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MECHANICAL TRANSPLANTING OF RICE



TRAINING OF TRAINERS MODULES

2017

The Cereal Systems Initiative for South Asia (CSISA) is a regional initiative to sustainably increase the productivity of cereal-based cropping systems, thus improving food security and farmers' livelihoods in Bangladesh, India and Nepal. CSISA works with public and private partners to support the widespread adoption of resource-conserving and climate-resilient farming technologies and practices. The initiative is led by the International Maize and Wheat Improvement Center (CIMMYT), implemented jointly with the International Food Policy Research Institute (IFPRI) and the International Rice Research Institute (IRRI), and is funded by USAID and the Bill & Melinda Gates Foundation.

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SESSION I

INTRODUCTION AND TRAINING OBJECTIVE



INTRODUCTION

Mechanical transplanting of rice (MTR) is a cost-effective establishment method for rice when compared to the existing and common method of manual transplanting. The primary drivers of the adoption of machine transplanting are rising labor scarcity and the high costs associated with manual transplanting. An increasing number of farmers adopting this technology in South Asia and are eager to learn the procedure of MTR. It is therefore important to develop a cadre of master trainers to assist many MTR service providers interested in expanding farmers' access to the technology. As master trainers need to have good knowledge of the technology and should have in-depth understanding of how to perform mechanical transplanting as well as nursery raising, this "Training of trainers (ToT) module" aims to provide overall instruction and information on how to conduct the ToT.

This training module covers critical topics on the principles and practices of MTR in the context of smallholder farming in South Asia, with emphasis on hands-on learning. The contents of the module provide guidance to the training facilitators on how to conduct rapid, two-day trainings on MTR, including detailed instructions on how to facilitate the training, training material requirements and how to conduct pre-and post-tests for training participants. MTR is better learned through multiple training sessions or as part of a farmer field school rather than in individual one-day trainings. Hence, while this module covers four training sessions that can be conducted consecutively over two days, they can also be split and applied as individual modules during a season-long farmer field school, or for more targeted training sessions.





WHO IS THIS TRAINING DESIGNED FOR?

Extension agents, rural agricultural service providers, and progressive farmers interested in understanding and/or practicing mechanical transplanting of rice.

ORGANIZATION OF THE MODULE

After presenting a general introduction on the training format and requisites for a two-day training, four independent learning sessions are described as follows:

1. Training objectives, key messages to participants, participants' expectations and pre-test evaluation
2. Mat-type nursery
3. Mechanical transplanting of rice
4. Repair and maintenance of a mechanical rice transplanter and post evaluation

Instructions are given for facilitators on how to implement each session. This includes a review of the learning objectives, key messages, required materials, and step-by-step instructions on how to conduct the training session from start to finish, while also working to encourage experiential learning. Most sessions include a component during which the facilitator is expected to give a brief technical presentation on the topic. Presentations are intended to be discussion oriented. The facilitator should therefore allow time for participants to ask questions, and in turn elicit questions and feedback, if few trainees are speaking.

Technical details on each session have been provided to guide the technical content for each of these presentations. Along with the module, presentations in soft copy can also be provided to facilitate the classroom sessions. Facilitators should simply follow the given details and use the material presented to initiate discussion and assure that all technical points are covered. Care should be taken to allow all participants to speak and to encourage especially shy participants, such as women or youth, to speak and ask questions.

Handouts in the form of modules and factsheets, and related videos can also be provided at the end of the session.

Lastly, trainings are to begin with a pre-test of participants' knowledge and end with a post-test of their knowledge after the training. The change in participants' scores gives an indication of their progress in learning. Readymade pre- and post-test sheets are included within this module. Simply print them on regular size paper for use.

TRAINING AIMS AND OBJECTIVES

Through training facilitators, the aim of this module is to improve extension agents', progressive farmers' and agricultural machinery service providers' awareness, skill and knowledge about mechanical transplanting and associated machinery practices so that they can adopt and practice a cost-effective crop establishment method. This module is designed to cover major principles needed to establish rice using mechanical transplanters in a productive and integrated way.

By the end of the sessions, participants/master trainers should be able to:

- ✓ Understand and explain the benefits of transplanting using a mechanical transplanter
- ✓ Explain the difference between wet- and dry-type nurseries
- ✓ Explain the process of mat-type nursery preparation
- ✓ Understand the potential to take up mat-nursery preparation as a business
- ✓ Identify different parts of the mechanical transplanter and explain the technical specifications associated with each part
- ✓ Calibrate the mechanical transplanter properly
- ✓ Demonstrate to others the procedures of mechanical transplanting
- ✓ Understand agronomic management practices like weed, water, nutrient management, and plant protection measures
- ✓ Understand the scope of providing the service of mechanical transplanting as a business



KEY CONSIDERATIONS FOR TRAINING

Key considerations for planning, preparation, and organization of training events are detailed below. Training facilitator(s) should read each section carefully to ensure effective and efficient implementation of the training.

Participants	The number of participants per batch should be limited to a maximum of 20 with a good mix of male and female participants.
Venue	Trainings are to be held primarily in the field, where participants are encouraged to learn the mechanical transplanting procedures by doing. For brief orientation and setting the scene, the training can be started in a classroom or similar venue near a field.
Requisites	Ensure that prior to the commencement of the training; all the pre-requisite materials as mentioned in the sessions are available in proper quantity and in working condition.
Trainers	Extension agents or field staff who have already received some training on mechanical transplanting and are well aware of different transplanting procedures are best suited facilitators for this training.
Participants	A pre-evaluation test before starting the training sessions is to be deployed to judge the knowledge level of each participant. A post-evaluation test at the end of all training sessions should be conducted to evaluate the impact of the training. The questionnaires are attached in the annex.

COURSE PREPARATION, DURATION, MATERIALS AND SETTINGS

The course is designed for a two-day (approximately eight hours per day) training, including demonstrations and practical exercises and excluding lunch and breaks. The content is divided into four instructional sessions as follows:

DAY ONE			
Session	Topic	Approximate duration (minutes)	
		Classroom	Hands-on
1	Introduction, training objectives and pre-test	30	-
2	Mat-nursery	60	120
DAY TWO			
3	Mechanical transplanting of rice	60	120
4	Repair and maintenance and post evaluation	-	90

PLANNING AND PREPARATION FOR THE HANDS-ON TRAINING

It is not possible to conduct the hands-on training until a few activities are in place before the start of the training. Though we suggest completing the below-mentioned activities beforehand, it is important to remember to explain these steps to the participants during the classroom session. The following is the list of activities that need to be completed prior to the training, in order to be fully prepared for the hands-on components of the sessions:

1. Mat-nursery preparation:

Prepare a wet/dry mat-nursery (for one acre of transplanted rice) 14-18 days before the scheduled date of training, following the steps mentioned in the module. The nurseries should be located in a nearby field where the hands-on MTR training will be conducted. Use this mat-nursery for demonstrating how to cut and prepare seedlings for mechanical transplanting into the main field.

2. Seed bed preparation:

Start preparing the bed three days before training. Prepare two raised seed beds, one for a wet and one for a dry seedling nursery. Follow these steps for preparation:

- a. Plough the field, then puddle (in wet-type nursery only) and level it. After puddling, leave the field to settle for 24 hours.
- b. Once the soil is settled, prepare a raised bed 20 m long, 1.5 m wide and 15 cm high. Leave the bed to settle for 36-48 hours. Afterward, settle the bed with a plank. Also, prepare channels of 60-80 cm width all around the bed.
- c. Use this currently prepared bed for demonstration and conducting hands-on-training on mat-nursery preparation.

3. Treat and sprout seeds

Treat the seeds as per the instructions given under agronomic management practices (page 17) and keep them on hand before starting the training on the mat-nursery.

4. Land preparation:

One day before the start of the training, prepare approximately one acre of land, where demonstration and hands-on training on mechanical transplanting will take place. Follow the given steps for puddled MTR:

- a. Till the field to a depth of 5-7 cm using a harrow, cultivator, or power tiller.
- b. Puddle the field and then level it. Permit the field to settle for 12-24 hours.

In order to prepare for a non-puddled MTR training, implement the following steps:

- a. Dry till the field one to two times using a harrow, power tiller, or cultivator followed by planking.
- b. Before transplanting, apply a light irrigation and drain off any excess water (>2-3 cm).

For classroom sessions, ensure the following materials are available:

1. Multi-media projector and screen for presentations
2. Whiteboard/blackboard, duster and markers
3. Notebook and pen for each participant
4. One printout of the pre- and post-tests for each participant (see annexes I and II)
5. Handouts (paper versions of the presentations) for each participant
6. One copy of communication materials and videos for each participant (pen drive or CD)

HOW TO CONDUCT THE TRAINING SESSIONS

Day 1 (Sessions I and II)

Introduction

Assemble training participants in a classroom or similar facility. Start the session with a welcome address. The trainer should give a brief introduction of himself/herself and other resource persons present. Ask the participants to introduce themselves by giving their personal details such as their primary occupation and area of agricultural operation. It also helps improve the group team spirit if you ask each participant to share one interesting fact about themselves.

In addition, the training facilitator should

- Give a brief introduction on MTR
- Inform participants on the agenda for each day of the training

Pre-test

Distribute the pre-test questionnaire (annex I) among participants and ask them to answer each question individually. Make sure that the participants fill it on their own and not after discussing with others.

