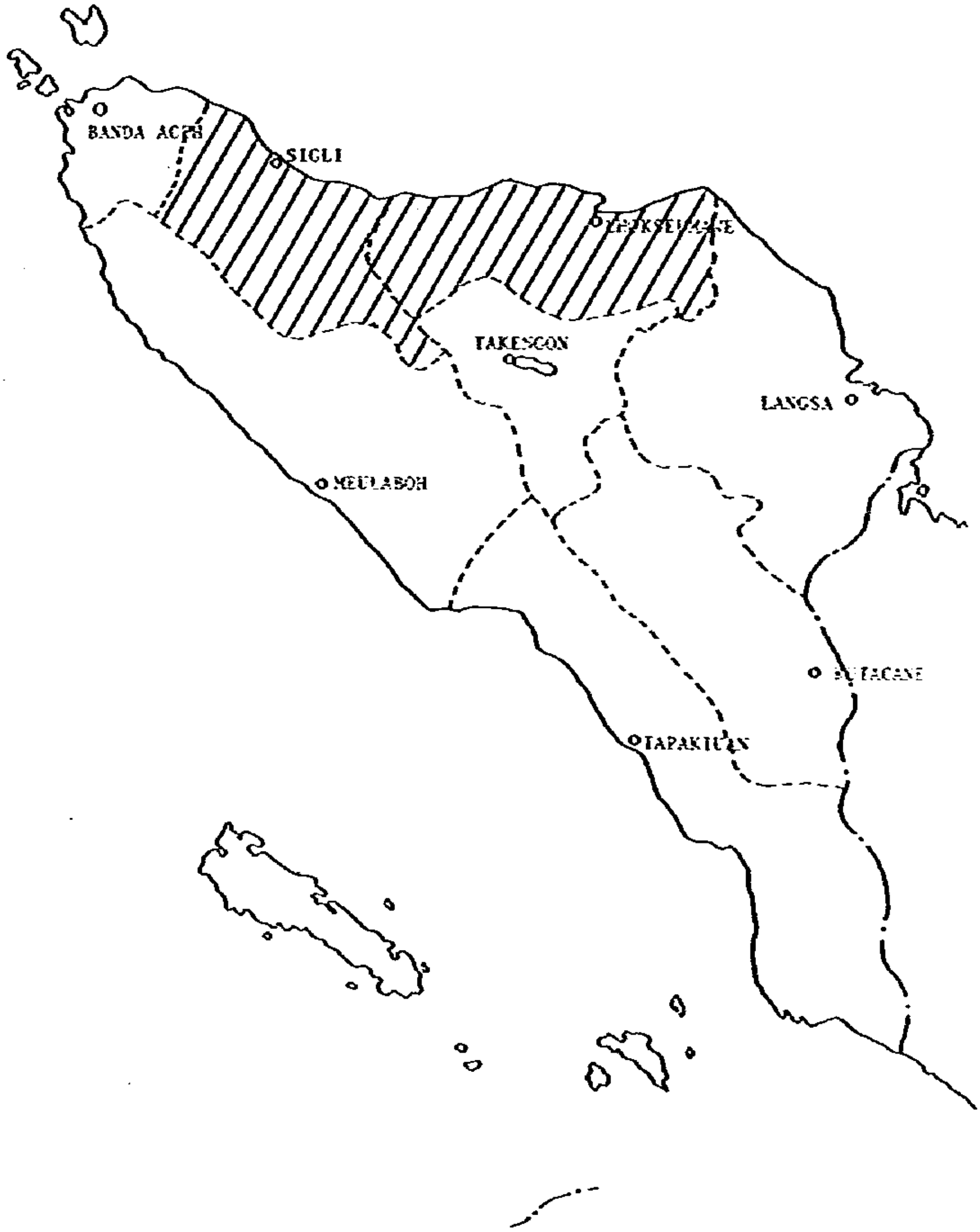
5-4 Results of the Survey

5-4-1 Field

(1) Aceh Province



Notes: 1. Oblique lines show the subject Districts for survey.
2. o marks are the location of the capital of District.
3. --- lines are the borders of the District.

Fig. 5-9 The Subject Districts of Aceh Province

Table 5-3 shows the survey areas in Aceh. Throughout the dry and rainy seasons, the survey was conducted in the two provinces of Aceh Utara and Pidie.

Table 5-3 Subject Districts, Sub-Districts and Villages in Aceh Province

	Field No.	District	Sub-District	Village
Dry-season	1	Aceh Utara	Jeunieb	Lamok Ulim
	2	"	"	Gambong Blang
	3	"	"	Lueng Teungoh
	4	"	Samalanga	Geulumeung Bunghok
	5	"	"	Matang Jareueng
	6	"	"	Sangso
	7	Pidie	Meureudu	Manyangcut
	8	"	"	Beuragan
	9	"	"	Benasah Bie
	10	"	Banda Dua	Kuta Baroh
	11	"	"	Uteun Baya
	12	"	"	Raya Tunong
Rainy-season	13	Aceh Utara	Reusangan	Pante Gajah
	14	"	"	Meunasah Timue
	15	"	"	Pante Piyeu
	16	"	Meurah Mulia	Blang Cut
	17	"	"	Meunasah Tanjung
	18	"	"	Meunasah Meurir
	19	"	Jeunieb	Lueng Teungoh
	20	"	"	Pandah Janeng
	21	Pidie	Meureuda	Blang Cut
	22	"	Banda Dua	Kuta Baroh
	23	"	Meureudu	Blangawee
	24	Aceh Utara	Samalanga	Pulo Drien

Table 5-4 Postharvest Losses in the Field, Aceh Province

Dry Season (1981)

Field No.	Variety	Losses (%)				Difference of Harvesting Time to Opt. (day)	Yie[illegible] (to[illegible])
		Reaping	Threshing	Winnowing	Drying		
1	SEMERU	0.2	0.1	0.1	trace	-3	5.1[illegible]
2	SEMERU	0.5	0.1	0.3	trace	-3	8.6[illegible]
3	IR-36	0.3	0.1	0.1	trace	±0	7.3[illegible]
4	B - 1	0.7	trace	0.1	0.1	±0	8.2[illegible]
5	IR-32	0.5	0.3	0.3	trace	±0	6.2[illegible]
6	IR-38	0.2	0.2	0.2	trace	±0	6.5[illegible]
7	SEMERU	0.4	0.2	0.1	0.1	±0	6.4[illegible]
8	SEMERU	0.7	0.1	0.2	trace	+3	6.4[illegible]
9	GALUR HARAPAN	0.5	0.1	trace	trace	±0	6.7[illegible]
10	SEMERU	0.4	0.1	0.1	trace	±0	6.2[illegible]
11	SEMERU	0.4	0.1	trace	trace	+3	8.1[illegible]
12	SEMERU	0.5	0.1	trace	trace	+3	6.15
	Average	0.4	0.1	0.1	trace		6.8[illegible]

Table 5-5 Postharvest Losses in the Field, Aceh Province

Rainy-Season (1982)

Field No.	Variety	Losses (%)							Difference of harvesting time to Opt. (day)	Yield (ton/ha)
		Reaper & Binder	Reaping	Power Thresher Hand feed	Power Thresher Throw-in	Threshing	Winnowing	Drying		
13	SEMERU	—	0.4	—	—	0.4	0.1	trace	±0	6.694
14	CISADANE	—	0.5	—	—	0.3	trace	trace	+1	7.456
15	CISADANE	—	0.1	—	—	0.2	0.2	trace	-4	6.701
16	IR-36	—	1.3	—	—	0.2	0.3	trace	±0	5.863
17	IR-36	—	0.8	—	—	0.2	0.1	trace	-5	6.258
18	IR-36	—	0.7	—	—	0.4	trace	trace	-3	4.701
19	CIMANDIRI	—	0.9	0.7	1.6	0.6	0.1	trace	+3	5.149
20	B - 1	3.4	0.3	1.1	1.1	0.3	0.6	trace	-1	5.570
21	IR-46	—	0.5	0.6	1.9	0.8	0.1	trace	±0	5.737
22	CIMANDIRI	1.5	0.3	trace	1.7	2.0	2.3	trace	+3	7.276
23	C. H. 16	1.9	0.4	0.4	0.9	0.5	0.3	trace	±0	7.451
24	CIMANDIRI	—	0.6	0.8	2.2	1.2	0.1	trace	+2	6.524
	Average	2.3	0.6	0.6	1.6	0.6	0.4	trace		6.282

Note: All farmers are using sickle, cut from middle portion and thresh by trampling.

1) Reaping

Reaping work in the province is normally done with sickles and rice is mowed at 1/3-1/2 of its height from the ground surface. This is called the middle-reaping method. Farmers surveyed were exclusively using this method for reaping.

Aceh Utara and Pidie, the object districts for the survey, are representative rice growing territories in the province and HYV is widely cultivated. Accordingly, all farmers surveyed are growing HYV.

In rice kinds which were grown by 2 or more farmers, loss generation was compared. The result was shown in Table 5-6.

Table 5-6 Reaping Losses by Varieties in Aceh Province

										Averag[illegible]
Variety	SEMERU	0.2 (-3)	0.5 (-3)	0.4 (±0)	0.4 (±0)	0.4 (±0)	0.4 (+3)	0.5 (+3)	0.7 (+3)	0.[illegible] (+[illegible]
	IR-36	0.8 (-5)	0.7 (-3)	0.3 (±0)	1.3 (±0)	—	—	—	—	0.[illegible] (-[illegible]
	B - 1	0.3 (-1)	0.7 (±0)	—	—	—	—	—	—	0.[illegible] (-[illegible]
	CISADANE	0.1 (-4)	0.5 (+1)	—	—	—	—	—	—	0.[illegible] (-[illegible]
	CIMANDIRI	0.6 (+2)	0.3 (+3)	0.9 (+3)	—	—	—	—	—	0.[illegible] (+[illegible]

Note: ( ) shows the difference of harvesting time to Opt. time.
- shows early harvesting, + shows late harvesting (Unit: days)

Referring to the table, IR-36 has the largest average loss rate in spite of early reaping. In other words, it tends to create not larger losses. However, it may be concluded that there is no significant difference of reaping loss between rice kinds, as far as the table is concerned.

Next, losses were compared depending on the adequacy of reaping timing, and its result is as shown in Table 5-7. In this case to prevent deviation, the data of IR-36 are not included, because it showed relatively higher loss ratio. Also, to judge a suitable time for reaping, farmer's opinions were listened to and the maturity of the crop was carefully observed.

Table 5-7 Reaping Losses by the Difference of Harvesting Time to Optimum in Aceh Province

Difference of Harvesting Time of Opt.								Average(%)
-4 (day) or more	0.1	—	—	—	—	—	—	0.1
-1 ~ -3	0.2	0.3	0.5	—	—	—	—	0.3
±0	0.4	0.4	0.4	0.7	—	—	—	0.5
+1 ~ +3	0.3	0.4	0.5	0.5	0.6	0.7	0.9	0.6

Referring to the table, there is a trend that, the later the reaping time, the larger the reaping loss. However, this trend is not so significant.

2) Threshing

Threshing is carefully performed by trampling. Also, the loss ratio is extremely small; a maximum 2.0% to an average minimum trace 0.4%.

In this province, threshing work is conducted several days after reaping. Consequently, the paddy becomes more easily threshable. This, along with careful threshing work, is one of the major reasons for less threshing loss.

3) Cleaning

Threshed paddy is mainly cleaned manually by female laborers in close vicinity to a field. The paddy drops from overhead using winnowers to clean the paddy by windpower. The work is done very carefully. The loss ratio was a trace - 2.3%, as small an average as 0.2%.

4) Drying

After threshing and cleaning, the paddy is transported to farmers and then rice for personal consumption is dried in front yards of farmers' houses. For under-sheeting, mats (Tical) are used and the rice is dried under the sun to a moisture content of 15-16%. On the other hand, paddy to be sold is often sent to the market half-dried. During sun-drying, losses sometimes arise due to by domestic fowl and other livestock. However, the amount is usually very small. In addition, rice is very carefully handled during the work, so that no significant loss was generated, according to the survey.

5) Loss in Mechanical Processing

Table 5-8 indicates the results of measured losses in the mechanical processes of reaping, bunching, threshing and drying.

Table 5-8 Quantitative Losses of Reaper & Binder, Power-thresher and Dryer in Aceh Province

Machine / Field	Reaper & Binder	Power Thresher		Dryer
		Hand-hold	Throw-in	
19	— %	0.7 %	1.6 %	trace %
20	3.4	1.1	1.1	"
21	—	0.6	1.9	"
22	1.5	trace	1.7	"
23	1.9	0.4	0.9	"
24		0.8	2.2	"
Average	2.3	0.6	1.6	"

In the following description, the survey results are explained for each machine.

a) Reap-binder

i) In swamp farms, it is impossible to collect spilled paddy in wheel treads. Therefore, an indirect method was first applied. This is one in which a collective amount from the survey area (20x5m) was compared with that from the standard (control) zone of the same area. However, there was a difference of more than ±6.0% for the collective amounts in the survey areas (due to non-uniform growth). This fully explained the inadequacy of loss estimation for very small amounts. In consequence, the survey was valid only when crawling tires were attached to machines and when machine reaping was permitted by farm conditions. Then, spilled paddy was recovered from the field surface after rice bundles were transported away, out of 3 Ubinans (2.5m x 2.5m x 3 positions). In this way the loss was directly estimated.

ii) If stalk is short (70 - 80cm), the kernel portion is apt to contact with moving parts, e.g. elevating claw of the binder, causing kernel spillage. For each kind of rice in the fields, kernel spillage and vertical stalk height were shown in Table 5-9, according to the survey results.

Table 5-9 Varieties and Characteristic by Subject Field

Field No.	Variety	Strength Resistance of Paddy Grains When Threshing	Shattering Habit	Plant Height (in Standing)
19	LR-28	80g (Moisture content 18~19%)	Medium	72 cm
20	B - 1	70g (" ")	———	70
21	IR-46	80g (" ")	———	83
22	Cimandiri	90g (" ")	Medium	99
23	GH-16	70g (" ")	Easy	110
24	Cimandiri	80g (" ")	Medium	90

Source: Descripsi padi, Varietas unggul, Dinas Pertanian, Aceh 1981

iii) Mechanized binding work is necessary to facilitate handling after reaping and to prevent kernel spillage loss. However, as far as the experimental machine was concerned, it was considered difficult to operate the machine for a long time using the present binding mechanism and binder string under the current method of maintenance and control. Accordingly, in order to simplify the mechanism, another area to be developed may include what bundling mechanism should be employed instead of the present binding mechanism.

Further, binding materials should be commercially available at any site and at a low-cost. Therefore, a comprehensive study should be made mainly on such traditionally used materials at present, e.g. straw, sliced bamboo, long-fibrous grass, etc.

iv) Reaping height should be largely controllable to respond to the conventional farming system, kinds of rice and the actual stalk height at maturity. Otherwise, the machine will not be versatile.

v) The collecting boat took a relatively small load even with swamp field work and could not move straight when fully loaded. Consequently, it appeared that the boat applied an excessive burden to the operator.

vi) Reaping Machine Work Conditions

A reaping machine is a moving field machine which responds to conditions different from those of threshing and drying work done in fixed positions. The conditions include those in the field (area, bearing power of ground, drainage condition), cultivation (transplanting, growing), machine weight, operability, and so forth. Requirements of the field and cultivating conditions in relationship to the machine might be reduced along with future improvement of the machine mechanism. But it will be currently impossible to resolve the problems of all of the foregoing conditions only by the development of the machine body.

b) Engine Thresher

i) Small bundles were made by lower reaping using a binder machine. Small bundles were also supplied by the conventional method of middle reaping and then, both were compared. Comparative specifications are shown for both rice bundles.

Table 5-10 Comparison of the Bundle of Paddy between Hand-hold and Throw-in.

Threshing Way / Items	Hand-hold	Throw-in
Variety	H. Y. V.	
Bundle Length	70 ~ 90 cm	50 ~ 55 cm
Range of Grain Attached (from panicle end)	30 ~ 45 cm	
Shattering Habit	Medium, Easy (70 ~ 90 g)	
Moisture Content (Paddy)	17 ~ 19 %	
Moisture Content (Stalk)	20 ~ 30 %	
Materials for Bundling	Sting	Raw stalk with paddy
Weight of Bundle	900 ~ 1,200 g	700 ~ 800 g
Grain-straw Ratio	3 ~ 4 : 6 ~ 7	4 ~ 5 : 5 ~ 6

ii) According to a test where small bundles of rice were threshed manually after field drying, no practical difficulties were observed, except for the stalk length of 70cm or less. However, when the bundles were gathered from the field by about 9:00 AM and morning dew had not dried on the rice bundles, the straw of the bundles was not smoothly discharged from the threshing cylinder which clogged, causing separation problems. Therefore, work should not be done in the very early morning or immediately after being re-wetted by rainfall.

iii) Throw-in threshing is judged basically inadequate for the experimental machine. If applied, processing capabilities will drastically drop because of the inconsistency of the specification of the catcher mesh, straw discharge port size, and attached engine output. This occurs no matter which is employed, raw crop threshing or dried threshing.

iv) Recommendation of Threshing

If the field drying period is extended for rice bundles, drying can generally proceed. However, wetting may occur from a rainfall, possibly resulting in cracked kernels. HYV has easy shattering kernel nature, so that, if the crop is mechanically threshed to make operations easier, later rain damage will be effectively prevented. Threshed rice may be of such a volume that it can be temporarily stored under the floor of a high-floor house or even in a room.

In threshing, hand-hold is easily applied. Therefore, the middle-reaping method of the conventional system shall be changed to low portion-reaping. Also, there is small difference of specific gravity between chopped stalks and raw crops and winnowing separation becomes difficult. However, the matter of cleaning will be solved by common application of a vibrating sieve by winnowing paddy after preliminary drying.

In cleaning after drying, the thresher may be a drum type and, only large straw shall be removed. In addition, winnower cleaning shall be performed after completion of drying. By this process, piling will disappear and this is particularly featured in the post harvest handling in Aceh. Consequently, the matter of colored rice will be completely solved.

Notes:
1. Oblique lines show the subject Districts for survey.
2. o marks are the location of the capital of District.
3. --- lines are the broders of the District.

(Fig. 5-10 The Subject Districts of West Jawa Province)

Table 5-11 shows survey areas in West Jawa.

In the dry season, the Bekasi District and Bogor District were surveyed and, in the rainy season, the Bekasi and Karawang Districts were investigated.

Table 5-11 Subject Districts, Sub-Districts and Village in West Java Province

	Field No.	District	Sub-district	Village
Dry-season	1	Bogor	Kariu	Cariu
	2	"	"	Mekarwangi
	3	"	Jonggol	Weninggalih
	4	"	"	Jonggol
	5	Bekasi	Babelan	Bahagia
	6	"	"	Babelan
	7	"	"	Babelan Kota
	8	"	Bekasi	Telukpucung
	9	"	"	Perwira
	10	"	"	Kalabang Tengah
	11			
	12			
Wet-season	13	Karawang	Ciramaya	Tegalwuaru
	14	"	"	Sukatani
	15	"	Karawang Wetan	Cibungur
	16	"	Karang Pawitan	Marang
	17	Bekasi	Rumahabang	Tanjung Baru
	18	"	Bekasi	Malgamarya
	19	Karawang	Karawang	Tanjung Pula
	20	Bekasi	Cibitung	Sari Mukuti
	21	"	"	"
	22	"	Karawang	Kaum Tanjung Pula
	23	"	Rengasdengklok	Rengasdengklok Selatan
	24	"	Karawang	Tonjung Pula

Table 5-12 Postharvest Losses in the Field, West Jawa Province

Dry-season (1981)

Field	Variety	Losses (%)					Yield (kg/ha)	Harvesting System
		Reaping		Threshing		Drying		
		Upper	Lower	Tramping	Banting			
1	CISADANE	1.3	—	0.2	—	Trace	7,497	Nyeblok
2	CISADANE	0.9	—	0.2	—	Trace	6,489	"
3	CISADANE	1.7	—	0.3	—	Trace	6,879	"
4	CISADANE	1.6	—	0.4	—	Trace	6,072	"
5	CISADANE	0.9	—	0.3	—		6,624	Bawon
6	IR-36	0.6	—	0.6		—	4,208	"
7	CISADANE	1.3	—	0.2	—	—	6,876	"
8	CISADANE	3.7	—	0.4	—	—	5,762	"
9	CISADANE	6.3	—	1.2	—	—	5,880	"
10	CISADANE	—	5.5		2.3	—	5,567	"
Average		2.0	5.5	0.4	2.3	Trace	6,185	

Table 5-13 Postharvest Losses in the Field, West Jawa Province

Wet-season (1982)

Field No.	Variety	Losses (%)										Yield (kg/ha)	Difference of Harvesting Time to Opt. (day)	Harvesting System
		Reaper & Binder	Reaping		Power Threader	Pedal Threader	Threshing		Temporary	Winnowing	Drying			
			Upper	Lower			Tramping	Banting						
13	CISADANE	—	—	2.4	0.3	2.0	—	3.3	0.8	Trace	Trace	7,071	+2	Bawon
14		—	—	—	4.1	2.2	—	4.7	0.8	Trace	Trace	6,394	±0	"
15	CISADANE	2.8	1.3	—	1.3	1.6	0.2	—	—	Trace	Trace	6,499	±0	"
16	IR-36	4.5	6.4	—	0.7	0.6	0.1	—	—	Trace	Trace	6,012	+5	"
17	SEMERU	2.2	3.2	—	2.4	2.3	1.3	—	—	0.1	Trace	4,324	+5	"
18	CISADANE	1.5	—	1.0	0.8	0.9	—	1.7	1.4	Trace	Trace	7,067	-2	"
19	CISADANE	—	1.3	—	—	—	0.2	—	—	—	Trace	5,707	±0	Nyeblok
20	SEMERU	—	2.9	—	—	—	0.6	—	—	—	Trace	5,756	-3	Bawon
21	IR-36	—	4.0	—	—	—	0.3	—	—	—	Trace	5,434	±0	"
22	CISADANE	—	0.7	—	—	—	0.4	—	—	—	Trace	4,698	±0	Nyeblok
23	CISADANE	—	—	0.2	—	—	—	1.5	1.1	—	Trace	5,611	±0	Experiment
24	IR-36	—	—	0.3	—	—	—	2.6	0.5	—	Trace	3,309	±0	"
Average		2.8	2.8	1.0	1.6	1.6	0.4	2.8	0.9	Trace	Trace	5,657		

In addition to the survey made in the dry season, a seminar was held in the province for technical transfers. Therefore, the survey was conducted only on 10 farmers, 2 less than originally planned, because of the limited schedule.

1) Reaping

In the province, all surveyed farmers were cultivating HYV. This is because the survey area was set at the Karawang, Bekasi and Bogor Districts, central rice growing areas in the northern plain, where there were almost complete irrigating facilities.

Varieties of the surveyed were limited to only three kinds of Cisadane, IR-36 and Semeru. Cisadane is particularly popular among farmers.

Table 5-14 indicates a comparison of reaping losses of these 3 varieties. In the table, data were collected only from farmers who used Bawon and high reaping, in order to eliminate other factors of loss generation.

Table 5-14 Reaping Losses by Varieties in West Java Province

Variety							Average (%)
	CISADANE	0.9	1.3	3.7	6.3	1.3	2.7
	IR-36	0.6	4.0	6.4	—	—	3.7
	SEMERU	3.2	2.9	—	—	—	3.1

Referring to the table, IR-36 has the largest loss generation. Semeru and Cisadane follow in that order. In other provinces, too, IR-36 shows larger losses.

Then, relating to reaping tools, lower portion-reaping is most popularly adopted using sickles in dry fields in the province, as described earlier. However, in wet fields, high portion-reaping is made. Accordingly, the tools in use are not specified. Therefore, sickle reaping and ani-ani reaping could not be compared within one field in terms of loss ratio.

Hence, lossess are compared herein for low portion-reaping and high portion-reaping as follows:

Table 5-15 Reaping Losses by Reaping Portion in West Java Provi...

									Average (%)
Reaping Portion	Lower	2.4	1.0	—	—	—	—	—	1.7
	High	1.3	6.4	3.2	1.3	2.9	4.0	0.7	2.8
	Reaper & Binder	2.8	4.5	2.2	1.5	—	—	—	2.8

Table 5-16 Reaping Losses by Reaping Portion in West Java Province (Bawon System)

							Average (%)
Reaping Portion	Lower	2.4	1.0	—	—	—	1.7
	High	0.9	1.3	3.7	6.3	1.3	2.7

Table 5-15 shows a simple comparison between low-reaping and high-reaping for farmers surveyed during rainy season. In this case, data for farmers No. 23 and 24 were omitted from the table because reaping was applied after test setting. Also for a reference, results of binder reaping loss are noted.

On the other hand, Table 5-16 indicates an comparison for the same kind as above, while eliminating factors caused by varieties and reaping styles by choosing farmers who grow Cisadane and reap by the Bawon system.

Referring to these tables, high-reaping shows higher loss than low-reaping. This may be because head reaping often causes larger unreaped loss and trampling loss, according to our observation possibly resulting in larger losses.

Particularly for the Bawon system where 200-300 workers come together for reaping in 1 ha, unreaped loss and trampling loss may further increase.

As described above, where many workers participate in reaping and payment is made by piecework, reaping is often carried out speedily and roughly, obviously causing larger losses.

To compare the Bawon and Ceblok reaping systems, loss ratio are shown comparatively in Table 5-17.

Table 5-17 Comparison of Reaping Losses by Bawon with Ceblok in West Java Province

Harvesting System									Average (%)
	Bawon	0.9	1.3	3.7	6.3	1.3	3.2	2.9	2.8
	Ceblok	1.3	0.9	1.7	1.6	1.3	——	——	1.4

The data in the table were taken from farmers who were exclusively using high reaping. Further, data on IR-36 were omitted, because this variety tended to create larger losses.

Referring to the table, it will be understood that larger losses are generated with Bawon reaping than with Ceblok.

Next, Table 5-18 is a typical comparison for loss generation depending on reaping time.

Table 5-18 Reaping Losses by the Difference of Harvesting Time to Optimum in West Java Province

Difference of Harvesting Time to Optimum days						Average (%)
-3 ∿ -1	1.0	2.9	1.5	——	——	1.8
±0	1.3	1.3	4.0	0.7	2.8	2.0
+1 ∿ +3	2.4	——	——	——	——	2.4
+4 ∿ +6	6.4	3.2	2.2	4.5	——	4.1

In the table, too, data on farmers No. 23 and 24 are omitted. In addition, data of binder reaping loss are included on the table to supplement the relatively smaller number of data.

As far as the table is concerned, reaping loss tends to increase when passing the optimum reaping season.

The later reaping is done, the more shattering kernels increases. This tendency is obviously proved also in a reaping test separately carried out in the same province. The details of this test will be described in 5-4-1 (6) "Tests for Loss by Reaping Time".

2) Threshing

The normal threshing procedure in the province is either the trampling or beating method respectively corresponding to high-reaping or low-teaping. In rare cases, stick beating is used after high-reaping. However, none of the surveyed farmers used it.

The amount of threshing loss substantially depends on which method is used. Its trend is shown in Table 5-19. For a reference, survey results of losses by pedal thresher and engine thresher are also shown together.

Table Table 5-19 Threshing Losses by Threshing Method in West Java Pr…

Threshing Method									Average (
Trampling	0.2 1.2	0.2 0.2	0.3 0.1	0.4 1.3	0.5 0.2	0.6 0.6	0.2 0.3	0.4 0.4	0.4
Beating	2.3	3.3 (3.2)	4.7 (4.2)	1.7 (1.3)	1.5 (1.1)	2.6 (1.4)	—	—	2.7
Power Thresher	0.3	4.1	1.3	0.7	2.4	0.8	—	—	1.6
Pedal Thresher	2.0	2.2	1.6	0.6	2.3	0.9	—	—	1.6

Referring to the table, the largest loss is caused by scattering paddy during beating. Figures in (5-19) for beating loss represent the scattering loss ratio.

Meanwhile, some farmers temporarily piled rice bundles in the fields after reaping, as a preliminary step to threshing. At that time, loss was observed, so that the loss ratio of temporary piling was measured. In its detailed method, PVC sheets, etc. were laid on th the fields on which paddy bundles were temporarily stacked. Then, after threshing work, remaining paddy was recovered.

