Final Report

On

MANUAL RICE TRANSPLANTER

Submitted to:

Department of Science & Technology
Government of India, Technology Bhavan,
New Mehrauli Road, New Delhi-16

Implementing Institute

Manipur Science & Technology Council
Central Jail Road, Imphal-795001

1. Title of the Project :Mamual Rice Tramsplamter

2. Principal Investigator :Shri Th. Suremdramath Simgh
Senior Scientific Officer
Manipur Science & Technology Council
Central Jail Road, Imphal-795001

3. Implementing Institution :Manipur Science & Technology Council
Central Jail Road, Imphal-795001

4. Date of commencement :18.01.1999

5. Planned date of completion :17.01.2001

6. Actual date of completion :

7. Objectives as stated in the project proposal:

i) To introduce a new technology of Manual Rice Transplanter in the state.

ii) To have a clear weed free environment of Plantation.

iii) To obtain recommended row to row and plant to plant spacing plantation.

iv) To save time and labour

8. Experimental work giving full details of experimental set up, methods adopted, data collected supported by necessary tables, charts, diagrams & photographs.

a) Physical Description and working principle of Mamual Rice Tramsplanter

The main components of Manual Rice Transplanter consists of

i) Handle
ii) Seeding pushing lever
iii) Fingers
iv) Seeding Tray
v) Tray Indexing mechanism
vi) Skid

- The Manual Rice Transplanter is a six row manually operated equipment specially designed to transplant mat type rice seeding in puddle soil in rows. The equipment is designed in such a way that the activation of the various mechanisms of the equipment is obtained in the sole movement of the seeding pushing lever and that also during the pull of the lever and the mechanisms remain deactivated during the pushing of the lever or the transplantation process.

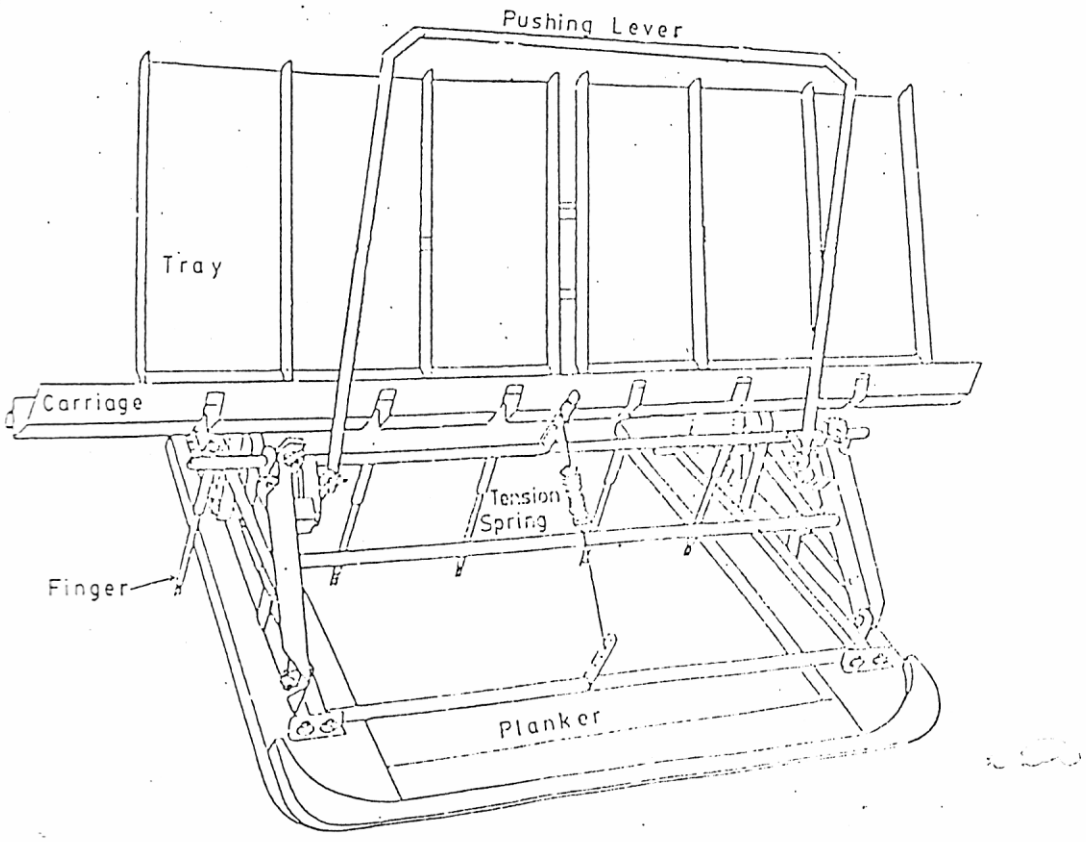
- The Tray indexing mechanism consists of the tray and the gears. The movement of the seedling pushing lever is transmitted to the tray indexing mechanism with the help of connecting levers and a freewheel.

