벼의 慣行收穫作業體系에 關한 特性分析

An Analysis of Operational Characteristics of Traditional Paddy Harvesting Systems

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摘 要

우리나라의 收穫機械化및 收穫後 作業技術의 開發을 위한 基礎情報를 얻기위하여 典型的인 水稻作農業地域이라고 할 수 있는 平澤, 金堤地域과 都市近郊 農業地域인 晋陽地域에서 벼收穫作業에 關한 調査를 實施하고 慣行收穫作業의 地域別, 作業別 特性을 分析하였으며 作業能率, 所要勞動力및 勞動力構成에 關한 分析을 實施하였다.

平澤地域의 경우에는 日本型 品種인 아끼바레와 미네히까리品種및 統一系 品種을 對象으로 하여 調査員이 收穫期間동안 調査地域內에 常住하면서 約 65ha의 圃場面積에 對해 比較的 精密한 調査를 實施하였으며 金堤地域에서는 日本型品種과 統一系品種만으로 區分하여 約 200ha에 相當하는 圃場面積에 對해 農家聽聞調査를 實施하였고 晋陽地域에서는 統一系品種만의 圃場 40ha에 對해서 農家聽聞調査를 實施하였다.

그 結果를 要約하면 다음과 같다.

1) 慣行收穫作業은 大體的으로 Fig.(1-1)에 表示된 바와 같은 順序에 따라 遂行되고 있었으며 地域, 品種, 勞動力狀態등에 따라 收穫作業 工程이 部分的으로 省略되고 있었다.

2) 刈取, 結束및 脫穀作業日은 地域, 品種에 따라 差異가 있었으며 平澤, 金堤및 晋陽地域의 統一系品種 平均刈取日은 各各 9月29日, 9月26日 및 10月 7日로서 南쪽地域일수록 6~10日程度 늦게 遂行되고 있었다. 그러나 結束作業日과 脫穀作業日은 地域에 따른 傾向를 나타내고 있지 않았다.

3) 平澤地域의 경우 아끼바레 品種과 統一系 品種은 全體의 80%程度가 10日以內에 刈取, 結束作業을 完了하고 있었으며 平澤地域의 미네히까리 品種을 비롯한 其他地域의 品種에 있어서는 10日동안에 50%程度의 刈取作業이 遂行되고 있었다. 大體的으로 平澤地域에 比해 金堤와 晋陽地域에서 作業期間이 길게 나타나고 있는바 이것은 主로 收穫作業勞動力 不足에 起因된것으로 判斷되었다.

4) 刈取作業과 結束作業間의 較差日數는 4~6日範圍로서 地域및 品種에 따라 差異를 보이지 않았다. 그러나 結束作業과 脫穀作業의 平均較差日數는 4~23日 範圍로서 地域및 品種에 따라 큰 差異를 보이고 있는바 이는 根源的으로 勞動不足및 乾燥, 貯藏施設의 未備에 起因되고 있다고 判斷되며 收穫機械化의 促進, 乾燥 貯藏施設의 開發및 普及, 政府收買를 早期에 實施하므로서 穀物의 量的, 質的 損失 原因이 되는 結束作業과 脫穀作業間의 較差日數를 短縮시키는 것이 바람직한 것으로 判斷되었다.

5) 慣行收穫作業能率 分析結果 作業能率은 地域에 따라 若干의 差異를 보이고 있었으며 刈取作業, 結束作業및 脫穀作業 能率은 各各 33.64~38.63 P/man-hr, 61.6~72.0 P/man-hr 및 29.85~31.35 P/man-hr 範圍였으며 뒤집기 作業과 줄가리 作業의 平均作業能率은 各各 167.43 P/man-hr 및 138.38 P/man-hr 程度였다.

6) ha當 慣行收穫—乾燥作業 所要勞動力은 멍석

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乾燥作業 所要 勞動力을 除外한 경우 313.6~361.6 man-hr/ha 範圍로서 收穫作業類型에 따라 差異가 있을 수 있으며 所要勞動力이 많은 脫穀作業의 作業能率 提高方案과 時急한 刈取, 結束作業의 機械化 方案이 要望되며 精選및 包裝作業에서의 勞動力 節減을 위한 硏究가 要請된다.

7) 收穫作業에 動員된 勞動力의 男女構成比는 地域및 作業의 種類에 따라 差異를 보이고 있었으며 刈取, 結束作業에 比해 脫穀作業의 男子構成比가 若干 높게 나타났다. 平澤, 金堤및 晋陽地域에서의 男子構成比는 各各 91.6, 65.9 및 56.9%로서 平澤의 경우가 가장 높게 나타나 있어 이 地域의 勞動力事情이 他地域에 比해 比較的 良好한 것으로 보이며 晋陽의 경우가 가장 나쁜것으로 나타났다.

8) 典型的인 水稻作 農業地域인 金堤와 平澤地域의 경우에 刈取 結束및 脫穀作業은 各各 73.4%, 83.7%가 품앗이 또는 품삯 勞動力에 의해 遂行되고 있는 反面, 晋陽地域의 경우에는 78%가 家族勞動力에 의해 이루어지고 있어 地域에 따라 差異를 보이고 있었다.

典型的인 水稻作 農業地域의 收穫作業을 遂行하기 위한 勞動力의 主要供給源이 품삯 勞動力으로 나타나고 있는바 勞動力 不足現象이 深化될 경우에는 農村勞賃上昇 때문에 農家經營은 크게 壓迫을 받게 될것으로 展望되므로 이를 解決하기 위해서는 早速한 收穫作業 機械化의 促進이 要望된다.

Ⅰ. Introduction

Traditional paddy post-production system in Korea consist of various processes, such as cutting, shocking, bundling, drying and threshing. Operational methods and means employed in these processes have basically unchanged for decades, except for the threshing which is done with the mechanical power.

However, the traditional system is now being faced with necessary alterations and modifications. In general, much more efficient methods are required to meet ever-increasing challenge posed by the shortage of the rural labor due to the rapid farm to non-farm migration as accompanied by the overall and swifting national economic development and urbanization. In addition, we may definitely need a new type of post-harvest technology for the high yield variety(HYV) whose cultivation is now covering more than 70 percent of the total paddy field. It might be inevitable for rural Korea to encounter with great difficulty in maintaining the present production status and to further promote the agricultural productivity, unless some counter-measures to solve these problems should be researched and identified.

The first step toward the improvement of the present post-harvest system may be to understand its operational characteristics, problem areas and constraints against any new and further development. A rational approach to solving these problem areas must be based on the present state of art in the traditional system. Patterns of working processes and their consequences in relation to calender dates, regional peculiarities and custom should be identified and determined. Rate of the work performance and labor demand involved in the post harvest should be determined.

In this study, it was attempted to analyze the present situation of operational characteristics of the traditional field harvest system of the paddy, including the performance rate to each of the major field processes and labor demand and supply.

Ⅱ. Method of Data Collection

Three representive regions from different regions of the country were selected for the field measurment and survey work. Specifically, the regions selected for this study were: the Pyungtaik area of the Gyunggi

Province, located on the northern section; the Gimje area of the Jeonla-bug Province, located on the central section; and the Jinyang area of the Gyung-nam Province, located on the southern section of Korea.

For the Pyungtaik area, all of the paddy fields within a bounded plane were identified in reference to their size, ownership, and rice variety planted. After the identification was made, the actual operational timing of the field works from cutting to threshing for each of the sample field, the labor input, and the performance rate, respectively, were measured by surveyors kept stationed in each of the these regions or areas. The analysis of the data obtained was considered very important for assessing the characteristics of paddy harvest operations. However, all the necessary information as for the Pyungtaik area could not be obtained at the time of harvesting. But it was collected later during the off-farming season by means of interviewing. More datailed information on the area, its size, and the duration of works are summarized in Table (1).

Table 1. Names of the field araes and the number of fields surveyed for the study.

Region	Field area	Duration
Pyungtaik, Ohsung, Anwha	65 ha (127)	Sept. 15-Nov. 15, 1977
Gimje, Weolchon, Bongweol	200 ha (490)	March 1-15, 1978
Jinyang, Moonsan, Oksan	40 ha (130)	Feb. 15-28, 1978

( ). number of fields

Ⅲ. Results of Data Analysis and Discussion

1. Processes of Traditional Harvesting Operation

Traditional paddy harvest processes and their operational methods, respectively, were varied to some extent according to different regions, varieties planted, labor available, and the kind of threshers used. Some of the major processes and their consequences with respect to the traditional system are shown in Fig. (1).