During the survey in the rainy season, 5 farmers were low-portion-reaping with a temporary piling loss ratio of a maximum 1.4%, minimum 0.5% and mean 0.9%.

3) Cleaning, Drying

In the province, cleaning and drying work are not done at the farm level, and paddy as threshed in the fields is directly sold to KUD or brokers.

Paddy drying is applied only to that to be used for private consumption. In the work, rice was carefully handled and loss was not usually observed.

4) Transportation

In the province, middle portion-reaped paddy stalks are conveyed using a Sundan, a kind of carrying pole. In this process, a loss was observed. Therefore, a survey was performed and the result will be described in 5-4-3.

5) Loss Survey Employing Harvesting Machine

Table 5-20 Reaping Losses by Harvesting Way (West-Java)

(%)

Harvesting Way	Sickle Cutting		Binder	Reaper
	High	Low		
Quantitative(%) Losses	2.8	1.0	2.8 (incl. shattered kernel in vessel)	1.0

a) Binder

Average 1.3% of loss due to shattering kernels is generated by the impact when discharging rice bundles, and is included in 2.8% loss.

b) Reaper

i) Amount of loss differs as follows depending on reaping height from the ground surface.

47.7 cm —— 2.1%
30.0 cm —— 0.6%
17.6 cm —— 0.2%

As is obvious in the above, the higher stalk is reaped, the larger the loss arises. This is because, when the reaping height is high, heads of shorter stalks often remain unreaped (non-uniform head height). Also, even if short stalks are throughly reaped, they are not readily collected reaped bundles but often fall on the ground, possibly resulting in losses.

ii) When straw chips adhere to the divider forming a block, the cutting blade may push stalks before reaping if rice was not planted in straight lines. This may cause unreaped loss.

c) Threshing Losses with Power Thresher

Table 5 - 21 Threshing Losses with Power Thresher (West Jawa)

Threshing Method		Quantitative Losses(%)	Materials to be fed and Feeding Condition
Power Thresher	Hand-hold	1.6	low cut, raw
	Throw-in	1.1	high cut (about 40 cm), raw
Pedal Thresher		1.6	high cut, raw, hand-hold
Conventional	Beating	2.7	high cut, raw, hand-hold
	Trampling	0.4	high cut (about 40 cm L.), raw

i) Amount of loss varies as a function of moisture content in paddy. Especially if the moisture in straw is high (rain-wetting, falling-down, bad drainage, early-morning reaping), loss may increase due to poor separation.

ii) The husking ratio is normally small. Further, manual throw-in threshing has a smaller ratio than manual threshing. This may be because the straw is working as a damper.

iii) In case of a variety having relatively irregular maturity (i.e. IR, Sumeru), threshing losses become greater.

iv) When bundles were temporarily piled for the preparation of threshing, loss of shattering kernels was observed to a large degree.

d) Power Thresher (Hand-hold Method)

i) There is a difference in the range of kernel-bearing in each paddy stalk. Non-threshed kernels appear depending on the kernel-bearing degree and regularity of the heads. Of course, the larger range is the worse than the heads are regulated, the larger the non-threshed loss results.

ii) If the manual carrying volume is too much for one time or stalk length is longer than 100 cm, a part of the bundle is apt to overflow when inserting the paddy stalks into the charging chute, possibly resulting in non-threshed loss.

e) Power Thresher (Throw-in)

Where longer stalks are used for supplied material (normal value is about 40 cm) or moisture contents in paddy and stalks are high.

f) Loss in Pedal Thresher

In this case, the thresher is manually operated. carrying volume at one time should be small. Hence, losses of non-threshing, in-straw kernels, etc. become less.

g) Loss during Cleaning by Winnower

i) Volume of loss differs depending on operating technique of operator, especially for the manual winnower.

ii) Normally, there is substantially no loss discharged to No. 2 outlet and No. 3 outlet. However, with wet raw material cleaning performance becomes poorer and in turn causes larger losses.

6) Items on the Performance of Machines for Agricultural Mechanization Mechanization

a) Binder, Reaper

i) In wet or muddy fields having surface water, mud adheres to steel wheels and the machine is difficult to run.

ii) Work efficiency is greatly influenced by the field area, dimension, way of planting and ease of drainage.

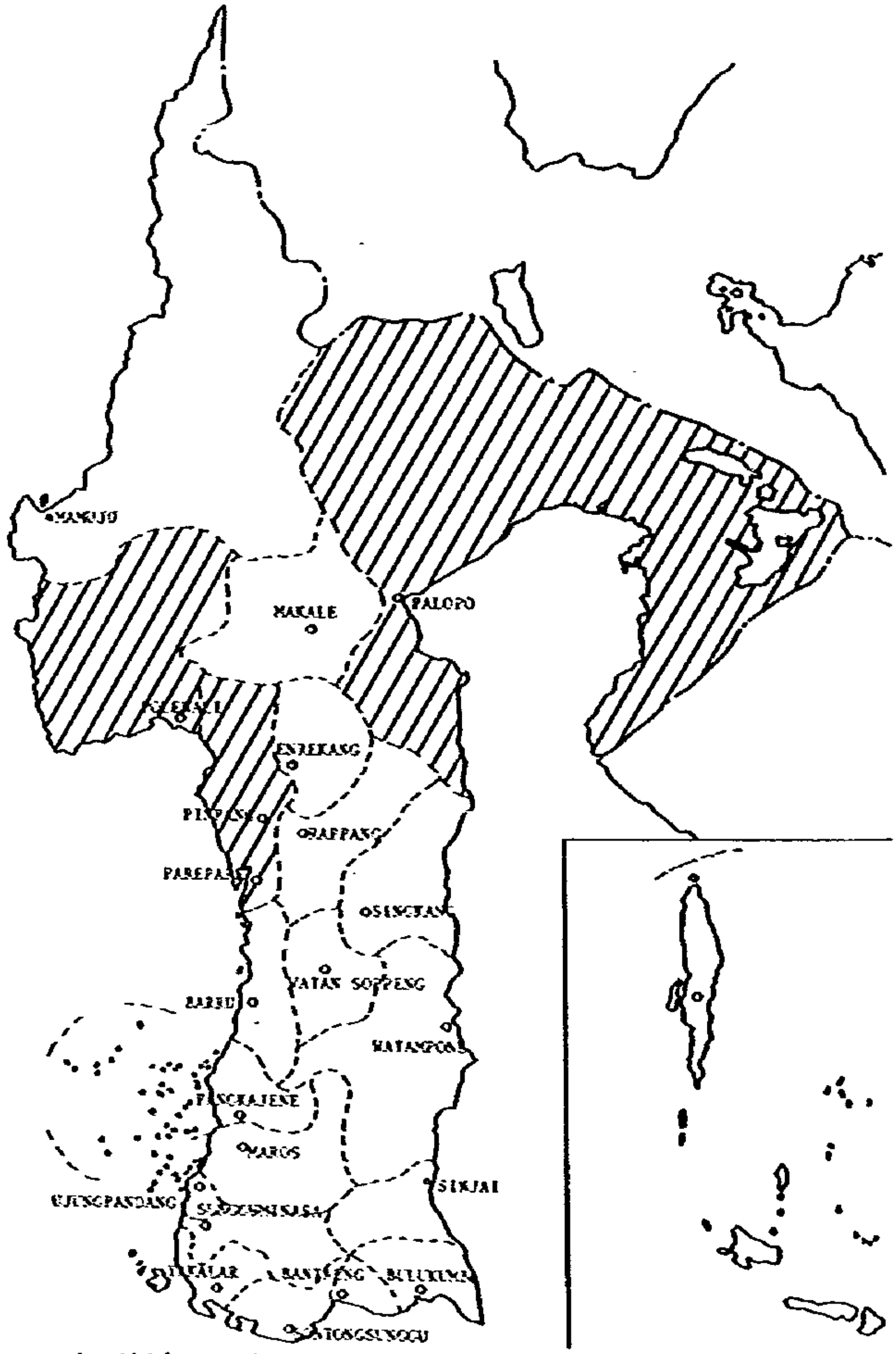
b) The binder can work even in water-covered fields or deep muddy soil, as long as a bunching vessel is mounted. However, in this case, operating efficiency drops by about 50% due to additional unloading of paddy bundles from the bunching vessel and slipping run.

c) Thresher

The hand-hold method of threshing is superior to the throw-in method, in view of threshing capability pei thresher power. However, in actual practice the handling capacity of a machine is often determined by whether paddy stalks are easily supplied to the thresher. In the hand-hold method, rice will be handled at a greater rate in case of small, bunched bundles of suitable stalk lengths. In this point of view, an automatic thresher with an auto-feeder may provide better performance.hold.

d) If we plan an optimum line of machines for harvesting, taking local conditions into account, we can propose the following system for the least losses and best processing capabilities; namely a reaper is shall be middle portion cutting and then, it is sun-dried and packed in bags and transported to the threshing site where it is supplied to a throw-in type thresher.

(3) South Sulawesi Province



Notes: 1. Oblique lines show the subject kabupatens for the survey
2. o marks are the location of the capital of kabupaten.
3. --- lines are the borders of the kabupaten.

Fig. 5-11 The Subject Kabupatens of South Sulawesi

Table 5-22 shows the Survey Areas in South Sulawesi.

Table 5-22 Subject District, Sub-District and Village in South Sulawesi Province

	Field No.	District	Sub-district	Village
Dry-season	1	PINRANG	MATIROBULU	ALITA
	2	"	"	MANARANG
	3	"	"	MARANNU
	4	"	PATAMPANUA	TEPPO
	5	"	"	LEPPANGENT
	6	"	"	TONYAMANG
	7	LUWU	SULI	SULI
	8	"	"	"
	9	"	"	"
	10	"	LAROMPONG	LAROMPONG
	11	"	"	SUYAMUS
	12	"	"	"
Wet-season	13	POLMAS	POLEWALI	TAKATIDUNG
	14	"	"	TONYAMANG
	15	"	"	DARMA
	16	"	WONOMULYO	SIDODADI
	17	"	"	MAPILLI
	18	"	"	KEBUNSARI
	19	PINRANG	MATTIROSOMPE	MATTONGAN TONGAN
	20	"	"	LANRISANG
	21	"	"	MASSULOWALIE
	22	"	DUAMPANUA	LAMPA
	23	"		KAMALI
	24	"		BUNGI

Table 5-23 Postharvest Losses in the Field, South Sulawesi Province

Dry-season (1981)

No.	Variety	Losses (%) Reaping	Threshing	Drying	Yield (ton/ha)
1	IR-42	0.8	3.9	Trace	5,677
2	IR-42	1.1	3.7	Trace	4,755
3	IR-42	1.0	4.0	Trace	5,959
4	IR-42	3.1	2.7	Trace	4,564
5	IR-42	1.1	6.2	Trace	4,982
6	IR-42	0.7	1.5	Trace	6,124
7	IR-26	2.0	5.1	Trace	5,885
8	IR-26	0.7	2.5	0.1	5,091
9	IR-42	2.8	3.3	Trace	6,861
10	IR-42	0.9	3.6	Trace	3,444
11	IR-42	0.2	7.4	Trace	5,126
12	IR-42	0.8	2.0	Trace	2,772
	Average	1.3	3.8	Trace	5,103

Wet-season (1982)

No.	Variety	Losses (%) Reaping	Threshing	Drying	Difference of harvesting time to Opt. (day)	Yi[illegible] (t[illegible])
13	IR-38	0.2	3.3	Trace	+1	[illegible]
14	IR-42	0.6	2.7	Trace	+3	[illegible]
15	IR-54	0.5	2.1	Trace	±0	[illegible]
16	IR-54	0.7	2.6	Trace	±0	[illegible]
17	IR-54	0.5	3.2	Trace	-7	[illegible]
18	IR-54	3.2	2.4	Trace	-1	[illegible]
19	IR-42	1.7	6.9	Trace	+2	[illegible]
20	IR-54	1.1	3.4	Trace	+1	[illegible]
21	IR-42	1.3	4.4	Trace	+1	[illegible]
22	IR-42	0.9	3.3	Trace	±0	[illegible]
23	IR-42	1.0	1.9	Trace	-1	[illegible]
24	IR-54	1.0	2.0	Trace	+2	[illegible]
	Average	1.1	3.2	Trace		[illegible]

Note) All farmers are using sickle, cut from lower portion, and thresh by beating. Harvesting system is Bawon.

Pinrang District and Luwu District were selected as survey areas in dry season, and Palmas District and Pinrang District were survey in rainy season.

1) Reaping

Reaping is normally done by lower-reaping using sickles. Head chipping using ani-ani is seen only in areas where local varieties are grown. Since the survey areas include many well-irrigated zones, farmers in the survey were totally cultivating HYV of the IR variety. In other provinces, domestically bred HYV or HYV cross-bred between an excellent local variety and IR is more often preferred and chosen by farmers. It will be a characteristic of this province that out of HYV, IR varieties are dominantly grown.

Referring to the difference of loss for each variety, Table 5-24 shows a summary.

Table 5-24 Reaping Losses by Varieties in South Sulawesi Province

										Variety (%)
Variety	IR-42	0.8	1.1	1.0	3.1	1.1	0.7	2.8	0.9	1.2
		0.2	0.8	0.6	1.7	1.3	0.9	1.0	—	
	IR-54	0.5	0.7	0.5	3.2	1.1	1.0	—	—	1.2
	IR-26	2.0	0.7	—	—	—	—	—	—	1.4

The order of farmer preference, ranked from large to small degree of preference is IR-42, IR-54, IR-26 through both dry and rainy seasons. Only one farmer was using IR-38 Sead.

Referring to the table above, no substantial difference of loss is observable between each variety. Because these varieties belong to the IR properties, differences might not occur to an appreciable degree.

Next, the effect of delayed reaping time was analyzed in terms of loss and the result is shown in Table 5-25.

Table 5-25 Reaping Losses by the Difference of Harvesting Time to Optimum in South Sulawesi Province

Difference of Harvesting Time to Optimum Day								Average
	-3 (day)	0.5	—	—	—	—	—	0.5
	-3 ∿ -1	3.2	1.0	—	—	—	—	2.1
	±0	0.5	0.7	0.9	—	—	—	0.7
	+1 ∿ +3	0.2	0.6	1.7	1.1	1.3	1.0	1.0

The survey of reaping time was carried out only during the rainy season. Accordingly, there are little data to analyze these phenomena. However, it will be concluded as a general trend that, the more maturity progresses, the larger loss results.

On the Table 5-25, the figure of the loss included a loss during temporary piling in field after reaping, therefore, actual reaping loss may be less.

2) Threshing

In the province, the normal practice is beating. This method may be traditionally making use of shattering habit of the Indica type rice. Compared with other methods, it has better work efficiency, but larger loss is caused.

In the beating method, losses consist of two factors of scattering and non-threshing. According to the observation, total losses comprise about 2/3 scattering and 1/3 non-threshing.

Fig. 5-12
Beating Method

The relationship between the sheet and loss was surveyed in 6 farmers. Table 5-26 and Fig. 5-13 show the results.

Table 5-26 The Relationship Between the Size of Sheet and the Threshing Losses by Beating

Farmer	Size of Sheet (m^2)	Losses (%)
A	5.5	6.88
B	10.5	3.35
C	5.6	4.40
D	3.8	3.33
E	13.3	1.85
F	5.4	1.99

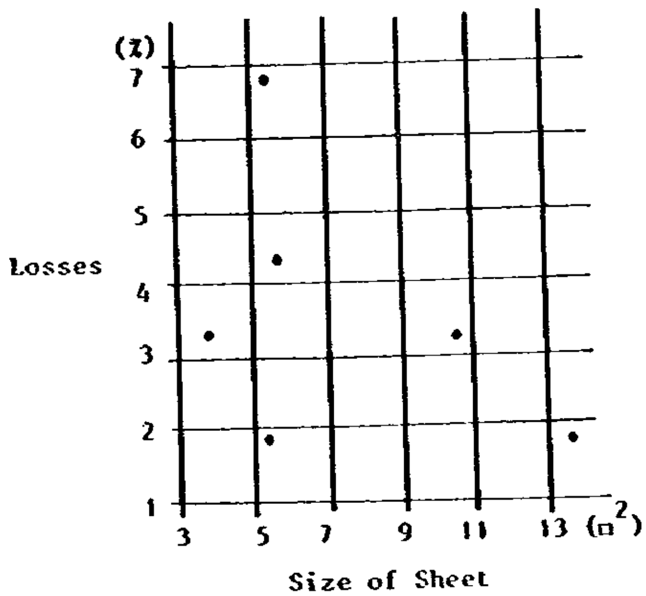


Fig. 5-13 The Relationship between the Size of Sheet and the Threshing Losses by Beating

Although little data is available from only 6 farmers, there is a tendency that threshing loss decreases where sheets larger than 7 m² are employed.

3) Drying

In general, non-cleaned, non-dried paddy is procured by KUD and commercial sector from farmers. At the farm level, rice is more often sold while with a moisture content of 18-22% without being dried.

Consequently, when paddy is dried by farmers, it is mostly used for household consumption. Also, the volume is less. Therefore, paddy is dried in small lots, whenever time is available. In usual practice, mats (TICAL) are spread along the roadside or in the front yard of the house, etc. and paddy is dried under the sun.

During drying, losses by domestic ducks and other fowl occur, but the volume is very small.

4) Cleaning

Cleaning work is not generally done in the province, except that large foreign matter is removed. Hence, loss during cleaning was not measured at the time of the survey.

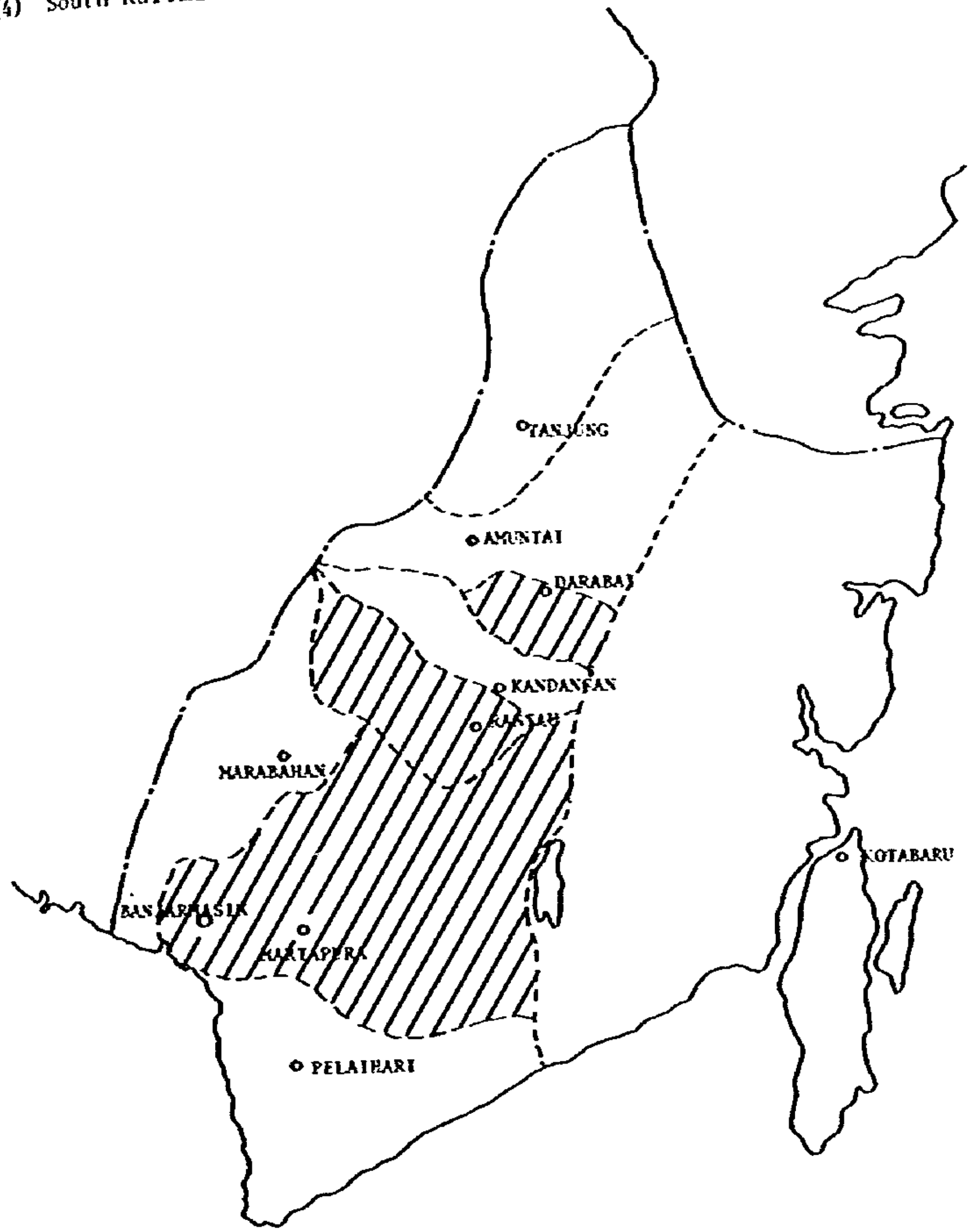
The reason why no cleaning work is generally done in the province will be summarized as follows:

a) According to the traditional method, paddy reaped using ani-ani are dried while still bearing ears. Then, using a wooden mortar and pestle, threshing, husking and milling are performed in one process. Therefore, it was not customary to perform paddy cleaning.

b) The beating method is used for threshing. Therefore, relatively well-matured paddy can be threshed.

c) Even if paddy is not well separated or dried, buyers are prepared to buy.

(4) South Kalimantan



Notes: 1. Oblique lines show the subject kabupatens for the survey.
2. o marks are the location of the capital of kabupaten.
3. --- lines are the borders of the kabupaten.

Fig. 5-14 The Subject Kabupatens of South-Kalimantan

Table 5-27 Surveyed District, Sub-District and Village in South Kalimantan Province

	Field No.	District	Sub-District	Village
Dry-season	1	BANJAR	ASTAMBUR	TAMBAK DANAN
	2	"	"	"
	3	"	"	"
	4	"	MARTAPULA	SUNGAI BATANG
	5	"	"	"
	6	"	"	"
	7	HULUSUNGAI TENGAH	HARUYAN	HAPULANG
	8	"	"	"
	9	"	"	BARIKIN
	10	"	LABUAN AMAS UTARA	BANJAI PAMANCKIH
	11	"	"	"
	12	"	"	"
Wet-season	13	TAPIN	TAPIN-UTARA	PARANDAKAN
	14	"	TAPIN-TENGAH	PANDARAGAN
	15	"	"	"
	16	"	TAPIN-SELATAN	SAWANG
	17	"	"	"
	18	"	"	PANPAIN
	19	HULU SUNGAI TENGAH	HARUYAN	HAPULANG
	20	"	"	"
	21	"	BATU BENAWA	BULU
	22	"	"	"
	23	"	LABUAN AMAS SELATAN	DURIANGANTANG SELATAN
	24	"	"	SUNGAI RANGAS

Table 5-27 shows the survey areas in South Kalimantan. In the dry season, the Banjar and Fulu Sungai Tengah Districts were chosen. In the rainy season, the Tapin and Fulu Sungai Tengah Districts were selected.

Table 5-28 Postharvest Losses in the Field, South Kalimantan Province

Dry-season (1981)

Field No.	Variety	Losses (%) Reaping	Threshing	Drying	Winnowing	Yield (ton/ha)
1	C4-63	2.5	0.8	trace	trace	2,736
2	C4-63	1.7	4.2	trace	trace	2,621
3	PANDAC (L.V.)	0.8	1.5	trace	trace	3,603
4	C4-63	4.9	0.9	trace	trace	2,790
5	PANDAC (L.V.)	1.3	0.4	trace	0.2	3,357
6	LEMO (L.V.)	0.8	0.4	0.1	trace	4,998
7	IR-36	3.6	0.1	trace	trace	3,954
8	IR-36	2.3	2.0	0.1	trace	4,349
9	IR-36	2.7	0.8	trace	trace	3,879
10	IR-5	1.2	1.6	trace	trace	3,892
11	C4-63	1.1	0.4	trace	0.2	3,752
12	IR-5	0.8	1.4	trace	0.1	3,232
	Average	2.0	1.2	trace	trace	3,597

-season (1982)

...d	Variety	Losses (%) Reaping Sickle	Ani-ani	Threshing	Winnowing	Drying	Yield (ton/ha)	Difference of harvest-ing time to Opt. (day)	Remarks
[illegible]	BINJAI (L.V.)	—	1.5	—	Trace	Trace	3,316	+3	2 times reaping 1 time threshing
[illegible]	IR - 32	1.4	—	0.4	Trace	Trace	4,958	±0	2 times reaping 2 time threshing
[illegible]	TINCHILAN(L.V.)	—	1.2	Trace	0.1	Trace	3,656	±0	1 time reaping 2 times threshing
[illegible]	IR - 32	1.3	—	0.1	Trace	Trace	4,146	+5	2 times reaping 2 times threshing
[illegible]	ATUNG	—	0.8	0.1	0.4	Trace	6,577	+3	1 time reaping 2 times threshing
[illegible]	DUTUNG (L.V.)	1.8	—	0.4	Trace	Trace	2,636	+5	2 times reaping 2 times threshing
[illegible]	IR - 42	1.0	—	0.2	Trace	Trace	5,538	+5	2 times reaping 2 times threshing
[illegible]	IR - 42	0.9	—	3.6	Trace	Trace	4,976	±0	2 times reaping 1 time threshing
[illegible]	IR - 32	1.0	—	2.1	0.1	Trace	3,139	+3	2 times reaping 2 times threshing
[illegible]	IR - 32	0.8	—	0.6	0.2	Trace	4,624	±0	2 times reaping 2 times threshing
[illegible]	SIANCHI(L.V.)	—	1.5	Trace	0.5	Trace	2,259	+5	1 time reaping 2 times threshing
[illegible]	SIANCHI(L.V.)	—	1.8	0.7	Trace	Trace	2,849	+3	2 times reaping 2 times threshing
	Average	1.2	1.4	0.7	0.1	Trace	4,056		

Note) All farmers are using Ani-ani or sickle, cut from upper portion, and thresh by tramping.

1) Reaping

There were many farmers growing the local variety in the province compared with other survey areas. Accordingly, many rice varieties were taken for the survey.

Table 5-29 is a presentation of losses for each kind.

Table 5-29 Reaping Losses by Varieties in South Kalimantan Province

Variety						Average (%)
H.Y.V	IR - 5	1.2	0.8			1.0
	IR -32	1.4	1.3	1.0	0.8	1.1
	IR -36	3.6	2.3	2.7		2.9
	IR -42	0.9	1.0			1.0
	C4 -63	2.5	1.7	4.9	1.1	2.6
L.V	SPANCHI	1.5	1.8			1.7
	PANDAK	0.8	1.3			1.1
	OTHERS L.V.	1.5	1.2	0.8	1.8	1.3

Referring to the table, two varieties of IR-36 and C4-63 have extremely higher loss ratios, which means they belong to varieties occurring larger reaping loss. (In the table, C4-63 indicates a loss of 4.9% but this may come from shattering loss.) In addition, Spanchi also has a slight loss ratio. However, according to an observation carried out at the site, the major cause is late reaping.

HYV is generally considered to have higher in shattering habit and causes larger reaping loss. However, as indicated in the table, this criterion is not always true. There will be many varieties of HYV, which exhibit similar or lower loss ratio than local varieties.

Then, regarding the loss ratio for each reaping style, traditional ani-ani reaping was seen widely throughout the province. However, for farmers who are growing HYV, sickles are gradually being introduced for reaping.

The following data relate to a comparison of loss between use of ani-ani and sickles.

Table 5-30 Reaping Losses by Tools in South Kalimantan Province

Reaping Tools								Average (%)
Ani-ani	0.8 1.5	1.3 1.8	0.8 1.5	1.2	0.8	1.2	0.8	1.2
Sickle	1.4	1.3	1.8	0.9	1.0	0.8	1.0	1.2

Note) The data of IR-36 and C4-63 were excepted for excluding the factor of reaping losses by varieties.