    - The Function of the connecting levers is to convert the pull of the seedling tray into rotary motion of the gear via the freewheel.
    - The Function of the freewheel is to make the gear rotate only during the pull of the lever so that the gear rotates in one direction only.
    - The peculiarity of this gear is that rotary motion of the gear is converted into linear motion of the seedling tray. For this an arc shaped mating tooth whose radius is equal to the radius of the gear slide s along the helically guided ways of the gear as the gear rotates during the pull of the lever. The arc shaped tooth can swivel about a bar, which supports the tray, and thus the rotary motion is converted into linear motion.
    - The gear has also a provision for automation returnable movement of the seedling tray so that the gear after it has reached its extreme position automatically returns back in the opposite direction. This is achieved by counter threading the gear in the same pitch as that of the previous helix and the two ends of the two counter threads are joined at each and so that there is no discontinuity in the movement of the seedling tray. The seedling tray moves only when the gear rotates and the pitch of the gear determines its movement. Thus the movement of the tray can be increased or decreased according to our requirement by changing the pitch of the gear. The gear mechanism is similar to a nut and screw in which the arc shaped tooth in the form of a nut wound and unwound around the gear so that for each rotation of the gear there is linear motion of the mating tooth.

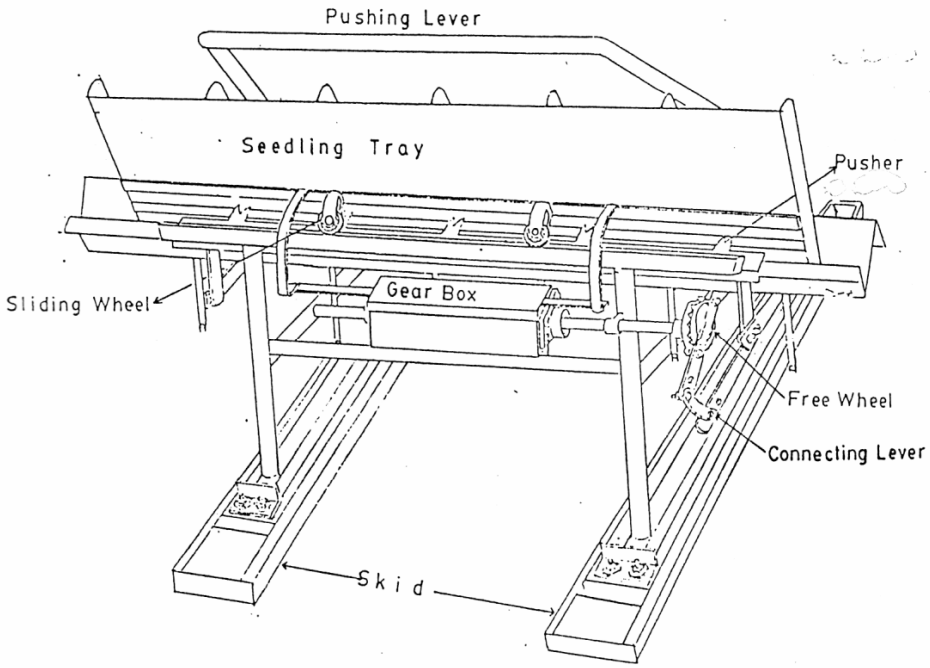
- The tray has wheels, which slide along a hollow bar so as to support the weight of the tray and facilitate smooth movement of the tray. This movement of the tray for each pull of the seedling pushing lever gives an indexing mechanism to the tray so that the seedling are exposed to the transplanting process without any interruption.

- There are six pushers provided behind the seedling tray and whose movement the seedling-pushing lever controls so that the pushers move only during the pull of the lever. The movement of the pushers is effected by the sliding of a pin which is connected to the pushers through a slot which is made on a lever connected to the seedling-pushing lever and accordingly the movement of the pusher can be increased or decreased by increasing or decreasingly the size of the slot.

- The slope of the tray is determined by the weight of the seedling placed on the tray so that friction doesn't hamper the sliding of the seedling.
- Six fingers are provided whose spacing are determined by the recommended row to row spacing and the depth can be adjusted accordingly to our requirement which are provided with adjustable nuts.
- A tension spring is provided so as to provide a spring back action to the fingers so that the fingers do not touch the seedlings during the pull of the seedling pushing lever and to counter the gravity effect of the fingers so that transplanting is carried out effectively.
- A planker is provided at the front which will level the ground before the seedlings are planted so that there is no trace of footprints and it will play the role of a flat. Two handles on each side of the equipment are also provided so as to facilitate handling of the Transplanter.



