Technical Report No. CP-3

WORKING REPORT

on

FARM MACHINERY OPERATION

at

CHAO PHYA PILOT PROJECT

MASAMICHI NUMATA

EXPERT ON FARM MACHINERY

MARCH 1985

THAI IRRIGATED AGRICULTURE DEVELOPMENT PROJECT

JAPAN INTERNATIONAL COOPERATION AGENCY

ERRATA

Page No.	Line	Erratum	Correction
51	12	1.5 cm	15 cm
64	(B) - 5	$S' = \frac{300T}{2(r_1^3 - r_2^3)}$	$S' = \frac{300T}{2\pi(r_1^3 - r_2^3)}$
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Preface

This is the final summarized working report of machinery operation conducted at the Chaophya Pilot Project.

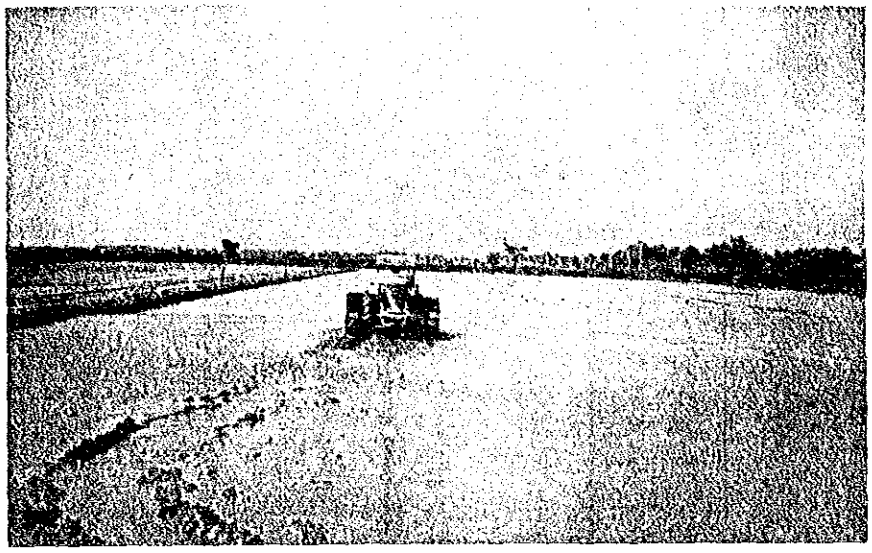
The trial and activity program of farm machinery operation of the Chaophya Pilot Project has been made with the intention of finding out a good way of mechanization on rice cultivation in this area, at the beginning of when I was appointed here as a farm machinery expert, with the consensus of mutual discussion between the Thai officials and the Japanese experts.

The conception was to conduct the mechanization of all the work on rice cultivation in the trial farm and to establish the most effective and economical mechanization method on the rice double cropping in this area. Besides, it should display a driving force in modernization of agriculture.

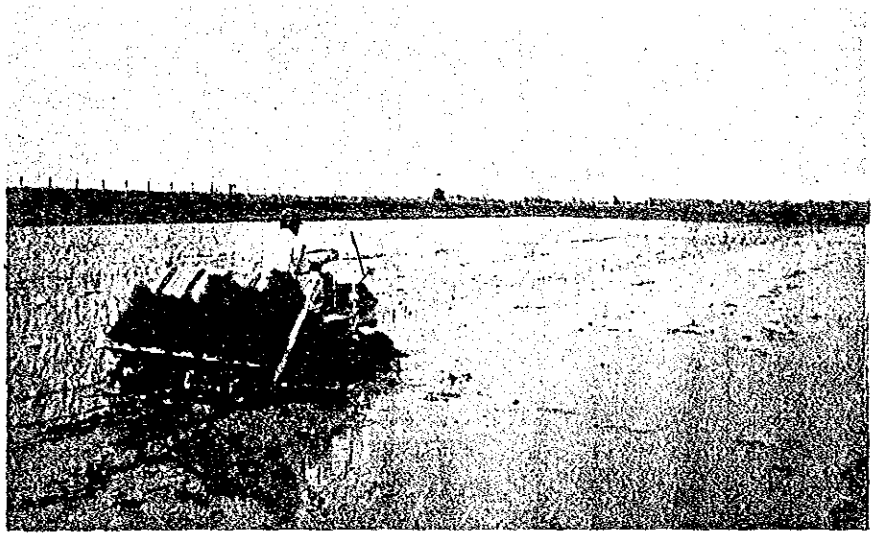
Since the completion of land consolidation, we have been grappling with the preceding duties that adaptability and practicability trials of machines to every work on rice cultivation to be suitable in this particular in cooperate with Thai staff. During 3 years extended period, the target has almost been completed by the effort of all the staff.

On the termination of the Irrigated Agriculture Development Project, I have pleasure to put and compile together our activities which have been conducted at sub-project in Chaophya. It is hoped that this report will give the essence of machanized rice double cropping to the persons who are engaged in this field and that it may play an important role in helping to raise the productivity to the vicinity of the project and to similar condition areas.

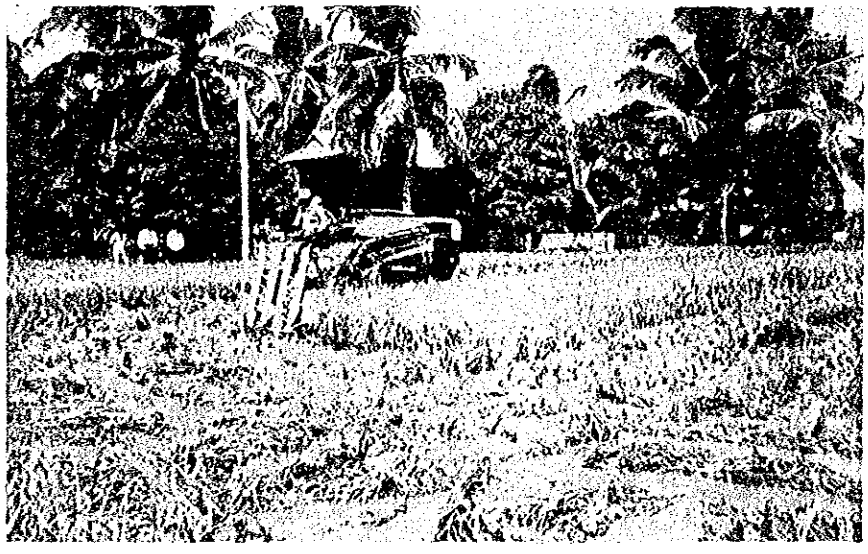
A view of the direct sowing
by tractor with broadcaster



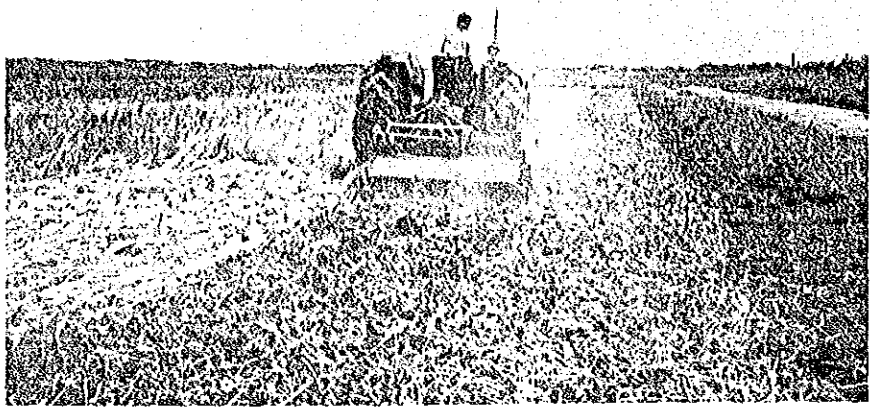
A view of the rice transplanting
by rice transplanter PL-500W



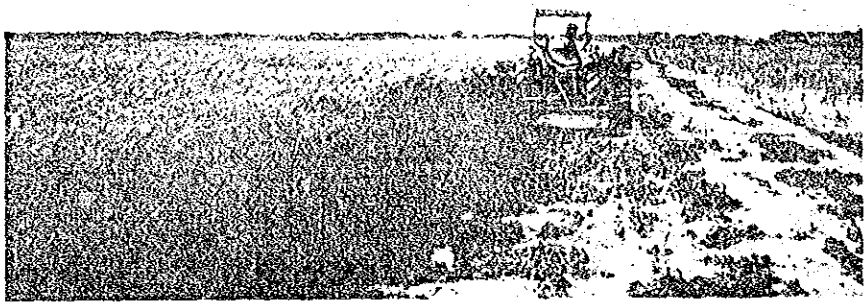
A view of the harvesting
by swamp type combine harvester



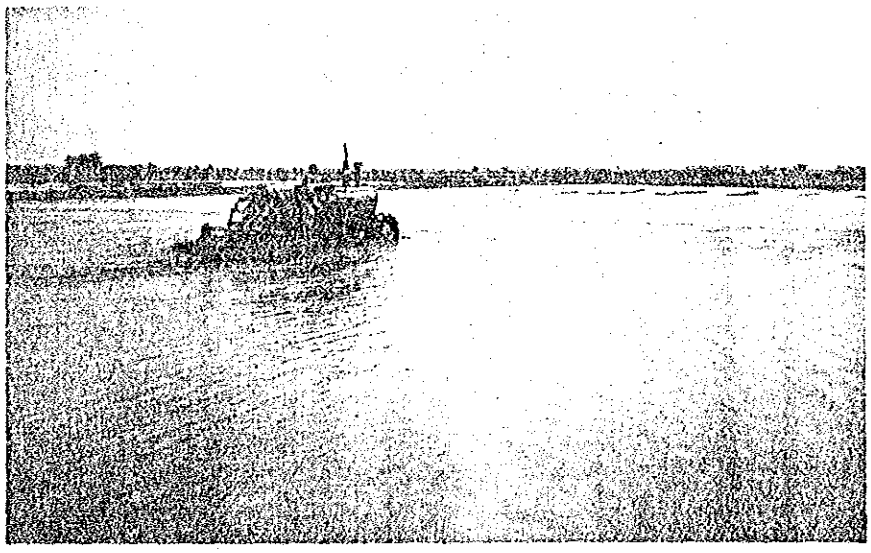
A view of the plowing in dry condition



A view of the plowing in green manure



A view of field preparation



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Working report on farm machinery operation in Chaophya Pilot Project
From Dec. 1981 - Sep. 1984

The summarized activities on farm machinery operation in the Chaophya Pilot Project are given below.

The objectives are :

1. Establishment of the most effective and economical method of mechanized rice cultivation in this area.

2. Raising the technique of machinery operation, maintenance and repairing; planning of operation and management of mechanized work to the persons who are engaged in this field.

3. To collect the necessary data to the motor pool such as mechanization center, or joint using of farm machinery for farmers' association that has been planned for future in the project area.

4. Advice and consultation for management of machinery service to farmers.

Re-leveling work of trial farm

When I was assigned here, all the plots of trial farm were still remaining in under un-even-leveled condition, although the consolidation work of trial farm was finished a long time ago.

Under this circumstance, every trial works such as soil preparation, water management, improved rice cultivation techniques were not so smoothly carried out.

It was needed to make the plots re-leveling because the leveling extent of each plot in the trial farm was done about (±)10 cm. to 20 cm. by the field consolidation work. This leveling extent was not suitable for executing of the improved rice cultivation.

In order to make a better basical condition of field that the leveling extent should be under (±)5 cm. for rice cultivation, the re-leveling work was carried out in dry season of 1992 and 1993 by agrimotor equipped with paddy wheels, rotary-plow and drive-harrow etc.; alternated between in dry soil condition and in standing water condition of field, because the soil moving capacity by agrimotor was very less volume than by construction machine such as bulldozer. The result was as follows.

Result of re-leveling work by agrimotor at the trial farm

Plot number	Area (in rai)	Worked hour	Fuel consumption (litre)	Remarks
In the dry season of 1992				
220	3.96	16.5	80	Complete
230	3.94	5.6	28	"
140	3.78	5.2	25	"
240	1.90	2.2	11	Not complete
110	2.89	13.0	70	"
120	4.06	6.6	30	"
130	4.13	6.3	30	"
In the dry season of 1993				
110	2.89	15.7	110	Complete
120	4.06	11.1	95	"
130	4.13	3.8	31	"
150	4.52	25.7	67.5	"
160	3.97	18.6	57.7	"
240	1.90	15.0	44	"

* The leveled ratio of re-leveling finished in the plot was under (±)5 cm.

Used machine were : Massey Ferguson Tractor (75 HP)
Johndeer Tractor (72 HP)
Yanmar Tractor (33 HP)
Yanmar Power Tiller (7 HP)

Working equipments : Rotavater, Front blade,
Trailer, Drive-harrow.

1. Establishment of the most effective and economical method of mechanization work on rice cultivation in this area.

1-1 Adaptability study through the field work for practicability and suitability of the machinery on all kind of work for rice cultivation,

1-1-1 Field preparation work by heavy tractor attached with several kinds of the working equipments.

i) Observation and study the running condition of tractor in the paddy field attached with :

a. Float rag wheels.

b. 3 kinds of different type of paddy wheels.

c. High-rag tires only.

d. Rotavator for plowing in dry condition and in wet condition.

e. Rotavator for plowing in the standing water condition.

f. Wooden leveler for leveling and planking work.

g. Drive-harrow for leveling and planking work.

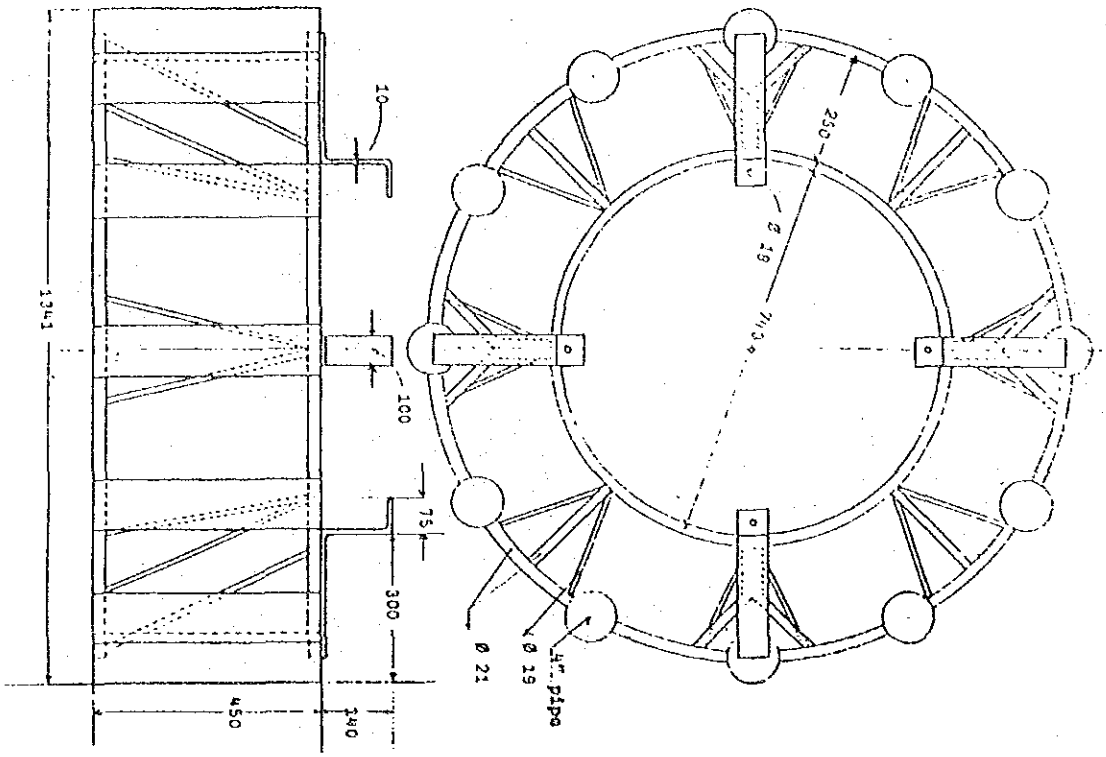
At the beginning of Project activity, heavy tractor as 75 HP, 72 HP, and 33 HP. Tractors which were holding in the project were not smoothly running or could not run in a certain plot where some part was deep mud soil even the tractor was equipped with several paddy wheels as mentioned above in wet condition and standing water condition of field. The soil in this area is very particularity as heavily sticky and deep mud soil after irrigation.

Therefore, in 1982, the project had tried repeatedly to make an improved paddy wheels which was suitable for particular soil condition.

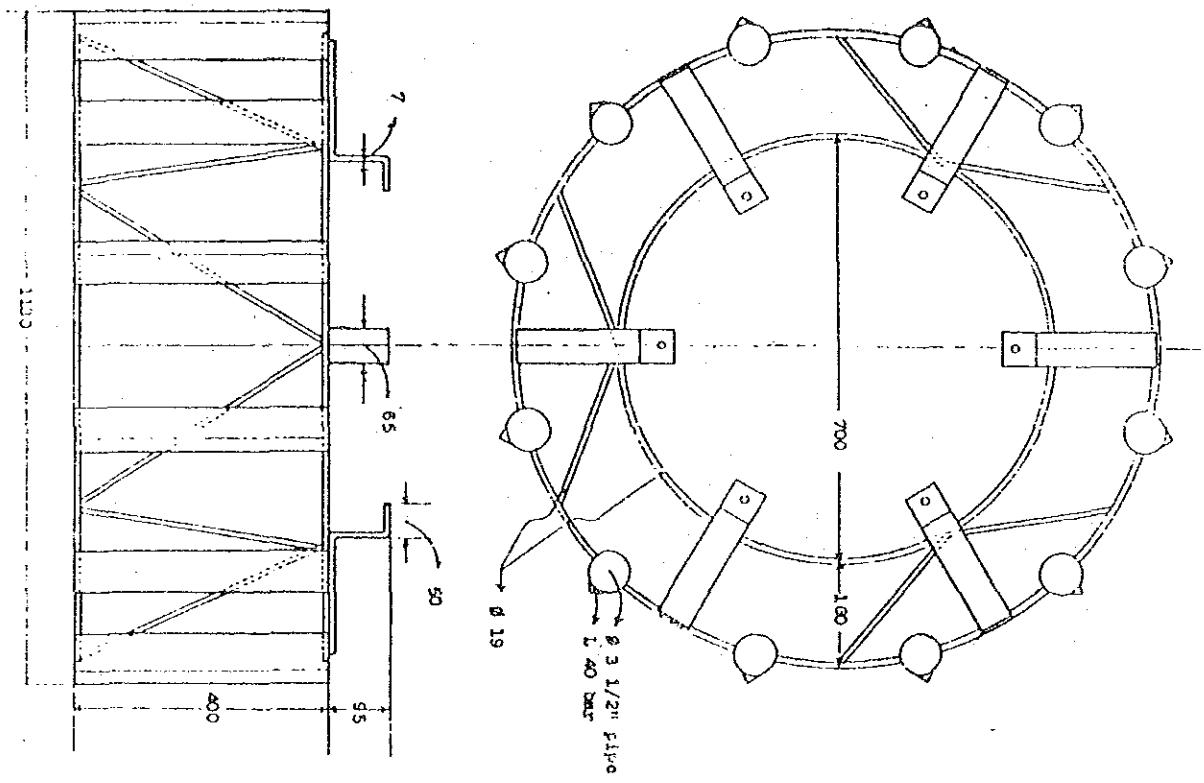
The improved paddy wheels were quite good to prevent the sinking of tractor, but we had not been completely satisfied in the smooth running of the tractor on any condition of field. After several reforming trial, final modification of paddy wheels had been made on Nov. 1983, it was very effective much more than the former one, this meant that the form of wheel-rags were against soil adhering and prevented the sinking of tractor in the maddy place.

