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EVALUATION STUDY ON IBRD LOAN PROJECT

FARM MECHANIZATION PILOT PROJECT IN KOREA

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AN EVALUATION OF FARM MECHANIZATION PILOT PROJECT IN KOREA

CONTENTS

SUMMARY AND CONCLUSIONS

1. This survey was made for the purpose of evaluating performances of the comprehensive farm mechanization pilot projects (CFMPP) and rice transplanting & harvesting mechanization pilot projects (RTHMPP) which have been supported and financed by the government to exhibit the machinery utilization and it's joint utilization patterns from 1977. To achieve the survey objectives, 4 CFMPP areas established upto 1978, the selected 8 RTHMPP areas and 200 farm households were surveyed.

2. The comprehensive farm mechanization pilot projects are to exhibit the mechanizations of whole series of rice cropping works in the large scale plain areas. Among the project areas, the size of Cholwon project area was 1,000 ha of paddy field and the size of the other project areas such as of Giho, Dongjin and Dalsung FLIA were 300 ha. The total number of machineries including tractor, combine, rice transplanter and binder held by the individual project are ranged from 95 for Cholwon and 50-60 for other project areas. The space area of the ancilliary facilities was about 400-650 pyong. The investment for the project equipments were mostly depended on the central and

local government subsidies. The total amount of investment for Cholwon and other project areas were equivalent to 530 million won and 200-300 million won respectively.

3. The rice transplanting and harvesting mechanization pilot project areas are located in the 271 sites throughout Korea, whose management organization consist of FLIAs. agricultural cooperatives, rural guidance officies and farmers' groups. The project started with one or two machines including transplanter, binder and combine. The number of machines have been increased according to the increasing demand for machinery works, and now many of the project areas are equipping with tractors and grain dryers. The average surveyed area holds 5 machines which is valued about 11 million won.

In case of this project, the transplanter and harvester were procured by the government subsidy of the whole amount and the other machineries by the institutional credit. The existing building was used jointly for storage of the machinery.

4. The utilization of the farm machinery in the surveyed CFMPP areas were mainly custom works and were managed by the project organization itself. Among the surveyed RTHMPP areas,

there were three project areas where the farmers' group managed the transplanter & binder which was lent to the farmers group with or without charges by the project authorities. There was one place where an individual carried out the contract works by renting the machinery from the project authorities. In case of the seedling works, there was two areas where the individual farmers borrow nursery boxes for individual seedling works. It can be said therefore that the seedlings technique for the mechanized transplanting is in the process of wide generalization in the surveyed areas. However, the large farm machines such as tractors and combines were operated for the contract works directly by the project authorities.

The distribution of the field for the machinery works varied with the work commitment of farmers, locational characteristics of the project and the structure of individual farm management patterns, etc.

5. The average area plowed by a tractor was 26.6 ha which is equivalent to 37% of the working ability in a season. The working area for land preparation per tractor was averaged at 27.8 ha or 66% of the working ability. To increase the rate of tractor utilization, some of the surveyed areas extended

their tractor plowing to the pasture of the project area. However, the expansion of the tractor working area is required for more economical tractor use.

The working area per transplanter was 10.7 ha in average and ranged from 5.3 ha to 21.3 ha. To increase the rate of transplanter utilization are required such as the improvement of supply conditions for seedling boxes, and development of the seedling method.

The average working area of a binder was 5.7 ha or 42% of the working ability. And combine worked 11.9 ha in average, a high rate of utilization. For the expansion of binder use, it is necessary to improve the binding rope and to develop technology to decrease grain flattering.

6. Increases of machinery working areas are mainly due to the diffusion of farm mechanization technology, increase of farmers' demand for machinary custom works owing to the cost savings and the improvement of management techniques. Especially, the average area of power transplanting increased by 23% for the period of 1978-1979.

7. To increase the demand for contract works, the project operators employed contract farmers with priority, for mitigating the increase of farmers' cash expenses incured by work contract. There was an example that the farm mechanization pilot project implemented in the area where severe labour competitions were prevailed between rice and vegetable cropping raised the area of contract works.

Some decision-makings of the project management bodies, however, restricted the supply of contract works through such as restrictions on growing late varieties of rice, excessuve collectivization of working areas in the small scale pilot project areas and asking the serial work commitment comprising plowing-transplanting-harvesting.

8. The machinery working efficiency decreased due to the unskilled operators, unfavorable conditions for repair and maintenance of the machinery, scattered working area and the difficulties to adjust working orders. The planed areas were completed by extending the working hours per day, however, in the most surveyed areas.

9. The custom rates of the machinery works were varied from area to area. In general, the custom rates of the CFMPP areas were lower than that of the RTHMPP areas. Farmers' general opinion on the levels of the custom rates was showed very affirmatively. The custom rates were determined on the basis of machinery working costs. In some pilot project areas, the costs such as salary, depreciation cost of facilities and machineries were not included in determing the custom rates. In some areas, custom rates were fixed before the work commencement. In this case, actual cash balance of the project management often showed deficits because of inaccurate forecasting on costs. Collection of the project managers collected custom charges after completion of the contract works. There was a case to collect the custom rates after harvest of rice. This method raised some problems in procuring the management costs.

10. The most direct effect of the farm mechanization pilot project would be labour savings: The labour savings by machinery works were estimated at 396 man-days for tractor, 171 man-days for transplanter, 104 man-days for binder and 365 man-days for combine. The labour savings per one million

won of capital investment were averaged 30 man-days in the CFMPP areas and 55 man-days in the RTHMPP areas.

11. It is expected that the effects of labour savings derived from the farm mechanization would contribute to changes in the farm management including increase of cropping intensity, increase of land productivity, substitution of the draft animal and increase of non-farm incomes, etc. Since farm mechanization is at its early stage, these effects could not be found in the project areas. The socio-economic effects such as free from the conventional heavy works and increase of leisure were the other benefits from the projects.

12. The social cost saving, generated from the difference between the conventional working costs and machinery working costs, were amounted to 49 thousand won per ha of tractor works, 32.5 thousand won per ha of the power transplanting plus growing seedlings, 56.6 thousand won per ha of binder work and 53.9 thousand won per ha of combine works. On the other hand, the farmer's cost savings measured by the difference between the conventional working costs and custom rates for the machinery works were equivalent to 50 thousand won per ha of tractor

works, 62 thousand won per ha of transplanter works, 67 thousand won per ha of binder works and 100 thousand won per ha of combine works. The cash balance of the management bodies showed dificits for every contract work; 2.3 thousand won/ha of tractor work, 29.2 thousand won/ha of transplanter work, 10.6 thousand won/ha of binder work and 46.8 thousand won/ha of combine work.

13. The benefit-cost ratio was estimated at 0.94 and 1.03 for the standardized CFMPP and RTHMPP areas respectively by discounting the average benefits and costs with 15% of interest. The internal rates of returns for the projects were estimated at 12.9% and 16.4% respectively.

Under the assumption of 10% annual increase of real wage rate and the present rate of machinery' utilization, the internal rate of return of the projects would be 23.7% and 33.8% respectively. If the present level of wage rate keep constant and the rate of machinery utilization increase by 30%, the IRR of the projects will increase up to 23.6% and 34.3% respectively. Accordingly, the increase of the rates of machinery utilization is desirable in the RTHMPP areas and promotion of comprehensive farm mechanization as the real wage rates hikes will bring out the good results.

I. INTRODUCTION

1. Situation and Characteristics of Farm Mechanization Pilot Projects

The promotion of farm mechanization has been considered recently, as one of the most important fields in Korean agricultural policies owing to the labour shortage and wage-hike in rural area. Accordingly, the pertinent counter-measures have been carried out such as land consolidation and on-farm development, monetary support, diffusion of farm mechanization technologies, expansion of after-service facilities and encouragement of a suitable group farm machinery uses.

As a part of the farm mechanization measures, the government have initiated two types of farm mechanization pilot projects from 1977. The one is the comprehensive farm mechanization pilot project (CFMPP) for the large-scale plain areas. Heavy machineries such as tractors, combines, transplanters and dryers have been introduced to carry out the whole series of works for rice cultivation in the project area. A comprehensive farm mechanization pilot project covers about 300 hectars in average and equipped with more than 50 machines.

These large-scale pilot projects are operated by FLIAs and Ag. Cooperatives.

The other type of farm mechanization pilot project, named as the Rice Transplanting and Harvesting Mechanization Pilot Project (RTHMPP), includes 10 to 20 hectares of paddy land with 2-5 machines mainly of rice transplanter, binder or combine. This type of pilot projects, have also been managed by the agricultural institutions and farmer's organizations such as FLIAs and agricultural cooperatives the bases of custom services.

The CFMPPs were established in Gangwon province in 1977 and in Gyonggi, Jeonbuk and Gyongbuk provinces in 1978. Total number of the comprehensive pilot project areas in 1979 was 7 sites including three areas additionally established in Gyongnam, Jeonnam and Choongnam provinces. In 1980, each provinces are going to operate one comprehensive pilot project by establishing two more projects for Choongbuk province and Cheju island. These comprehensive pilot projects have the diversified objectives not only of farm mechanization in the area but also of training farmers on farm mechanization technologies, exhibition of machinery utilization, machinery

repairs and services and experiment of large-scale group machinery uses.

