Asian nations, and these rice mill systems have continued up to the present.

About 1960, introduction of a combination of a small size rubber roll type or flash (centrifugal) type husker and a blowing friction type whitener from Japan and other nations began in Indonesia. While an Engelberg huller processes white rice from paddy using a single machine, this combination produced milled rice of high recovery and high quality, as it separately processes brown rice from paddy and white rice from brown rice. This combination made rapid penetration particularly to custom mills, as it was possible to install equipment with relatively small capital investment. Farm gave up hand pounding, which has low recovery for the labor and with which only milled rice of low quality is obtained, and made use of services of custom mills as the milling fee decreased. These custom mills marched into the field of commercial milling as their business grew, and became the mainstream of the system of rice milling in Indonesia by expelling large-scale mills. It was a rather peculiar phenomenon which is not observed in other South East Asian nations.

Among paddy huskers centrifugal flash type huskers, which made penetration to a considerable extent in West Java Province at one time, gradually disappeared due to the reason that broken rice is excessive because of their defect in mechanical construction, and almost none are currently seen.

Paddy huskers of the rubber roll type are presently used as the mainstream in the whole nation.

As for rice whiteners, mills which used individual Engelberg type hullers added rubber roll type huskers and used Engelberg type hullers only as whiteners. Many rice mills employ this system even now.

On Jawa Island the number of Engelberg type hullers is extremely small at the present and blowing friction type whiteners are used at the majority of rice mills.

These machines which were first introduced from Japan were imitated in Taiwan, Indonesia and other countries and modified versions were imported. From a number of years ago, huskers made in China and whiteners made in Taiwan became very popular and their market shares increased. In the current situation, the number of machines imported from Japan on a commercial basis is very small except for those which are brought through government assistance.

The initial basic composition of a conventional large-scale mill, that is, European type rice mill, was the underrunner (emery disk) type husker, compartment type paddy separator and cone (conical emery) type whitener. Since introduction of rubber roll type huskers and blowing friction type whiteners, however, emery type huskers were replaced by rubber roll type huskers due to various reasons such as adjustment is troublesome and the broken rice generation rate is large in particular. Also, cone type whiteners were replaced by blowing friction type whiteners which do not require special techniques, as frequent adjustment because of wear to rubber brakes as well as servicing of emery were troublesome.

Because of the policy of banks in the 1970's and also by the pressure caused by the flooding of small-scale mills, the majority of conventional large-scale mills lost their functions as rice mills and many have suspended business. Among rice mills which are managed and operated by different businesses, however, there are mills which were positively improved and are equipped with almost satisfactory facilities.

Various small, medium and large machines have been introduced from Japan as rice milling units including those with government assistance since 1970. But they were not necessarily what matched actual needs, and many are still used now without machine performance fully exhibited for their expenses. In the current situation, rice milling units of same type have not been continually imported since that time.

4-4-3 Milling Machines

Rice milling machines of almost every type available in the world are in Indonesia at the present time.

Of this equipment, important machines for rice milling are paddy huskers, rice whiteners and paddy separators located between paddy huskers and rice whiteners. Differences in the performance of individual machines exert a major influence over losses in the milling stage.

As an emphasis was laid on the type and combination of machines during the study made this time, the structure, functions and background of the machines in Indonesia were analyzed. An outline is presented in the follow

(1) Manual Pounding

Manual pounding is a method in which paddy is placed in a wooden mortar and is pounded for a long time using a hand-held pestle or a foot-activated pestle on a farm to obtain milled rice for home consumption from paddy.

The milled rice obtained from this considerable labor is of uneven milling with excessive bran sticking and low appearance. With the high yielding variety in particular, the broken rice content is large and only milled rice of extremely low milling recovery is obtained.

Almost no manual pounding is currently observed because of the penetration of machine milling. The milling fee paid to rice mills by farms for custom milling of rice for home consumption is 6 - 10% of the obtained milled rice. This figure is considered to indicate that farms have judged that custom milling is more advantageous than manual pounding milling from the standpoints of milled rice recovery, difference in quality and labor.

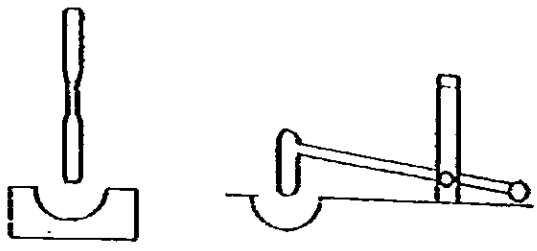


Fig. 4-43 Manual Pounding

(2) Engelberg Type Huller

The Engelberg type huller performs milling in a high pressure milling chamber by stirring and friction. It is the origin of all friction type whiteners.

This machine is of a structure in which the pressure in the interior is increased causing the rice kernels to moderately stay inside the chamber while adjusting the opening degrees of the feeding gate and discharging gate. Then, the husk and bran layers on surfaces are torn off and eliminated with a screen allowing rice kernels to pass through the gaps between the rotating stirring roll and the knife projecting toward the interior from stationary part. Finally, the milled rice is exhausted through the exhausting gate.

It was originally developed for peeling off coffee bean shells and was then modified for application to rice. Because of the simple structure and functions, it has until recently been widely used not only in Indonesia but throughout all of South East Asia as a huller in small scale mills.

This machine has a section with a knife that applies portional pressure to the rice and produces broken rice, and the basic structure of its milling chamber involves problems. Furthermore, adjustment of the machine must be made within a short time after the start of milling at three places: the feeding gate, exhausting gate and knife. Therefore, it is extremely difficult to get the machine to perform consistantly even for an experienced operator, and this is its largest problem. There are some mills at which the machines are used with the knives replaced by rubber additions such as old tires among other modifications, but such measures are not fundamental solutions to the problems.

operation is well matched with rice conditions. However, the milling recovery decreases extremely if conditions and method of operation are unsuitable to even a minor extent, and the difference may be as large as 5%. There are cases in which paddy remains in the milled rice, and it is common that excessive milling is done to obtain a uniform milling degree. Low milling recovery and generation of broken rice increase as a result. Although milling can be made twice and a relatively high milling recovery can be obtained with the local variety, high milling recovery cannot be expected with the high yielding variety. At any rate, the milled rice is of low commercial value because of bran stuck to the surface and due to uneven milling. In this present situation, rice milled with Engelberg type hullers is not generally appreciated as a white rice commodity in Indonesia today.

Because of the enforcement of Presidential Decree No. 122, individual use of these machines should be discontinued within the near future.

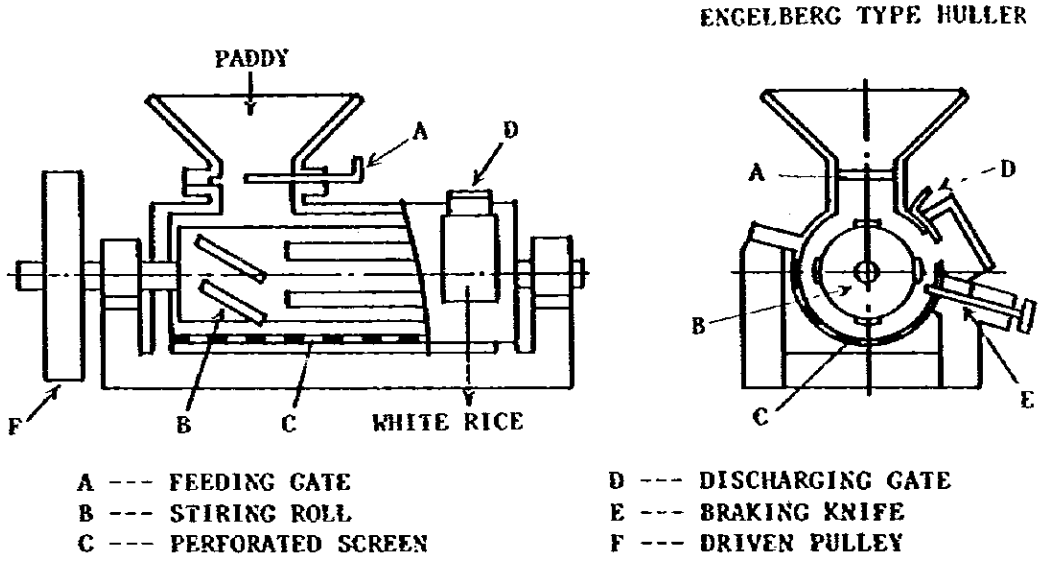


Fig. 4-44 Engelberg Type Huller

(3) Rubber Roll Type Husker

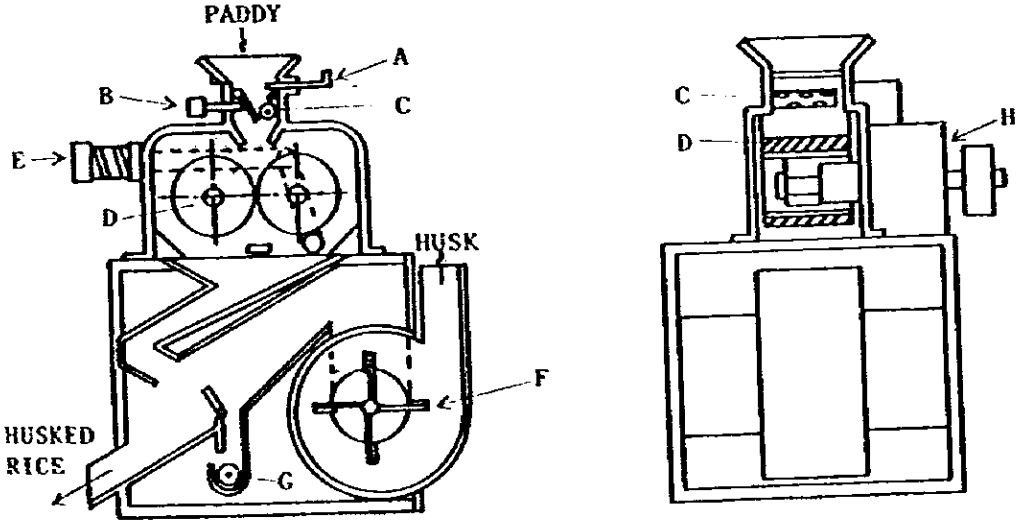
The rubber roll husker is a structure in which husk is removed from paddy by the pressure and hull during kernels is passing through between contacting rubber rolls which rotate in opposite directions at different peripheral speeds. Recently, the machine is combined with an aspirator to blowing the husk away. This machine, which was developed in Japan and penetrated the Japanese market, was introduced in Indonesia in the 1950's.

Although it was not popular at the beginning because of the short life of the rubber rolls, it was recognized later that the cost for replacement or rubber rolls was fully compensated by the low broken rice content and high milling recovery. Another reason that permitted major penetration of this machine is that it almost always exhibits the expected performance because of the elasticity of rubber even when it is operated by an inexperienced operator.

Even with rubber roll consumption, husking efficiency was improved by the development of synthetic rubber and also by research and development made by manufacturers. Durability was improved and it has become possible to produce them locally with a reduction in price. These factors also helped the penetration of the rubber roll type huskers.

This rubber roll type husker forms the mainstream of paddy huskers in rice-growing nations in the world today. Rubber roll type huskers imported from Japan in the initial stage were the 6 inch type with husk aspirators. Those made in China, which have been in use since a number of years ago, are also of the 6 inch type. This type has the largest penetration rate and all manufacturers use interchangeable rubber rolls of a common size. This factor also contributed to the penetration of these machines.

With a single passing of paddy through this machine, only 70 - 80% of the paddy becomes brown rice. There are many cases, therefore, where a paddy eliminating separator is jointly used or the husking ratio is increased by passing the paddy causing the paddy to pass through the paddy husker twice in order to reduce the burden on the rice whitener.



A --- FEEDING GATE
B --- FEED CONTROL VALVE
C --- FEEDING ROLL
D --- RUBBER ROLL
E --- ROLL ADJUSTING MECHANIZM
F --- HUSK BLOWING FAN
G --- IMMATURED GRAIN OUTLET
H --- DRIVEN PULLEY

Fig. 4-45 Rubber Roll Type Husker

(4) Flash (centrifugal) Type Husker

The flash (centrifugal) type husker is of such a simple structure that paddy is thrown out from the center portion of an impeller that rotates at high speed. Then, the husk is broken off due to the impact of collision against the rubber ring in the circular portion.

This machine was also developed in Japan after the rubber roll type husker, and it is still used today to a small extent.

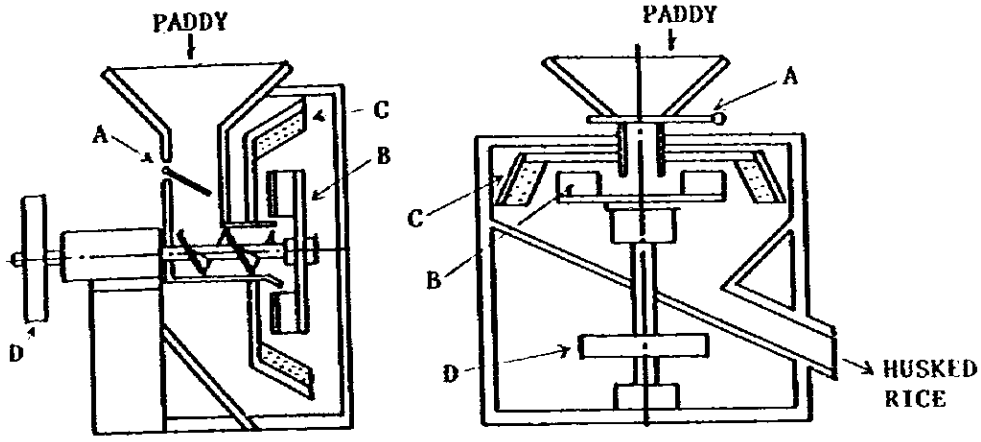
This machine penetrated Indonesia with West Java Province as the nucleus to a degree that is not observed in other nations and was used until recently. However, very few of these machines can be observed today because of the penetration of rubber roll type huskers.