Moreover, it played to help the smooth running of tractor on paddy field operation although the fields were un-leveled condition and heavily sticky, deep mud soil condition.

Sketch of paddy wheel for T-6500 & HF-185 Tractor (Figures are in cm.)



Sketch of paddy wheel for YH-330DT Tractor (Figures in cm.)



Sketch of paddy wheel for KF-45 (figures are in mm.)

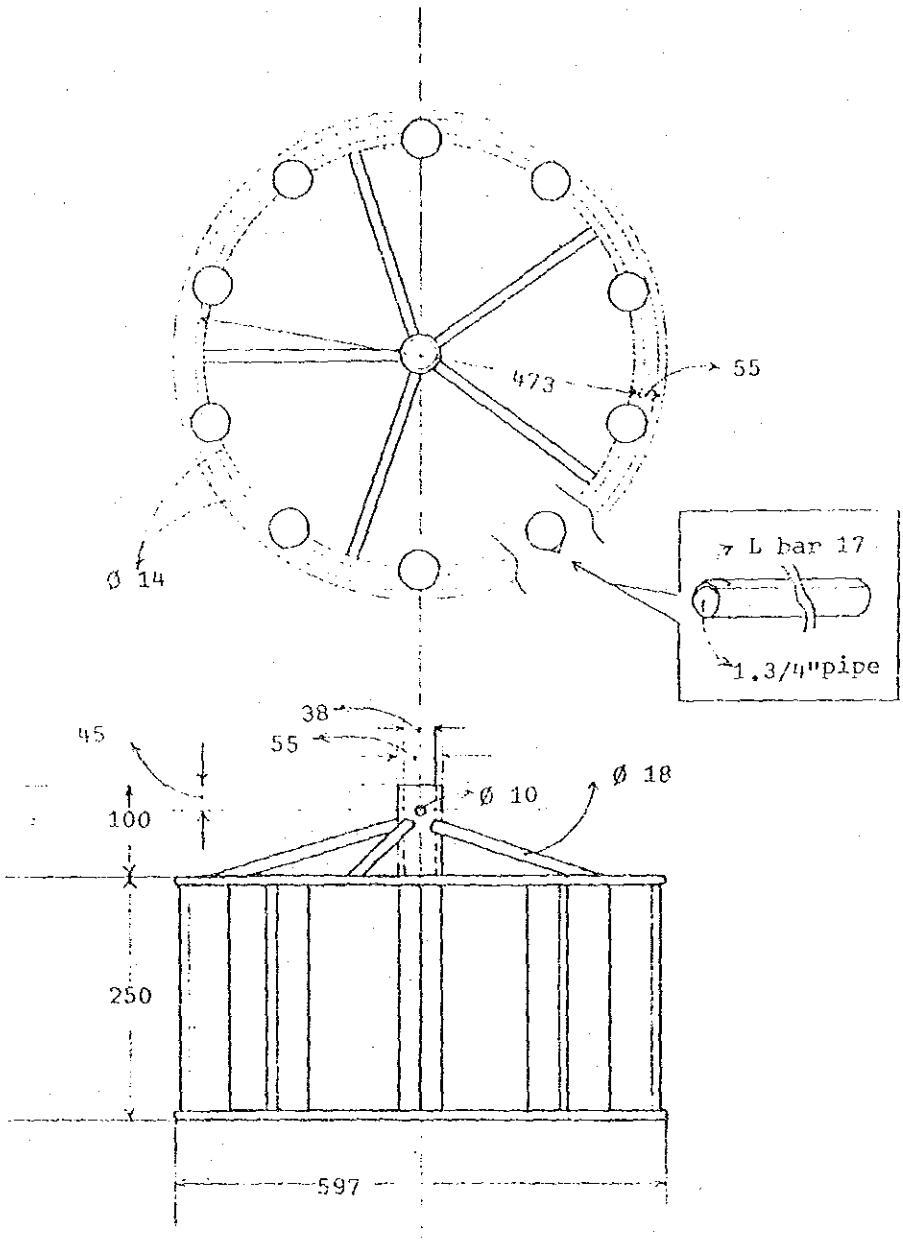
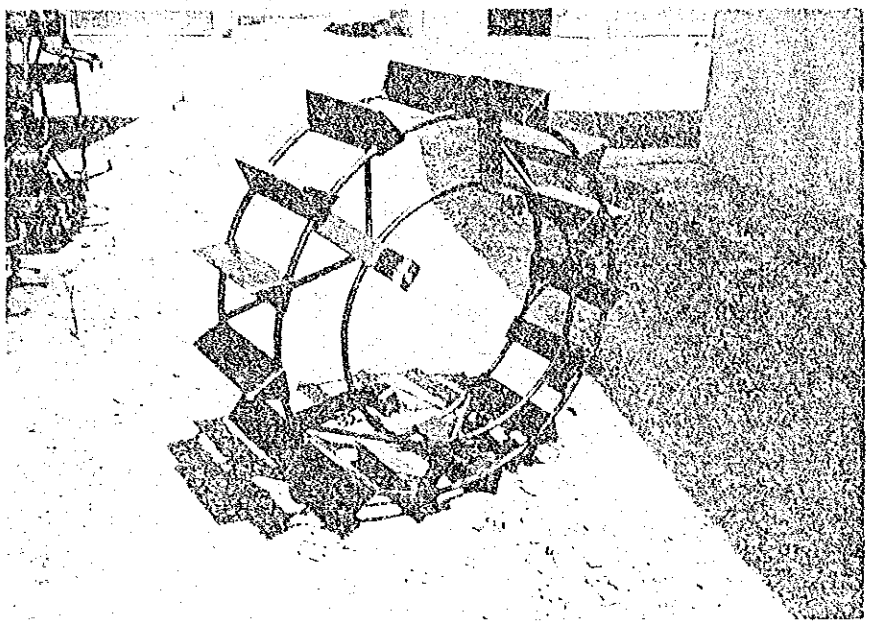


Figure-1

Improved paddy wheels which were designed by C.P.P.P. in 1982

For YM-330 Tractor (33HP)



For MF-135 Tractor (75HP)

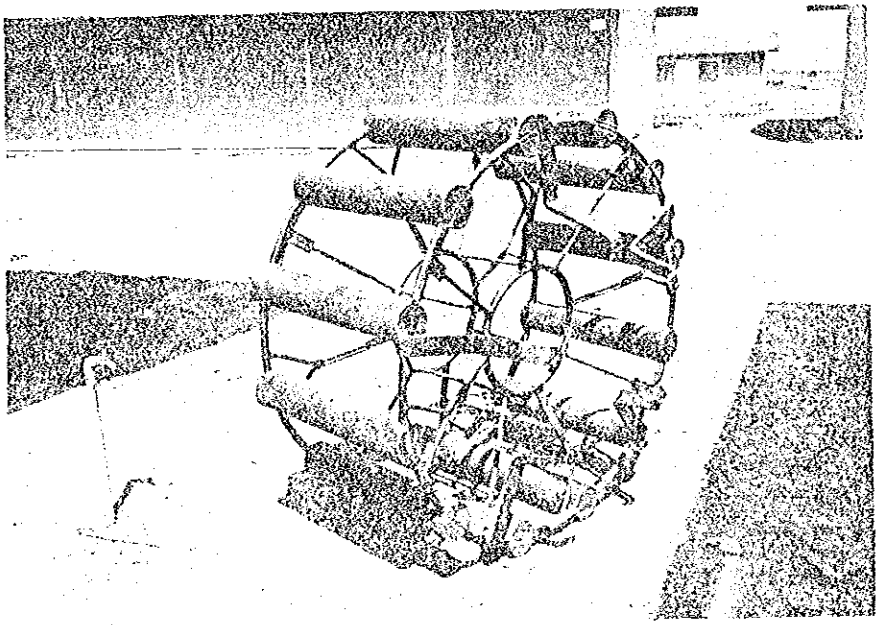
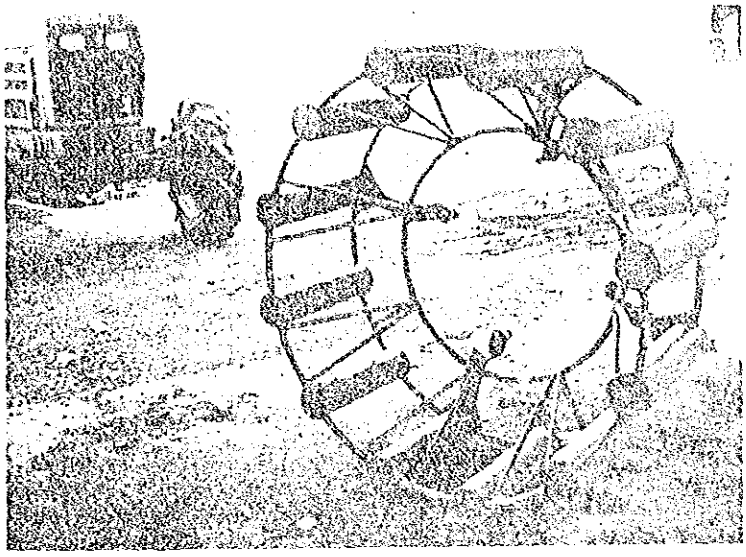
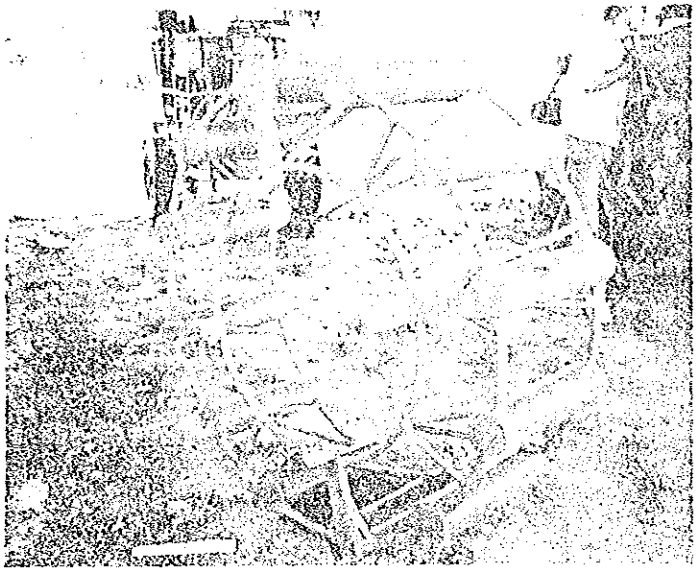


Figure-2

Improved paddy wheels which were reformed in 1963 for heavy tracter

For T-6500 of 65HP tracter



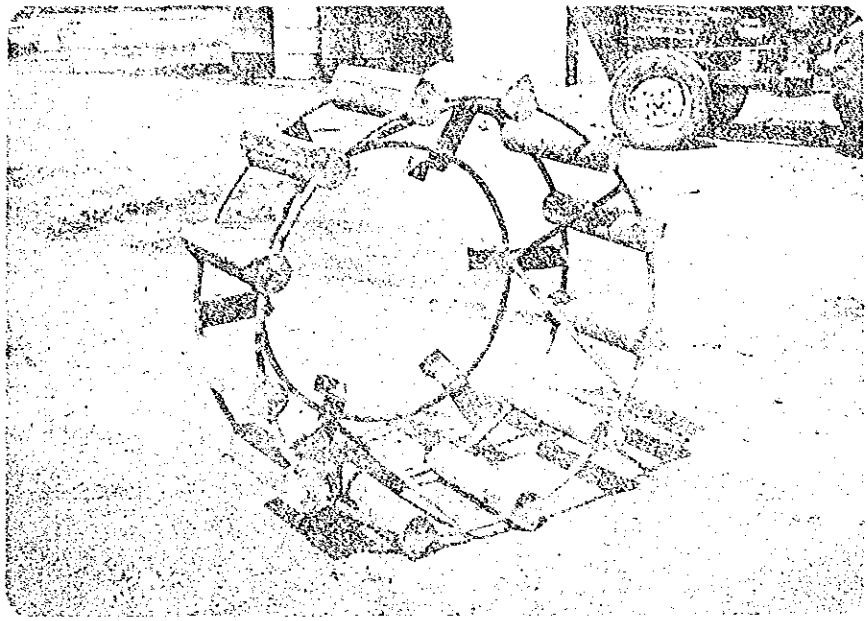


For MF-185 of 75HP tracter

A view of the paddy wheels which were attached to tracter

Figure-3

Improved paddy wheels for YI-330D tractor
designed by C.P.P.P. reformed in 1983



A view of the work equipped
with above paddy wheels

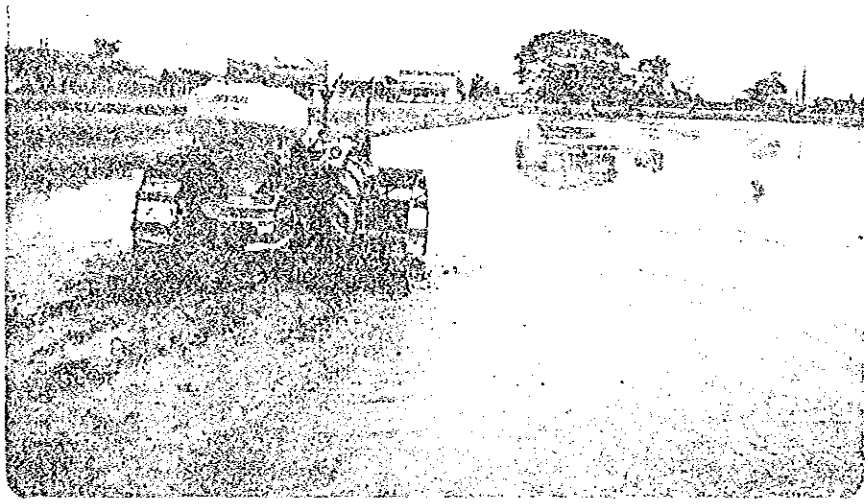
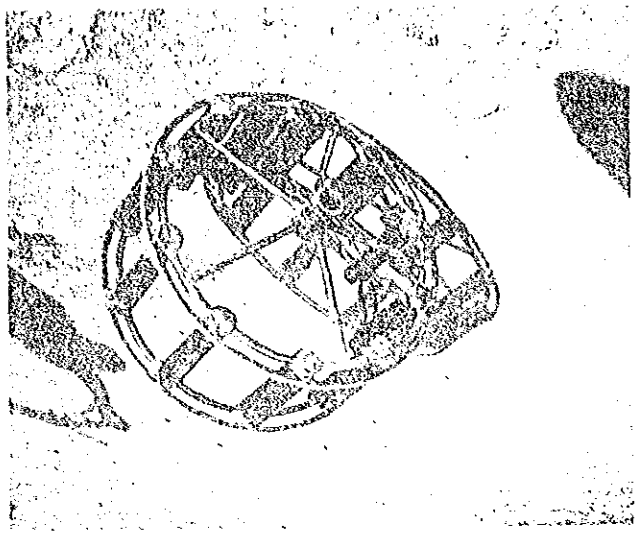
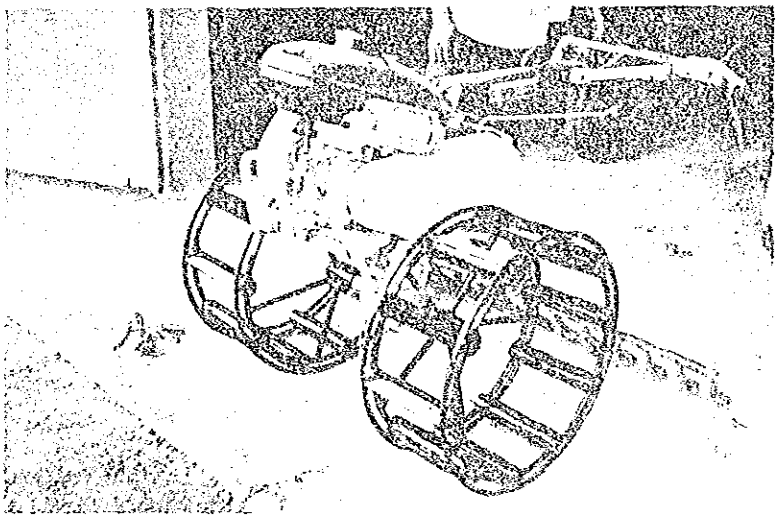


Figure-4

Paddy wheels were designed by C.P.P.P
for KC-45 power tiller in 1984

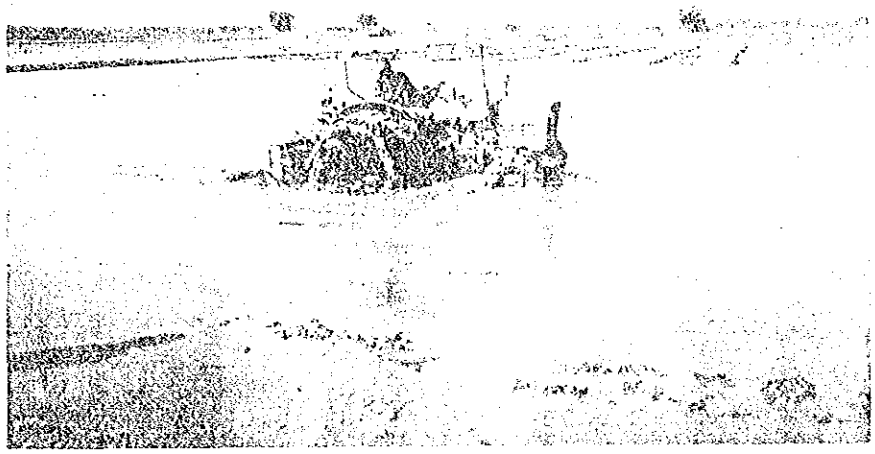




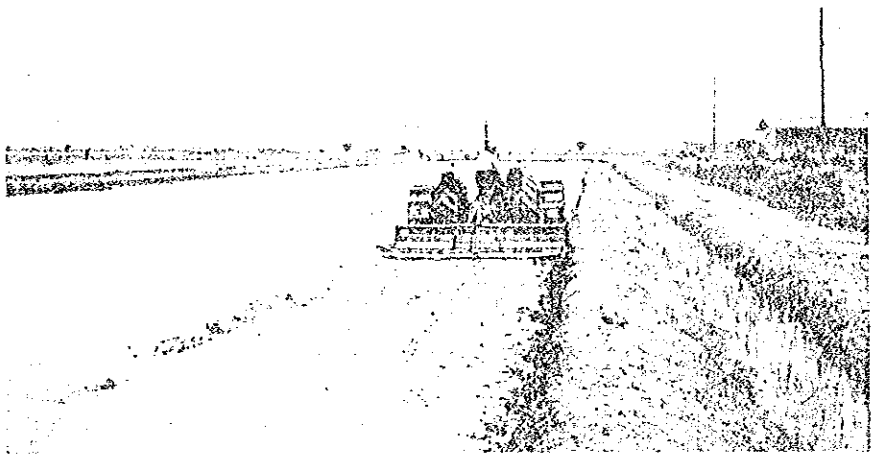
Improved paddy wheels were attached to KC-45F power tiller

A view of planking work

A view of field preparation by YM-330D
equipped with the improved paddy wheels



A view of field preparation by T-6500
equipped with the improved paddy wheels



ii) Adaptability and practicability test of heavy tractor on field preparation work.

a. Plowing work by 75 HP, 72 HP, 33 HP, 65 HP Tractors attached with AR and RL type of Rotavator in dry condition and in standing water condition of field.

b. Puddling work by 75 HP, 33 HP, 65 HP Tractors attached with Rotavator and Drive-harrow.

c. Leveling and planking work by 75 HP, 33 HP, 65 HP Tractors attached with Drive-harrow and wooden leveler.