Manual Rice Transplanter (Front View)



Manual Rice Transplanter (Rear view)

TECHNICAL SPECIFICATION AND WORKING FEATURES OF MANUAL RICE TRANSPLANTER

Width of the equipment	=1280mm
Height of the equipment	=457mm
Weight of the equipment	=20Kg
Row spacing	=170mm
Slope of the tray	=45
Working width	=930mm
Operating speed	=0.22-0.28 Km/h

The different plant to plant and row to row spacing with the probable production of plants in one sq. meter are given below:

Table 1: Plant Spacing (cm)

Spacing No.	Row to Row & Plant to Plant spacing (Cm)	No of hills in one sq.meter	No. of plants in one hill	No. of plants in one sq. meter	Total no. of plants after the tillering of 3 secondary plants
1.	20 x 15	30	3	90	270
2.	15 x 15	36	3	108	324
3.	20 x 10	50	3	150	450
4.	15 x 10	60	3	180	540

Source: Dhiren, N., 2000

The spacing in Table 1 are used for different types of varieties and will also depend on the age of the seedling to be used. From amongst the various spacing the one which the agricultural scientists strictly recommended is spacing no.3 with row to row spacing of 20 cm and plant to plant spacing of 10 cm, even though spacing no. 4 has the maximum number of plants, it is not recommended for transplanting as there are many disadvantages when the plants are planted very densely.

(b) Brief description of experimental work:

As a trial production we manufactured two equipments of Manual Rice Transplanter in the first year. The fabricated was carried out keeping in mind the minimum weight and easy operation and maintenance of the technology so that the rural housewives have easy access to the technology. One of the transplanters was given a trial run so as to test the practical feasibility of the technology. The trial was conducted on conventional seedling grown during Kharif season in which the seedlings are long, thick with heavy interlocking of the roots. The outcome of the trial was not so satisfactory as far as transplanting is concerned but it threw some light on the possibility of using this technology as a substitute for the traditional method of rice cultivation and we could also note the shortcomings associated with this technology. Before any modification was carried out, we decided to test the suitability of the technology on dapog seedling in which the seedlings are thin, short with much reduced interlocking of the roots. For this dapog nursery was raised on a small scale. The trial conducted on dapog seedling showed some positive results compared to the previous trial on conventional seedling. But, still the technology was not devoid of any defect and some modifications on the existing technology were necessary so as to make the technology fully operational. We conducted successive trials on the same type of seedlings after carrying out the necessary modifications and with each trial the technology becoming more and more operational. From these trials we could note one important thing that for successful operation of the transplanter, incorporation of a precise technology is very much essential and all the mechanisms are interrelated, which make the modifications on the technology quite difficult. So the modification on one part tends to have a serious impact on another part so as to impair the technology. This is the main reason for this delay in coming up with an operational technology in time. Taking note of these factors into consideration we carried out the necessary modifications on the technology. With a positive out come we conducted a trial on a model field using dapog seedling which proved quite beneficial because it was the first time we tested the suitability of the technology on a real field and we could note the shortcomings which are really hampering the functioning of the technology. After carrying out the necessary modifications we conducted one more trial using the same seedling and the result was almost satisfactory as far as transplanting technology is concerned. During the trial we

saw some missing action which we believe was due to the mud content of the soil which was attached to the roots of the seedling. So during the raising of the dapog nursery it is recommended that the seeds should be sown on loose or riverine alluvium or in the exceptional cases clay loam may be used so that the soil can be washed off easily. Since this type of soil is found in most of the parts of the country so there is no doubt that the technology will find its acceptance in most parts of the country. Then we switched onto conventional seedling grown during Rabi season in which the seedlings are short and the roots are also quite short compared to the seedlings grown during Rabi season. The trial conducted on this seedling confirmed beyond any doubt that the technology is operational.