Classroom session on mat-type nursery

Start the session by giving a brief introduction about the mat-type nursery, including the agronomic advantages and business-generating potential, though participants should also be cautioned that they will need time and effort to learn how to correctly make the nursery. Ask the participants if they have any doubts about nurseries and clarify those. After this, take the participants to the field and start the hands-on training as per the instructions given in session II (page 12).

Classroom session on agronomic management practices

After the hands-on training is completed, take the participants back to the classroom. After a short break, start the subsequent classroom session and explain in detail the agronomic management practices required to grow a healthy nursery.

Day 2 (Sessions III and IV)

Introduction and hands-on field session

Start the session by giving a brief introduction about mechanical transplanting and its advantages and disadvantages, highlighting the point that participants will need to learn how to use the machine correctly and efficiently. Ask the participants if they have any doubts about mechanical transplanting, and address their concerns and questions. After this, take the participants to the field and start the hands-on training as per the instructions given in session III (page 26).

Classroom session on agronomic management practices

After the participants are done with transplanting, take them back to the classroom and explain the agronomic management practices needed to optimize mechanical rice transplanting through presentation combined with lecture.

Session on repair and maintenance

Conduct this session in an open space or a covered area with ample light. Prior to starting the session, keep the transplanter ready for display. Explain the repair and maintenance procedures, one by one, by referring to the instructions given in the session IV (page 44).

Post-test evaluation

After conducting all of the training sessions described above, distribute the post-evaluation questionnaire (annex II) among participants. Give them a few minutes to answer the questions, which should be done individually. Next, score the exams and compare the pre- and post-test results and share with the participants. This will indicate how much their knowledge has improved. Participants with relatively low levels of improvement should be considered to attend a second training to improve their skills. Finally, wrap up the session after clarifying any remaining doubts.



SESSION II

MAT-TYPE NURSERY



INTRODUCTION

Mat-type nursery is a prerequisite for transplanting rice mechanically. The primary difference between a normal and mat-type nursery lies in the way a mat-type nursery is prepared. Note that a nursery raised through conventional methods cannot be used for mechanical rice transplanting.

This session highlights the sequential steps in preparation and management of a mat-type nursery. It will also cover the business aspect of raising a mat-type nursery, as many farmers and service providers are growing mat-type nurseries and selling the seedlings for profit.

This session has been divided into three sections:

- a. Preparation of a mat-type nursery
- b. Agronomic management practices suitable for a mat-type nursery
- c. Growing mat-type nurseries as a business

At the end of this session, participants should be able to:

- ✓ Understand the differences between traditional and mat-type nurseries
- ✓ Explain the necessary preparation, materials needed, and procedures of wet- and dry-type mat nursery preparation
- ✓ Explain the agronomic management practices required for establishing and optimally managing a mat-type nursery
- ✓ Understand the potential to use mat-type nursery production to generate income as part of a service provision business



PREPARATION OF MAT-TYPE NURSERY

Classroom session

Start this session by giving the participants a verbal overview of mat-type nurseries and their advantages and disadvantages. Participants should be encouraged to pay careful attention to the procedures on how to produce them. Keep encouraging the participants to raise queries and clarify them as you go along. Make sure to cover the following topics during the course of the session.

What is a mat-type nursery?

In a mat-type nursery, seedlings are raised on a thin layer of soil (0.5-0.75 inch) placed on a perforated polythene sheet. The polythene sheet prevents the seedling roots from penetrating into the underlying soil while also helping to create a dense mat of roots. The mat can be cut into desired sizes to fit into the trays of the mechanized transplanter.

Advantages of the mat-type nursery

- Requires less area as compared to conventional nursery (30 m² vs. 400 m²) for one acre.
- Produces healthy seedlings of 18-20 cm height (2-3 leaves) in 14-18 days.
- Minimizes root damage as seedlings are not uprooted, thus reducing transplanting shock and enabling faster recovery and tillering in the field.
- Reduces the labor requirements for nursery raising.

Disadvantages of the mat-type nursery

- Only young and healthy seedlings can be transplanted. Old ones cannot be transplanted.
- Some extra investment (e.g. polythene sheets, frame, Farm Yard Manure etc.) is required compared to the traditional method.
- The method is knowledge-intensive, and may take some time to master.



Practical session in the field

After the theory session on “mat-type nursery preparation” is completed, take the participants to a nearby field selected for conducting the hands-on portion of these training sessions. As mentioned in the “planning and preparation for the training” part, the following items need to be already in place before starting the hands-on training:

- A ploughed, puddled and levelled field.
- A raised bed, approximately 20 m long, 1.5 m wide and 10-15 cm high, prepared in advance.
- Treated and pre-germinated seeds (8-10 kg/acre of hybrid or 15-18 kg/acre of inbred). Additional prerequisites for mat-type nursery preparation are described below.

Requisites

The training facilitator should carefully describe each of the items needed on the list below for raising mat-type nurseries, and explain their use and importance in nursery development.

1. Good quality seeds: 8-10 kg/acre of hybrid or 15-18 kg/acre of inbred
2. Nursery area: For transplanting one acre, 1.5 m wide x 20 m long
3. Polythene sheet (perforated): 1.5 m wide X 20 m long
4. Soil cleaning sieve
5. Soil and farmyard manure mixture of approximately 4 parts soil to 1 part manure
6. Watering can
7. Iron frame: An iron frame (1.2 m wide x 1.2 m long) is required to maintain the depth of soil layer. The frame should be:
 - 0.5 inch thick iron frame for wet-type nursery preparation
 - 0.75 inch thick iron frame for dry-type nursery preparation
8. Gunny bag
9. Sickle/sharp knife for cutting mats
10. Gloves and mask for safety while treating seed



Good quality seed



Perforated polythene sheet



Soil cleaning sieve



Watering can



Gunny bag



Iron frame



TYPES OF MAT NURSERY

Based on the method of preparation used, two types of mat nurseries can be distinguished, including:

A. Wet-type mat nursery

B. Dry-type mat nursery

Wet-type mat nursery

Steps for preparation

Prepare the bed by following these steps one day in advance, and explain the steps to the participants during the interactive hands-on training.

1. Puddle the field and let it settle for one day.
2. After that, prepare a raised bed of 20 m length, 1.5 m width, and 10-15 cm height. Leave the bed to settle for 1-2 days.
3. Keep ~60-80 cm channel/furrow between the beds.

On the day of the training, ask the participants to watch and follow these steps:

1. Add farmyard manure (FYM) in the channel/furrow and fill it with water. Mix FYM with soil to make a fine slurry.
2. Spread the perforated polythene sheet and remove air bubbles that may have formed underneath.
3. Place the iron frame on the bed and over the polyethylene sheet, and spread the well-mixed soil and FYM slurry over the top of the sheet.
4. Level the bed surface using a plank.
5. Spread the seeds evenly on the bed. Start with the borders and then move to the central area. Assure that the seeds are evenly distributed to avoid excess competition between seedlings.
6. Repeat steps 3, 4 and 5 until the entire nursery area is covered.
7. Cover the seeds with a thin layer of straw or banana leaves to protect them from bird predation or other damage. Remove the cover after 2-3 days.

Pictorial description of steps



Prepare a raised bed



Add FYM in channels



Spread the perforated polythene sheet evenly over the bed and remove any air bubbles



Place the iron frame on top of the polythene sheet and put soil and the farmyard manure mixture on top of the sheet and level



Spread the seeds evenly, starting from the border



Cover the bed with straw

Dry-type mat nursery

Steps for preparation

- Plough and level the field before bed preparation. Puddling is not required.
- Prepare a raised seed bed of 20 m length, 1.5 m width, and 10-15 cm height.
- Collect soil from a weed-free field and sieve it, using a 2-mesh sieve to get clod free soil.
- Mix farmyard manure with the sieved soil at a ratio of 4 parts soil to 1 part manure. It is best to mix the soil on a polythene sheet (if another is available).
- Follow the rest of the steps as indicated under wet-type mat nursery preparation.

Pictorial description of steps



Sieve the dry soil



Mix soil and FYM



Spread seed evenly over the bed



A frame with sections can also be used (both for dry- and wet-type mat nursery preparation)



A prepared dry-type mat nursery bed

AGRONOMIC MANAGEMENT PRACTICES

After preparing the nursery bed, take the participants back to the classroom and carefully explain the following agronomic management practices that will improve the productivity of the rice crop.

Variety selection

Based on the land type, the following are some varieties that could be used:

For low and medium land	Swarna-Sub 1, Swarna, Pooja, CR 1009, CR 1018, CR 1009-Sub1 Ranidhan, Pooja, Savitri, Pratikshya, BINA dhan 11
For upland	Sahbhagi dhan, Lalat, Khandagiri, DRR 42
For flood-prone areas	Swarna- Sub 1, CR 1009-Sub1, BINA dhan 11

Seed treatment

Treating seeds helps to reduce the risk of fungal infection in the rice crop. The following steps explain how to treat seeds.