Referring to the table, mean values of the loss ratio show exactly the same figures, perhaps by chance. This might mean there is no substantial difference of reaping loss ratio between ani-ani and sickle reaping.

There is a trend of relatively late reaping in the province. To check how this affects loss, a comparison was made for each reaping time.

Table 5-31 Reaping Losses by the Difference of Harvesting Time to Optimum in South Kalimantan Province

Difference of Harvesting time to Opt.					Average (%)	Varieties
±0 (day)	1.4	1.2	0.9	0.8	1.1	IR-32, IR-42 IR-42 L.V.
+3	1.5	0.8	1.0	1.8	1.3	L.V. AYUNG IR-32 SPANCHI (L.V.)
+5	1.3	1.8	1.0	1.5	1.4	IR-32 L.V. IR-42 SPANCHI (L.V.)

Referring to the table, there is a tendency that loss increases when reaping is made later than at the optimum time. In other words, later reaping may contribute to a larger loss ratio.

2) Threshing

In the province, threshing was mainly done by trampling. Many farmers were threshing a second time some time after the first threshing. The loss ratio was also small. Of 24 farmers surveyed, only 2 farmers used single threshing. Their loss ratios were as high as 2.0% and 3.6%, respectively.

Also, many farmers did not thresh rice immediately after reaping but threshed on the next day or after several days. This might be because, when time is taken after reaping, heads were dried to make easythreshing, and thus resulting in fewer non-threshed kernels and threshing loss.

During the rainy season survey, 10 farmers were sampled to check loss ratio dependent on when threshing was done, immediately after reaping or several days later. The result is shown below:

Table 5-32 Threshing Losses in South Kalimantan Province

							Average (%)
Just after Reaping	0.4	0.2	2.1	0.6	—	—	0.8
Some Days Later	0.4	Trace	0.1	0.1	Trace	0.7	0.2

It is obvious that there is a trend of a larger loss ratio when threshed immediately after reaping, rather than threshing afterward.

Loss ratio may also be affected by the skill and carefulness of workers. However, these factors are not easily represented numerically or analytically.

3) Drying

Paddy drying was done under the sun using mats. In the province drying after threshing is carried out in two stages. In the first stage, moisture content is reduced to about 17-18% and then the paddy is cleaned by winnowers and temporarily stored. Thereafter, paddy is dried to 14-15% and then restored.

In both of these drying methods, paddy was carefully handled and, although slight loss appeared by domestic fowl, substantially few loss was measured.

4) Cleaning

Cleaning work is performed in the province using winnowers. This is a significant characteristic of the postharvest work in the province.

This loss with winnowers was extremely low, i.e. less than 0.1% for an average 24 farmers.

In addition, a more detailed survey of winnower's cleaning in the province was carried out during the rainy season survey, and the results will be described in 5-4-1(8).

(5) Summary of Survey on Field Work

Relating to reaping loss, there is a trend of late reaping among farmers throughout the 4 provinces. This may stimulate larger loss ratio.

There are already many experimental reports stating that reaping loss increases gradually when the reaping is done later and later. According to the Team's survey results, the same tendency is recognized in all 4 provinces.

Farmers are apt to reap paddy later because of labor shortages (especially in outer Jawa). However, in view of reducing reaping loss, the so-called in-time reaping should be more emphatically promoted.

Next, regarding varieties, a larger loss ratio appeared with IR-36 throughout the 4 provinces, out of the presently popular varieties, according to results of the survey. When introducing a new variety in the future, care should be taken to breed a variety to create a lower reaping loss ratio.

HYV normally appears with higher shattering habit and higher loss probability compared to local varieties. It will be true that there are many varieties having greater shattering habit but, even for HYV, there will be some varieties having similar or even better shattering habit than the local varieties.

In addition, it is not always valid that a variety with an easier shattering habit exhibits a larger reaping loss ratio at any time, contrary to the presently accepted knowledge. It will of course be a fact that there is a close relationship between shattering habit and the degree of reaping loss ratio. But, a further detailed survey should be carried out to investigate this relationship for each rice variety.

In this case, however, if reaping is carefully done at an optimum time, reaping loss difference between each variety will be considerably compensated.

Then, regarding reaping tools, the Ani-ani method makes reaping panicles by hand while leaving a lot of unrippen panicles unavoidably together with poor work efficiency. The ani-ani method may be reasonable with local varieties, because panicles do not grow regularly. However, for HYV, sickles will be more and more widely introduced in the future because of uniformity of maturity.

A good example for the above is South Kalimantan, where there are many swampy fields, reaping is not performed using sickles. However, in HYV-growing areas, high portion-reaping is gradually popularized using sickles. There was no remarkable difference of loss ratio in high reaping between Ani-ani and sickles. However, labor efficiency for the latter is superior to that of the former.

If consideration is given only to reaping loss, lower portion-reaping with sickles will be the best method in view of low loss and good labor efficiency. In this case, however, threshing is done by beating. Accordingly, the overall loss ratio might be made larger.

In the forms of reaping work, there were Bawon, Niebrock, Tebasan, otenyoron, family labor, and so on. Among these, the Bawon method apparently created a larger reaping loss ratio.

As described above, as long as Bawon is used for reaping work, it may unavoidably cause large losses. However, there are many people who are living on Bawon work like agricultural laborers in Jawa, a serious social problem will result if the Bawon reaping system is immediately ceased.

It is an obvious fact that the loss ratio of beat-threshing is the largest of all threshing methods. In this case, scattering loss occupies the major factor of the beating loss. How to decrease scattering is an important point to reduce this loss.

Although beat-threshing creates larger loss, it has better operating efficiency so that this method is widely used in West Jawa and South Sulawesi, out of the 4 provinces. Of course, necessary conditions include a dry field during harvesting.

In both provinces, farmers were not using any means to prevent scattering, except that a simple sheet of about 5 m^2 is used as a base. If the sheet is made larger and the surroundings are vertically screened, scattering loss will be considerably prevented.

However, as described in the section on reaping loss, it will be very difficult to charge reaping workers to apply any device to reduce the loss, as long as the work is done with Bawon.

Also, lower portion-reaped paddy stalks are temporarily piled in a corner of the field before threshing. The loss at that time was an average 0.9% according to a measurement done for 5 farmers in West Jawa. But this loss will be easily reduced by the introduction of sheeting under the piled paddy stalks.

Foot-threshing creates less loss, which will substantially be negligible. However, compared with beat-threshing, foot-threshing suffers from much poorer labor efficiency. In addition, panicles must be threshed twice in this method, which is more labor-consuming. Therefore, it will be very questionable as to when in future such work can be employed, because the harvesting volume increase and introduction of two crops a year are demanded socially along with the employment of more efficient postharvest treatment.

In a village in South Kalimantan, mat of sliced bamboo, etc. was used during foot-threshing to acilitate threshing work.

Such a simple implement can be bought and maintained by anyone and, if it is more widely used, field work will become more efficient and losses will be more effectively prevented. In the future, government effort is strongly recommended to develop, reform and popularize such kinds of agricultural implements.

Regarding drying work, sold paddy is almost all undried in West Jawa and South Sulawesi, except that for household consumption. Where undried paddy enters distribution routes from the farm level, quality losses will be caused in the later processes. Therefore, suitable drying should be introduced at the farm level to decrease moisture content in the paddy.

Out of the 4 provinces, survey areas in Aceh, West Jawa and South Sulawesi have many zones of two crops a year with HYV popularized. Accordingly, not much time is available for postharvest handling. Also, there is no significant difference in selling prices between dried and raw paddy. These factors may be included in the reasons of raw paddy circulation. In particular, after the introduction of HYV, harvesting work is often carried out in mid-rainy season in two-crop areas. Accordingly, drying work becomes very difficult.

In aceh and South Kalimantan, cleaning work is carefully conducted. However, in West Jawa and South Sulawesi, it is not done at all.

If foreign matter, immature kernels or empty kernels are contained, milling recovery will be aggravated together with influencing the quality of milled rice. Therefore, cleaning should be done at the farm level. However, even if cleaning is applied to undried paddy, it will not be very effective. Rather, drying and cleaning shall be planned in a series of work. It will be an effective method to solve the matter of drying and cleaning to train farmers through PPL activity, and to sell paddy after drying and cleaning and to refund the profits from this to them, by virture of incentives offered by the government.

All farmers shall be conscious that drying and cleaning have to be done by themselves. It will be connected to the efforts to improve work more efficiently, e.g. introudction of winnowers in the cleaning process, and so forth.

Of course there will be another principle that drying and cleaning should be done at the processing level more efficiently, because larger amounts of paddy are treated there. However, roads and warehouses are t completely prepared in most village in the country, in view of transact-g condition. In consequence, there are too many risks in quality losses ere unconditioned paddy is put in transacting routes. Accordingly, it s concluded at present that drying and cleaning shall be carried out at e farm level for better profits.

(6) Tests for Loss by Reaping Time

If harvesting is done after the optimum time, shattering kernels in-reases, which may directly cause larger reaping losses.

Reagarding the Proceedings of the Workshop of GRAIN POSTHARVEST TECHNOLOGY, 979, Indonesia, P. 96, the following data are reported for reaping loss crease when harvesting time is late.

Table 5-33 Plant Conditions of IR-38 and IR-36

Plant Condition	IR-38	IR-36
Ave. Height to the Apex of Canopy (cm)	98.4	77.5
Ave. Height to the Base of the Panicle (cm)	66.4	68.5
Ave. Number of Stems	18.6	26.1
Ave. Yield (ton per ha.)	5.028	2.964
Grain Moisture Content (%)	18.02	19.59
Straw Moisture Content (%)	-	72.99
Planting Distance (cm)	25x25	25x25
Grain-Straw Weight Ratio	44.1	54.2
1000 Grain Weight (g)	26	21

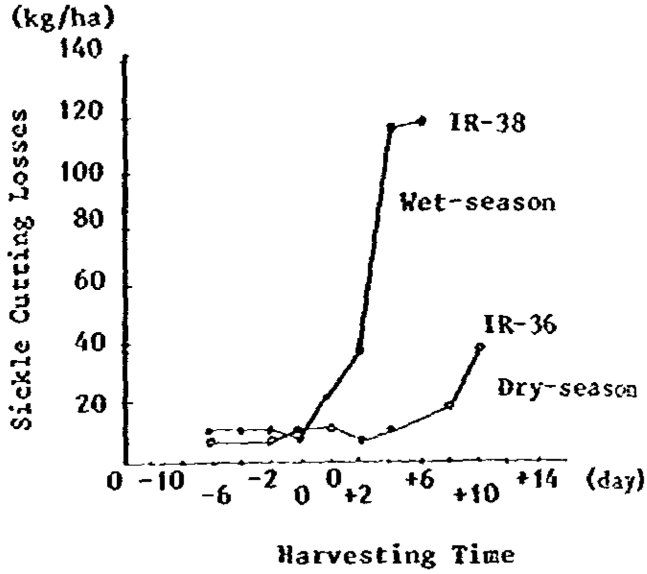


Fig. 5-15 Sickle Cutting Losses at Different Harvesting Dates

Also, IRRI made a similar report.

According to the scope of the experiment done by the survey team, reaping loss was investigated for each harvesting time, in a time series. In addition, by analyzing brown rice and milled rice after harvesting, a study was intended to check how the rice quality changed depending on harvesting time and what effect would appear on the quality losses thereof.

1) Method

a) Harvesting Volume Measurement

The standard method of the survey team was applied.

b) Measurement of Reaping Loss (quantitative)

Using Ubinan (6.25 m^2), shattered kernel and panicles were collected and expressed by weight percentage as reaping loss.

c) Evaluation of Qualitative Loss

According to the method specified by the survey team, test paddy was husked and milled, and then, the brown rice and milled rice were analyzed.

d) Varieties

Two varieties were chosen, namely Cisadane and IR-36; the former is one of domestic bred variety and is more widely grown now, and the latter has the largest cultivation area among IR varieties.

e) Test Period

Harvesting was performed every third day as follows referring to the growing conditions of rice:

CISADANE, March 25 (3 days prior to the optimum day) - April 12 (15 days after the optimum day)

IR-36, April 2 (9 days prior to the best day) - April 23 (12 days after the optimum day)

To determine these optimum harvesting days, data from farmers were collected relating to growing conditions and such timing was taken when mature heads turned yellow by about 90%. Thus, the survey team formed conclusion.

f) Reaping Area

The reaping area was selected at 100 m^2 at a time. For each reaping time, loss ratio was obtained. As for test fields, necessary conditons were specified that there was uniform growth and substantially no damage by disease, insects and rodents etc. Area per field was chosen at 0.1 ha or larger, for experimental convenience.

g) Husking, Milling

Total collected amounts of paddy out of 100 m^2 were husked and milled and then divided into smaller fractions to make up samples for the analysis. Husking and milling were carried out by the following combination of machines:

a) Milligm Machine for the Test

Rubber roller type test milling machine + Friction type test milling machine

b) Conventional Milling Machine

Rubber roller type husking machine (2-pass) + Jet-Air friction type milling machine (1-pass)

h) Test Sites

CISADANE

Desa. Rengasdenglok Sulatan,
Kec. Rengasdenglok, Kab. Karawang, Jawa-Barat

IR-36

Desa. Tanjung Pula, Kec. Karawang,
Kab. Karawang, Jawa-Barat.

Reaping work was conducted by lower portion-reaping with Japanese saw type sickles. For threshing, power threshers were used. All measured weight of paddy was converted to a moisture contents of 14% and foreign material content of 3%.

2) Results

a) Leaping Quantitative Losses

Table 5-34 CISADANE

Heresting Time	Amount of Losses (kg/ha)	Losses (%)	Thousand-Kernel-Weight of Paddy
(3/25 (-3 day)	16.9	0.3	30.5
3/28 (±0 day)	12.4	0.2	30.9
3/31 (+3 day)	9.7	0.2	30.4
4/3 (+6 day)	15.2	0.3	30.9
4/6 (+9 day)	23.2	0.4	30.7
4/9 (+12 day)	22.0	0.4	29.9
4/12 (+15 day)	29.0	0.5	30.7

Note: Estimated Yield 5,611 kg/ha

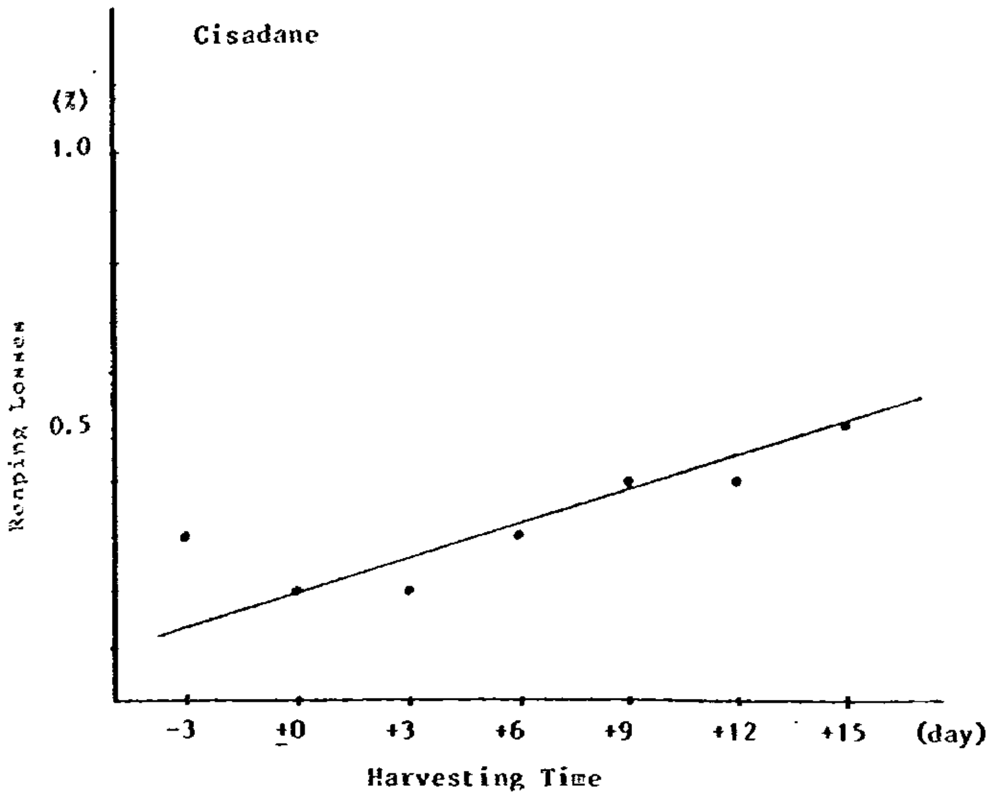


Fig. 5-16 Reaping Quantitative Losses

Table 5-35 IR-36

Harvesting Time	Amount of Losses (kg/ha)	Losses (%)	Thousand-Kernel-Weight of Paddy (g)
4/2 (-9 day)	2.7	0.1	22.4
4/5 (-6 day)	6.5	0.2	23.4
4/8 (-3 day)	14.9	0.5	22.2
4/11 (±0 day)	9.7	0.3	22.9
4/14 (+3 day)	14.8	0.4	23.2
4/17 (+6 day)	14.1	0.4	23.0
4/20 (+9 day)	25.3	0.8	22.4
4/23 (+12 day)	26.8	0.8	22.8

Note: Estimated Yield 3,309 kg/ha

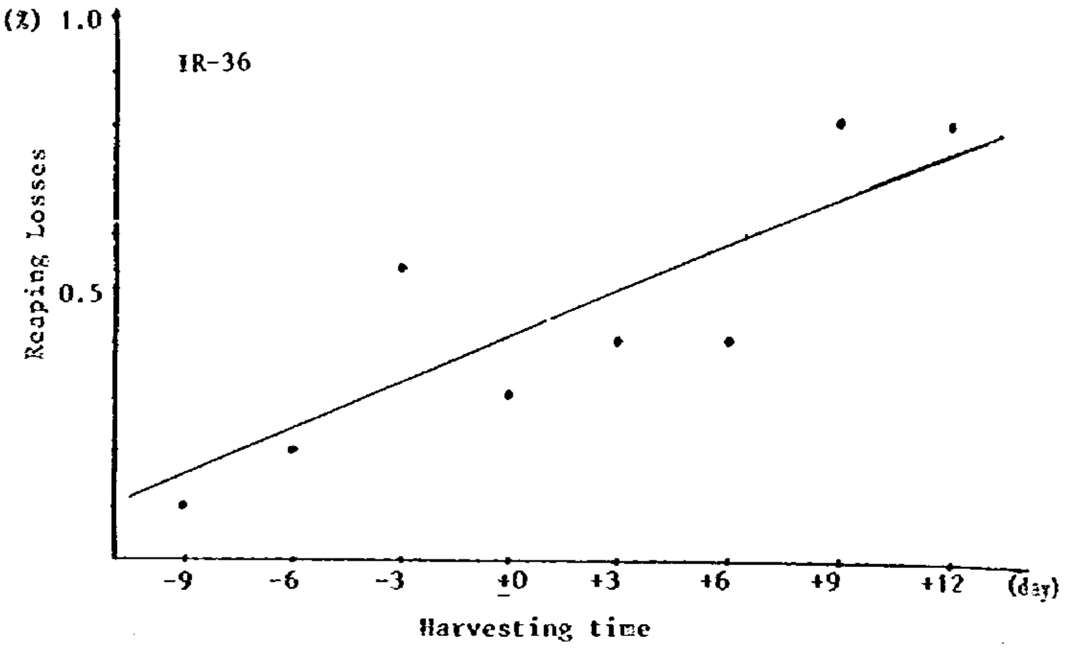


Fig. 5-17

Regarding reaping loss, shattering kernels loss obviously increases when reaping time becomes later than the optimum time. Also, compared with Cisadane, IR-36 had a larger loss incremental rate, which was considered to have larger shattering habit.

However, both kinds had no large reaping loss ratios nor large incremental loss rates due to delay from the best timing, for both varieties, while being compared with the foregoing reports.

This may be because the reaping area per time was as small as 100 m^2 and, moreover, workers conducted very careful reaping work in consideration of experimental purposes, thus resulting in such few losses. Accordingly, in practical reaping work, it is expected that both the loss ratio and incremental rate may become larger.

2) Qualitative Loss

i) Analysis of Brown Rice

Results of brown rice analysis are as shown below:

Table 5-36 The Result of Analysis Brown Rice of Cisadane (Test Husker)

Harvesting Time (day)	Head Rice (%)	Immatured K. (%)	*Damaged K. (%)	Chalky (%)	Broken (%)	Paddy (%)	Foreign Matters (%)
-3	71.9	5.9	7.2	13.3	1.5	0.1	0.1
±0	78.9	1.7	6.8	11.0	1.4	0.2	0.0
+3	73.2	1.7	12.0	10.3	2.5	0.2	0.1
+5	63.4	0.8	21.9	12.8	1.0	0.0	0.1
+9	43.2	0.0	19.5	13.1	23.7	0.5	0.0
+12	47.9	0.1	31.1	12.8	8.0	0.1	0.0
+15	40.9	0.1	34.9	11.3	12.4	0.3	0.1

Note) *The deta of damaged K. includes crack K.

Table 5-37 Cracked Kernel Ratio of Cisadane

Harvesting Time (day)	-3	±0	+3	+6	+9	+12	+15
Crack (%)	0	2.4	5.5	13.9	14.4	25.8	29.7

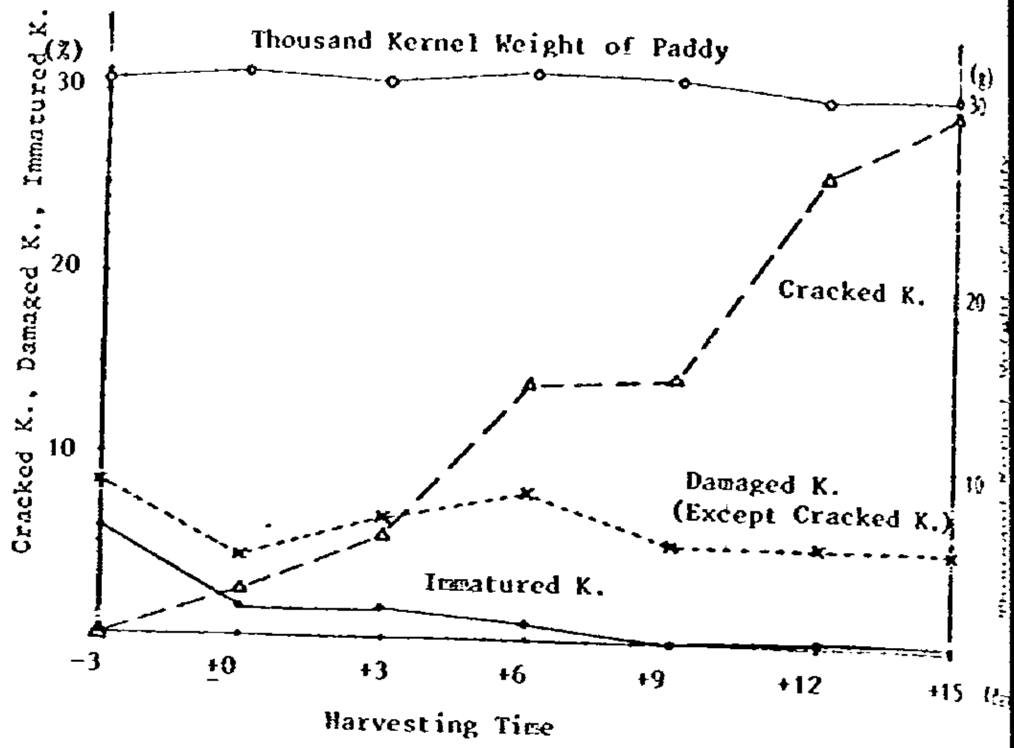


Fig. 5-18 Cracked Kernel, Damaged Kernel and Immatured Kernel Ratio in Brown Rice of Cisadane

Table 5-38 The Result of Analysis Brown Rice of IR-36 (Test Husker)

Harvesting Time	Head Rice	Immatured K.	*Damaged K.	Chalky	Broken	Paddy	[illegible]
(day)	(%)	(%)	(%)	(%)	(%)	(%)	[illegible]
-9	65.6	20.2	6.9	12.0	12.9	1.9	0.5
-6	64.0	5.8	7.8	12.1	9.9	0.4	0.1
-3	66.0	6.6	9.6	11.1	6.5	0.2	0.1
±0	66.0	4.7	11.8	9.7	7.6	0.1	0.1
+3	68.8	2.4	8.7	12.4	7.2	0.3	0.2
+6	66.1	1.8	14.8	8.6	8.1	0.4	0.2
+9	68.0	1.4	12.2	9.2	8.8	0.4	0.2
+12	72.9	0.8	12.0	9.9	3.7	0.7	0.4

Note). *The data of damaged K. includes cracked K.

Table 5-39 Cracked Kernel Ratio of IR-36

Harvesting Time (day)	-9	-6	-3	±0	+3	+6	+9	+12
Crack (%)	0.3	0.6	0.0	0.5	0.7	0.5	0.5	0.7

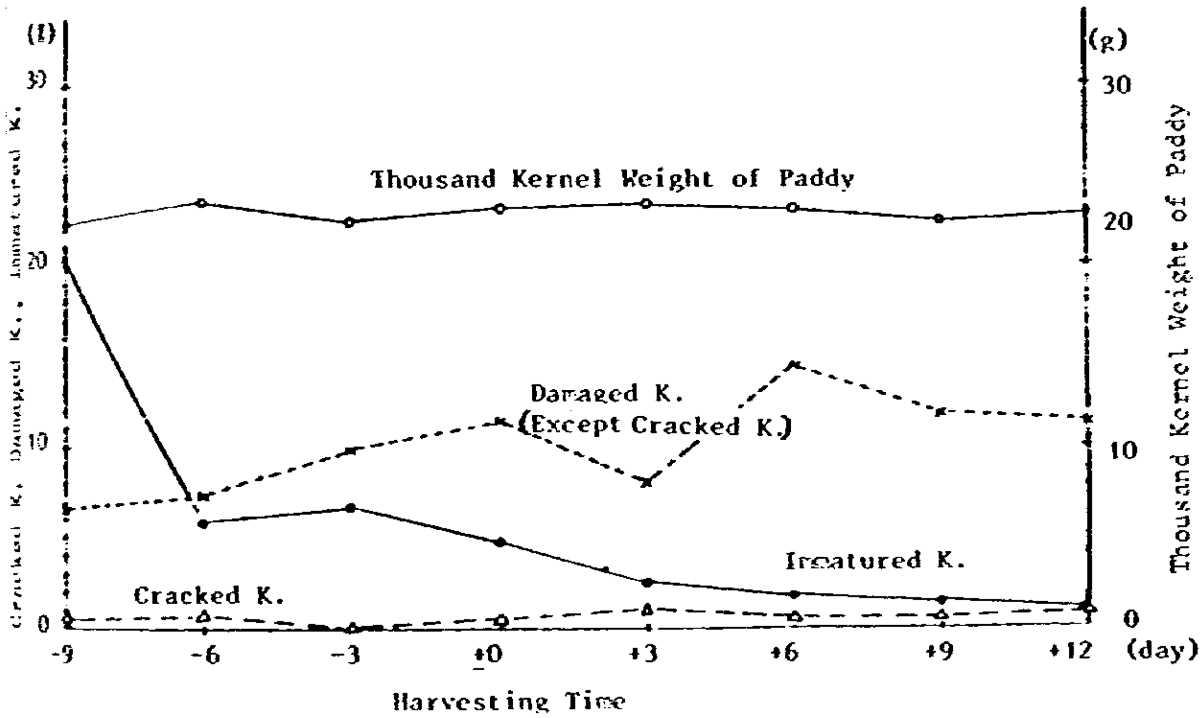


Fig. 5-19 Cracked Kernel, Damaged Kernel and Immatured Kernel Ratio in Brown Rice of IR-36

When reaping time is later, the propportion of sound kernels becomes lesser for Cisadane. This comes mainly from an increase of damaged kernels, especially cracked kernels and broken kernels. In particular, damaged kernels significantly increase. Among the damaged kernels, cracked kernels obviously occupy a major fraction of increasing number of damaged ones.