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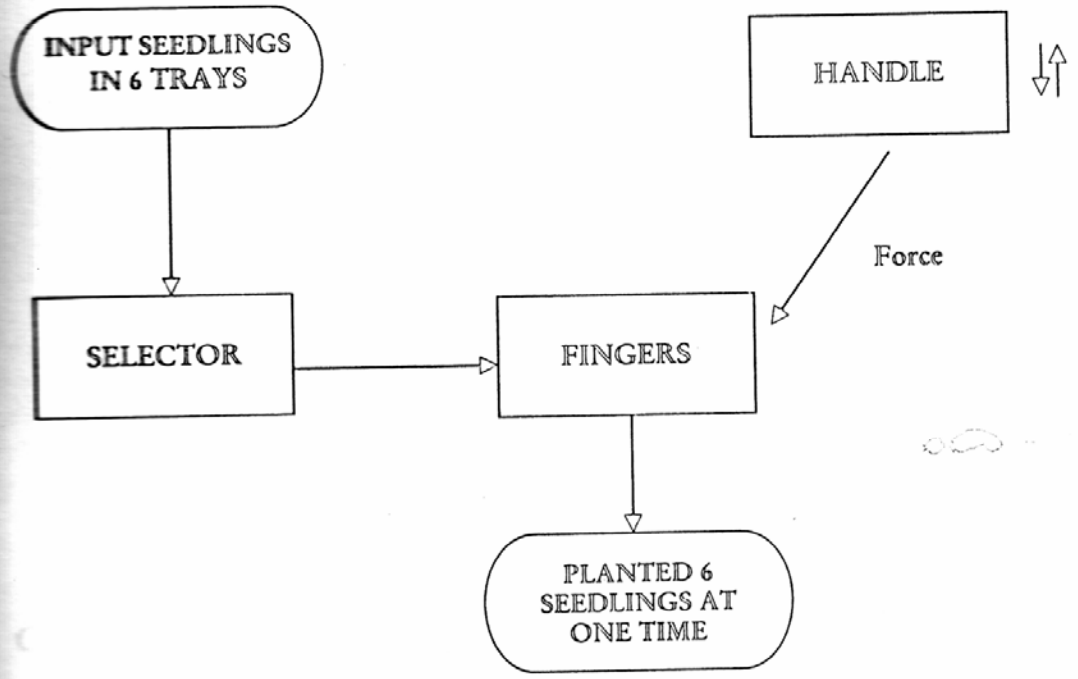
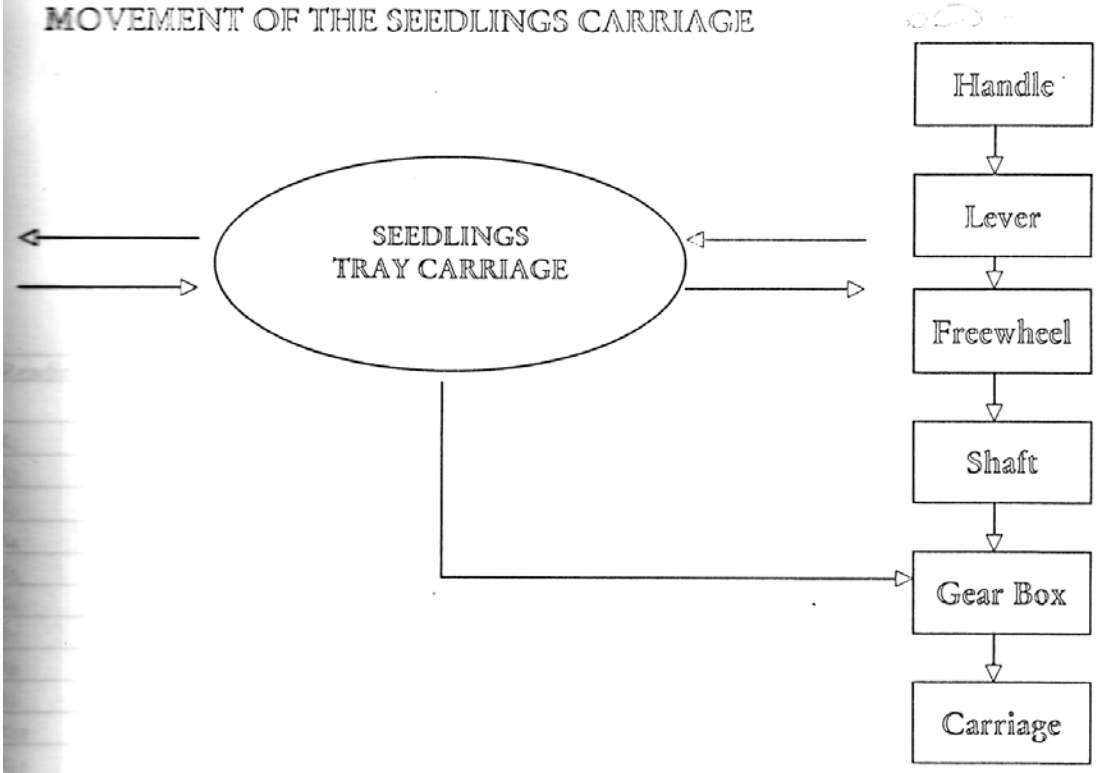
WORKING PRINCIPLE OF MANUAL RICE TRANSPLANTER