Steps for seed treatment

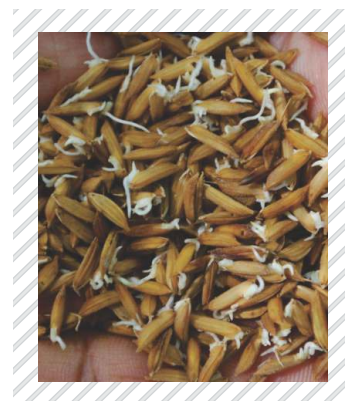
- Before treating seeds, be sure to wear a mask and gloves. Fungicides are poison, so it is important to protect yourself.
- Treat the seeds with carbendazim/vitavax @ 2g/kg.
- Dip the seeds in 10 litres of water and leave them under water for 12-16 hrs.
- Remove empty and chaffy seeds, which will float on the water surface.
- Drain and place soaked seeds in gunny bags for 24 hrs.
- Sprinkle water over gunny bag at regular intervals and keep turning the bag for proper aeration. This will keep the seed moist and avoid heat damage. After about 24 hrs, seeds will sprout.
- When a small root is visible, seeds are ready for sowing.
- Note that any seeds that have developed long roots are not suitable for sowing.



Remove chaffy seeds



Seeds at right stage for sowing



Over-germinated seeds are not suitable

Selection of Seeds

Water management

Water management is critical both for wet and dry beds. Too much or too little water can damage the seedlings.

- Irrigate the mat-type nursery beds using a watering can.
- To keep the bed moist, sprinkle water 5-8 times/day for the first 3-4 days. After that, fill the furrows /channels between two beds with water by flooding.
- Stop irrigation one day before transplanting. At this time, drain off any stagnant water in the nursery.
- Mats should be relatively dry before they are transplanted. Dry mats are easier to cut, and more suitable for transplanting.



Keep the bed moist by sprinkling water or irrigating

Fertilizer management

- Apply 100 g DAP with 500 g sand one week after sowing. 100 g is the suitable rate for a nursery of this size, which is intended to transplant one acre of land.
- In the case of nutrient deficiencies (yellowing), apply a foliar application of 0.5% zinc sulphate (21%) plus 2.5% urea. Repeat the application after 5-7 days, if symptoms reappear.
- In case the symptoms of iron deficiency are visible (interveinal yellowing and chlorosis of leaves), spray 0.5% solution of ferrous sulphate (5 g per liter of water).

Seedbed weed management

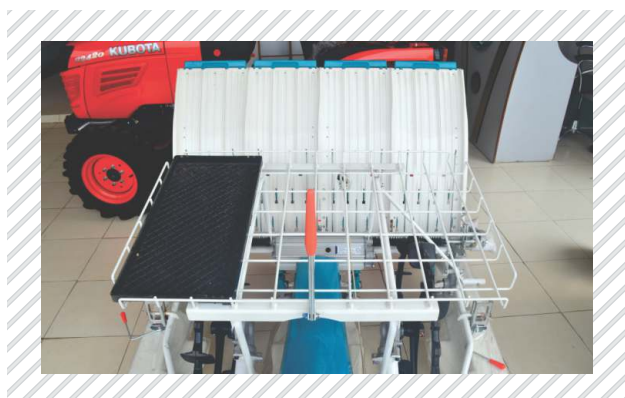
Generally, weed infestation should not be a serious problem if relatively weed-free soil and farmyard manure were used when preparing mat-type nurseries. The polythene sheet also restricts weeds from emerging out of the soil. However, if weeds still emerge, remove them manually.

Cutting mats for transplanting

- Seedlings of 18-20 cm height (2-3 leaves at most) are ideal for mechanical transplanting
- Properly managed seedlings usually attain this height within 14-18 days after sowing.
- Before cutting, ensure that the nursery is dry. Use a sharp sickle/knife to cut the mats to the desired size, based on the width of the seedling platform/tray on the paddy transplanter that will be used. Generally the widths follow these measurements:
 - For paddy transplanter made by VST company: 60 cm x 22.5 cm
 - For paddy transplanter made by Kubota/Mahindra : 60 cm x 30 cm



Cutting mats of required size



Seedling platform: Kubota tray



Seedling platform: VST tray

- While transporting to long distances, it is important to ensure that the mats do not dry out. This can be accomplished by sprinkling them with water regularly. In general, it is recommended to transplant the mats on the same day that the mats are cut.



Transporting the mats

RAISING MAT-TYPE NURSERY A BUSINESS OPPORTUNITY

Raising mat-type nurseries can be an excellent business opportunity for farmers, service providers, women, and unemployed youth. Some communities have also been successful when they have worked in groups to raise community nurseries, with seedlings that can then be sold to other farmers or mechanical transplanting service providers.

Experience sharing by successful mat-nursery entrepreneurs

In this session, you can invite a service provider, one who is already running a successful business of selling mat-nursery grown seedlings, and ask him or her to share their experience with the participants. The following list has some useful questions to ask the visiting service provider:

- What were your initial monetary investments?
- What is the cost of raising a nursery for an acre of land transplantation?
- Which activities or strategies do you believe make your business profitable?
- How do you encourage demand from farmers or service providers for mat-nursery grown rice seedlings?
- What challenges did you face in running your business?
- What benefits are farmers or mechanical rice transplanter service providers getting from your business?

This interaction will provide the participants with a good initial idea of how to start a mat-type nursery business. It will also encourage potential nursery growers to take up the business.

Cost-benefit analysis

- The following cost-benefit analysis is a simple example that can be explained through group discussion.
- The goal of explaining the cost-benefit analysis is to give participants a general idea of how profitable a mat-type nursery business might be.
- Read out the items listed in the table below, and ask the participants to work as a group and calculate and explain the approximate cost involved.

Cost-benefit analysis

- Make sure the participants know that the cost data are average from real farmers growing mat-type nurseries.
- Use a flip chart/white board to note down the costs.
- In order to make the analysis more relevant for the trainees, ask the participants what the market price for seedlings is in their area, or if they don't know, have them agree on a reasonable cost.
- Calculate how much money could be made from a seed bed of an agreed upon size by multiplying the price of seedlings by the size of the bed.
- Calculate the profit by subtracting costs from benefits.

Use the following table as a reference to conduct this analysis.

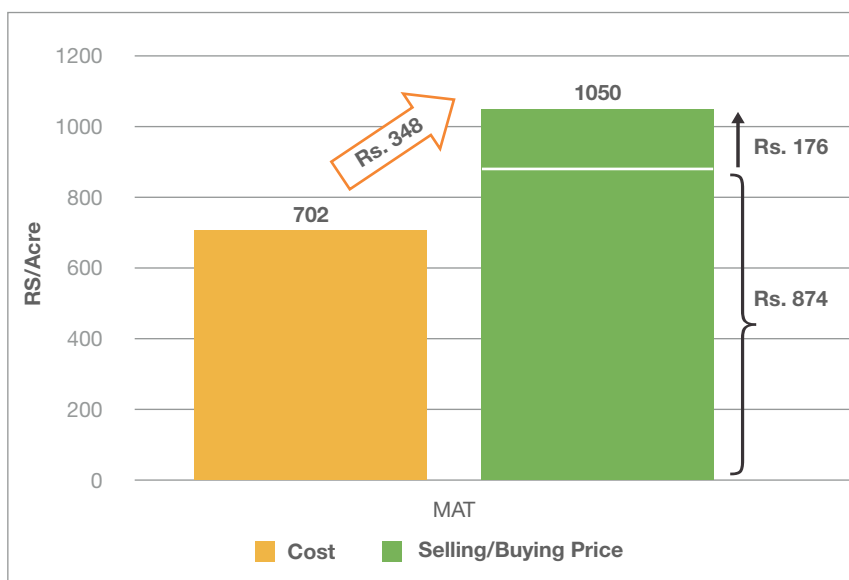
Cost incurred¹ in preparing mat-type nursery to transplant onto one acre of land during kharif season²

Heads	Entrepreneur (Cost in Rs.)	Farmer (Cost in Rs.)
Seed cost	372	346
Ploughing & Puddling (Tractor) cost	72	81
Fertiliser cost	7	37
FYM (+ transport) cost	24	57
Herbicide cost	0	0
Pesticide cost	7	10
Irrigation cost	10	59
Labour cost	154	212
Other cost (polythene, straw, etc.)	56	72
TOTAL 1 (excluding uprooting cost)	702	874
Uprooting cost	187	210
TOTAL 2 (including uprooting cost)	889	1084

¹Based on a survey of 30 mat-nursery entrepreneurs and 43 farmers who grow mat-nursery for their own use in three districts (Puri, Balasore & Bhadrak) of Odisha

²Most of the farmers in Odisha used to raise wet-bed mat nursery. However, the cost incurred in dry-bed mat nursery may marginally increase (~ Rs.100) due to additional labour and irrigation.

Profit margin from mat-type nursery business (seedlings needed to transplant one acre of land. The cost/price excludes uprooting expenses)



A mat-nursery entrepreneur makes a profit of Rs. 348 from nursery sufficient for one acre. A farmer/buyer pays Rs. 1050 for nursery for one acre, which is transplantation which is Rs. 176 more than his own cost of production (Rs. 874). But he/she gets healthy rice seedling as when required without taking any risk.

Keeping a record of mat-type nursery seedling buyers

Explain to the training participants the importance of recordkeeping for monitoring their business profits. The following table can be used to record orders received for seedlings from clients. This information will also help in planning for the next season and assuring that mat-type nursery businesses have sufficient clients to turn a profit.

List of farmers who receive services

Farmer's name and address	Mobile no.	Land area	Date of transplanting (tentative)

At the end of the session, ask the participants to express any doubts and clarify those.