The rice transplanting and harvesting mechanization pilot project (RTHMPP) aims at exhibition of farm machinery utilization and more importantly at the encouragement of joint use of farm machinery. These pilot project areas were built up initially at 26 sites in 1977 and one hundred of pilot areas were operated throughout Korea in 1978. In 1979, the total number of RTHMPP was 271, of which 145 were operated by FLIA, 51 were operated by agricultural cooperatives and 47 were operated by village farmers' groups and 28 were operated by public agencies respectively.

The government is scheduled to build up 1,460 sites of RTHMPP in each Myon and Eup by 1986 throughout Korea. The functions of RTHMPP will cover not only the joint use of farm machinery but also the role of local machinery service center. Accordingly, the rice transplanting and harvesting machanization pilot projects are expected to be a key role in promoting the successful farm mechanization program in Korea.

2. Objectives, Contents and Methods of the Survey

The objectives of the survey are to review the present status of management and to analize costs and benefits of the comprehensive farm mechanization pilot project areas and RTHMPP areas. The main items surveyed for the objectives could be classified as follows

- Number of farm machinery and facilities holdings
- Amount of investment
- Management pattern of the pilot project areas
- Situation of farm machinery utilization
- Management costs, and custom charges
- Major factors affecting on machinery utilization
- Additional return to investment

The surveyed areas covered 4 CFMPPs under management, and 8 sites out of the 100 RTHMPPs established up to 1978. They were selected considering the provincial distribution. Ten to twenty five farm households were sampled in each pilot project area based on farm sizes and two hundred farm household in total were surveyed as shown in (Table I-1).

As to the methods of survey, surveyers interviewed with farmers and project managers to get information on the items

mentioned in the above. The items unavailable in the project fields were exploited with the data collected by MAF and ORD. The survey period for work performance was determined from July 1978 to July, 1979.

(Table I-1)

List of Sample Farm Mechanization Pilot Projects and Number of Farm Households Surveyed

Operating Organizations	Locations	No. of Farm Households Surveyed
(Comprehensive Farm Mechanization Pilot Project Areas)		
Cheolwon Gun Machinery Centre	Cheolwon Gun Gangweon-Do	20
Giho FLIA*	Pyeongtaek Gun Gyonggi-Do	14
Dongjn FLIA	Kimjae Gun Junbuk-Do	17
Dalsung FLIA	Dalsung Gun Gyongbuk-Do	22

Operating Organizations	Locations	No. of Farm Households Surveyed
(Rice Transplanting and Harvesting Mechanization Pilot Project Areas)		
Baekam Ag. Cooperative	Yongin Gun Gyonggi-Do	15
Jinjam Ag. Cooperative	Daeduck Gun Choongnam-Do	21
Bongsan Ag. Cooperative	Damyang Gun Junnam-Do	13
Sangseo Ag. Cooperative	Buan Gun Junbuk-Do	16
Namyeon Ag. Cooperative	Jangsung Gun Junnam-Do	16
Gyongsan FLIA	Gyongsan Gun Gyongbuk-Do	15
Milyang Gun Rural Guidance Office	Milyang Gun Gyeongnam-Do	10
Juduk Ag. Cooperative	Joongweon Gun Choongbuk-Do	21
Total	12 Project	200

* FLIA: Farm Land Improvement Association

II. Project Size and Management Types

1. General Background of the Project Areas

Comprehensive farm mechanization pilot project area

The comprehensive farm mechanization pilot project area (CFMPP) is aimed at mechanizing a series of rice cultivation works in the selected area located in largescale plain areas. The CFMPP covers 300 ha of paddy field and it's main purposes are to exhibit farm mechanization, to carry out farm works for the project farmers, to train farmers for machinery operation and to repair farm machinery. Up to now, the CFMPP under management are 4 sites where the farm land bases for farm mechanization were well prepared by means of land consolidation and on-farm development.

Cholwon CFMPP is located at the southern part of demilitarized zone in Gangwon province where farmers' dwelling, entrance and exit are restricted on account of military purposes. Accordingly trip farming have being done by the project farmers. It is needless to say that rice productivity in the area have showed very low level on account of daily working time restrictions and shortage of available labour forces.

To cope with the production constraints, 300 ha of paddy field was initially chosen and let Jungang FLIA to manage CFMPP. Size of the pilot area have increased from 300 ha to 1,000 ha by adding extra area of 400 ha in 1978 and 300 ha in 1979. The project area is under commanded by the government directly owing to operation right turnover from FLIA to Cholwon-Gun office. The total number of farm families was estimated at 620 and average farm size was about 1.6 ha which is comparatively higer than that of other areas.

The other three CFMPP areas were fostered each with 100 ha of rice paddy in 1978 and the area expanded to 300 ha in 1979. All the project areas have been commanded by FLIA concerned. In case of Dalsung area commanded by Dalsung FLIA, the project areas consisted of 3 isolated sites, one of which is located at 12 km from the machinery hangar. Giho area in Pyongtack and Dongjin area in Gimje are located around the hanger. Wage level in Dalsung area was the highest because Dalsung area is located at suburban district. An average farm size of Dalsung and Pyongtack area is less than one hectare while Gimje area consisted of the large farms with 2.2 ha in average.

(Table II-I)

Size of Paddy Land and Number of Farm Households in Surveyed Comprehensive Farm Mechanization Pilot Project (CFMPP) Areas, 1979

Areas	Paddy Land (ha)	Number of Farms (Households)	Paddy Land per Household (ha)
Cheolwon	1,000	620	1.6
Giho	300	390	0.8
Dongjin	300	136	2.2
Dalsung	300	446	0.7

Rice Transplanting and Harvesting Mechanization Pilot Project (RTHMPP) Area

Apart from the comprehensive farm mechanization pilot project areas, RTHMPP is aimed at developing the joint utilization system and exhibiting mechanized rice transplanting and harvesting by means of transplanter and binder. Generally speaking, this project is very simple and small in size comparing with the CFMPP. In addition to the above facts, project locations are not confined to the large scale plain area. The total number of 271 RTHMPP areas as of 1979, are distributed throughout Korea.

As of 1979, the distribution of RTHMPP areas by province and operating organization is shown in table II-2.

(Table II-2)

Harvesting Distribution of Rice Transplanting and Mechanization Pilot Projects (RTHMPP) by Operating Organization and by Province, 1979

Provinces (Do)	Operating Organizations				
	FLIA	Agr. Coopera-tive	Village Farmer's Group	Others	Total
Gangwon	-	8	20	1	29
Gyonggi	15	14	-	-	29
Choongbuk	4	18	1	5	28
Choongnam	11	25	7	5	48
Jeonbuk	2	10	1	5	18
Jeonnam	3	29	-	-	32
Gyongbuk	13	37	-	-	50
Gyongnam	3	4	18	10	36
Cheju	-	-	-	1	1
Total	51	145	47	28	271

The number of areas by province except Cheju island are well distributed 18-50 sites in each provinces and the total number of the pilot areas consisted of 51 for FLIA, 145 for agricultural cooperatives, 47 for village group farms and 28 for others such as rural guidance office, agricultural colleges and agricultural agencies concerned.

The size of RTHMPP area and the number of machinery to be procured were determined not based on the project area but the increase of demand for farm machinery utilization. Accordingly, the number of farm machinery holdings have been increased annually.

According to the survey results, the management sponsorship of the 8 RTHMPP areas are consisted of FLIA for Gyeongsan, Gun rural guidance office for Milyang and Agricultural cooperative for the remainder. In two cases of the above mentioned, actual management have being done by farmers joint works in the areas. Among the surveyed areas, Jinjam, Bongsan, Gyongsan and Juduck areas are located in the suburban area of large cities, Sangseo, Nammyon and Milyang areas are located at plain zone and Baekam is located at semi-mountainous zone.

The pilot projects for farm mechanization are supported with the necessary machinery, man power and facilities in carring out the projects but the methods of the project management is decided by the management organizations. Therefore the sponsorship of management should determined the pertinent utilization system of farm machinery and secured the area to achieve the objectives of the project. The management types varied widely with the different socio-economic conditions such as farm environment, levels of mechanization technology and land conditions.

2. Equipments and Investments of the Projects

To achieve the objectives of the farm mechanization pilot projects, a pertinent facilities are required to store and manage the farm machinery introduced. At the same time, the number of farm machinery to be introduced should be determined considering the project area and working ability by machines.

Comprehensive farm mechanization pilot project area

The CFMPP areas hold the highly efficient farm machinery such as tractors, combines, dryers and transplanters which

could be substituted by small machinery like power tillers and binders. The areas have also the restrictive number of power tillers and sprayers already supplied. Reviewing the farm machinery holdings by the project areas, Cholwon project area has 22 tractor and 26 transplanters, 23 combines and 24 dryers. For the full mechanization of the project area, 20 transplanters and 70 combines are required additionally considering the maximum working ability* of the machinery.