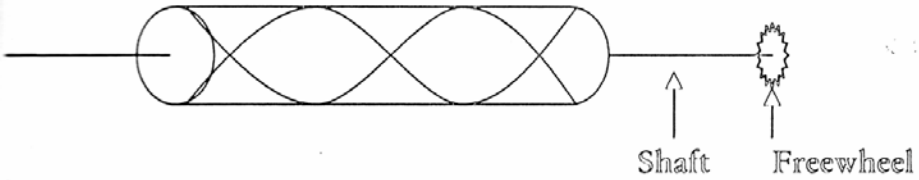


MOVEMENT OF THE SEEDLINGS CARRIAGE



Gear Model (Spiral threading and counter threading):

Gear is designed for automatic returnable when the Tray Carriage reach the end of the Tray Channel.



C) Observation

The following tables give a comparative statement of the working features of Manual Rice Transplanter and Conventional Method. The readings were taken at the time of actual field trial runs.

Table 2: Working Depth, (mm)

Readings	Manual Rice Transplanter	Conventional Method	Average working depth, M	Average working depth, C
x_1	20	27		
x_2	22	25.7		
x_3	21.5	26.8		
x_4	23	27.5		
x_5	22.5	25.8		
x_6	23	26		
x_7	24	26		
x_8	23.8	27.8		
x_9	25	26		
x_{10}	25.5	27.5	24.28	27.18
x_{11}	24.6	28		
x_{12}	25	25.8		
x_{13}	25.5	30		
x_{14}	25.7	27		
x_{15}	25.7	28.8		
x_{16}	26	29		
x_{17}	25	26.8		
x_{18}	25.8	27.9		
x_{19}	26	26.7		
x_{20}	25.9	27.5		

- **M-Average working depth for Manual Rice Transplanter=$\sum x/2$**
- **C-Average working depth for Conventional Method=$\sum x/20$**
- **Maximum working depth is 30mm (Source: Dhirem N, 2000)**