SESSION III

MECHANICAL TRANSPLANTING OF RICE



INTRODUCTION

Mechanical transplanting of rice is the process of transplanting young rice seedlings, which have been grown in a mat nursery, using a paddy transplanter. This session covers in detail the method of mechanical transplanting of rice, and the types of paddy transplanters available in South Asia, their parts, features, operating mechanism and adjustments.

Agronomic management practices are also important in determining yield and productivity. A brief description of the management practices on weed, fertilizer, water, and insect management will therefore also be covered in this session. As more farmers are buying paddy transplanters and using them to provide transplanting services to fellow farmers on an affordable fee-for-service basis, new business and income-generating opportunities are being created for rural entrepreneurs. An analysis of the economics of service provision, and the benefits accrued by farmers and service providers, have also been integrated into this module, in order to improve trainees' understanding of the opportunities offered by transplanting service businesses.

At the end of this training session, the participants should be able to:

- Explain the advantages of establishing a rice crop using a mechanical transplanter
- Identify and explain how the different parts of a mechanical transplanter work
- Adjust the transplanter as per the given operational guidelines
- Explain the agronomic management practices required for establishing the rice crop under mechanical transplanting
- Understand the repairing and maintenance procedures necessary for the mechanical transplanter
- Verbalize the benefits of providing mechanical transplanting services to farmers
- Explain the cost involved and expected profit from a mechanical transplanting business



WHAT IS MECHANICAL TRANSPLANTING OF RICE ?

Mechanical transplanting of rice is the process of transplanting young rice seedlings, which have been grown in a mat nursery, using a paddy transplanter. In conventional manual transplanting practice, 8-12 laborers are required to transplant one acre. The process is also very time consuming and difficult. However, if self-propelled paddy transplanters are used, three people can transplant up to three to four acres in one day. This has great advantages in areas where farm labor is scarce and expensive.

Advantages

1. Efficient use of resources by saving labor cost (Rs. 600 per acre) and irrigation water saving (up to 10% less)
2. Timely transplanting of seedlings at the optimal age (14-18 day old seedlings)
3. Reduced transplant shock
4. Ensures uniform spacing and optimum transplant density (26-28 hills/m² with 3-4 seedlings per hill)
5. Higher yield compared to the traditional method
6. Lower incidence of 'Bakanae' disease due to less root injury
7. Lowers drudgery and health risks for farm laborers
8. Improved employment and entrepreneurship opportunities for rural youth and women through the development of custom service businesses
9. Increases income and helps to improve rural livelihoods

Tools and materials required for training

1. Mechanical transplanter (ideally a walk-behind and riding type)
2. Mat nursery 'cakes' of required size
3. Sickle and/or sharp knife for cutting mat cakes
4. Scale for measuring the cake's size as per the mechanical rice transplanter's seedling platform
5. Trays/bags for carrying mat cakes of rice seedlings
6. Recommended dose of fertilizer
7. A well-leveled field (preferably by laser land leveler) that has been only lightly tilled (no puddling)
8. Apply irrigation 12 hours before transplanting. Maintain 1-2 cm of flood water during mechanical transplanting. Drain out any water in excess of this amount.
9. Recommended herbicides (pre- and post-emergence)

HANDS-ON TRAINING SESSION (IN FIELD)

After completing the introductory session, take the participants to the field selected for hands-on training. Keep the two types of transplanter, including the walk-behind and riding type, ready for display and operation. The description given below will help in explaining the features and functions of the transplanters.

1. Self-propelled paddy transplanter (walk-behind type)

Features

Kubota and Mahindra generally provide quality self-propelled walk-behind type paddy transplanters in India. The specifications of commonly available walk-behind transplanters are given below.

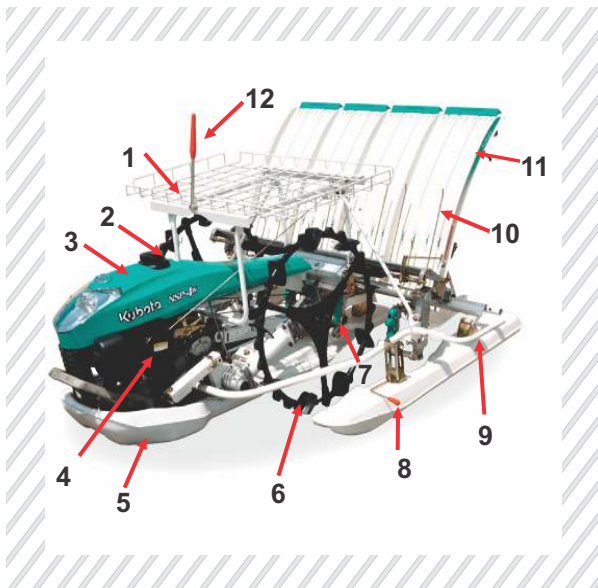
Specifications

Length (cm)	:	245
Width (cm)	:	148
Height (cm)	:	84-95
Weight (kg)	:	170
Row to row spacing interval (cm)	:	30
Hill-to-hill spacing interval (cm)	:	11.7/13.1/14.7
Power requirement (hp)	:	3.7, petrol engine



Walk-behind transplanter

- The walk-behind paddy transplanter consists of prime mover (petrol engine), transmission, float, planting wheels, fender rod, planting marker, central row marker seedling press, seedling platform, seedling tray, seedling tray shifter, pickup finger.
- The safety clutch mechanism is important and prevents the breakdown of the planting device from the impact of any stones or debris in the field.



Labeled diagram of walk-behind transplanter

1. **Seedling tray** : It is used to keep the extra seedlings
2. **Fuel tank inlet** : Open it for filling fuel in tank and tighten it
3. **Fuel tank** : To fill-up fuel for operating the transplanter
4. **Engine** : It works as prime mover to operate the transplanter
5. **Floating board** : It is a base that helps the transplanter to move and plant seedlings or to keep extra seedling cakes
6. **Planting wheel** : It is used to transplant in muddy conditions
7. **Planting finger** : It is used to pick the seedlings and transplant
8. **Planting marker** : It helps in planting the seedlings in straight rows
9. **Fender rod** : It moves seedling trays in to and fro motion
10. **Seedling press** : It is used to keep the cakes straight and avoids folding of the cakes
11. **Seedling platform** : It is used to keep the seedlings for transplanting
12. **Centre row marker** : It helps in running the transplanter in a straight line

2. Self-propelled paddy transplanter (riding type)

a. One-wheel riding type

Features

- The most commonly available self-propelled riding type transplanter in India.
- Can transplant eight rows in a single pass.
- Power transmission system consists of an engine, V-belt, cone clutch and gearbox. V-belt and cone clutch transmits power from engine to transmission system.
- A propeller shaft from the gear box provides power to the transplanting mechanism mounted over the float.
- The float facilitates the transplanter to glide over the mud in the field during transplanting.
- The scroll shaft mechanism is meant for left and right movement of the tray and downward movement of the nursery to where transplants are mechanically picked up and established in the soil.

Planting mechanism

Type: Separate crankshaft & connecting rod system with seedling pusher

Growing density of seedling: 34-42 hills/m² (depending on hill-to-hill distance)

Number of seedlings per hill: 3-8 (adjustable according to density and thickness of seedlings)

Width of seedling mat: 22 cm

Planting depth: 0 – 6 cm (adjustable)

Capacity: 0.325 -0.5 acre/h



Self-propelled riding type paddy transplanter

Engine model	:	Single cylinder air cooled diesel
Rated power	:	2.94 KW
Rated speed	:	2600 rpm
Weight	:	305 kg
Overall dimensions L x W x H	:	250 x 213.1 x130 cm
Row number	:	8
Row to row spacing	:	23.8 cm
Distance between hills	:	14-17 (standard), 10-12, 12-14, 17-20, 20-23 cm (optional)
Planting speed	:	0.44-0.54 m/second
Road travelling speed	:	8.2 km/hr

b. Four-wheel riding type (Japanese, Korean)

Features

- A riding-type paddy transplanter
- Capable of transplanting six rows
- A double-acting transplanting mechanism (engine operated with one sun and four planetary gears) enhances transplanting speed, meaning more land can be covered in one day
- Adjustable number of seedlings per hill, depth of transplanting (maintained constant automatically) and hill-to-hill distance
- Comes with six seedling racks



Four wheel riding type paddy transplanter

Specifications

Overall length (cm)	:	302
Overall width (cm)	:	214
Overall height (cm)	:	153
Weight (kg)	:	570
Engine type	:	12 hp, 4-cycle, air-cooled OHV gasoline
Maximum output (rpm)	:	1200-1800
Starting method	:	Electric
Traveling section		
Steering	:	Power steering
Row to row spacing (cm)	:	30
Depth of transplanting (cm)	:	1.5 to 4.5
Tyre		
Front	:	Anti-puncture tyre with wheel disc
Diameter (cm)	:	65
Rear	:	Solid rubber
Shifting		
Front	:	4 speeds
Reverse	:	1 speed
Transplanting section		
Number of rows	:	6
Hill to hill distance (cm)	:	12 to 22 (depending on plant population)
Transplanting speed (m/sec)	:	0.24-1.30