It is said that the large broken rice content and resultant low milling recovery are reasons why the use of this machine was discontinued. But problems lie in the incomplete technical structure of this machine.

First of all, if cleaning of paddy is incomplete, paddy hardly enters the machine through the inlet and the inflow is unstable. Besides, throw-out from the impeller is not equal over the entire circumference and accordingly the husking action is not positively applied, the shape of the rubber ring changes as it wears, and the husking action becomes even worse. Furthermore, the machine is used with increased revolutions because the amount of left-over rice is large, and generation of broken rice increases as a result.

When changeover from local variety to high yielding variety is made and if the paddy is insufficiently dried or contains a large amount of cracked rice, broken rice is easily produced in this stage. When a comparison is made with a rubber roll type husker as used for brown rice, a clear difference appears in the broken rice ratio. However, since there is no brown rice market, the difference in the white rice is rather small because the cracked rice which does not become broken rice using a rubber roll type husker becomes broken rice due to the pressure in the interior of a whitener.

It is unfortunate this centrifugal type husker of a simple construction with only one shaft is discarded due to the circumstances of the past. This should be one of subjects of study for improvement in the future.



A --- FEEDING GATE
B --- IMPELLER
C --- RUBBER RING
D --- DRIVEN PULLEY

Fig. 4-46 Flash (Centrifugal) Type Husker

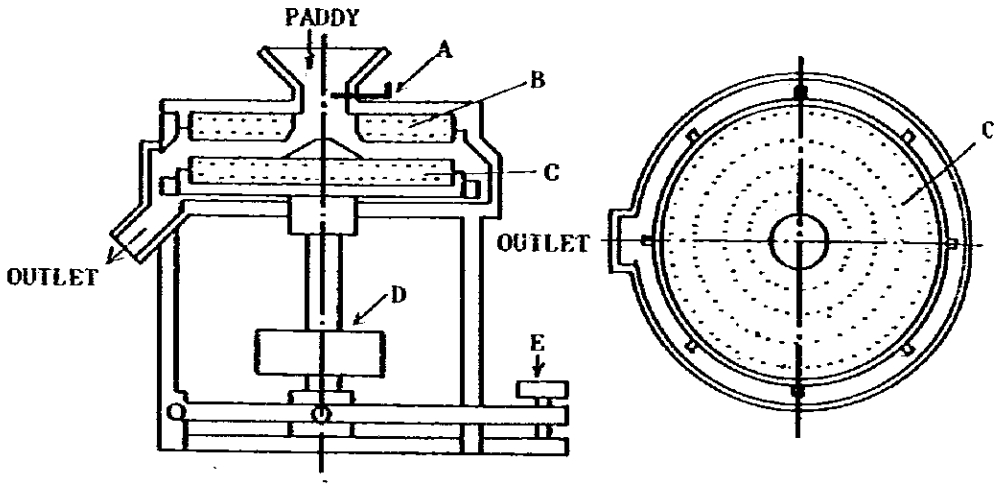
(5) Underrunner (emery disk) Type Husker

The underrunner (emery disk) type husker is a stone mill type husker. The construction is such that only the lower of two disk type emery stones rotates. The fed paddy is husked while it passes through the gap between the two emery stones from the upper center portion and is then discharged toward the circumference.

Huskers of this type were used for a long time until rubber roll huskers were introduced. Although their remains are observed in Indonesia at large scale rice mills, it appears that none of them are in operation today.

Although it is advantageous that, forming and bonding of emery stones can be made in the field using magnesia cement and emery grains and that these emery stones are durable, it is hard to keep the clearance between emery stones fixed at all times. Thereby, broken rice is produced when rice kernels pass through this uneven clearance. The large generation of broken rice is an important characteristics. As such broken rice is cracked during whitening and is lost together with bran, it is considered that the milling recovery of an underrunner (emery disk) type husker is lower by about 5% compared to that of a rubber roll type husker.

Furthermore, the machine requires delicate adjustment, experience is required in its maintenance and the husking ratio is low. Therefore, this machine is destined to naturally disappear with appearance of rubber roll type huskers.



A --- FEEDING GATE
B --- EMERY STONE (STATIONARY)
C --- EMERY STONE (ROTATING)
D --- DRIVEN PULLEY
E --- CLEARANCE ADJUSTMENT DE

Fig. 4-47 Under Runner (Emery Disk) Type Husker

(6) Screen Type Paddy Separator

The screen type paddy separator is the most primary paddy cleaner. It separates brown rice by passing it through the openings in wire mesh by making use of the fact that paddy gathers in the upper layer and brown rice gathers in the lower layer because of the difference in friction between paddy and brown rice. A mixture of paddy and brown rice is caused to flow over inclined wire screens.

Multi-layer wire screens of three to five layers are used and the wire mesh is reduced from the upper to lower layers. Despite the use of wire mesh rice passes in layers over the inclined screen surfaces and some paddy slides down the screens without passing through the wire mesh. The majority of the part which slide down over the top screen is paddy and it is fed to the paddy husker. The mixture of paddy and brown rice which slides down over the second screen and subsequent screens is further separated, and only the kernels which

passed through the wire mesh of the bottom screen is fed to the rice whitener as brown rice.

This separation method was used for a long time as auxiliary equipment since rubber roll type huskers were developed in Japan. They still remain at the present for small size farms.

Of the surveyed areas, it was found that many of these separators are used in West Java Province but all of them are close to homemade machines. Because of the fact that equal downflow from the hopper does not occur and rice does not form required separation layers even in the second screen and subsequent screens, paddy of a considerable volume still remains in the brown rice unless the husking ratio of the paddy husker is good. In the case of the IR varieties, the paddy husker is used for double passing in general, and it is effective for improving the capacity of the mill and the milling recovery.

Separation of long grains is more difficult than short grains by this method, and there is a room for further improvement in the basic structure. Although its cost may be low, this method based on the precondition of human power tactics has a problem for building in a rice mill in the future.

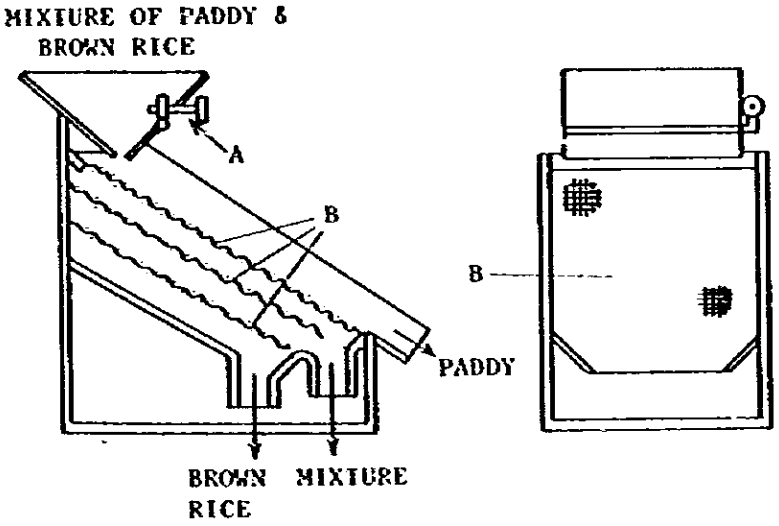


Fig. 4-48 Screen Type Paddy Separator

(7) Compartment Type Paddy Separator

The compartment type paddy separator is an oscillating separation machine that makes use of differences between paddy and brown rice in friction, specific gravity, size and elasticity.

A rice flow channel is formed by combining numerous walls of triangle shape. When horizontal oscillation is applied, brown rice moves toward lower part of the inclination while sinking to the lower layer, and paddy moves to the upper part of inclination as largely affected by oscillation and also by the angle of reflection by the wall while floating to the upper layer. Thus separation of paddy and brown rice is accomplished. The capacity and size of the machine are determined by the number of compartments in this flow channel.

It is a main function of European type rice mill equipment, and is still operated at so called large-scale rice mills in Indonesia. It is always used at a large-scale rice mills in main rice-producing nations throughout the world except for Japan, and its performance is recognized worldwide.

The body is made of wood and the interior is lined with sheet metal. As the construction permits local production with relative ease, machines made in Indonesia are sufficiently fulfilling their functions. However, the machine size is large and a large floor space is required for its installation. A solid foundation that withstands vibrations is also required. Furthermore, as the number of compartments is nearly ten, experience is required for adjustment of distribution to these compartments, inclination and revolution. The machine is not adequate for small lot production because of rice remaining in the compartments. These points are the problems of this separator to be solved in the future.

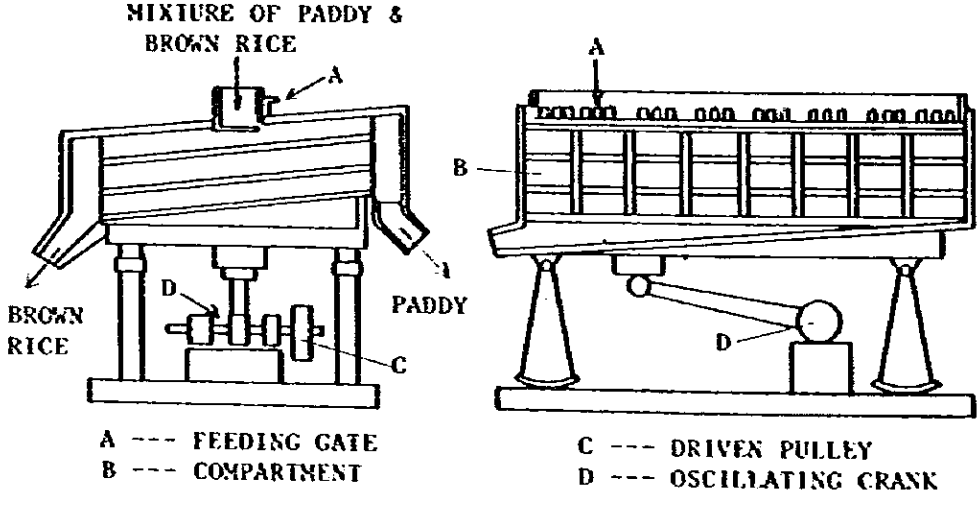


Fig. 4-49 Compartment Type Paddy Separator

(6) Tray (oscillator) Type Paddy Separator

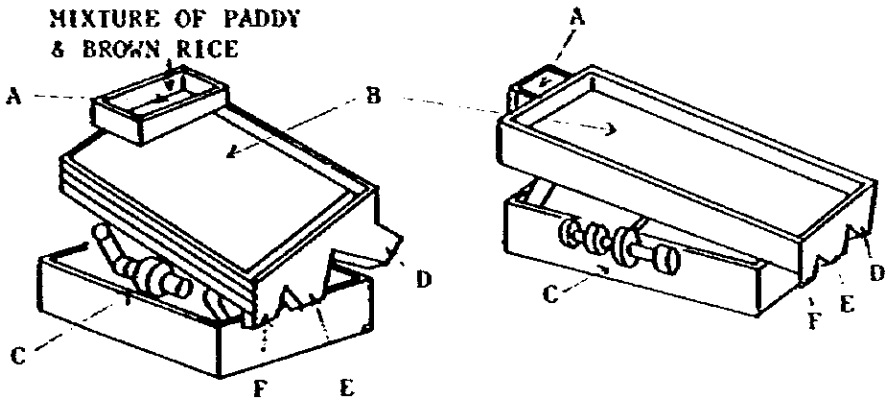
This separator is also an oscillating separation machine that makes use of differences between paddy and brown rice in friction, specific gravity and size.

A separating plane tray having numerous projections or indentations is tilted back and forth and right and left and is then moved up and down and diagonally. The mixture of paddy and brown rice which was supplied to the upper portion flows downward while interfering with each other. In the meantime, paddy and brown rice are segregated and discharged and separated into three kinds, that is, brown rice, mixture and paddy by means of the separating plate.

This separator was developed about 20 years ago by a Japanese manufacturer who experienced difficulty with separation of long grains with screen type paddy separators. It is a main component of every rice mill unit made in Japan. Paddy selection in Japan is currently about to be switched to this system.

The construction is relatively simple and permits adjustment of the inclination angle and separating plate while adjusting to selecting conditions. It also provides the advantage of requiring a small floor space for installation.

Although the machine price is high at the present, it is desired that this machine will be widely used in the future through cost reduction by rationalization of manufacturing processes.



A --- DISTRIBUTOR
B --- INDENTED TRAY
C --- OSCILLATING CRANK
D --- BROWN RICE OUTLET
E --- MIXTURE OUTLET
F --- PADDY OUTLET

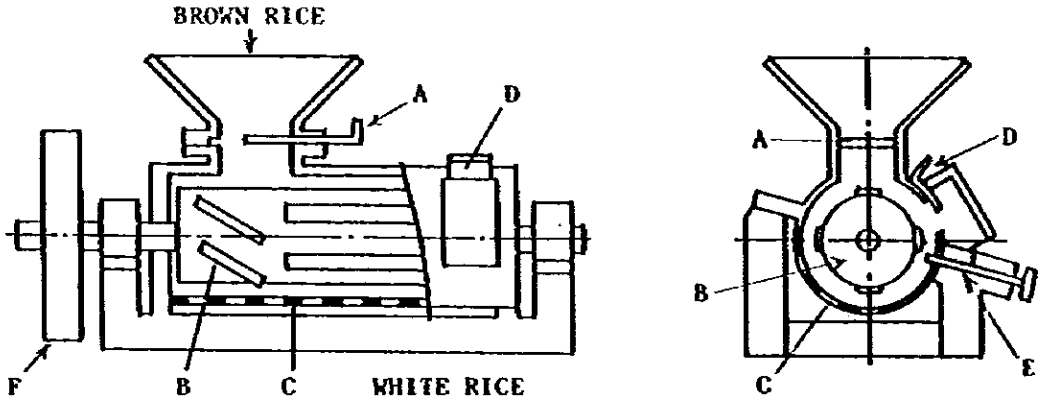
Fig. 4-50 Tray (Oscillation) Type Paddy Separator

(9) Engelberg Type Whitener

The Engelberg type whitener is built with a rubber roll type husker as in the prestage for production of brown rice from paddy before an Engelberg type huller. This Engelberg type huller is used, without any structural, modification, as an exclusive whitener for production of white rice from brown rice.