Giho, Dongjin and Dalsung area with 300 ha of paddy field hold 8-13 tractors each. Dongjin project area holds 19 transplanters, one binder, 14 combines and 15 dryers. Dalsung project area holds 10 transplanters, 16 binders, 10 combines and 9 dryers. Giho project area holds 13 transplanter, 5 binders and 11 combines and dryers respectively. Outstandingly, Dalsung has 16 binders because of farmers preference for the binder to combines. Consequently, the number of tractor holdings are considered enough to cover the project area comparing the wori-working ability with the project areas. On the other hand,

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* Working ability by machinery are based on 48ha for tractor with 46 ps, 21.6 ha for transplanter, 13.3 ha for binder and 10.8 ha for combine.

transplanters are limited in number except Dongjin area. The other areas excluding Dalsung are short of 10 havesters based on the working ability of combine.

The major facilities in each project area are consisted of storage houses for machinery, seedling bed with heating facilities, drying places and office building. Total space area for the facilities is 600 pyong for Dongjin, 460 pyong for Giho, and 370 pyong for Dalsung project area.

In case of Cholwon project area, total amount of investment for the machinery and facilities is equivalent to 535 million won, of which 325 million won invested for farm machinery procurement and 215 million won invested for the related facilities. Giho, Dongjin and Dalsung invested total amount of 300 million won, 265 million won, and 225 million won for equipments and facilities respectively.

Site area for the ancillary facilities is about 1,000-2,000 pyong. If we include the land value of site area, the total amount of investment would increase for more. In case of Dalsung, the site area for the ancillary facilities is smaller than that of the others on account of high land prices.

(Table II-3)

Number of Farm Machineries and Size of Project Facilities in the Surveyed CFMPP Areas, 1979

	Cheolwon	Giho	Dongjin	Dalsung
Number of Major Farm Machineries (in each)				
Farm Tractor	22	10	8	13
Rice Transplanter	26	13	19	10
Binder	-	5	1	16
Combine	23	11	14	10
Grain Dryer	24	11	15	9
Facilities 1/ (in Pyeong) 2/	650	459	605	374

1/ Include buildings for office, machinery storage, paddy rice sprouting and grain dryers.

2/ I Pyeong equals to about 3.3 square meters.

(Table II-4)

Amount of Investments for Machineries and Facilities by Sources in Surveyed CFMPP Areas, 1979 (in market prices)

	Surved Projects				
	Cheolwon	Giho	Dongjin	Dalsung	Total
Farm Machinery		(Mil. Won)			
Central Gov't	253.8	130.1	117.8	111.9	613.6
Local Gov't	63.4	32.5	28.1	28.0	152.0
Operating Organization	-	-	19.3	-	19.3
Total	317.2	162.6	165.2	139.9	784.9
Facilities					
Central Gov't	107.0	25.3	12.4	25.3	174.2
Local Gov't	107.0	25.3	13.7	26.7	159.0
Operating Organization	-	81.1	67.8	33.2	191.7
Total	213.9	131.6	94.0	85.2	524.7
Grand Total	531.1	294.2	259.2	225.1	1309.6

The Korean government has supported the management agencies through the government subsidy and institutional loan. In case of farm machinery, 80% of the machinery price is subsidized by the central government and 20% of that is also subsidized by the local government. Dongjin area has some amount of investment burdened by the management agency which is respresented for the evaluation of existing farm machinery held before the project commensment. Total amount of investment for the ancillary facilities was procured with 50% of subsidy by the central government and 50% from the local government subsidy.

Rice transplanting and havesting machanization pilot project

In the initial time of the RTHMPP, one or two rice transplanters and binders were introduced for each project according to the working abilities of the machines and degree of concertation of the project farmers. As of the end of 1979, farm machineries held by 271 pilot project areas are consisted of 500 transplanters and 400 binders. So to speak, the average number of machines per pilot area is 1.8 transplanters and 1.5 binders. Considering the number of machinery, 1.6

transplanters and 1.2 binders per project area in 1978, it is can be understood that working area for rice transplanting and harvesting have been increased. In addition to that, the project areas hold the various machinery such as 110 tractors, 90 combines and 70 dryers as of the end of 1979.

(Table II-5)

Changes in Farm Machinery Holdings of Entire Rice Transplanting and Harvesting Mechanization Pilot Projets (RTHMPP)

	1978		1979	
	Total	Average per Project	Total	Average per Project
Number of Projects	100		271	
Number of Machineries (in each)				
Farm Tractor	74	0.7	111	0.4
Rice Transplanter	158	1.6	488	1.8
Binder	115	1.2	398	1.5
Combine	34	0.3	91	0.3
Dryer	53	0.5	68	0.3

Source: Unpublished MAF Data

As shown in table II-6, the number of machinery holdings by the 8 pilot project areas are distributed unequally. Nammyon and Milyang own only rice transplanter, one or two, and Gyongsan area has one binder and one transplanter. Especially, the tractors and combine holdings concerned, Baekam and Bongsan own one tractor respectively and Juduck & Bongsan have one dryer. 4 project areas including Juduck have combines also.

A special ancillary facilities could'nt be found in the surveyed area because the existing storage houses were used for machinery keeping instead of establishing new facilities except drying facilities. A simple vynil houses have been used for nursery bed of rice.

As we reviewed already, new investment for the RTHMPP areas is mostly expended for machinery procurement and amount of investment by the pilot areas are distributed from 2 million won for Milyang to 17,2 million won for Baekam area. The financial supports for machinery procurement were quite different from that of the CFMPP area; 70% of the central government subsidy and 30% of institutinal loan for transplanter, and half subsidy and half loan for binder and combine. For tractor

(Table II-6)

Number of Farm Machinery Holdings in Surveyed RTHMPPs, 1979

Surveyed Projects	Number of Farm Marchineries					Investments		
	Farm Tractor	Rice Trans-planter	Binder	Combine	Grain Dryer	Central Gov't	Operating Organization	Total
	(in each)					(in Mil. Won)		
Baekam	1	2	3			10,604	6,579	17,183
Jinjam		3	2	1		6,224	5,101	11,325
Bongsan	1	1		1	1	8,172	8,702	16,874
Sangseo		5	5	1		8,389	7,763	16,152
Namyeon		1				3,343	3,330	6,673
Gyongsan		1	1			1,506	1,506	3,012
Milyang		4				1,952		1,952
Juduck			1	2	1	8,614	6,654	15,268

and dryer procurement, 100% of the value of machinery have been supported by loan.

3. Types of project management

Utilization patterns by machinery

From the view point of project management, the utilization types of farm machinery could be classified as follows

a. Direct management: Management body carry out machinary farm work by receiving work charges or rates.

b. Joint or group commitment: Management of farm machinery are commited to a special farmers group with and without machinery rent.

c. Management commitment: Management of farm machinery is commited not to farmers group but to a selected private individual or agricultural agencies.

d. Rent to individual: Farm machinery and equipment are rented to individual farmers and machinary works done by farmers themselves.

These types can also be classified into two types in farmer's point of view;

a. Work contracts: Special works are committed to a private individual or organization by paying work charges or custom rates.

b. Cooperative management: Joint works are carried out by by farmers group.

The utilization patterns by farm machines and works are summarized in table II-7.

Growing Seedlings

Apart from the conventional method of seedling, special technology and facilities are required for the working system of rice transplanter. To use transplanter, 8 times of seeding density than the conventional are required. For the use of rice transplanter, special method of seedling and a certain size of seedling boxes should be prepared. Expenses for growing seedlings are considered higher than that of conventional one. In the initial period of transplanter introduction, the most important constraint was the diffusion of new seedling method.

The pilot project area introduced transplanter achieved transplanting work less than full working ability of the machine. The management of rice transplanting was carried out directly by the rural guidance office and management organization. As

time goes by, the technology for growing rice seedling have been developed diversifically.

Direct management of seedling bed are still prevailed in the CFMPP areas and 8 RTHMPP areas surveyed. Of the 8 RTHMPP areas, Baekam, Jinjam and Bongsan areas have implemented direct management. For the comprehensive farm mechanization pilot project area with 300 ha of paddy field, a large scale building were constructed to grow seedlings. In the process of growing seedlings, much labour is required to sow and to remove seedling boxes from hot house to open paddy field for their hardening. To save labour in the seedling stage, the equipments such as soil grinder, mixer and automatic seed driller were procured. In case of Juduck, the seedling boxes have been lent to an individual, who trained in the field of seedling technology, for his commercial production of seedlings. Since this pilot area is located in suburban zone, he seems to have many difficult problems in hiring labours and utilizing the unfavorable facilities.

Likewise, cash expenditures of the farmers have been increased on account of labour intensive technology in the seedling stage. To solve the increase of cash expenditure,

joint management of seedling bed carried out by farmers group works in Nammyon, Gyongsan and Milyang pilot areas. Of the comprehensive farm mechanization pilot project areas, a part of the Dalsung area committed to the rural guidance office and all the management of the seedling bed was implemented by farmers themselves. In case of Giho area, growing seedlings in hot house has been done directly by Giho FLIA but seedling bed for hardening were established in each village unit for farmers' group management.

Bongsan pilot project area failed to control temperature in the vynil house. Accordingly, a lot of seedlings were purchased from other areas to transplant seedlings on time in the field. To reduce uncertainty and damages rising in seedling stage, Cholwon and Sangseo project areas distributed nursery boxes to individual farmers.