These working equipments (except wooden leveler) were driven by P.T.O. of tractor. And the improved paddy wheels which modified by the Project were equipped to tractors when doing above test in standing water condition.

In wet season and dry season of 1982, the adaptability test of plowing, puddling and leveling work carried out by 75 HP, 33 HP of tractors. In case of 33 HP tractor, it was overloaded sometime on both works in dry condition and in standing water condition due to heavy clay soil. In case of 75 HP tractor, it was sunk down even equipped with the first modification of paddy wheels at a certain part where was deep mud soil, so it was not complete satisfied work that the running of tractor was not so smooth in this particular soil

Therefore, in parallel with having repeatedly modification of paddy wheels, the project had tried to dry up fields completely as 5 cm. of soil crack in dry season for enhancement of soil bearing capacity, and procured the improved tractor which was 65 HP, 4 wheel-drive type to be suitable for paddy field use.

In dry season and wet season of 1983, the field preparation work in the trial farm by heavy tractor was very smoothly progressed, because it was using with the second modified paddy wheels; and enhanced the bearing capacity of soil by drying up the field.

On November 1983, the improved paddy wheels were reformed three more times to obtain the smooth running of tractor and power tiller in this particular condition of field such as heavily sticky and deep mud soil, that was the reason the project reached the goal of fulfilment in smooth using of heavy tractor and power tiller in this particular soil and performed the mechanized rice cultivation systematically

d. Adaptability test results :

d-1 Adaptability test result of soil preparation work by tractor in the trial farm in dry season 1982 - 1983

* Used machine : MF-135, T-6500 Tractors with Drive-harrow

* Total area

Puddling area : 28.60 rais

Leveling area : 33.30 rais

* Total worked hours

Puddling work : 13.0 (0.35 ha/h) (0.46 h/rai)

Leveling work : 30.0 (0.19 ha/h) (0.9 h/rai)

* Fuel consumption

Puddling work : 115 litres (8.86 litres/h ; 4.02 litres/rai)

Leveling work : 235 litres (7.83 litres/h ; 7.06 litres/rai)

** Usually, the planking work shall be done cross wise, but all the plots had been done 4 times at least for making a good condition of the field level. Plot No.120, 140, 240 (total = 9.74 rais) had been done more than 4 times of planking work according to the request by agronomist who wanted to make the fields in complete level to be most suitable for the applied research work of several kind of rice cultivation, because the result of applied research of rice cultivation was required accurately. Therefore, these fields were needed to be good level as well as possible.

During this work, the field preparation work by tractor was quite smoothly carried out as a whole. But heavy tractor struggled in the muddy soil at plot No.110 and 150 of fields where some parts were very soft and muddy soil, because the re-leveling work of these plots had been done just before the last cultivation; and some parts of these two plots were cut the soil out, some parts

were filled the soil up about 20 cm. This meant that the plots could not dry completely since the re-leveling work finished till this time. The bearing capacity of soil was very low, and obstructed the smooth progression of the tractor as far as these two plots. Therefore, the field where was refilled soil up when leveling was necessary to dry up completely after once paddy cultivation for smoothly use of machinery.

d-2 Adaptability test result of field preparation work by tractor in the trial farm in wet season 1993

d-2.1 Plot No.220 : 3.96 rais
Used machine : MF-135 (75 HP) W/Drive-harrow
Worked hour : 3 hours
Fuel consumption : 21 litres (5.3 litres/rai)
** Puddling and leveling work was done twice.

d-2.2 Plot No.230 : 3.94 rais
Used machine : T-6500 (65 HP) W/Drive-harrow
Worked hour : 5 hours
Fuel consumption : 31 litres (7.9 litres/rai)
** Puddling and leveling work was done thrice.

d-2.3 Plot No.140 : 3.9 rais
Used machine : T-6500 (65 HP) W/Drive-harrow
Worked hour : 4.7 hours
Fuel consumption : 29 litres (7.63 litres/rai)
** Puddling and leveling work was done thrice.

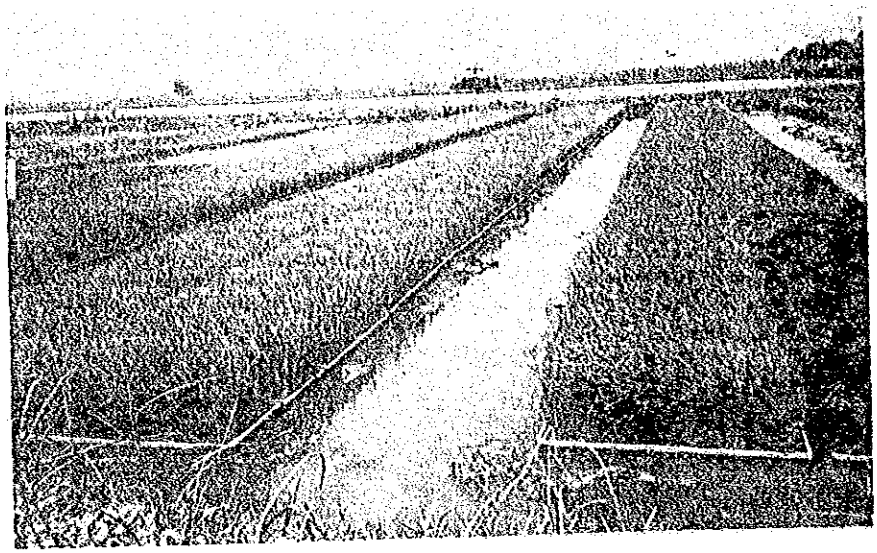
d-2.4 Plot No.240 : 1.7 rais
Used machine : MF-135 (75 HP) W/Drive-harrow
Worked hour : 1.2 hours
Fuel consumption : 9.5 litres (5.0 litres/rai)
** Puddling work was done twice.

d-2.5 Plot No.240 : 1.7 rais
Used machine : T-6500 (65 HP) W/Drive-harrow
Worked hour : 1.1 hours
Fuel consumption : 7 litres (4.1 litres/rai)
** Leveling work was done one time.

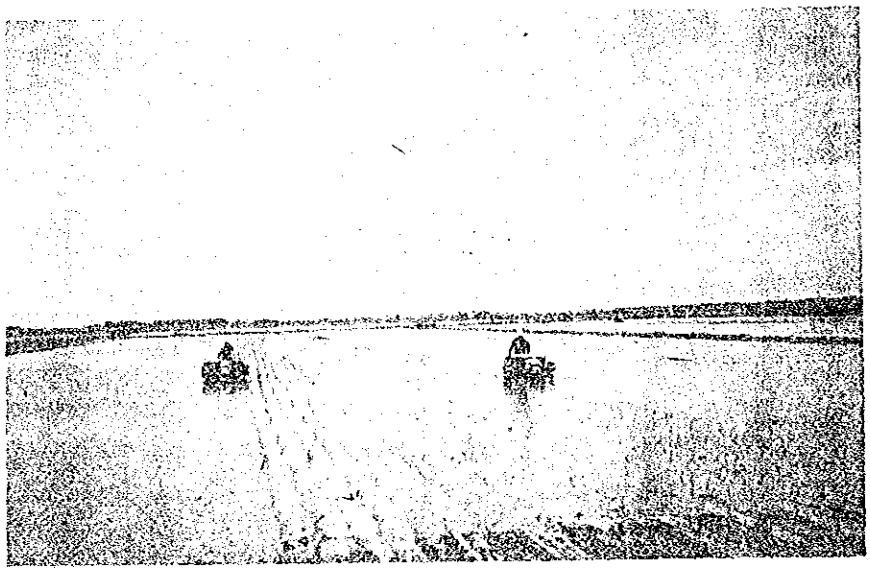
Note : Both tractors have been equipped with the improved paddy wheels for this work, because the tractors could not run without the improved paddy wheels in the fields where the depth of standing water was about 10 cm. to 15 cm.

It was necessary that the work was repeated twice or thrice because field level was not so good and, in some parts, the tractor struggled in the heavy sticky and deep mud soil.

A view of the box nursery



A view of rice transplanting by walking-type planter



A view of rice transplanting by riding-type planter

1-1-2 Transplanting work by S-400 and PL-500W Transplanter

I) Adaptability test and observation study.

a. S-400, walking type 4 row, rice transplanter

b. PL-500W, riding type 5 row, rice transplanter

c. Field managementfor rice transplanter

On January 1982, the first adaptability test of S-400 walking type, rice transplanter was done one month after I was assigned to this project, but the test S-400 rice working type transplanter could not run in this particular soil condition except a certain place in the plot where a few parts were shallow soil.

In 1983, we found a soil preparation method for the rice transplanteruse in this particular soil after many trials.

The method was : the water was kept in the field 10 cm. to 15 cm. depth about 6 or 7 days continuously after field preparation work finished. This period of standing water in the field, the melted and colloidal soil precipitated and settled down in the bottom of field; then the membranous marter grew on the surface of soil in the field by microbes and algae.

With this process, it would turn the sticky and muddy soil into good condition for using the rice transplanter.

Drained water from the field that the water depth in the plot came to about 5 cm. after found out the membranous matter which was covering on surface of soil, then the rice transplanter could work smoothly except over 25 cm. depth of soft and muddy soil.

In parallel with above trial, we tried to procure the PL-500W rice transplanter which was improved for soft and muddy soil use, and procured it at the end of 1982.

d. Adaptability test results

d-1 Test result of rice transplanting work by S-400, 4 row-walking type.

Date of transplanting	: 2nd. of September, 1992
Field and area	: Plot No.120, 140 (7.34 rais)
Used machine	: S-400, 4 row-walking type
Kind of - paddy variety	: RD-23
- nursery method	: Box-nursery
- seedling age	: 26 days
Planting space	: 30 cm. x 16 cm.
Used number of box-seedling	: 49 boxes/rai
Worked hour av. per unit area	: 2.35 h/rai
Planting speed of machine	: 1.4 km/h
Planting precision	: 0.47% of miss planted and floated hills under observation of 24,000 hills.

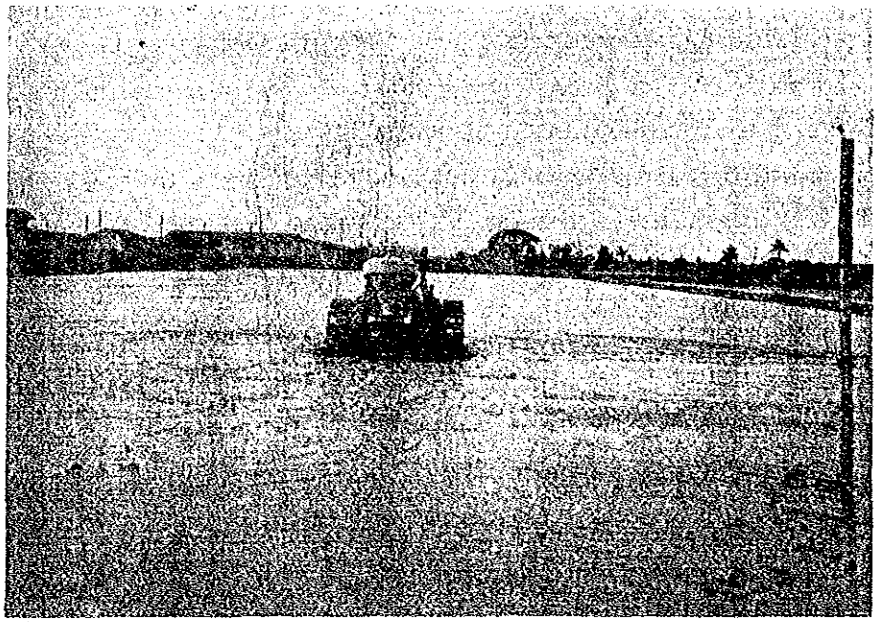
d-2 Test result of rice transplanting work by 5 row-riding type.

Date of transplanting	: 2nd. of May, 1993
Field and area	: Plot No. 120, 130 (7.4 rais)
Used machine	: PL-500W, 5 row-riding type, 4 wheel-drive, double wheels.
Kind of - paddy variety	: RD-21
- nursery method	: Box-nursery
- seedling age	: 17 days
Planting space	: 30 cm. x 16 cm.
Used number of box-seedling	: 40 boxes/rai
Worked hour av. per unit area	: 1.44 h/rai
Planting speed of machine	: 1 km/h
Planting precision	: 0.38% of miss planted and floated hills under observation of 20,000 hills.

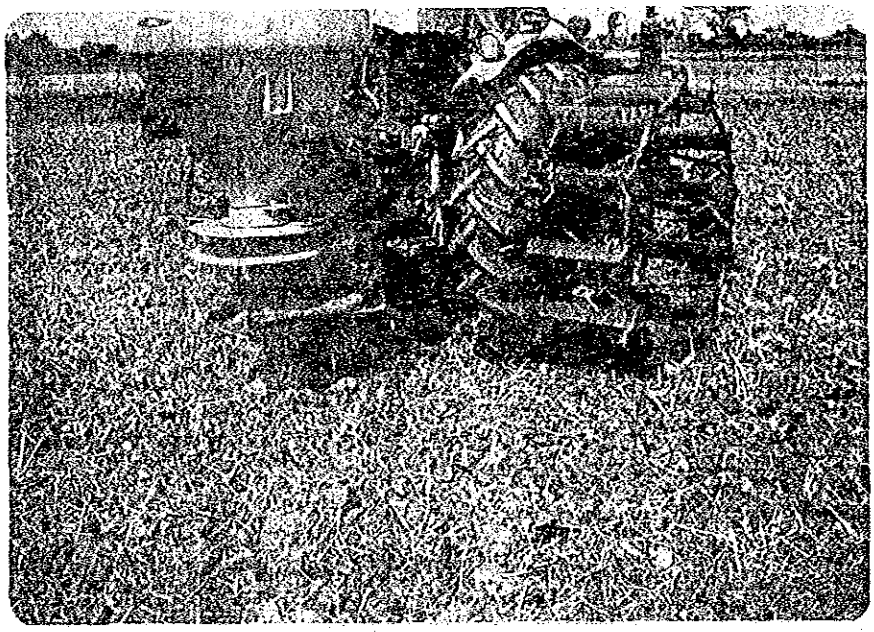
Through the observation of above work, the former one that the S-400, rice transplanter was smoothly worked after taken many trial of field management that the field was kept in standing water 6 to 7 days after field preparation finished, in this period turned the melted and colloidal soil into good condition for machine use. The later one that transplanted by PL-500W, the hills form in planted rows were somthing disordered in spite that the planting work had been smoothly carried out because the soil was too soft. The field was kept standing water 4 days from the day of soil preparation finished to the day of transplanting; that period was not enough to turn the soil into good condition from the muddy, soft soil by field preparation work.

In order to get the better result of transplanting machine, it should make good condition soil that the field shall be kept 6 or 7 days at least with standing water after finished date of soil preparation work to transplanting date.

A view of the direct sowing
by tractor with broadcaster



A view of basal dressing



1-1-3 Direct sowing trial and basal dressing trial by tractor equipped with MBC-2610 of broadcaster in the trial farm.

i) Adaptability test and observation study

a. Direct sowing work.

b. Basal dressing work.

With the intention of finding out the mechanized direct sowing method, the project procured MBC-2610 of broadcaster at the beginning of 1993, because the manual direct sowing method has been popularized in this area.

The mechanical rice direct sowing work trial was carried out according to the past experience, and was in consideration of :-an uniform density of sowing seeds.

-the protection of the seeds from rotting by deep sowing.

-making an uniform growing of paddy at beginning stage.

For the fulfilment of above important points, the treatments were as follows.

First of all, fields were prepared 4 days before sowing and kept in standing water about 15 cm. depth until colloidal soil settled down to bottom of field that meant to protect the seeds go in deep of soft soil.

Second, kept the field in standing water about 15 cm. depth when sowing by machine. The depth water played a role of buffer and helped on uniform density of sowing seeds when going through in the water down to soil.

Third, used seeds were being germinated. The roots of germinated seed were protected to go deep in the soft soil and helped growing paddy at the beginning stage.

a-1 Adaptability test result of direct sowing by machine

* Used machine : YM-330DT Tractor with MBC-2610 Broadcaster
* Tractor speed : 1st. gear, high speed position (4.5 km/h)
* Engine rpm. : 2,000
* P.T.O. rpm. : 975
* Outlet index of broadcaster : 7
* Wide of spread : 13 metres
* Paddy variety : RD-23 (germinated seed)
* Quantity of seed : 38 kg. in dry (9.2 kg/rai)
* Area : Plot No.120 (4.13 rais)
* Field condition : In standing water about 15 cm. depth
* Worked time : 16 minutes
* Fuel consumption : 1.5 litres

On Jan. 1983, the first trial of mechanical direct sowing by YM-330DT tractor attached with broadcaster was carried out with uniformity sowing and speedly work. But unfortunately, the sowed field was damaged by the attack of the bird-inflocks after drained water from the field, because in the vicinity of the field was not same condition.

The second trial of mechanized direct sowing was carried out on Dec, 1984

* Date : Dec. 20th, 1984
* Used machine : YM-330DT Tractor with MBC-2610 Broadcaster
* Tractor speed : 1st. gear, high speed position (3.6 km/h)
* Engine rpm. : 1,800

* P.T.O. rpm. :about 877

* Outlet index of broadcaster : 7

* Effective spreading wide : 13 metres

* Paddy variety : RD-23 (germinated seed)

* Quantity of seed : 12.5 kg /rai) in dry

* Area : Plot No. 160 (3.97 rai)

* Field condition : In standing water about 15 cm. depth

* Worked time : Net 9 minutes
: Total 16 minutes

* Fuel consumption : 2 litres (0.5 litre/rai)

* Seed treatment

The seeds were soaked in water 2 days after finished water selection of seeds.

Wrapped the soaked seeds up in the canvas sheet for 3 days. The seeds were being germinated and roots of seed grew 15 mm. to 20 mm. during the above treatment, and then spread the germinated seeds on the canvas sheet to dry them till the roots became soft. This means to protect the roots of germinated seeds break when sowing by machine. When making for dry the roots of seeds, should keep under roof, do not dry them under direct sun-shine.