Compared to direct production of white rice from paddy, the milling recovery is improved to a considerable extent and broken rice is reduced because high pressure is not applied.

Compared to the blowing friction type whitener to be described later, however, the white rice quality is inferior and milling recovery and broken rice are also inferior. It is same as that of the Engelberg type huller described earlier in that adjustment of feeding gate, discharging gate and knife is difficult. It is considered that Engelberg type whiteners will in time disappear from Indonesia.



A --- FEEDING GATE
B --- STIRING ROLL
C --- PERFORATED SCREEN
D --- DISCHARGING GATE
E --- BRAKING KNIFE
F --- DRIVEN PULLEY

Fig. 4-51 Engelberg Type Whitener

(10) Cone (conical emery) Type Whitener

The cone (conical emery) type whitener is an abrasive type rice whitener using a vertical reversed conical emery stone.

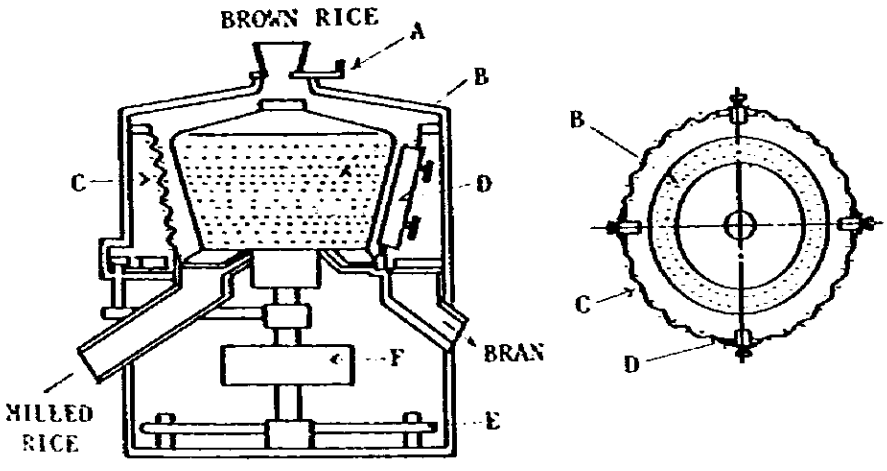
Brown rice , which fall downward through the gap between the reversed conical emery stone mounted on a rotating vertical shaft and the screen with a rubber brake mounted on the stationary portion along the circumference, are whitened while being temporarily held in the whitening chamber. This process makes use of the floating action up to the angle of reflection against the screen caused by the reversed cone.

Although two or three units of this machine were used in Indonesia in a system as main whitening machines of large-scale rice mills, many of them were replaced by blowing fricting type whiteners.

Emery stones can be formed in the rice mill as alumdum with grade mesh around 18 and can be bonded at normal temperatures using magnesia cement. However, considerable experience and technique are required for forming emery stones. We were told that it has recently become difficult to obtain materials for emery stones and consumables such as rubber brakes and screen.

Experience and special techniques are required for operation and adjustment such as adjustment of clearance between the conical emery stone and rubber brake. Overmilling and generation of broken rice will result if any error is made in the operation such as adjustment of the machine.

Because this machine can not be handled by an amateur in both machine adjustment and operation, it is considered that the machine has no future. However, the basic function of a vertical type is logical for whitening, and there is a room for improvement of its construction in the future.



A --- FEEDING GATE
B --- EMERY STONE
C --- SCREEN
D --- RUBBER BRAKE
E --- CLEARANCE ADJUSTMENT
F --- DRIVEN PULLEY

Fig. 4-52 Cone (Conical Emery) Type Whitener

(11) Blowing Friction Type Whitener

This whitener is basically what was produced by major modification to Engelberg type hullers. Bran layers are torn out of rice grains in the whitening chamber by high pressure stirring and friction. The bran is removed by blown air from the interior and thus paddy become clean white rice.

Rotating screw and stirring roll are located in the interior of the horizontal whitening chamber. This rotating screw and stirring roll are surrounded by hexagonal or octagonal shaped screen. Air blow from the blo is made from the stirring roll through the shaft to pass through the scree mesh to prevent rise of grain temperature. This eliminates the sticking o bran to rice surfaces so that glossy white rice is produced. The discharg gate is constructed to permit easy adjustment of the pressure to the whiten ing chamber by means of a weight or a spring so that rapid pressure varia- tion will not occur.

This machine was developed in Japan about 30 years ago and is now wid spread throughout Indonesia in combination with the rubber roll type husk It has become the mainstream of rice whitening machines. The type that is widely used in Indonesia at the present is what was wide spread throughout Japan in the latter half of the 1950's. The circulating type of machine that produces white rice by repeatedly whitening four to five times is use as the model. Its improved model with modification to the screen portion is currently being used in Indonesia.

The general specifications are that the flow rate is reduced and whit rice finishing is made by one or two whitening cycles when whitening of lo grains is made with this machine in a tropical area. Even if mechanical ef ciency is low and temperature rise high, generation of broken rice is mini milling yield is high, glossy look to the white rice is obtained and the commercial value of white rice is high. The current situation is that this machine is widely used everywhere in the world based on recognition of thes advantages.

Rice whitening machines of this type produced by various manufacturers are currently used in Indonesia, but it appears that they are used in an unnatural condition. Particularly because of application of excessive pressure to brittle grains such as the I.R. varieties, generation of broken rice is large and likewise the milling recovery drops.

Even when the flow rate is increased, the result is better in both milling yield and generation of broken rice at rice mills in which whiteners are used in system or double passing is made in the same machines, compared to the result at rice mills where ringle passing is made. Uneven milling is also minor and white rice of high quality is obtained as the whole.

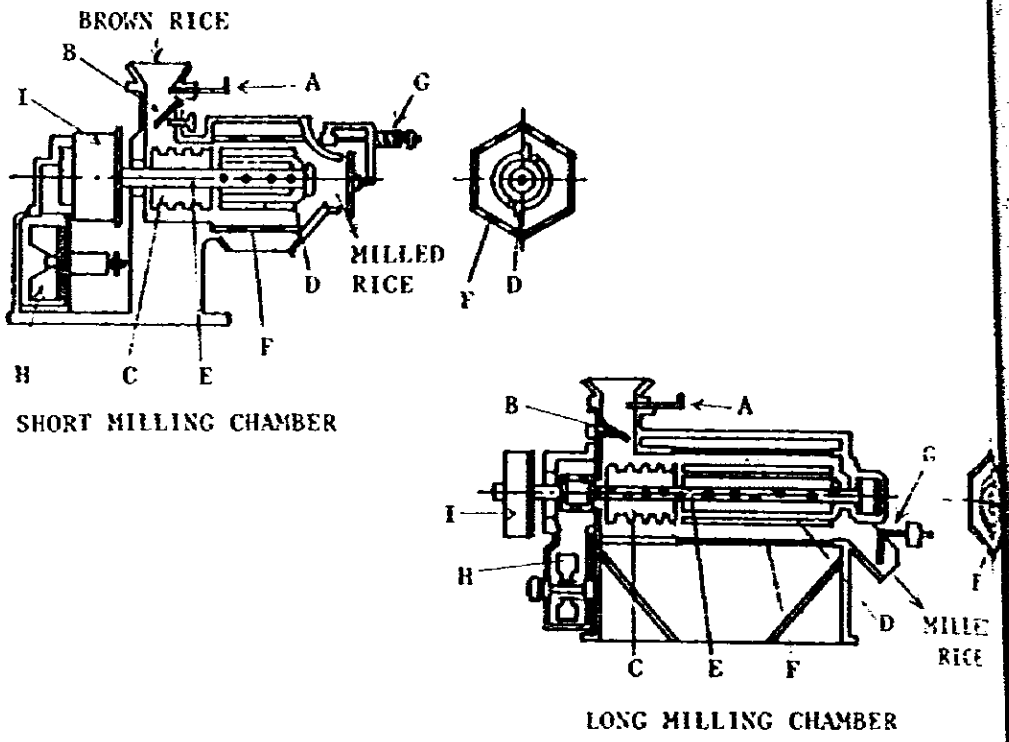
About 1/2 of the indicated capacity is the suitable capacity level for whitening of rice of the I.R. variety.

The whitening chambers of rice whiteners produced by Japanese manufacturers are longer than conventional chambers by 50 - 70%, as many of them were designed to match the single pass operation. Even when these rice whiteners are used, the capacity to be used for whitening the I.R. variety should be 1/2 - 2/3 of the indicated capacity.

The standard for estimation of the basic capacity of a rice whitener of this type is the milling roll surface area (L x Dπ) or the screen surface area (L x Dπ) and the required horse power. The structure of the whitening chamber varies by manufacturer, but it is considered advantageous also in the aspects of the gloss appearance of white rice and commercial value of white rice if the surface area of the screen is large compared to the capacity, the clearance to the milling roll is not extreme and if the pressure applied to the rice can be considerably reduced for application to the I.R. varieties of Indonesia.

One of reasons why rice whiteners made in Taiwan are popular here is that screens, which are consumables, are of simple construction to permit production even by local iron workshops.

Rice whitening machines of this type should be studied more in the future and should be modified to a construction suitable to the realities of Indonesia and to permit application of the I.R. variety.



A --- FEEDING SHUTTER
B --- FEED ADJUST VALVE
C --- SCREW ROLL
D --- MILLING ROLL
E --- HOLLOW SHAFT
F --- PERFORATED SCREEN
G --- PRESSURE WEIGHT
H --- BLOWER
I --- DRIVEN PULLEY

Fig. 4-53 Blowing Friction Type Whitener

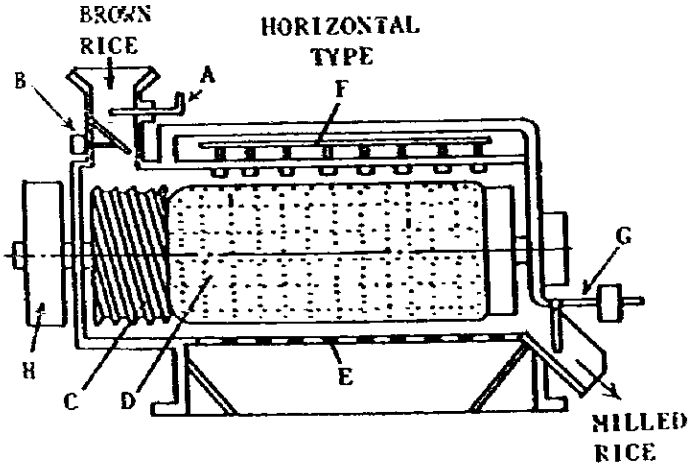
(12) Abrasive Type Whitener

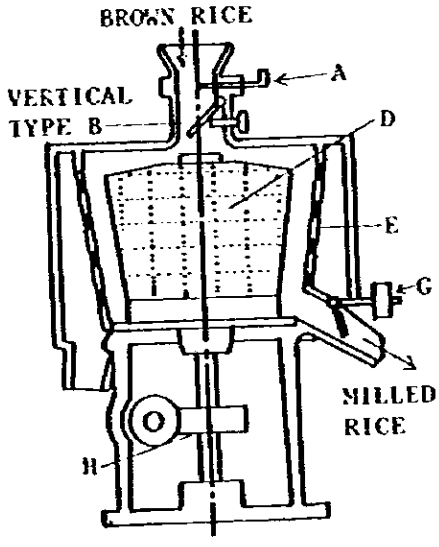
The abrasive type whitener is a system in which bran layers are scraped off from surfaces of brown rice with an emery stone.

A cylindrical emery stone is surrounded by a cylindrical perforated screen, and the rice discharge outlet is equipped with a pressing plate for regulating the internal pressure. The emery stone uses carborundum emery grains. They are sharp and the degree of their hardness is high. Fine grits #30 - #60 grits is used. As they were baked at about 1,400°C, the bonding stress is high and the emery stone may be used for a long time, but local repair cannot be made.

Abrasive type whiteners have been used for sake brewery's factories in which starch layers are deeply ground down and also for the beginning stage of ordinary whitening in Japan. As it is possible to grind off surface layers under low pressure of internally brittle rice produced in tropical areas, whitening may be performed with generation of broken rice kept at minimum. However, because of the fact that bran layers and start layers are ground off without distinction, there is a fear that over-milling is made and the milling recovery drops if they are used up to the white rice stage. Accordingly, they are used for only the beginning stage in many cases. There also are cases where numerous scratches are produced on rice surfaces because every grains are too sharp, and although the apparent whiteness increases, inferior gloss is produced and the commercial value as white rice is inferior.

Abrasive type whiteners are available in either horizontal or vertical types. Many of them used in Indonesia today were brought from Japan as components of rice milling units. But some of them have problems in price, supply of spare parts, operation and also in the commercial value of white rice in the current white rice market in Indonesia.



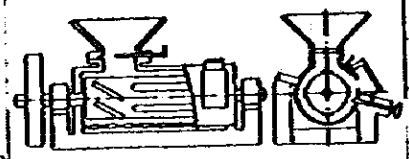
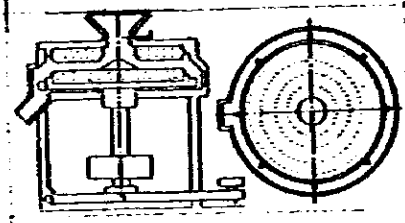
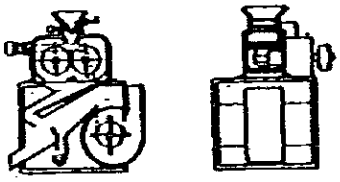
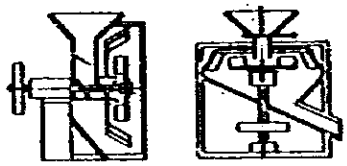


A --- FEEDING SHUTTER
B --- FEED ADJUST VALVE
C --- SCREW ROLL
D --- ABRASIVE STONE
E --- PERFORATED SCREEN
F --- RESISTING BAR
G --- PRESSURE WEIGHT
H --- DRIVEN PULLEY

Fig. 4-54 Abrasive Type Whitener

Table 4-20 Worldwide Vicissitude of Milling Facilities Used in ...