Also, there is a decreasing tendency for immature kernels when reaping time shifts later. This may be mainly because of a decrease of green immatured kernels.

Relating to IR-36, on the other hand, the amount of immat kernels obviously decreases depending on the degree of reaping time delay. However, other kernels do not exhibit any significa change. As a result, sound kernels are increasing in proporti to immature kernels.

Regarding damaged kernels other than chalky kernels (defor kernels, black-speckled kernels, etc.), there was no significant tendency of change even when the reaping time differs.

ii) Analysis of Milled Rice

Table 5-40 The Result of Milled Rice Analysis of Cis (Test Mill)

(Test Mill)

Harvesting Time (day)	Head Rice (%)	Broken Kernel (%)	Chips (%)	Chalky Kernel (%)	Damaged Kernel (%)
-3	81.6	10.6	0.0	7.7	0.1
±0	81.9	10.5	0.0	7.2	0.4
+3	66.3	26.0	0.1	7.1	0.5
+6	55.4	34.9	0.2	8.1	1.4
+9	31.0	54.5	1.0	8.1	5.4
+12	23.0	57.8	1.9	10.8	6.5
+15	21.5	62.6	1.4	8.0	6.5

Table 5-41 The Result of Milled Rice Analysis of Cisadane (Existing Mill)

Harvesting Time	Head Rice	Broken Kernel	Chips	Chalky Kernel	Damaged Kernel
(day)	(%)	(%)	(%)	(%)	(%)
-3	82.5	9.4	0.1	5.4	2.6
±0	78.6	13.7	0.2	4.9	2.6
+3	61.5	25.2	0.5	8.8	4.0
+6	54.6	34.1	0.5	9.6	1.2
+9	30.0	54.1	2.2	11.1	2.6
+12	19.5	57.6	2.7	14.9	5.3
+15	26.6	54.0	3.4	12.9	3.1

Table 5-42 The Result of Milled Rice Analysis of IR-36 (Test Mill)

Harvesting Time	Head Rice	Broken Kernel	Chips	Chalky Kernel	Damaged Kernel
(day)	(%)	(%)	(%)	(%)	(%)
-9	43.2	45.5	0.4	8.3	2.6
-6	49.9	42.6	0.1	6.1	1.3
-3	52.3	36.3	0.1	9.7	1.6
±0	55.8	32.1	0.3	10.0	1.8
+3	69.3	19.6	0.1	9.9	1.1
+6	64.9	23.8	0.2	8.3	2.8
+9	67.0	22.3	0.2	8.7	1.8
+12	73.3	14.5	0.2	10.0	2.0

Table 5-43 The Result of Milled Rice Analysis of IR-36 (Existing Mill)

Harvesting Time (day)	Head Rice (%)	Broken Kernel (%)	Chips (%)	Chalky Kernel (%)	Damaged Kernel (%)
-9	46.6	37.0	1.5	8.4	6.5
-6	49.9	34.5	0.8	7.2	7.6
-3	59.3	28.6	0.8	6.8	4.5
±0	60.4	23.3	1.0	9.7	5.6
+3	70.0	18.0	0.5	7.0	4.5
+6	57.1	23.0	1.2	11.2	7.5
+9	64.0	21.1	0.6	8.5	5.8
+12	71.4	16.9	0.8	6.4	4.5

...h of Milled Rice Analysis Result
...st Mill)

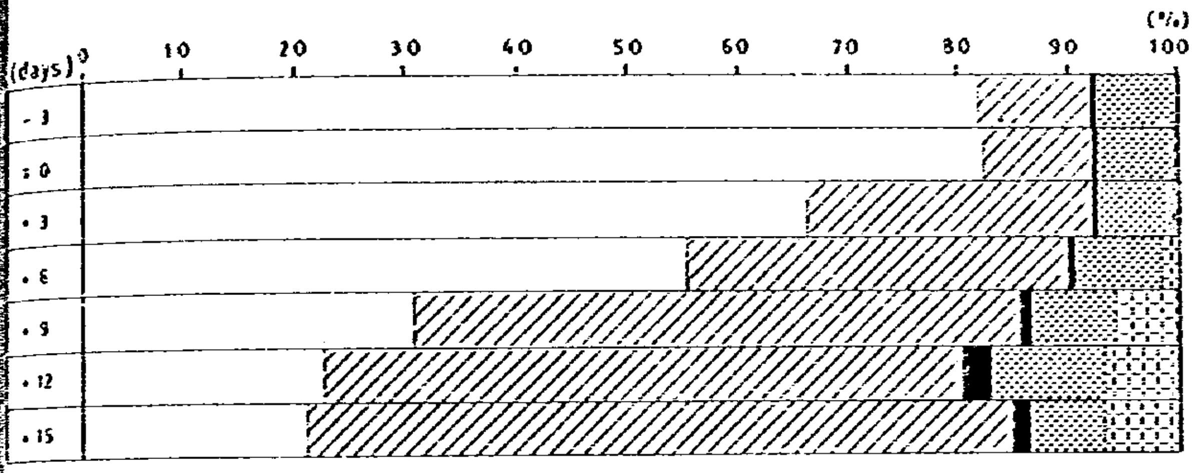


Fig. 5-20 Cisadane

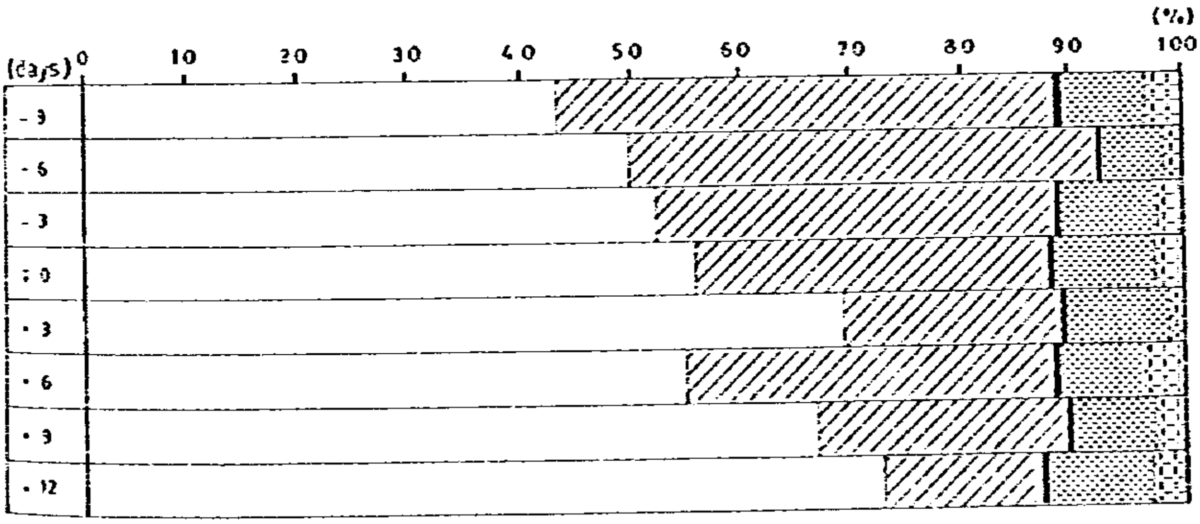
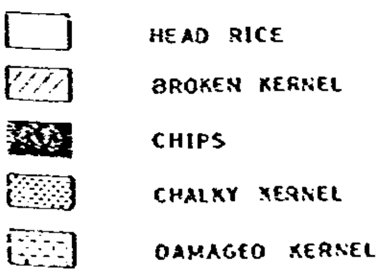


Fig. 5-21 IR-36



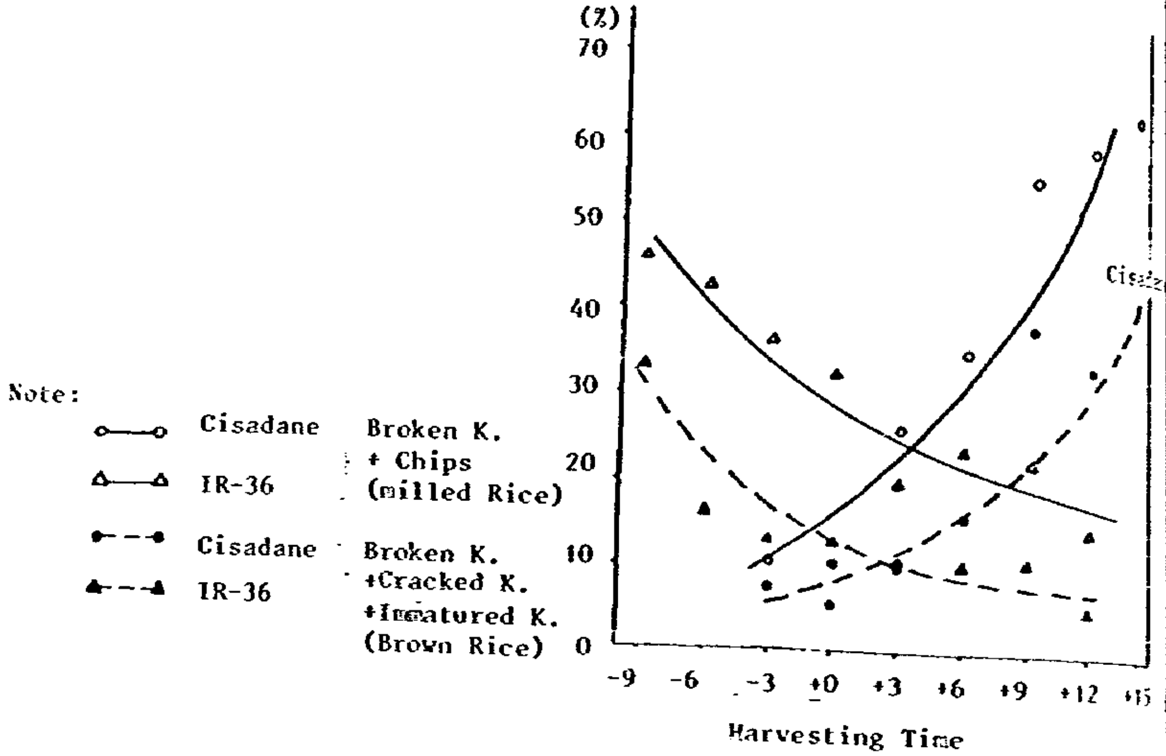


Fig. 5-22 Correlation Graph of Broken Kernel and Chips in Milled Rice with Broken Kernel, Cracked Kernel and Immated Kernal in Brown Rice

Table 5-44 Milling Recovery of Cisadane (Existing Mill)

Harvesting Time	-3 (day)	±0 (%)	+3 (%)	+6 (%)	+9 (%)	+12 (%)	[illegible]
Paddy → Brown Rice	75.6	75.1	75.4	74.5	76.3	73.7	[illegible]
Brown Rice → Milled Rice	89.2	88.9	88.4	89.0	87.2	87.5	[illegible]
Total	67.4	66.8	66.7	66.3	66.5	64.5	[illegible]

Table 5-45 Milling Recovery of IR-36 (Existing Mill)

Harvesting Time	-9 (day)	-6 (%)	-3 (%)	±0 (%)	+3 (%)	+6 (%)	+9 (%)
Paddy → Brown Rice	75.2	75.4	75.0	75.5	75.8	75.1	76.6
Brown Rice → Milled Rice	83.8	86.1	85.0	86.9	86.7	85.5	84.7
Total	63.0	64.9	63.8	65.6	65.7	64.2	64.9

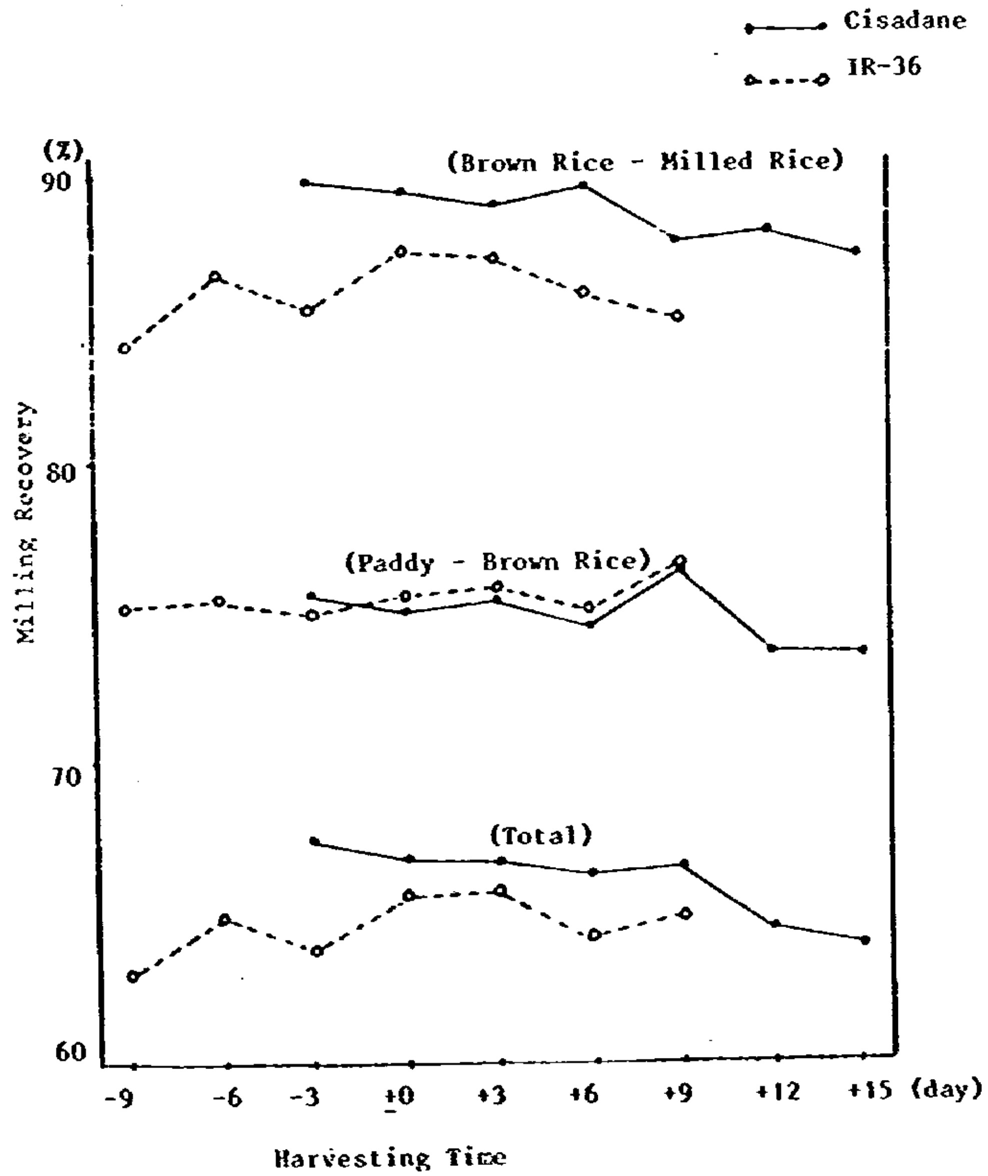


Fig. 5-23 Milling Recovery of Cisadane and IR-36 (Existing Rice Mill)

For analyzing milled rice, a test milling machine and existing milling machine were used for milling rice and the results of analysis were compared. However, there was no significant difference observable between both data.

Cisadane shows an increasing trend of broken kernels and small broken kernels all the more when reaping time turns later than the optimum day. Also, regular kernels decrease. But, in case of IR-36, broken kernels decrease depending on delay of reaping time, which is completely opposite to that of Cisadane

Fig. 5-22 is a graphic representation of the proportional content of the total of broken kernels, cracked kernels and immature kernels out of brown rice of both Cisadane and IR-36 and the same of broken kernels and small broken kernels out of milled rice for the same varieties, under a parameter of reaping time. Referring to the figure, it will be concluded that there is a strong correlation between proportion of broken kernels, cracked kernels and immature kernels out of brown rice and the same of broken rice out of milled rice.

Regarding husking recoverage, Cisadane tends to have smaller value for each husking recoverage when reaping is done later. On the other hand, IR-36 has substantially the same yields from paddy to brown rice, which are materially similar to those for Cisadane. Recoverage of milled rice (brown rice to milled rice) is lower than that for Cisadane. Also, the recoverage becomes lower before and after the optimum time when there is a recoverage peak. Overall recoverage exhibits the same tendency.

3) Discussion

Quantitative loss tends to increase when reaping time gets later, although its decrement is small. This result well agrees with those of many other reports as well as this survey.

According to Kazuo Nagato's report (Quality and Its Examine of Rice, by Shozo Tanaka, 1969), the quality of rice depends on reaping time and, as shown in the following graphs, green kernels tend to decrease when reaping time delay but, instead, brown kernels and cracked ones increase.

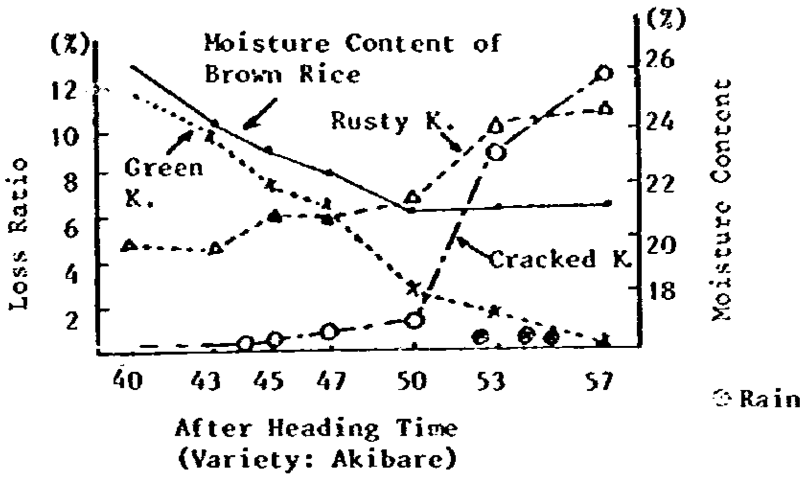


Fig. 5-24 Harvesting Time and Rice Quality (Nagato)

Also, Mr. Hatano and Mr. Matsushima compiled a similar report in 1941 as indicated in the following figure.

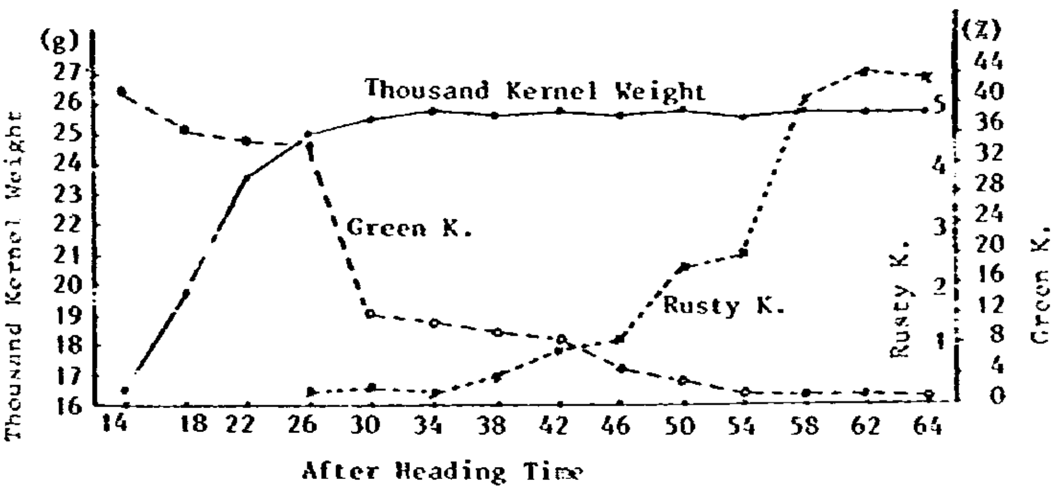


Fig. 5-25 The Relation Between Harvesting Time, Kernel Weight and Rice Quality

Also in this experiment, Cisadane showed similar results, conforming substantially to theoretical conclusion. In particular, when reaping time gets later, cracked brown rice increases, which is reflected on an increase of broken kernels among milled white rice. The yield also decreases. However, for damaged kernels other than cracked kernels there was no significant changes. Further, brown rice, etc. did not increase at all.

Since there are broken kernels, cracked ones and immature ones in brown rice, milled white rice natually and proportionally contains broken kernels and small broken kernels, in a linear relationship. If the contents of the former increase, grade of milled rice is degraded and, in addition, milling recovery may also turn lower.

If early reaping is done, immature kernels increase and, if reaping is made late, cracked rice significantly appears. Accordingly, in-time reaping should be done for the purpose of reducing quantitative and qualitative losses.

In case of IR-36 on the other hand, immature kernel (green kernels or opaque kernels(decreases when reap-timing is made later, at the stage of brown rice. However, no significant change appears in the content of cracked kernels, damaged ones, etc. Referring to the results of analysis with milled rice, broken kernels decrease along with retardation of reaping time. The tendency was completely contrary to that of Cisadane. This may be because of the following 2 reasons:

a) The best time of harvesting for IR-36 was misjudged, so that the presumed optimum date for the experiment was actually earlier than the actual time. As a result, early reaping wad adopted.
b) IR-36 belong to the super-early variety. It matures in a short period. Accordingly, paddy was not completely matured causing poor formation of paddy. Therefore, even if in-time reaping is done, broken kernels tend to occur in a larger amount. Consequently reap-timing should be correlative to broken kernels because of the advancement of paddy maturity.

Regarding the reason a), judgement of in-time reaping might not be erroneous, as far as the analysis on the weight of 1,000 kernels and immature kernels was concerned. Also according to the results of actual observation, time judgement would not be deviated more than a week.

Regarding the reason b), Indonesian specification (I-B) specifies the milled rice mixing ratio of broken rice at 35% maximum. It clearly explains that there are many varieties which may easily produce broken rice as a general character for the varieties. Moreover, IR-36 has lower recorage from brown rice to milled rice, compared with Cisadane, so that IR-36 may be easily broken.

However, the creation of broken kernels may be reduced when reaping time is delayed. The answer will not be gained from only one experiment such as the present survey. This problem should be analyzed and concluded throughout future studies.

Lookign at common characteristics of Cisadane and IR-36, there is only one fact that loss by shattering kernels generally increases when rice is reaped later and, on the other hand, immature kernels and green kernels decrease at that time. Other than the above, there is no relationship between them. In other words, the results are too different with both so that any common conclusion for both varieties will not be definitely described.

The test was performed only once as described earlier. Therefore, similar tests should be necessarily repeated. However, if the result above is valid, the reaping time of IR-36 shall be determined after a thorough and comprehensive study on shattering loss, quality loss and the relationship of the next cultivation to the present harvest.

(7) Survey of Actual Conditions of Custom Threshing in Aceh Province (In Pidie and Aceh Utara Districts, Aceh Province)

Custom threshing using threshers could not be observed in the survey regions while the survey was made during the 1981 dry-season crop harvest. Partly because of the recommendation made by the survey team during the dry-season survey, custom threshing activities could be frequently seen during the rainy-season harvest in February to April, 1982, showing that mechanization in this area was rapidly in progress. The actual conditions are surveyed at this time soon after the start of the mechanization to attempt to find a direction for the future.

1) Conditions Related to Mechanized Threshing Work

a) Background for Custom Threshing

i) Delay in Threshing by Labor Shortage during Harvesting

In the survey regions, traditional piling work was still extensively carried out.

One reason why this practice is still continued is that this piling method also serves as a temporary storage function for paddy bundles. This is an unproductive method to solve the labor shortage during threshing.

ii) Fewer Qualitative Losses due to Colored Kernels

Storage of paddy bundles before threshing under insufficient dry conditions is reputed to generate heat due to the microorganism and physical action of kernels. Colored kernels are reputed to be the cause. Prompt threshing by machine would improve the condition of inclucing discolored kernels.

iii) Increasing Charges

The labor wages for routine work in the survey areas and their vicinities are sky-rocketing due to social and economic reasons. The wage level was reaching the level of which rice-growing farms could afford to pay. Labor wages for threshing by trampling and winnow cleaning corresponded to 9 to 10% and 3 to 5%, respectively, totaling 12 to 15%.

iv) Development of Equipments that Adapt to Local Conditions

Types of threshers that hold culms by middle portion-cutting and supply semi-dried paddy bundles as the raw material cleaned to a certain degree have been developed and are about to be distributed and sold to farms.

v) Changes in Farm Life

The penetration of TVs at the farm level is still low. Almost all farms have radios. Motorbikes are beginning to be used by farmers. Tilling of lowland fields, which is the prime responsibility of farmers, is common in fields which have good roads by custom tilling using tractors at 5 Rp/m^2.

Although limited in number, some winnowers are also engine powered. In the environment stated above, custom threshing by motive-powered threshers will be accepted by farmers without any resistance.

b) Custom Threshing and Government Regulations

All business activities are obligated to acquire licenses. Rice mills must also obtain a license. Because threshers are considered as part of the equipment that makes up rice mills, custom machine threshing also requires approvals. That threshers were part of rice mills can be attributed to the postharvest practice when Ani-ani was used to reap paddy bundles. At present, such a situation does not exist in the regions. Custom threshing is actually part of field work that clearly has no direct relationship with rice mills. Nevertheless, an interpretation of expansion is made, involving custom threshing under the current situation. How the approval system for private threshing services will be operated under the current situation when machine threshing is promoted by the government will greatly affect the future of custom threshing.

c) History before Introduction of Threshers

i) Motive-Powered Threshers

Efforts to introduce threshers on a commercial basis started 2 to 3 years ago. The threshers were motive-powered threshers of a hand-hold type with a double-barrel type used extensively in some regions of Japan where there was difficulty in drying paddy after harvesting. Paddy bundles were supplied by the routine local reaping method. (Culm lengths were short, and bundling was made using straw with paddy, and threshing by hand-holding panicles was dangerous, as well as difficult, and paddy could not be threshed well.) As anticipated, this type frequently caused straw plugging and poor separation. Their performance was not satisfactory. For this reason, the type failed to be extensively used as is. After improvement efforts made by manufacturers, thresher adaptability has been improved to today's standard. Utilization efforts and contrivances by users have also been of value.

In addition to the foregoing type, IRRI and votex types have been recently used. A further study is required regarding an adaptability to the local farming works. These equipment types will be described later.

ii) Pedal Threshers

Pedal threshers are an intermediate development stage for mechanization of threshing work.

In the survey regions, both government and private sectors have tried to use pedal threshers without success. There are only a few hand-made pedal threshers being used on a trial basis. This can be attributed to the following:

Pedal threshers have to be operated while hand-feeding paddy. What can be fed are rice stubbles. Rice was reaped in the survey regions only by an intermediate reaping method because of after-process work. It is difficult for farmers to change reaping posture. The farmer work system has been established by all regional and social conditions of the region in which it is used. It has survived a series of processes of natural winnowing, and the current system has been left as a series.

- Heavy labor which is constantly required during operation is unbearable for the farmers. It is difficult for the farmers to accept a motion (shoulder pulling) which has not been experienced in the farming works.
- An anachronism is consciously felt when farmers find themselves having to depend on human labor at a time when there are motorbikes around them and even winnowers have small air-cooled engines as motive power sources.

d) Number of Motive-Powered Threshers in Use

According to statistics, motive-powered threshers in use in Aceh Province in 1981 are as shown in Table 5-46. The increase within the past year is considered to be sharp, and the actual conditions cannot be estimated based on this data alone.

Table 5-46 Numbers of Power Thresher (ALAT PERONTOK) in Aceh Province

KABUDATEN	1978	1979	1980	1981
1. ACEH BESAR	1	2	5	8
2. PIDLE	1	1	10	13
3. ACEH UTARA	1	2	9	14
4. ACEH TENGAH	-	-	-	-
5. ACEH TIMUR	-	-	1	2
6. ACEH TENGGARA	-	-	-	-
7. ACEH BARAT	-	-	-	1
8. ACEH SELATAN	-	-	-	-
Total	3	5	25	38

Source: Informasi Date Pertanian Tanaman Pangan Propinsi Daerah Istimewa Aceh.

Dinas Brtmiah Tanaman Pangan Propinsi Daerah Istimewa Aceh 1981.

