CHINESE-AMERICAN

JOINT COMMISSION ON RURAL RECONSTRUCTION

Food & Fertilizer Series: No. 2

TRANSLATION OF SURVEY REPORT ON TAIWAN'S RICE LOSSES ON FIELDS AND DRYING GROUNDS DURING HARVEST

Prepared by

Department of Agriculture & Forestry

Taiwan Provincial Government

April 1955

TAIPEI, TAIWAN, CHINA

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with Subsidy from

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FOREWORD

The following is an English translation of a report prepared in Chinese by the Taiwan Provincial Department of Agriculture & Forestry. The report outlines the procedures and findings of an investigation of paddy rice loss on representative farms of Taiwan. The work was undertaken on the 1954 2nd rice crop under the JCRR project code number TW-K-40. The total cost of the survey was approximately NT$ 39,000, toward which the Joint Commission on Rural Reconstruction contributed NT$15,500.

The findings of this survey, although not to be considered fully conclusive, nevertheless indicate that losses amounting to about 3 per cent occur on the farms during harvesting of the crop. It is also pointed out that these losses can be substantially reduced by (1) planting Ponlai rather than the local or Chailai variety of rice, (2) employing improved threshing equipment, and (3) utilizing improved or concrete-surfaced drying grounds. The last is especially important in those areas which experience inclement weather during the harvest season.

It may be necessary to conduct similar surveys on subsequent crops in order to determine more accurately the exact losses. Further surveys should be made to determine losses during transportation, processing and storage after the rice leaves the farm. Surveys of losses during marketing and during preparation in the consumers' homes are also required. The Taiwan Normal University under JCRR sponsorship is already pre-testing survey techniques with regard to the latter, while the Taiwan Provincial Government is considering surveys of the former.

It is believed that these surveys will render information which will be invaluable in adopting appropriate measures to eliminate or reduce losses which occur from time of harvest of rice until it is finally utilized, thus increasing Taiwan's overall food availability without increasing actual production.

Ralph N. Gleason
Chief, Food & Fertilizer Division
J. C. R. R.
July 1955

Introduction

In June 1954 Mr. Virgil Pettit, an American grain storage expert, visited Taiwan to observe rice loss in the various stages from the field to the consumer. He indicated, based on his experience in other countries, that the loss might be as high as 35% of the Island's total rice production. However, the reliability of the estimate remained to be proved by field surveys.

Rice in Taiwan not only feeds civilians and soldiers on the Island, but also constitutes a portion of Taiwan's agricultural export. For these reasons, to increase rice production has become one of the most important tasks of the agricultural branches of the Government. To minimize rice loss after production is undoubtedly another sure approach to the production goal.

In view of the above an overall survey of rice losses in the different stages from the field to the consumer was planned by the JCRR and this Department with the cooperation of various other organizations concerned with this problem. It was agreed that this Department would be responsible for investigating losses in the fields and drying grounds, the Provincial Food Bureau for investigating losses during storage, processing, and transportation, and the Joint Commission on Rural Reconstruction for investigating losses in the consumers' homes.

Therefore, this report pertains only to the investigation on fields and drying grounds during harvest. The purpose of the survey is to determine the extent of such losses and how to reduce these losses in order to gain more from the production increase.

During the harvest of the second rice crop in 1954, the various District Agricultural Improvement Stations were instructed by this Department to select, in accordance with the rice acreage ratios among the rice producing districts throughout the entire Province, a total of 200 representative rice-growing families for this investigation. Altogether, about a hundred persons were drafted to perform the investigation which was completed in about a month. This pamphlet is a report on the investigation, prepared and published for the information and reference of the organizations concerned. It is inevitable that there may be biases in some of the figures contained therein,

because the investigation is the first of its kind ever conducted in this Province. Comments on the report will be welcomed and much appreciated.