The cutting operation was done manually by use of sickles. And cut plants were laid down on the ground for a partial sun-drying. To obtain the uniform degree of drying down to about 15% of the grain moisture content, cut plants were initially and partially dried during one to several days. And they were overturned so that the portion of the material that were not exposed to the sun could be redried. The next step was to do the bundling operation, the size of bundles being dependent upon the threshers to be used. Bundles were moved to the ridge of the field or convenient places in the field to stack up for the shocking operation. Until being ready for the threshing operation, the bundles were temporarily left in the field and were covered by the vinyl sheet when rained. Then, bundles were moved to the farmstead or a place in the field where the threshing operation was done.

Processes of the traditional harvesting operation surveyed showed some variations by region. In the Pyungtaik region, paddy bundles of Indica-type varieties treated for shocking were rarely moved to the farmstead. Instead, the threshing operation was carried out in the field. In this way, farmers attem

pted to reduce grain losses incurred during handling. It was noticed that, in the Pyungtaik area, about 32 hills were bound in a single bundle to treat them efficiently in association with semi-auto threshers. Semi-auto threshers were equipped with functionally ineffective separation units, compared to the autothresher. Because of this, an additional winnowing work was required to clean the grains after threshing.

In the Gimje region, harvesting patterns of the Japonica-type varieties were a little different from those of the Pyungtaik region. That is, paddy bundles were piled by cross-stacking, placing the panicles towards the center. Most of the paddies after being dried by the shocking operation were threshed in the field. In some cases, overturning and cross-stacking operations were omitted.

In harvest of TONGIL varieties in the Gimje area, either the overturning operation or the shocking one was omitted, or both were completely omitted as an effort to reduce grain losses. Grains after threshing did not have to go through the winnowing operation as in the case of the Pyungtaik region, because the auto-threshers being used mostly in the Gimje area were equipped with highly effcient separation units.

The insufficiency or shortage of labor in this region compelled farmers to omit some operations. At the same time, the labor problem resulted in the rapid increase in and wide dissemination of the auto-threshers. In addition, farmers in the region bounded one single paddy bundle with approximately 72 plant hills. When threshing the plant bundles, they were disassembled to fit with the automatic thresher.

In the Jinyang region, paddy harvest procedures practiced were in order of the foll-

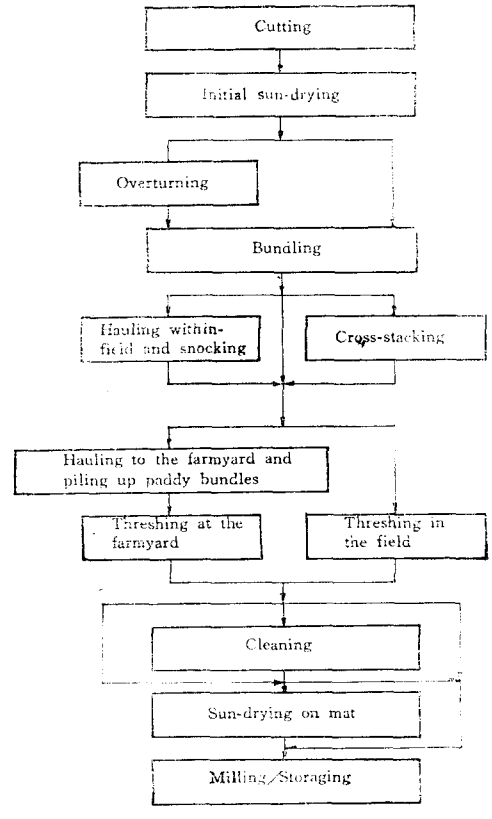

Fig. (1) Schematic diagram of processes involved in the traditional post-harvest system.

owing:cutting, partial drying in the field, bundling, and threshing in the field. The shocking or cross-stacking process was omitted and thershing was applied several days after cutting. The size of plant bunldes was very small with approximately 16 hills of plants. This was different from that of other regions surveyed, where plant bundles could be directly fed into the automatic thresher without disassembling.

2. Analysis of harvest timing and duration

Generally speaking, working days, on

which each of processes of the paddy harvest operation was accomplished, might be affected by the region, variety, weather, and labor available in association with subsequent crops to be planted.

To study how each process in the traditional field harvesting operation was accomplished in relation to the calendar date, a cumulative frequency distribution of the job accomplishment was analyzed as shown in Fig.(2) to(7).

The timing and duration of each of major harvesting operations for a variety within a region could be completely determined by this analysis.

From these Figures, it may be noticed that the curves behave differently according to region and variety. Characteristics of the curves could be represented by the statistics obtained, as shown in Table (2). Several important points were found from this analysis:

First, the cutting operation as the first process of post-production operation was begun in the beginning of the last 10-day of September, and delayed considerably as moving toward southern regions. Since the cutting operation was started at about the same degree of maturity of the paddy regardless of regions and varieties planted, it was easy to understand that the nursery seeding and consequent transplanting operation accomplished earlier in the northern section than the southern section.

Second, for a given region, timing of the cutting operation for the HYV was earlier one to two weeks than that for most traditional varieties.

Third, the duration of the cutting operation for a given region and for a given variety was very short: majority of the work accomplished within about 10 days.

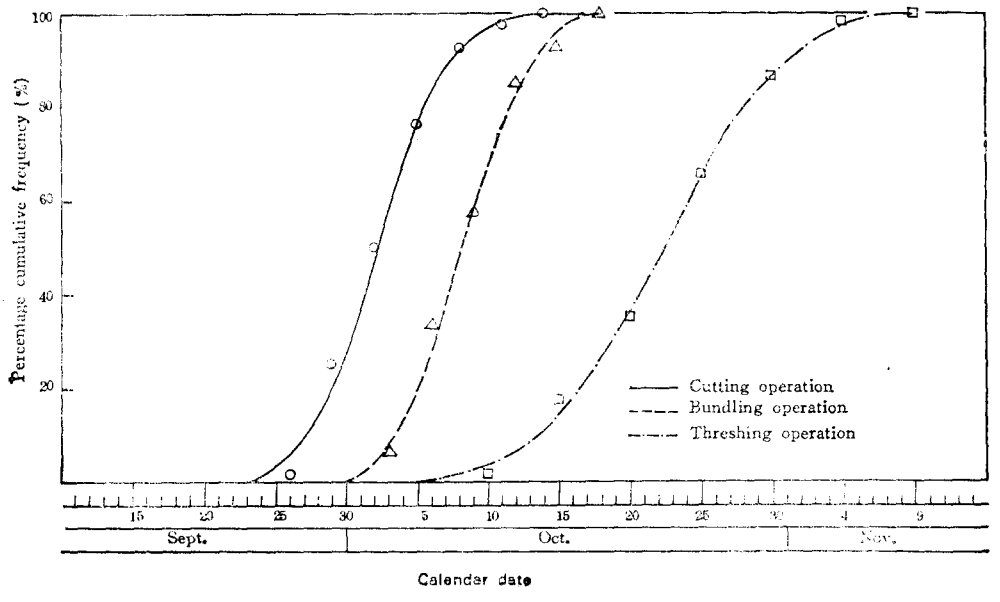

Fig. (2) Percentage cumulative frequency distribution of the performance rate for the traditional cutting, bundling and threshing operation for the AKIBARE variety accomplished on specified calendar date (Pyungtaik).

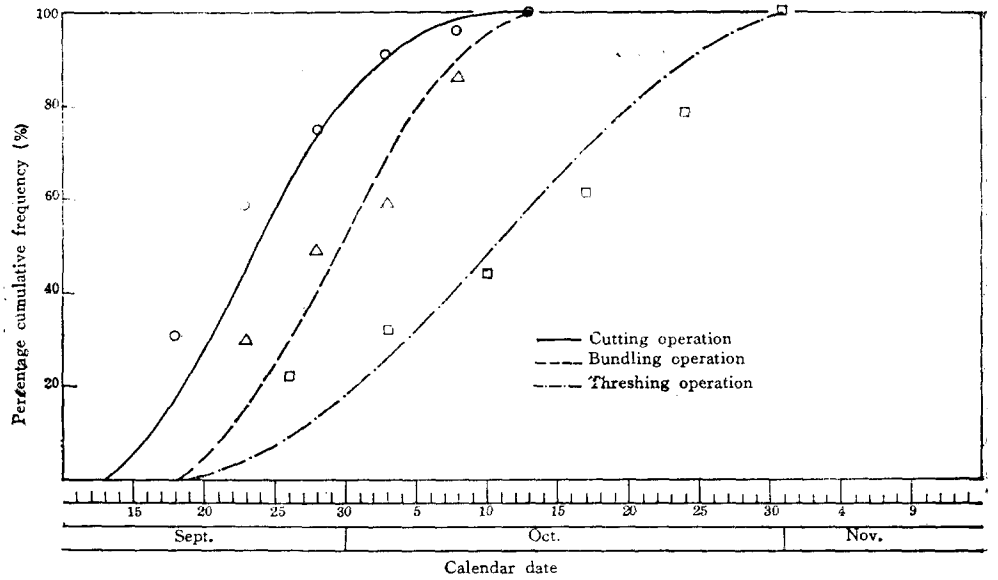

Fig. (3) Percentage cumulative frequency distribution of the performance rate for the traditional cutting, bundling, and threshing operation for the MINEHIKARI variety accomplished on specified calendar date (Pyungtaik)