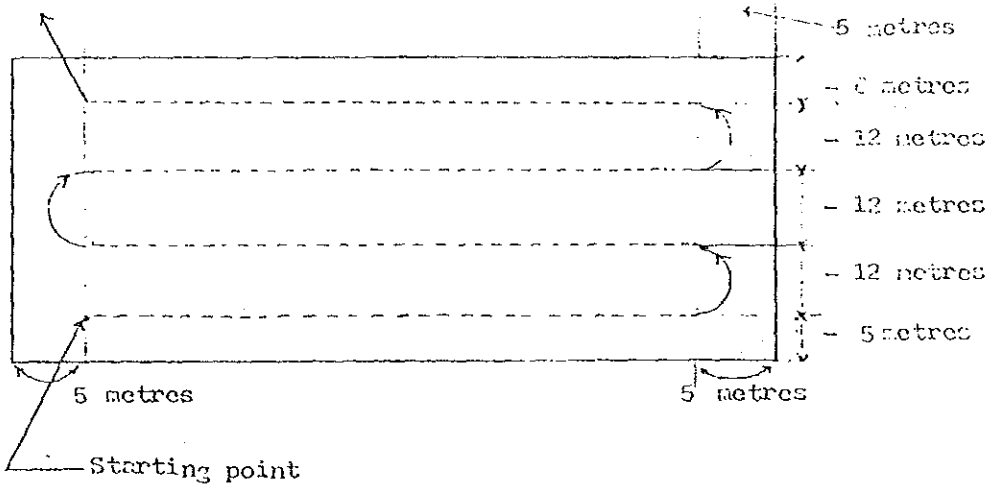
** In this trial, machine direct sowing was nicely carried out with uniform sowing very speedly as shown above record.

a-2 Working method of paddy broadcaster by Tractor

Before use this machine, must devide the field like the following picture. And make the machine as follows.

1. Tractor speed : 1st. gear, high position
2. Engine rpm. : 1,800
3. Outlet index of broadcaster : No.7
4. P.T.O. rpm. : Low speed position (about 877)

(The way of work as shown in below)



Remarks : Used paddy seeds are germinated in condition of 15 mm. to 20 mm. lenght of roots, and 6 - 10 hours dried under shade, do not dry them under direct sun shine.

Quantity of paddy seeds are used about 12 kg/rai (RD-31) in the case of above mentioned conditions such as item 1, 2, 3, 4.

Other variety of seeds shall be adjusted the index number of the shutter opening position and P.T.O. speed etc., according to the size of seeds or condition of germinating seeds.

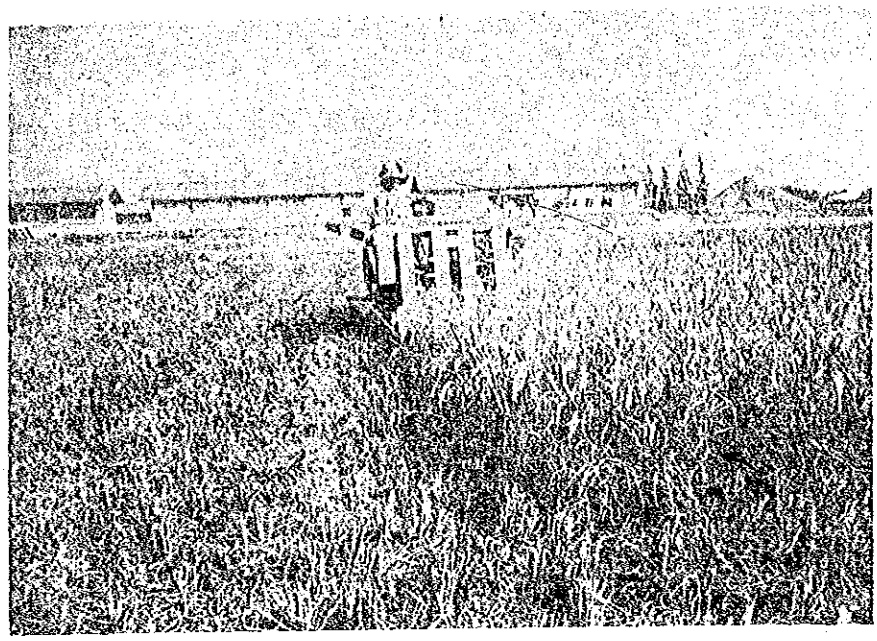
b-1 Adaptability test result of basal dressing work by tractor equipped with broadcaster

* Used machine : YM-330DT Tractor with Broadcaster MBC-2010
* Working speed : 4.5 km/h, 1st. gear, high speed position
* Engine rpm. : 2,000
* P.T.O. rpm. : 975
* Outlet index of broadcaster : 7 or 8
* Area : 1.32 hectares, Plot No.110, 150, 160
* Worked hour : 1.5 hours (8 minutes/rai)
* Net worked hour : 1.0 hour (5 min/rai), feeding time 3 min/rai
* Used fertilizer : Ammophos (in granular)
* Quantity of fertilizer in the each plot :
  No.110 235 kg. (81.3 kg/rai)
  No.150 488 kg. (106.8 kg/rai)
  No.160 345 kg. (86.9 kg/rai)
* Fuel consumption : 8.7 litres (0.76 l/rai)

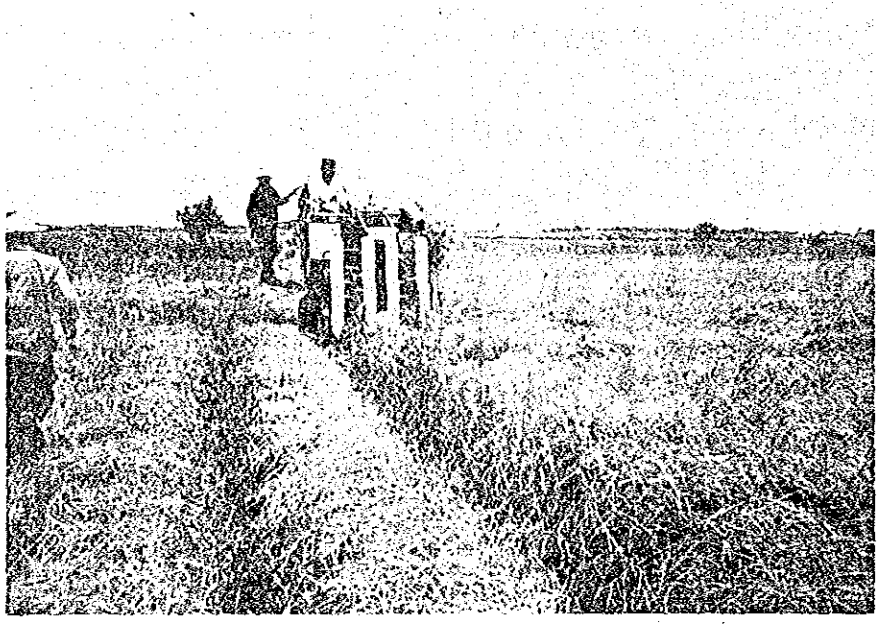
** This trial has been done for the purpose of knowing about the practicable of machine work of basal dressing in the paddy field; and manual work was compared with the machine work in capacity and uniformity.

The trial was very effectively carried out without any problem. The basal dressing had been spread more evenly than the manual dressing, and also it was speedly done as mentioned above.

A view of the harvesting
by TC-2000 combine harvester



A view of the harvesting
by TC-3500 combine harvester



1-1-4 Harvesting work by Combine Harvester and Thresher

i) Adaptability test and observation study

a. Combine harvester (TC-2000D, HL-1800, TC-3500)

b. Threshing work by Thresher (4' type and 5' type)

c. Observation of lost grains under combine harvesting and man power harvesting.

On dry season and wet season in 1982 - 1983, the project had tried the adaptability test of combine harvester, TC-2000D HL-1800 type, on several conditions of fields.

Through the adaptability test, it was understood that the working ability of normal type combine harvester on the soft soil was higher than 0.25 kg/cm^2 of soil bearing capacity in 10 cm. depth for TC-2000D, and for HL-1800 of combine harvester.

For getting enough bearing capacity of soil to use combine harvester, it was necessary to dry the field about 15 days before harvesting in the dry weather of harvesting stage. And in wet weather, the field was dried more than 20 days before harvesting work. But it was not sure to get enough bearing capacity of soil to use combine harvester, depending on the quantity of rainfall in this period.

On November 1984, therefore, the project procured an improved combine harvester TC-3500 for swamp use type; and tried it in the farmers fields on May, 1984 because the paddy harvesting has been finished in the trial farm at this time.

The adaptability and efficiency test by this machine was much better than normal type combine harvester.

And it was able to work in much more softness soil than the normal type combine harvesters even received rainfall except extremely heavy rain in field drying period.

a-1 Adaptability test result of harvesting work by TC-2000D Combine Harvester

* Date of harvest : 12th. Jan. 1993
* Field and area : Plot No.140 of trial farm 3.8 rais
* Kind of paddy variety : RD-23
* Used machine : TC-2000D Combine Harvester
* Required working time : 5.5 hours (1.45 h/rai)
* Fuel consumption : 9 litres (2.36 l/rai) diesel oil
* Working speed : 3rd. gear of working position
* Yield of paddy : 429.3 kg/area (689 kg/rai)
* Condition of grown paddy :

Average height of paddy was 120 cm. in good grown condition, and the co-efficient of lodging seemed to be index 3.

** It applied the number of index which is using in Japan as a standard of the lodging co-efficient to this case.
(For example : Non lodging is index 0, complete lodging is index 6)

Date of transplanting was 7th. Oct. 1992 by PL-500W

* Field condition :

The hardness of soil was good enough for using the combine harvester. Water was drained 20 days before harvesting.

** With regarding to above work, the TC-2000D was very nicely carried out without any troubles in using the first, second and the third speed of gear position. In case of used the fourth speed of gear position, the threshing drum and the paddy carrying chains could not be treated nicely due to over load work.

Therefore, to gain the best result of this machine should use by either 2nd. or 3rd. gear position according to the condition of the grown paddy.

a-2 Adaptability test result of harvesting work by HL-1800 Combine Harvester

* Date of harvest . 13th. Jan. 1993
* Field and area : Plot No.130 of trial farm (2.1 rais)
* Kind of paddy variety : RD-23
* Used machine : HL-1300 Combine Harvester
* Working capacity : 3.16 hours 1.5 h/rai (0.94 h/area)
* Fuel consumption : 5.0 litres (2.38 l/rai) diesel oil
* Working speed : 3rd. gear of working position (1.58 km/h)
* Yield of paddy : 395 kg/area (616 kg/rai)

* Condition of the grown paddy :

Average height of paddy was 118 cm. in medium grown condition and paddy was non-lodging.

* Field condition :

Drained water from the field 16 days before harvesting. The hardness of soil in plot No.130 was not even, there was some hard enough part for using combine harvester in a certain place where the some part was omitted to use the combine harvester. Therefore, in case of this machine use, the water should be drained from the field more than 16 days before harvesting day if the field has not showed a good tendency of drainage.

a-3 Adaptability test result of harvesting work by swamp type Combine Harvest (TC-3500) on dry season of rice cultivation in 1984

* Date of harvesting	:	May 15th, 1984
* Field and area	:	Farmer's field (5.24 rais)
* Kind of paddy variety	:	Look-phasom
* Used machine	:	TC-3500, swamp type (35 HP.)
* Required worked time	:	3.9 hours (0.75 h/rai)
* Fuel consumption	:	17 litres (3.25 l/rai)
* Working speed	:	2nd. gear, middle speed position (2.55 km/h)
* Hight of paddy	:	132 cm. average
* Yield	:	4,500 kg.
* Grown paddy condition	:	Good and non-lodging

* Field condition :

The water in the field has been drained before 15 days of harvesting, but soil was not so hard because it has received rain about 23 mm. during 15 days in drying period.

** The harvesting work in this field, swamp type combine harvester, TC-3500 has nicely worked out without any troubles and it seemed to run very smoothly with high performance though the soil of field was not enough hard to use normal type combine harvester.

A view of the threshing work
by Semi - Auto feeding thresher

Same as above

b-1 Test result of threshing work by local made semi-auto feeding thresher

(1) By 5' semi-auto feeding type

* Date of the work : 17th. Nov. 1993
* Area (in the farmer's field) : 4 rais
* Used thresher : 5' type local made thresher W/65 HP.
* Worked time : 1.53 hours
* Threshed paddy : 1,650 kg. (22 bags)
* Fuel consumption : 5.5 litres (1.37 litres/rai)
* Fuel consumption per ton : 3.3 litres/ton (0.25 litre/bag)
* Working capacity : 1,044 kg/h (0.4 h/rai)
* Required labour : 7 persons (0.35 man/day/rai)

(2) By 4' semi-auto feeding type

* Date of the work : 25th. Aug. 1983 - 29th. Oct. 1993
* Total area : 31.02 rais
* Used thresher : 4' type local made thresher W/14 HP.
* Worked time : 41.77 hours
* Threshed paddy : 25,879.6 kg. (Average moisture is 17.88%)
* Fuel consumption : 49.9 litres (1.6 litres/rai)
* Fuel consumption per ton : 1.93 litres/ton (0.145 litre/bag)
* Working capacity : 619.6 kg/h (1.35 h/rai)
* Required labour : 7 persons (1.18 men/day/rai)

** Through the observation of above work, the threshing had been smoothly carried out even the paddy was not enough dried. The threshing capacity between bumper crop and poor crop was much different. The machine efficiency of 5' type thresher and 4' type thresher could not be compared in this time, because the yields were much different between farmer's field (worked by 5' type) and trial farm (worked by 4' type).

c-1 Observation record of lost grains by TC-2000D Combine Harvester

* Date of harvesting : 12th Jan. 1993

* Field and area : Plot No.140 (3.8 rais)

* Variety : RD-23

* Lost grains per 3.3 m^2

(Sampling 1)

Nomber of grains : 1926

Weight : 63.8 g.

Moisture of grain : 15.9%

(Sampling 2)

Number of grains : 1824

Weight : 57.0 g.

Moisture of grain : 15.8%

* Average of lost grains per square metre

Ripened grains : 568

Weight : 18.3 g.

Moisture of grain : 15.85%

* Yield of paddy : 429.3 kg/area (689 kg/rai)

* Percentage of lost grains: 4.26% against above yield

c-2 Observation record of lost grains by HL-1300 Combine Harvester

* Date of harvesting : 13th Jan. 1993

* Field and area : Plot No.130 (2.1 rais)

* Variety : RD-23

* Lost grains per 3.3 m^2

(Sampling 1)

Number of ripened grains : 1,142

Weight : 29.4 g.

Moisture of grains : 15.4%

(Sampling 2)

Number of ripened grains : 1,188

Weight : 30.7 g.

Moisture of grains : 15.2%

* Average of lost grains per square metre

Ripened grains : 353

Weight : 9.10 g.

Moisture of grains : 15.3%

* Yield of paddy : 385 kg/area (616 kg/rai)

* Percentage of lost grains : 2.36% against above yield

c-3 Observation record of lost grains by man power harvesting

* Date of harvesting : Dec. 10-11, 1982
* Field : Plot No.110, 120
* Variety : RD-23
* Lost grains per 3.3 m^2

(Sampling 1)

Number of ripened grains : 1,502
Weight : 39.2 g.
Moisture of grains : 14%

(Sampling 2)

Number of ripened grains : 1,954
Weight : 44.4 g.
Moisture of grains : 13.9%

* Average of lost grains per square metre

Ripened grains : 523.6
Weight : 12.67 g.
Moisture of grains : 13.95%

* Yield of paddy : 351 kg/area (561 kg/rai)
* Percentage of lost grains : 3.6% against above yield
* Number of man power : 5 men/day/rai (8 hours/day)

The lost grains of threshing work and gathering the paddy to threshing place could not calculated.

Supposedly, it was considerable that the lost grains in these works might have been happened about same volumes of as above.

With regarding to these observation, it is clearly understood that the lost grains of machine harvesting were much less than the manual harvesting.

2. Raising the technique of machinery operation, maintenance and repairing; planning of operation and management of mechanized work to the persons who are engaged in this field.

2-1 Guidance and training for proper handling of machinery operation and maintenance techniques.

Untill recently, the most important reasons in obstructing the rice mechanized cultivation in this area seemed to be immaturity and lack of mechanical knowledge, lack of management and maintenance of machinery.

And besides, the soil condition of this area was very particular as heavily sticky and deep muddy soil.

With a view to train the personnel to be experts in machinery and farm mechanization, the project had the following activities for dissolving the above problems and in order to fulfil the project implementation program.

i) Guidance and training

a. To systematize the duties.

b. To train the operaters for proper handling and effective operation of machinery.

c. To guide the mechanics for taking more responsibility towards on their duties, and rising more technique to maintain the machinery for displaying the maximum out-turn always, also to attain the maximum durability of machinery.

a-1 Systematic management of mechanized work

* To make working program of machinery in alliance with the agronomy section, and the fulfilment of rice double cropping program shall be progressed timely.

* The persons who are in charge of this section have to check and manage always the proceeding of work :

Whether the field condition is suitable .
Whether the machine is best condition.
Whether the operater has to take proper handle of the machine.
Whether the machine is made routine service properly.

* The spare parts which are necessary quantity to repair the machine timely have to be stocked always for systematic mechanized work.

b-1 Training the proper operation of machinery

* How to handle the tractor in the paddy field :
  Puddling by tractor with rotavater.
  Leveling by tractor with drive-harrow.
  Planking by tractor with drive-harrow.

* How to handle the transplanter riding type in the deep muddy soil.

* How to handle the combine harvester.

c-1 Guidance and training to mechanics

* Daily checking of machinery.

* Periodical checking of machinery.

* Maintenance of machinery before and after working season.

* Maintenance and repairing of vehicles.

In order to raise the operation and maintenance techniques, the above activities were carried out through the work of project implementation and familiarized with rapid advancement. The following manual and pamphlet have been published and are being used.

* Mechanics' and drivers' handbook.

* Proper handling and maintenance manual for battery.

* Adjustment of number of seedling and maintenance manual of transplanter.

* Guide line for maintenance and trouble shooting of agricultural machinery.

* How to handle tractor for good soil preparation on rice cultivation (Pamphlet).

* Proper handling and maintenance for transplanter.

* Operation manual for combine harvester.

* Tentative judgement of trafficability of soil.

* Relation between the time of drainage and trafficability of soil for using combine harvester.

** Through the observation of the beginning period, it seemed that the operaters and the mechanics have a good knowledge and practice in a general way, but some points were needed to raise. On the new machines which are especially improved for using on rice cultivation, they have not enough knowledge and practice.

In order to raise the operation and maintenance techniques, the persons who are concerned in this field had effort to learn the modernized machinery and its technology through the performance of their practical duties. In parallel with their practices, the preceding manuals and pamphlets have been published to them step by step for advancement of modern technology.

In the second half of the project extended period, the operaters and mechanics have rapidly familiarized on their technique, knowledge about modern machinery, operation technique of mechanized rice cultivation and proper maintenance of modern machinery.

Furthermore, they have acquired the effective and systematized management of mechanized work on rice double cropping that have to be contributed for smoothly mechanization work and raising paddy production.