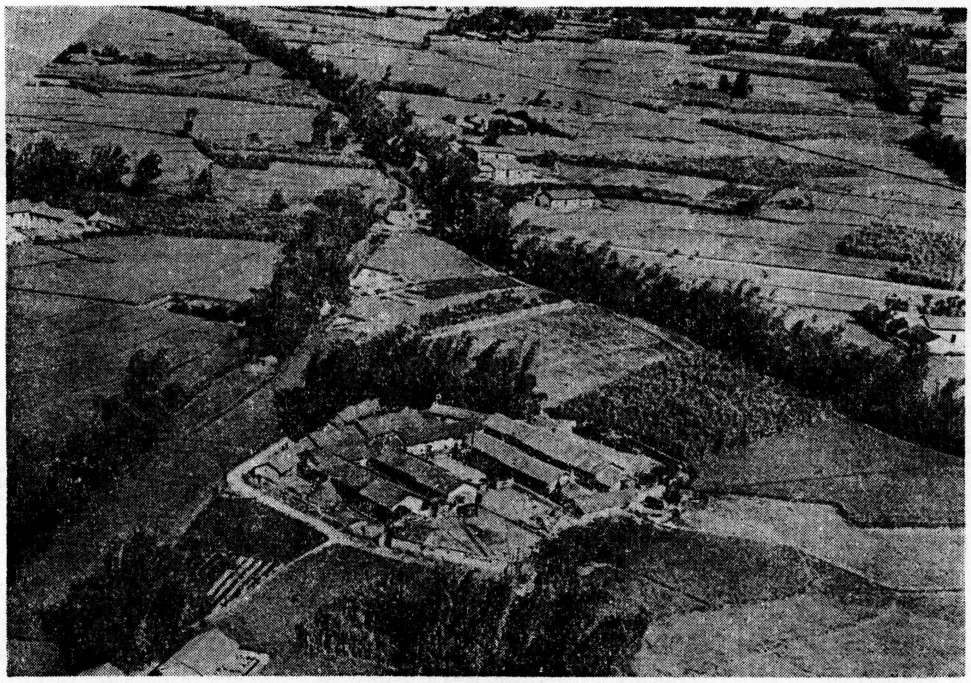
Thanks are due to the Joint Commission on Rural Reconstruction for its subsidy to this Department for conducting the investigation.

Y. K. King, Commissioner,
Taiwan Provincial Department
of Agriculture & Forestry

I. A Description of the Investigation

1. Areas Covered by the Investigation:

Plain, mountainous and coastal regions in the seven districts under the jurisdiction of this Department's subordinate Agricultural Improvement Stations, including Taipei, Hsinchu, Taichung, Tainan, Kaohsiung, Taitung and Hualien.



Investigation was conducted on 200 selected rice farms scattered throughout Taiwan. Note the drying grounds in open spaces in farmyards and the surrounding rice fields.

2. Objects of Investigation:

Only families whose farm acreage, land productivity and work efforts were representative of the majority of rice farmers in the areas surveyed were selected for investigation.

3. Methods of Investigation:

(1) Loss on Fields

(a) Items investigated included: natural detachment, fallen heads of rice, mowing and grains not beaten out of rice stalks.

(b) The investigators chose at random a few Tsubos (six feet by six feet) of rice land after the rice was harvested by the farmers for spot checking of the above-mentioned losses. Calculation of the average loss per Tsubo and per hectare (equivalent to 3,025 Tsubos) was based on the results of this spot check.

(c) The loss difference between Ponlai and Chailai varieties, as well as between the use of improved and old-type threshing machines, was investigated.

Technicians of an Agricultural Improvement Station determining the amount of rice left on the field after harvest. Note threshing machine in background.