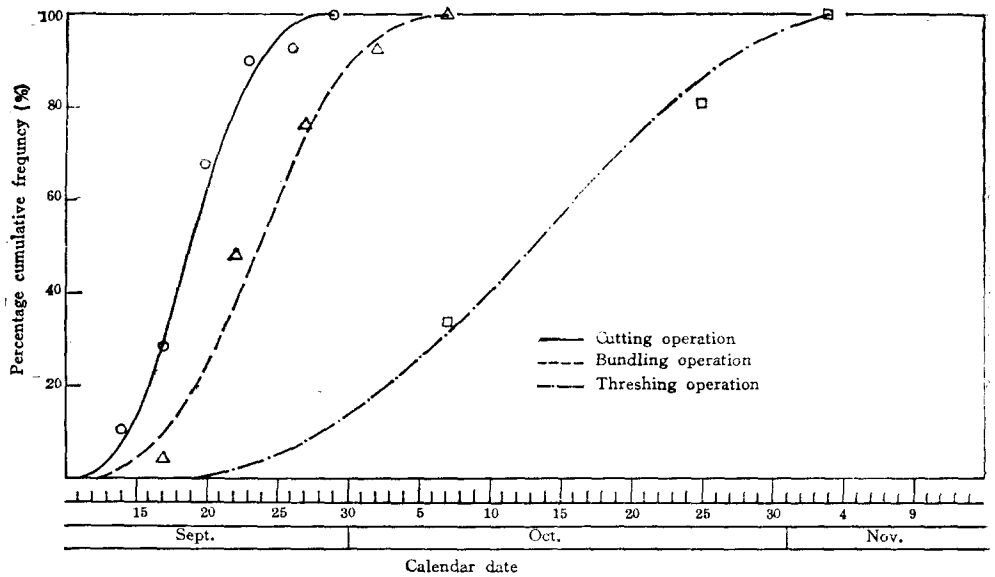

Fig. (4) Percentage cumulative frequency distribution of the porformance rate for the traditional cutting, bundling, and threshing operation for the TONGIL sister-line variety accomplished on specified calendar date(Pyungtaik).

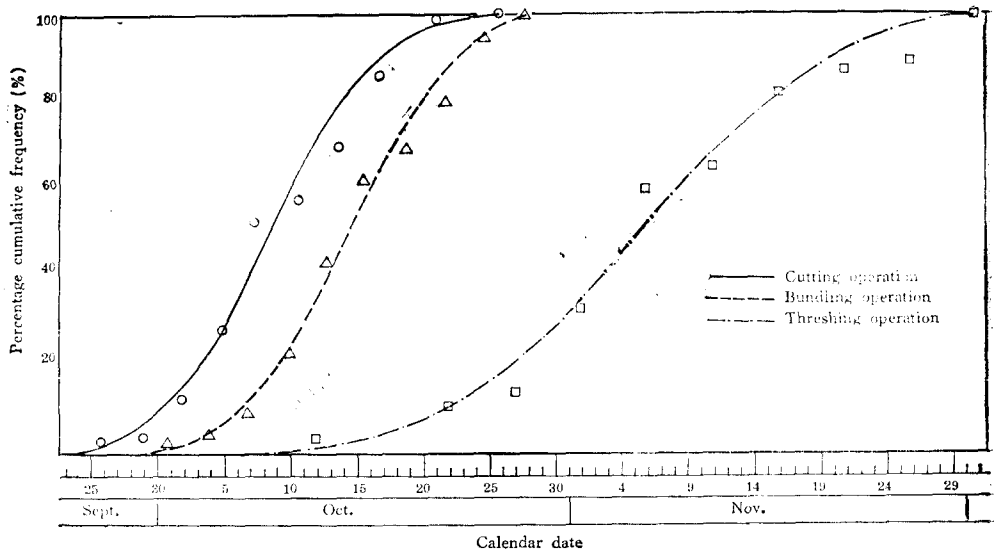

Fig. (5) Percentage cumulative frequency distribution of the performance rate for the traditional cutting, bundling, and threshing operation for the Japonica type variety accomplished on specified calendar date(Gimje).

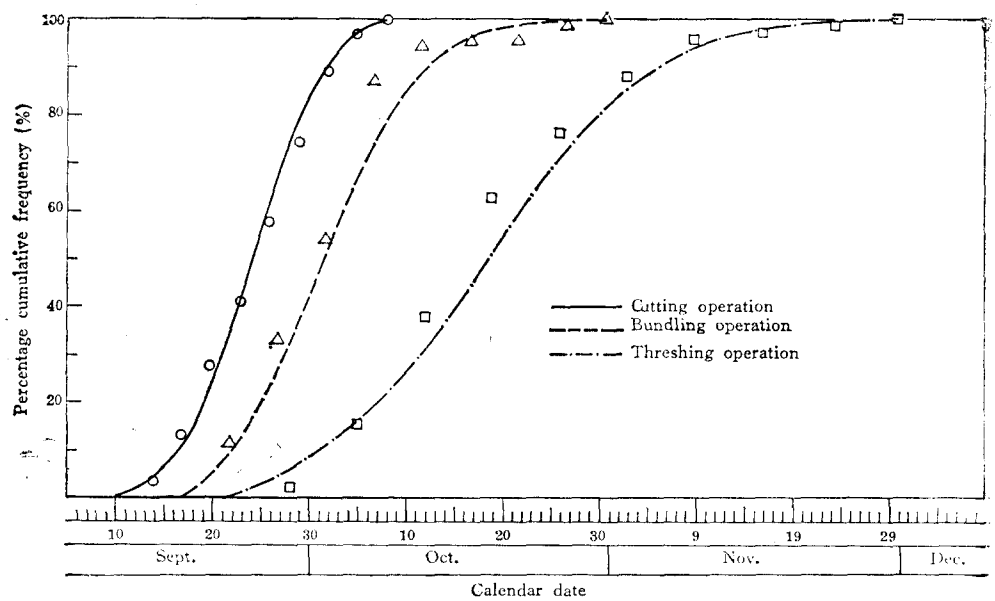

Fig. (6) Percentage cumulative frequency distribution of the performance rate for the traditional cutting, bundling, and threshing operation for the TONGIL sister-line variety accomplished on specified calendar date(Gimje).

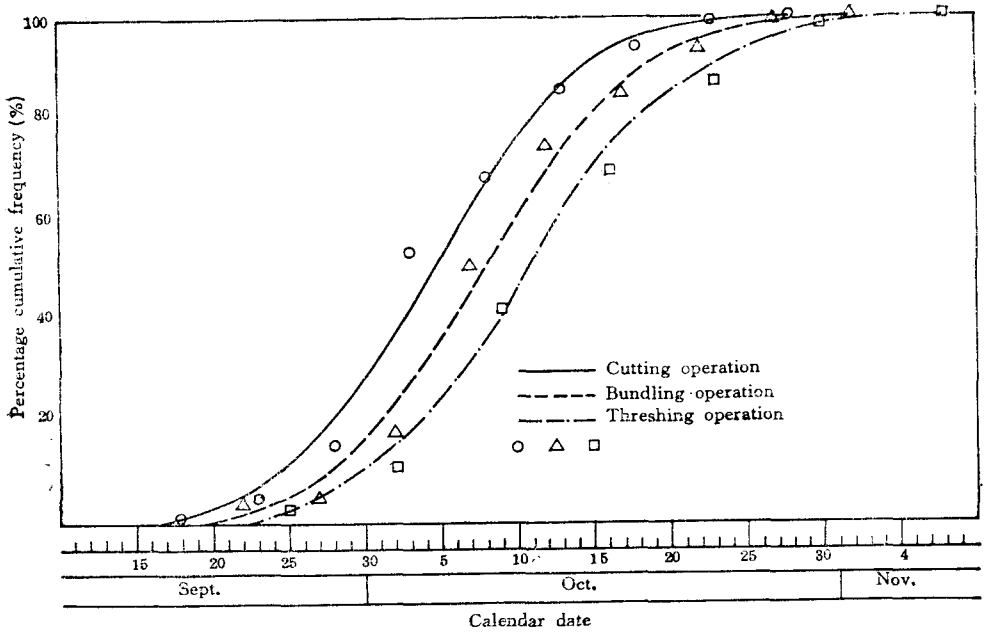

Fig. (7) Percentage cumulative frequency distribution of the performance rate for the traditional cutting bundling, and threshing operations for the TONGIL sister-line variety accomplished on specified calendar date(Jinyang).