(1) Paddy Husker

No.	Type	Figure	Area	Popular → Some ⇢ (1900 '20 '40 '60)
1	Engelberg Huller (Paddy White rice)		Asia	
			Japan	
			America	
			Europe	
2	Under Runner		Asia	
			Japan	
			America	
			Europe	
3	Rubber Roll		Asia	
			Japan	
			America	
			Europe	
4	Flash		Asia	
			Japan	
			America	
			Europe	

Paddy Separator

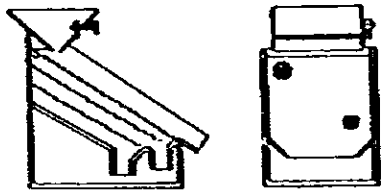
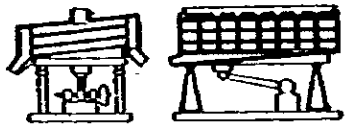
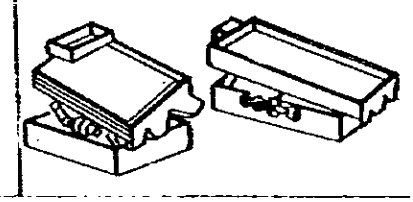
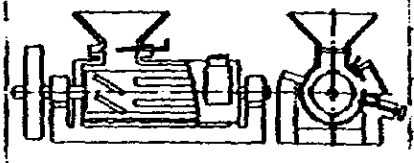
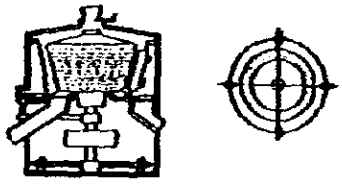
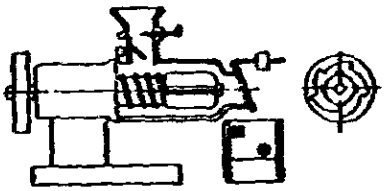
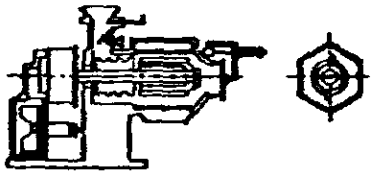
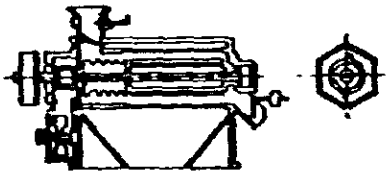
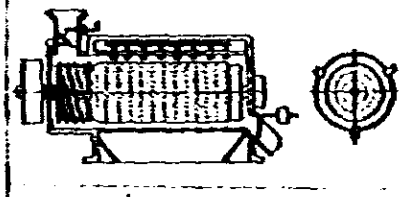
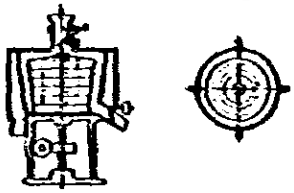
5	Screen		Asia	
			Japan	
			America	
			Europe	
6	Compartment		Asia	
			Japan	
			America	
			Europe	
7	Tray		Asia	
			Japan	
			America	
			Europe	

Table 4-20 Worldwide Vicissitude of Milling Facilities Used in Indonesia

(2) Rice Whitener (Pearler Polisher)

No.	Type	Figure	Area	Popular → / Some ⇢ 1900 '20 '40 '60 '80
9	Engelberg (Brawn rice Milled rice)		Asia	⇢
			Japan	
			America	→
			Europe	
10	Cone		Asia	→
			Japan	
			America	⇢ ⇢
			Europe	→
11	Friction		Asia	
			Japan	→
			America	
			Europe	
12	Blowing Friction (Short chamber)		Asia	⇢ ⇢ ⇢
			Japan	→ ⇢ ⇢
			America	→ →
			Europe	⇢ ⇢
13	Blowing Friction (Long chamber)		Asia	⇢ ⇢
			Japan	→ →
			America	⇢ ⇢
			Europe	⇢ ⇢
14	Horizontal Abrasive		Asia	⇢ ⇢ ⇢
			Japan	→ →
			America	⇢ ⇢
			Europe	⇢ ⇢
15	Vertical Abrasive		Asia	
			Japan	→ →
			America	
			Europe	

4-4-4 Milling Facilities

(1) Current Classification

1) Engelberg huller mill
2) Small-scale rice mill
3) Large-scale rice mill
4) Rice milling unit

(2) Classification in This Survey

The criteria for evaluation of a rice mill are the kinds of main machines which constitute the mill, size, capacity and quantity of these machines, additional machines and accessories. Kinds of main machinery and their combination are the most important factors.

In recent years, however, kinds of rice mill equipment have been diversified, their contents also changed, and accordingly, changes in machinery and methods of use became complicated. As a result, the character of the rice mill is not clear enough by the current method of classification.

Accordingly, minute classification is required also for seeking the most suitable rice mill facilities for Indonesia in the future, and the following classification was made with this potharvest loss survey as the opportunity.

The paddy husker, paddy separator and rice whitener were used as the main machine elements which constitute each rice mill in this classification. Although preliminary cleaner and other machines may be provided this is an important matter and was handled separately from this classification.

Table 4-21 Type and Combination of Milling Machines

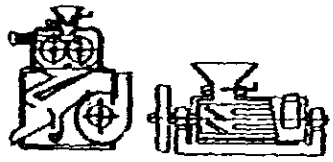
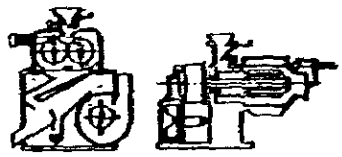
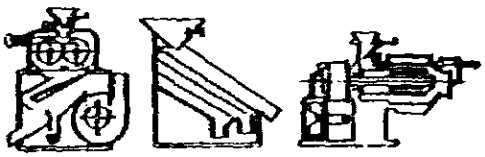
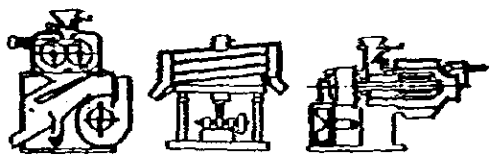
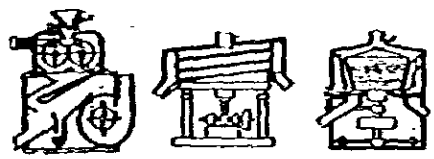
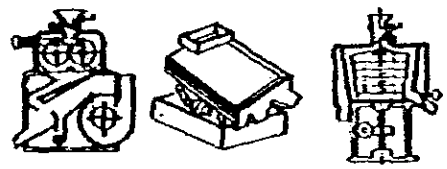
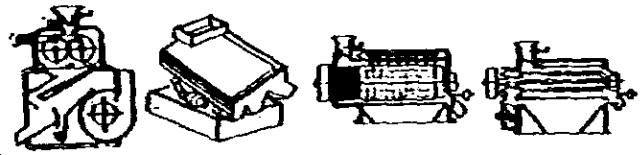
CODE NO.	TYPE AND COMBINATION	ILLUSTRATION
1	ENGELBERG HULLER	
2	RUBBER ROLL HUSKER + ENGELBERG WHITENER	
3	RUBBER ROLL HUSKER + BLOWING FRICTION WHITENER	
4	RUBBER ROLL HUSKER + SCREEN PADDY SEPARATOR + BLOWING FRICTION WHITENER	
5	RUBBER ROLL HUSKER + MECHANICAL SEPARATOR	
6	RUBBER ROLL HUSKER + MECHANICAL SEPARATOR + CONE WHITENER	
7	RUBBER ROLL HUSKER + MECHANICAL SEPARATOR + ABRASIVE WHITENER	
8	RUBBER ROLL HUSKER + MECHANICAL SEPARATOR + ABRASIVE WHITENER + BLOWING FRICTION WHITENER	

Table 4-22 Total Number of Rice Mill, and Its Capacity and Production

Reference No.	1	2	3	4	5	6	7	8	9	10	11	12
Calculation			2/1			5/4			8/7		10/7	8/11x100
Province	Large Rice Mills			Small Rice Mills			All Rice Mills			White Rice		
	Number of Mills	Capacity 1000 ton Rice/Year	Average Capacity ton Rice/Year	Number of Mills	Capacity 1000 ton Rice/Year	Average Capacity ton Rice/Year	Number of Mills	Capacity 1000 ton Rice/Year	Average Capacity ton Rice/Year	Production 1000 ton Rice/Year	Presumed average capacity ton Rice/Year	%
1. D.I. Aceh	61	54	885	1,179	438	372	1,240	492	397	488	394	110
2. North Sumatra	158	152	962	4,186	707	169	4,344	859	198	1,053	242	82
3. West Sumatra	6	6	1,000	3,064	598	195	3,070	603	196	613	200	98
4. Riau	-	-	-	528	125	237	528	125	237	167	316	75
5. Jambi	-	-	-	682	11	16	682	11	16	257	377	4
6. South Sumatra	6	4	667	3,185	871	273	3,191	876	275	587	184	150
7. Bengkulu	-	-	-	645	15	23	645	15	23	115	178	13
8. Lampung	20	23	1,150	2,269	445	196	2,289	468	204	431	188	108
9. DKI Jakarta	-	-	-	76	22	289	76	22	289	32	421	69
10. West Jawa	215	254	1,181	10,285	2,562	249	10,500	2,816	268	3,985	380	71
11. Central Java	245	163	65	4,679	1,380	295	4,824	1,543	320	2,928	607	53
12. D.I. Yogyokarta	-	-	-	887	464	523	887	464	523	261	294	178
13. East Jawa	207	465	2,246	4,888	2,310	473	5,095	2,774	544	3,662	719	75
14. West Kalimantan	-	-	-	1,628	267	160	1,628	267	164	369	227	72
15. Central Kalimantan	-	-	-	372	161	433	372	161	433	115	309	140
16. South Kalimantan	12	15	1,250	971	283	291	982	298	303	446	454	66
17. East Kalimantan	-	-	-	840	184	219	840	184	219	79	94	220
18. North Sulawesi	-	-	-	648	193	298	648	193	298	155	239	124
19. Central Sulawesi	-	-	-	584	219	375	584	219	375	118	202	185
20. South Sulawesi	34	34	1,000	6,997	1,381	197	7,031	1,415	201	1,148	163	123
21. Southeast Sulawesi	-	-	-	97	12	124	97	12	124	31	320	38
22. Bali	-	-	-	1,373	603	439	1,371	603	440	419	306	144
23. NTB	23	22	957	394	254	645	471	276	586	368	781	75
24. NTT	-	-	-	129	45	349	129	45	349	118	915	38
25. Maluku	-	-	-	10	4	400	10	4	400	24	1,400	29
26. Irian Jaya	NA	NA		NA	NA		NA	NA				

(3) Milling Capacity of Rice Mill

Determination of the actual capacity and potential capacity of each rice mill is important for planning basic programs and various documents have been drawn up in the past. However, many of these do not match the actual condition. This is considered because there is a problem in the assessment of the fundamental capacity of each rice mill.

The capacity per hour at each rice mill, number of hours of operation per day and number of days of operation per year are multiplied, totalling for rice mills in each area is made and thus the actual capacity or potential capacity per year is calculated. How close the result of calculation is to reality is unknown under the current situation, that is, the use of diversified milling machines and diversified milling methods. Comparison between areas is difficult if totals for each area are made using different criteria, as there are no available objective criteria for assessment of capacity for all of Indonesia matched with the actual conditions.

The capacity of a machine indicated by the manufacturer is the maximum capacity for good paddy conditions and the machine may be operated over a broad capacity range of two and a half times higher. Therefore, calculation should be made by the combination of the reference capacity of the machine and method of its use. There are also cases with individual machines in a plant used with their capacities unbalanced.

From the viewpoint of reduction of losses, it is necessary to establish the optimum capacity and method of use of diversified machines for paddy conditions, based on repeat experiments. Criteria for judgement of the capacity of each machine is indicated below.

Table 4-23 Type of Milling Machine According to the Capacity

	ENGELBERG HULLER		RUBBER ROLL HUSKER		BLOWING FRICT WHITENER	
	REQUIRED POWER (hp)	CAPACITY kg/hr PADDY	RUBBER ROLL SIZE(INCH)	CAPACITY kg/hr PADDY	REQUIRED POWER (hr)	CAPAC kg/hr
SMALL SIZE	7	300	(WIDTH) 2 1/2 3 4	200 400 600	3 7	2 4
LARGE SIZE	10	500	6 10	1000 2000	10 15 20	6 8

(4) Rice Mills in Surveyed Areas

Rice milling machines located in surveyed areas are within the range of the kinds and combinations described up to the past paragraph. However, their kinds and combinations vary with the local conditions of each area.

On Java Island, the high yielding variety has spread in general and in Western Java and Eastern Java in particular, competition among rice mills and stimulation from the exterior are keen and positive measures for improvement have been taken. When these mills are observed from an international standpoint, however, many of them do not have functions or the structure of rice mills.

In outside of Java Island, partly due to the fact that local variety of relatively good rice milling conditions still remains, progress of rice mills is slow due to stability rice mills in the interior regional societies, little stimulation, restrictions on of funds and so forth, and districtly apparent new and old rice mills are present in wide variety, and many rice mills require improvements.