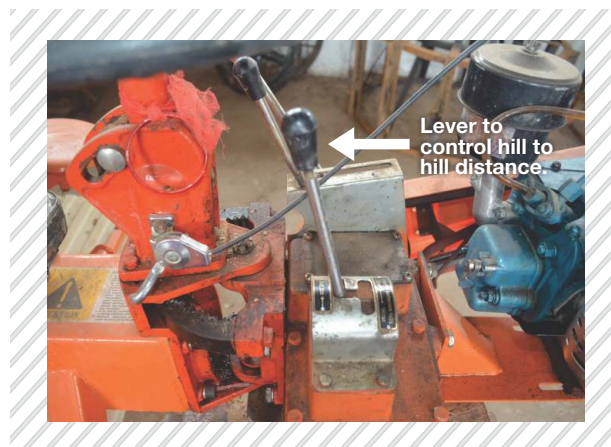
PARTS OF PADDY TRANSPLANTER (WALK-BEHIND AND RIDING TYPE)

The self-propelled mechanical paddy transplanter has two main sections: a) transport and b) planting

Transport system consists of:	Planting system consists of:
<ul style="list-style-type: none"> diesel engine 	<ul style="list-style-type: none"> floating board
<ul style="list-style-type: none"> gear box 	<ul style="list-style-type: none"> nursery platform
<ul style="list-style-type: none"> lever for adjusting hill spacing or forward speed 	<ul style="list-style-type: none"> transplanting fingers with screws for adjusting the number of plants per hill
<ul style="list-style-type: none"> power tiller operated shaft 	<ul style="list-style-type: none"> depth setting lever
<ul style="list-style-type: none"> toothed steel wheel (riding type only) 	<ul style="list-style-type: none"> chains for height adjustment of float board
<ul style="list-style-type: none"> driver's seat 	<ul style="list-style-type: none"> pedal for float-lifting
<ul style="list-style-type: none"> two seats for people to assist with transplant trays (in riding-type only) 	

PLANTING SECTION CONTROLS

1. Hill-to-hill distance control: There is a lever in the machine that can be set to a particular hill-to-hill distance, marked on an attached plate.
2. Planting marker: One of the major benefits of mechanical transplanting is establishing the crop in straight rows, and for that, every return pass should be parallel to the previous one. This can be achieved with the help of a marker that is attached to the machine. The machine should be moved forward during the return pass in a manner so that the marker stays above the last transplanted row of the previous path.



Hill-to-hill distance control



Planting marker of riding-type transplanter



Planting marker of four-wheel type

3. Planting clutch: The planting clutch is used to engage or disengage the power to the fingers that are used to pick up and transplant seedlings.

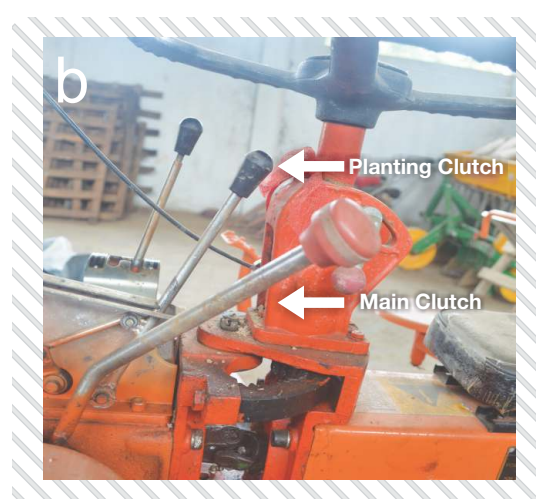
The clutch should be engaged:

- While transplanting

The clutch should be disengaged:

- While feeding the nursery mats
- Operating the transplanter in transportation mode
- Whenever actual transplanting is not done (e.g. during turns)

4. Main clutch: The clutch is meant for engaging and disengaging the power system. If the machine is to be used in the field, the clutch should be engaged and disengaged for idle movement of the engine. The clutch system of walk-behind (a) and riding type (b) mechanical rice transplanter is shown below.



Planting clutch and main clutch

5. Accelerator: The accelerator fitted near the steering wheel of the riding-type and on the handle of the walk-behind type transplanter is meant to control forward movement at the desired speed. Follow the manufacturer's recommendation for the correct speed.



Accelerator of walk-behind type



Accelerator of riding type

6. Floating board: The floating board is a base that helps the transplanter to move and plant the seedlings. It is also used to keep extra mat seedling cakes.

a On a riding-type machine, a pedal connected through a chain controls the floating board movement. If the machine gets stuck in the mud, then press the pedal with your hand several times to free the transplanter. The engine power will also help to move the machine out of the mud.

b In a walk-behind type transplanter, movement of the lever triggers the hydraulic mechanism, which controls the movement of the floating board. "Up" position is used for lifting the floating board and vice-versa.



Floating board on a riding-type transplanter



Floating board on walk-behind type transplanter

The molded rectangular plates on the lower side of the floating board with round and smooth edges (from front to back) help to create corrugation in the field. This improves the smooth and directional movement of the machine in straight lines. The corrugations in both types of transplanter also improve the establishment of seedlings in lines. An additional benefit is the rapid distribution of irrigation water.

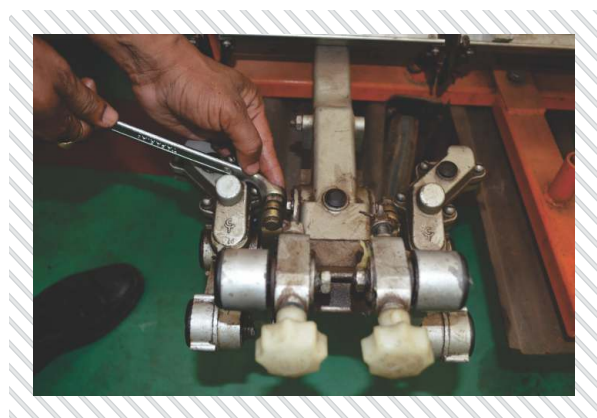
ADJUSTMENTS OF THE TRANSPLANTER

1. Adjust V-belt tightness

Test the tightness of the transplanter's V-belt by pressing the center of the belt downward to 1-2 cm with your fingers. If there is more than 2 cm of flexibility, adjust the belt by changing the position of the engine rack.

2. Side clearance adjustment of the separating needle

- Maintain side clearance at 1.25 mm, even on both sides.
- To adjust clearance, first loosen the lock bolt on the transplanting crank and lock nut on the side of the rocker arm.



Loosen lock bolt and nut of transplanting crank

- Move the transplanting arm (by lightly knocking the crank) to the right and left so that the side clearance of the separating needle and seedling gate are evenly distributed.
- According to the size of the clearance, place split shims between the rocker arm and transplanter's arm.



Removing shim and after adjustment setting shim back in place

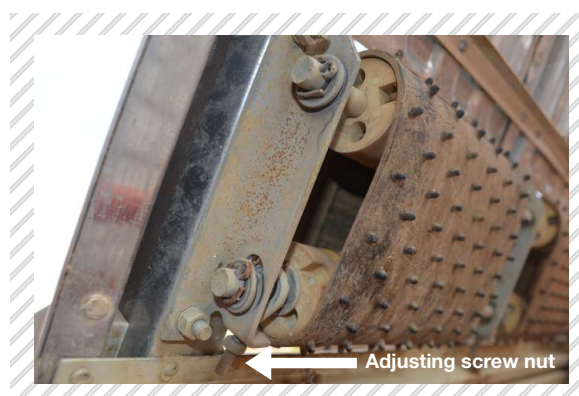
- For the adjustment of the transplanter's arm when the movement is in the direction of the rocker arm, all shims should be removed first before adjustment.
- After adjustment, put the slit shims into place, then the lock bolts and the fixing nut should be tightened up again.



After adjustment, tighten the nut and bolt

3. Seedling delivery belt adjustment

- When the seedling delivery belt slips and longitudinal seedling delivery stops, this is a clear message that the belt is too loose. To tighten the belt, move the screw in counter-clockwise direction.
- When the seedling platform makes a knocking sound while delivering seedlings, the belt is probably too tight. Move the screw in a clockwise direction to loosen the belt.



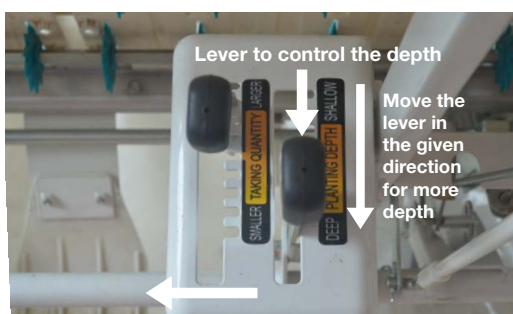
Seedling delivery belt adjustments

4. Adjustment of transplanting depth

Transplanting depth can be adjusted properly by the transplanter operator as per steps described below. This adjustment is required because shallower transplanting depth can result in displacement of the seedlings during irrigation. Conversely, deeply transplanted seedlings can face submergence if flood water is too deep.

Walk-behind type

Slide the lever handle to set the desired depth; the depth increases by moving the lever towards the operator and vice versa.



Riding type

First loosen the fastening steel wire attached to the lifting rod. Rotate the lever to set the desired depth. Counter clockwise rotation will increase the planting depth and vice versa. After adjusting, lock the screw rod /lifting rod with the fastening steel wire.