3. Collection of necessary data of farm machinery work to the moter pool such as mechanization center, or joint using of farm machinery for farmers

3-1 Efficiency test result and estimation of machinery utilization cost.

a. Efficiency test result of field preparation work by tractor in the trial farm on wet season 1984

* Used machine : T-6500 Tractor with improved paddy wheels.
* Working equipment : AR-60,Rotavater; HB-2800B,Drive-harrow.
* Puddling area : 15.08 rais (Plot No.110, 120, 130, 160)
* Planking area : 23.35 rais (Plot No.110, 130, 140, 150, 160,
* Worked hour
  - Puddling : 7.7 hours (1.96 rais/h) (0.51 h/rai)
  - Planking : 18.15 hours (1.29 rais/h) (0.78 h/rai)
* Fuel consumption
  - Puddling : 57.5 litres (7.46 l/h) (3.81 l/rai)
  - Planking : 133.5 litres (7.35 l/h) (5.74 l/rai)

** The plowing work has been done just after harvesting of former crop finished, so for puddling work, fertilizer or green manure had to be mixed in the soil for some plots. And the work was done one time only.

The planking work was done three to four times repeatedly in cross way for keeping good condition of field-level continuously.

In this season, the work was very nicely carried out without any troubles, and operation technique much more advanced than before.

a-1 Cost estimation of machinery utilization for the soil preparation in the trial farm of IADP. Chao Phya in 1984

a-1.1 Tractor (model T-6500, 65 HP, 4 wheel-drive type)

Capital expense	: P (Price)	390,000 ฿
Life of machine	: n (Year)	10
Utilized hour in a year	: H	900 hours
Ratio of stational cost in a year : Fc = 22.1% of P		
Stational cost in a year : Tf = (D+@1+@2+@3+@4)		93,990 ฿
depreciation value : D = (P-S)/n		34,200 ฿
* S = Scrap value is regarded as P x 10%		
capital interest : @1 = i x (P+S)/2, (i = 0.12)		25,090 ฿
maintenance cost : @2 = (0.05 x P)		19,000 ฿
garage expense : @3 = (0.005 x P)		1,900 ฿
stational lube. cost : @4 = (0.01 x P)		3,900 ฿
Stational cost per hour	: T1 = (Tf/H)	93.31 ฿

a-1.2 Rotavater (model AR-60)

Capital expense	: P (Price)	65,000 ฿
Life of machine	: n (Year)	8
Utilized hour in a year	: H	400 hours
Ratio of stational cost in a year : Fc = 25% of P		
Stational cost in a year : Tf = (D+@1+@2+@3+@4)		16,250 ฿
depreciation value : D = (P-S)/n		8,125 ฿
* S = Scrap value is regarded as P x 0%		
capital interest : @1 = i x (P+S)/2, (i = 0.12)		3,900 ฿
maintenance cost : @2 = (0.05 x P)		3,250 ฿
garage expense : @3 = (0.005 x P)		325 ฿
stational lube. cost : @4 = (0.01 x P)		650 ฿
Stational cost per hour	: T2 = (Tf/H)	40.03 ฿

a-1.3 Drive-harrow (model HB 2300-B)

Capital expense	: P (Price)	54,000 ฿
Life of machine	: n (Year)	9
Utilized hour in a year	: H	500 hours
Ratio of stational cost in a year	: Fc = 25% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	13,500 ฿
depreciation value	: D = (P-S)/n	6,750 ฿
* S = Scrap value is regarded as P x 0%		
capital interest	: @1 = i x (P+S)/2, (i = 0.12)	3,240 ฿
maintenance cost	: @2 = (0.05 x P)	2,700 ฿
garage expense	: @3 = (0.005 x P)	270 ฿
stational lube. cost	: @4 = (0.01 x P)	540 ฿
Stational cost per hour	: T3 = Tf/H)	27 ฿

a-1.4 Improved paddy wheels (local made, designed by C.P.P.P)

Capital expense	: P (Price)	11,000 ฿
Life of implement	: n (Year)	9
Utilized hour in a year	: H	900 hours
Ratio of stational cost in a year	: Fc = 21% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	2,310 ฿
depreciation value	: D = (P-S)/n, (S = P x 0%)	1,375 ฿
capital interest	: @1 = i x (P+S)/2, (i = 0.12)	660 ฿
maintenance cost	: @2 = (0.01 x P)	110 ฿
garage expense	: @3 = (0.005 x P)	55 ฿
stational lube. cost	: @4 = (0.01 x P)	110 ฿
Stational cost per hour	: T4 = (Tf/H)	2.57 ฿

a-1.5 Working capacity

$C = W \times V/10 \times E = Ct \times E$

C = Practical working capacity (ha/h)

W = Working wide (m)

V = Working speed (km/h)

$E = C/Ct \times 100$ = Working efficiency in the field (%)

$Ct = W \times V/10$ = Theorical working capacity (ha/h)

(a) Puddling work (or plowing work)

C = 0.31 ha/h

W = 1.52 m.

V = 2.6 km/h (Position of speed change lever is 3rd. of low)

E = 73.5%

Ct = 0.395 ha/h

(b) Leveling work

C = 0.21 ha/h (If the work was done 1 time = 0.62 ha/h)

W = 2.0 m.

V = 4.1 km/h (Position of speed change lever is 4th. of low)

E = 26% (76%)

Ct = 0.82 ha/h

a-1.6 Working cost

To = Fcf + Fco + Lc

Fcf = Fuel cost (diesel 7.04 ฿/litre)

Fco = Lube. oil cost = Fcf x 0.3 (36.00 ฿/litre)

Lc = Labour wages (56.00 ฿/day)

In case of puddling work :

Fcf = 52.52 ฿/h (7.46 litres/h)

Fco = 15.76 ฿/h

Lc = 7.00 ฿/h (56.00 ฿/8 hours/day)

To1 = 75.28 ฿/h

In case of leveling work :

Fcf = 51.74 ฿/h (7.35 litres/h)

Fco = 15.52 ฿/h

Lc = 7.00 ฿/h (56.00 ฿/8 hours/day)

To2 = 74.26 ฿/h

a-1.7 Total working cost

TE = T1 + T2 + T4 + To1

7-1 Puddling work : 211.79 ฿/h (108.01 ฿/rai)

TE' = T1 + T3 + T4 + To2

7-2 Leveling work : 197.14 ฿/h (151.43 ฿/rai)

b. Efficiency test of field preparation work by tractor at pilot area on wet rice in 1994

* Number of farmer : 32

* Used tractors : MF-135 (75 HP) attached with improved paddy wheels.
T-6500 (65 HP)

* Working equipments : AR-60 Rotavater and HB-2300 Drive-harrow

* Puddling area : 337 rais - 84 rais by MF-135
- 253 rais by T-6500

* Planking area : 316 rais (by T-6500)

* Worked hours

Puddling work : 133.0 hours (0.53 h/rai) (1.9 rais/h) by T-6500
36.0 hours (0.43 h/rai) (2.33 rais/h) by MF-135
Total = 169.0 hours

Planking work : 93.0 hours (0.30 h/rai) (3.40 rais/h) by T-6500
Total = 93.0 hours

* Fuel consumption

Puddling work : 295 litres; 8.19 l/h (3.51 l/rai) by MF-135
1040 litres; 7.81 l/h (4.11 l/rai) by T-6500

Planking work : 715 litres; 7.69 l/h (2.26 l/rai) by T-6500

In this season, the field condition was very good for tractor use, that is the bearing capacity of soil was quite enough to run the tractor because the farmers made the fields completely dry up for enhancement of soil bearing capacity about 1 month period before this season; according to the direction of the project staff.

There were a few farmers' fields where were deep muddy soil; some farmers had not take the project direction to dry the field completely before season and the tractor had not smoothly worked.

b-1. Cost estimation of machinery utilization for the soil preparation in the pilot area of IADP. Chao Phya in 1984

b-1.1 Tractor (model T-6500, 65 HP, 4 wheel-drive type)

Capital expense	: P (Price)	380,000 ฿
Life of machine	: n (Year)	10
Utilized hour in a year	: H	900 hours
Ratio of stational cost in a year	: Fc = 22.1% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	83,980 ฿
depreciation value	: D = (P-S)/n	34,200 ฿
* S = Scrap value is regarded as P x 10%		
capital interest	: @1 = i x (P+S)/2, (i = 0.12)	25,080 ฿
maintenance cost	: @2 = (0.05 x P)	19,000 ฿
garage expense	: @3 = (0.005 x P)	1,900 ฿
stational lube. cost	: @4 = (0.01 x P)	3,800 ฿
Stational cost per hour	: T1 = (Tf/H)	93.31 ฿

b-1.2 Rotavater (model AR-60)

Capital expense	: P (Price)	65,000 ฿
Life of machine	: n (Year)	8
Utilized hour in a year	: H	400 hours
Ratio of stational cost in a year	: Fc = 25% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	16,250 ฿
depreciation value	: D = (P-S)/n	8,125 ฿
* S = Scrap value is regarded as P x 0%		
capital interest	: @1 = i x (P+S)/2, (i = 0.12)	3,900 ฿
maintenance cost	: @2 = (0.05 x P)	3,250 ฿
garage expense	: @3 = (0.005 x P)	325 ฿
stational lube. cost	: @4 = (0.01 x P)	650 ฿
Stational cost per hour	: T2 = (Tf/H)	40.03 ฿

b-1.3 Drive-harrow (model HB 2300-B)

Capital expense	: P (Price)	54,000 ฿
Life of machine	: n (Year)	8
Utilized hour in a year	: H	500 hours
Ratio of stational cost in a year	: Fc = 25% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	13,500 ฿
depreciation value	: D = (P-S)/n	6,750 ฿
* S = Scrap value is regarded as P x 0%		
capital interest	: @1 = i x (P+S)/2, (i = 0.12)	3,240 ฿
maintenance cost	: @2 = (0.05 x P)	2,700 ฿
garage expense	: @3 = (0.005 x P)	270 ฿
stational lube. cost	: @4 = (0.01 x P)	540 ฿
Stational cost per hour	: T3 = Tf/H)	27 ฿

b-1.4 Improved paddy wheels (local made, designed by C.P.P.P)

Capital expense	: P (Price)	11,000 ฿
Life of implement	: n (Year)	8
Utilized hour in a year	: H	900 hours
Ratio of stational cost in a year	: Fc = 21% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	2,310 ฿
depreciation value	: D = (P-S)/n, (S = P x 0%)	1,375 ฿
capital interest	: @1 = i x (P+S)/2, (i = 0.12)	660 ฿
maintenance cost	: @2 = (0.01 x P)	110 ฿
garage expense	: @3 = (0.005 x P)	55 ฿
stational lube. cost	: @4 = (0.01 x P)	110 ฿
Stational cost per hour	: T4 = (Tf/H)	2.57 ฿

b-1.5 Working capacity

C = W x V/10 x E = Ct x E

C = Practical working capacity (ha/h)

W = Working wide (m)

V = Working speed (km/h)

E = C/Ct x 100 = Working efficiency in the field (%)

Ct = W x V/10 = Theorical working capacity (ha/h)

(a) Puddling work (or plowing work)

C = 0.30 ha/h

W = 1.52 m.

V = 2.6 km/h (Position of speed change lever is 3rd. of low)

E = 76%

Ct = 0.395 ha/h

(b) Leveling work

C = 0.54 ha/h

W = 2.0 m.

V = 4.1 km/h (Position of speed change lever is 4th. of low)

E = 66%

Ct = 0.92 ha/h

b-1.6 Working cost

To = Fcf + Fco + Lc

Fcf = Fuel cost (diesel 7.04 ฿/litre)

Fco = Lube. oil cost = Fcf x 0.3 (36.00 ฿/litre)

Lc = Labour wages (56.00 ฿/day)

In case of puddling work :

Fcf = 54.93 ฿/h (7.31 litres/h)

Fco = 16.49 ฿/h

Lc = 7.00 ฿/h (56.00 ฿/8 hours/day)

To1 = 78.47 ฿/h

In case of leveling work :

Fcf = 54.14 ฿/h (7.69 litres/h)

Fco = 16.24 ฿/h

Lc = 7.00 ฿/h (56.00 ฿/8 hours/day)

To2 = 77.38 ฿/h

b-1.7 Total working cost

TE = T1 + T2 + T4 + To1

7-1 Puddling work : 214.98 ฿/h (113.14 ฿/rai)

TE' = T1 + T3 + T4 + To2

7-2 Leveling work : 200.26 ฿/h (95.95 ฿/rai)

c. Result of efficiency test of rice transplanting by S-400 in model farm

* Date of transplanting	: June 30, 1993
* Field and area	: Model farm 9 rais
* Used machine	: S-400, 4 row-rice transplanter
* Variety, kind of seedling	: RD-23, box-seedling
* Age of seedling	: 25 days
* Planting space	: 30 cm. x 16 cm.
* Used number of box-seedling	: 48 boxes/rai
* Worked time	: 9.2 hours (planting speed = 1.4 km/h)
* Planting precision	: 0.52% (under observation of 20,000 hills)
* Average worked hours	: 1.15 hour/rai
* Fuel consumption	: 5.0 litres (0.63 litre/rai)

* Field preparation

Puddling and leveling work were done by tractor; final planking work was done by power tiller and wooden leveler.

After finished field preparation, it should keep standing water continuously in the field about 6 days. In this period the melted soil precipitated and setted down in the bottom of field, and then the sticky and muddy soil turned into good condition of soil by membranous matter and algae.

** Through the observation of this work, the rice transplanter was nicely carried out, but the planting precision was not so good because some parts in the plot were remaining un-leveled and too deep water, so 1.4 km/h of planting speed seemed to be too fast. Accordingly, the planting speed should be 1 km. to 1.2 km/hour according to field condition for getting better planting precision.

c-1. Cost estimated for utilization of rice transplanter
(in case of S-400, 4 row-walking type rice transplanter)

c-1.1 Rice transplanter (model S-400, 4 row)

Capital expense	: P (Price)	42,620 ฿
Life of machine	: n (Year)	8
Utilized hour in a year	: H (Hour)	320 hours
Ratio of stational cost in a year	: Fc = 24% of P	
Stational cost in a year	: Tf = (D+C1+C2+C3+C4)	10,627.30 ฿
depreciation value	: D = (P-S)/n	5,274.23 ฿
* S = Scrap value is regarded as P x 1%		
capital interest	: C1 = i x (P+S)/2, (i=0.12)	2,532.77 ฿
maintenance cost	: C2 = (0.05 x P)	2,131 ฿
garage expense	: C3 = (0.005 x P)	213.10 ฿
stational lube. cost	: C4 = (0.01 x P)	426.20 ฿
Stational cost per hour	: T = (Tf/H)	33.21 ฿

* Machine price was in 1978

c-1.2 Working capacity

C = W x V/10 x E = Ct x E

C = 0.14 = Practical working capacity (ha/h)

W = 1.2 = Working wide (m)

V = 1.4 = Working speed (km/h)

E = 82% = C/Ct x 100 = Working efficiency in the fiel

Ct = 0.17 ha/h = W x V/10 = Theorical working capacity

c-1.3 Working cost

To = 35.72 ฿/h = Fcf + Fco + Lc + Lc'

Fcf = 5.94 ฿/h = Fuel cost (gasoline 11.00 ฿/litre)

Fco = 1.78 ฿/h = Lube. oil = Fcf x 30% (36.00 ฿/litre)

Lc = 7.00 ฿/h = Labour wages (56.00 ฿/day)

Lc' = 21.00 ฿/h = Helper wages (56.00 ฿/day) 3 persons

c-1.4 Total working cost

TE = T + To

TE = 69.93 ฿/h (79.27 ฿/rai)

d. Result of efficiency test of rice transplanting by PL-500W in trial farm

* Date of transplanting : Dec. 22, 1983 and Dec. 27, 1983

* Field and area : Plot No.130, 160 (4.13 rais, 3.97 rais)
Total = 8.1 rais

* Used machine : PL-500W (5 row, double-wheel, 4 wheel-drive)

* Variety, kind of seedling : RD-23, Box-seedling

* Age of seedling : 21 days (No.130), 18 days (No.160)

* Planting space : 30 cm. x 18 cm.

* Used number of the box-seedling : 52 boxes/rai (No.130), 47 boxes/rai (No.160) average = 49.5 boxes/rai

* Worked time : 5.0 hours (No.130), 4.7 hours (No.160)
Total = 9.7 hours

Note : Planting speed was set 1.1 km/h.
Turning & feeding time was 1.43 minutes

* Planting precision : Average miss-plant and floating-plant were 0.38% under observation of 2,000 hills.

* Average worked hour : 1.20 hours/rai

* Fuel consumption : 9.5 litres (1.17 litres/rai)

* Field preparation

Puddling and leveling were done by tractor T-6500 equipped with improved paddy wheels, and utilized attachments were rotavater (AR-60) and drive-harrow (HB-2800). Kept the field in standing water about 15 cm. depth continuously 6 days after finished leveling work. During this period, the soil in colloidal condition was settled in the bottom of field and turned the soil into good condition for using the transplanter. Drained water out and made the water depth in the field about 5 cm. just before starting the transplanting work.