2) Threshers Utilized in Custom Threshing

a) Number of Threshers in Operation

Data on custom threshing in the survey regions is 1 to 2 years old. It is true that the number of units in operation is increasing rapidly. However, an accurate number of units in operation cannot be obtained. It is estimated that 60 to 80 units were in operation in Pidie and Aceh Utara Districts during the harvest season of the 1981/82 wet-season crop. No threshers for personal use were operated, and all threshers were estimated to be used for custom threshing.

b) Custom Thresher Types

At present, 3 types are in operation, and all of them are of a throw-in type. Data for a comparison of them is shown in Table 5-47.

Table 5-47 The Specification of Existing Power-Threshers in D.I.K.

Type of Machine / Items	Yanmar-D D-900	Votex, Ricefan	THB Type (Made in Thailand)
Mechanism			
Drum	Double drum	Single drum (Combined fan)	Axial flow
Width of drum (mm)	695	500	1,200
Cleaning Mechanism	Winnower	Non	Winnower and Oscillating Screen
Size and Weight	Medium (1,140x1,100x1,665 m/m 140 kg.)	Small	Large
HP (Horsepower)	Medium (7 - 10 ps.)	Small (5 ps.)	Large (9 - 13 ps.)
O&M			
Screening Performance	No Good (Troublesome)	No Good	Good
Moving Method	Carrier	Manpower (4 Persons)	Carrier
Supplying High Moisture Content Materials	Difficult	Easy	Easy
Grain Losses	Average	Many (Free grain discharged with staw) Unthreshed grain	Few (little)
Initial Cost (including Engine, carrier)	1.20 - 1.45 (Million Rp.)	1.35 (Million Rp.)	1.40 - 1.70 (Million Rp.)
Estimated Number of Operating Machines	40 - 50 (Machines)	20 - 30 (Machines)	1 - 2 (Machines)

c) Combination of Thresher, Engine and Carrier

The combination of thresher, engine and carrier is indicated in Fig. 5-26.

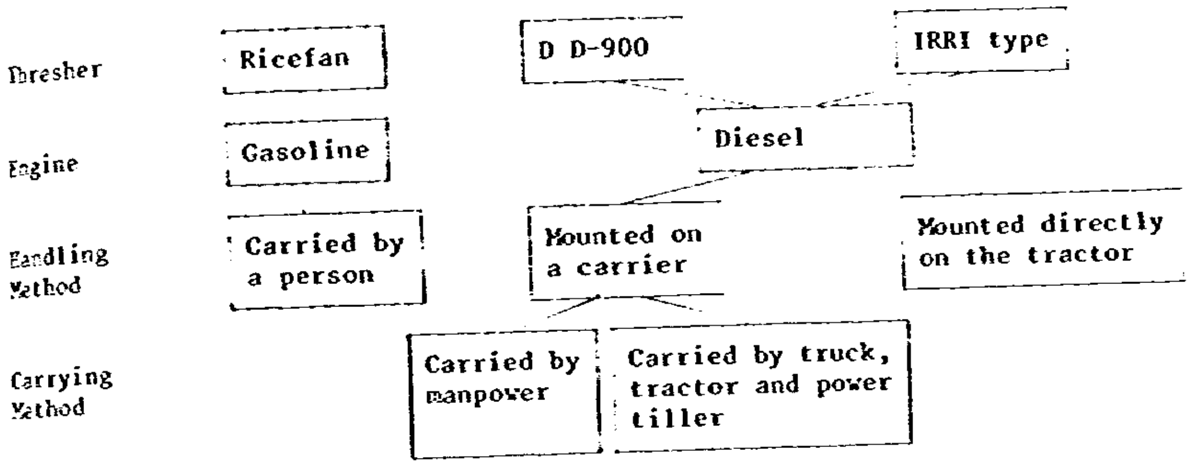


Fig. 5-26 Combination of Thresher, Engine and Carrier

3) Custom Threshing Utilization

a) Ownership Mode

Custom threshing facilities are owned by private and public owners. Public-owned threshers are those that are owned by DOLOG-KUD but are operated by private citizens under DOLOG-KUD supervision.

b) Handling Charge

The handling charge is 10% of the output (cleaned paddy) with privately owned machines, and 4 to 5% with the DOLOG-KUD route because no depreciation cost is considered. The handling charge for the former is broken down to 3 to 4% of the 10% for 2 to 3 operators and assistants and 6 to 7% to the owners including fuel cost. This is the proportion commonly distributed. The charge is 9 to 10% of the output for the trampling method. Winnowing is needed as an after-process, and the charge for it is 3 to 5%. In total, it reaches approximately 15% at maximum.

c) Moving Range

There is a term of a week to 10 days in harvesting time in a sub-district unit. Movements are made in a range of several sub-districts matching the lag. As shown in Fig. 5-26, the moving method differs depending on equipment type. It naturally differs on roads and in fields. Equipment is pulled manually or using a vehicle, is carried on a truck, or is manually carried.

d) Operating Place

This depends on equipment weight and moving method. At present, votex-type machines are used inside fields, and DD-900 and TH8 machines, on roads and in farm yards.

e) Feed Rice Bundles

Rice bundles generally fed to threshers in the survey region are as shown in Table 5-48.

f) Real Handling Capacity

There is a considerable difference between indicated capacity and actual handling capacity as shown in Table 5-49. The largest causes for this are the condition of rice bundles fed and the operating method.

Table 5 - 48 Description of Paddy Stalk Bundle

Reaping Method	Sickle, (Middle portion cutting)
Materials for Bundling	Stalk paddy. (There are panicles at the knot of bundle.)
Bundle Length	50 ~ 55 cm
Weight of Bundle	700 ~ 800 g
Grain Straw Ratio	4 : 6
Drying Degree	after 1 ~ 2 days drying in the field, after 2 ~ 7 days piling. (Grain moisture content 18 ~ 20%, Straw 20 ~ 30%)

Table 5 - 49 Hourly Capacity of Power Thresher

Type / Hourly Cap	Yanmer D D-900	Votex Ricefan	IRRI TH8 Type (Made in Thailand)
Nominal Cap (kg/hr)	600 ~ 900	1,000	1,000 ~ 1,500
Practical Cap (kg/hr)	400 ~ 600	400 ~ 500	750 ~ 1,000

Table 5-50 Description of Paddy Stalk Bundles for Throw-in Type Threshing

Variety	H. Y. V.
Length of ear	30 ~ 45 cm
Shattering Habit (resistance against pulling)	Moderate, Easy (70 ~ 90 g)
Reaping Method	Raw sickle, Middle portion
Materials for Bundling	Reaped raw stalk with paddy
Bundle Length	50 ~ 55 cm
Weight of Bundle	700 ~ 800 g
Grain-Straw Ratio	4 ~ 5 : 5 ~ 6
Drying Degree	After drying for 1 ~ 2 days in the field, after piling for 2 ~ 7 days
Paddy	17 ~ 19 %
Stem	20 ~ 30 %

g) Relationship of Custom Threshing with Processes Before and After

In the survey regions, piling work is always performed as a process before threshing. As stated in 5-1 Actual Conditions of Piling, it can be said that threshing raw material is already there. Movable or transportable threshers can work there, and transportation of raw material in a large quantity becomes unnecessary. After threshing, paddy is bagged at 70 to 75 kg per gunny sack and 30 to 50 kg depending on the bag size per palm fiber bag. Bags are carried by farmers. Sometimes merchants come with small trucks.

h) Operator and Assistants

2 to 3 persons are sent as operators and assistants by the side that does custom threshing. Normally, a family labor force of 2 to 3 persons is added from the farm that asks threshing to be done. Operators and assistants are young males employed by the owners. The owners occasionally come to the sites to inspect the work, but do not operate the threshers.

i) Maintenance Management

During the season, threshers are moved like a caravan and are placed in fields or farm yards. Threshers are operated 5 to 6 hours a day, and minor trouble frequently occurs. Screwdrivers and wrenches are the only tools carried, and only simple repairs are performed. In the event of a machine failure, the faulty section is removed and welding or boring is done at town repair shops. About one store in one sub-district handles belts, bolts, nuts, ball bearings, etc. from which these parts are available. According to one owner, the machine trouble way happen and cease works every 4 day during the season, and more than a half day is wasted on repairs.

j) Operating Hours

Annual operating hours are estimated as follows:
(7 hrs/day x 30 days/harvest season) x 0.7 (operating ratio)
x 2 harvests/year = 300 hrs/year

4) Evaluation of Machine Types

a) YANMAR, DD-900

This model is most commonly used and is manufactured in Surabaya, Jawa Timur. Threshers are shipped to Medan Port by sea and are then transported on land. The transportation cost from the factory to Medan Port is 100,000 Rp per unit, accounting for more than 15% of the price.

Its history dates back 2 years. 10 units were delivered to DOLOG. Because rice culms were thrown in, it plugged up with straw. Since then, an improvement has been made on its concave mesh, etc., and it now is highly adaptable to the local situation. However, because of it, the separation performance has been sacrificed (the concave mesh has been expanded to allow more shattered paddy and straw cuts to pass through so that cleaned paddy can no longer be obtained). A double threshing casing is used, and there is quite a lot of paddy kernels in the discharged straw. Discharged straw is sieved by hand through a large screen (approx. 1 m x 3 m) made by hand by the user. This leaves a problem in terms of labor saving. Basically, the equipment type is a modified version of a paddy thresher in Japan and lacks durability. Its construction does not take into consideration the maintenance situation in Indonesia. Only one model is offered at present. However, 2 to 3 models with different handling capacities will be required in the future.

b) Votex (Ricefan)

It is said that the equipment was developed in the Netherlands for barley. Its threshing casing and blower fan are combined, and the equipment is contained in one unit together with the engine. It is compact and lightweight (130 kg). It can be carried by 4 persons and is suitable for use in fields which do not have field roads. However, its blower fan and threshing casing are combined, and the threshing chamber makes the discharge of straw easy, the construction is of an open type, and its separation performance is poor. Because paddy stays in the threshing casing only for a short time, free paddy and unthreshed paddy are left in large quantities, increasing losses substantially. This is a practical problem. For this reason, farmers spend much time in handling discharged straw in order to recover losses as much as possible. However, it is difficult to recover unthreshed paddy. As a technique in operating the machine, farmers thresh by holding the culm by hand in order to extend the time for the paddy to stay in the threshing chamber. The panicles near the hands and those used for bundling remain unthreshed until the last moment.

The sensitivity of farmers regarding the discharge of DOLOG purchased a large number of these threshers in time for harvesting the 1981/82 wet-season crop. A thorough survey in advance is desirable when selecting the equipment types.

c) IRRI TH8 Type Manufactured in Thailand

It could be confirmed that one unit is in operation in the KUD route. The machine threshing conditions in the survey regions were very close to those of the plains in Central Thailand, and this is the only type that is extensively used in that area. The bundles are small, and culm lengths thrown in are approximately 50 cm. Because rice culm is dried 1 or 2 days in the field and the final work at the farm level is involved in obtaining cleaned paddy, this type can be considered as an optimal type among the existing threshers. This will be explained more later.

It has an axial-flow type construction, and paddy always stays in the threshing casing for a certain period of time. The straw discharge outlet is of an open construction, and plugging is not encountered often even though rice culm is thrown in. Well separated paddy can be obtained in spite of the rough mesh of the concave sieve, which is used to increase the kernel discharging efficiency, as both a winnowing and vibrating sieve are used.

Because the equipment is large, it has to be mounted on a carrier, and it cannot be transported into a field. At present, it is only used by a road or in farmyards. Even if field roads are to be expanded in the future, this bottleneck has to be solved by making the equipment more compact and lighter, or by mounting it directly on a tractor.

5) Thresher Selection Conditions

a) To Match the Current Farming Work Mode

What has to be fully recognized is that it is extremely difficult to force the established farming work mode used by farmers to match the machines. Anything which would affect the work mode of the current processes before and after threshing would make it difficult for the mechanization of threshing itself to be accepted by the farmers.

b) To Adapt to Threshing Raw Material

Threshing machines shall be changed in accordance with the rice to be fed to the machines. This means that only one type of equipment can be used when the characteristics of the supply material (reaping height, whether bundled or not, degree of dryness, etc.) differ.

For instance, machine operation in a field is very hard at wet and swampy field. Raw rice has to be carried to the threshing site. This means that rice is reaped high portion for making the overall volume small. Machines must suit these characteristics of the rice.

c) To Adapt to Field Roads and Bridges

There will be limitations on the weight depending on how the equipment is carried - either by a carrier or by men. There will also be limitations on the type of equipment.

6) Trial Calculation of the Utilization Cost of a Privately Managed Thresher (YANMAR DD-900) (Unit: Rp.)

The calculation example is used to study economy when threshers are owned privately and custom threshing is offered on a private basis. The calculation is on a cost calculation basis. An attempt was made to make individual values as realistic as possible after using data which was obtained in the survey of custom threshing actually performed in the field.

The method of calculation differs from that of the cost calculation way in which economy is discussed centering on a technological standpoint.

a) Maintenance Cost (Fixed Expense)

i) Depreciation

- Average annual depreciation cost

$$= \frac{\text{*Purchase price - scrap value}}{\text{Durable years}} = \frac{1,350,000-135,000}{3} = 405,000$$

* Purchased price

Unit	650,000
Engine	500,000
Carrier	200,000
Total	1,350,000

Payment terms: Installment payment (1/2 down-payment, then in 4 monthly installments of 1/8 increments)

- Variable annual depreciation cost

$$= \frac{\text{Purchase price - scrap cost}}{\text{Durable hours}} \times \text{Annual operating hours}$$

$$= \frac{1,350,000-135,000}{900} \times {*300} = 405,000$$

* 300 hrs/year ≑ 7 hrs/day x 30 days/month x 1 month/ season x 2 crops per year/year x 0.7 (operating ratio)

ii) Repair Cost

- Average annual repair cost

$$= \frac{\text{Purchase price x gross repair cost coefficient}}{\text{Durable years}}$$

$$= \frac{1,350,000 \times 0.3}{3} = 135,000$$

- Average repair cost per hour

= Purchase price x repair cost coefficient per hour

= 1,350,000 x 0.0003

≑ 450

iii) Garage Charge

Annual garage charge
= Purchase price x Garage charge coefficient
= 1,350,000 x 0.01
≑ 13,500

iv) Other Charges

- Interest on capital
  Paid in cash (installment payment, 1/2 down-payment, bal...
  in 4 monthly payments of 1/8 increments)

- Taxes and Dues
  Purchase price x Tax and Dues rate = 1,350,000 x 0.005
  = 6,750

- Insurance Premium
  Purchase price x Insurance premium rate = 1,350,000 x 0.0...
  = 3.375
  (Calculation basis for taxes and dues, as well as insura...
  premiums not confirmed)

e) Annual Fixed Charge Ratio*

$$\frac{\text{Annual fixed charges (total of maintenance cost)}}{\text{Purchase price}} \times 100$$

$$= \frac{563.625}{1,350,000} \times 100$$

$$= 41.8$$

b) Operating Charges

i) Fuel Cost

Annual fuel cost
= Fuel consumption per hour x unit price x total annual cons... hours
= *1.5 x **88 x 300
= 39,600

* 1.5 ℓ/hr ≑ 220 g/ps/hr x 8.5 ps x 0.8 (specific gravity)
** Official kerosene price (there are some examples in which kerosene is sold for 105 Rp/ℓ to end-users)

ii) Lube Oil Cost

30% of annual fuel cost. 39,600 x 0.3 = 11,890

iii) Moving cost

Not calculated as machines are pulled and moved in principle by men.

iv) Labor Cost (part-time workers)

Annual working days x daily pay x workers employed
= 60 x {(3,000 x 1) + (2,000) x 2}
+ 441,000

v) Operating and Management Cost

No management cost needs be calculated as machines will be owned privately for the moment. However, 5% of the income is calculated as business cost.

Annual treated quantity x Utilization rate x 0.05
= (500 x 300) x (0.1 x *100) x 0.05
= 75,000

* Paddy purchase price KUD

vi) Repayment of Principal on Borrowing

Own funds will be used.

c) Total Annual Cost

Annual maintenance cost (fixed expenditure) + annual operating (variable expenses)

= 563,625 + 557,490
= 1,121,115

d) Annual Utilization Fee Revenue

Annual treated quantity x utilization rate
= (*500 x 300) x **0.1 x 100 Rp (per kg of paddy)
= 1,500,000

* Handling capacity 500 kg/hr
** 10% of cleaned paddy

e) Profit as Operating Entity

i) Annual utilization fee revenue - total annual expense
= 1,500,000 - 1,121,115
= 378,885

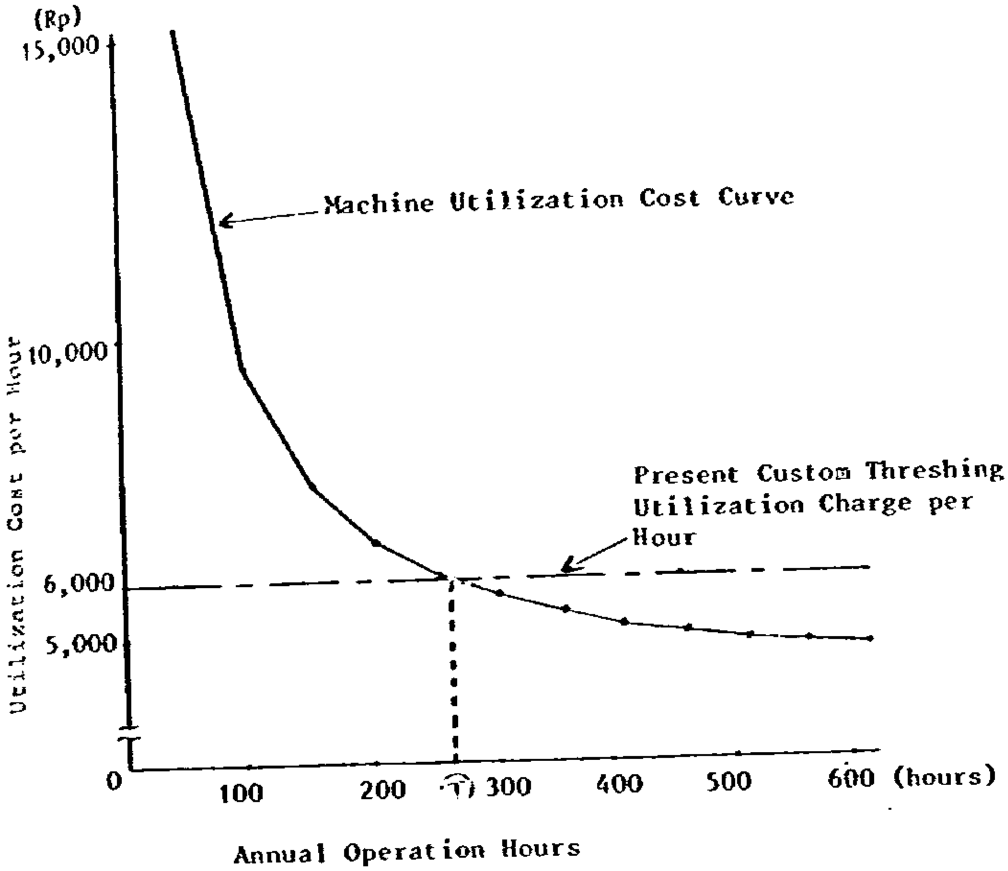
ii) Profit rate to utilization fee revenue

$$\frac{378,885}{1,500,000} \times 100 = 25.3$$

iii) The profit rate to the utilization fee income in this calculation is 25.3%, which is very large. This is the reason why the current utilization of 10% of output of paddy is high.
Farmers, who ask paddy to be threshed, feel that tea, cakes, and snacks which are traditionally offered during farming work cost 400 to 500 Rp/day/worker as cash outlay, which is becoming a large expense item. It should be noticed that machine threshing requires a shorter period of time and fewer people compared with manual threshing and winnowing and is regarded favorably by farmers.

f) Machine Utilization Expense Curve

Figure 5-27 shows a machine utilization expense curve based on this trial calculation.



T indicates the annual working hours which account for the break-even point for the present custom threshing utilization charge.

Fig. 5-27 Machine Utilization Cost Curve

7) Future Direction

a) Selection of Machine Types and Models

Aside from equipment types that will be developed in the future, the following two types can be selected as equipment that are adaptable to the current postharvest handling method and machine technology level (manufacture and repair) in the survey regions within the range of modification of the existing machine types.

i) IRRI Type, Model TH8

As stated, these type are designed to have minimum plugging, unthreshed paddy, empty rice kernels, etc. even when semi-dried paddy reaped at intermediate heights and bundled in small bundles is supplied. The cleaning function is enough to obtain the le of cleaned paddy required in the survey regions as a relatively large vibrating sieve and winnowing are combined. However, the machine is large and heavy, and it moving range is limited. It can be used only by roads or in farm yards. It cannot be opera in fields.

ii) Combination of IRRI Thresher and Winnower

IRRI has developed a compact throw-in feeding thresher (among its models. Its principal specifications are: capacity 600 kg/hr, and can be carried by 2 persons (100 kg). estimated manufacturing cost is US$217.22 (1979, price in the Philippines), excluding a gasoline engine.

It is one of the few equipment types that meet the harves situation in the survey region in Aceh Province in terms of and operation. One drawback of this type is that because its weight is already minimum, its principal function is to thresh, and no cleaning function is equipped.

This drawback can be covered by combining these functional thresher and a hand-operated winnower (if necessary, the thresh engine can be used). Both can be carried inside fields only by men.

By separating the threshing and cleaning functions, the m becomes simple, and their maintenance and management can be sim By making minor changes, they can be utilized for other purposes such as threshing of soybeans and can be operated matching the materials fed. (Example. Axial rotation of the thresher thresh casing and that of winnower wind casing no longer correlate as they are separate machines. They can easily be used for other than rice.)

b) Utilization

i) Utilization of Association Organizations

Organization of machine utilization is important to effic utilize a limited number of machines. Organized utilization in individual Kolompok Tani (farmer group) or several Kolompok at present, must be studied.

ii) The foregoing trial calculation shows that the current utilization charge should be made to be appropriate. For this purpose, a normal competition mechanism should preferably be intorduced to custom threshing on a private and commercial basis in order to correct the utilization charge in conjunction with custom threshing operated by public organizations.

(8) Actual Situation and Test of Winnower Utilization

1) Purpose of Survey

Paddy sold as a commodity in Indonesia by farmers has two extremes. One type of paddy is fully cleaned and well dried. The other type is raw-crop and is neither cleaned nor dried at all, depending on the region. A correlation exists between paddy cleaning and drying. Cleaning is not possible unless paddy is dried to some extent. The two extremes in drying and cleaning still exist as a regional difference. Within individual districts, the difference is small. A survey and test of the utilization of winnowers to study the situation regarding the utilization of winnowers in the cleaning process and to determine the limit to the contribution which winnowers can make improvements in the cleaning stage.

In the rice producing area in the plains in the north of West Java Province, immature kernels (chalky and green kernels) were detected in larger quantities than in normal years during the harvest time (particularly in the early delivery rice areas in January, February, and March) of the 1981/82 wet-season crop. This became a big issue when farmers sold paddy to KUDs or PUSKUDs. KUDs and PUSKUDs bought rice from farmers, but could not sell the paddy to DOLOGs as they did not have facilities to clean the paddy enough to meet the DOLOG standard. KUDs and PUSKUDs had a large stockpile of unsold paddy and had to refuse buying paddy temporarily. The survey team was conducted the survey in the regions and was asked various questions on the matter by government officials, KUDs, and farmers. It was judged necessary to study utilizing winnowers at the farm level to improve such a situation in the future, even though there might be a variety of possible solutions.
This also prompted them to make the test.

2) Definition of Winnowers

Significance of paddy cleaning by winnowers is given in the following.

a) To remove foreign matter in order to enhance the degree of quality of paddy as a commodity.

b) To sort empty paddy in order to increase the paddy value. The principles of a winnower as a cleaner are to place materials in an air current (air flow), to separate paddy by its flying distance. A width-flow impeller is rotated manually or by an engine to generate air flow. Figure 5-23 shows an example of a winnower popularly used in South Kalimantan Province.

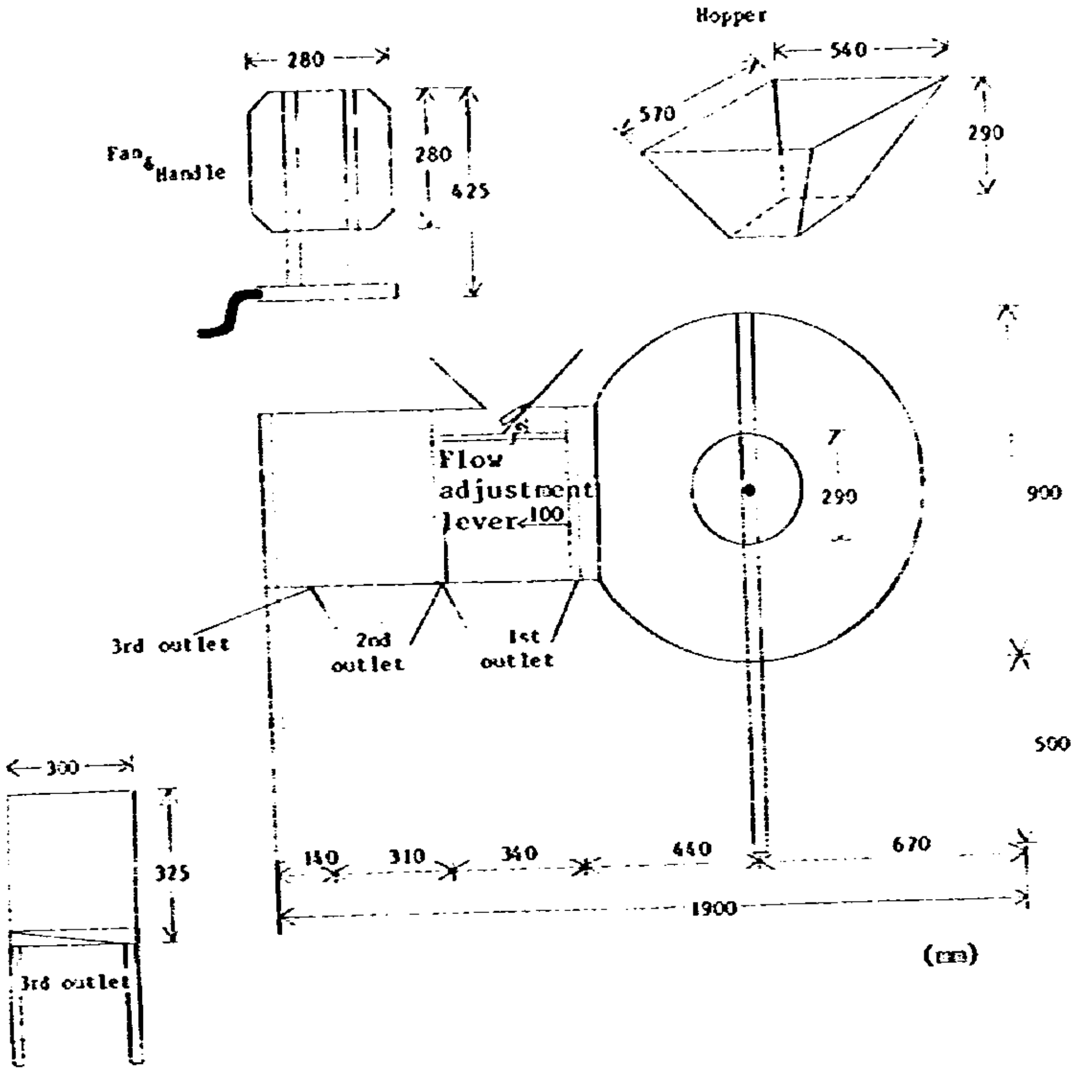


Fig. 5-28 Typical Winnower in South Kalimantan

3) Penetration of Winnowers

South Kalimantan and West Sumatera Provinces are known in Indonesia as regions in which winnowers are extensively used. Among the regions covered by the survey team (Aceh, West Jawa, South Sulawesi, and South Kalimantan Provinces), winnowers were frequently found in Aceh Provinces. Winnowers could not be found in the other two provinces.

a) South Kalimantan

Statistics on the penetration of winnowers have not been obtained yet. According to the information obtained during the survey in the survey regions, 20 to 30% of farms growing rice are estimated to be possessing winnowers. The history of winnowers in these areas is not clear, and it is said that winnowers have been in use for more than 40 years.

b) Aceh Province

In the established farming method, paddy is cleaned by winn[illegible] utilizing natural wind. The utilization of winnowers is increasing recently. However, the absolute number is still low, counting [illegible] units per village (desa).