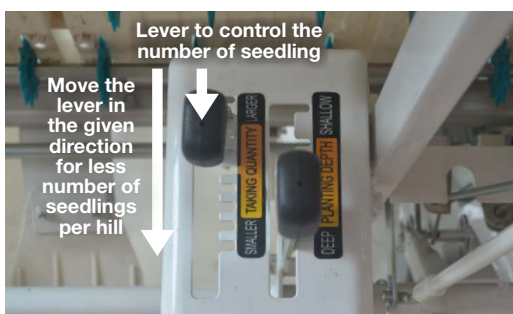
Adjustment of transplanting depth

5. Adjustment of seedling fetching quantity

The recommended seedling quantity per hill with mechanical transplanting is 2-3 seedlings, which can be adjusted as shown in the below. The operator should ensure and check that each finger on the transplanter picks up and distributes an equal seedling quantity. The proper number of seedlings tends to result in high yield.

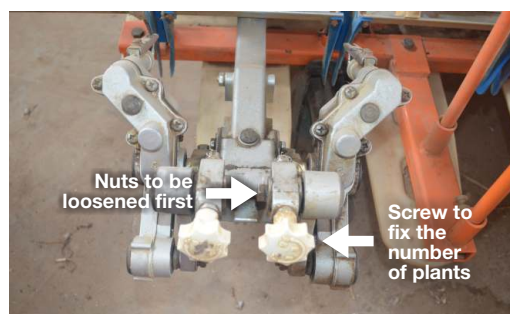
Walk-behind type

Pull the lever towards the operator to reduce the number of plants per hill, and vice versa.



Riding type

In this type, clockwise rotation increases the number of plants per hill and vice versa. Before setting the screws to the desired position, the nuts have to be loosened. Caution must be taken that all the screws are set equally so that all the fingers pick up an equal number of seedlings.



Seedling quantity adjustment

6. Replacement of transplanting finger

The transplanting fingers on a rice transplanter tend to wear out quickly. For smooth operation, frequent inspection is needed. Damaged fingers should be replaced quickly. For replacement of the fingers, first unscrew the transplanting finger(s) and take out the pressure cover. Before tightening up the screw, replace the finger(s) and install the pressure cover.

OPERATIONAL GUIDELINES

Steps of field preparation

Prepare the field by following the given steps 1-2 days before the hands-on training session. On the day of the training, show the prepared field to the participants and explain the steps to them for their knowledge and understanding.

- Plough the field to a depth of 5-7 cm using a harrow or cultivator. Puddle the field and level it using a plank and allow the soil to settle for 12-24 hours.
- Under non-puddled conditions, the soil should be tilled one to two times using a harrow or cultivator, and then planked/leveled.
- If weed density is high, a pre-plant application of a non-selective herbicide, such as glyphosate (Roundup/Glycel) @ 1.0-1.5% solution + 0.1% surfactant or Ammonium sulphate or paraquat (Gramoxone) @ 0.3-0.5% solution, should be applied 24-48 hours before ploughing.
- Before transplanting, apply a light irrigation and drain off any excess water.
- While transplanting, maintain a uniform depth of 2.0-3.0 cm of standing water.

Ensure that, on the day of training, there must one bed of nursery prepared well in advance for a demonstration of mechanical transplanting and the field should be ready for transplanting.

Follow the given steps for conducting the hands-on training:

- Check that the nursery cake of seedlings is of required size as per the nursery tray. Put nursery cakes at the two opposite bunds of the field in the direction of transplanting for easy loading.
- Before starting, check the engine in the following order:
 - Check whether the fuel tank is full or not. If not, then fill it
 - Open the oil circuit
 - Open the throttle
 - Check whether the clutch is separate and the gear shift lever is in the neutral position
- Before going to the field for transplanting, check whether all fingers are working or not in the following order:
 - The transplanter should be placed on a flat surface
 - Start the engine
 - Engage the gear to run the transplanter and check whether all fingers are in working condition or not
- Replace the transport wheel of the transplanter with the transmission/logged wheel and remove the rear wheels.



Replace the transport wheel of the transplanter with the transmission/logged wheel

- Check whether the float is properly placed. Generally, the float is attached with a chain to the main body and kept at 5th – 7th ring of the chain.
- Start the transplanting by first giving a demonstration and then ask each participant to run the transplanter themselves.
- Start transplanting by leaving the space equal to the width of the transplanter at three sides of the field near the bunds. This helps in avoiding any damage to the already transplanted field. Follow the path as indicated by the arrows in Figure1 for transplanting.
- Put nursery cake in the space provided on the tray. Also keep some cakes on the float/rack. If the cake is finished in the middle of the operation, then use the cake placed on the float/rack.
- Other than driver/operator, one or two persons sitting at the back of the transplanter should always check whether all fingers are picking seedlings or not. If finger misses, then reverse the nursery cake, adjust or replace it.
- Supply seedlings in a timely manner and do not transplant the seedlings while turning at the end of the field.
- Don't touch any rotating part during transplanting to avoid accidents.
- Stop the machine if something is abnormal during operation and find out the problem and adjust it.

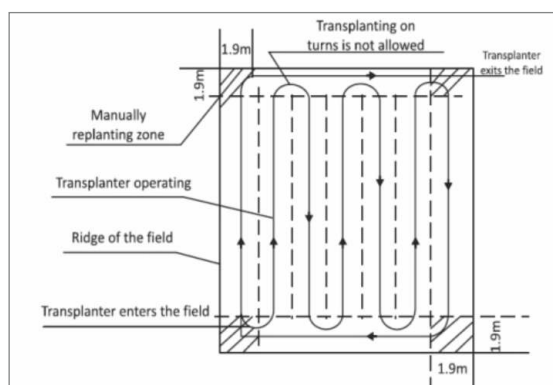


Figure 1 Sketch showing the movement of transplanter



Leave area equivalent to one pass of the transplanter

- If the paddy transplanter gets stuck in the field, do not pull out the machine by force. Reduce the load (mats, drivers, assistants etc.) from the machine and then run the transmission wheel forward by pressing the pedal.
- Fill the space left at corners, missing gaps or hills manually.

IMPORTANT DO'S AND DON'TS

Do's

- Transplant into a well prepared and levelled field only.
- Sufficient soil settling time after preparing the field and water level in the field are the key factors for the success of mechanical rice transplanting.
- Maintain 2-3 cm of standing water on the field while transplanting.
- Use healthy nursery seedlings of optimum age.
- Handle the nursery mats carefully with minimum disturbance while loading into the machine.
- When the transplanting is over, fingers should be in “up” position. If not, then adjust them manually.
- Lift the planting platform while driving over the bund or smoothen it for easy movement.
- After transplanting, use the same crop management practices as recommended for the manually transplanted crop.

Don't

- Avoid using mechanical transplanter in lowland conditions where water remains stagnant throughout the season.

AGRONOMIC MANAGEMENT PRACTICES (CLASSROOM SESSION)

After the hands-on training on transplanting finishes, take a break, and start the session on agronomic management practices in the classroom. Use the given information for conducting the session:

a. Fertilizer management in the transplanted crop

Rice Crop Manager, a decision support tool can be used for calculating field-specific fertilizer requirements for a given variety. The tool is available at <http://webapps.irri.org/in/od/rcm>. Otherwise, apply fertilizers as per details given below:

Name of fertilizer	Rate of fertilizer application (kg/acre)			
	Basal (before transplanting)	At transplanting	At active tillering ¹	At panicle initiation ²
DAP	35-40	-	-	
Urea	-	6-8	25-35	25-35
MOP	15-20	-	-	15-20
ZnSO ₄	10	-	-	-

If DAP is not available, substitute it with other complex fertilizers like Gromor and NPK mixtures @ 80-100 kg N/ha, 40 kg P₂O₅/ha, and 40-60 kg K₂O/ha

1. Active tillering (AT) stage: 15-25 DAT
2. Panicle initiation (PI) stage: For short-term varieties/hybrids (25-40 DAT), medium-term and long-term varieties/hybrids (35-55 DAT)

Note: Incorporate a full dose of zinc and phosphorus, and a half dose of potash at the time of field preparation. Apply fertilizer uniformly throughout the field. Nitrogenous fertilizer should be applied in splits. Use ferrous sulphate @ 0.5% solution in case of iron deficiency.

b. Weed management

Before land preparation (if weed density is high, apply 24-48 hrs before)		
Herbicide	Dose	Target weeds
Glyphosate (Roundup/Glycel)+ 0.1% surfactant or Ammonium sulphate	1000 ml/acre	Perennial and other emerged weeds
Pre-emergence (use any one)		
Pretilachlor 50 EC (Rifit or Erase)	600 ml/acre	Grasses, broad-leaved weeds and sedges
Butachlor 50 EC	1000-1200 ml/acre	Grasses, broad-leaved weeds, and sedges

- Apply pre-emergence herbicides, 0 to 3 days after transplanting, by broadcasting after mixing in 60 kg sand per acre or by splash bottle method in standing water of 3-5 cm depth.