Transplanter and Binder

The management type of rice transplanter and binder in the surveyed CFMPP areas was mostly taken the direct management based on custom work. Operators of the machinery were hired for the working period and then short term trainning and practice was made for the machinery operations. In case of the

RTHMPP areas, the typical management type was also the direct management. By the way, Nammyon, Gyongsan and Milyang pilot areas have adopted farmer's group working types. In the Juduck project area, the machinery were rented to an individual farmer for his performance of contract works.

Tractor and Combine

For the successful operation of tractor and combine, which are riding type and large size machineries, adequate trainning and expertness are required and much repair costs are also needed when a stumbling block happened. On account of the above reasons, the management pattern in all of the surveyed areas have undertaken the direct management in carring out the contract works with employments of specialized operators.

Other Machinery

The comprehensive farm mechanization pilot project areas owned power tillers to lend to the farmers and to carry out supplemental scrap works done by tractors. Except in Cholwon pilot project area, many farmers in the project areas owned power tillers for their land preparation. Some farmers without

power tiller rented it from the project organizations to carry out the contract works of land plowing and preparation. In this case, the management authority has indicated a special area to work by the lease farmers of power tiller when the tractor couldn't cover land plowing and preparation works during labour peak time. Sprayers owned by the CFMPP areas were used to manage the seedling bed and it leased to the village joint pest and insect control team during the growing period of seedlings in main paddy fields.

Selection of Machinery Working Area

Collectivization of land is a desirable for to exhibit the efficiency of machinery works. Actually it seems to be difficult to collectivize paddy land in the pilot project area because of the land distribution and contract works of individual farmers.

In case of the four CFMPP areas and Sangseo, Nammyon, Gyongsan and Milyang, the areas to be mechanized are collectivized comparatively because the project area is located at the large plain area. Work volume per machine per day is also required collectivized at one place. Of the four RTHMPP areas, Sangseo area was the special place where the individual growing

seedlings was prevailed comparing with the other three areas where the joint works by farmers were implemented. Bongsan project area, where the semi-forcing culture of tomato was prevailed, had the difficulty in carrying out the seed bed control and rice transplanting due to labour competition with the tomato harvesting works.

Baekam project area had some troublesome to carry out the mechanized works in the field without land consolidation and, moreover, the area located in the vally of the mountains.

(Table II-7)

Operating Types of Major Farm Machineries in Sample Farm Mechanization Pilot Projects, 1979

Areas	Grouping Degree of Working Area	Machinery Operation Types by Machinery[2]			
		Direct Management	Joint Commitment	Management Commitment	Rent to Individual Farmers
CFMPP Areas					
Cheolwon	Grouped (3)[1]	● △ □			
Giho	" (1)	◐ △ □			
Dongjin	" (1)	○ △ □			
Dalsung	" (1)	● ▲ □	● ▲		
RTHMPP Areas					
Baekam	Scattered	○ △ □			
Jinjam	"	○ △ □			
Bongsan	"	○ △ □			
Sangseo	Grouped	△ □			○
Namyeon	"		△ □		
Gyongsan	"		△ □		
Milyang	"		◇ □		
Juduk	Scattered			○ △	

1/ The numbers of grouped working areas are in the parenthesis.

2/ ○ ; Seedling
△ ; Transplanter & Binder
□ ; Tractor & Combine
Black symbols indicates that a part of the working area has been worked by the type indicated.

III. FARM MACHINERY USE AND EXPENDITURES

1. Situation of Farm Machinery Use

Tractor

In 1979, the average utilization acreage of rice paddy per tractor in the surveyed areas is represented 27.8 ha for land preparation and 26.6 ha for plowing. Tractor utilization for land preparation showed a little bit higher than plowing, on account of the better working efficiency in power transplanting works than power tiller and draft animal works. According to the agricultural Engineering Research Institute of ORD, tractor working abilities for plowing and land preparation were reported 72 ha and 48 ha respectively. Based on the above working abilities, the rates of tractor utilization revealed 37% for plowing and 66% for land preparation.

Considering the above facts, the counter measures to increase the rate of tractor utilization should be reviewed to reduce the fixed costs of tractors.

(Table III-1)

The Size of Farm Tractor Use in the Surveyed Areas, 1979

Areas	Number of Tractor Held	Number of Tractors Worked	Working Area per Tractor	
			Plowing	Land Preparation
CFMPP Areas	.....(in each)		..... (ha)	
Cheolwon	22	22	32	32
Giho	10	10	10.7	15.3
Dongjin	8	4 1/	28.5	32.5
Dalsung	12	12	6.3	19.2
RTHMPP Areas				
Baekam	1	1	31	19
Bongsan	1	1	21.3	21.3
Total/Average	54	50	26.6	27.8

Note : 1/ Four tractors were introduced after working season.

The rates of the tractor utilization areas to the total project areas are as shown below.

Plowing works

Dal sung: 8.4%

Giho : 30%

Dongjin : 70%

Land Preparation works

Giho : 50%

Other areas: more than 70%

Dongjin pilot project area could not utilize 4 tractors out of the total tractors for the works of plowing and land Preparation in the spring time, and Dalsung pilot project area utilized 4 tractors, only for the works of land Preparation because of the late arrival of the imported tractors.

Transplanter

In general an average utilized area per rice transplanter in the CFMPP areas was about 10.7 ha or 50% of the working ability of 21.6 ha. Considering the above utilization rate,

(Table III-2)

The Size of Rice Transplanter Use in the Surveyed Areas, 1979.

Areas	Number of Rice Trans-planters	Number of Rice Transplanters Worked	Working Area	
			Total Area	Area per Rice Transplanter
CFMPP Areas	..... (in each)		..... (ha)	
Cheolwon	26	26	300	11.5
Giho	13	13	141.2	10.9
Dongjin	19	19	237.5	12.5
Dalsung	10	10	53	5.3
RTHMPP Areas				
Baekam	2	2	22	11.0
Jinjam	3	3	40.6	11.3
Bongsan	1	1	21.3	21.3
Sangsoe	5	4	44.6	11.2
Namyeon	2	2	28.7	14.4
Gyongsan	1	1	5.4	5.4
Milyang	1	1	5.8	5.8
Juduck	4	3	27.5	9.2
Total/Average	87	85	927.6	10.9

it can be said that the margin of transplanter utilization is big enough to raise the utilization rate. The rate of mechanical transplanting area to the total project area were 80% in Dong Jin, the highest one and 10.7% in Dalsung pilot area. On the other hand, an average utilized area of the transplanter in the RTHMPP areas was shown 11.5 ha which was generally bigger than that of the CFMPP areas. Gyongsan accomplished only 6.0 ha but Bongsan area achieved 21.3 ha of mechanical transplanting which was considered the highest work level comparing with the working ability of rice transplanter.

Sangseo project area could not used the drilling type transplanter on account of the soil type of clay loam in the paddy field. In case of Juduck pilot project area, the transplanter with two lines could not be used because of farmers discommitment of works.

Binder and Combine

An average utilized area per binder in the project areas, in 1978, was surveyed as 6.2 ha in the CFMPP area and 5.0 ha in the RTHMPP areas where the rate of utilized area was estimated at 46 and 37% of the area of working ability respectively. If we review the above facts in detail by project

areas, Dalsung area carried out 9.2 ha and Giho area achieved only 3 ha due to farmers preference on combine rather than binder. In case of the Juduck project area, the binder couldn't be used on account of the high price of rope and the severe flattering of paddy.

An average utilized area per combine in the both project area marked very high level as showing 12.0 ha for the CFMPP areas and 10.8 ha for the RTHMPP areas considering the combine working ability of 10.8 ha.

In detail Giho FLIA marked 13.7 ha per combine, the highest one among the CFMPP areas. On the contray, Dalsung area with the highest rate of binder utilization showed 6.0 ha per combine, the lowest rate of combine utilization among the pilot project areas.

(Table III-3)

The Size of Binder and Combine Use in the Surveyed Areas, 1978

	CFMPP Areas				Average of Surveyed RTHMPP Areas
	Cheolwon	Giho	Dongjin	Dalsung	
Binder					
Number of Binder held (in each)	-	5	1	5	9
Number of Binder Worked (in each)	-	5	1	5	18
Total Working Area (ha)	-	15	7.2	46	39.6
Working Area per Binder (ha)	-	3	7.2	9.2	5.0
Combine					
Number of Combine Held (in each)	12	3	5	2	2
Number of Combine Worked (in each)	12	3	5	2	2
Total Working Area (ha)	156	41	55.1	12	21.6
Working Area per Combine (ha)	13.0	13.7	11.0	6.0	10.8

2. Factors Affecting on Machinery Use

The rate of machinery utilization in the project areas is basically determined by the demand for machinery works of farmers, and decision makings of the management authority.

As mentioned already, the sizes of the project areas have been expanded since the pilot projects commencements in 1977. Likewise, it is expected that the diffusion of mechanization technology, farmers demand for machinery works and management techniques of the project authorities have been developed rapidly as the years of project management passed.

Table III-4 shows changes in the rates of transplanter utilization in the surveyed areas. The average worked area per transplanter in the CFMPP areas increased by 16.1%, from 9.3 ha in 1978 to 10.8 ha in 1979. In case of the RTHMPP areas, the rates increased outstandingly from 8.2 ha in 1978 to 11.5 ha in 1979.