** Through the observation of above work, the transplanter was nicely carried out and gained good result.

The planting precision was about 0.38%, that was maximum out-turn of this machine. The reason was good field level and uniform seedling.

d-1. Cost estimated for utilization of rice transplanter
(in case of PL-500W, 5 row-riding type rice transplanter)

d-1.1 Rice transplanter (model PL-500W, 5 row)

Capital expense	: P (Price)	155,000 ฿
Life of machine	: n (Year)	9
Utilized hour in a year	: H (Hour)	480 hours
Ratio of stational cost in a year	: Fc = 24% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	36,905.50 ฿
depreciation value	: D = (P-S)/n	17,437.50 ฿
* S = Scrap value is regarded as P x 1%		
capital interest	: C1 = i x (P+S)/2, (i=0.12)	9,393 ฿
maintenance cost	: C2 = (0.05 x P)	7,750 ฿
garage expense	: C3 = (0.005 x P)	775 ฿
stational lube. cost	: C4 = (0.01 x P)	1,550 ฿
Stational cost per hour	: T = (Tf/H)	76.89 ฿

d-1.2 Working capacity

C = W x V/10 x E = Ct x E

C = 0.134 = Practical working capacity (ha/h)

W = 1.5 = Working wide (m)

V = 1.1 = Working speed (km/h)

E = 81% = C/Ct x 100 = Working efficiency in the field

Ct = 0.165 ha/h = W x V/10 = Theorical working capacity

d-1.3 Working cost

To = 42.01 ฿/h = Fcf + Fco + Lc + Lc'

Fcf = 10.78 ฿/h = Fuel cost (gasoline 11.00 ฿/litre)

Fco = 3.23 ฿/h = Lube. oil = Fcf x 30% (36.00 ฿/litre)

Lc = 7.00 ฿/h = Labour wages (56.00 ฿/day)

Lc' = 21.00 ฿/h = Helper wages (56.00 ฿/day) 3 persons

d-1.4 Total working cost

TE = T + To

TE = 118.90 ฿/h (141.55 ฿/rai)

e. Result of efficiency test of direct sowing by machine

* Date : Dec. 20th, 1984
* Plot and area : No. 160, 3.97 rais
* Used machine : Tractor (YM-330DT) with broadcaster
* Tractor speed : 1st. gear, high speed position; 3.6 $^{km}/h$
* Engine rpm. : 1800
* P.T.O. rpm : 877
* Shutter open ratio of broadcaster : index - 7
* Sown wide of paddy : About 12 metres
* Paddy variety : RD-23
* Quantity of the sown seeds : 12.5 $^{kh}/rai$
* Field condition : Kept the field in standing water about 1 5 cm. depth and 4 days after finished field preparation.
* Worked time : 22 minutes (it includes the time of machine arrangement and field arrangement.) (5.5 minutes/rai)
* Actual sowing time : 11.5 minutes (2.9 minutes/rai)
* Fuel consumption : 2 litres (0.5 litre/rai)
* Density of rice plants after 18 days sowing : $148/m^2$

** The paddy seeds were being germinated and the roots of seed grew 15 mm. to 20 mm. when sowing work started, especially the root of germinated seeds had been treated to be soft by drying about 5 hours not under direct sunshine. This means to protect the roots of seeds break at the time of sowing by machine. Moreover, the dried roots of seed which was 15 cm. - 20 cm. has played a preventive role to bury deep in the soft soil of field and has helped a nice growing paddy plants at the initial stage. And it made uniform density of sown seeds when going through the water depth

The field preparation work was finished 4 days before sowing and kept the field in standing water till the melted soil settled down to the bottom of field.

e-1. Estimation of machinery utilization cost for direct sowing work

e-1.1 Tractor (model YM-330 DT, 33 HP)

Capital expense	: P (Price)	185,000 ฿
Life of machine	: n (Year)	10
Utilized hour in a year	: H (Hour)	900 hours
Ratio of stational cost in a year	: Fc = 21% of P	
Stational cost in a year	: Tf =(D+@1+@2+@3+@4)	38,110 ฿
depreciation value	: D = (P-S)/n	16,650 ฿
* S = Scrap value is regarded as P x 10%		
capital interest	: @1 = i x (P+S)/2, (i = 0.12)	11,100 ฿
maintenance cost	: @2 = (0.05 x P)	9,250 ฿
garage expense	: @3 = (0.005 x P)	925 ฿
stational lube. cost	: @4 = (0.01 x P)	185 ฿
Stational cost per hour	: T = (Tf/H)	42.34 ฿

e-1.2 Broadcaster (model MBC-2610)

Capital expense	: P (Price)	25,000 ฿
Life of machine	: n (Year)	8
Utilized hour in a year	: H (Hour)	200 hours
Ratio of stational cost in a year	: Fc = 25% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	6,250 ฿
depreciation value	: D = (P-S)/n	3,125 ฿
* S = Scrap value is regarded as P x 0%		
capital interest	: @1 = i x (P+S)/2, (i = 0.12)	1,500 ฿
maintenance cost	: @2 = (0.05 x P)	1,250 ฿
garage expense	: @3 = (0.005 x P)	125 ฿
stational lube. cost	: @4 = (0.01 x P)	250 ฿
Stational cost per hour	: T1 = (Tf/H)	31.25 ฿

e-1.3 Improved paddy wheels (local made, designed by C.P.P.P.)

Capacity expense	: P (Price)	7,000 ฿
Life of implement	: n (Year)	8
Utilized hour in a year	: H	900 hours
Ratio of stational cost in a year	: Fc = 21% of P	

Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	1,470 ฿
depreciation value	: D = (P-S)/n, (S = P x 0%)	875 ฿
capital interest	: @1 = i x (P+S)/2. (i = 0.12)	420 ฿
maintenance cost	: @2 = (0.01 x P)	70 ฿
garage expense	: @3 = (0.005 x P)	35 ฿
stational lube.cost	: @4 = (0.01 x P)	70 ฿
Stational cost per hour	: T2 = (Tf/H)	1.63 ฿

e-1.4 Working capacity

C = W x V/10 X E = Ct x E

C = 1.75 = Practical working capacity (ha/h)

W = 11 = Working wide (m)

V = 3.6 = Working speed (km/h)

E = 44% = C/Ct x 100 = Working efficiency in the field (%)

Ct = 3.96 = W x V/10 = Theorical working capacity (ha/h)

* Actual measurement of working hour was 11.5 minutes per plot (one plot ≒ 4 rais) and seeds supply in the tank of broadcaster with adjustment of machine and arrangement of field was 10.5 minutes. Total requirement of working hour was 22 minutes per plot. Usually, the time of seeds supply and arrangements (field, machine) are considered as 30% - 40% of whole working time due to the size of area or total worked area per day. Therefore, in this case, the working efficiency in the field (E) is considered 84% as (44% of field work) + (40% of required time for field arrangement and machine adjustment).

e-1.5 Working cost

To = 74.40 ฿/h = (Fcf + Fco + Lc + Lc')

Fcf = 38.40 ฿/h = Fuel cost (diesel 7.04 ฿/litre)

Fco = 11.52 ฿/h ≒ Lube. oil = Fcf x 30% (36.00 ฿/litre)

Lc = 7.00 ฿/h = Labour wages (56.00 ฿/day)

Lc' = 7.00 ฿/h = Helper wages (56.00 ฿/day)

e-1.6 Total working cost

TE = T + T1 + T2 + To

TE = 134.32 ฿/h (12.31 ฿/rai)

f. Test result of threshing work by local made semi-auto feeding thresher

(1) By 5' semi-auto feeding type

* Date of the work : 17th. Nov. 1993
* Area (in the farmer's field) : 4 rais
* Used thresher : 5' type local made thresher W/65 HP.
* Worked time : 1.53 hours
* Threshed paddy : 1,650 kg. (22 bags)
* Fuel consumption : 5.5 litres (1.37 litres/rai)
* Fuel consumption per ton : 3.3 litres/ton (0.25 litre/bag)
* Working capacity : 1,044 kg/h (0.4 h/rai)
* Required labour : 7 persons (0.35 man/day/rai)

(2) By 4' semi-auto feeding type

* Date of the work : 25th. Aug. 1993 - 29th. Oct. 1993
* Total area : 31.02 rais
* Used thresher : 4' type local made thresher W/14 HP.
* Worked time : 41.77 hours
* Threshed paddy : 25,979.6 kg. (Average moisture is 17.33%)
* Fuel consumption : 49.9 litres (1.6 litres/rai)
* Fuel consumption per ton : 1.93 litres/ton (0.145 litre/bag)
* Working capacity : 619.6 kg/h (1.35 h/rai)
* Required labour : 7 persons (1.13 men/day/rai)

f-1. Estimation of utilization cost for the thresher in case of 4' type

f-1.1 4' type semi-auto feeding thresher

Capital expense	: P (Price)	45,000 ฿
Life of machine	: n (Year)	8
Utilized hour in a year	: H (Hour)	450 hours
Ratio of stational cost in a year	: Fc	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	11,250 ฿
depreciation value	: D = (P-S)/n	5,625 ฿
* S = Scrap value is regarded as P x 0%		
capital interest	: @1 = i(P+S)/2, (i = 0.12)	2,700 ฿
maintenance cost	: @2 = (0.05 x P)	2,250 ฿
garage expense	: @3 = (0.005 x P)	225 ฿
stational lube. cost	: @4 = (0.01 x P)	450 ฿
Stational cost per hour	: $\underline{T}$ = (Tf/H)	25 ฿

f-1.2 Working capacity

C = 619.6 = Practical working capacity (kg/h)

E = 62% = C/Ct x 100 = Working efficiency in the field

Ct = 1,000 kg/h = Theorical working capacity (information of manufacturing)

f-1.3 Working cost

$\underline{To}$ = 59.93 ฿/h = Fcf + Fco + Lc

Fcf = 8.41 ฿/h = Fuel cost (Diesel 7.04 ฿/litre)

Fco = 2.52 ฿/h = Lube. oil ≒ Fcf x 30% (36.00 ฿/litre)

Lc = 49.00 ฿/h = Labour wages (56.00 ฿/day) 7 persons

f-1.4 Total working cost

TE = T + To

TE = 84.93 ฿/h (114.60 ฿/rai) (137.10 ฿/ton)

5. Test result of harvesting work by TC-2000D Combine Harvester

* Date of harvest : Jan. 12, 1993
* Field and area : Plot No.140 of trial farm 3.9 rais
* Kind of paddy variety : RD-23
* Used machine : TC-2000D Combine Harvester
* Required working time : 5.5 hours (1.45 h/rai)
* Fuel consumption : 9 litres (2.36 litres/rai) diesel oil
* Working speed : 3rd. gear of working position
* Yield of paddy : 429.3 kg/area (689 kg/rai)

* Condition of grow paddy

Average height of paddy was 120 cm. in good grown condition, and the co-efficient of lodging seemed to be index 3.

** It applied the number of index which is using in Japan as a standard of the lodging co-efficient to this case.
(eg. Non lodging is index 0, complete lodging is index 6)
Date of transplanting was Oct. 7, 1992 by PL-500W.

* Field condition

The hardness of soil was good enough for using the combine harvester because it was in dry season. The water was drained from the field 20 days before harvesting.

ง-1. Cost estimation of combine harvester, TC-2000D

ง-1.1 Rice combine harvester (model TC-2000D)

Capital expense	: P (Price)	345,000 ฿
Life of machine	: n (Year)	9
Utilized hour in a year	: H (Hour)	640 hours
Ratio of stational cost in a year	: Fc = 25% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	96,025.75 ฿
depreciation value	: D = (P-S)/n	42,693.75 ฿
* S = Scrap value is regarded as P x 1%		
capital interest	: C1 = i x (P+S)/2, (i=0.12)	20,907 ฿
maintenance cost	: C2 = (0.05 x P)	17,250 ฿
garage expense	: C3 = (0.005 x P)	1,725 ฿
stational lube. cost	: C4 = (0.01 x P)	3,450 ฿
Stational cost per hour	: T = (Tf/H)	134.42 ฿

ง-1.2 Working capacity

C = W x V/10 x E = Ct x E

C = 0.11 = Practical working capacity (ha/h)

W = 1.1 = Working wide (m)

V = 2.0 = Working speed (km/h)

E = 50% = C/Ct x 100 = Working efficiency in the field

Ct = 0.22 ha/h = W x V/10 = Theorical working capacity

ง-1.3 Working cost

To = 23.97 ฿/h = Fcf + Fco + Lc + Lc'

Fcf = 11.52 ฿/h = Fuel cost (gasoline 11.00 ฿/litre)

Fco = 3.45 ฿/h = Lube. oil = Fcf x 30% (36.00 ฿/litre)

Lc = 7.00 ฿/h = Labour wages (56.00 ฿/day)

Lc' = 7.00 ฿/h = Helper wages (56.00 ฿/day) 1 person

ง-1.4 Total working cost

TE = T + To

TE = 163.39 ฿/h (236.48 ฿/rai)

h. Test result of harvesting work by swamp type combine harvester(TC-3500) dry season rice of 1994

* Date of harvesting : May 15, 1994
* Field and area : Farmer's field (5.24 rais)
* Kind of paddy variety : Look-phasom
* Used machine : TC-3500, swamp type, 35 HP.
* Required worked time : 3.9 hours (0.75 h/rai)
* Fuel consumption : 17 litres (3.25 l/rai)
* Working speed : 2nd. gear, middle speed position (2.55 km/h)
* Height of paddy : 132 cm. average
* Yield : 4,500 kg.
* Crop paddy condition : Good and non-lodging
* Field condition

The water in the field has been drained before 15 days of harvesting, and soil was not so hard because it has received rain about 23 mm. during 15 days of drying period.

With the observation of this work, swamp type combine harvester, TC-3500 has nicely worked out without any troubles and it seemed to run very smoothly with high performance work though the soil of field was not enough hard to use normaltype combine harvester.

h-1. Estimation of utilization cost for combine harvester (TC-3500)

h-1.1 Combine harvester (TC-3500, for swamp using type)

Capital expense	: P (Price)	450,000 ฿
Life of machine	: n (Year)	9
Utilized hour in a year	: H (Hour)	450 hours
Ratio of stational cost in a year	: Fc = 24.9% of P	
Stational cost in a year	: Tf = (D+@1+@2+@3+@4)	112,207.50 ฿
depreciation value	: D = (P-S)/n	55,687.50 ฿
* S = Scrap value is regarded as P x 1%		
capital interest	: @1 = i x (P+S)/2, (i=0.12)	27,270 ฿
maintenance cost	: @2 = (0.05 x P)	22,500 ฿
garage expense	: @3 = (0.005 x P)	2,250 ฿
stational lube. cost	: @4 = (0.01 x P)	4,500 ฿
Stational cost per hour	: T = (Tf/H)	249.35 ฿

h-1.2 Working capacity

C = W x V/10 x E = Ct x E

C = 0.22 = Practical working capacity (ha/h)

W = 1.2 = Working wide (m)

V = 2.55 = Working speed (km/h)

E = 73% = C/Ct x 100 = Working efficiency in the field

Ct = 0.3 ha/h = W x V/10 = Theorical working capacity

h-1.3 Working cost

To = 53.90 ฿/h = Fcf + Fco + Lc + Lc'

Fcf = 30.70 ฿/h = Fuel cost (diesel 7.04 ฿/litre)

Fco = 9.20 ฿/h = Lube. oil = Fcf x 0.3 (36.00 ฿/litre)

Lc = 7.00 ฿/h = Labour wages (56.00 ฿/day)

Lc' = 7.00 ฿/h = Helper wages (56.00 ฿/day)

h-1.4 Total working cost

TE = T + To

TE = 303.25 ฿/h (227.44 ฿/rai)

3-2 Trial result of the foreknowing to trafficability of soil in the trial farm

As it is know that the soil characters as proper character, variable character, kinetics character of soil etc., are closely related to the trafficability of soil.

Notwithstanding, most of the institutes concerned in the developed countries have been searching to establish the formula of trafficability, the formula of accurate expressing for trafficability on the soil could not been formulated up to present.

In parallel with propagation of the farm mechanization, the method which is simplificative judging of trafficability is very required for making an adequate plan of farm mechanization, especially on rice mechanized cultivation program and for improvement of farm machinery.

In this connection, the Chaophya Pilot Project had repeatedly tried to observe the machinery running test in the several conditioned fields, and tried to measure the soil resistance in different condition of the field in particular, during past two years.

The results ate as follows :

a. Movility of tractor in the paddy field of several condition.

a-1 In case that the wheels-sinkage-depth did not exceed 15 cm. and without soil adhered to the wheels, the tractor had a good running result.

a-2 In case that the wheels-sinkage-depth exceeded 15 cm. but not over 20 cm. the tractor could run with some slippage; if soil adhered to the wheels continuously as to be drum or wheels caught soil in the cage, the tractor could not run.

a-3 In case that the wheels-sinkage-depth exceeded 20 cm. but not over 25 cm. the tractor could run hardly without soil adhered to the wheels, and it seemed to be high percentage of slippage.

a-4 In case that the wheels-sinkage-depth exceeded 25 cm. the tractor could not run.

** Used tractor : 75 HP. 2 wheel-drive type; 65 HP. 4 wheel-drive; and 33 HP. 4 wheel-drive; attached with improved paddy wheels.

The travel reduction by slippage seemed to be increased according to the wheels-sinkage-depth, wet soil and shortage of water in the field such as under 5.0 cm. of standing water; it caused the soil adhered to the wheels and influenced the movility of tractor.

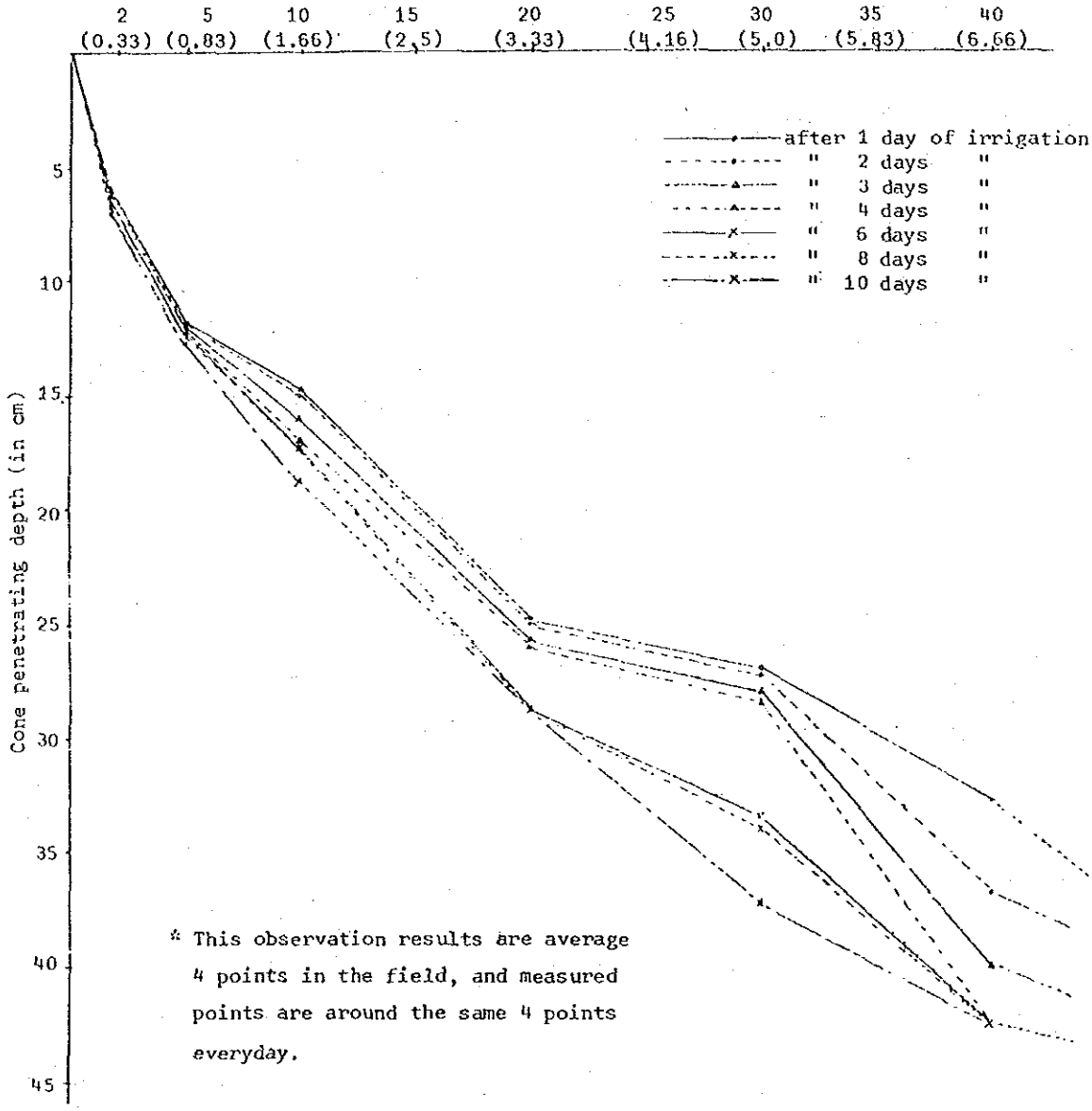
b. Measurement of soil resistance

For the purpose of knowing the soil character, it was measured in several soil condition by "SR-II" soil resistance tester. These results are shown in following papers.

b-1. OBSERVATION OF THE VARIATION OF SOIL BEARING CAPACITY AFTER IRRIGATION AT THE FIELD NO.230 (USED BY SR-II, SOIL RESISTANCE TESTER)

: Cone penetration curve

Cone index kg (kg/cm^2) used large cone.