If pre-emergence herbicide was not applied or weeds emerge even after using pre-emergence herbicides, use any of the following post-emergence herbicides depending on existing weed flora:

Post-emergence (select based on weed flora)			
Herbicide	Dose (product/acre)	Time of application	Target weeds
Bispyribac-sodium 10% SL (Nominee Gold, Adora, Taarak) @ 20 g ai/ha	80 ml	15-25 DAT*	Grassy weeds mainly <i>Echinochloa spp</i> and few broadleaf weeds
Bispyribac-sodium + pyrazosulfuron (Sathi 10% WP) @ 20 + 20 g ai/ha	80 ml + 80 g	15-25 DAT	Grassy weeds mainly <i>Echinochloa spp</i> , sedges mainly <i>Cyperus rotundus</i> and broadleaf weeds
Fenoxaprop-ethyl with safner (Rice Star) + ethoxysulfuron (Sunrice) @ 90 +18 a.i./ha	300-500 ml + 50 g	15-25 DAT	Grasses including <i>Leptochloa</i> , <i>Eragrostis</i> , <i>Dactyloctenium</i> broadleaf weeds and sedges
Chlorimuron+ metsulfuron (Almix) @ 4 g ai/ha	8 g	20-25 DAT	Broadleaf weeds and sedges

*DAT: Days after transplanting

- Use integrated weed management, including stale seed bed. Use stale-bed and crop rotation techniques to prevent weed growth.
- Mechanical weed control can be done using cono weeder and power weeder.
- One-hand weeding may also be added to remove escaped weeds before seed setting.
- Always use weed free healthy nursery.
- Before applying herbicides, read the labels to understand the toxicity and safety measures required.
- Spraying must be done on a sunny day when the wind is calm.
- A use flat fan nozzle for spraying.
- Wear protective clothing before spraying.
- Wash your hands properly with soap after application.
- Properly dispose off empty herbicide containers after use.

c. Water management

Maintain a 2-3 cm water level in the field, at least for 7-10 days after transplanting to ensure better crop establishment. Thereafter, subsequent irrigations should be applied at the development of hairline cracks. Active tillering, heading/panicle initiation and grain filling are three critical stages when water stress must be avoided.

d. Plant protection

Use integrated insect pest management to control insect pest attacks in your field. For controlling insect pests through chemical methods, control measures for some common insect/pest and diseases have been mentioned below:

Insect-pest management

Crop stage of insect-pest attack	Insect-pest	Control measures
Nursery	Stem borer, Thrips, Root nematode	<ul style="list-style-type: none"> Apply Phorate 10 G (Trade name: Foratoxor/Phormax/Thimate/Ratnamate) @ 5 kg/acre of nursery Or Fipronil 0.3 G (Trade name: Regent/Mahabir/Fauji/ Sriram Fipro Plus) @ 13 kg/acre of nursery, 5 to 7 days before pulling the seedlings for transplanting.
Vegetative stage	Stem borer	<ul style="list-style-type: none"> Clipping of leaf tips of the seedlings at the time of transplanting will help in destruction of egg masses Clean cultivation and destruction of stubbles Apply Phorate 10 G @ 4 kg/acre (Trade name: Foratoxor/Phormax/Thimate/ Ratnamate) Or Fipronil 0.3 G @ 10 kg/acre (Trade name: Regent/Mahabir/Fauji/ SriramFipro Plus)
	Leaf folder	<ul style="list-style-type: none"> Spray Triazophos 40 EC @ 160 ml/acre (Trade name: Trazan/Ghatak/ Trizoplus/Trip) Or Chlorpyriphos 20 EC @ 600 ml/acre
	Brown planthopper, White-backed plant hopper, green leaf hopper	<ul style="list-style-type: none"> Spray Imidacloprid 200 SL @ 50 ml/acre (Trade name: Corafider/Hilmida/Trishul) Or Thiamethoxam 25 WG @ 40 g/acre (Trade name: Exam/Thioguard/Evident)
	Mealy bug	<ul style="list-style-type: none"> Spot application of Phorate 10 G granules @ 5 kg/acre
	Gundhi bug	<ul style="list-style-type: none"> Spray Carbaryl 50 WP @ 600 g/acre during afternoon hours.
Reproductive stage	Stem borer	<ul style="list-style-type: none"> Spray Chlorpyriphos 20 EC @ 800 ml/acre Or Quinalphos 25 EC @ 600 ml/acre (Trade name: Cross/Quick/Exalux)
	Leaf folder, Ear-cutting caterpillar	<ul style="list-style-type: none"> Spray Triazophos 40 EC @ 200 ml/acre Or Chlorpyriphos 20 EC @ 800 ml/acre

Disease management

Crop stage of disease attack	Disease	Control measures
Nursery, vegetative and reproductive stage	Leaf blast/ Neck blast	<ul style="list-style-type: none"> In endemic area, adopt seed treatment with Tricyclazole 75 WP (Trade name: Beam/Baan/Newage) Or Spray Tricyclazole 75 WP @ 0.6 g/lit Or Carbendazim 50 WP @ 2 g/kg seed (Trade name: Bavistin/Curator)
	Sheath blight	<ul style="list-style-type: none"> Spray Validamycin 3 l @ 2.5 ml/lit (Trade name: Sheathmar/Delcin) Or Hexaconazole 5 EC @ 2 ml/lit (Trade name: Contaf/Mash/Samadhan-Plus) Reduce or delay the top-dressing of nitrogen fertilizer and apply in 2-3 splits
	Brown spot	<ul style="list-style-type: none"> In endemic area, adopt seed treatment with Carbendazim 50 WP + Mancozeb 75 WP @ 2g/kg seed or spray @ 2 g/lit of water (Trade name: Saaf/Safaya/ Sixer)
Post-flowering	False smut	Spray Propiconazole 25 EC @ 1 ml/lit at around flowering (Trade name: Tilt/ Result/Rezole)

BUSINESS OPPORTUNITY AS A SERVICE PROVIDER

A farmer, service provider or any machine dealer who buys a mechanical transplanter machine can start providing profitable services to interested farmers.

Ask the participants to develop a cost-benefit analysis by discussing among themselves. Use the following table as reference and for facilitating the discussion.

A person having mechanical transplanter can start his/her own business by providing machine services and other associated operations like nursery enterprise, repair and machinery repair and maintenance. The table mentioned below gives an average costing and revenue obtained using a transplanter. If the service provider is growing nursery as well, the cost of nursery preparation given in session II could be added.

Business opportunity for riding-type paddy transplanter:

RETURN	Unit	No. of units	Charge/unit	Gross Profit (INR)	Case
Land area serviced @ 2 acres/day for 45 days	Acre	90	1000	90000	
Gross Profit				90000	
VARIABLE COST					
Fuel @ 2 litre/acre	Litre	180	58	10440	
Driver's fee @ Rs.400/day	No. of days	45	400	18000	
Repair & maintenance (Lump Sum)	-	-	-	4000	
Earnings before depreciation & Interest	-	-	-	57560	
FIXED COST WITHOUT SUBSIDY					
Depreciation (Cost of Machine - Rs.210000/-)	-	1	42000	42000	
Interest on Capital @ 10% (Machine Transplanter)	-	1	21000	21000	
Net Profit	-	-	-	5440	Case 1
FIXED COST SUBSIDIZED @ 50%					
Depreciation (Cost of Machine - Rs. 105000/-)	-	1	21000	21000	
Interest on Capital @ 10% (Machine Trans-planter)	-	1	10500	10500	
Net Profit	-	-		26060	Case 2
Fixed cost subsidized @ 75%					
Depreciation (Cost of Machine - Rs. 52500/-)	-	1	10500	10500	
Interest on Capital @ 10% (Machine Transplanter)	-	1	5250	5250	
Net Profit	-	-		41810	Case 3

Business opportunity for walk-behind type paddy transplanter:

RETURN	Unit	No. of units	Charge/unit	Gross Profit (INR)	Case
Land area serviced @ 2 acres/day for 45 days	Acre	90	1000	90000	
Gross Profit				90000	
VARIABLE COST					
Fuel @ 2 litre/acre	Litre	180	58	10440	
Driver's fee @ Rs.400/day	No. of days	45	400	18000	
Repair & maintenance (Lump Sum)	-	-	-	4000	
Earnings before depreciation & Interest	-	-	-	57560	
FIXED COST without subsidy					
Depreciation (Cost of Machine - Rs. 1,80,000/-)	-	1	36000	36000	
Interest on Capital @ 10% (Machine Transplanter)	-	1	18000	18000	
Net Profit	-	-	-	-3560	Case 1
FIXED COST subsidized @ 50%					
Depreciation (Cost of Machine - Rs. 90,000/-)	-	1	18000	18000	
Interest on Capital @ 10% (Machine Transplanter)	-	1	9000	9000	
Net Profit	-	-	-	30560	Case 2
Fixed cost subsidized @ 75%					
Depreciation (Cost of Machine - Rs. 45000/-)	-	1	9000	9000	
Interest on Capital @ 10% (Machine Transplanter)	-	1	4500	4500	
Net Profit	-	-	-	44060	Case 3

SESSION IV

REPAIR & MAINTENANCE



TROUBLESHOOTING

The first step in troubleshooting problems with the mechanical transplanter is to gather information on the issue, such as an undesired output or a lack of expected functionality, and then to solve that issue with the recommended measures. The table below explains some frequently observed problems and their solutions. In case the problem persists after following the given solution, contact your nearest dealer.