Fourth, bundling operations were accomplished from several days to about a week after cutting operations. This point may be easily explained by the two frequency distribution curves on cutting and bundling operations which are almost in parallel regardless of the region and variety.

Fifth, in contrast to the cutting and bounding operations, the timing and duration of the threshing operation proved to be different. In general, the duration required to complete the threshing operation took more than a month. And about 65 percent of the work was finished within about 25 days. This is much longer period of time than those needed for the accomplishment of the cutting and bundling operations, respectively.

Sixth, one of distinct aspects of the paddy post-production in the Jinyang area compared to the two other areas was that the threshing operation in this area was completed within a very short period of time after the bundling operation. One of the reasons for this may be explained by the fact that the post-production in the Jinyang area was performed mainly by the family-supported labor by the use of auto-threshers. The auto-thresher was plentifully available in the region. Thus, it was unnecessary for farmers to wait until, as in the case of the Gimje and Pyungtaik areas, about 10 adult laborers required for the semi-auto thresher operation were secured. Definitely, farmers in the Jinyang area were much more concerned about the grain losses incurred owing to the delay of threshing operations.

Seventh, in the Pyungtaik area the duration of the threshing operation of the HYV was much longer than that of the conventional varieties. In other words, the cut plants

of the HYV in this region were left long in the field unthreshed. One of the reasons for having this relatively long shocking operation might be on the part of farmers to have sufficiently dry grains whose moisture content could be made down to about 15 percent so that the grains after threshing could be sold directly to the Government

Table (2) Statistics related to timing and duration of major post-harvest operations.

Region	Variety		Operations	Mean	S.D.	C.V.	SK	α^4	x^2
Pyungtaik	Japonica type	AKIBARE	Cutting	Oct. 3	3.91	40.27	−0.33	2.65	26.74
			Bundling	Oct. 10	6.21	63.69	−0.36	0.40	27.85
			Threshing	Oct. 25	6.65	37.46	−0.04	2.26	10.99
		MINEHI-KARI	Cutting	Sept. 26	7.10	67.27	1.07	2.70	15.61
			Bundling	Oct. 1	7.37	61.90	1.20	1.52	22.37
			Threshing	Oct. 14	12.91	57.55	1.29	1.62	23.64
	TONGIL sister-line		Cutting	Sept. 20	3.79	18.65	0.08	3.13	12.05
			Bundling	Oct. 7	5.10	42.49	0.79	2.59	6.81
			Threshing	Oct. 17	12.61	51.04	−0.58	1.78	6.75
Gimje	JAPONICA type		Cutting	Oct. 11	6.48	39.49	0.83	1.97	104.76
			Bundling	Oct. 16	6.12	35.25	0.55	3.07	133.39
			Threshing	Nov. 9	12.58	41.68	0.17	2.85	161.41
	TONGIL sister-line		Cutting	Sept. 26	6.05	35.93	−0.52	2.32	61.62
			Bundling	Oct. 4	7.72	52.77	−0.44	4.51	208.22
			Threshing	Oct. 21	12.83	47.70	0.15	3.59	78.75
Jinyang	TONGIL sister-line		Cutting	Oct. 7	7.70	35.21	0.50	2.90	37.37
			Bundling	Oct. 11	8.01	37.66	0.41	2.07	46.31
			Threshing	Oct. 15	8.85	37.39	0.15	2.87	22.02

without an additional drying. Farmers were considerably concerned with the grain moisture content of the HYV, for most of the HYV produced was purchased by the Government and the grain moisture content was the most important single factor in deciding the grading of the rice.

Another reason might be ascribed to a peculiar practice of threshing found in this region. Most of farmers depended upon custom threshing operations in which semi-auto threshers were used almost without exception. Use of such threshers required about 10 male-laborers as a operational team, thus took a long stand-by period until thresher along with this large team of laborers were made available.

In expressing the operational timing of a process and its relation to subsequent processes of the post-harvest system, the so-called interval days could be used as a useful index. In this study, the interval days referred to as the number of days required between operations of two different processes which were treated for the same sample material. Table(3) shows the statistics related to the interval days between cutting and bundling operations(C-B), bundling and threshing (B-T), and cutting and threshing(C-T), respectively. They were analyzed for different varieties and regions. Figure(8) to(13) shows cumulative frequency distributions of

these interval days.

The analysis of the interval days indicated much clearly as to when each successive or later processes progressed in relation to its preceding or earlier processes. And, the percentage-wise job performance expected to be completed for given interval days could be obtained easily by use of the curves analyzed. For example, in the Pyungtaik region, about 80% of the bundling operation of the HYV was expected to be completed within 6 days after cutting, and about 70% of the threshing operation, within 16 days after bundling.

From the analysis of the interval days, it was quite apparent that the Jinyang region had a different distribution compared to those of the Pyungtaik and Gimje regions, respectively. Specifically, more than 90% of the bundling was completed within 3 days after cutting, and 80% of the threshing was completed within 6 days after the bundling operation. The reasons for this were discussed in the previous section.

In summary, the interval days between cutting and bundling operations were about 5

Table (3). Statistics related to the interval days of major post-harvest operations.

Region	Variety	Intervals	Mean	S.D.	C.V.	SK	α^4	X_2^0
Pyungtaik	AKIBARE	C—B	6.08	1.82	29.93	0.32	4.78	78.88
		B—T	14.95	6.15	41.14	0.32	2.42	13.01
		C—T	20.86	5.94	28.48	0.31	2.48	9.86
	MINEHIKARI	C—B	5.68	1.91	33.63	0.63	2.10	18.89
		B—T	13.14	8.81	65.67	1.18	1.85	14.13
		C—T	19.12	9.41	49.21	—0.20	1.83	24.99
	TONGIL sisterline	C—B	5.10	22.1	41.57	—0.19	0.08	17.44
		B—T	23.00	12.99	56.48	—1.23	1.57	11.60
		C—T	28.33	11.90	42.00	—0.98	1.50	15.03
Gimje	JAPONICA type	C—B	6.13	2.32	37.80	0.27	3.60	108.40
		B—T	22.00	9.82	45.00	—0.10	4.82	166.15
		C—T	26.39	11.03	41.80	—0.42	4.10	410.93
	TONGIL sisterline	C—B	6.32	3.25	51.42	—0.21	17.24	176.40
		B—T	15.60	10.76	68.97	0.52	4.56	171.22
		C—T	23.21	12.05	51.92	0.02	4.35	147.61
Jinyang	TONGIL sisterline	C—B	4.08	1.01	24.84	—0.42	4.30	8.60
		B—T	4.88	2.54	52.25	0.54	2.96	95.65
		C—T	8.56	2.85	33.29	0.72	3.50	130.65

(*1) C: cutting operation, B: bundling operation, T: threshing operation.

to 6 days for all regions. However, longer intervals were required to complete the job from bundling to threshing operations in the Pyungtaik and Gimje regions, respectively. It was especially the case with the TONGIL variety.