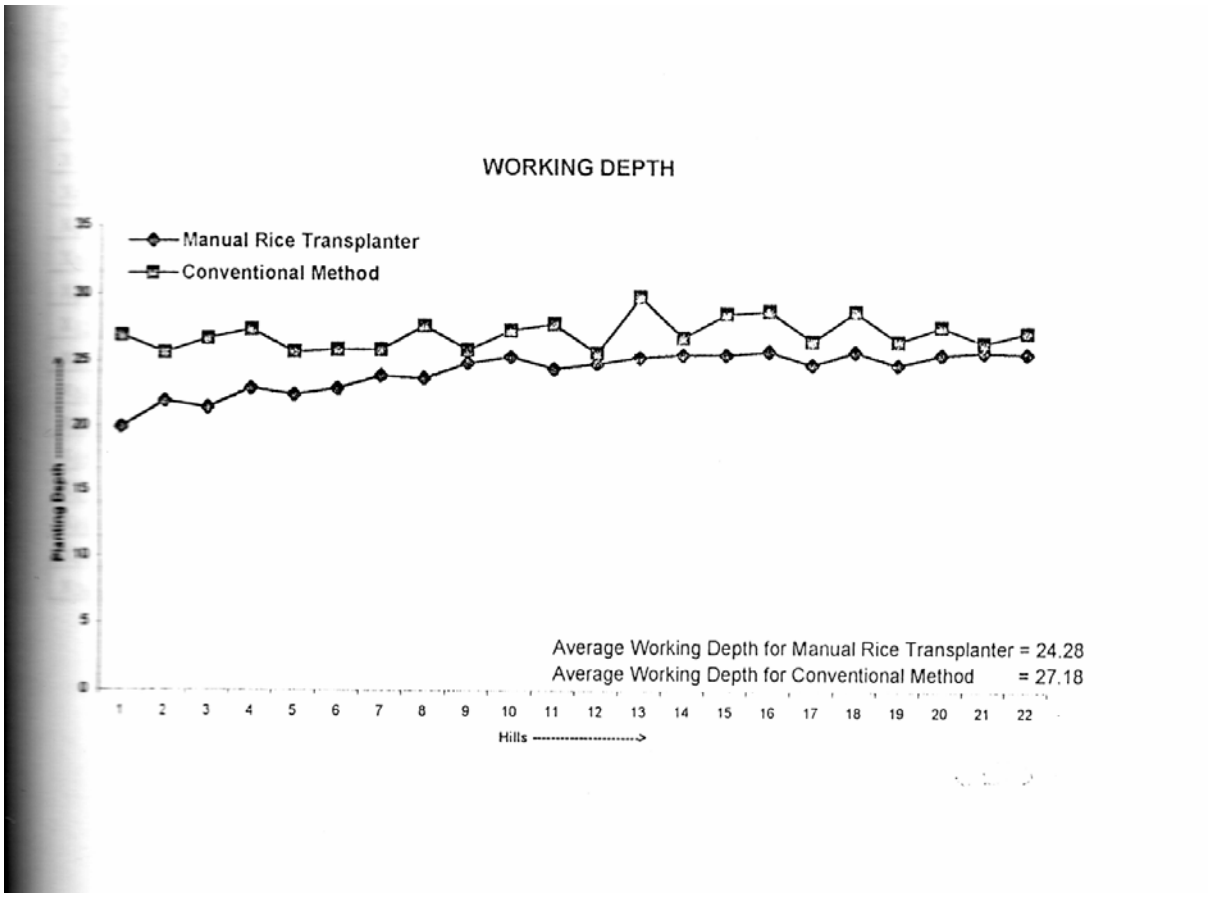
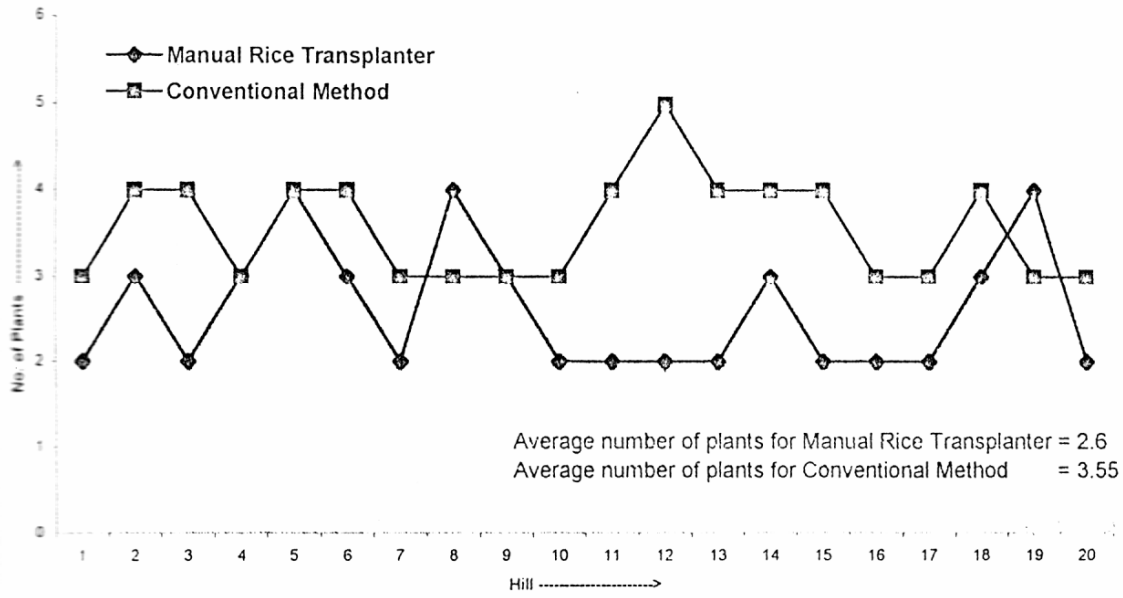

WORKING DEPTH
Manual Rice Transplanter
Conventional Method
Planting Depth
Average Working Depth for Manual Rice Transplanter = 24.28
Average Working Depth for Conventional Method = 27.18
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Hills

Table 3: Plants/ Hill

Readings	Manual Rice Transplanter	Conventional Method	Average no of plants per hill Pm	Average no. of plants per hill, Pc
x_1	2	3		
x_2	3	4		
x_3	2	4		
x_4	3	3		
x_5	4	4		
x_6	3	4		
x_7	2	3		
x_8	4	3		
x_9	3	3		
x_{10}	2	3	2.6	3.55
x_{11}	2	4		
x_{12}	2	5		
x_{13}	2	4		
x_{14}	3	4		
x_{15}	2	4		
x_{16}	2	3		
x_{17}	2	3		
x_{18}	3	4		
x_{19}	4	3		
x_{20}	2	3		

- Pm-Average no. of plants per hill for Manual Rice Transplanter=$\sum x/20$
- Pc-Average no. of plants per hill for Conventional Method= $\sum x/20$

PLANTS PER HILL



CALCULATION OF LABOUR REQUIREMENT (Man-h/ha)

a) **Manual Rice Transplanter**

Number of persons required to transplant one hectare=2

Hectare coverage in one hour by 2 persons=0.035 ha/h

∴ Time required to transplant one hectare=1/0.035=28.57 h

Total labour requirement for one hectare=57.14 Man-h/ha

b) **Conventional Method**

Number of persons to transplant one hectare=2
Hectare coverage by 2 persons in one hour =0.025 ha/h

∴ Time required to transplant one hectare by 2 persons=200h

Total Labour requirement for one hectare=400 Man-h/ha

We would like to highlight some of the important modifications which we have carried out on the technology.