(Table III-4)

Changes in Average Transplanting Area per Rice Transplanter, 1978-1979

	Worked Area per Transplanter	
	1978	1979
CFMPP Areas	..... (ha)	
Cheolwon	11.5	11.5
Giho	8.3	10.9
Dongjin	12.3	12.5
Dalsung	3.3	5.3
Average of Surveyed RTHMPP Areas	8.2	11.5
Total Average	8.9	10.9

The increased rates of the machinery utilization were reflected the compound factors including the increase of farmers demand for machinery utilization. The factors to determine farmers demand are consisted of the degree of labour savings size of the non-farm incomes and the opportunity of income generation by changing farm management organization. Besides, the degree of farmers recognition on the new mechanization technology will affect the demand of machinery utilization.

Growing seedlings for transplanter use requirs much more costs than the conventional method. Accordingly, cash expenditures for the committed works are considered comparatively high. In case of the direct management of growing seedlings, the contract farmers were hired preferentially in the course of growing seedling works. The operators of transplanters and binders were selected out of the farmers who participated in the pilot projects and their income decrease incurred by contract works was compensated by cash wage.

The Bongsan area where the semi-forcing culture of tomatoes was prevailed achieved the highest record of 21 ha per transplanter mainly because of labour competetion between tomato culture and rice transplanting.

Compulsory cultivation of the high yielding varieties of rice in the project areas decided by the management authorities has brought the results of shortening the transplanting period of rice. For this reason Gyongsan project area with 10 ha of the collectivized land, with one transplanter, one binder covered only 5 ha, 50% of the project area, for power transplanting work.

On the other hand, Dalsung and Giho project area had utilized the tractors for the land consolidation and on-farm

development and for plowing pasture lands in the neighbourhood of the project areas.

Machinery working efficiency has affected to the rate of machinery utilization directly or indirectly. The factors affecting on the working efficiency per hour are such as the operation techniques, plots size and soil conditions of the working areas.

In case of the transplanter operation, the operators trained recently worked out less than 1 ha per 8 hour working day during first 1-3 days. After 3-4 days passed, the operators become skillful to work more than 1.3 ha. The area without land consolidation has the different working efficiency according to the shape and size of the plots. In case of Jinjam project area, transplanter working efficiency decreased by 20-30% in the non-cosolidated land, however.
In order to carry out the planned areas, daily working hours had been expanded. In Baekam area where the tractors were available, plowing and land preparation works by tractor could not be carried out to the extend of farmers demand on account of the non-consolidated land conditions and poor access roads.

According to the soil textures of the paddy field, the rate of working efficiency was different and the utilization

of machinery was not allowed in some cases. One of the reason of low rate of combine utilization in Dalsung area, 6 ha per combine, was the land condition of bad drainage. In Sangseo area the drill type transplanter could not be used due to the clay soil and bad drainage conditions.

Working costs is varied with the degree of land distribution condition. Such kind of wasteful expenditures were generated usually from failures in adjustment of working schedule. But almost of the surveyed areas with exceptions could make daily work area grouped.

3. Rates and Costs of Machinery Custom Services

The rates and costs of machinery custom services is considered the most important economic variable for the performance of pilot project, because custom rates are the cash expenditures for farmers and incomes for the management authorities.

The Levels of Rates of Machinery Custom Services

The rates of tractor custom work per ha in the surveyed areas are shown in Table III-5. Apart from the other project

area, Cholwon CFMPP area imposed 33,000 won in daily bases. In case of the other project areas, the rates of plowing work ranged from 15,000 won for Baeckam to 41,300 won for Dongjin project areas. The rates of land preparation work ranged from 20,000 won/ha for Dongjin to 36,000 won/ha for Dalsung project area.

Comparing the plowing rates with land preparation rates in each pilot project areas, Giho area had the same rates and the rates of land preparation works in Dalsung and Baeckam areas were 1.2 and 2 times higher than the rates of plowing works in the same areas. On the other hand, the custom rates of the land preparation works in Dongjin pilot project area was equivalent to half of the custom rates for plowing, because of the relative custom rates of draft animal works in the vicinity of the project areas.

In Bongsan project area, tractor custom work was done only for the project area with free of charges.

The custom rates applied for the seedling and transplanting works in the RTHMPP areas were 1.5 times higher in average than that of the comprehensive farm mechanization pilot project areas in 1979. Among the comprehensive farm mechanization pilot

(Table III-5)

Rates of Tractor Works in the Surveyed Areas, 1979

Areas	Rates per Ha	
	Plowing	Land Preparation
CFMPP Areas	..... 1,000 won	
Cheolwon	(33.0)1/	(33.0)1/
Giho	22.5	22.5
Dongjin	41.3	20.0
Dalsung	30.0	36.0
RTHMPP Areas		
Baekam	15.0	30.0
Bongsan	0	0

Note: 1/ Daily Rates.

project areas, Cholwon imposed 93,000 won per ha, the lowest custom charges for the rice transplanting, and Dalsung area imposed 150,000 won/ha, the highest one. The other project areas like the Dongjin pilot project imposed 100,000 won/ha. The custom rates of the transplanting and seedling works in the RTHMPP areas ranged from 211,500 won in Baeckam to 138,700 won in Bongsan.

(Table III-6)

Rates of Custom Rice Seedling and Transplanting in the Surveyed Areas, 1979

	Rates per Ha Seedling + Transplanting	Transplanting Only
CFMPP Areas	..... 1,000 won	
Cheolwon	93.0	42.0
Giho	104.0	-
Dongjin	100.0	-
Dalsung	150.0	-
RTHMPP Areas		
Baekam	211.5	-
Jinjam	165.0	-
Bongsan	138.7	-
Sangsu	-	54.0
Namyeon	N/A[1/]	-
Gyongsan	N/A[1/]	-
Milyang	N/A[1/]	-
Juduck	177.0	-

Note: 1/ Not decided as of Aug., 1979

The Cholwon and Sangseo areas, where the seedling work was committed to the individual farmers, applied 42,000 won and 54,000 won per ha of transplanting acreage respectively.

The custom rates for binder works including cutting and binding were varied from 54,000 won/ha in Baeckam, to 30,000 won/ha in Giho and 39,000 won/ha in Dalsung area. The custom charges for the combine works comprising cutting and threshing were revealed as 105,000 won/ha in Dalsung, 99,100 won in Songsan and 60,000 won/ha through 70,000 won/ha in the other project areas.

The difference in custom rates between binder and tractor was equibalent to 30,000 won/ha in Giho and 39,000 won/ha in Dongjin area, which amount is represented for the threshing work.

The farmers responses to the levels of the custom rates appeared to be very satisfactory. As indicated in table III-8, the number of farmers who agreed with the question that the rate rate was cheap, suitable and pertinent were estimated at 70% of the total farmers surveyed. Of course, the evaluation of the farmers reaction to the level of the custom charges are considered different each other with the gaps of farmers

(Table III-7)

Rates of Custom Rice Harvesting in the Surveyed Areas, 1978

Areas	Rates per Ha	
	Binder 1/	Combine 2/
CFMPP Areas	..... 1,000 won	
Cheolwon	-	72.0
Giho	30.0	60.0
Dongjin	30.0	69.0
Dalsung	39.0	105.0
RTHMPP Areas		
Baekam	54.0	-
Jinjam	31.8	-
Bongsan	-	99.1
Sangseo	37.5	-
Juduck	-	64.5

Note: 1/ Rice cutting and binding.

2/ Rice cutting and threshing.

understanding, the farm management & cash expenditure structures, the income structures and the other socioeconomic factors.

(Table III-8)

Farmers' Response to the Rates of Rice Seedling and Transplanting

	Number of Farms' Responded (Household)	Percentage (%)
Much Expensive	47	23.7
Expensive	31	15.3
Suitable	48	24.3
Cheap	66	32.8
Not Answered	8	4.0
Total	200	100.0

Determination of custom rates and methods of fee collections

The rates were determined finally through discussion with the representatives from Gun administration offices, Gun rural guidance offices and farmers. And the bases of custom rates were mainly from estimated or expended total expenditures.

When they determine custom charges before work season, how to estimate the wage rate and unit prices of input materials correctly are problems. Actually, the most project areas, especially the rice transplanting and harvesting mechanization pilot project areas, did not include items in estimating rates such as the personel costs for management, depreciation for replacement of the facilities and other business management costs and the amount of subsidy for the machinery procurement. When they determine custom charges on the base of pre-estimation of costs, the deficit of cash balance would be happened on account of the big difference between the actual expenditures. But pre-determination of the custom rates makes farmers easy in planning farm management.

The conventional custom charges acted as a criteria to determine the custom rates in all project areas. In cases of

the Songseo area, the determination of the costom rates was based on the estimated conventional rates before the work season.

Most of the project areas collected the custom charge after completion of the works within a certain period. Exceptionally, project Cheolwon and Bongsan collected the custom charges before commencement of the project.

Dongjin area collected the custom charges after harvest of rice. Accordingly, farmers had a good impression on the method. But the method has problems of procurement of the shorterm operational cost. Dongjin FLIA borrowed money, however, from the unit agricultural coopertive to cover the shorterm operating costs and then repaid interest and principal after rice harvest.