As clearly justified, it could not be recommendable to have such long interval days because a large amount of grain losses could be incurred during this period. From this point of view, the harvesting practice in the Jinyang area could be assessed as very desi-

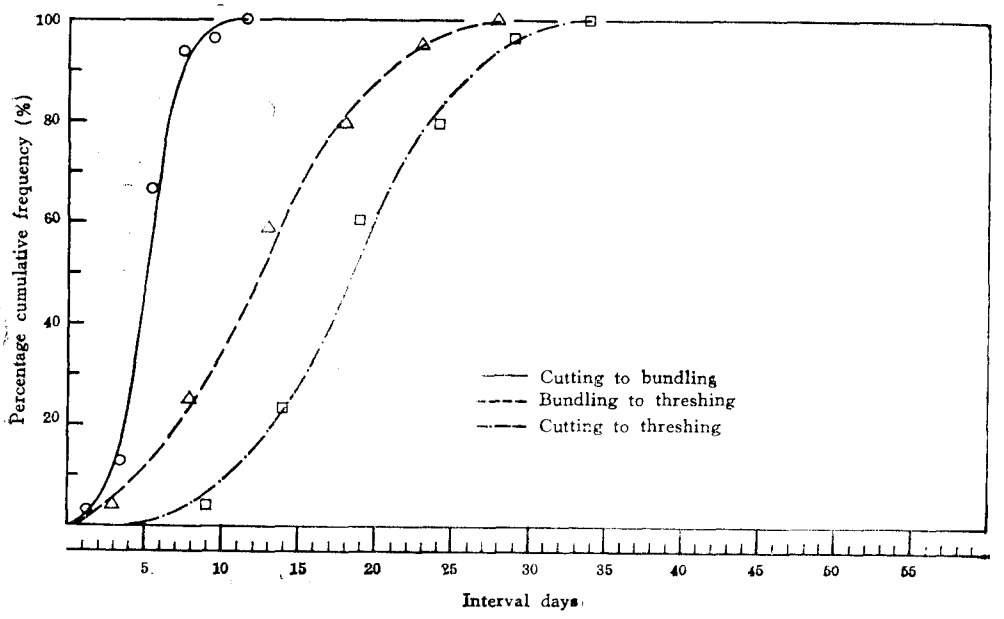

Fig. (8) Percentage cumulative frequency distribution of interval days for the periods between cutting and bundling operation, bundling and threshing operation, cutting and threshing operation, respectively, for the AKIBARE variety (Pyungtaik)

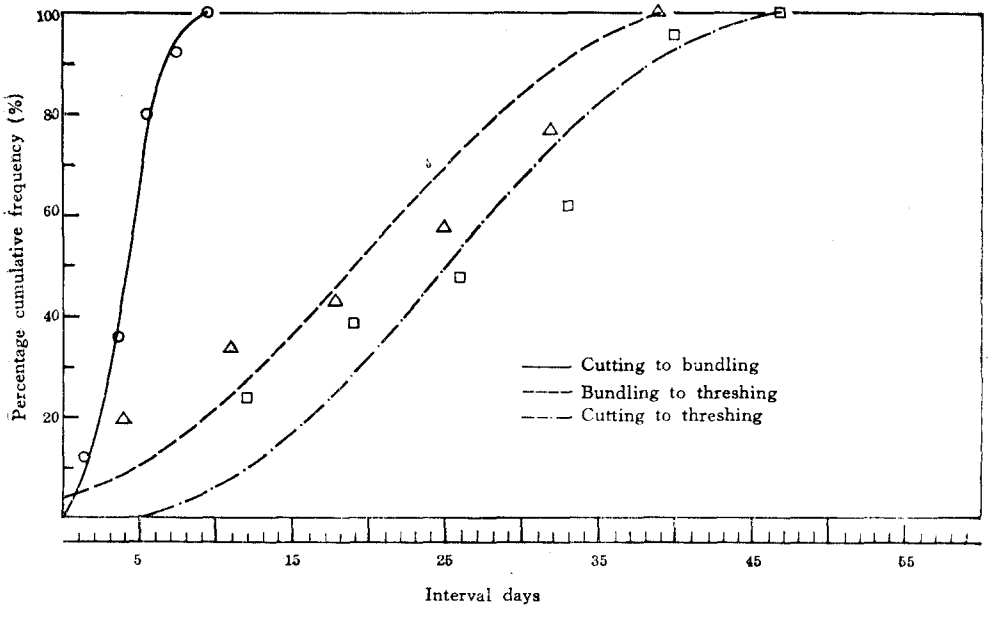

Fig. (9) Precentage cumulative frequency distribution of interval days for the periods between cutting and bundling operation, bundling and threshing operation, cutting and threshing operation, respectively, for the MINEHIKARI variety (Pyungtaik).

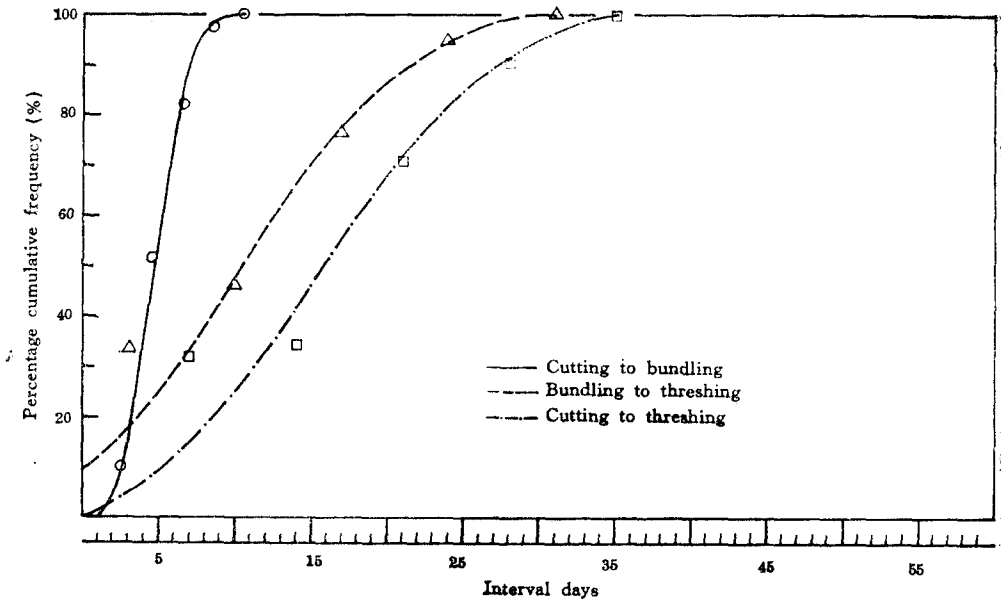

Fig. (10) Percentage cumulative frequency distribution of interval days for the periods of cutting and bundling operation, bundling and threshing operation, cutting and threshing operation, respectively, for the TONGIL sister line variety(Pyungtaik).

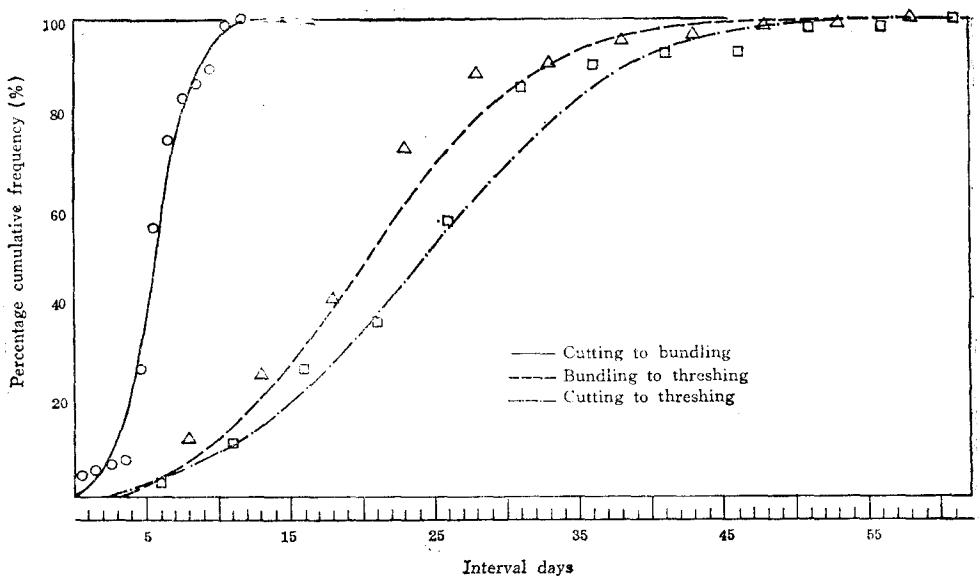

Fig. (11) Percentage cumulative frequency distribution of interval days for periods between cutting and bundling operation, bundling and threshing operation, cutting and threshing operation, respectively, for the JAPONICA type variety(Gimje).