1) Aceh Province

This is the place where I.R. 32, 36 and 38 of high yielding variety are widely planted. Colored rice was produced in a large quantity due to problems before milling, that is, unsuitability of threshing and drying handling in particular. At the present time, the white rice quality in the milling stage is seriously affected adversely. When rice milling equipment in main rice growing areas in Aceh Province are generally observed, classification can be made into multistage mills, which are completed in outline, and mills equipped with rubber roll type huskers plus Engelberg type whiteners. Individual use of Engelberg type whiteners is not observed very much.

At a multistage mills, a rubber roll type husker, a compartment type separator and a blowing friction type whitener are used. Engelberg type whiteners have been gradually replaced by blowing friction type whiteners.

The equipment level is rather high in this province probably because labor shortage is a problem in this area, and rice mills are actually wrestling with the improvement of equipment.

2) West Jawa Province

This province is one of the largest rice producing province in the country. As it includes Jakarta and Bangdung, its international influence and stimulation is the largest. In addition, the number of small-scale rice mills is the largest in the country. Regarding improvement of rice milling facilities, this state is most positive together with East Jawa Province in Indonesia.

Although the local variety is still remains in mountainous areas. High yielding variety are mainly plantedin the northern coastal area, which is the main rice-producing area. In recent years, however, Cisadane, is rapidly making penetration as it is superior in yield and taste. Because the grain size of this variety is larger than that of other I.R. variety, it is also suitable for rice milling conditions.

Rubber roll type huskers with screen type paddy separators and blowing friction type whiteners have penetrated small scale rice mills in principal places of production. In addition, double passing is made for both husking and whitening. Accordingly, both milling recovery and quality are so good that they are not inferior to those of large scale rice mills. However, the sight of many workers playing only as elevators is not the vision of what future milling factories should be.

Many other rice mills exist, including those which were introduced from outside of the country in the form of economic assistance. But it is hard to find a rice mill which can be used as a model for future rice mills in Indonesia.

At the two-crop area along the coastline, large scale harvesting is made during the rainy season. Accordingly, paddy of high moisture content cannot be dried and will deteriorate soon. Also, because of the unsuitable method of drying, cracked kernels are produced in large quantity, affecting the quality of milled rice greatly. These problems should be solved prior to the stage of rice milling.

3) South Sulawesi Province

Although I.R. varieties are mainly planted in the rice belt zone in the middle part of the province, the local variety and the improved local variety are planted in other rainfed field areas and montainous areas in the north.

Thre are many rice mills at which Engelberg type hullers are individually used. According to data from 1979, the share of hullers of this type used in this area is 77%, which is far greater than that in other areas. The fact that the local variety remains to a great extent is considered to be one of the reasons there is little desire to improve milling facilities.

4) South Kalimantan

As most rice cultivation is dependent on changes in water level, the local variety occupies a majority in this area and the improved short type is limited to irrigated areas and only some rainfed fields.

Most rice mills still use Engelberg type hullers and rubber roll type huskers. Cases where individual Engelberg type hullers are used have decreased gradually.

5) East Jawa Province

The history of revolution and development of rice mills in Indonesia was lead by East Jawa with Surabaya which is a trade town as the nucleus. It appears that the experience and achievements established in East Jawa expanded to all of Jawa and to outside of Jawa Island. According to the data of 1979, the mean capacity of a rice mill in East Jawa is about twice as much as that in West Jawa and Central Jawa as for both large scale and small scale mills. These figures indicate that rice milling trade is very active in East Jawa.

Regarding rice mill facilities which were observed and studies during the survey, there was no fundamental difference from rice milling machinery located in West Jawa.

6) Central Jawa Province

Being located between East Jawa and West Jawa, this province is influenced by both of them. Therefore, rice mills are also of identical trends. According to statistical data, the rice milling capacity to rice production is 53%, which is the lowest among the three Jawa provinces.

7) South Sumatra Province

All rice mills are located in places of production, and custom milling for farms is the major operation. Because of the fact that the entire distribution is made in the form of milled rice, no rice mills are located in places of distribution or places of consumption.

The total number of rice mills was 3,214 in 1981, of which those which have a combination of a husker and a whitener are 821 and the remaining 2,393 mills use an individual Engelberg type huller. The milling capacity is 1,184,880 tons at the present time, and this figure means that it is possible to digest the total paddy production of 1,092,754 tons. However, problems lie in the milling recovery and milled rice quality. At a mill equipped with a husker and a whitener, the milling recovery is about 65% if the paddy quality is at an average level. At a mill equipped with only an individual Engelberg type huller, however, it is said that the milling yield is 57.5% in single passing. The milling fee is 10% of the milled rice.

The average paddy and quality of milled rice are as shown below.

Average Paddy Quality

Impurities	5.7%
Moisture Content	14.5%
Green & Chalky Grain	2.8%
Defective Paddy	2.5%

Quality of Milled Rice

	Husker+Whitener	Engelberg alone
Broken Rice	38.5%	42%
Breweries (fine broken)	1.6%	3.4%
Chalky	1.45%	1.45%
Discolored	3.0%	3.0%
Husk	0.5%	1.5%

8) Lampung Province

The majority of rice mills in the Central Producing areas are equipped with a rubber roll husker plus whitener. In the areas in which local variety is planted, however, the percentage of rice mills equipped with them is 15% and mills with individual Engelberg type huller occupy 85%.

In the entire province, mills with rubber roll type husker plus whitener occupy 22.5% of all, and mills with individual Engelberg type huller occupy the remaining 62.5%. At mills with individual Engelberg huller, generation of fine broken rice and broken rice is large, and the milling yield is also lower by about 5% than mills with rubber roll type husker plus whitener. The milling fee is 10% of milled rice.

4-5 Custom Milling

(1) Form of Milling

Of paddy of 32,000,000 tons produced in Indonesia, the majority except for what is subject to manual pounding which is a very minor quantity is treated at rice mills in the country and is converted to milled rice of about 22,000,000 tons. It can be estimated that approximately 65% of this white rice is for the farms' home consumption, 10% is delivered to BULOG and 25% is delivered to the markets.

For the 65% of the milled rice mentioned above, the ratios of rice which is possessed by farms and is custom milled and of rice purchased in the form of white rice for home consumption after selling are not known. But it is certain that the quantity of custom milled rice is extremely high, and the loss of custom-milled rice is the most important problem, although no figure that expresses its scale appears anywhere.

The types of rice mills are private small-scale mills, private large-scale mills and KUD and PUSKUD mills. They can be generally classified as follows.

Private Small-Scale Mill	Custom Milling		
" "	"	Commercial	
Private Large-Scale Mill		"	BULOG
KUD Mill	(Custom Milling)	"	"
PUSKUD Mill		(Commercial)	"

(2) Custom Milling

Determining the losses caused by custom milling is not easy because various conditions are involved, but it involves a large problem related to losses.

In one observed example, in the case of custom milling, the milling recovery is 58 ∿ 63% with an Engelberg type huller mill and 60 ∿ 65% with a husker and whitener mill. When continuous milling is performed, on the other hand, 65 ∿ 67% is obtained at both mills. The quantity treated at a time is small for custom milling, the kinds of rice milling machines used at mills and the specified functions of these machines involve factors which disallow any prevention of losses.

1) Problem of Small Milling (Custom Milling)

The machines are paddy huskers which convert paddy into brown ri into white rice. No matter how a husker is adjusted or even if repe passing of paddy through it is made, there is not much difference in brown rice obtained as a result. In the case of a whitener, however, the result will be largely different by differences in adjustment eve it is minor. It is possible to produce overmilled rice, and it is al possible to produce broken rice of a large quantity. The problem lie in this point. Another problem is that, because white rice cannot be obtained from the beginning of whitening due to the fact that pressu is not applied to brown rice until the whitening chamber is filled up with rice, the initial undermilled rice required remilling.

According to what we have observed, it is usual that the quantity of paddy brought at a time to a custom mill by a farm is 30 to 40 kg, and what is individually prepared is largely diversified in variety, dryness, cleanliness, mixing ratio of immature rice and so forth.

It is not possible for the machine operator to make adjustments in advance. He adjusts the flow rate and pressure at the discharge gate while observing the rice that flows out of the white rice discha gate after commencement of milling. When a whiteness level that is cl to the desired level is obtained, he observes conditions for a while, places the white rice container with another one, and the under milled rice in the initial stage is milled again together with the brown ric It is normal for this length of time to be a few seconds to one min- ute. But double milling of this initially milled rice will lead to ov milling and further loss.

In a test of a whitener in general, it is said that accurate mill recovery cannot be obtained unless continuous milling of 30 minutes t one hour is performed. The main reason for this is that it is necessa to treat a quantity at which the loss of remilling under milled rice produced during adjustment in the initial stage and the loss produced due to over milling during adjustment can be ignored in the calculati

The capacity of machines used at custom mills is 0.2~0.5 ton of paddy per hour, but setting of 0.5 ton per hour forms the maincurrent at the present time. Accordingly, paddy of 30 kg passes through the machine within 4 minutes, and the quantity during the first minute is over milled. Furthermore, because of the fact that a farm requests o

a clear distinction be made between his rice and somebody else's rice, it is not possible to allow rice to remain in the machine. If the entire volume is discharged, under milled rice is produced due to the drop of pressure in the machine. In order to prevent any occurrence of this problem, milled rice should be input in small quantities before the inflow of brown rice terminates, so that white rice is discharged up to the last moment. Therefore, this portion is double milled. These factors are serious problems which positively lead to drops in the milling recovery. In conclusion, machines in small size rice are too large as custom milling machines for farms. It is estimated that the loss produced by these operations is around 2%.

2) Problem of Insufficiently Dried Paddy

There are many cases where the paddy brought in by farms is insufficiently dried, and particularly paddy right after harvest contains moisture of as much as 16~18% on occasion. When the moisture content is high, rice is brittle and easily breaks up in the whitener. In addition, it is crushed, discharged together with the bran and the milling recovery becomes even worse. As an example, the milled rice recover was as low as 56% out of paddy with a moisture content of 17%.

3) Milling Fee and Milling Degree (Whiteness)

The milling fee is 6~10% of finished milled rice or 5~10 RP per kg of paddy. As the custom miller takes white rice of a quantity that is equivalent to his milling fee out of the total quantity of the milled rice and returns the remaining portion to the farm, he has little interest in the milling recovery. Probably because farms request whiteness for the rice they eat, it appears that mill operators make milled rice sufficiently white so that no complaints are raised. In general, white rice is whitened to an unnecessary level and over milling is done. Even when over milling is done, the whiteness will not increase beyond a certain level, what occurs as a result is a reduction in milling recovery and an increase in the volume of broken rice. When this phenomenon is observed from the side of the miller, it is more advantageous for him as the quantity of bran increases. It is estimated that the loss caused by over milling of custom milled rice is around 1%.

4) Loss Caused by Custom Milling

The loss in the milling recovery caused by custom milling is estimated as about 3~5% of the total quantity. It means that the total quantity lost is estimated as about 600,000 tons for 32,000,000 tons x 60% = 19,200,000 tons, which is a considerable loss.

4-4-6 Imported and Domestic Machines

(1) Introduction

The majority of whiteners used in Indonesia used at the present time were imported as completed machines from outside of the country, particularly from Japan, China and Taiwan. Domestic production or assembly with technical cooperation has already been commenced for some of them, but the kinds of machines produced or assembled in the country are still limited. Purely domestic products are also available, but the share is still small.

Many machines imported from abroad were individually produced as single machines, that is, single paddy huskers and single whiteners. In the recent years, the import of complete sets equipped with consistent processes has been minor, and only complete sets were
or the like, not commercially.

(2) Rice Milling Machines made in Japan

Rubber roll huskers and blowing friction type whiteners introduced from Japan made a major contribution to the reduction of losses in rice milling and the improvement of the quality of milled rice accompanying the reformation to rice mills in Indonesia since the 1960's.

1) Single Machines

In the initial stage these machines were used to replace components of European type large scale rice mills. Paddy huskers included in these machines are of 6-inch type and they are very broadly used in Indonesia at the present time. Rice whiteners were used for 4 to 5 passing as circulation type in Japan, and they became the model for rice whiteners which are imported from Taiwan and other countries.

Because of the fact that distribution of rice in Japan is made with brown rice, paddy huskers are produced by farm machinery manufacturers and rice whiteners are produced by producing machinery manufacturers, and their markets are different. The situation in Japan exerts various influences over Indonesia, which imports rice milling machines. For example, huskers and whiteners were initial imported individually.

2) One Pass Type

Since then, the introduction of machines called one pass type, which is a combination of a paddy husker and a rice whitener, and machines of small capacity (200~300 kg/hr), a set composed of a paddy husker and a rice whitener combined with a bucket elevator or the like located between them, was begun for newly established custom mills and other purposes to replace Engelberg type hullers. The concept of this combination laid the foundation for current small scale rice mills. The width of rolls of paddy huskers in Japan is around 2-1/2 inches, and whiteners are of one pass type with long milling chambers. Both of them were developed for farms. Machines with a larger capacity are available today, some of which are produced in Indonesia under a technical tie-up. With these machines, however, double passing through paddy huskers can not be made when paddy conditions are inferior, and this problem remains today.

3) Rice Milling Unit

Rice milling units, generally known as R.M.U., of a capacity of 0.5~1.0 ton per hour (relatively simple type complete units) were introduced from Japan mainly through the government.

These units constitute consistent stages from paddy to white rice by combining a rubber roll type husker or a tray oscillation type paddy husker and a whitener through a bucket elevator. Of this basic composition, the whitener is available in either abrasive type or blowing friction type. The abrasion type whiteners initially used had such problems as the surface of glossy white rice being inferior and operation being difficult, and it appears that blowing friction type whiteners are mostly used at the present time.

4) Plant Type

Completed plants of a capacity of 2 to 4 tons per hour were introduced from Japan over 10 years ago. Each one of these plants came complete with a preliminary cleaner, husker, paddy separator, whitener, broken rice separator, white rice mixing device, scaling equipment, etc. However, these plants were not sufficiently utilized and the stages after broken rice separators were not used. The actual reasons why they are not used today are that this equipment does not match the realities of Indonesia at the present time and their efficiency is inferior, considering equipment costs. This consideration is proved by the fact that identical plants were not installed since then.