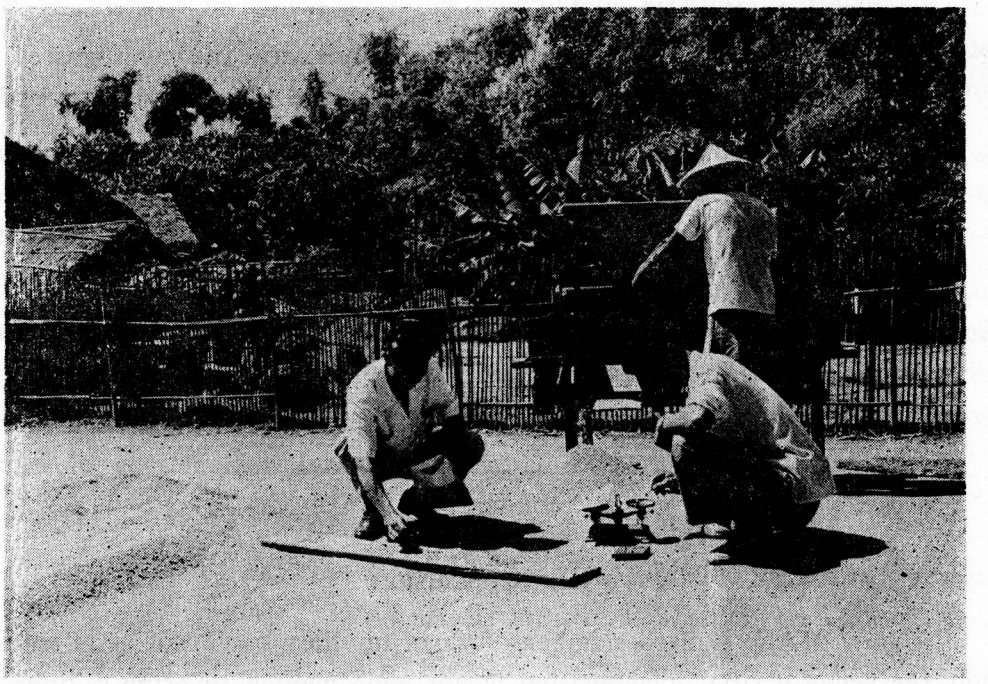
(2) Loss on Drying Grounds

(a) Items investigated included the quantity of paddy grains attached to rice heads after threshing, losses during spreading, turning, winnowing, and losses through rains, etc.

(b) After the harvest acreage had been ascertained, farmers were allowed to move their harvested paddy to drying grounds in their usual way. Each day during the rice-drying the above-mentioned

losses and the dry weight of the grain were checked.

(c) The loss difference between the use of concrete-surfaced and mud drying grounds was investigated.



Technicians of an Agricultural Improvement Station determining the amount of rice lost during drying and winnowing. Note hand-operated winnowing machine in operation.

II. A Description of Statistical Methods Employed

1. Materials used for preparing the statistical tables contained in this report are derived from the adjusted data supplied by the "Survey Reports" of the various District Agricultural Improvement Stations.
2. Each figure in the tables, except those in the "Number of Farm Families Surveyed" and "Acreage Surveyed" columns, is the biometrical "mean" of the original data gathered during the survey.
3. The units of averages appearing on all the tables are either hectare or kilogram. The "Acreage Surveyed" refers to the acreage (in hectare) of rice farms surveyed and not that of drying grounds.
4. The figures showing rice losses on fields are the average of the losses

pertaining to the four groups entitled "Ponlai Rice Threshed with Improved Machine," "Chailai Rice Threshed with Improved Machine," "Chailai Rice Threshed with Old-type Machine," and "Ponlai Rice Threshed with Old-type Machine."

5. Figures showing rice losses on drying grounds are the averages of the losses on "concrete-surfaced drying grounds" and "mud drying grounds."
6. Data collected from the surveyed areas having drought or typhoon damage and other greatly discrepant figures (e.g. those showing rice losses on drying grounds in Taitung District) are not included in the statistics but are tabled separately for comparison with those of normal areas.
7. The main purpose of the investigation was to find out the percentage loss of rice during harvesting as shown on the tables in this report.
8. The tables are arranged in the order of their relative brevity and sources of the data are explained in footnotes. Special explanations of figures are given in the "Remarks" column.

III. Conclusion

In view of the limited number of farm families surveyed, it is possible that the scope of the investegation is not wide enough to bring to light the general picture of Taiwan's rice losses. However, information on rice losses on the field and drying ground can be obtained from the findings which are presented with recommendations for remedying the losses.

1. Factors Related to Rice Loss on Fields

The amount of rice loss on fields is closely related to the variety of rice planted and the type of threshing machines used. It was found that, as shown on Table 2 in this report, less loss occurred when Ponlai variety was planted and when improved threshing machines were used.