4) Utilization Status of Winowers

a) South Kalimantan

Winnowers are owned by 20 to 30% of farms. The other farms rent implements only from farmers that have implements. Winnowing by means of natural wind is no longer common. The rental is gen[illegible] accepted to be 1% of paddy output.

After threshing paddy is sun-dried to 16 to 18% and is winnowed by winnowers. Cleaned paddy is again sun-dried, that is, finish drying, as a general practice.

Winnowers in South Kalimantan invariably have outlet Nos. 1, 2, and 3. Generally, the No. 1 outlet discharges paddy as a product, and No. 3 outlet, foreign matter and empty kernels that are discarded. The number of cleaning cycles for the No. 2 outlet is decided in accordance with the condition of raw paddy. Cleaning is generally repeated between 1 and 3 times. In general, the winnowing degree lowers when the paddy moisture is high, and the number of winnowing cycles is high. In many instances, what is discharged to the No. 2 outlet in the first winnowing is partly discharged to the No. 1 outlet by retreatment, becoming product paddy. Figure 5-29 shows patterns of various cases practi[illegible] Among these patterns, Pattern A is most common, followed by Patter[illegible] Pattern C, D, and E are extremely rare.

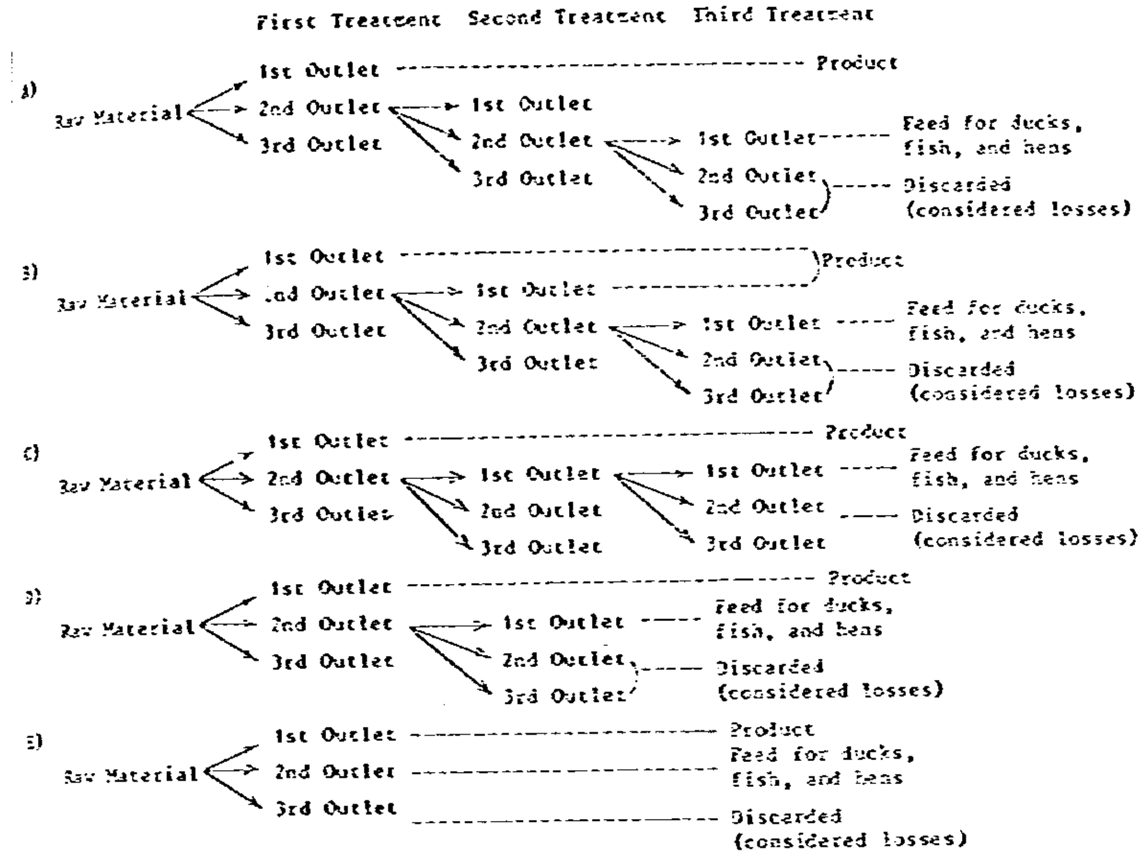


Fig. 5-29 Patterns of Winnowing Work in South Kalimantan Province

b) Aceh Province

Because the number of winnowers in use is limited, cleaning is subcontracted by owners of winnowers or by those who rented winnowers by charging 3.5 to 5% of paddy output including labor cost. During the peak season, one winnower works several tons a day. In this region, rice is threshed after reaping and drying in fields so that paddy is dried to an extent it can be winnowed after threshing. Winnowers are being replaced smoothly by natural wind winnowing performed by traditional work.

Further details regarding the utilization status of winnowers in the region are described in 5-4-1 (8).

c) Winnowers are principally used in paddy cleaning after thresh[illegible]. In addition, some rice mills use winnowers to remove rice bra[illegible] attached to milled rice and coffee bean silver skins.

5) Winnower Specifications and Price

a) South Kalimantan Province

There are quite a few winnower craftsmen throughout the provi[illegible]. Basically, the construction at the winnower is the same as that of Japanese-made winnowers. Winnowers are made of wood (Kayu lanan). They work approximately 500 kg per hour, and their durable years are considered to be 10 to 15 years. The current price is about 20,0[illegible] Rp/unit. In terms of improvements in their functional structure, a feed roller to increase the work accuracy and an impeller-shaft spee[illegible] accelerator to continue work by hand for a long time are added.

b) Aceh Province

Winnowers are not sold at regular sales distribution channels. Their shapes, sizes, and construction are varied. In many instances, carpenters in the region make them by following samples. This is the reason why there are so many varieties. Very original ideas ca[illegible] be found in contrivances with the feed roller and moving method. So[illegible] of them have an engine. Winnowers are made to order, and the prices are varying.

6) Performance Test of Popular-Type Winnowers Made and Used in South Kalimantan Province

a) Outline of Test

It is fund that farmers in the region have been utilizing win-nowers for cleaning regardless of whether paddy is for their own con-sumption, or for sale. In other areas, winnowers are just starting to be used only recently, or cleaning work itself is not clearly posi-tioned in the established farming techniques in many areas. Everyt[illegible] about rice including distribution needs to be analyzed in order to [illegible] out how such a regional difference has materialized.

A cleaning test was made with winnowers actually utilized in South Kalimantan, but the survey was limited to investigating losses as well as the degree and efficiency of cleaning work.

b) Survey Method

The same 12 farmers that were conducted during the survey in the wet-season crop were selected.

The degree of losses, foreign matter, immature kernels, and sound kernels were studied by operating the winnowers in accordance with the traditional paddy cleaning performed by farmers with winnowers. The cleaning rate was analyzed by sampling paddy discharged at t e discharge outlets. The mechanism of the winnowers was also studied.

c) Test Procedure

i) A specimen (300 g) before treatment was picked out from sample paddy. The paddy was sun-dried to a moisture content of 16 to 18% after threshing by trampling without cleaning it as farms normally did.

ii) 100 kg of sample paddy was prepared.

iii) The sample paddy was fed to a winnower which was operated as farmers would normally operate it. The time required was measured at that time.

iv) The number of recleaning the paddy discharged at the 2nd outlet was decided based on the judgement of a farmer who would normally operate winnowers.

v) After winnowing, the discharge quantities from the individual outlets were measured and were reduced in quantity and samples (300 g each) were taken.

vi) Paddy discharged at the 2nd outlet which remained there after recleaning paddy from the 3rd and 1st outlets was separated by the winnower and again by hand and the loss quantity was obtained.

vii) The samples (300 g each) were test-winnowed to clean them, and foreign matter and empty rice kernels were measured.

viii) The selected paddy was measure. Brown rice was reduced in quantity to make samples for analysis (50 g each).

ix) Brown rice samples (50 g each) were analyzed in their ordinary form. Items were provided for hard green (sound kernels) and soft green (immature kernels) so that they can be distinguished separately.

d) Test results

i) Twelve winnowers were used in the test. They were different in detail, but their basic construction was nearly the same. Figure Figure 5-28 shows an example.

ii) Table 5-51 shows specifications, operation details, treating capacities, etc. of the test machines.

iii) Table 5-52 shows the analysis results of the samples selected at the outlets to determine the cleaning degree.

iv) Tables 5-51 and 5-52 are summarized in the following.

- Specifications

Dimensions	190 x 30 x 140 cm (L x W x H)
Impeller blades	4
Hopper capacity	24 kg
Material	Wood (kayu lanan)

- Operations

Impeller shaft speed	119 rpm
Number of repetitive cycles of 2nd outlet	1
Number of workers	2 to 3

- Materials

  Paddy moisture content 17.9%

  Varieties HYVs

- Handling capacity 515 kg/hr

- Mixed proportion of immature kernels at individual outlets:

Before Treatment	After Treatment
	1st Outlet → 2.6%
4.7% ←	2nd Outlet → 0.8%
	3rd Outlet → 1.3%

- Proportion of discharge weights at that time broken down by discharge outlet

Before Treatment	After Treatment	1st Outlet
	1st Outlet → 94.7%	1.2%
100% ←	2nd Outlet	0.5%
	3rd Outlet → 3.7%	

- Losses

	1st Outlet ----- None	
Raw Material ←	2nd Outlet --- 0.1%	(Discharge at 2nd outlet repetitively treated once. No repetitive treatment for the 3rd outlet.)
	3rd Outlet ---	

Table 5-51 The Result of Winnower Test

Farmer No.	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	Average
Number of fan vane	4	4	4	4	4	4	4	4	6	4	4	4	4
r.p.m. of fan	110	121	119	93	121	87	120	106	135	156	135	132	119.2
Capacity of hopper (kg)	21.0	22.3	23.4	25.6	20.3	21.3	23.1	26.4	22.8	28.5	22.4	28.3	23.8
Treatment times of 2nd outlet	1	0	2	2	0	0	2	2	1	2	2	2	2
Number of workers	3	3	3	3	2	2	3	2	2	3	2	2	2.5
Capacity per hour (kg)	461.4	-	1,148.7	539.9	406.1	282.0	549.5	354.5	416.0	459.8	515.0	536.2	515.4
Price (Rp)	15,000	15,000	15,000	15,000	15,000	15,000	25,000	35,000	30,000	25,000	25,000	25,000	19,600
Used years	5	2	3	3	6	5	4	2	4	15	2	2	4.4
Variety of paddy	IR-32	IR-32	IR-32	cisadane	IR-32	Duyung	IR-32	IR-42	IR-32	IR-32	spanchi	spanchi	
Paddy moisture (%)	17.8	22.6	22.9	15.3	18.6	16.2	14.5	16.4	17.7	15.4	18.9	16.5	17.9
Weight rate 1st outlet grain (%)	96.7	92.5	98.2	97.6	93.1	95.3	95.3	94.3	91.5	91.5	94.4	96.1	94.7
Weight rate 3rd outlet grain (%)	trace	trace	trace	trace	trace	trace	trace	trace	trace	0.2	trace	trace	trace
Empty & Foreign Materials [illegible] (%)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 5-52 The Result on Analysis of Paddy Samples from Winnowers

Sample \ Item		Sound Kernel Rice (%)			Immature K. (%)			Damaged K. (%)	Foreign Matter (%)	Total (%)
		Others	Trans-parent Green	Total	Dead Green	Others Green K	Total			
1	Before Treatment	92.32	0.82	93.14	trace	2.54	2.54	4.19	0.12	99.99
	1st outlet	89.54	0.78	90.32	trace	2.13	2.13	3.94	0.04	96.43
	2nd outlet	2.78	0.04	2.82	trace	0.36	0.36	0.01	trace	3.19
	3rd outlet	trace	trace	trace	trace	0.05	0.05	0.24	0.08	0.37
4	Before Treatment	89.31	0.28	89.59	0.47	3.59	4.06	6.31	0.04	100.00
	1st outlet	88.91	0.28	89.19	0.36	1.70	2.06	6.20	0.04	97.49
	2nd outlet	0.48	trace	0.40	trace	0.05	0.05	trace	trace	0.45
	3rd outlet	trace	trace	trace	0.11	1.84	1.95	0.11	trace	2.06
7	Before Treatment	92.86	1.65	94.51	0.11	1.70	1.81	3.59	0.08	99.99
	1st outlet	90.92	1.45	92.37	0.11	1.13	1.24	2.00	0.04	95.65
	2nd outlet	1.94	0.20	2.14	tracs	0.48	0.48	1.14	trace	3.76
	3rd Outlet	trace	trace	trace	trace	0.09	0.09	0.45	0.04	1.58
8	Before Treatment	85.76	5.02	90.78	3.28	3.55	6.83	2.32	0.08	100.01
	1st outlet	84.91	3.04	87.95	2.93	0.85	3.78	2.12	0.04	93.89
	2nd outlet	0.85	1.98	2.83	0.30	1.43	1.73	0.16	trace	4.72
	3rd outlet	trace	trace	trace	0.05	1.27	1.32	0.04	0.04	1.40
9	Before Treatment	85.51	0.44	85.95	0.63	7.84	8.47	5.54	0.04	99.99
	1st outlet	84.13	0.36	84.49	0.12	1.86	1.98	5.15	0.04	91.65
	2nd outlet	1.38	0.08	1.46	0.06	2.18	2.24	0.13	trace	3.83
	3rd outlet	trace	trace	trace	0.45	3.80	4.25	0.26	trace	4.51
10	Before Treatment	85.26	2.97	88.23	1.90	2.38	4.28	7.45	0.04	100.00
	1st outlet	81.38	2.58	83.96	1.74	2.22	3.96	2.61	0.04	90.57
	2nd outlet	3.00	0.39	3.39	0.03	0.03	0.06	4.02	trace	7.47
	3rd outlet	0.88	trace	0.88	0.13	0.13	0.26	0.82	trace	1.96
Average	Before Treatment	88.50	1.86	90.36	1.07	3.60	4.67	4.90	0.07	100.00
	1st outlet	86.60 (91.83)	1.46 (1.55)	88.06 (93.38)	0.88 (0.93)	1.65 (1.75)	2.53 (2.68)	3.67 (3.89)	0.04 (0.04)	94.30 (100.00)
	2nd outlet	1.75 (44.87)	0.40 (10.26)	2.15 (55.13)	0.07 (1.79)	0.75 (19.23)	0.82 (21.02)	0.92 (23.60)	trace (0.25)	3.90 (100.00)
	3rd outlet	0.15 (8.33)	trace trace	0.15 (8.33)	0.12 (6.07)	1.20 (66.15)	1.32 (72.22)	0.32 (17.78)	0.03 (1.67)	1.80 (100.03)

Table 5 - 53 Immatured Kernel Ratio Contained in Material Paddy and Ea[illegible] Outlet

Item / Sample	Immature Kernel Total (%)		
	Dead Green	Others	Total
Pre-Treatment	1.07 (100.00)	3.60 (100.00)	4.67 (100.00)
1st Outlet	0.88 (82.24)	1.65 (45.83)	2.53 (54.18)
2nd Outlet	0.07 (6.54)	0.75 (20.83)	0.82 (17.56)
3rd Outlet	0.12 (11.22)	1.20 (33.34)	1.32 (28.26)

e) Conclusions of Test

Under the condition that paddy discharged at the 2nd outlet [illegible] repetitively cleaned once:

i) Separation Performance to Remove Immature Kernels by Winnower

45% of immature kernels mixed in raw material paddy could be removed. In the test, the object component (sound kernels) [illegible] in the product increased from 95.3 to 97.4%.

ii) Weight Ratio of Discharge Quantity from Each Outlet:

1st outlet ———— 95.9% (sound kernels)
2nd outlet ———— 0.5% (livestock feed)
3rd outlet ———— 3.7% (empty kernels, foreign matter, etc.)

iii) Loss Quantity less than 0.1%

f) Separation Test for Green Kernels (Butir Hijau) by Winnower and Sieve

As part of the survey program "Milled Rice Test II", a milled rice test was made for paddy mixed with different proportions of [illegible] kernels. Prior to the test, in order to obtain sample paddy mixed with intended proportions of immature kernels, paddy was prepared by using a hand-operated winnower and sieve. Needless to say, green and immature kernels were not of the same quality. In the test, green kernels (by the Indonesian standard) that became an issue in Karawang District of West Jawa Province during the 1981/82 wet-season crop only were analyzed. The results are shown in Table 5-54.

Table 5 - 54 Green Kernel Content and its Weight after Winnowing (%)

Sample No.	Green Kernel Content of before-Winnowing	Winnowing method / Result	Sieve *		Winnower **		
			Remained	Passes	1st Outlet	2nd Outlet	3rd Outlet
I	8.9	Ratio of Wt.	71	29	78	20	2
		Green Kernel Content	4.2	26.1	7.8	20.2	34.8
II	11.9	Ratio of Wt.	61	39	73	22	5
		Green Kernel Content	6.1	37.7	10.5	24.7	35.1

* Sieve Specifications Dimension 260 x 140 mm
Mesh size 20 x 1.9 mm
Rate of openings 36%
Operation Quality 250 g/time/1 min. operation
Paddy thickness on sieve 13 ~ 15 mm

** Winnower Specifications Ohya Tancho - go
Dimension 1.085 (L) x 580 (W) x 940 (H) mm
Weight 37 kg
Operation Revolution of fan axle 240 ~ 250 r.p.m.
Rotation of handle 78 ~ 80 r.p.m.
Opening of shutter 7 mm

When paddy contained with 8.9% of green kernels was separated by a sieve, green kernels decreased to 4.2% on the sieve mesh, while green kernels increased to 26.1%. The weight ratio at that time was 71:29. Table 5-55 shows green kernels contained in paddy as an object (green kernels) component content.

Table 5 - 55 Rate of Green Kernel Content after Winnowing

(%)

Sample No.	Green Kernel Content before Winnowing \ Winnowing Method	Sieve *	Winnower **
1	8.9	26.1	21.5
2	11.9	37.1	26.6

* Under - Sieve

** Total outlet No. 2

Basically, as a matter of principle, it is not possible to completely separate green kernels only by specific gravity separation by means of kernel length separation by a sieve and winnower. However, it can be considered as a reference test as an actual solution method for the green kernel problem when a sieve or winnower, which is most commonly available to farmers, is used. The value is low as an object component content. However, as carried out by some farmers with winnower, it will be possible to increase the degree by repetitively treating the discharge from the 2nd outlet during the work. When a sieve and winnower are compared, a sieve is suitable for the purpose of separating green kernels. However, when the characteristics of a sieve are considered, re-cleaning by a sieve is suitable after roughly cleaning by using a winnower and reducing the quantity at farmer's level.

g) Items and Improvements on Winnower Mechanism Requiring Study

i) The User Opinions Were Obtained for Study in which Direction the Second Outlet should Face

Face of the second outlet on the same side as that of the first outlet, the operator can make adjustments while watching the separation operation. However, the quantity of paddy that can be received in front of the winnower decreases, and discharged paddy has to be removed more frequently. The situation is opposite when the second outlet is provided on the side opposite the first outlet.

ii) Fitting a Feed Roller (See Fig. 5-30)

Fragments of cut straw are contained in a large quantity in paddy for cleaning in the traditional threshing method (trampling, beating with a stick, and other methods). For this reason, the cleaning degree lowers due to an uneven flow rate by not having a feed roller. The same phenomenon is observed when drying of paddy is not sufficient. Winnowers in Aceh Province already incorporate a feed roller. However, the shapes of the rollers need improving.

iii) To Provide an Acceleration Mechanism in order to Stabilize the Rotation of the Impeller Shaft and to Make Wind Pressure Uniform (See Fig. 5-31)

The speed of the impeller shaft is approx. 120 rpm. It is difficult for an operator to drive the shaft for a long period of time without an accelerator means. The revolution speed tends to lower, and the separation degree degrades. In terms of human engineering, the optimal revolution speed of human arms is 70 to 80 rpm, and an acceleration mechanism (gear, chain, etc. are utilized) will be needed.

iv) To Provide Adjustable Partition Panels to partition the 1st, 2nd, and 3rd Outlets

The partition panels require a secure stopping system that will not move due to vibrations during the operation.

v) To Study the Change from Manual Drive to Motive Power Dri

In order to maintain a certain revolution speed for a lo time and to increase the degree and processing ability, vi have to be operated by motive power. This results in labor sa

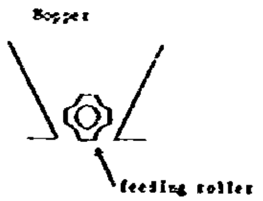


Fig. 5-30 Feeding Roller

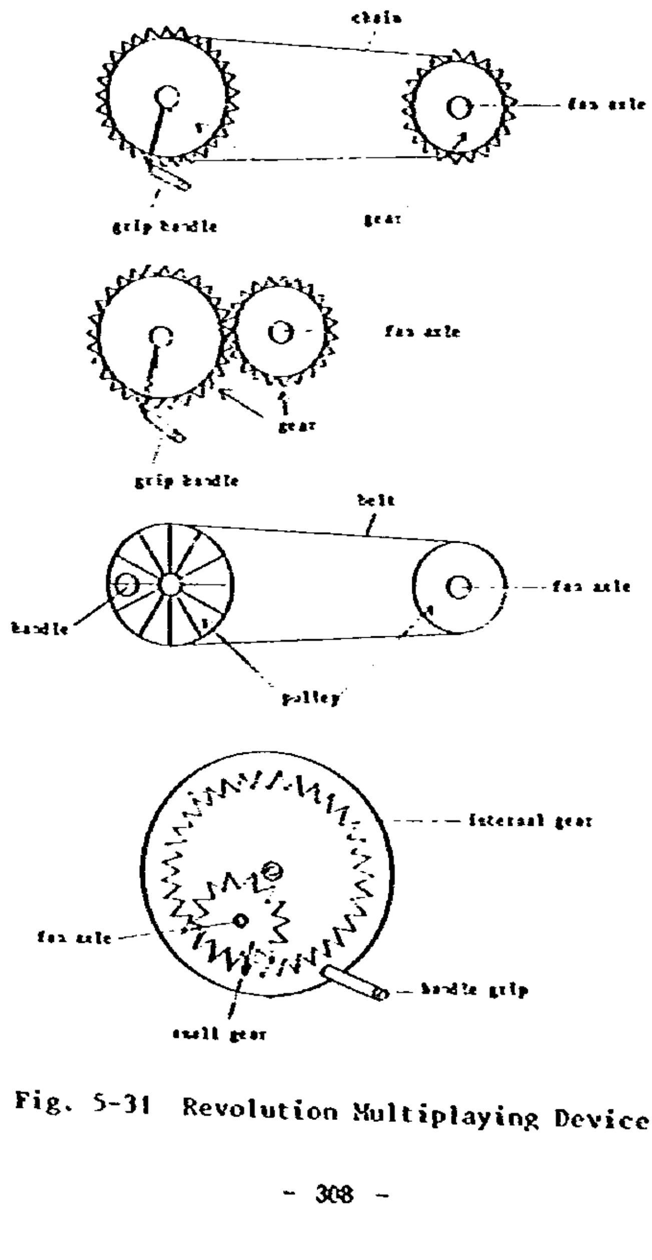


Fig. 5-31 Revolution Multiplaying Device

j) Future of Winnower Utilization

Winnowers as cleaning implements have many advantages. The following four points in particular are the conditions that meet the current state of farming implements for Indonesian agriculture that is in this development stage.

i) The price level is acceptable to the farmer's purchasing power.

ii) User requirements regarding handling capacity and usage can be met.

iv) Winnowers can be manufactured locally by using local materials and technology.

In spite of these features, the penetration of winnowers has a great regional difference. There must be some factors that refuse their penetration, or various conditions related to paddy that do not require cleaning itself. Based on this standpoint, an analysis of the cause for it cannot be avoided if postharvest processing improvements are to be attained.

As an example of the approach to winnower utilization, a combination with a thresher, which will be used more in the future, can be considered. Normally, threshers incorporate the same mechanism as that of winnowers as a cleaning mechanism. However, threshers of this type are heavy and are very difficult to be carried in regions where district roads are not existent and fields condition are not developed. This will hamper their penetration. As a solution to this problem, if the threshing and cleaning mechanisms of the thresher can be split and if cleaning work can be substituted by a winnower, the thresher shall be lighter, and the difficulty of transportation shall be solved. Furthermore, the investment amount would be smaller.

5-4-2 Storage

(1) Results of Storage Test (Storage Simulation Test)

Data concerning the actual state of rice storage in Indonesia is ex-tremely limited.

The principal purpose of fact-finding surveys of this type is to make time-series measurements of quantitative and qualitative losses of rice generated during storage in order to check the availability of the storage order to check the availability of the storage functions which individual storage facilities have.

Simulation tests were conducted in the provinces (DOLOG level), dis-tricts (KUD level), and villages (farm level) that were covered in the dry and rainy surveys.

Sample lots of paddy and/or milled rice tasted were installed in the ing places during the dry-season survey (survey period: September to the of November, 1981). The sample lots were stored for as long as about 6 m until the wet-season survey (February to the end of May, 1982.). During the test period, the temperature and humidity in the storage locations were conti-nuously measured and recorded by automatic temperature and humidity recor (See Figures 5-32 through 38)

1) Location

a) Farm Level

i) Aceh Province

- Lueng Teungoh Jeunieb Aceh Utara
- Sangso Samalanga Aceh Utara
- Manyang-cut Meureudu Aceh Pidie
- Kuta Baroh Banda Dua Aceh Pidie

ii) West Java Province

- Weninggalih Jonggol Bogor
- Jonggol Jonggl Bogor

iii) South Sulawesi Province

- Marannu Mattiro Bulu Pinrang
- Teppo Patampanua Pinrang
- Suli Suli Luwu
- Suyamus Larompong Luwu

iv) South Kalimantan Province

- Tanbaktanan Astambur Banjar
- Sungaibatang Martapula Banjar
- Hapulang Haruyan Hulu Sungai Tengah
- Binjai Pamangkih Labuan Amas Utara Hulu Sungai Tengah

b) KUD Level

i) Aceh Province

- KUD Meurah Jaya
  Meureudu Aceh Pidie
- KUD Kuta Glee
  Samalanga Aceh Utara

ii) West Jawa Province

- Pus KUD Unit II
  Karawang

iii) South Sulawesi Province

- KUD Alitta
  Mattiro Bulu Pinrang
- KUD Suli
  Suli Luwu

iv) South Kalimantan Province

- KUD
  Kertahayar Banjar
- KUD
  Labuan Amas Utara Hulu Sungai Tengah

c) DOLOG Level

i) Aceh Province

- Sub DOLOG
  Tijue Aceh Pidie

ii) West Jawa Province

- Sub DOLOG Umbul Purwasari II
  Karawang
- Sub DOLOG
  Karawang

iii) South Sulawesi Province

- Sub DOLOG
  Macorawalie Sawitto Pinrang

iv) South Kalimantan Province

- Sub DOLOG
  Labuan Amas Utara Hulu Sungai Tengah

2) Results and Analysis of Storage Tests

During the rainy survey, the sample lots installed 6 months before were recovered. Records of the automatic temperature and hu recorder and of qualitative and quantitative losses were also exa At the same time, samples for a milling test were collected. Based the samples gathered and on data, an analysis and assessment of loss were made.

a) The Maximum and minimum temperature during each measurem the top and bottom layers of the pile in DOLOG warehouses in S Sulawesi and South Kalimantan differed by as much as approxima 10°C during the day (12 a.m. to 2 p.m.) and nighttime (midnigh to 6 a.m.). The relative humidity shows an inverse correlatio phenomenon. Great variations in temperature and humidity in wa houses during the day are causing adverse affects to the storag function. The color and smoothness of surface of rice kernels are degenerated during storage. In Aceh Province in particular, more colored kernels could be noticed. (See Figures 5-37 and 38).

b) Rice temperatures upon completion of simulations were measured in DOLOG warehouses in South Sulawesi and South Kalimantan Provinces. The results show that temperature of rice were lower by 1 to 4°C than the temperature inside the warehouses during the day. Variations of rice temperatures in the top, middle, and bottom layers of the pile tended to go lower from top to bottom.

c) A clear supremacy of difference could be noticed in temperature and humidity inside DOLOG warehouses in South Sulawesi and South Kalimantan Provinces compared with those in buildings of warehouse offices which had the best environmental conditions. Variations in monthly average, maximum, and minimum temperatures were smaller compared with those inside warehouses. Variations in average, maximum, and minimum humidities were also smaller compared with those inside warehouses. Variations of corresponding average, maximum, and minimum relative humidities change in inverse correlation to variations in the temperature. (See Figures 5-37 and 38)

d) The minimum temperature on the bottom layer in the DOLOG warehouse of South Kalimantan Province increased to 21°C in January. For this reason, the relative humidity stayed at nearly 100%. Condensation was about to form on paddy and rice whose temperature was below the minimum temperature. (See Figure 5-37)

e) In all of the DOLOG warehouses, the temperature on the bottom layer was generally lower than that on the top layer compared with variations of average, maximum, and minimum temperatures and humidities on the top and bottom layers of the piles. However, this trend could not be noticed for relative humidity. (See Figures 5-37 and 38)

f) The quantitative losses of paddy storage in the farm level test are larger than those of KUDs and DOLOGs. (See Table 5-56)

In many instances, however, no preventive measures are taken. For this reason, quantitative losses of paddy at the farm level are larger compared with the other levels. Conversely, some farmers through attention to store and manage rice for their own consumption.

g) Insects that are generated in warehouses include rice weevils, small rice weevils, auguimois grain moths, etc. Many ticks eat rice bran were generated in DOLOG warehouses in West Java Province during the rainy season during which time both temperature and humidity increase. Those rodents that damage rice are gray rats, tiger rats, mice, etc., and damage is done mostly by tiger rats.