5) Consideration

Leadership of the import of rice milling machines introduced to Indonesia, formerly held in Japan, is about to be assumed by those which are made in Taiwan and China today. The reason does not lie in prices alone. In fact, there are few differences in the prices of individual machines. It is felt that machines made in Japan will not fit in the Indonesian market if they were produced competitively among manufacturers with only production cost taken into account. Furthermore, the prices of spare parts are high and the supply of spare parts is not stable. These factors are probably also responsible to the switching of leadership for rice milling machines to other countries.

(3) Rice Milling Machines made in Taiwan and China

Although rice milling machines produced in Taiwan and China started as imitations of Japanese machines, what governs the market in Indonesia at the present time are paddy huskers made in China and whiteners made in Taiwan. They are used in continuous operation for long periods of time, and they are deemed satisfactory by users in Indonesia in terms of structure, appearance and commercial value.

Rubber rool paddy huskers are of 6-inch type only, and do not differ from those made in Japan. The rubber roll, which is the only consumable in a paddy husker, is of the same dimensions as those rubber rolls made in Japan and is interchangeable with Japanese rolls and/or local made. It made possible the entry of Chinese huskers into the market of Indonesia.

Whiteners are the machines which exert the largest influence over the milling recovery out of rice milling machines. Whiteners made in Taiwan exhibit a performance which is almost equal to that of Japanese long chamber type, and they produce excellent quantity of rice, particularly in terms of glossy white rice. They are not merely imitations of Japanese machines; many modifications are made so that the screen rotates to prevent the accumulation of bran. The screen, is made by combining a number of flat perforated sheets. They are now actually produced by local iron work-shops, and they are available from any dealer. This is one of the good reasons why this machine was able to penetrate this market.

(4) Machines made in Europe

Conventional large size plants included machines made in Germany and the U.K., and it appears that the type made in the U.K. was used as the model for Engelberg type hullers. It seems that many whiteners made in West Germany are imported according to recent statistics.

A pure European type plant with a capacity of 4 tons per hour, introduced ten years ago, was observed in a survey area. It is complete with a preliminary cleaner, rubber roll husker, independent husk aspirator, compartment type separator, cone type whitener and broken rice separator, and it produces white rice of good quality. Although each individual machine is produced to be solid, they appear to be excessive. Accordingly, it can be involved and the operating cost is considered to be high.

It is a problem that servicing, operation and adjustment of the cone type whitener are difficult for even experienced operators. It cannot be foreseen that this plant will become fixed in Indonesia.

(5) Machines Domestically Produced in Indonesia

Some factories in Indonesia produce pure Indonesian machines using imported machines used as models, and some factories carry out partial production and assembly under technical tie-ups with foreign manufacturers. The ratio of domestically produced machines to the total demand is not clear enough, but they are in reality rarely observed at survey areas. There were opinions among users of these machines that their performance drops within a short period of time due to wear and other factors, because these machines have problems with accuracy and durability.

CHAPTER V METHODS AND RESULTS OF THE SURVEY

CHAPTER V METHODS AND RESULTS OF THE SURVEY

1 Outline of the Survey

1-1 Survey at Farm Level

Rice production in Indonesia has been changing dramatically and this ansition is still going on. However, it is not always true that this chnical alteration is performed in the most preferable style. Instead, has been causing confusion in each farming activity. Especially in the stharvest work, too much works is required for increase rice production.

According to the concept of this survey, losses in the postharvest ocess will be studied and searched for in real terms, at the farm level. so, relating to the postharvest practices, the survey will be carried on social customs, cultivating attitudes, irrigating conditions, growing thods, harvesting practices, and so on. Thus, the current status of post- rvest practices will be described for 4 provinces and, on the basis of e survey results of the losses, a proposal will be submitted to improve e situation.

In addition, it was expected that the amount of losses may differ ending on whether it is the rainy or dry season, because of changing rvesting conditions. Accordingly, the survey was carried out in both e rainy and dry season.

1-2 Survey Employing Mechanical Harvesting Equipment

In Indonesia, rice production has been largely innovated in recent ars, where it is necessary to change postharvest handling according to cultivating technologies. Also, society has been significantly modernized is stimulating diversification of consumer tastes for rice quality and provement of rice distributing systems. In addition, due to the shortage labor, labor saving is becoming another important theme in rice production. consideration of these circumstances, it is deemed timely to propose chanization of postharvest treatment. The survey shall be regarded as part thereof.

Among postharvest handling processes, the major working process at the mer level include reaping, threshing and drying. Husking and milling cesses are not normally done by farmers, according to the characteristics the work, therefore, it will be excluded from the experimental survey.

Representative types of binders, power threshers and flat bed type dryers for paddy will be selected and tests for mechanization will be performed in Aceh and West Jawa; in the former province, there is a great amount of loss due to an extreme shortage of labor and, in the latter, considerable losses are appearing because of a presence of an excessive amount of labor. Further, by comparing the mechanical method with the conventional method, qualitative and quantitative losses and economic advantages will be studied.

However, this experimental survey is not intended to investigate the performance of a certain type of machine or its operating accuracy under given working conditions (farm condition, growing condition, operating skill etc.). But instead, it is aimed at collection of universal data as much as possible.

In the evaluation of the losses, the mechanical method will be compared with the conventional one, where a total of harvesting works, quantitative loss and qualitative loss is compared between the two methods. Qualitative loss will be checked by a quality analysis of milled rice obtained from a mechanically harvested paddy.

5-1-3 Survey of Milling

The milling process is the final stage of postharvest handling of rice. Because rice is put on the market as milled rice, various conditions and requirements are collectively specified in the milling process. These conditions include kinds and combination of milling machines, quality of the paddy, drying method, moisture content, degree of milling, and so forth. Therefore, quantitative and qualitative losses will be investigated for each condition.

5-2 Definition of the Losses

5-2-1 Quantitative and Qualitative Losses

These losses include losses of rice arising from reaping stage to the transportation to consuming areas, in terms of both quantity and quality.

In this case, only food for human consumption is used while the other parts will not be included, i.e. chaff, bran, to be normally removed during the milling process, etc.

Quality loss of rice means a degree of degradation occurring during postharvest handling processes. It is represented by a price difference between each quality on the market.

However, quality degradation coming from the growing period before harvest will not be regarded as a quality loss of postharvest work (damaged kernels, cracked kernels, broken kernel and red rice). The price difference due to quality on the market means a difference of prices between normal and abnormal rice.

Normal rice means a commodity of such a degree that its quality of paddy or milled rice is transacted within a scope of the mean price. Abnormal rice means those crops whose transacting price is discounted from the price of normal rice because of poor quality.

The quality of rice is evaluated by the market price. For milled rice, quality items include degree of milling, moisture content, foreign material, damaged kernels, broken kernel and its condition. For the paddy, quality is represented by the yield of milled rice x the quality of milled rice.

In response to price fluctuations on the market, the width of price differences also changes. However, for the purpose of this survey, the price difference at the time of the survey will be used.

2-2 Definition of the Losses by Stages

(1) Harvesting Loss

Harvesting loss means the quantitative loss arising during reaping work and handling work of panicles or bulk of paddy on farms. This loss may arise from kernel spillage, gleanings, non-reaping during harvesting work, parcel spillage during transportation on farms, and kernel spillage during temporary drying farms, and so on. However, natural kernel spillage before harvesting is not included in this loss.

(2) Loss During Threshing Work

Both for manual and mechanical threshing, the quantitative loss includes scattering, unthreshed kernels, remaining paddy in the straw, etc. during threshing work and preparatory and cleaning work around the site. Qualitative loss mainly includes, cracked kernels, broken rice, and so forth arising during mechanical threshing. The loss is obtained as devaluation by an analysis of milled rice after milling is completed.

(3) Loss in the Drying Stage

Quantitative loss is generated by scattering during the drying work and/or birds and animals. Weight loss due to excessive drying (moisture content less than 14%) is compensated to bring the moisture content up to 14% and is not counted as a loss. Cracked kernels appearing in this stage cause degradation of rice quality, because they will appear as broken rice after milling. Therefore, it is attributed to qualitative loss.

(4) Loss in the Cleaning Stage

Paddy scattered during work and mixed in non-recoverables (straw trash, empty kernels) is not included in quantitative loss.

(5) Loss in the Transportation Stage

Spills during transportation belong to quantitative loss. Also, qualitative loss means quality degradation due to rain, etc.

(6) Loss in the Warehousing Stage

Loss due to rodents, birds and/or insects causes quantitative loss during warehousing. Also, deterioration due to bacteria or fungi is included in qualitative loss.

(7) Loss in the Milling Stage

Yield difference after Milling is defined as quantitative loss. In addition, quality deterioration of Milling rice, i.e. market price difference due to quality is attributed to quality loss.

5-3 Method of the Survey

5-3-1 Selection of Survey Area and Field

The survey conducted in total eight provinces in Indonesia. Out of these, General Survey took place in four provinces (DI Aceh, West Java, South Sulawesi, South Kalimantan) during both of the dry and rainy season as agreed upon with Scope of Work of the Survey. For rainy season survey, the other four provinces also included as area for observation Survey. For the selection of districts for survey in province, the following necessary condition were taken into account.

(1) The object area shall be in the harvesting season.

(2) The object area shall be a representative district in the province.

(3) The object area belongs to those suffering from large postharvest losses. Or it may possibly become one in the near future.

(4) An area where fundamental statistical data will be readily and promptly obtainable for the purpose of the survey.

Furthermore, 2 sub-districts each were selected in an object district under the same necessary conditions. From each sub-district thus selected, 3 villages were chosen and, in each of these villages, one field (farmer) was sampled, in general. Thus, 12 fields each for a province, i.e. 48 fields in total were chosen separately for a dry harvest and a rainy one. Accordingly, 96 fields were taken as object samples throughout the survey period.

In actually selecting the sample field, the following subjects were comprehensively checked.

(1) High-yielding variety is grown.

(2) Irrigating area where there are two crops in a year

(3) Minimum 500 m^2 area (for mechanical experiment, 1 ha.)

(4) Rice uniformly grows without damage due to pest and rodents

(5) Availability of farmers' cooperation and understanding

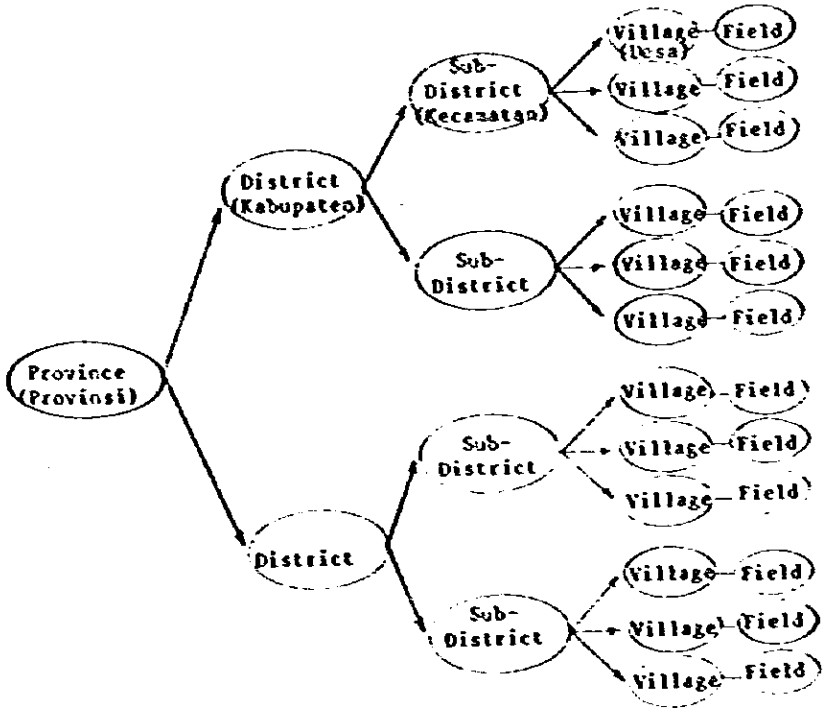


Fig. 5-1 Selection Way of the Subject Field of This Survey

5-3-2 Preliminary Survey

(1) Survey Method

A preliminary survey was conducted before the ultimate survey, to check how many sample plots should be taken out of a field (500 m^2 object) with sufficient reliability when diagnosing the harvesting volume.

1) Twenty plots were freely sampled out of a field which could be regarded as representative in Indonesia. Then, in each plot, rice was reaped while preventing gleanings and kernel spillage, and making sure none remained uncollected after harvesting. After threshing, the crops were measured and the moisture content was metered. Then, the harvested volume from each plot was obtained by converting it to 20% moisture content. One plot was taken as 2.5m x 2.5m = 6.25 m^2. This is a unit expressing area, called the Ubinan.

2) Sandard deviation of harvesting volume(σ) was obtained for each plot.

3) Sample number (n) having a 95% precision was calculated by the following equation.

$$0.95 = 2.093 \times \frac{\hat{\sigma}}{\sqrt{n}}$$

$$\sqrt{n} = 2.093 \times \frac{\hat{\sigma}}{0.95}$$

$$n = (2.093 \times \frac{\hat{\sigma}}{0.95})^2$$

4) The value (n) obtained by the foregoing equation was rounded off to the nearest whole number. Also, if the value of (n) is less than 3, at least 3 plots were taken for the survey, in consideration of the difference between fields.