2. Factors Related to Rice Loss on Drying Grounds

The difference between the loss on the concrete-surfaced drying ground and that on the mud drying ground is insignificant under normal weather conditions (Table 3). This is due to the fact that 55.2%, or the greater part, of rice loss on drying grounds is due to grain attached to

discarded rice heads and 32.3% is due to loss during winnowing. The amount of grains attaching to drying grounds only represents 12.5% of the loss total, as shown on Table 6. Therefore, the main factor contributing to rice losses on drying grounds is the grain attached to discarded rice heads; other factors such as winnowing and treatment are man-made. In rainy seasons, the kind of drying grounds becomes the major factor affecting rice loss on grounds.

3. Estimated Annual Total Rice Loss on Fields and Drying Grounds in Taiwan

According to Table 1, rice losses on fields and drying grounds per hectare are 70.1 and 28.8 kilograms respectively, a total of 98.8 kilograms or 2.96% of the total harvest. Based on the above data, the annual loss from Taiwan's two rice crops, with a total acreage of 800,000 hectares, is estimated to be 80,000 metric tons of paddy rice.

4. Difficulties In and Recommendations For Avoiding the Two Losses

Because rice has the largest acreage and yield among the major agricultural crops in Taiwan, and because its harvesting and drying have to be done outdoors, it is impossible to keep it entirely free from damage from wind, rain and man-made factors. It often rains during the harvest of both the first and second rice crops in Taiwan. Loss can hardly be avoided, especially when farmers are harvesting a crop in a hurry so as to be ready for seeding the next crop or to prevent possible damage from a threatening typhoon or heavy rains. However, from the present findings, it is generally agreed that part of the loss can be saved by improvements as recommended below:

(1) Extension of Ponlai Variety and Improved Threshing Machine

Less natural detachment of grains occurs in Ponlai rice when ripe because of stronger stalks. It can better withstand wind and escape damage during harvesting. Improved threshing machines beat out grains more thoroughly. Hence, the extension of Ponlai variety and use of improved threshing machines will undoubtedly reduce rice losses in fields.

(2) Further Improvement In the Improved Threshing Machine to Reduce the Number of Rice Heads Cut Off from Stalks During Threshing

The handling of rice heads cut off from stalks during threshing takes a lot of time because grains remaining on them have to be detached by hand. Farmers usually use the grains still attached to the heads to feed their domestic animals. Waste of grains in this manner accounts for more than half the rice loss on drying grounds and illustrates the greatest defect of the locally-made threshing machine. If the machines can be further improved to reduce the number of rice heads broken during threshing, rice loss on drying grounds can certainly be reduced.

(3) Conversion of Mud Drying Grounds into Concrete-surfaced Ones in Areas Often Having Rains During Harvest Seasons

The difference in service value between the concrete-surfaced and mud drying grounds on rainy days has been discussed in the foregoing. The mud drying ground is unserviceable in the northern part of Taiwan during harvest of the second rice crop. Rice harvested during seasons of changeable weather has to be piled up and is subject to loss from sprouting caused by the weather. Therefore, concrete-surfaced drying grounds are indispensable to farmers in the northern areas. If more rice driers are provided and early-ripening rice varieties chosen for planting in these areas, the results in terms of loss reduction will be most gratifying.

(4) Expansion of Farmers' Drying Grounds

Farmers whose drying grounds are small or jointly-owned usually resort to using the highways to meet their need of more space for rice drying. Highways are neither wide nor flat enough for drying purposes. Since they are far away from farms, more labor is required to guard the rice spread on them and bring it to storage; consequently there are more possibilities of loss. Expansion of farmers' drying grounds will be a practical solution to the above problem.

(5) Conducting Educational Campaigns or Production Contests to Encourage Care and Protection of Harvested Rice

Besides losses from implements and lack of facilities for rice harvesting, there are other man-made factors such as, the choice of harvest time, and techniques employed in harvesting, spreading, turning, winnowing and storage, all of which, if not performed carefully and properly, will lead to rice losses both on the field and drying ground. It is recommended that educational campaigns and contests be held to call farmers' attention to the need of careful handling to protect their harvest from loss or damage.