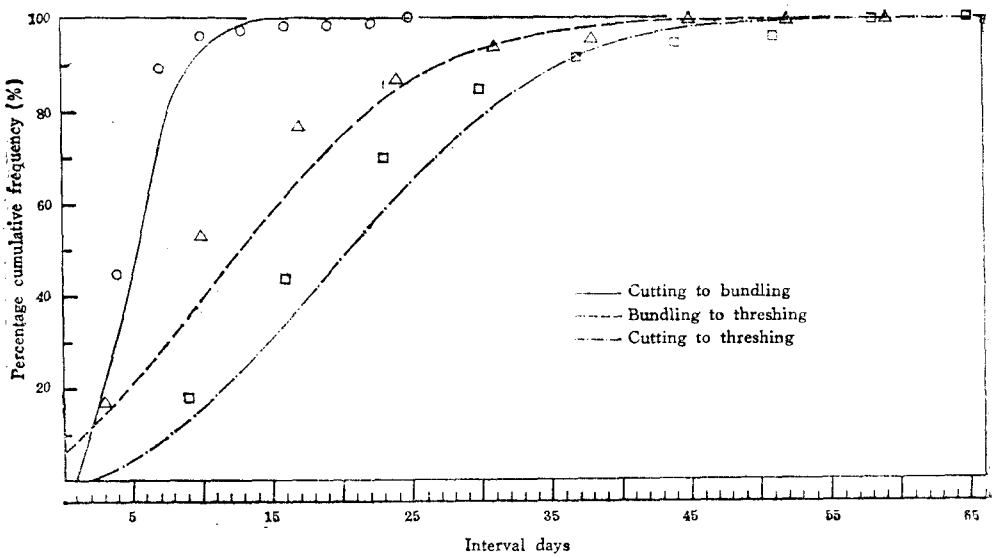

Fig. (12) Percentage cumulative frequency distribution of interval days for the periods between cutting and bundling operation, bundling and thershing operation, cutting and threshing operation, respectively, for the TONGIL sister line variety(Gimje).

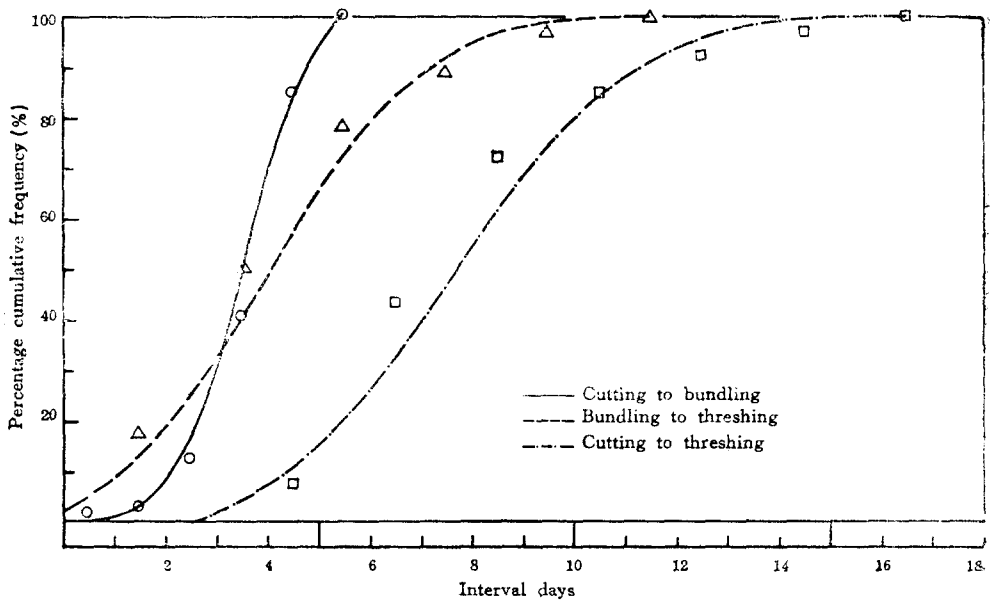

Fig. (13) Percentage cumulative frequency distribution of interval days for the periods between cutting and bundling operation, bundling and threshing operation, cutting and threshing operation, respectively, for the TONGIL sister line variety(Jinyang).

rable.

3. Analysis of performance rates of traditional post-harvest operations

Most of harvesting operations such as cutting, bundling, overturning, and shocking were performed manually, thus requiring a large amount of labor in accomplishing these jobs. This was especially important in those areas where double cropping of the rice and barley created a peak labor demand during the paddy harvesting season.

Thus, this study attempted to find out the performance rate of each operations which was supposed to be closely related to the labor demand to be discussed in later section. Since the performance rate was affected by such factors as working conditions, and worker's individual competency, the performance rate of each of major operations was expressed by the percentage frequency distribution so that not merely its mean value but variation from the mean could be assessed. Performance rates of major post-harvest operations were analyzed as shown in Fig(14) to (18). The statistical test for this analysis was also summarized in Table(4).

The performance rate of each of the operations showed a little difference by regions, but generally formed to a normal distribution curve.

Table (4) Statistics related to performance rates in Pyung/man-hour of major post-harvest operations

Region	Operations	Mean	S.D.	C.V.	X_0^2
Pyungtaik	Cutting	34.59	7.85	22.69	6.63 **
	Bundling	61.60	20.00	32.42	6.57 **
	Threshing	31.26	2.87	9.18	8.22 **
Gimje	Cutting	33.64	7.81	23.22	35.51 n.s.
	Bundling	65.80	11.11	16.88	37.35 n.s.
	Threshing	29.85	6.85	22.95	23.83 n.s.
Jinyang	Cutting	38.63	6.62	17.14	6.76 **
	Bunding	72.00	16.52	22.95	10.59 n.s.
	Threshing	31.35	11.72	37.37	6.73 **
Gimje	Overturning	167.43	59.85	35.75	10.86 **
Pyungtaik	Shocking	138.38	54.70	39.24	18.70 n.s.

However, the regional difference of the mean performance rate for the same operation was quite small compared to the variation from mean. For exemple, mean performance rates of the cutting operation for the Pyungtaik, Gimje and Jinyang were 34.6, 33.6, 38.6 Pyung per man-hour, respectively, giving their maximum difference of 5(38.6-33.6) Pyung per man-hour. However, the standard deviations of the performance rate of the regions were 7.85, 7.81, 6.62 Pyung/man-hour, respectively, which proved to have greater values than those of the maximum difference of the mean performance rate by region. In the statistical test, the hypothesis that the means of performance rates of the same operations for the three different areas were equal was accepted. Thus, the performance rates of the same operations for the three different areas were equal was accepted. Thus, the performance rates for the

different areas were pooled together to give 34.8±7.8 Pyung/man-hour for the cutting, 65.8±15.5 Pyung/man-hour for the bundling, and 30.5±7.2 Pyung/man-hour for the bundling, and 30.5±7.2 Pyung/man-hour for threshing operations, respectively.

Rates of overturning and shocking operations as measured in the Pyungtaik and Gimje areas were 167.43 and 138.38 Pyung/man-hour, respectively, with a wide range of variations, which might be accounted for the difference in the operational practice.

The performance rate of the threshing operation in the Pyungtaik area, where majority of the work was conducted by use of semi-auto threshers, proved to be about the same as those in the Gimje and Jinyang areas where use of auto-threshers was in common. It could be especially noted that, even though semi-auto threshers have a greater machine capacity than auto threshers, the former had about the same labor efficiency per unit of threshers as the latter. Use of semi-auto threshers not only gave noadvantages in the labor

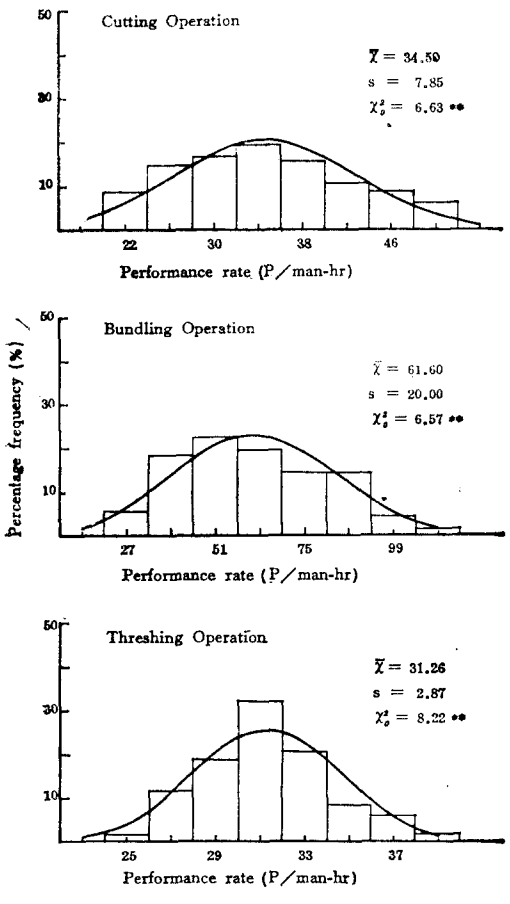

Fig. (14) Percentage frequency distribution of the performance rate in the traditional cutting, bundling, and threshing operation(Pyungtaik).