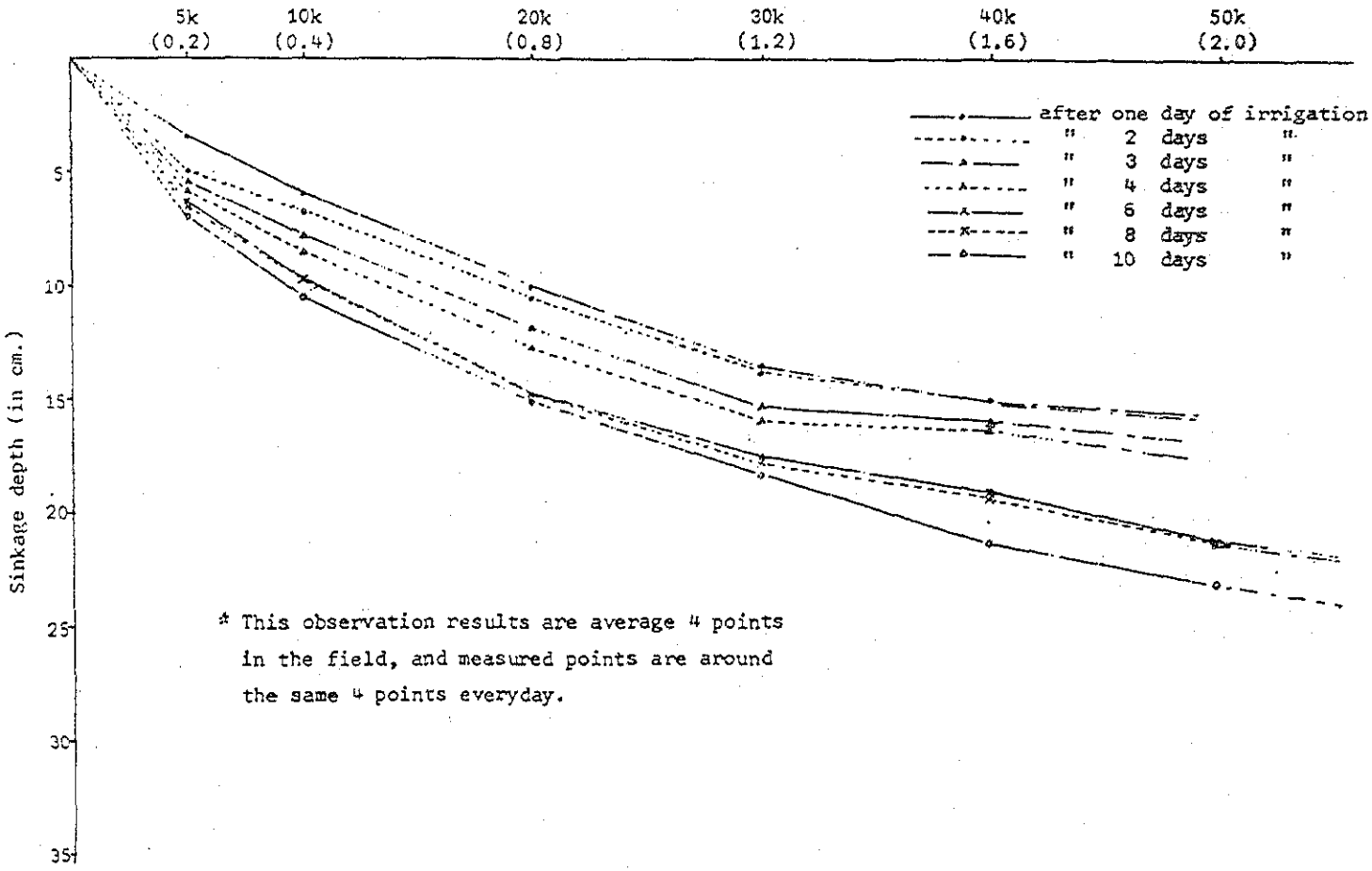


* This observation results are average 4 points in the field, and measured points are around the same 4 points everyday.

b-2. OBSERVATION OF THE VARIATION OF SOIL BEARING CAPACITY AFTER IRRIGATION AT THE FIELD NO. 230
(USED BY SR-II, SOIL RESISTANCE TESTER)

: Rectangular plate sinkage curve

Vertical load on the plate 100 mm. x 25 mm. kg.,(kg/cm^2)



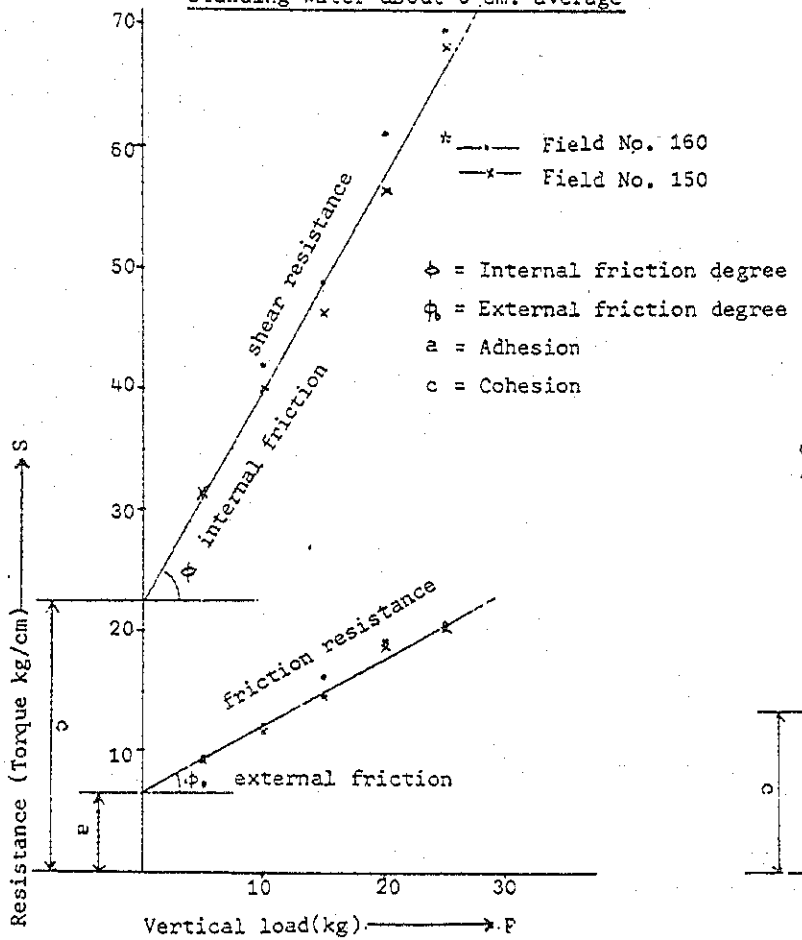
* This observation results are average 4 points in the field, and measured points are around the same 4 points everyday.

b-3. OBSERVATION OF THE SHEARING AND FRICTION RESISTANCE (USED BY SR-II, SOIL RESISTANCE TESTER)

Shear and friction diagram

(A) 4 days after irrigation in field.

standing water about 3 cm. average



* —·— Field No. 160

—×— Field No. 150

ϕ = Internal friction degree

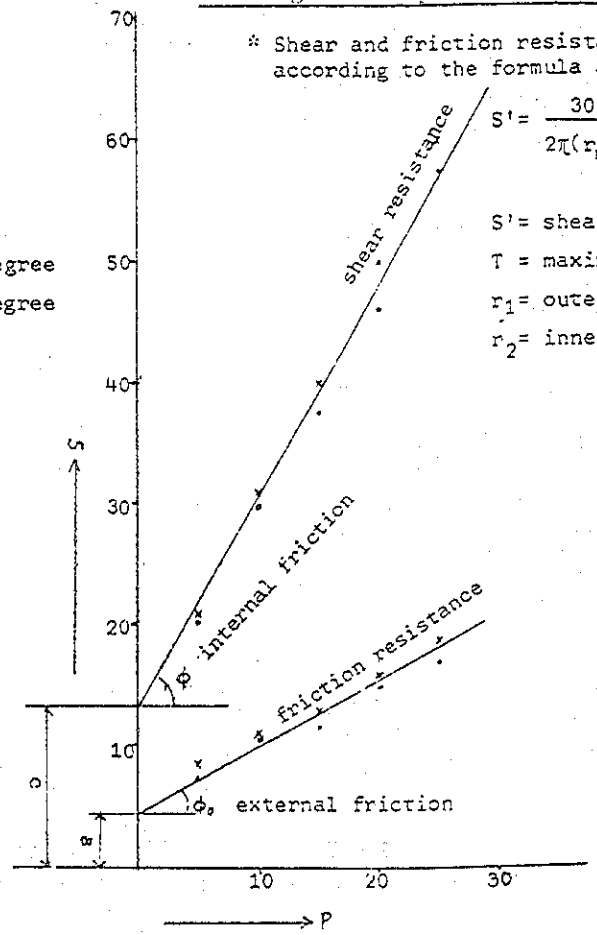
ϕ_0 = External friction degree

a = Adhesion

c = Cohesion

(B) 7 days after irrigation in field and after puddling.

standing water depth about 10 cm. average



* Shear and friction resistance can be calculated according to the formula as follows :

$$S' = \frac{300T}{2\pi(r_1^3 - r_2^3)} = \frac{47.7T}{r_1^3 - r_2^3} \fallingdotseq \frac{T}{2}$$

S' = shear or friction resistance

T = maximum torque(kg/m)

r_1 = outer radius of ring = 5 cm.

r_2 = inner radius of ring = 3 cm.

c. Analyzation of preceding data for trafficability rating of soil

On the strength of the preceding results, we try to presume the trafficability of soil for a simple way of judgement, and to make suitable working condition of the soil, depth of standing water for the machinery use in this area.

From the measurement result of soil resistance, the field soil is gradually softened from the surface to the deepward in parallel with the lapse of days in standing water in the field, but softened soil depth and soil character are not become in portion to the lapse of days. For example, in considering, the relation between observation results and wieght of working machine, the suitable condition of soil for machine work which will have the effective result is under a week after irrigation in the field, if the ground pressure of machine is under 1 kg/cm^2 and standing-water-depth is about 10 cm. to 15 cm. at the time of work.

Furthermore, the form of paddy wheels have important effect on movility of the tractor in the paddy field. This means that unsuitable form of paddy wheels influences greatly the soil adhering to wheels and to obstruct the movility of tractor,so that it must be carefully adapted a suitable one.

On the other hand, when making a quite good leveling of field, the tractor has to work two or three times of puddling and planking works repeatedly, so the softness of field soil is deepened every work and also the lapse of days, that the deepened soft soil in field is causing to reduce the trafficability.

Therefore, if it should be carried out to finish the works of field preparation in a week after irrigation in the field, it could adapt a most effective method of mechanization work in rice cultivation in this area.

In consequence of analyzation with the observation results, it can be concluded the trafficability of soil as following rating standard as far as in this area.

c-1 Simplified foreknowing method of trafficability of soil by corn penetration index and sinkage depth of rectangular plate in this area (by SR-II soil tester)

sinkage depth of rectangular plate vertical load 30 kg. in cm.	cone index av. 25 cm.depth in kg/cm^2	depth of foot mark in cm.	rating of trafficability (A)	(B)	(C)
0 - 10	over 2.0	0 - 6	very good	very good	very good
10 - 15	2.0 - 1.5	6 - 12	good	good	good
15 - 20	1.5 - 1.33	12 - 17	quite good	little hard	little hard
20 - 25	1.33 - 1.25	17 - 23	little hard	hard	hard
25 - over	1.25 - 0	over 23	hard	impos-sible	impossoble

Remarks : (A) is 33 HP.tractor, (B) is 65 HP.tractor, (C) is 75 HP.tracto

* Each tractor is attached with improved paddy wheels and keep 10 cm. to 15 cm. depth of standing water in the field.

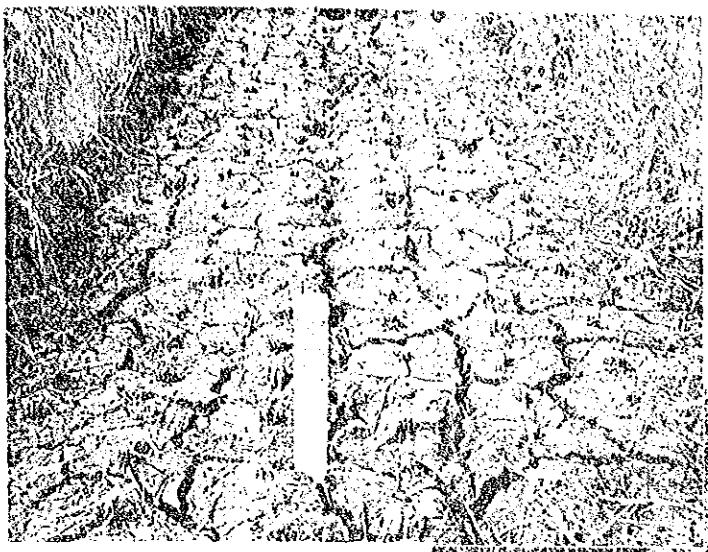
Working equipments as Rotavater and Drive-harrow are used for puddling and planking work.

* The size of rectangular plate is 10 cm. x 25 cm.

* The base area of cone is 6 cm^2.

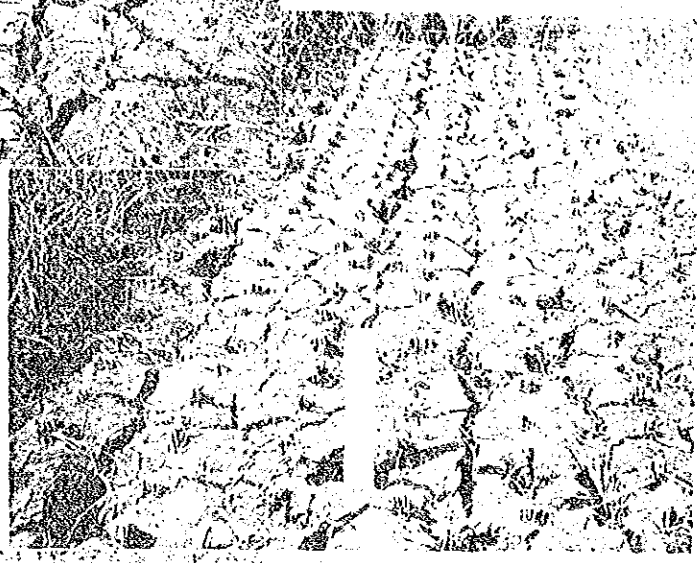
Soil condition for combine harvester

in relation between the time of drainage and soil hardness



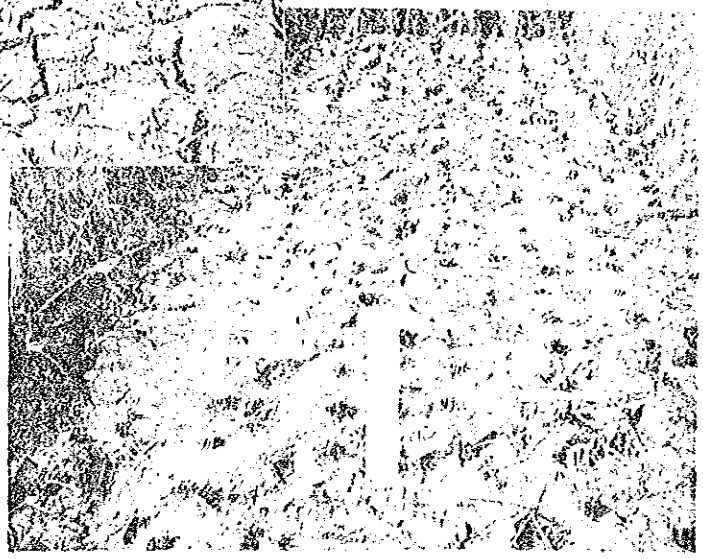
Drained water

30 days before harvesting



20 days

15 days



10 days

3-3 Relation between the time of drainage and the trafficability of soil for using combine harvester on paddy harvest

On the strenght of the following result of soil-resistance measurement, it can be presumable that the limit of soil softness for working ability of the combine harvester (TC-3500, swamp type) is over 0.25 kg/cm^2 in 20 cm. depth of soil by cone penetration result or less than 20 cm. of rectangular plate (25 mm. x 100 mm.) sinkage depth at the 10 kg. vertical load.

On the other hand, the normal type combine harvester as low-crawler type, is able to work over 0.25 kg/cm^2 in 10 cm. depth of soil by cone penetration result or less than 10 cm. of rectangular plate (25 mm. x 100 mm.) sinkage depth at the 10 kg. vertical load.

Namely, the suitable day of drained water from field is about 15 days before harvesting day for swamp type combine harvester. And for normal type combine harvester, it is necessary to drain the water from field more than 20 days before harvesting day at this season in the project area.

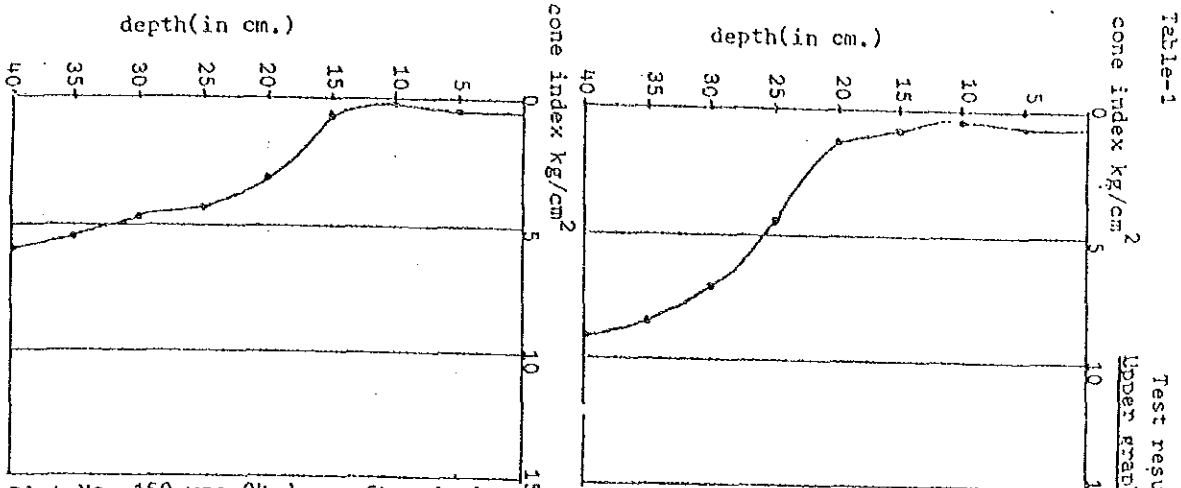
The harvesting stage comes in dry weather, the necessary date of drained water from field is about 10 to 15 days before harvesting date for swamp type combine harvester. And for normal type combine harvester is more than 15 days before harvesting date. The time of drainage day shall be decided whether the draining tendency of plot is easy or not.