- The finger is modified by welding one curve shaped facilitator to the rear end of the finger, which will help in proper insertion, and positioning of the seedling in the soil.
- The multiple bend of the carriage has been modified to a single bend which conforms to the correct position of the seedling when the seedlings re placed [illegible] tray. This facilitates easy and proper transplanting.
- The size of the rectangular holes on the carriage through which the fingers are supposed to pass during the downward strike are reduced almost to the size of the finger so that no unwanted seedling is carried down and obstructs the transplanting process.
- The slope of the tray has been reduced in such a way that it facilitates the sliding of the seedlings due to its own weight.
- The size of the finger has been reduced so that only the desired amount of seedling is carried down during the transplanting process, as dapog seedlings are thin in size. The maximum recommended working depth is 30 mm. * *

- During the downward strike the finger could touch only the root portion and transplanting couldn't be done effectively. To overcome this difficulty we have increased the height of the Pivot on which the lever hinges so that finger can reach the stem portion and thus avoiding any interruption in the transplanting process.
- We thought that by increasing the movement of the pusher, the transplanting process could be carried out effectively but it proved more of a problem than a solution. In one complete movement of the tray, the pusher moves 33 times which resulted in piling up of the seedlings and try to overturn, thus hampering the transplanting process. So there is no justification in increasing the movement of the pusher.

10. **Detailed analysis of results indicating contributions made towards increasing the state of art knowledge in the subject.**

From the many trials we had conducted we could also gain a lot of experienced regarding the transplanting technology. These are some of the experimental findings.

- One important finding is that very short and thin seedlings are not suitable to this technology as they are carried down easily along with the seedlings, which are being pushed down by the finger and obstruct the transplanting process. Seedlings of the height of one foot and 2-3 mm in thickness are quite suitable to this technology. If two thin seedlings are used, there is a chance of breakage of the seedling at the stem and may result in unsatisfactory transplanting.
- One major drawback regarding the use of conventional seedling, which is grown during Rabi season, is that the roots are heavily interlocked so a considerable force is required to be applied on the handle during the downward strike. It has been confirmed beyond any doubt from the various trials that the technology is most suitable to dapog seedling.
- The need of using herbicides or insecticides to control weed will be sufficiently reduced as this technology ensures plant to plant and row to row spacing which will allow the use of mechanical hand-hoe or rotary weeders or the weeds can be removed manually.

- One important thing, which we have to keep in mind, is that only good quality seeds should be used for sowing during the preparation of dapog seedling. This will ensure no missing action during transplanting.
- During conventional transplanting the non-skilled women have a tendency to insert the seedling deep inside the ground which slows the tillering of the plant. This can be effectively reduced during transplanting by Manual Rice Transplanter by the use of adjustable fingers. The recommended maximum number of plants in one hill is 3*. Though the number of plants will depend on the age of the seedling to be used.

As of now there are two transplanting methods that the farmers usually practice.

- Conventional Method
- Line Transplantation Method (Japanese method)
  - In the Conventional method, the seedlings are planted haphazardly with some presumed plant-to-plant distance. The idea behind his transplanting method is to plant as much as seedling as possible in a specified area so as to maximized the use of plot. In addition to this when the seedling are planted very close to each other than the limit specified than many problems may arise which may be detrimental from economical and social aspects.
  - First the plants will start competing against each other for want of nutrient thus the need for more fertilizer to compensate for this malnourishment of the plants.
  - Secondly when the plants grow the leaves will shadow the plants which are growing in its immediate vicinity which will result in stunted growth of the plant will not be able to produce gain accordingly to its capacity and the chances of producing chasse grain are increased.
  - Thirdly, as the use of mechanical weeders is ruled out, the only option left is herbicides and weedicides which the roots of the plants will absorb and may not be safe for human consumption. The maintenance of the plants becomes more and more difficult.
- In the Line Transplantation method the seedlings are planted with the required plant to plant and row to row spacing. The idea behind this method is to nullify the demerits associated with conventional method of transplantation and it is the number of high quality grains that a plant can produce, which is of utmost importance and not the number of plants. Thus the yield/hectare by this method is more than that of the conventional method.