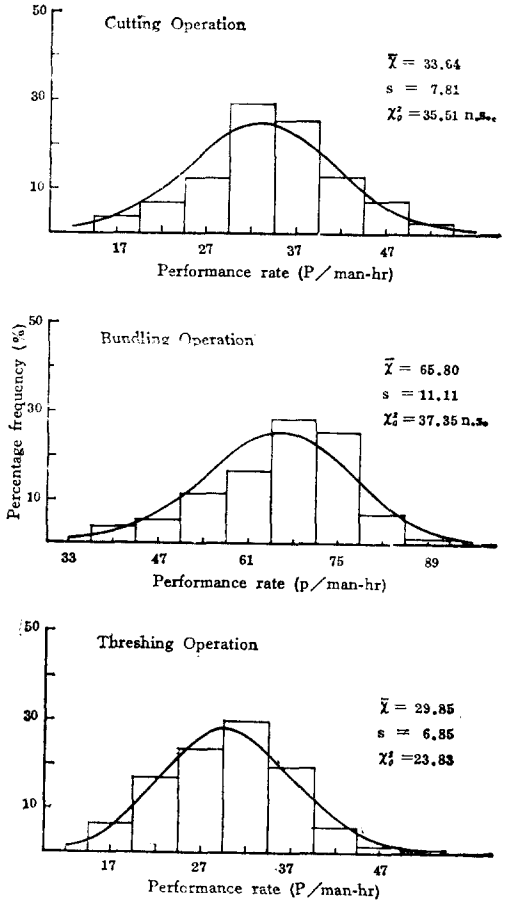

Fig. (15) Perecentage frequency distribution of the performance rate in the traditional cutting, bundling, and threshing operation(Gimje).

efficiency, but also caused reduction in milling recovery rates and delay of working duration as a whole. This points would be specified to be explained in later sections. Thus, it is strongly recommended that semi-auto threshers used presently in the Pyungtaik area should be substituted by auto-threshers. In this substitution, however, needless to mention, some economic burden could not be avoided for an initial investment for purchasing new auto-threshers.

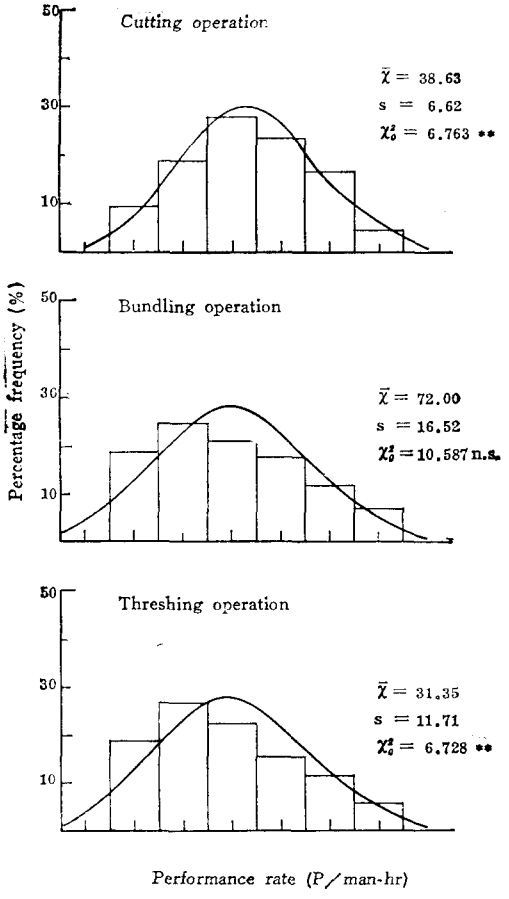

Fig. (16) Percentage frequency distribution of the performance rate of the traditional cutting, bundling, and threshing operation (Jinyang).

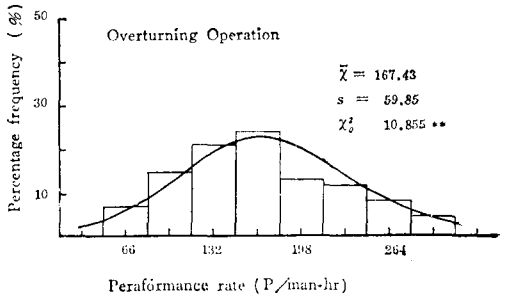

Fig. (17) Percentage frequency distribution for performance rate of the traditional overturning operation(Gimje).

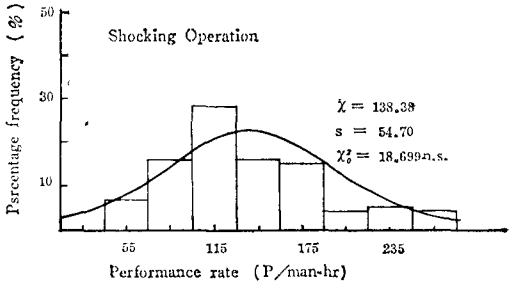

Fig. (18) Percentage frequency distribution for performance rate of the traditional shocking operation(Pyungtaik)

4. Labor demand and supply for the traditional harvesting system.

In planning the rational post-harvest production systems, it is sometimes necessary to determine the labor requirement in performing various operations involved in the systems. The labor demand could be different due to a plant varietal difference, weather conditions, regional peculiarities of the performance practice, and effectiveness of tools and machinery used.

Consequently, in this study, traditional paddy harvesting systems were categorized into four that could cover all the cases involved. Estimated labor requirements for each of the systems were analyzed mainly on

the basis of the measurements made. Table (5) shows the labor demand for each of the different categories.

In category "A", some of operations such as hauling operation within the field and the winnowing of threshed grains omitted as done in the Pyungtaik area in association with the harvest of traditional varieties. But, in the system "B", hauling within the field for the shocking operation and the shocking operation itself were totally missed to perform the threshing operation directly within the field as generally practiced in association with the HYV. The system "C" was associated with the harvest operation of traditional varieties in the Gimje area where the winnowing operation was furthermore omitted to make use of auto-threshers with a fine separation unit.

Finally, the system "D" was concerned with the general practice of the HYV harvest in the Gimje and Jinyang areas where the overturning, hauling within the field, shocking, and transporting the dried plants to a farmstead were abbreviated with a view to reducing grain losses incurred such operations.

As indicated in Table(5), labour requirements for each of the systems established were of considerable variation. The system "C" was the most effective as far as the total requirement of labor is concerned. The labor demand for all of the system could be increased considerably if the weather was not cooperatively good.

There were three sources of labour supply for the performance of post-harvest operations. The first one was that all or partial work was performed by the labor available within a farm family. The second one was that outside laborers were hired on a daily basis or by work area and/or volume of work is discharged(work-volume wage). A third source of the labor supply could come from the labor exchange system established with neighboring families.

Regardless of which kinds of labor-supply sources were utilized, different number of

Table(5) Labor demand for traditional paddy harvest.

Operation	Labor req'd (man-hr/ha)	Harvesting systems			
		A	B	C	D
Cutting	87.1	○	○	○	○
Initial sun-drying on field	—	○	○	○	○
Overturning	17.9	○	○	○	△
Bundling	46.1	○	○	○	○
Hauling within the field	16.3[1)]	△	○	○	○
Hauling within field and shocking (cross-stacking)	21.7	○	△	△	△
Handling to farmyard and piling up paddy bundles	40.1[1)]	○	△	△	△
Threshing	99.4	○	○	○	○
Cleaning	48.0	△	○	△	○
Packing	48.0	○	○	○	○
Total		360.2	362.8	314.8	344.9

○: Performed △ Abbreviated

1) Refer to Reference(1)

female laborers were actually conducting the post-harvest operation.

The actual labor-supply ratio of male to female could be accepted as a useful index to express not only some of the characteristics of the labour quality but also the degree

Table (6) Sources of labor supply in performing major post-harvest operations.