5. The Value and Importance of Arresting Rice Loss

From the old saying, "In high noon we harvest; each grain the result of labor hardest," we all realize the hardship of producing a crop. It is a pity to lose what has been produced. It is just like letting a fish escape from the net. In view of Taiwan's continual population increase and the difficulty of acquiring more arable land, it is imperative that the area yield of the crop be increased and attention be given to arresting rice loss. It is possible that, through correction of defects found in rice handling, Taiwan's annual rice loss (80,000 metric tons of paddy rice) on fields and drying grounds can be reduced by one-half, or 40,000 metric tons. This would be sufficient to feed 200,000 people for a year* and would unquestionably enhance the Island's food program.

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* Since the rate of milling return is 75%, 40,000 metric tons of paddy rice in dry weight can be milled into 30,000 metric tons of brown rice. At the average yearly consumption rate of 150 kilograms of brown rice per capita, 40,000 metric tons of paddy rice saved from loss would be sufficient to feed 200,000 people.

IV. Statistical Tables

Table 1. Taiwan's Rice Losses on Fields and Drying Grounds

Unit: kg/ha.

Districts surveyed	Survey items	Number of farm families surveyed	Average harvest per hectare	Average loss per hectare	Percentage loss of rice harvested	Remarks
Entire Province	Loss on fields	194	3,340	70.1	2.10	Data from 6 families surveyed in typhoon/drought-afflicted areas are not included.
	Loss on drying grounds	172	3,350	28.8	0.86	Data from 28 families in Taipei and Taitung Districts are not included.
	Total	366	3,345	98.9	2.96	

Note: (1) Source: from Tables 2 and 3.

(2) Each of the 200 farm families surveyed was investigated for both losses on fields and drying grounds. The above figure shows the number of families surveyed for losses on fields as 194 only. Data from 6 families (one in Taipei and 5 in Hsinchu Districts) whose farms had a poor harvest due to damage from drought/typhoon at the time of investigation, were not included in the statistics of total rice loss lest they should affect the loss percentage, but are given on Table 8 for reference. The figure indicating the number of families investigated for losses on drying grounds is 172, because data from 28 families surveyed in Taipei and Taitung districts show greater discrepancies than other districts. They are also omitted from the statistics but are contained in Table 9 for reference.

(3) Theorectically, the average harvest recorded during the survey of the losses on fields should equal that recorded during the survey on drying grounds due to the fact they refer to the same rice crop. Because of a difference in the number of families whose data are accepted for inclusion in the statistics, a slight difference appears between them.

Table 2. Taiwan's Rice Losses on Fields Surveyed

Unit: kg./ha.

Districts surveyed	Item	No. of farm families surveyed	Average harvest	Average loss	Percentage loss of rice harvested
					(%)
All seven rice producing districts in Taiwan	Ponlai rice threshed with improved machine	101	3,548	56.8	1.60
	Chailai rice threshed with improved machine	36	2,873	71.4	2.48
	Chailai rice threshed with old-type machine	54	3,097	87.9	2.84
	Ponlai rice threshed with old-type machine	3	6,338	184.5	2.91
	Total	194	648,014	13,609.0	
	Mean		3,340	70.1	2.10

Note: (1) Source: from Table 4.

(2) Since the average loss per hectare is calculated from the average loss per Tsubo of families surveyed, the number of hectares of rice farms surveyed is exactly the same as that of farm families surveyed and is omitted from the Table.

Table 3. Taiwan's Rice losses on Drying Grounds Surveyed

Unit: kg./ha.

Districts surveyed	Item	No. of farm families surveyed	Acreage surveyed	Average harvest	Average loss	Percentage loss of rice harvested
						(%)
Five rice producing districts in Taiwan	Cement drying ground	74	32.3	3,378	28.3	0.84
	Mud drying ground	98	42.4	3,329	29.2	0.88
	Total	172	74.7	250,269.7	2,153.79	
	Mean			3,350	28.8	0.86

Note: (1) Source: from Table 5

(2) The "Acreage Surveyed" refers to the acreage of rice farms and not that of the drying grounds surveyed.