The measurement soil resistance are as shown in following tables.

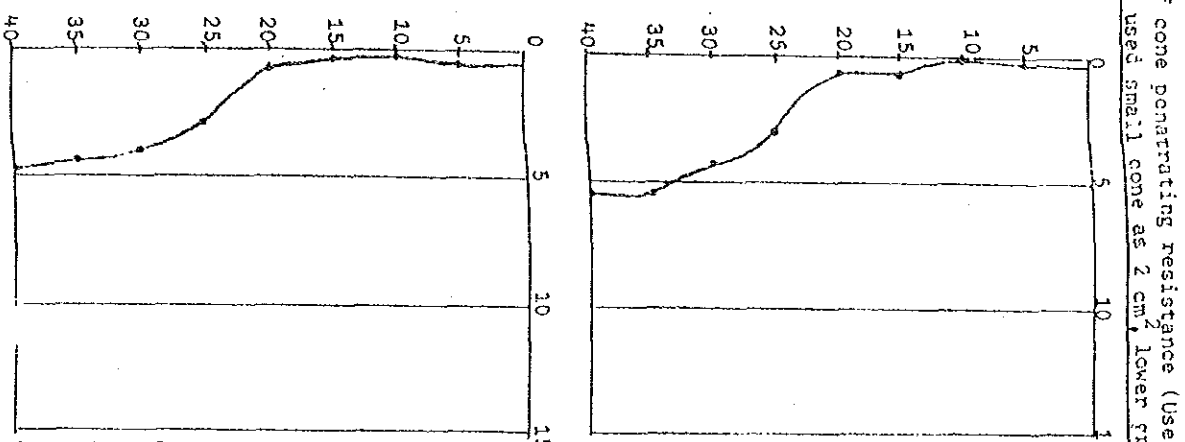
Table-1

Test result of cone penatrating resistance (Used SR-II Soil resistance tester)

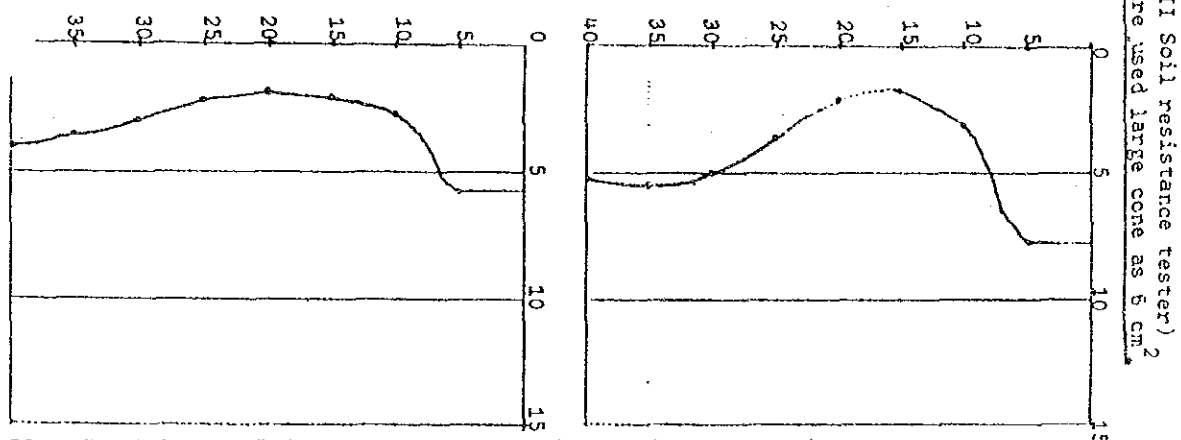
Upper graph are used small cone as 2 cm^2, lower graph are used large cone as 6 cm^2



Plot No. 160 was 24 days after drainage and 4 days after 22 mm. rainfall.



Plot No. 150 was 10 days after drainage, 5 days before harvesting.

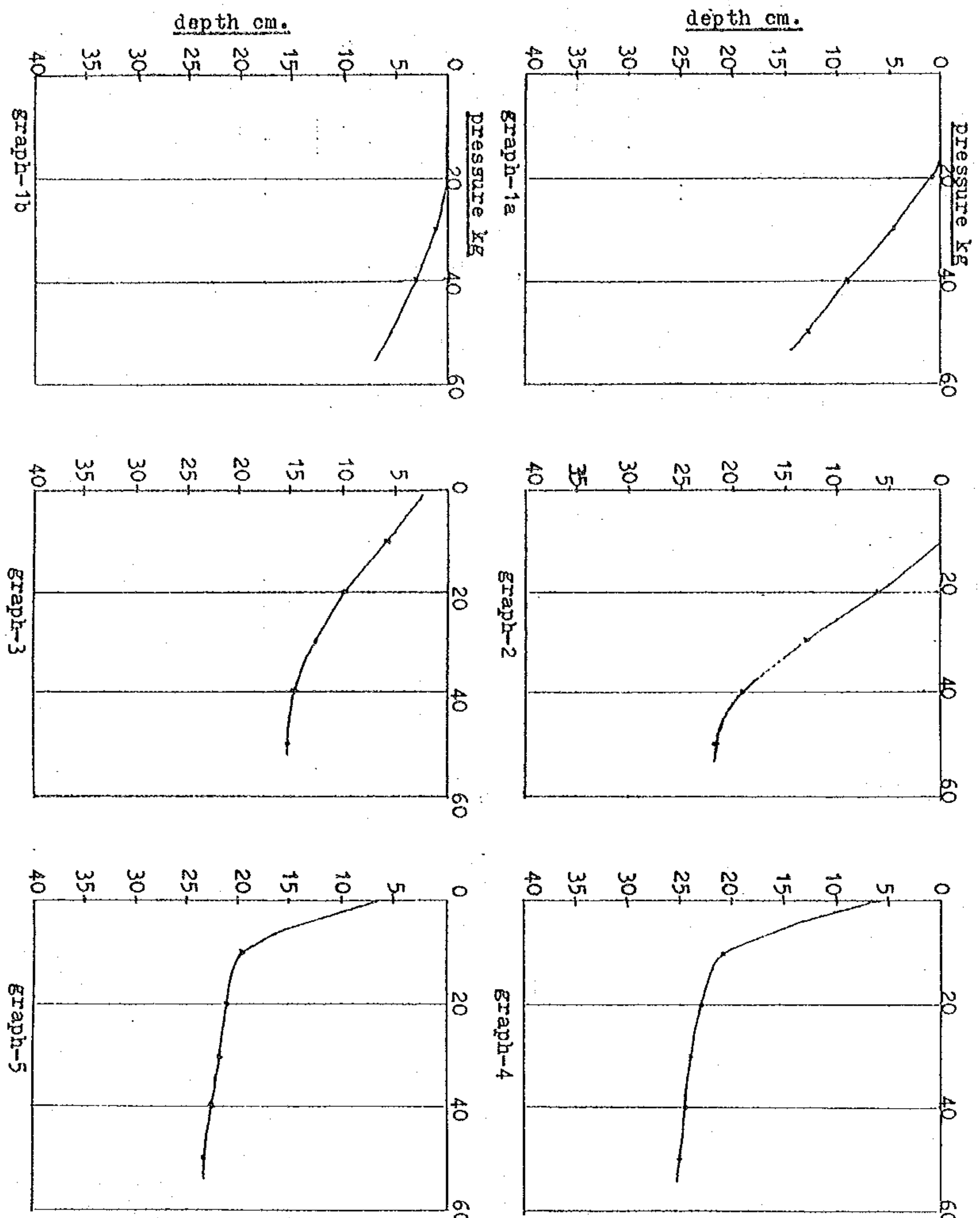


Plot No. 110 was 15 days after drainage just before harvesting.

* Remarks : The cone penatrating speed was about 1 cm./sec. Figures of test result are average measurement of 8 points randomly from each plot.

Table-2

Test result of rectangular plate sinkage (25 x 100mm.)



Remarks :

Graph-1a, plot No.160 was 24 days after drainage & 4 days after received 22 mm. rainfall.

Graph-1b, plot No.160 was measured by large size of rectangular plate as 50X100 mm.

Graph-2, plot No.150 was 10 days after drainage, 5 days before harvesting.

Graph-3, plot No.140 was 2 days after irrigation for soil preparation work.

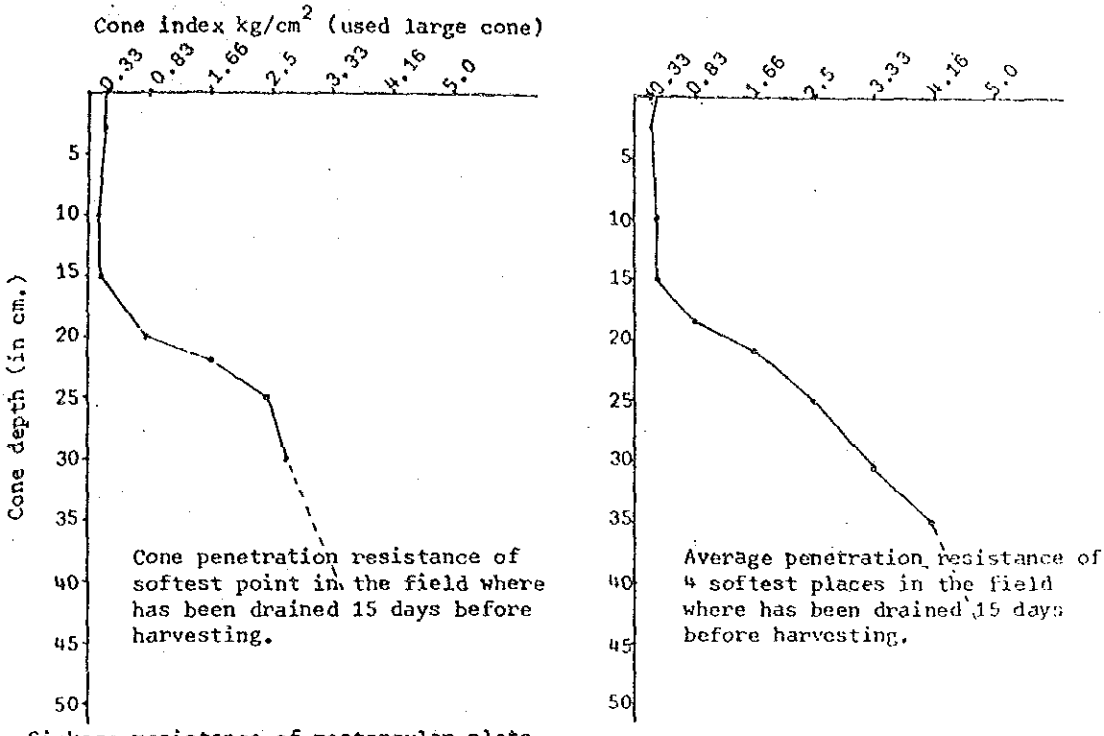
Graph-4, plot No.140 was 7 days after irrigation and after soil preparation work.

Graph-5, plot No.140 was 7 days after irrigation for soil preparation work.

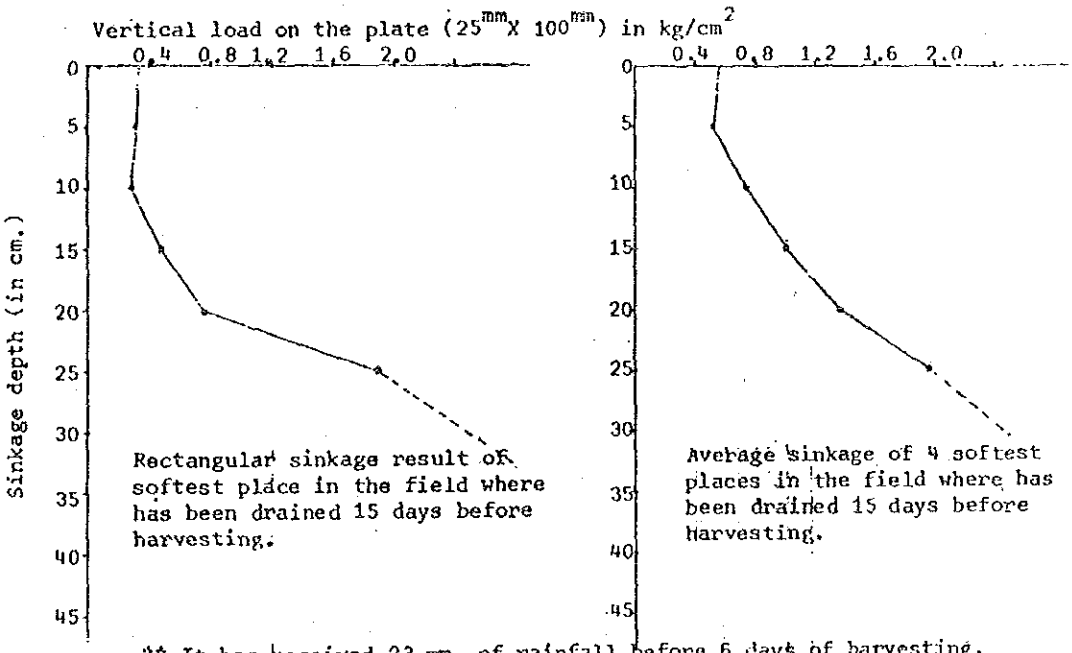
The figures in the graph are 8 points average which is randomly taken from each plot.

Table-3 OBSERVATION OF SOIL BEARING CAPACITY FOR USING COMBINE HARVESTER
(USED BY SR-II SOIL RESISTANCE TESTER)

Cone penetrating resistance



Sinkage resistance of rectangular plate



** It has received 23 mm. of rainfall before 6 days of harvesting.

** These measuring results are at the same time of harvesting work in the farmer's field on May 1984.

4. Advice and consultation for management of machinery service to farmers

In alliance with the farm machinery section and agro-extension section, the mechanized work of field preparation, transplanting machine were displayed at the model farmer's field and at the 4 H club's field. And also we had observation study of above machinery work at the 120 rais of area demonstration plan and 165 rais of farmers' fields in the pilot area directed by the project, whether its adaptability was suitable for progression of the modernized technology of rice double cropping and, whether it was acceptable to the farmers.

In 1983, we have tried the joint using of farm machinery, managing by the co-operative with having the aim of strenthening the co-operative, and whether it was acceptable and suitable than above way to the farmers.

With consideration of above results and their social environment, it was advisable that the farm machinery joint use was managed by the co-operative, like as a machinery Bank.

4-1 Supporting service to the farmers in the pilot area.

11-1 Field preparation work by tractors carried out as follow:

In 1982, 165 rais (includes re-leveling work of field)
In 1983, 412 rais (plowing, puddling, planking)
In 1984, 404 rais (plowing, puddling, planking)

Especially in 1984, the work was very nicely progressed because the farmers had made the field to be completely dried for enhancement the soil bearing capacity under the project direction.

11-2 Pests and insects control

In 1983, 389 rai of farmers' fields were controled by the carpet sprayer and got good result.

11-3 Transportation of the product

In 1983, 111.5 tons of paddy was carried to the rice-mill in Bang-na and Lad-bua-luang in order to promote the associated marketing program of the project.

11-4 Harvesting work

In 1984, 255.2 rais of farmers' field were done by combine harvester, TC-2000, TC-3500, and HL-1800

After the middle of 1983, above supporting services were carried out associated with the co-operative to promote the joint using of farm machinery and, to encourage the co-operative activities.

Appendix

The list and condition of farm machinery and vehicles which were assisted by Government of Japan

* Less than ₱ 50,000 per unit of farm machines which are not equipped the engine are not listed.

Year	Name of Machine	Frequent Utility	Condition of Custody	Remarks and Major Repairing During Last Year
1977	Tractor JD-2030, 72HP	A	A	This was lent out to Maetong Project, because it was not suitable for paddy use.
"	Tractor YM-330T, 33HP	A	A	Replace clutch-disc with new one.
"	Rice transplanter B-400	D	A	
"	Combine harvester TC-2000D,Nc.1	D	A	Overhauled the engine.
"	Combine harvester TC-2000D,No.2	D	A	Replaced winnower-fan, cylinder-head with new one.
"	Rice mill plant 1 ton type	F	A	
1979	Tractor MF-185, 75HP	A	A	Replaced hydraulic system, replaced battery with new one.
1980	Power sprayer CGD-3H	D	A	Replaced nozzle-piece.
"	Thresher PK-70K	E	A	
"	Tractor YM-330DT, 33HP	A	A	Replaced oil-seal of front axle, front-gear-case with new one.
"	Rice transplanter YP-200	D	A	
"	Drill Seeder 5 row	H	A	Can not use it in this area.
"	Front dozer KHL	D	A	
1982	Grain dryer HDR, 4t	D	A	
"	Transplanter PL-500W, 5 row	D	A	
"	Combine harvester HL-1800	D	A	Replaced main belt with new one.
"	Drive harrow H-2800, No.1	D	A	
"	Tractor T-6500 65HP, No.1	A	A	Replaced oil-seal of front-axle, draw-bar ball-joint with new one.
1983	Thresher local made, 5'type	D	A	

1983	Tractor T-6500 64HP, No.2	A	A	Replaced P T O - shaft with new one
"	Rotavater AR-60, No.1	D	A	
"	Drive harrow HB-2800, No.2	D	A	
"	Rotavater AR-60, No.2	D	A	
"	Combine harvester TC-3500	D	A	Replaced chain-case-cover, conveyer-gear-box, clutch plate with new ones.
"	Movable pump Ø 8"	D	A	
"	Field cart 500 kg	A	A	Repaired driving chain, replaced main pulley with new one.
"	Drive harrow HB-2800, No.3	D	A	
"	Rotavater AR-60, No.3	D	A	
"	Seeding plant	D	A	
"	Carpet sprayer CGH-400H	D	A	
	Vehicles & Boat			
1977	Toyota Landcruiser No.1	A	C	
"	" " No.2	A	A	This is being used in the Project center.
"	Nissan Crane truck	B	A	
1979	Toyo station wagon	A	A	Overhauled the engine.
"	Honda motor Bic. CB-125T	A	A	
1980	Mitsubishi truck 2 ton	A	A	Overhauled the engine
"	Suzuki motor Bic. A-100, No.1	A	A	Overhauled the engine
"	Suzuki motor Bic A-100, No.2	A	A	Overhauled the engine
1981	Nissan Patrol VMG-160	A	A	Repaired front-axle.
"	Nissan Mini-bus VRGE-23	A	A	
1983	Nissan Patrol, Diesel	A	A	
"	Mitsubishi wagon GLX-2000	A	A	

1983	Suzuki motor Bic. ER-125, No.1	A	A
"	" " " No.2	A	A
"	" " No.3	A	A
"	" " " No.4	A	A
"	Blitz tire changer	C	A

Remarks :

Rating of the frequent utility is as follows :

A is frequent used.
B is used 1 - 3 times in a week.
C is used 1-3 times in a month.
D is used in seasonably.
E is used 3-10 times in a year.
F is used a few times in a year.
G is not used in this year.
H could not be used.

Rating of the custody condition is as follows :

A is maintained in best condition.
B is not problem to use.
C is necessary for something repair.
D is not under usable condition.