Working costs of farm machinery

The working costs of farm machinery are consisted of the fixed costs such as machinery, and ancillary facility costs, maintenance costs, personnel salary and interest on capital investment, and the variable costs such as wages for hired labour and operators, repair cost, fuel and oil, electricity and materials.

The average costs required for the farm mechanization works are presented in table III-9. The cost for managers' salary were excluded on account of the difficulties in allocating the costs. Interests on the capital investment for the facilities and equipment were also excluded, for the investment was made by the government subsidy. When the project is operated for the purpose of profit making, the capital costs should be included in the working costs.

The depreciation costs of tractor was allocated to plowing and land preparation works by 40% each. The depreciation costs of transplanter includes the cost of seedling boxes. The cost of ancillary facilities per transplanter was the largest because of inclusion of building for growing seedlings.

The operating cost of plowing per ha of tractor working acreage including wages, fuel and oil, materials and repair & maintenance costs was estimated at 13.2 thousand won and the total management costs measured as the operating costs plus depreciation of facilities and tractor showed 25.3 thousand won in average. The level of the management cost were 60-160% of the average costom charges.

The operating cost of land preparation works by tractor was amounted to 11.7 thousand won per ha which cost was a

little bit less than the cost for plowing works. The management costs were equivbalent to about 33-60% of the average custom rates surveyed in the project areas. Accordingly, the collection of management costs was possible. The average management cost per ha varied from 67% to 120% of the custom rates.

The average operating cost of transplanting per ha was estimated at 100.5 thousand won reflecting labour and material intensive works of growing seedlings. The level of the costs was appeared 57-108% of the custom rates surveyed in the project areas. The management cost including the depreciation costs of machines and facilities was estimated at 154.2 thousand won which was mostly higher than custom rates of the project areas except 3 RTHMPP areas.

The average operating cost of binder per ha was 32.6 thousand won which was similar to the levels of the custom rate. If the depreciation costs be included, the management cost will be high. In case of combines, the average operating cost was 49.3 thousand won which was occupied 47-82% of the custom rates and the total management cost was amounted to 93.5 thousand won. The area with lower management cost than

(Table III-9)

Average Costs of Operating Major Machineries in the Surveyed Areas

	Tractor		Rice Transplanter	Binder	Combine
	Flowing	Land Preparation	Seedling+ Transplanting	Cutting & Binding	Cutting & Threshing
Average Working Area per Machine (ha)	26.6	27.8	10.9	5.7	11.9
Fixed Costs	..... (1,000 won)				
Machinery Depreciation	308.3	330.3	547.1	81.3	492.7
Facilities Depreciation	13.4	13.4	38.9	10.5	33.3
Maintenance Costs	154.5	161.8	30.0	36.1	273.8
Subtotal	476.2	505.5	616.0	127.9	799.8
Operating Costs per Ha	.....(1,000 won)				
Wates	3.9	3.4	61.9	12.7	17.7
Oil and Electricity	3.5	2.5	6.9	4.6	8.6
Other Meterials	-	-	29.0	9.0	-
Maintenance and Repair	5.8	5.8	2.7	6.3	23.3
Subtotal	13.2	11.7	100.5	32.6	49.3
Depreciation of Machinery & Facilities	12.1	12.4	53.7	16.1	24.2
Grand total	25.3	24.1	154.2	48.7	73.5

the custom charges were only two out of the 6 combine using areas.

IV. ANALYSIS OF PROJECT EFFECTS

To analyze the project investment efficiency, the expected effects and costs should be classified apparently, and then the classified effects and costs should be quantified and be valued with socio-economic prices.

In this survey, the expected effects of the farm mechanization pilot projects include the labour saving of the project farmers, increase of land and labour productivities, comprehensive changes of farm management structure such as cropping system and income structures, and the diffusion of mechanization technologies as a derived effect. On account of the short-term experience of the projects, it is almost impossible with the restricted sample surveys to estimate the effect of technology diffusion and changes in the farm management structure by the restricted sample surveys.

There are many conceptual difficulties in selecting prices to evaluate the actual benefits and costs. The detail discussion on such kind of difficulties will be given in the next contexts. Accordingly, this analysis covered the labours and cost saving effects generated from the machinery utilization by the project farmers. The other effects were simply described

according to the results of surveys in the project area. Finally, the analysis of project investment efficiency was based on the collected data from the surveyed project areas.

1. Labour Saving and Changes in Farm Housedhold Management

The mechanized works for rice cultivation in the pilot farm mechanization project areas promoted the labour efficiency by saving labour input and diverting saved labour forces to other sectors. Accordingly, the various changes in farm management were happened in the project areas.

At first, lets identify the number of labourers saved by substituting the conventional works with tractor use. Tractor can carry out various farm works by connecting attachments. The most important tractor works are plowing, land preparation, and transportation of farm inputs and products. The number of saved labourers per ha. of tractor work were 7.1 Man-days for plowing, 4.2 man-days for land preparation, 5.7 man-days for transportation works.

The total number of saved labour forces per one tractor were estimated at 396 man-days, for the 3 kinds of works mentioned in the above.

Rice transplanter saves 192 man-days per ha of transplanting work, with manpower. If we consider the labour intensive work for growing seedlings in the boxes which requires 3.5 man-days per ha more than the conventional methods, net saved labour forces for power transplanting is equivalent to 15.7 man-days per ha or about 171 man-days per transplanter.

Binder saved 18 man-days per ha or 104 man-days per binder in cutting rice comparing with the works by manpower with sickles. Combine with 11.9 ha of average worked acreage for cutting and threshing could saved 30.7 man-days per ha or 365 man-days per machine.

In case of rice drying works, the dryer could save only 6.2 man-day per ha. or 23.6 man days per machine because of the additional labour requirement for transportation and packing and low operation rate with the fovourable weather conditions to dry paddies last year.

To compare the labour savings in the farm mechanization pilot project areas, labour savings per one million on basis were estimated as shown in the table IV-2. Labour savings per one million won in the comprehensive farm mechanization pilot project areas were estimated at 31.4 man-days in average and

(Table IV-1)

Labor Savings in Major Rice Cropping Works through Farm Mechanization, Average of the Surveyed Areas

Machinery Used	Types of work	Average Working Area per Machine	Saved Labor per ha.	Total Saved Labor per Machine
		(ha)	(person/ha)	(person)
Tractor	Plowing	26.6	7.1	188.9
	Land Preparation	27.8	4.2	116.8
	Transportation	15.8	5.7	90.1
	Total		17.0	395.8
Transplanter	Seedling	-	-3.5	-38.2
	Transplanting	10.9	19.2	209.3
	Total	10.9	15.7	171.1
Binder	Cutting & Binding	5.7	18.2	103.7
Combine	Cutting & Threshing	11.9	30.7	365.3
Grain Dryer	Drying	3.8	6.2	23.6

the ranges of labour savings were from 20 man-days to 40 man-days. On the other hand, the labour savings per million won investment in RTHMPP areas were 55.1 man-days in average and ranged from 19 mandays to 60 man-days.

The labour savings in the CFMPP areas were less not so big compared with the heavy investment, because CFMPPs have managed machineries in conjunction with the exhibition of machinery works and technical training. But the labour forces saved in the rice transplanting and harvesting mechanization pilot project areas were appeared very large because of full-utilization of machineries for the rice transplanting and harvesting works. The large differences in labour savings among the RTHMPP areas were due to the variation of machinery holdings and the working levels.

Likewise, we can save a lot of labour forces by means of mechanization of rice farming. The saved labour can be used for other works, or for rice culture to increase labour quality and paddy areas per farm household.
In addition to these, the saved labour forces can be allocated for cultivation of upland cash crops, and also be employed in non-farm sectors.

(Table IV-2)

Labor Savings per One Million Won Investment on Machineries and Facilities, Average of the Surveyed CFMPP Areas.

Areas	Total Saved (A)	Amounts of Total Investment (B)	Saved Labor per One Million Won Investment (A/B)
	(Person)	(Million Won)	(Person)
Cheolwon	21,008	531.2	39.6
Giho	6,449	294.2	21.9
Dongjin	9,222	259.2	35.6
Dalsung	4,486	225.0	19.9
Average	10,291	327.4	31.4

(Table IV-3)

Labor Savings per One Million Won Investment on Machineries, Average of Surveyed RTHMPP Areas

Areas	Total Saved Labor (A)	Amounts of Investment (B)	Saved Labor per One Million Won Investment (A/B)
	(Person)	(Million Won)	(Person)
Baekam	1,066	17.2	62.0
Jinjam	722	11.3	63.8
Bongsan	908	16.9	53.8
Sangsec	818	16.2	50.6
Namyeon	389	6.7	58.3
Gyongsan	109	3.0	36.2
Milyang	37	2.0	19.0
Juduck	820	15.3	53.7
Average	609	11.1	55.1

Although the survey result did not reveal any clear case of conversion of saved labour to other sectors, 38% of the surveyed farm families in the pilot project areas expressed their hope of expansion of rice cropping acreage. Introduction of rice transplanters have become the constraints to barley cropping in the paddy field by advancing of rice transplaning season but some farmers were able to convert their saved labour forces to vynil house horticulture. Female labour forces were additionally employed for growing of seedling for mechanical transplanting. They would be idled otherwise.