- The plants are maintained with the required plant to plant and row to row spacing, the plants will have sufficient area to absorb its nutrients without causing any malnourishment to other plants and they will have sufficient exposure to sunlight. Thus the plants can will be its maximum limit in a short period of time and thus it will be able to produce filled grains.
- Since there is enough space to allow the use of mechanical hand-hoe or rotary weeder, the use of herbicides or insecticides can be reduced considerably or may not be used at all. Thus the plants will be prevented from being exposed to the harmful effects of the herbicides and will be quite safe for human consumption.
- This method can be effectively used in those areas where there is scanty water or the irrigation which heavily depends on rain water so that when the rainfall stops the soil may harden which can be softened easily with the use of a mechanical weeder.

12. Conclusion summarizing the achievements and the indication of scope for future work.

From our experimental findings and a very careful comparision of the merits and demerits associated with each technology and as per the recommendations of the agricultural scientists we can infer that the Japanese method of rice transplantation is the best method as far as rice transplanting is concerned. In spite of the many advantages associated with this method people shy away from using this method as they do not have the patience to follow the tedious practices associated with this method and the lack of sufficient knowledge about transplanting which has social and economic implications is also one of the factors for not using this method. The following gives the plus points of using Manual Rice Transplanter.

-It incorporates all the advantages associated with the Line Transplanting method of rice transplantation.

-It is user-friendly as the technology is quite simple for any woman can have easy access to it and it relieves the farmers of all the tedious practices. They do not have to depend on skilled woman which helps to achieve better economy by fulfilling the requirement of low and medium income group people.

-There wouldn't be much maintenance problem as the technology is not so sophisticated so as to make the handling quite difficult and the equipment is free from all conventional fuel viz. Petrol, kerosene, diesel, etc.

-They will not be subjected to physical exhaustion, which they usually experience during conventional transplanting.

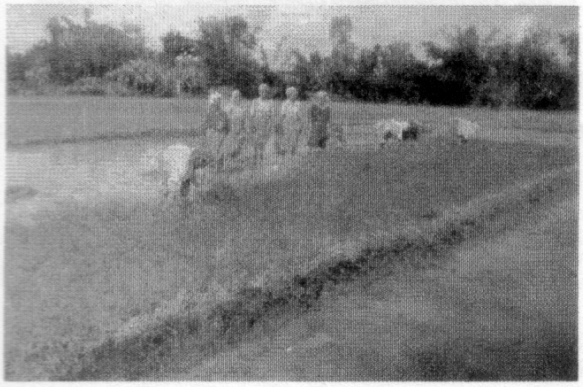
-This method facilitates the use of harvesting machines.

-The wastage problem will be very much reduced as this technology ensures production of filled grains, which would be a very big contribution for the society as the society is having a serious headache in managing the waste problem.

-Besides these advantages the technology has many technical advantages like more operating speed, more hectare coverage in unit hour and less labour requirement.

Since the technology finds its suitability in dapog seedling it would be fair to weigh the advantages of raising dapog nursery over other nurseries.

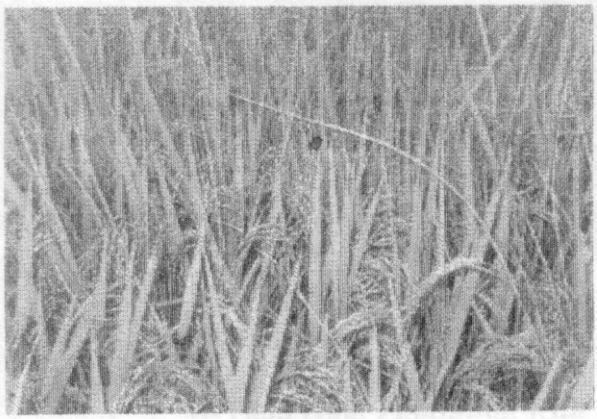
- The same maintenance and the demerits are inevitable during the raising of the conventional nursery. The nursery area required to provide seedlings for transplanting one hectare is roughly 1/10 of a hectare and the seed rate is 40-50 Kg/ha.
- A small area is required for raising dapog nursery, 30-40 m2 being enough to raise seedlings for transplanting one hectare. This type of nursery can be raised during draught and flood condition. So during floods and drought conditions there will not be any problem in raising this type of nursery.



Manual Plantation by Manipuri Woman

Line Plantation Method

Manual Plantation



Plantation with Machine