Losses by rodents are comparatively small because there is food in abundance.

Losses by rodents are comparatively small because there is food in abundance. The actual state of rodent damage by rats will have to be studied over a certain period of time.

As stated, deterioration factors that lead to losses during storage are respiration of rice/paddy, action of microorganisms, heat generation, rodent damage, etc. All these factors become more active when the temperature and humidity are high. The duration of store milled rice deteriorating the quality of rice is estimated to be approximately 3 months under the natural conditions.

There are only few examples of tests. At present, tests of this type are continuously undertaken by Indonesia.

The current rice storage situation in Indonesia is that, as can be seen in the BULOGs' storage conditions, some rice is unavoidably stored in old private warehouses with poor facilities because of a shortage of warehouses owned by BULOGs. The collection of data on storage tests for some duration such as this will be valuable to the BULOG program to improve storage.

Table 5-56 Total Results of Simulation Test Related to Rice Storage

(%)

Province \ Item		Farm level: Quantitative loss	Farm level: Qualitative loss	KUD level: Quantitative loss	KUD level: Qualitative loss	DOLOG level: Quantitative loss	DOLOG level: Qualitative loss	Summary
D.I. Aceh	Milled rice	-	-	-	-	-	-	
	Paddy	2.2	14.5	0.9	23.0	0.7	12.0	Quantitative loss is caused by vermin damage Most of qualitative loss is caused by mixing discolored kernels so that a reduction of price occurs
West Jawa	Milled rice	-	-	0.4	5.0	0.2	2.5	Qualitative loss caused by bad exteriors of rice Loss caused by relative reduction of price
	Paddy	1.5	2.3	-	-	-	-	Loss caused by badly dried paddy
South Sulawesi	Milled rice	-	-	-		0.4	3.8	Price reduction caused by bad exteriors and partially mixed discolored kernel
	Paddy	1.8	3.2	0.4	2.7	0.8	1.2	Insect grow extremely on farmer level
South Kalimantan	Milled Rice	-	-	-	-	0.1	3.0	
	Paddy	1.3	1.5	0.3	2.2	0.5	1.5	

Notes: —— means not operated.
The duration of simulation is scheduled for about 6 mounths.
Lot of storage test is 70 kg at farm level, 2 ton at KUD level and 20 ton at DOLOG level.
Calculation of qualitative loss is indicated by reduction of price valve. This value is calculated on rice price of each region which is compared beginning and terminating time of test.

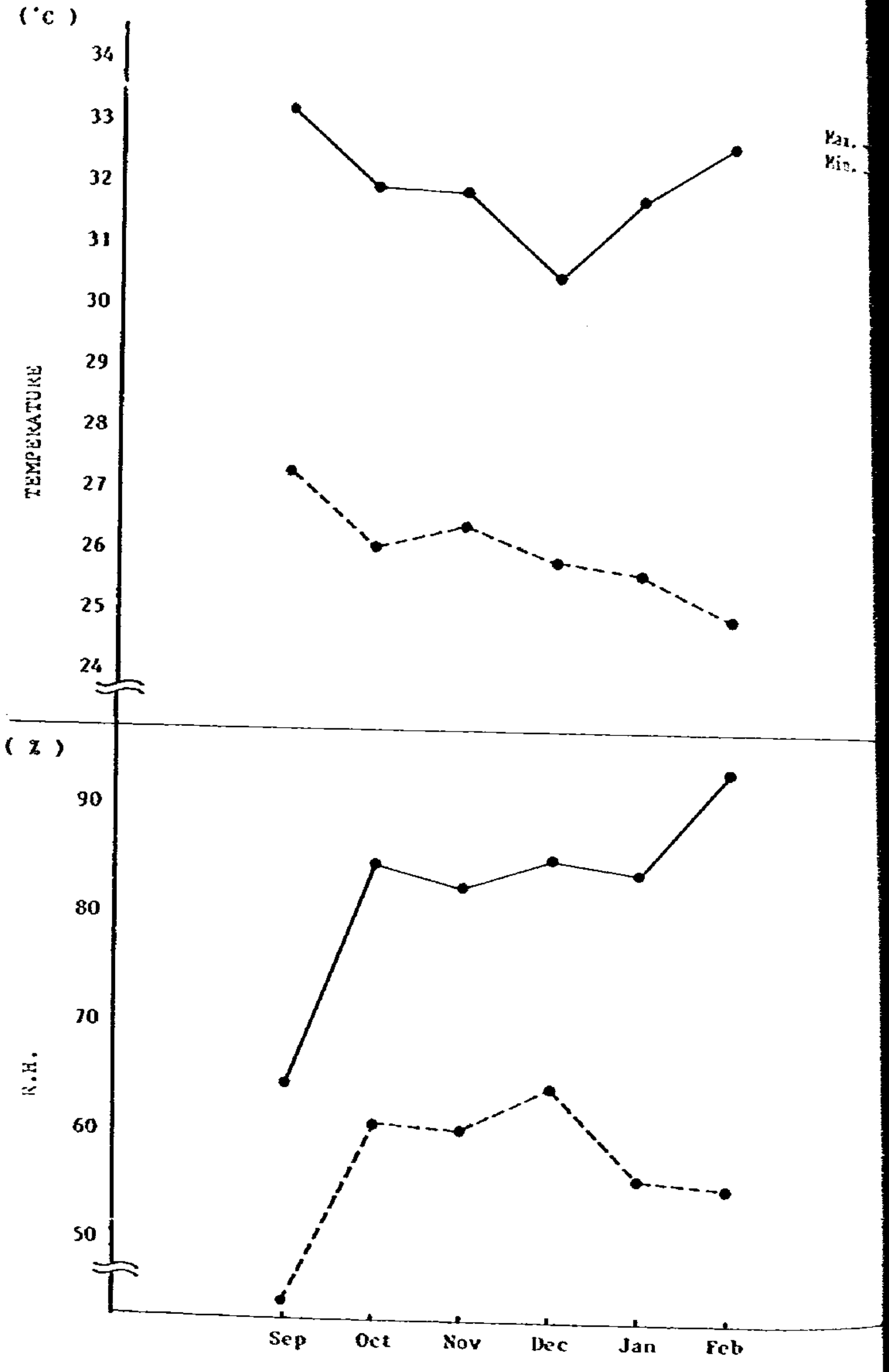


Fig. 5-32 Temperature and Relative Humidity (R.H.) in Aceh, Dolog (pidie)

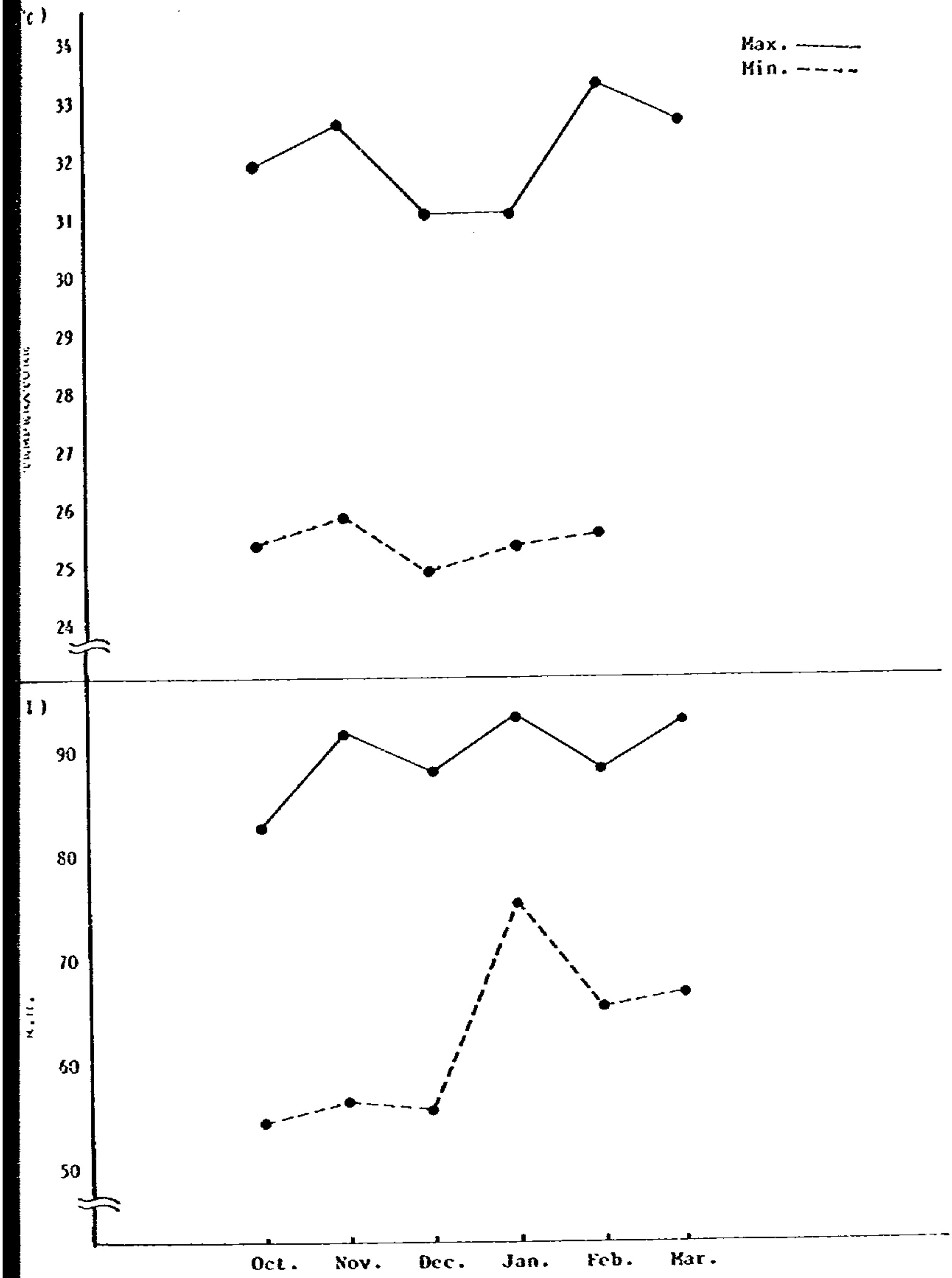


Fig. 5-33 Temperature and R.H. in Aceh, KUD (KUTA GLEE)

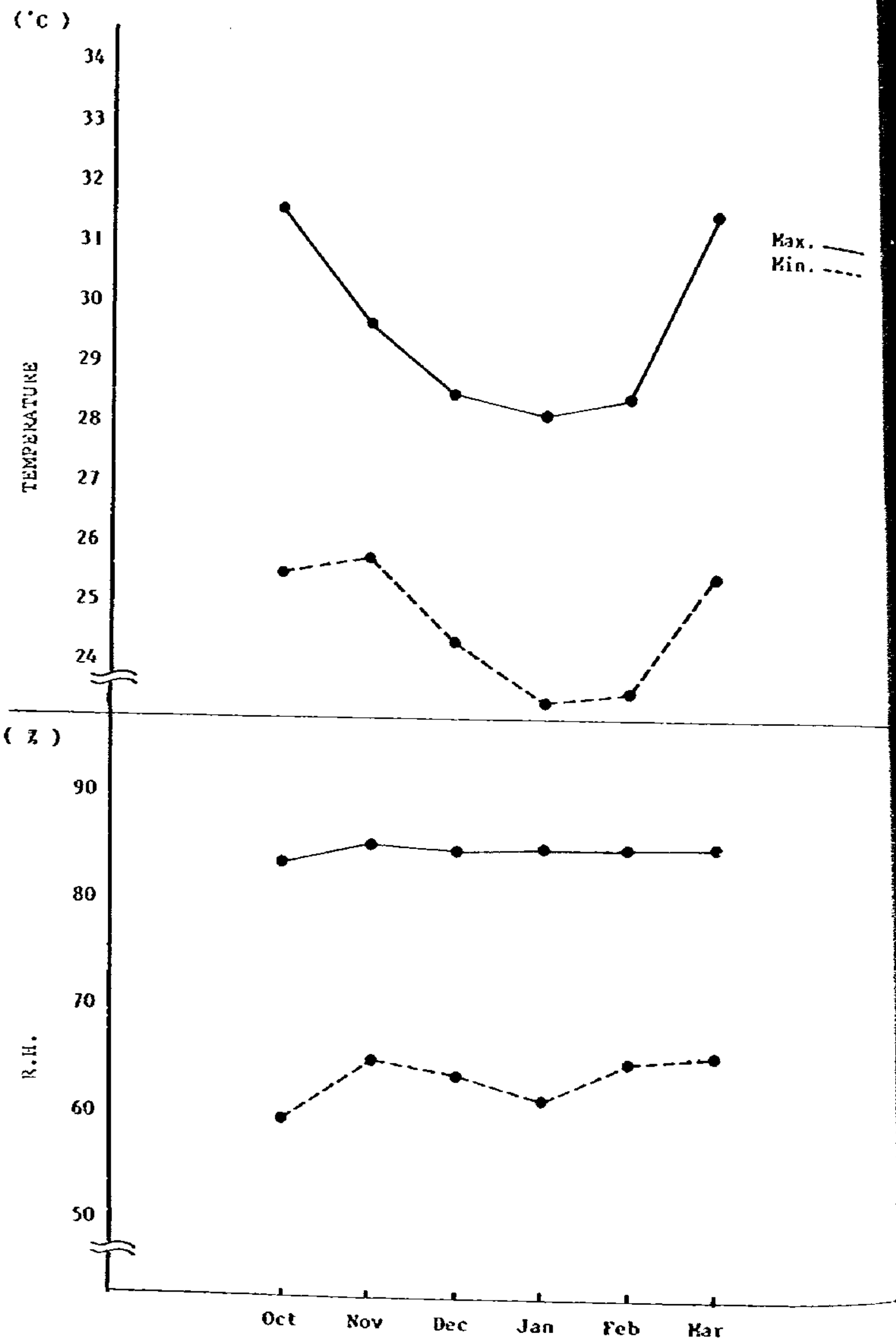


Fig. 5-34 Temperature and R.H. in Aceh, KUD (MEURAH JAYA)

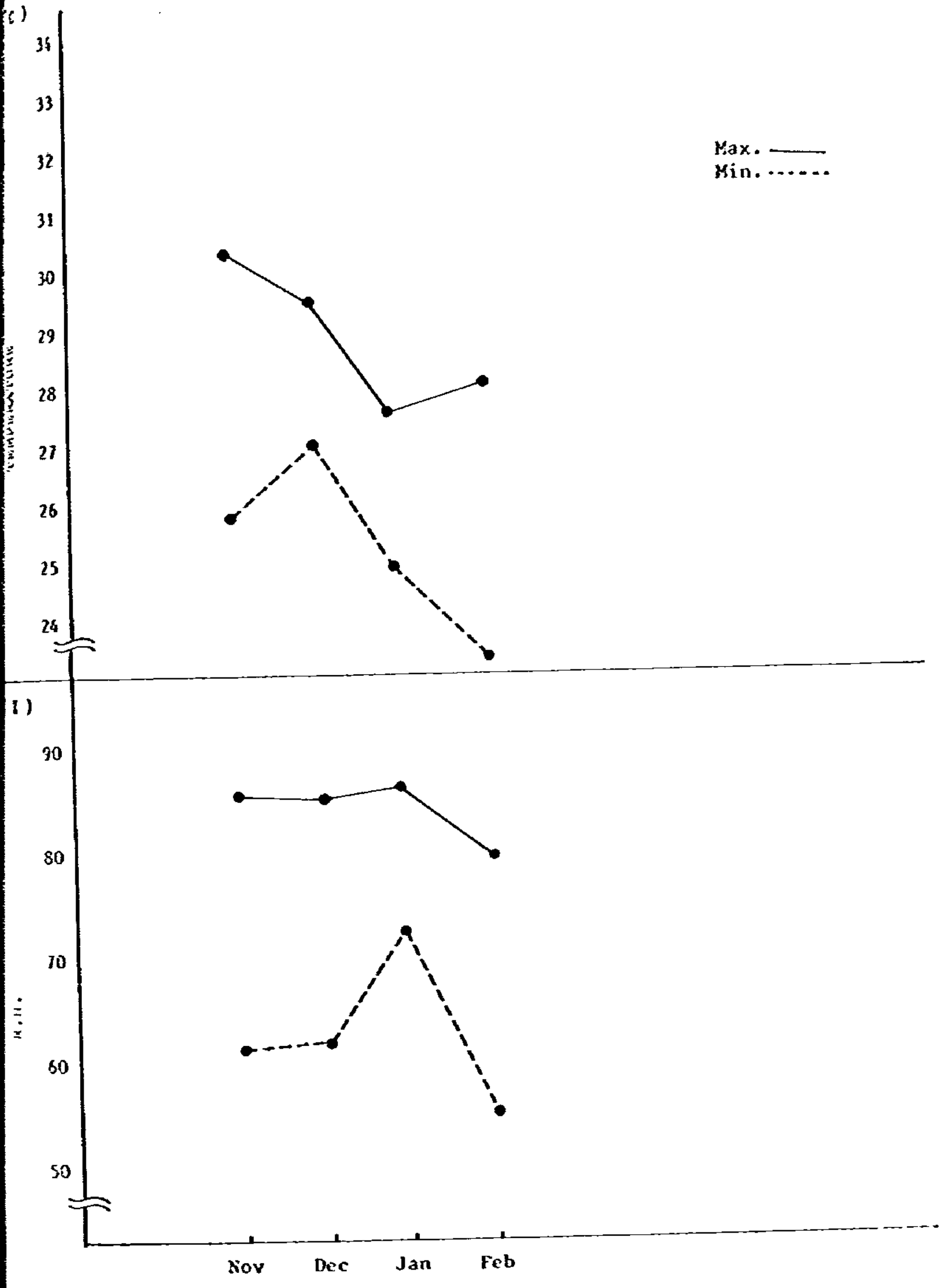


Fig. 5-35 Temperature and R.H. in Java, DOLOG (KARWANG)

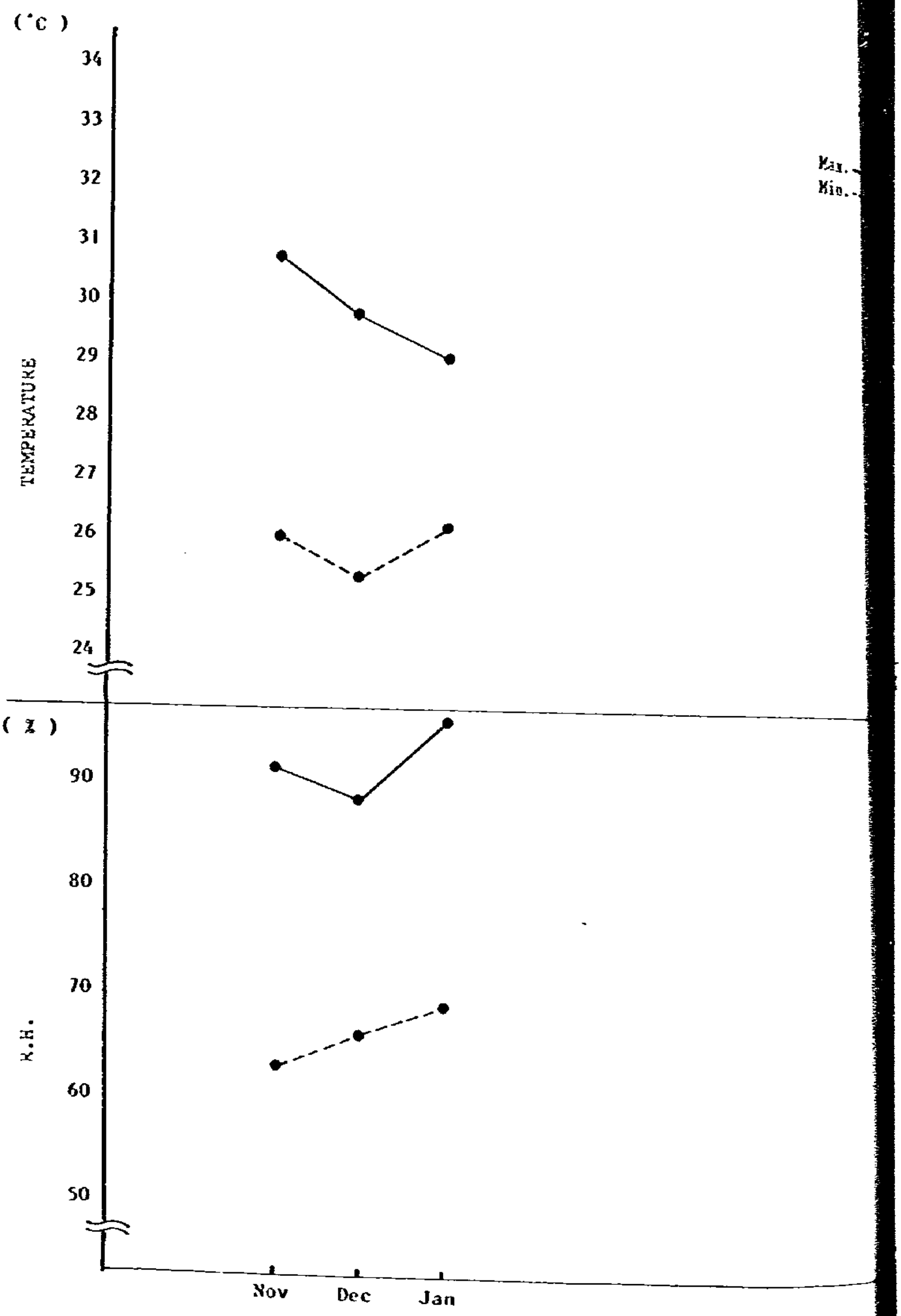


Fig. 5-36 Temperature and R.H. in Jawa, PUSKUD (KARAWANG)

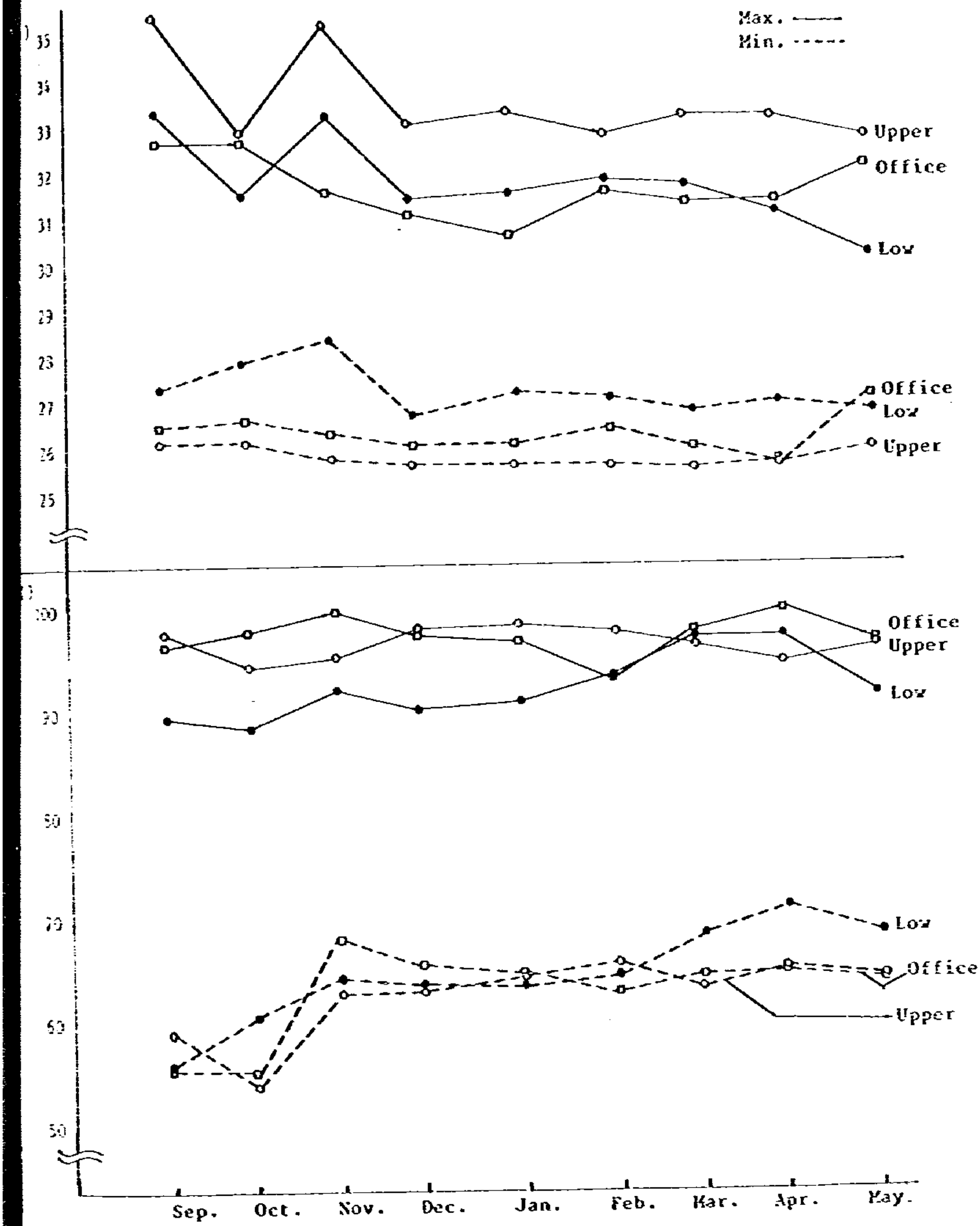


Fig. 5-37 Temperature and R.H. in Sulawesi, DOLOG (PINPANG)

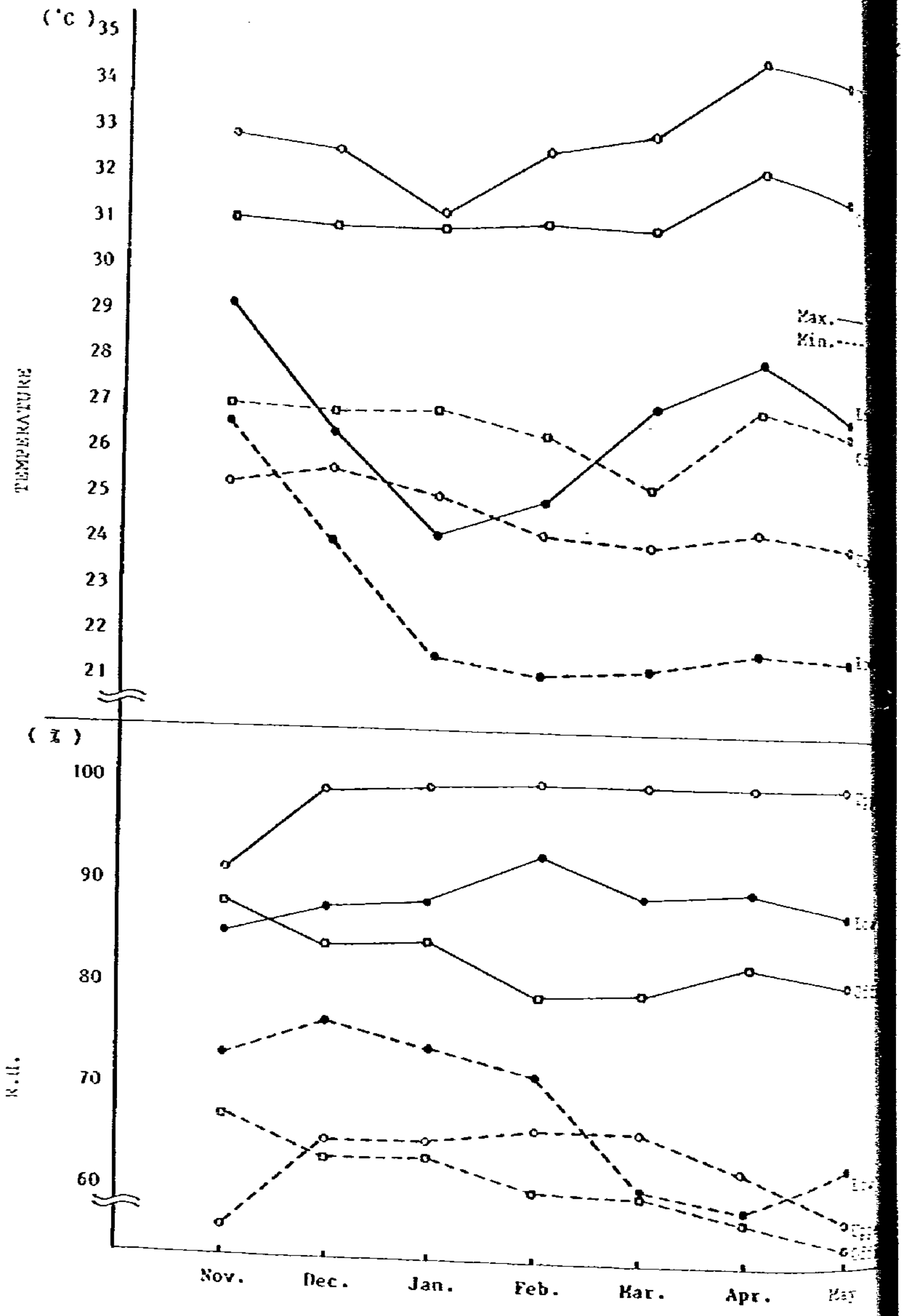


Fig. 5-38 Temperature and R.H. in Kalimantan, DOLOG (H.S.T.)