Table 4. Rice Losses on Fields, by Districts

Unit: kg./ha.

District	Ponlai rice threshed with improved machine				Chailai rice threshed with improved machine				Chailai rice threshed with old-type machine				Ponlai rice threshed with old-type machine				Sub-total of farm families surveyed
	Number of farm families surveyed	Average harvest	Loss	Percentage loss	Number of farm families surveyed	Average harvest	Loss	Percentage loss	Number of farm families surveyed	Average harvest	Loss	Percentage loss	Number of farm families surveyed	Average harvest	Loss	Percentage loss	
Taipei	16	3,070	53.7	1.75	5	2,127	63.5	74.4									21
Hsinchu	25	3,927	70.7	1.80	2	2,990	43.9	2.99									27
Taichung	18	3,363	58.3	1.73	24	3,033	76.3	1.49	3	3,608	159.3	4.41					45
Tainan	18	3,622	52.8	1.49	3	2,886	69.6	2.51	34	3,143	76.9	2.45					55
Kaohsiung	18	3,449	44.0	1.28	2	2,628	62.0	2.41	14	2,700	99.8	3.70					34
Taitung	2	5,012	57.5	1.12					1	6,300	124.0	1.96	3	6,338	184.5	2.91	6
Hualien	4	3,302	51.5	1.56					2	2,725	66.5	2.44					6
Total	101	358,343	5,739.5		36	103,421	2,569.3		54	167,236	4,746.7		3	19,014	553.5		194
Mean		3,548	56.8	1.60		2,873	71.4	2.48		3,097	87.9	2.84		6,338	184.5	2.91	

Note: (1) Source: "Survey Reports" submitted by various District Agricultural Improvement Stations.

(2) "Percentage Loss" refers to percentage loss of rice harvested.

Table 5. Rice Losses on Drying Grounds, by Districts

Unit: kg./ha.

District	Cement drying ground					Mud drying ground					Sub-total of farm families surveyed
	No. of farm families surveyed	Acreage surveyed	Average harvest	Average loss	Percentage loss of rice harvested	No. of farm families surveyed	Acreage surveyed	Average harvest	Average loss	Percentage loss of rice harvested	
Hsinchu	13	13.0	3,283	19.4	0.59	19	19.0	3,643	21.8	0.60	32
Taichung	23	9.2	3,315	40.7	1.23	22	8.3	3,116	50.5	1.62	45
Tainan	13	3.4	3,302	25.7	0.78	42	12.4	3,135	27.2	0.86	55
Kaohsiung	22	6.4	3,731	30.4	0.81	12	2.4	2,577	26.0	1.01	34
Hualien	3	0.3	2,743	17.4	0.63	3	0.3	3,420	23.2	0.68	6
Total	74	32.3	109,105.1	913.80		98	42.4	141,164.6	1,239.99		172
Mean			3,378	28.3	0.84			3,329	29.2	0.88	

Note: Source: from "Survey Reports" submitted by various District Agricultural Improvement Stations.

Table 6. Percentage of Rice Losses on Drying Grounds

Unit: kg./ha.

Kind of drying ground	Number of farm families surveyed	Acreage surveyed	Loss factors and their percentages per hectare							
			Loss total	%	Grains attaching on heads	%	Grains attaching on drying ground	%	Loss during winnowing	%
Cement drying ground	74	32.3	28.3	100	17.3	61.1	2.7	9.5	8.3	29.4
Mud drying ground	98	42.4	29.2	100	14.8	50.7	4.3	14.7	10.1	34.6
Total	172	74.7	2,153.79		1,184.14		268.86		696.65	
Mean			28.8	100	15.9 (a)	55.2 (d)	3.6 (b)	12.5 (e)	9.3 (c)	32.3 (f)

Note: (1) Source: from Table 7

(2) Average loss per hectare=(a)+(b)+(c)=28.8 kg.

Loss total=100%=(d)+(e)+(f)

Table 7. Detailed Breakdown of Rice Losses on Drying Grounds

Unit: kg./ha.