(1) Survey Result

Table 5 - 1 Result of Preliminary Survey

Plot No (a)	Wt of Paddy	Moisture Content	Wt of Paddy (M.C.20% xa)	$Xa - \bar{X}$	$(Xa - \bar{X})^2$
1	3.96 kg	22.1 %	3.856 kg	0.0464	0.00215296
2	4.02	23.5	3.844	0.0344	0.00118336
3	3.99	23.2	3.830	0.0204	0.00041616
4	3.85	21.9	3.758	-0.0516	0.00266256
5	4.00	22.2	3.890	0.0804	0.00646416
6	3.96	22.0	3.861	0.0514	0.00264196
7	4.04	22.9	3.894	0.0844	0.00712336
8	4.07	23.5	3.892	0.0824	0.00678976
9	4.09	22.5	3.962	0.1524	0.02322576
10	3.91	23.1	3.758	-0.0516	0.00266256
11	3.97	22.0	3.870	0.0604	0.00364816
12	3.74	21.7	3.661	-0.1486	0.02208196
13	4.11	22.9	3.961	0.1514	0.02292196
14	4.09	23.2	3.926	0.1164	0.01354896
15	4.13	22.5	4.001	0.1914	0.03663396
16	3.72	23.0	3.581	-0.2286	0.05225796
17	3.71	22.4	3.599	-0.2106	0.04435236
18	3.72	22.4	3,608	-0.2016	0.04064256
19	3.93	22.5	3.807	-0.0026	0.00000676
20	3.76	22.7	3.633	-0.1766	0.03118755
Total			76.192	0	0.3226048
Average			3.8096		0.01613024

$$\sigma^2 = 0.01613024$$

$$\sigma = \sqrt{0.01613024}$$

$$\sigma = 0.12700$$

$$\text{Then, } n = \left(2.093 \times \frac{0.127}{0.95}\right)^2$$

As a result of the above, n = 0.0783<1 was obtained. In other words, it was made obvious that, by taking 1 Ubinan (6.25 m^2) out of 1 field (500 m^2) during harvesting volume estimation, the estimation would have an accuracy of

of 95±5%. Accordingly, for the purpose of the survey, 3 Ubinans were definitely taken per field to raise the accuracy.

5-3-3 Correction of Moisture Content and Foreign Materials

(1) Moisture Content Correction

Throughout the survey, all weight measurements of rice are corrected to 14.0% moisture content (W.B.) when compiling the weight as data. The moisture content meter to be used is an electric resistance type Kett (Leister-D). The specifications of these moisture meters are described in "5-3-6 List of Survey Equipment and Material".

(2) Correction of Foreign Materials

Paddy was manually cleaned, otherwise, locally manufactured winnowers were used to clean roughly the rice by specific gravity in order to classify the sample into smaller categories. Thereafter, manual cleaning was applied. Relating to foreign materials inclusion during estimation of the survey results, 3% was taken as the standard value.

5-3-4 Test Procedures

(1) Harvesting work

Loss arising in harvesting work is estimated; i.e. during reaping, bundling and other work in the field. In this case, the standard work in test plot (no-loss, perfect work) is compared with normal work on the same and mechanical work in the experiment as designed for the survey. Even a worker carries out operations in a narrow area while being watched by foreigners and governmental officers. Therefore, the work may be done carefully and conscientiously which would probably not being about accurate results. In addition, in view of the mechanical experiment, at least several tons of paddy were needed. Consequently, for the purpose of this survey this harvesting work was carried out in a relatively wide area (500 m², 1 ha for the mechanical experiment). Loss factors during this work include the type of work, reaping work attitudes (low-reaping, middle-reaping, high-reaping), reaping tools (small finger knife, sickle, reaping machine), methods of reaping, and so forth. These factors are studied and checked.

Also in case of mechanical reaping, a direct surveying method will be employed like in the survey of manual reaping losses, where spilled kernels are collected in a field. However, in swamp farms, the wheels of a reaping machine are apt to bury spilled kernels under the soil, making it difficult to recover them. In such cases, an indirect method will be applied; where the standard (control) zone of the same area and the mechanically reaped zone are compared in terms of harvesting volume. To validate such a method, it should be presumable that rice grows uniformly in both zones and there is no substantial difference of crops before the harvest between both zones. Such a field should actually exist.

Test machines are one-bunch cutter/binder and reaper (only in West Jawa). To choose the type of machine, an easy-handling lightweight model is necessary because farming roads are generally not well prepared. Binder losses are classified as those during binding and discharging. However, for the purpose of this survey, this classification was disregarded. The specifications of test machines appear in "5-3-6 List of Survey Equipment and Material".

(2) Temporary Storage at Field

During the period from reaping to threshing, rice is often stored temporarily at the field. Losses in this case will be measured. The storing is seen in field drying, piling, and so on. However, in Indonesia, there are many areas where threshing is immediately performed after reaping. Accordingly, the loss survey will be carried out for losses due to by rats and birds during field drying and that coming from quality deterioration due to wetting from rain, or any other causes arising during temporary storage. In some cases, reaped rice is temporarily stored at the threshing place waiting for threshing work. However, this is regarded as a part of the threshing work.

(3) Transportation by Farmers

Prior to and after each work, a carrying activity appears in most cases. Various Kind of Surveys are conducted for each aspect of the material (reaped stalks, threshed paddy, etc.), transportation way (Brud, Sundan, bag, etc.), transportation distance, and so forth.

(4) Drying by Farmers

Generally in Indonesia, farmers dry paddy only for their own use b... do not dry paddy to be sold. Drying by farmers is varied under variou... conditions (kinds of straw mat, thickness of paddy layer, number of stir... and related losses are checked.

(5) Threshing

Although different in each area, threshing is normally carried out either by trampling, beating, or stick beating, etc. More recently, threshers and engine-driven threshers are gradually being introduced. Loss for each method will be surveyed.

However, the survey for mechanical threshing will be applied only in two provinces (Aceh, West Jawa) by the convenience of test machines. The specifications of test threshers are described in "5-3-6 List of Survey Equipment and Material".

(6) Cleaning

Cleaning work is done either by natural wind, winnowers, or even by sieves. Referring to local peculiarities, a loss survey will be carried out for each method.

(7) Husking, Whitening

Husking and whitening works are conducted in custom rice mills, BUUD KUD mills, commercial mills, and so forth, while using a variety of single machines and their combination. Also, even with the same machine employed, the cleaning result differs depending on how it is controlled. These factors will be comparatively checked by an experiment and differential results will be obtained.

On the other hand, raw material paddy to be tested has differing qualities depending on the kind, rice condition during reaping and the preliminary process. For each factor (moisture content difference, mixing ratio of immature kernels, same foreign material, etc.), an experimental survey will be performed.

(8) Paddy Drying During Marketing Stage

In most custom mills, BULOG/KUD mills and commercial mills, there are paddy sun-drying yards. In some of them, drying machines are used. In representative work, contents of actual work and related losses will be surveyed.

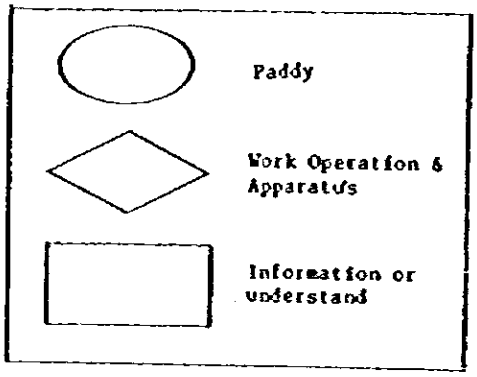
(9) Storage

Rice is stored in warehouses of farmers, village cooperative warehouses, BULOG/KUD warehouses, commercial warehouses and mill warehouses on each level. Comparing each storing condition, losses will be surveyed during handling, damage by insects, rats, birds fungi and bactria, and by other factors. In particular, rice quality deterioration during long-term storage will be an important theme of the survey. For this purpose, a storage test will be carried out in a warehouse for a period of 3-6 months.

(10) Transportation

Transportation means are available in a wide variety. These include manpower, bicycles (Becha), oxcart, trucks, ships, etc. Also, the packing method is classified into bulk and bag packing. For each case, loss will be surveyed by measuring rice in the sending spot and again at the destination. Factors of loss may include rough-handling, bags deformed by hooking, etc. Therefore, parameters should be analyzed.