The introduction of tractors have decreased the number of draft animals, while it increased beef cattles feeding or poultry & hog raising farms.

The farmers who committed their farm works to the mechanization authority demanded the employment opportunities. Accordingly, most of the farmers of the project areas participated in implementing project works. Some farmers were employed in the namufacturing industries located in the neighbourhood of the pilot project areas, or concentrated on the management of commercial shops.

But employment opportunity of the unskilled farm labours was generally restricted and scarce in the surveyed areas.

Therefore, the most important problem in farm mechanization can be said the efficient utilization of the saved labour forces. If the saved labour forces were idle or not to be economically employed, the farm mechanization would not be meaningful.

2. Production Cost Savings.

The cost saved by the mechanization are usually larger than the increased costs. The cost saving effects are appeared differently from the viewpoint of socio-economic aspects and farmers aspects.

The cost saving by farm mechanization is the difference between the farm mechanization costs and conventional working costs. It can be generated from the changes of physical inputs such as labour and materials.

The increasing costs by the machinization are consisted of such as the fuel and oil costs, repair costs, deprecations and management costs. On the other hand, the decreasing costs

are such as the costs of animal power and wages of saved labor. Accordingly the saved costs are the difference between the evaluated amount of the labour forces saved and the increased costs by mechanization. Therefore the cost saving changes according to the relative changes of wages and machinery prices.

To estimate the cost savings, the conventional working costs should be surveyed. The conventional costs surveyed in the project areas were 120.2 thousand won per ha for plowing-land preparation-transportation works, 186.8 thousand won per ha for the seedling-transplanting works, 185.6 thousand won for-cutting-threshing-drying works, and 105.3 thousand won for cutting work(Table IV-4).

Here the conventional costs contained selfserviced costs. In this study, it was evaluated by the purchased prices of farmers for convenience. According to the estimates, the self serviced costs per ha were equivalent to 120.8 thousand won for cutting-threshing and drying works, 116.2 thousand won for seedling-transplanting work.

Average farm mechanization costs by machinery in the project area are also shown in Table IV-4. The items included in this cost calculation was discussed in Chapter III.

Average mechanization cost in the surveyed areas for seedling-transplanting work was estimated at 154.3 thousand won per ha, combine work plus drying at 131.7 thousand won per/ha. The cost for plowing-land preparation-transportation by tractor was 71.2 thousand won per ha and the cost for cutting by means of binder was 48.7 thousand won per ha.

By using the conventional costs, custom rates, and machinery working costs discussed already, we are going to review the cost saving effects of the farm mechanization projects. Here the estimation of the cost savings are included the evaluation process of the physical inputs and labour forces saved. The costs saving accrued from the hired labours and purchased materials are thought as an effects of pure cost savings but savings of family labour and self-serviced materials would not be considered as cost savings if the saved resources were not employed in the other production activitics. On the other hand, the effects of cost saving will be increased when the saved labourers are employed in other sectors. Accordingly, it is desirable to grasp and survey the present status of the labour utilization and employment correctly. Unfortunately, this report could not cover the above facts on account of 2

(Table IV-4)

Cost Savings per ha of Working Area by Rice Cropping Mechanization, Average of the Surveyed Areas

	Tractor	Rice Transplanter	Binder	Combine Dryer
Type of Work	Plowing+ Land Preparation+ Transportation	Seedling+ Transplanting	Cutting+ Binding	Harvesting+ Drying
Working Area per Machine(ha)	27.3	10.9	5.7	11.9
Working Costs per ha	---------- (1,000 Won) ----------			
Conventional Works(A)	120.2	186.8	105.3	185.6
Self Supply	87.0	116.2	78.5	120.8
Cash Expense	33.2	70.6	26.8	64.8
Machinery Works(B)	71.2	154.3	48.7	131.7
Depreciations	34.3	53.8	16.1	74.7
Operating Costs	36.9	100.5	32.6	57.0
Rates of Machinery Custom Works(C)	69.0	125.1	38.1	84.9
Cost Savings				
Social Level (A-B)	49.0	32.5	56.6	53.9
Farm Level (A-C)	51.2	61.7	67.2	100.7
Surplus of Operating Organization (C-B)	-2.3	-29.2	-10.6	-46.8

years of shortterm experiences of the pilot projects.

Therefore, this study included the saved costs from family labour and self-services as benefits of effects of the farms mechanization for convenience. In the future, the in-depth studies on this fields should be made for the comprehensive and correct evaluation of the farm machinization projects.

At first, the saved costs derieved from the difference between the conventional working costs and the machinary working costs could be dealt with the social or national benefits. The social benefits were estimated at 56.6 thousand won per ha for cutting work by binder and the cost savings from the combine and dryer's works were equivalent to 53.9 thousand won per ha. The saving costs from tractor's works such as plowing, land preparation and transportation were amounted to 49.0 thousand won and 32.5 thousand won saved from the works, of growing seeldings and transplant by transplanter.

The cost savings from the farmer's point of view was measured by the difference between the conventional working costs and the custom rate of the machinery works. Farmers' cost savings by mechanization were estimated at 100.7 thousand won/ha from the combine-dryer's works and 67.2 thousand won/ha

from cutting works by binder, although this figure were not considered the negative benefits generated from grain flattering. The benefits got from the seedling and transplanting works were equivalent to 61.7 thousand won per ha, and the costs saved from the tractor's works such as plowing, land preparation, and transportation were comparatively small amount of 51.3 thousand won/ha.

The conventional working costs of the farm households are consisted of the self-serviced costs and the cash expenditures. But the expenditures for the custom rates of the machinary works are all the cash expenditures. From the aspects mentioned above, the increase in farmer's cash expenditures for the seedling and transplanting works was equivalent to 54.5 thousand won per ha, and for tractor, 35.7 thousand won/ha. The increase cash expenditures for the conbine plus dryer was 20.1 thousand won/ha and for binder work, 11.2 thousand won/ha.

If the saved labour forces are not employed in other income sources, the farmers economic conditions will be worsen because of the increased cash expenditures for farm mechanization. Accordingly, the employment opportunities for the saved labourers should be provided to cover the increased cash

expenditures. The large farmers' portion of cash expenditures is relatively higher than that of the peasant farmers. Therefore, the peasant farmers were easily unfavourable than large farmers in farm mechanization.

The pilot farm mechanization projects were managed by FLIA, agricultural cooperatives farmers group under the non-profit making purposes. But the average management agency was encountered the unaboidable negative cash balance. The receipts collected from the project farmers could cover the mechanical working costs but not the depreciation costs for farm machinery and ancillary facilities.

The dificits from machinery managements are as follows:

- Combine and dryer: 46.8 thousand won
- Transplanter (Seedling and Transplanting): 29.2 "
- Binder: 10.6 "
- Fractor(plowing, land preparation and Transportation) 2.3 "

3. Economic Evaluation of Project

For the analysis of project investment effects, the project costs such as investment and O & M costs, and expected

benefits should be identified correctly for the entire project period. Further more, the benefits and costs by the farm mechanization will be different among project management agencies and farmers.

The government subsidies for procurement of the machinery would not be costed from the view point of the management agencies such as FLIA and agricultural cooperative and the benefits of the agencies would be the custom rates collected from the project farmers. From the socio-economic aspects, the government subsidy should be costed and the project benefits should be also evaluated in the socio-economic aspects.

To analyze the internal rate of return of the farm mechanization project, the evaluation units such as all the pilot project area base, machinery base, individual project base should be determined in advance.

However, this report used the surveyed data and the internal rates of return were calculated on the basis of standardized CFMPP and RTHMPP separately. The resons to be based on the CFMPP and RTHMPP in estimating IRR were that the management pattern of the individual project areas not yet fixed and that the IRRS in each project areas would be varied. There was also

difficulties in allocating the joint-costs to the different machinery.

The number of machinery and capital investment for the machinery and facilities in the proposed standardzed CFMPP area and RTNMPP area are preseuted in tables IV-5 and IV-6. The project operation and maintenance costs are presented in table IV-7.

The most representative holdings of farm machinery was used and the capital investment costs were based on the 1979 prices. The total investment costs in the CFMPP area were amounted to 335 million won, of which 75% equivalent to 250 million won was allocated to the machinery procurement. In case of the RTHMPP area, the total amount of investment was 18 million won and the investment costs for facilities was not allocated, since existing buildings were used for machinery storage. Accordingly, the costs for the existing building were included in the project operation and maintenance costs. The operation and maintenance costs also include the management personnel expenditures and repair costs for the machinery.

The total amount of the O & M costs of the standardized CFMPP were equivalent to 14,899 thousand won, of which 32.2%

or 4,800 thousand won was management personnel costs. The personnel costs were estimated considering the salaries of a fulltime employee for a year, a permanant staff of the management agencies and cf 3 persons for 4 months.

In case of the RTHMPP area, the total O & M cost per year was estimated at 1,596 thousand won, of which personnel costs, repair costs and storage costs were amounted to 800 thousand won, 576 thousand won and 220 thousand won respectively. Here the personnel costs were based on one person for 4 months.