Region	Labor sources	Male-to-female rate (%)			
		Cutting	Bundling	Threshing	Average
Pyungtaik	Male worker	89.2	87.9	97.7	91.6
	Female worker	10.8	12.1	2.3	8.4
	Family labor	31.3	35.9	12.9	26.6
	Employed labor	57.7	55.0	87.4	66.7
	Exchanged labor	11.0	9.1	0.0	6.7
Gimje	Male worker	65.6	63.8	68.2	65.9
	Female worker	34.4	36.2	31.8	34.1
	Family labor	14.7	23.6	10.6	16.3
	Employed labor	58.9	45.9	57.1	54.0
	Exchanged labor	26.4	30.5	37.3	29.7
Jinyang	Male worker	46.6	47.2	59.1	50.9
	Female worker	53.4	52.8	41.0	49.1
	Family labor	81.0	8.7	66.4	77.7
	Employed labor	11.5	9.3	26.4	15.7
	Exchanged labor	7.5	5.0	7.2	6.6

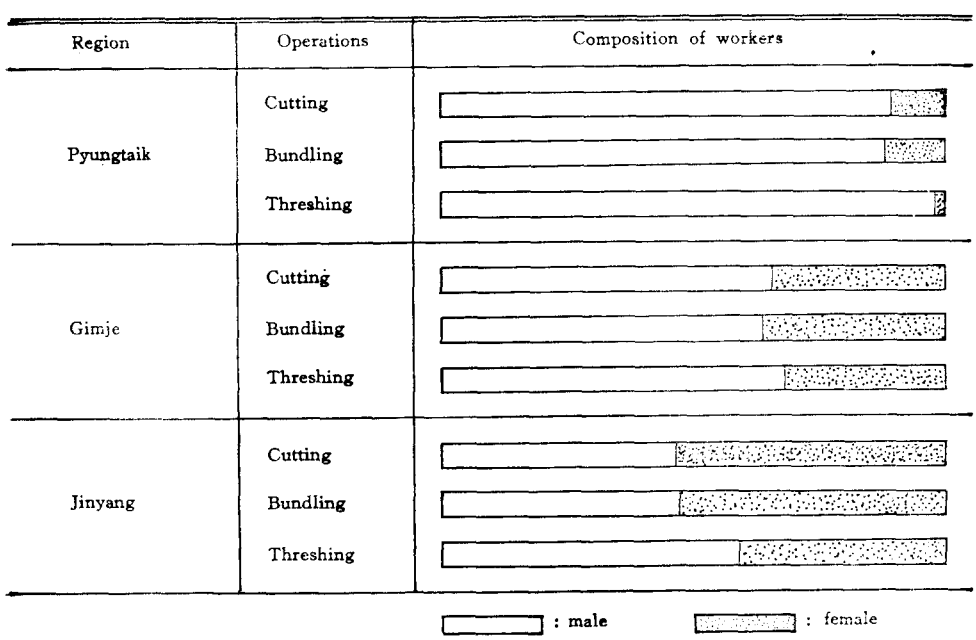

Fig. (19) Composition of workers mobilized cutting, bundling, and threshing operations by regions.

of mobilization of the family labor indirectly.

Table(6) shows the distribution of sources of the labor supply and its male-to-female composition ratio, which analyzed for the major paddy post-harvest operations in the three regions surveyed. Important findings may be summarized in the following.

First, the composition ratio of male to female laborers for the operation of cutting, bundling, and threshing showed a significant difference by regions. It was 91.6% in the Pyungtaik region, 74% in Gimje, and 50% in the Jinyang region, the highest ratio in Pyungtaik region was resulted from the threshing operation in which the custom work was widely practiced by use of semi-auto-threshers which usually required only a male adult laborer.

On the contrary, a relatively large number of female laborers were involved in accomplishing harvesting operations both in the Gimje region and the Jinyang region. The latter in particular showed a marked figure in the number of female laborers.

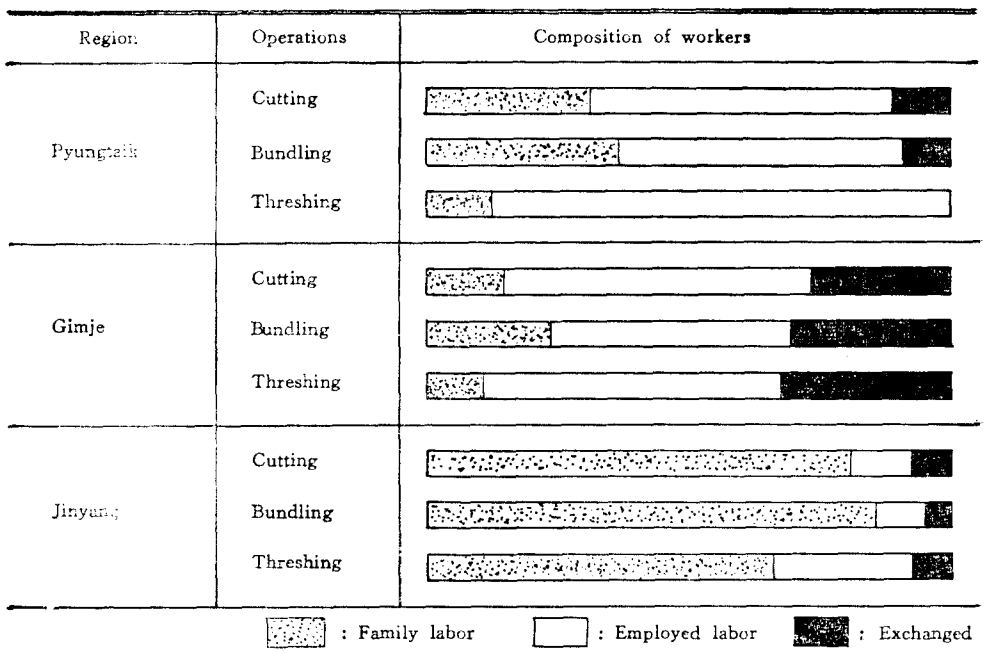

Fig. (20) Composition of workers to accomplish cutting, bunlding, and threshing operations by region.

Second, the distribution of sources of the labor supply was also proved different by regions surveyed, as shown in Table(6). On the whole, 73.4% and 83.7% of the labor supply for cutting, bundling, and threshing operations were exchanged and employed labor in Pyungtaik and Gimje regions, respectively, while 77.7% of harvesting operations was carried out by family-supported labor in the Jinyang region.

Ⅳ. Summary and Conclusions

The traditional paddy post-harvest system in Korea consists of various processes such as cutting, bundling, shocking, threshing and drying, The operational timing, duration,

performance rate, labor demand and supply, and tools and machinery used may primarily characterize the traditional system. The basic objective of this study was to characterize and determine these operational characteristics of the traditional post-harvest system. Three regions were selected for this study; (a) Pyungtaik, representing the northern section, (b) Gimje, representing the mid-section, and (c) Jinyang for the southern section of Korea.

The results obtained from this study may be summarized as follows:

1. The duration of cutting operation for a given region and for different varieties was very short, majority of the work being accomplished within about 10 days. And, average interval days between cutting and bundling operations was in the range of 4.08 to 6.32 days for all regions and varieties surveyed.

2. Interval days between bundling and threshing operations for the harvest of the HYV for the Pyungtaik and Gimje areas were 23±13 and 15.6±10.8 days, respectively. In contrast, it was only 4.88±2.54 days in the Jinyang area. Since the major grain loss in fields has been known to incur from such long interval days, a need for technological innovations to enable to shorten them in the Pyungtaik and Gimje areas was considered of extreme importance.

3. It was observed that there were regional differences in ways and means employed for threshing operations. The use of auto-threshers in the Jinyang and Gimje areas was dominant while that of semi-auto-threshers, in the Pyungtaik area. The size of bundles was accordingly different to fit with threshers used, having about 16 hills of plants in the Jinyang area, about 72 hills in the Gimje area, and about 32 hills in the Pyungtaik area.

4. Performance rates of major post-harvest operations did not show much difference by region, showing the pooled rates of 34.8± 7.8 Pyung/man-hour for the cutting, 65.8± 15.5 for the bundling, and 30.5±7.2 for the thresing operations, respectively.

5. The labor demand or requirement for the performance of various processes of post-harvest systems estimated at by taking into consideration regional and varietal peculiarities and characteristics. The total labor requirement for man-hour/hectare ranged from about 314 to 360.

6. The three typical sources of labor supply utilized for performing post-harvest operations were: (a) the family-supported labor, (b) laborers hired for per day or on the basis of the work-volume done, and (c) the labor exchanged among neighboring families. In the Jinyang area, more than 78 percent of work was performed by the labor available within the family. In contrast, employed laborers were prevalent in the Pyungtaik and Gimje area, with 66.7 and 54.0 percent, respectively.

In the Gimje area, about 30 percent of post-harvest works was accomplished by the exchange of labors among families while it was less than 10 percent both in the Pyungtaik and Jinyang areas.

7. The ratio of male-to-female laborer mobilized for mojor post-harvest operations showed some difference by region. The highest one was noted in the threshing operation in the Pyungtaik area, with 97.7% and, the lowest, in the cutting operation in the Jinyang area with 46.6%

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