5-3-5 Order of the Tests



(1) The Way of Experiment for Reaping Losses

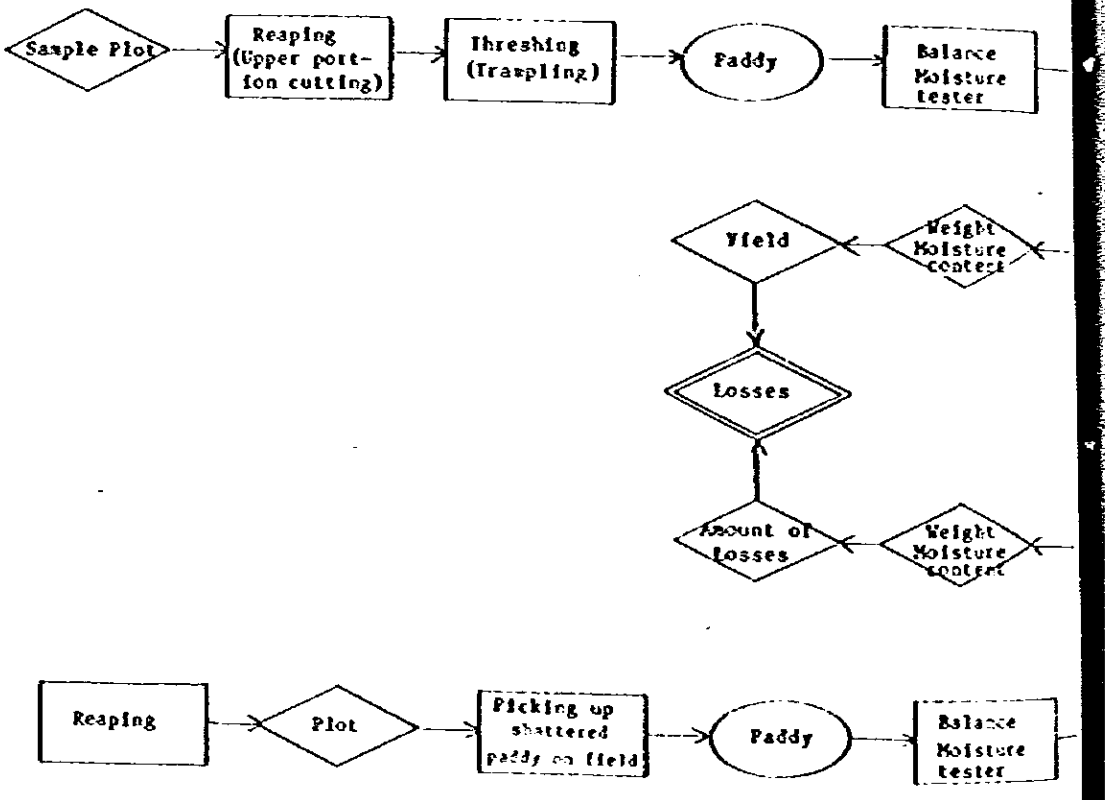


Fig. 5-2

(2) The Way of Experiment for Threshing, Winnowing Losses

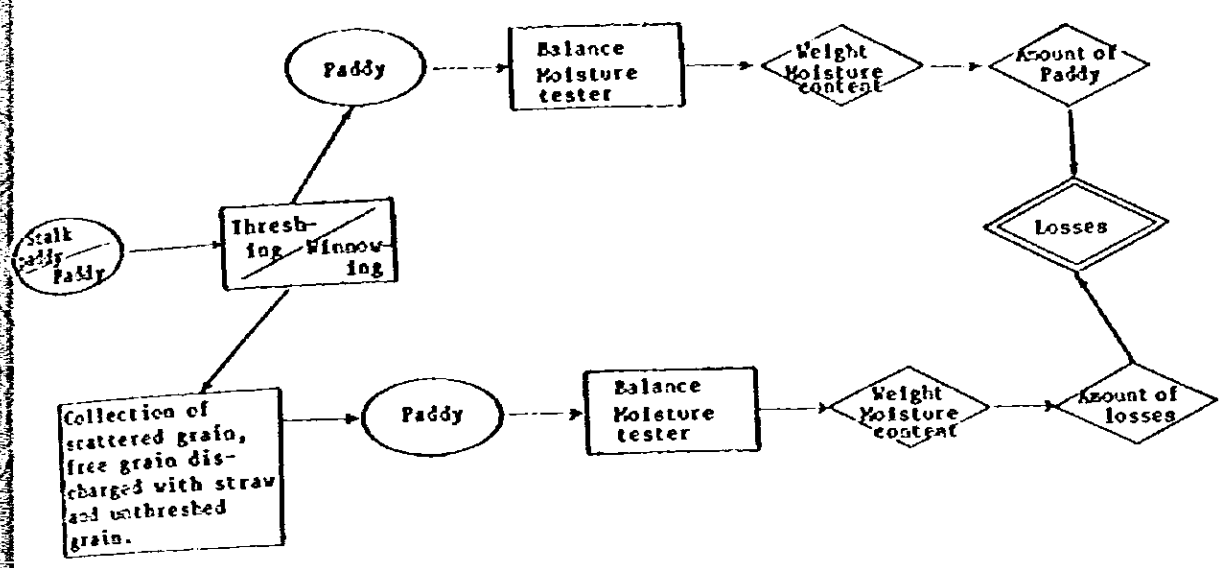


Fig. 5-3

(3) The Way of Experiment for Drying Losses

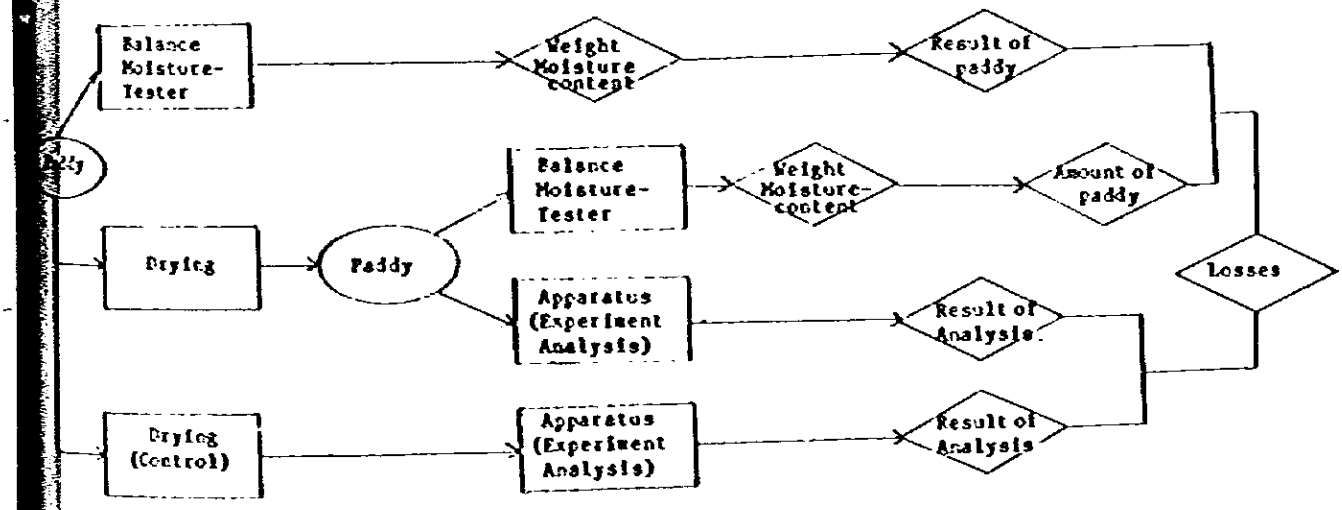


Fig. 5-4

(4) The Way of Experiment for Transportation Losses

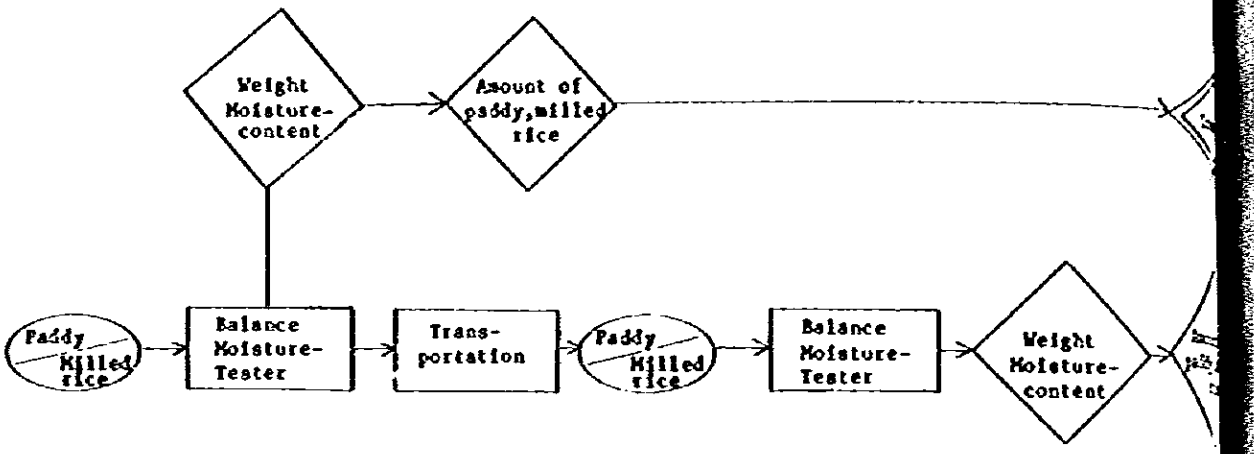


Fig. 5-5

(5) The Way of Storage Simulation Test

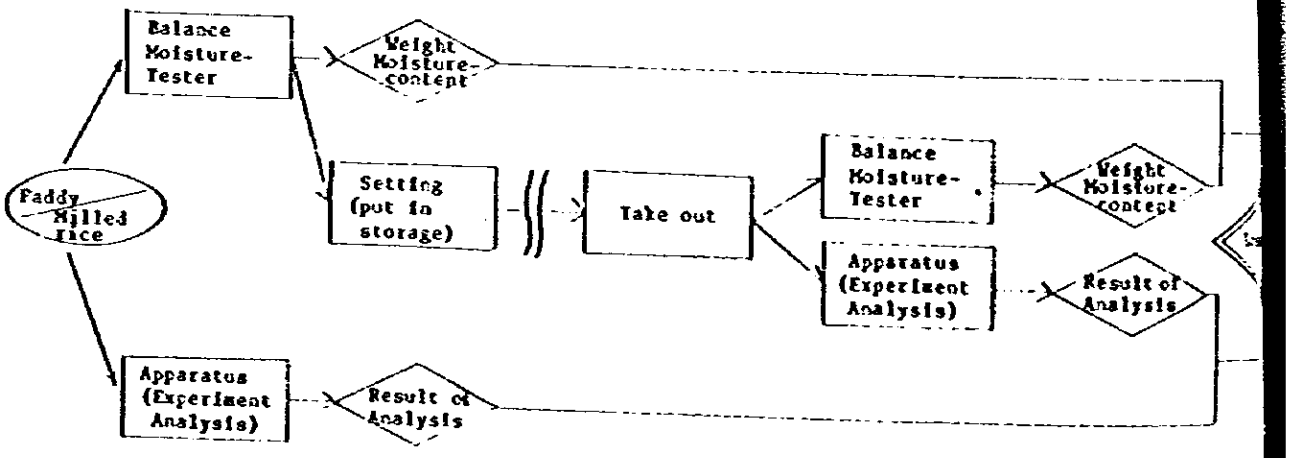


Fig. 5-6

(6) The Way of Experiment for Milling Losses

1) Type and Composition of Machines

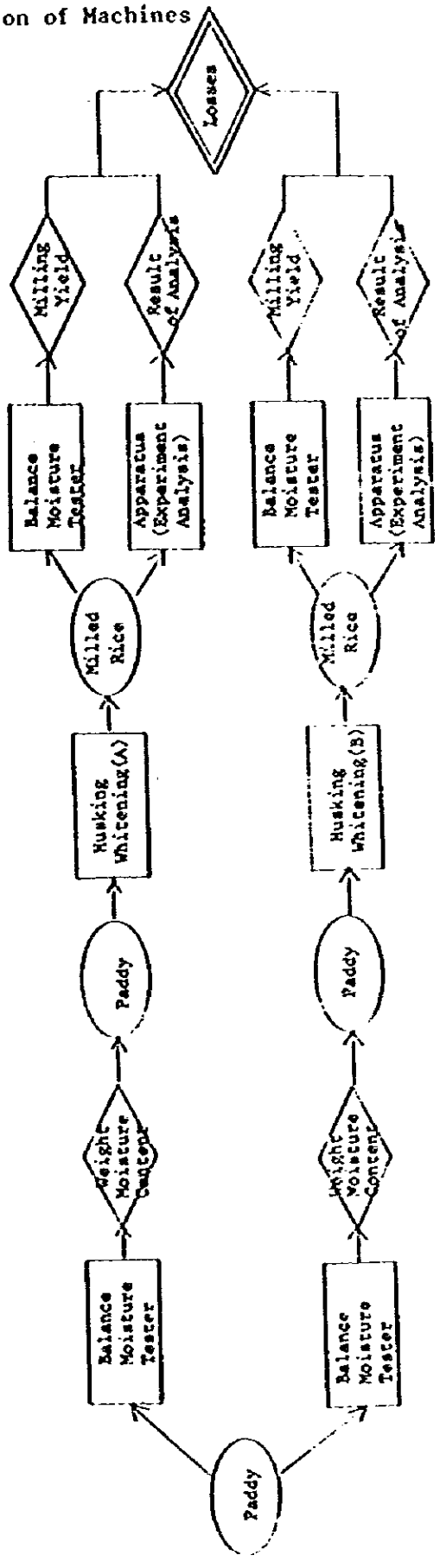


Fig. 5-7

2) Nature of Material

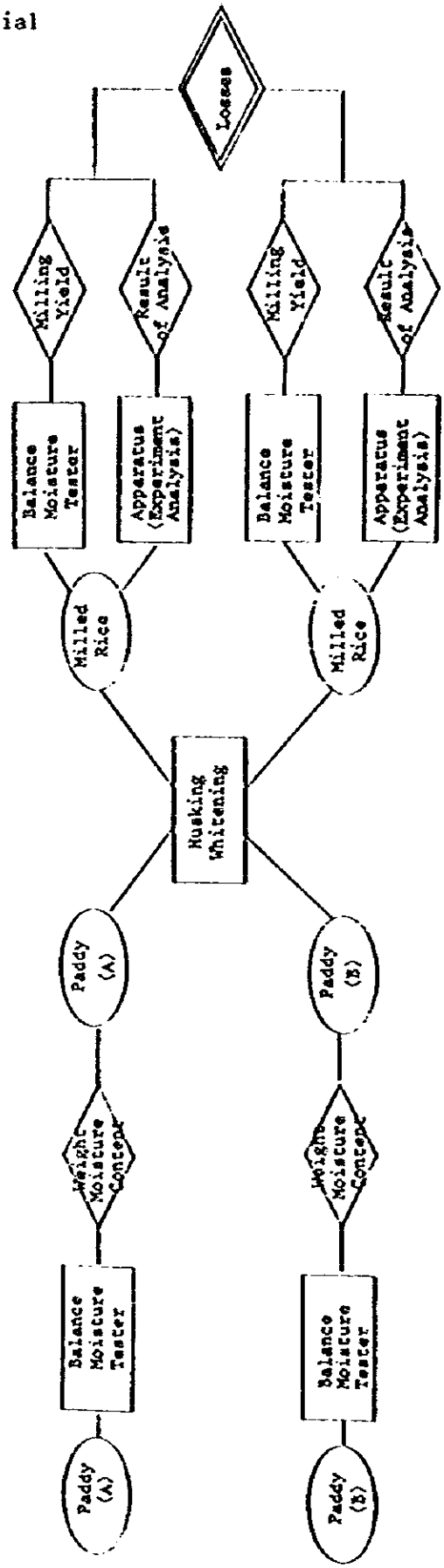


Fig. 5-8

5-3-6 List of Survey Equipment and Material

Table 5-2 Apparatus for the Survey

No.	Item	Specifications
1	Moisture Tester a) Riceter D-Type (Kett) b) PB - 1D (Kett)	Electric resistance type Measuring range brown rice 11~20% unhusted paddy 18~30% Accuracy ±0.5%(11~20%) "
2	Beam Balance	Measuring cap 2kg, Sensitivity 1g
3	Beam Balance	Measuring cap 15kg, Measuring cap 7kg Min. reading degree 100g(meas.) 50g(cap)
4	Beam Balance	Measuring cap 105kg Min. reading degree 100g
5	Table Balance	Measuring cap 200g
6	Spring Balance (for measuring paddy shattering resistance)	Measuring cap 100g
7	Hygro - Thermograph	Range of Measuring Temperature -20 ~ +40°C Relative humidity 0 ~ 100% Scale mark Temperature 1°C Relative humidity 1% Accuracy Temperature ±0.5% Relative humidity ±5% Sensor Temperature Bi-metal Relative humidity Hair of horse
8	Wet and Dry Bulb Thermometer	
9	Tube Termometer	
10	Grain Thermometer	50°C
11	Sample Bag	L, M, S (size)
12	Pincetter	
13	Sample Pan	
14	Sample Pan	
15	Sample Bottle	

16	A) Sieve Set	(4.0, 3.5, 3.0, 2.5, 2.0) round mesh
	B) Sieve	(1.5, 1.7, 2.0 mm) mesh
17	Measure Type	(50 m, 3.5 m)
18	Beaker	(500 mℓ)
19	Cylinders	(100 mℓ, 1 ℓ, 2ℓ)
20	Test Tubes	
21	New H. G. Solution	
22	Sample Divider	Food Agency of Japan Type 103 - B (small)
23	Grain Shape Tester	Food Agency of Japan Type
24	Grain Crack Inspector	for 50 grains
25	Magnifying Glass Set	
26	Grain Counter	for 100 grains, for 500 grains
27	Grain Trier	Long, Medium, Short
28	Vinyl Sheet	10 x 10 m, 3 x 3 m
29	Sunshine Gauge	Jordan Type
30	Stop Watch	
31	Tachometer	H-Type (Asahi), range 0 ~ 10,000 RPM one scale 2 R.P.M.
32	Ubinan	2.5 m x 2.5 m
33	Counter	
34	Rice Husker (Handy)	Rubber roller
35	Sickle	for rice reaping, serrated blade
36	Winnow	Local made
37	Winnower	Size 1.085(L) x 580(W) x 940(H) Rev. of fan axle 240 ~ 250 rpm Rev. of handle-grip 78 ~ 80 rpm Shutter openings 7 mm

38	Pedal Thresher	
39	Test Husker	TH035A (Satake) robber roll 200W, 110W, 50HZ
40	Test Pearler a) Parlest (Kett) b) MC-250 (Satake)	 Sample weight: Brown rice 10g Peeling time : Brown rice 30 sec. 250W, 110W, 50HZ
41	Reaper and Binder	HP20S (Kubota), Air-cooled gasoline engine 2.3ps/1800rpm, Single wheel, Lower portion cutting reciprocating blade, Effective width of reaping 20cm (one role), Wet paddy wheel and bandle collecting boat.
42	Reaper	AK-401 (Kubota), Air-cooled gasoline engine, Lower and middle portion cutting reciprocating blade, Effective width 120cm, Single wheel.
43	Power Thresher	SC3AE (Comma), Single under threshing cylinder, Air-cooled gasoline engine, 3.5ps/1800rpm, Width of threshing cylinder 60cm.
44	Dryer	KB-6WS (Yamamoto), Flat-bed (Twin box type) 1.2t x 2 boxes, Blower FB-58F 1.3 m^3/sec (1,550rpm), Diesel engine 5ps/2,200rpm.

Preferable equipment for survey

1. Grain Hydrometers 2. Grain Rigidity Tester 3. Rain Gauge

4. Table Balance (for 100g)