2) Tests on Storage Method at the Farm Level

1) Purpose

Paddy with a high moisture content harvested in the rainy season is forced to stored without being well dried. While waiting for the weather to turn better, paddy degenerates as time passes, and its quality deteriorates. When bad weather continues, extremely damaged kernels are produced. Quality deterioration of paddy is one of the most serious problems in postharvest processing in Indonesia since the introduction of high yielding varieties.

This processing should be performed at the farm level. The principal purpose of the test is to find out what would be the most effective and economical means and methods.

2) Outline of Test

a) Lumbung Test

The effect of preventing deterioration was made by storing high-moisture content paddy in a lumbung immediately after being harvested and by blowing a small quantity of air into the paddy by a hand-driven blower during its storage. In the test, blowing and non-blowing zones were installed for comparison. Both zones used approximately 2.5 tons each of paddy.

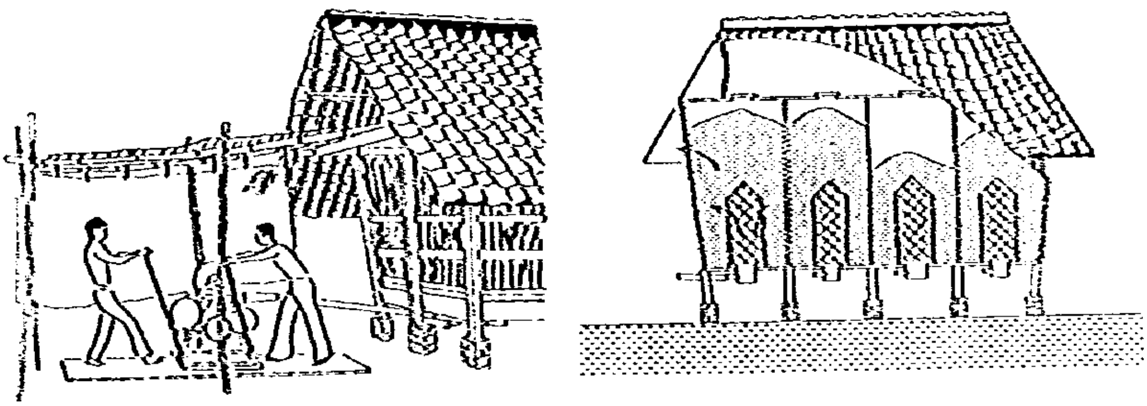


Fig. 5-39 Lumbun Test

b) Piling Test

High-moisture content paddy under the same conditions as those mentioned in the previous paragraph was piled on an outd concrete floor, and a small amount of air was blowed into pa by a hand-driven blower. The test was made to determine how deterioration of paddy could be saved.

Blowing and non-blowing section was provided for comparis The blowing zone was roofed with a translucent vinyl sheet cove ing to prevent rain and direct sunshine. Both zones had 0.5 to of paddy.

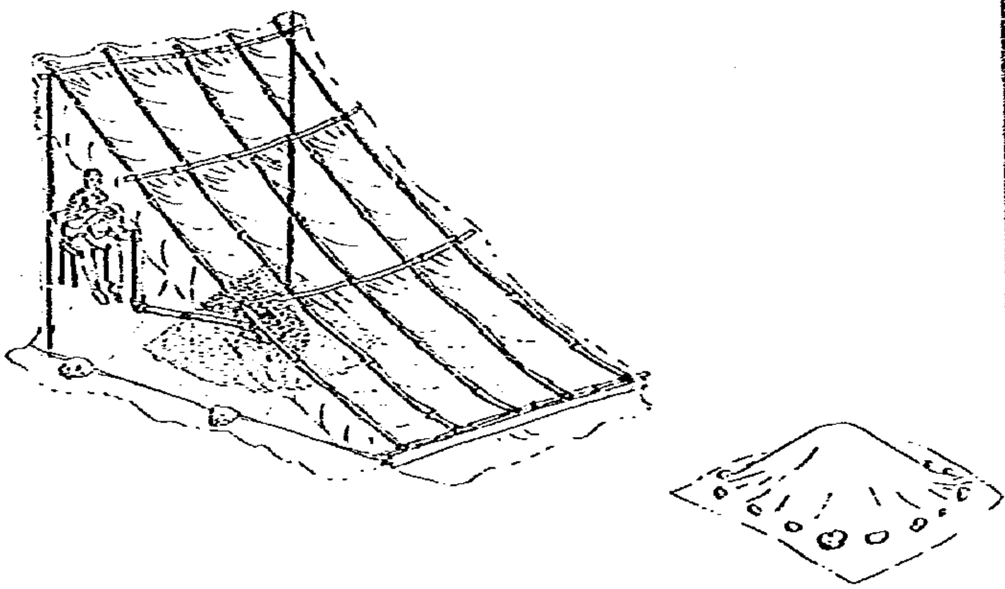


Fig. 5-40 Piling Test

c) Bagging Test

High-moisture content paddy is left in bags at farm level. A test was made on how paddy inside bags deteriorated as time passed.

Twelve plastic polyethylene fertilizer bags were made and 50 kg each of paddy was contained in them in accordance with the practical method used in Indonesia. The bags were placed under eaves in piles of 4. The paddy quality was checked after storing for 5, 10 and 15 days. A total of 0.6 ton of rice was used.

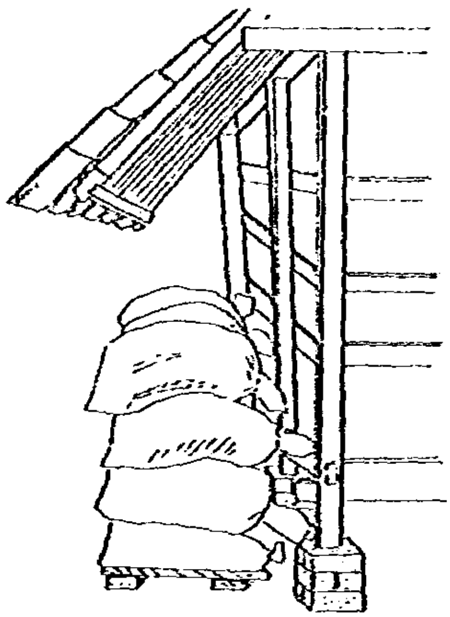


Fig. 5-41 Bag Test

d) Sun-Drying Test

The high-moisture content paddy under the same conditions used in the foregoing 3 tests was dried by direct sunshine in accordance with the practical method used traditionally. A test was made to compare it with the other tests.

e) Natural Air Drying Test (Control Test)

The high-moisture content paddy under the same conditions used in the foregoing 4 tests was dried by the safest way using nature air, and thus, a control zone was made to compare with the individual tests.

3) Preparation for Test

a) Test Site

The Karawang branch of the Central Research Institute of Food Crop, Karawang Branch (formerly Central Agricultural Research Instutute)

b) Test Facilities

i) Lumbung Test

A west Java type Lumbung that had already been installed at the test site was improved to meet the test purpose, and damaged sections of it were repaired for use in the test.

The Lumbung was partitioned to make 2 sections, and cylindrical wire netting for ventilation was installed the bottom center of the sections.

A hand-driven blower for ventilation was made by a local iron works.

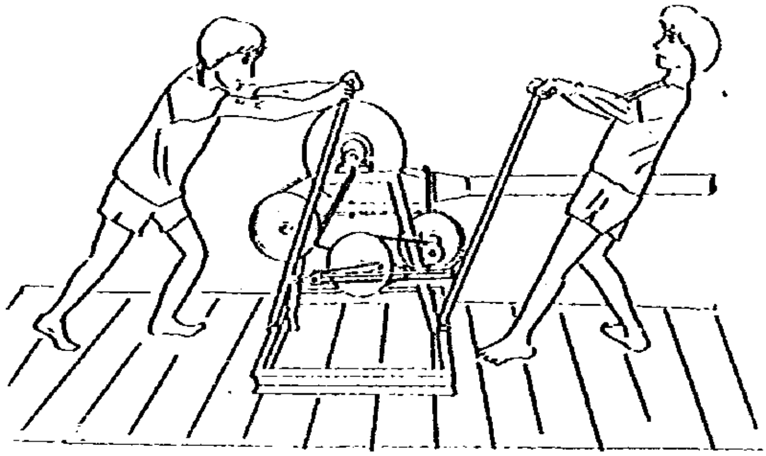


Fig. 5-42 Blower

ii) Piling Test

Conical wire netting was placed on a concrete floor paddy drying located in the Central Research Institute of Crop. A roof was made by forming a bamboo frame and spreading translucent vinyl sheeting. A hand-driven blower for ventilation was used by remodeling and repairing a small centrifugal blower.

iii) Paddy

Approximately 6.7 tons of high-moisture content paddy (moisture content approx. 25%) needed for the test was purchased from a farmer immediately after its harvest. The paddy was weighed for the individual test items and distributed.

The variety was Cisadane.

Lumbung test	2.5 tons x 2 sections	= 5 tons	Total 6.7 tons
Piling test	0.5 ton x 2 piles	= 1 ton	
Bagging test	0.05 ton x 12 bags	= 0.6 tons	
Sun-drying test	0.05 ton x 1 location	= 0.05 tons	
Air-drying test	0.05 x 1 location	- 0.05 tons	

4) Test Method

a) Lumbung Test

Paddy was stored in 2 sections after partitioning the Lumbung. The two sections were divided into a blowing section with air blowing and into a non-blowing section without air blowing. Air was blown into the blowing section for 3 hours from 9 a.m. until noon everyday when the relative humidity was comparatively low.

Air was blown at a static pressure of 25mm W.G. at 0.1 m^3/sec. This corresponded to 0.04 m^3/sec per ton of paddy and was the air blowing volume needed for storage-drying.

The storage test was completed approximately a month after starting to store high-moisture content paddy. Paddy from the top, intermediate, and bottom layers was individually taken out and was natural-air dried by a drier until the paddy was dried to the required moisture content. The temperature and humidity of each section were measured twice a day while the paddy was stored in the Lumbung.

As was the case with the blowing section, temperature variations and the moisture content in the non-blowing sections were measured. In about a week after entering storage, the rice temperature rapidly rose to 65°C, and degenerated yellow kernels in the top layer increased substantially.

Under the circumstances, the non-blowing test was interrupted. Air was blown for 3 hours from noon to 3 p.m., and paddy from the top, intermediate, and bottom layer was taken out separately about a month after starting storage and was dried.

Dried paddy from the individual layers was milled and was analyzed.

b) Piling Test

Paddy piled on concrete was separated into blowing and non-blowing zones. Air was blown to the blowing zone for 6 hours from 9 a.m. until 3 p.m. Air was blown at a static pressure of 15 mm WG at 0.05 m^3/sec per 0.5 ton of paddy. Air corresponded to 0.1 m^3/sec per ton of paddy and was sufficient for storage-drying.

The paddy nearly reached the required moisture content (15%) about 10 days after starting the test, and the test was ended. Temperature and humidity were measured twice a day. After finishing drying, the paddy was threshed and milled, and milled rice analyzed.

5) Test Results and Considerations

a) Lumbung Test

When a large quantity of high-moisture content paddy was stored in a storage without blowing air, the temperature rapidly increased within about a week. The rice deteriorate and became colored kernels. In the Lumbung, the top layer deteriorate extensively, while the bottom layer had a relatively large percentage of normal kernels. This can be explained by the fact that temperature of the bottom layer did not rise due to the rising current and that the rice temperature rose in the top layer.

It could be verified that even high-moisture content paddy could be stored for a long period of time without any change in quality by blowing a small amount of air even by a hand-driven blower.

The paddy moisture content decreased to about 18% (approx. a day) when a small amount of air was blown. However drying stopped after about 18%. This can be attributed to the small air blowing quantity and an air volume needed to dry the entire paddy could be sent as air blew through due to the fact that inside the storage became partially hollow due to sampling.

The recovery was low with paddy that had many colored kernels and the percentage of broken kernels was high after the paddy was threshed and milled. The yield with paddy in the blowing section was high even though the luster of milled rice was low, after st for a month. Milled rice had fewer broken kernels (7% - 15%).

b) Piling Test

By merely piling and leaving high-moisture content paddy outdoors, the temperature of paddy inside the bags slowly rises, although the degree of temperature rise is not as high as that in storage, creating deteriorated and germinated kernels. The damage in the top layer was low.

It was confirmed that blowing air into high-moisture content paddy and appropriate use of solar heat are highly effective in preventing degeneration while also facilitating drying. In threshing and milling results as well, broken kernels caused by cracking were fewer compared with sun-drying by the traditional farming practice.

Improvements can be established regarding drying at the farm level in the future by devising concrete measures based on air blowing and sun-drying.

Table 5-57 Results of Storage Test on High Moisture Contents of Paddy at Farm Level

Unit: %

Test Mark	Testing Condition	Existing Mill			Test Mill		
		Milled Rice			Milled Rice		
		Recovery	Broken	Discolored Kernel	Recovery	Broken	Discolored Kernel
Control	Natural Air Drying	69.2	17.3	0.4	68.4	14.6	0.5
Sundry	Sun Drying	64.2	31.0	0.5	66.3	47.0	0.5
LA - U	Lumbung W/Air, Upper	67.6	16.3	0.6	68.9	26.0	0.5
- M	Lumbung W/Air, Middle	69.0	16.2	0.6	68.1	23.4	0.4
- B	Lumbung W/Air, Bottom	67.4	13.9	0.7	70.3	26.7	0.7
LT - U	Lumbung W/O Air, Upper	65.2	19.4	48.5	69.3	46.2	12.5
- M	Lumbung W/O Air, Middle	65.0	15.6	6.9	70.4	18.5	3.4
- B	Lumbung W/o Air, Bottom	67.0	20.0	4.3	72.0	24.6	1.3
GA	Piling W/Air	65.7	16.6	0.5	64.3	20.5	
GA - A	Piling W/Air, Upper	64.8	28.2	3.6	61.1	33.4	0.5
GA - B	Piling W/Air, Bottom	66.5	18.3	28.4	67.9	31.0	
K - A	Bag, 5 Days, Bottom	65.0	28.1	0.0	64.0	14.9	1.4
- B	Bag,5 Days,Middle,B	64.5	28.4	0.0	65.2	11.6	11.5
- C	Bag,5 Days,Middle,V	66.9	27.5	0.0	66.0	8.9	
- D	Bag, 5 Days, Top	64.0	28.7	0.0	64.8	15.6	0.0
K - E	Bag, 10 Days, Bottom	64.7	25.5	0.0	62.3	16.1	0.0
- F	Bag,10 Days,Middle,B	67.9	19.4	0.0	64.7	16.4	0.0
- G	Bag,10 Days,Middle,V	67.6	20.4	0.5	64.2	15.9	0.0
- H	Bag, 10 Days, Top	65.6	30.1	0.5	65.2	13.2	0.0
K - I	Bag, 15 Days, Bottom	63.0	29.2	0.8	65.8	7.7	0.5
- J	Bag,15 Days,Middle,B	63.1	35.5	2.6	65.4	10.4	0.0
- K	Bag,15 Days,Middle,V	62.5	27.8	10.0	63.6	13.0	0.0
- L	Bag, 15 Days, Top	63.2	36.6	1.8	63.8	19.4	0.0

Table 5-58 Results of Milled Rice and Storage Method of High Moisture Contents of Paddy at Farm Level

Test Mark	Testing Condition	Existing Mill											Test Mill											
		Brown Rice					Milled Rice							Brown Rice					Milled Rice						
		Re-covery	Head	Immat-ured	Broken	Paddy	Re-covery	Head	Broken	Brewery	Chip		Milling Degree	Re-covery	Head	Immat-ured	Broken	Paddy	Re-covery	Head	Broken	Brewery	Chip	Dis-colored	Milling Degree
Control	Natural Air Drying	77.2	86.8	9.2	3.1	0.9	69.2	82.7	13.3	3.8	0.2	0.4	90.8	76.9	90.0	8.8	1.0	0.2	68.4	85.4	14.2	0.4	0.2	0.0	91.8
Sundry	Sun Drying	76.2	86.6	8.4	4.6	0.4	64.2	69.0	24.8	3.8	0.6	0.5	91.3	77.5	86.6	6.8	5.6	0.8	65.3	53.0	40.8	4.8	1.4	0.0	92.6
IA-U	Lusbun w/Air, Upper	76.4	87.5	9.6	2.7	0.2	67.6	83.7	15.5	0.7	0.0	0.6	90.0	76.5	84.8	14.0	1.8	0.0	68.9	74.0	25.4	0.5	0.1	0.0	90.0
M	" , Middle	76.8	87.1	10.5	2.1	0.3	69.0	83.8	15.7	0.4	0.1	0.6	92.9	77.9	87.2	9.7	2.5	0.1	68.1	76.0	23.2	0.7	0.1	0.4	92.9
B	" , Bottom	75.8	87.9	9.9	2.0	0.2	67.4	86.1	13.2	0.5	0.2	0.7	90.9	76.4	82.1	8.9	2.1	0.0	68.3	84.0	15.6	0.4	0.0	0.7	92.8
IB-U	Lusbun w/o Air, Upper	75.4	86.7	10.6	2.1	0.6	65.2	80.6	18.8	0.9	0.1	48.5	90.8	77.0	69.7	28.7	1.0	0.1	69.3	81.8	18.0	0.2	0.0	42.9	92.1
M	" , Middle	79.0	91.8	6.1	1.3	0.8	65.0	85.4	13.4	1.0	0.1	6.9	91.8	75.5	84.4	13.1	2.6	0.0	67.4	83.4	16.0	0.6	0.0	4.8	92.9
B	" , Bottom	76.6	88.1	9.2	1.7	1.0	67.0	80.0	18.8	1.0	0.2	4.3	92.4	77.8	45.3	12.6	2.0	0.1	68.0	77.4	21.8	0.6	0.2	2.9	90.8
C1	Piling w/Air	74.9	84.5	9.4	3.7	0.4	65.7	83.4	13.5	2.9	0.2	0.5	92.9	77.8	84.5	5.0	1.6	0.8	67.3	79.5	19.5	1.1	0.3	0.0	92.9
C2-A	Piling w/o Air, Upper	75.3	84.2	10.6	4.6	0.4	64.8	71.8	21.5	5.6	1.1	3.6	90.8	77.1	70.2	21.0	8.1	0.5	66.1	68.2	26.6	3.9	1.3	1.4	92.5
B	" , Bottom	74.1	88.4	8.4	2.8	0.4	66.5	81.7	15.6	2.5	0.2	28.4	91.7	79.4	60.8	67.0	1.8	0.4	67.9	79.0	20.5	0.4	0.1	21.8	91.5
B-A	Bag, 5 days, Bottom	76.5	88.5	5.8	4.8	0.4	65.0	71.9	24.7	3.0	0.4	0.0	91.3	77.2	89.6	9.1	1.0	0.1	64.6	85.1	14.4	0.4	0.1	0.0	92.0
B	" , Middle B	75.0	82.2	13.9	3.9	0.0	64.5	71.6	23.3	4.9	0.2	0.0	90.9	77.2	84.5	13.7	0.5	0.4	65.2	88.4	11.2	0.3	0.1	0.0	91.9
C	" , Middle U	80.3	88.8	7.2	3.5	0.0	66.9	72.5	22.5	4.7	0.3	0.0	90.5	77.1	84.4	14.3	0.8	0.4	66.0	91.1	8.6	0.2	0.1	0.0	91.3
D	" , Top	73.0	84.6	9.1	4.4	0.7	64.0	71.3	25.2	3.3	0.2	0.0	92.5	77.5	88.3	9.2	2.0	0.6	64.8	84.4	15.0	0.5	0.1	0.0	95.4
E	Bag, 10 days, Bottom	77.4	85.6	9.6	3.7	0.0	64.7	74.5	45.5	4.2	0.8	0.0	89.6	74.0	84.4	14.3	1.2	0.1	65.3	83.9	15.5	0.5	0.1	0.0	89.2
F	" , Middle B	78.9	84.0	11.6	4.1	0.2	67.9	80.6	15.6	3.7	0.2	0.0	89.2	76.9	84.7	14.0	1.0	0.1	64.7	83.6	15.8	0.5	0.1	0.0	92.2
G	" , Middle U	78.9	85.2	10.8	3.7	0.2	67.6	79.6	16.7	3.5	0.2	0.5	91.3	76.9	85.3	13.7	0.9	0.0	64.2	84.1	15.2	0.5	0.1	0.0	92.1
H	" , Top	78.0	86.3	9.3	4.4	0.0	65.6	69.9	25.7	3.9	0.3	0.5	90.5	77.5	84.8	14.6	0.3	0.2	65.2	86.8	12.9	0.3	0.0	0.0	92.9
I	Bag, 15 days, Bottom	79.5	83.1	7.6	3.7	0.5	63.0	70.8	23.4	5.5	0.3	0.8	91.7	77.2	88.0	10.5	0.5	0.5	65.8	92.3	7.3	0.3	0.1	0.5	92.1
J	" , Middle B	73.8	84.3	11.2	4.2	0.1	63.1	64.5	31.7	3.4	0.4	2.6	92.5	77.8	89.0	17.2	0.8	1.9	65.4	89.6	10.0	0.3	0.1	0.5	89.2
K	" , Middle U	77.6	83.8	10.8	4.6	0.8	62.5	72.2	23.6	4.0	0.2	10.0	93.4	76.4	70.6	28.0	1.2	0.2	63.6	87.0	12.7	0.2	0.1	8.5	92.9
L	" , Top	77.2	82.1	14.1	3.4	0.3	63.2	63.4	31.8	4.6	0.2	1.8	92.1	77.1	83.4	14.6	1.0	0.2	63.8	80.6	18.8	0.5	0.1	2.3	92.5

4-3 Transportation

Unfortunately, due to various restrictions, a transportation test or survey in the distribution stage could not be made.

As mentioned in the section in Chapter V relating to the actual situation of postharvest handling, losses were nearly non-existent in Aceh, South Sulawesi, and South Kalimantan Provinces. However, losses could be spotted in transportation using sandang in West Jawa Province, and the test made on transportation from fields to farms in West Jawa Province is reported in the following.

Stalk paddy are carried bare when transported by sandang (carrying poles), and losses by this carrying mode were reportedly large. However, actual loss values were not clearly determinable yet. In the test, loss quantities were measured. Due to time limitations, the survey was made with 9 persons at 3 farms.

1) Method

a) Sandang loaded with stalk paddy was enveloped in a bag made for the test in advance. The bag mouth had a cord around it, and the cord could be tied on the top section of the bag.

b) Farmers carried sandang from a field to the threshing site in the normal fashion.

c) After carrying, the bag was taken out and the weight (T_1) of shattered paddy was measured.

d) The carried stalk paddy were threshed by trampling to minimize losses, and the weight (T_2) of paddy was measured.

e) The loss ratio was calculated by using the following calculation formula:

$$\frac{T_1}{T_1 + T_2} \times 100$$

2) Result

Table 5 - 59 Transportation Losses of Sandang

(Farmer A)

Distance of Transportation 1.9 km

Variety SEMELU

Transporter	Total Amount of Transportation (paddy)	Total Loss	Loss (%)
A - 1	20,068.1 (g)	98.6 (g)	0.5
A - 2	21,683.9	123.5	0.8
A - 3	21,084.9	388.8	1.8

* A - 3 Transporter is 12 years old.

(Farmer B)

Distance of Transportation 1.0 km

Variety CIMANDILI

Transporter	Total Amount of Transportation (paddy)	Total Loss	Loss (%)
B - 1	32,330.0 (g)	259.8 (g)	0.8
B - 2	32,946.0	343.6	1.0
B - 3	23,707.0	98.4	0.4

(farmer C)

Distance of Transportation 1.2 km

Variety CISADANE

Transporter	Total Amount of Transportation (paddy)	Total Loss	Loss (%)
C - 1	22,133.4 (g)	168.8 (g)	0.3
C - 2	28,204.1	119.7	0.4
C - 3	31,516.6	87.0	0.3

Losses in transit by sandang were 0.3 to 1.8%, averaging 0.7%. As far as test results are concerned, losses were not as large as generally mentioned.

Losses were very large for A-3 in Table 5-59. Stalk paddy were carried by a boy of about 12 years. Because the work was new to him, he was unsteady and rested. The stalk paddy were jostled on each of these occasions.

Normally, adult males carried rice on sandangs, and approximately 50 kg including the weight of the sandang was carried each time for a distance of as long as 1 to 2 km. Although the work is arduous farmers balance the sandang well. They walk fast to gain rhythm when carrying the rice ears from the fields to the threshing sites.

When loading the stalk paddy onto sandangs, tip in several layers are piled up alternately and tightly so that the panicles do not fall off on the way. The upper sections of the panicles are secured by thin cords. Loading is performed carefully, and it takes a long time, 20 to 30 minutes, causing large time losses.

Field roads are not fully developed in West Java Province, and panicles cannot be moved by such means as bicycles and motorbikes. For this reason, sandang are an important and indispensable transportation means.