To estimate the project benefits, the following items: were surveyed in the areas:

- Working area by works and mechaniery.
- the saved resources such as labour, draft animal and materials
- the secondary benefits from the saved resources which can be utilized to increase the cropping intensity and new farming activities and to extend the non-farm activities etc.
- the benefits from raising beef cattle and other livestock by substituting the draft animal.

(Table IV-5)

Holdings of and Investment on Equipments in the Standardized CFMPP Areas

Equipments	Size	Unit Price	Total Amounts
	(each)	----- (1,000 Won) ---	
Machineries			
Tractor	8	8,389	67,112
Rice Transplanter	19	2,800	53,200
Combine	16	5,475	87,600
Grain Dryer	5	2,800	42,000
Sub-Total			249,912
Facilities	(Pyeong)[1/]		
Machinery Storage	100		18,471
Repair Shop	125		26,900
Grain Dryers	150		20,025
Rice Seedling	200		19,367
Sub-Total			84,763
Grand-Total			334,675

1/ One Pyeong equals to about 3.3 square meters.

Table IV-6. Holdings of and Investment on Machineries in the Standardized RTHMPP Area

	Number of Holdings	Unit Prices	Total Amounts
	(each)	----- (1,000) -------	
Rice Transplanter	3	2,800	8,400
Binder	2	723	1,446
Combine	1	5,475	5,475
Grain Dryer	1	2,800	3,800
Total	11	-	18,121

Table IV-7. Yearly Management Cost in the Standardized Project Areas

	Standardized CFMPP Area	Standardized RTHMPP Area
	---------- (1,000 Won) ----------	
Salary	4,800	800
Machinery Maintenance Costs	10,099	576
Machinery Storage Expenses	-	220
Total	14,899	1,596

Unfortunately, the indirect benefits derived from the diffusion of mechanical technology were not surveyed on account of measurement difficulties.

The various survey was tried to evaluate the benefits from the saved resources but the good results could not be gotten in the project areas. Recently, the situation of farm management have changed in accordance with the changes of agricultural status, which was not solely attributable to the labour savings. The more difficult problem in survey was the measurment of project effects for wage earning groups.

For the above reasons, the evaluation of the saved resources was based on the regional prices such as wages, rental charge of draft animal and market prices of materials. The benefits and costs evaluated on the basis of the regional prices are as shown in the tables IV-8 and IV-9.

Based on the estimated benefits and costs, the internal rates of returns for the CFMPP area and the RTHMPP area were estimated. For the calculations, the project period was set up as 10 years considering economic lifes of tractor and combine with the largest life among the machineries terminated their economic life during the project life would be replaced by new capital investment.

It is needless to say that the higher B/C ratio means the better project to be implemented. In case of B/C ratio calculation, a certain interest rate that is opportunity cost of capital should be determined to discount the expected benefits and costs. From the cash flow point of view, the project with higher benefits in the earlier years is considered more justifiable and economical than the project with the benefits generated slowly throughout the project life.

The B/C ratios of the CFMPP area are showed 1.30 at 5%, 1.09 at 10% and 0.94 at 15% of discount rates. In case of the RTHMPP area, the B/C ratios were estimated at 1.25 at 5%, 1.03 at 15% and 0.94 at 20% of discount rate. Accordingly, the CFMPP area is more favourable under the low rate of discount because the project had higher benefits and higher investment costs in early stage of the project than the RTHMPP area. On the other hand, the RTHMPP area is more profitable under the high rate of discont because the area has the reciprocal conditions of the CFMPP area. Consequently, when the interest rate of capital is low, the promotion of the CFMPP area is more desirable vice versa.

The effects of the farm mechanization projects are different with the relative increase of wages and machinery prices.

(Table IV-8) Yearly Social Net Gains* of the Standardized CFMPP Area

	Working Areas(ha/machine)	Net Cost Reductions/ha		Total Cost Reductions	
		Wages	Others	Wages	Others
		(1,000 Won)			
Tractor	218.4	56.9	40.3	12,427.0	8,801.5
Rice Transplanter	207.1	92.0	-3.0	19,053.2	-621.3
Combine	190.4	136.0	-8.6	25,894.4	-1,637,4
Grain Dryer	190.4	21.2	-8.2	4,036.5	-1,561.3

* Measured by the difference between costs of conventional and machinery works.

(Table IV-9) Yearly Social Net Gains of the Standardized RTHMPP

	Working Areas(ha/machine)	Net Cost Reductions/ha		Total Cost Reductions	
		Wages	Others	Wages	Others
		(1,000 Won)			
Rice Transplanter	32.7	92.0	-14.1	3,008.4	-461.1
Binder	11.4	92.6	-13.6	1,055.6	-115.0
Combine	11.9	136.0	-8.6	1,618.4	-102.3
Grain Dryer	11.9	21.2	-8.2	252.3	-97.6

During the period from 1971 to 1978, the relative farm wage rates have increased by 15% of average annual rate to the price of machinery. It is expected that wage hikes will continue in the future with economic development.

The B/C ratios of the CFMPP area under the assumption of 5% ennual increase of real wage rates were estimated at 1.54 at 5%, 1.09 at 15% and 0.96 at 20% of discount rate. In case of 10% of wage hike, the B/C ratio increased to 1.10 at 20% of discount rate.

Likewise, the B/C ratios of the RTHMPP area under the 5% of wage hike were appeared 1.52 at 5%, 1.10 at 20% of discount rate. When the real wage rate hikes by 10% annually, the B/C ratios increase to 1.62 at 10% and 1.29 at 20% of discount rate. Consequently, the B/C ratios of the RTHMPP area were increased relatively much more than that of the CFMPP area with the increases of real wage rates. This result is attributable to the benefits from the labour savings which was higher in the RTHMPP area where the labour intensive works such as the transplanting and harvesting were mechanized.

Internal rate of return is the discount rate which makes the present value of benefits and costs same. Accordingly,

(Table IV-10) Benefit/Cost Ratios at the Various Levels of the Real Wages Changes in the Standardized CFMPP Area

Yearly Rates of Real Wage Increases (%)	Levels of Discount Rates			
	5%	10%	15%	20%
0	1.30	1.09	0.94	0.83
5	1.54	1.28	1.09	0.96
10	1.85	1.52	1.28	1.10

(Table IV-11) Benefit/Cost Ratios at the Various Levels of the Real Wages Changes in the Standardized RTHMPP Area

Yearly Rates of Real Wage Increases (%)	Levels of Discount Rates			
	5%	10%	15%	20%
0	1.25	1.13	1.03	0.94
5	1.52	1.35	1.22	1.10
10	1.83	1.62	1.44	1.29

when the internal rate of return of a project is higher than the social rate of discount or the opportunity cost of capital, the project would be judged to be valuable to invest.

As mentioned above, the rate of machinery utilization by improving the mechnization technology and wage-hike in rural areas are expected. Accordingly, the sensitivity tests of IRR were made under the assumption of annual rates of real wage hike to be 5% and 10%, and of the increase of machinery working area to be 10%, 30% and 50% in average.

The internal rates of return of the CFMPP area showed 12.9% based on the present level of real farm wages and the present rate of machinery utilization. The rate is slightly higher than the interest rates on the loans provided by NACF. With increases in machinery working area, the expected IRRs are estimated at 16.4% at 10% increase of working area, 23.6% at 30% increase of working area and 31.2% at 50% increase of working area. The expected internal rates of return with the real wage hikes were calculated, as shown in table IV-12, to be 18.2% at 5% annual increase of real wage rate and 27.7% at 10% annual increase respectively. In case of the compound increase of real wages and machinery working area, the IRRs are

calculated as 22% at 5% annual increase of wage rate and 10% increase in the working area, 35.9% at 10% increase of wage rate and 30% increase in the working area.

For the RTHMPP area, the IRR under the present wage level and the present rate of machinery utilization was estimated at 16.4% which was higher than that of the CFMPP area. If real wage increases with annually rate of 5%, and machinery working area increases by 10%, the IRR will be 31.4%. The IRR at 10% increase of wage rate and 30% increase in working area is calculated to 53%.

In conclution, the farm mechanization projects revealed the sufficient investment efficiency even though the study had many constraints in estimating benefits and costs. The invesiment efficiency of the farm mechanization pilot project will be better, as real wages hike and utilization rate of farm machinery increases.

(Table IV-12) Internal Rates of Return (IRR) at the Various Levels of the Real Wage Changes and Increase of Machinery Working Area in the Standardized CFMPP Area

Yearly Rates of Real Wage Increase (%)	Rates of Increases in Average Working Area per Machine			
	Presnet Level	10%	30%	50%
	(%)			
0	12.9	16.4	23.6	31.2
5	18.2	22.0	29.7	37.8
10	23.7	27.7	35.9	44.3

(Table IV-13) Internal Rates of Return (IRR) at the Various Levels of the Annual Real Wage Changes and Increases of Machinery Working Area in the Standardized RTHMPP Area

Yearly Rates of Real Wage Increase (%)	Rates of Increases in Average Working Area per Machine			
	Present Level	10%	30%	50%
	(%)			
0	16.4	22.2	34.3	47.6
5	25.5	31.4	44.0	57.8
10	33.8	40.0	53.0	67.4