District	Cement drying ground							Mud drying ground						
	Number of farm families surveyed	Acreage surveyed	Losses per hectare					Number of farm families surveyed	Acreage surveyed	Losses per hectare				
			Loss total	Grains attaching on heads	Grains attaching on drying ground	Loss during winnowing	Loss through rains			Loss total	Grains attaching on heads	Grains attaching on drying ground	Loss during winnowing	Loss through rains
Hsinchu	13	13.0	19.4	12.2	4.6	2.6	—	19	19.0	21.8	10.2	6.6	5.0	—
Taitung	23	9.2	40.7	25.0	1.8	13.9	—	22	8.3	50.5	28.7	2.9	18.9	—
Tainan	13	3.4	25.7	15.7	1.1	8.9	—	42	12.4	27.2	13.3	2.3	11.6	—
Kaohsiung	22	6.4	30.4	17.7	0.9	11.8	—	12	2.4	26.0	11.7	1.2	13.1	—
Hualien	3	0.3	17.4	5.5	2.9	3.0	6.0	3	0.3	23.0	7.4	4.2	3.8	7.8
Total	74	32.3	913.80	556.91	86.73	268.36	1.8	98	42.4	1,239.99	627.23	182.13	428.29	2.34
Mean			28.3	(a) 17.3	(b) 2.7	(c) 8.3				29.2	(d) 14.8	(e) 4.3	(f) 10.1	

Note: (1) Source: from "Survey Reports" submitted by various District Agricultural Improvement Stations.

(2) The average loss per hectare on cement drying ground is 28.3 = (a) + (b) + (c); that on mud drying ground is 29.2 = (d) + (e) + (f)

(3) Loss through rains happened only in Hualien and, therefore, is not included in the statistics.

Table 8. Rice Losses on Fields in Drought/Typhoon-Afflicted Areas Surveyed

Unit: kg./ha.

District	Disaster	Variety of rice surveyed	Type of threshing machine used	Number of farm families surveyed	Average harvest	Average loss	Percentage loss of rice harvested (%)
Taipei	Drought and typhoon	Chailai	Improved	1	1,093	78.7	7.20
Hsinchu	Drought	Ponlai	Improved	5	1,444	57.5	3.98

Note: (1) Source: from "Survey Reports" submitted by District Agricultural Improvement Stations.

(2) Due to drought/typhoon damage, the harvest from the farms surveyed was particularly low, thereby increasing the percentage loss of rice harvested. For that reason, data pertaining to these farms are separately tabled for reference.

Table 9. Rice Losses on Drying Grounds Surveyed in Taipei and Taitung Districts

Unit: kg./ha.

District	Cement drying ground					Mud drying ground					Sub-total of farm families surveyed
	No. of farm families surveyed	Acreage surveyed	Average harvest	Average loss	Percentage loss of rice harvested	No. of farm families surveyed	Acreage surveyed	Average harvest	Average loss	Percentage loss of rice harvested	
Taipei	11	6.8	2,688	3.3	0.12	11	6.6	2,927	5.2	0.18	22
Taitung	5	0.5	4,777	82.1	1.72	1	0.1	3,508	5.8	0.17	6

Note: (1) Source: from "Survey Reports" submitted by District Agricultural Improvement Stations.

(2) Data pertaining to these two Districts have shown greater discrepancies than other Districts. They are, therefore, given in separate tables for reference.

(3) The fact that the loss in Taipei is the lowest of all Districts can be attributed to careful handling of rice on drying grounds.

(4) The average loss on drying grounds in Taitung District is as high as 82.1 kgs per hectare. According to the original data collected during the survey, 68.3 kg is the amount of grain attached to the discarded heads and 13.8 kg. is the amount of loss sustained from other factors. Therefore, it can be deduced that the farmers surveyed in Taitung were not careful enough in handling their rice on drying grounds. They probably used the discarded heads, to which some grains were still attached, to feed their domestic animals, thereby causing increased loss.

(5) In Taitung District, only one family was investigated for loss on mud drying ground. The data gathered therefrom are considered insufficient to represent the entire District and are included in the Table for reference only.