Problem	Cause	Troubleshooting
Missing hills or uneven plant spacing	<ul style="list-style-type: none"> Poor or uneven growth of seedlings in mats Seedling mat is thin Wear and tear of transplanting fingers 	<ul style="list-style-type: none"> Use mat nurseries grown with recommended practices Use recommended seed rates to maintain optimum seedling density in nursery Slow the crossfeed time (time of picking the seedlings by fingers) of transplanter Check the transplanting fingers and replace if required
Seedling mats collapse on the seedling platform	<ul style="list-style-type: none"> Mat is thin High moisture content in the mat Wider gap between seedlings Rolling and drying of seedlings during transportation 	<ul style="list-style-type: none"> Ensure minimum mat thickness of 0.5 to 0.75 inches Dry the nursery to firm it up Use recommended seed rate to maintain optimum seedling density in nursery Allow the cakes to straighten and moisten them before transplanting
Poor sliding and congestion on seedling platform	<ul style="list-style-type: none"> Non-uniform cakes and mismatch of cake size Cakes are dry 	<ul style="list-style-type: none"> Maintain prescribed cake size Replace uneven cakes Sprinkle water on cakes before planting to improve sliding
Seedlings not released from planting finger especially in clay soils	<ul style="list-style-type: none"> Mud gets stuck to the claws when the water level is low in the field The seedling is stuck in the planting fingers resulting in the poor pickup Mats are too wet 	<ul style="list-style-type: none"> Apply irrigation and maintain 2-3 cm water in the field Set the seedling depth to deep planting (2-3 cm) Dry the mats to the right moisture before transplanting
Floating and moving seedlings	<ul style="list-style-type: none"> More water depth High speed of the transplanter Less planting depth Improper field preparation 	<ul style="list-style-type: none"> Remove excess water and maintain it at 2-3 cm height Reduce the speed of the transplanter Increase planting depth Ensure field is well prepared and levelled before transplanting

Problem	Cause	Troubleshooting
Transplanter floats, sinks or presses soil against adjoining row	<ul style="list-style-type: none"> • Excess puddled field (muddy) • Excess water in the field • High speed of the transplanter • Improper leveling of the field 	<ul style="list-style-type: none"> • Reduce water level and let soil surface get firmed (Transplanting may be postponed for a couple of days) • Reduce the speed of the transplanter • Level the field properly before transplanting
Seedlings unable to get transplanted in soil	<ul style="list-style-type: none"> • Poor root development • Dry nursery is being used • High speed of the transplanter • Foreign materials in the seed bed 	<ul style="list-style-type: none"> • Improve seedling root development by following recommended practices for seedbeds • Wet the nursery slightly • Reduce speed of the transplanter • Remove foreign materials before initiating nursery seed bed preparation
Hill spacing becomes smaller, especially in soft soil and deep water	<ul style="list-style-type: none"> • Excess water in the field • Slippage of transmission wheel 	<ul style="list-style-type: none"> • Drain out excess water from field • Lower the wheel to avoid wheel slippage
Transmission wheel clogs; restricts forward movement	<ul style="list-style-type: none"> • Transmission wheel is attached in reverse direction • Improper field preparation 	<ul style="list-style-type: none"> • Attach the transmission wheel in the correct direction. If problem persists, remove the washer from the 3-point hubs present in the larger pulley • Check the soil condition. Use transplanter with optimum water level

MAINTENANCE OF THE PADDY TRANSPLANTER

- Clean the transplanter after transplanting. This will protect the metal parts from corrosion and increase machine life.
- Check the condition of the fingers. If the fingers are damaged, replace them.
- Replace the engine oil and gear oil regularly as per instructions given by manufacturers in the operation manual of the transplanter.
- Check whether all the components are in good condition.
- Store the machine in a shaded place and keep it covered when not in use.

ANNEX I: PRE-EVALUATION FORM

Extension agents, farmers and service providers' training pre-evaluation form:

Venue:

Date:

Name of participant: _____

Profession: _____

Please put tick (✓) mark on the correct answers

Total time: 10 minutes

Question	Answer		
Questions related to mat nursery			
1. What is the seed rate of hybrid rice for raising nursery to transplant one acre?	8-10 kg/acre	10-12 kg/acre	15-18 kg/acre
2. What is required for mechanical transplanting?	Flat-bed manual nursery	Raised-bed manual nursery	Mat-type nursery
3. How much area is required for raising mat nursery bed for transplanting of one acre field?	100 m ²	50 m ²	30 m ²
4. What should be the ideal age for seedlings to be transplanted?	14-18 days	21-30 days	31-40 days
5. Which chemical is used for seed treatment?	Bavistin	Pretilachlor	Bispyribac Sodium
Questions related to transplanting			
6. What is pre-emergence herbicide?	Herbicide applied before weed emergence	Herbicide applied before crop emergence	Herbicide applied after weed emergence
7. What is post-emergence herbicide?	Herbicide applied after weed emergence	Herbicide applied after crop emergence	Herbicide applied before weed emergence
8. How much standing water is required for machine transplanting?	1-2 cm	2-3 cm	3-5 cm
9. When should phosphatic fertilizer be applied?	Panicle initiation	Active tillering	Basal/ at the time of filed preparation
10. Which is most appropriate nozzle for herbicides application?	Flat fan	Flood jet	Hollow cones
11. In general, how many rows are there in riding type transplanter?	8	10	6
12. Which part of the transplanter helps in maintaining straight rows while transplanting?	Planting marker	Clutch	Lever

ANNEX II: POST- EVALUATION FORM

Extension agents, farmers and service providers' training pre-evaluation form:

Venue:

Date:

Name of trainee: _____

Profession: _____

Please put tick (✓) mark on the correct answers

Total time: 10 minutes

Question	Answer		
Questions related to mat nursery			
1. What is the seed rate of hybrid rice for raising nursery to transplant one acre?	8-10 kg/acre	10-12 kg/acre	15-18 kg/acre
2. What is required for mechanical transplanting?	Flat-bed manual nursery	Raised-bed manual nursery	Mat-type nursery
3. How much area is required for raising mat nursery bed for transplanting of one acre field?	100 m ²	50 m ²	30 m ²
4. What should be the ideal age for seedlings to be transplanted?	14-18 days	21-30 days	31-40 days
5. Which chemical is used for seed treatment?	Bavistin	Pretilachlor	Bispyribac Sodium
Questions related to transplanting			
6. What is pre-emergence herbicide?	Herbicide applied before weed emergence	Herbicide applied before crop emergence	Herbicide applied after weed emergence
7. What is post-emergence herbicide?	Herbicide applied after weed emergence	Herbicide applied after crop emergence	Herbicide applied before weed emergence
8. How much standing water is required for machine transplanting?	1-2 cm	2-3 cm	3-5 cm
9. When should phosphatic fertilizer be applied?	Panicle initiation	Active tillering	Basal/ at the time of filed preparation
10. Which is most appropriate nozzle for herbicides application?	Flat fan	Flood jet	Hollow cones
11. In general, how many rows are there in riding type transplanter?	8	10	6
12. Which part of the transplanter helps in maintaining straight rows while transplanting?	Planting marker	Clutch	Lever

ANNEX III. LIST OF MANUFACTURERS AND SUPPLIERS/ DISTRIBUTORS OF PADDY TRANSPLANTER IN INDIA

Sr. No	State	Company	Address
1	Odisha	VST	C/o. The Shantilata Trust, Plot No.1294, Gopalpur, NH-5, (Cuttack-BBSR Road), Cuttack-753011 Odisha, Ph:+91-671-2586686, +91-9040044062
2		Kubota	Nigamananda Associates, Meghadamburu, Near Tamulia Gate, Balasore Odisha 756056 sudhansuparida.bls@gmail.com Ph: +91 9040353089 / 9777086421
3		Kubota	Arup Infratechs, AT / Ekchalia P.O. Pipili, PS Pipili, Puri, Odisha arupinfratechs@gmail.com Ph: +91 9437018895
4		Kubota	Samson Agri Power Equipments Pvt. Ltd, 236, Rout Complex, Laxmisagar Chhak, Cuttack Road, Bhubaneswar Odisha 751006 samsonagri@yahoo.com Ph: 0674-3192055 / 9437024445
5		Mahindra	Vikrant Engineers, A-38, Industrial state, Cuttack-753010, Odisha, India, Ph: 18004256576, +91 9778955556
6		Class	M/s. Ramlingaraj Automobiles, 101-A, Acrux Gokul Plaza, Bomikal, Cuttack Puri Road, Bhubaneswar, Odisha, Ph: +91 9778003500 E-mail: rochan.pattnayak@madhukan.com
7		Class	M/s. Hirakud Motors, Laxmi Talkies Road, Sambalpur, Orissa. Phone / Fax 0663-2532681 / 2520138 Mobile 9861013108 E-mail HMSambalpur@claasservice.com
8		Class	M/s. Sourav Agency, Ground Floor, Harabhairav Complex, Near Yamaha show room , N.H. 6, Bargarh, Orissa- 768026 Mobile 09937074255 E-mail: claasodisha@gmail.com
9		Class	M/s. Komal Agency, Halapanda Rice Mill Complex, Bye Pass Road, N.H.43, Jeypore, Distt. Koraput, Orissa- 764001 Mobile 9124808063 E-mail :komalenterprise48@gmail.com
10		Class	M/s. Narmada Industry, Near Sadar Police Station, Paramanandapur, Bhawanipatna, Kalahandi Dist, Odisha Mobile 9937055440 E-mail: ansumandas83@gmail.com
11		Class	M/s. Krishna Motors, NH-5, Pathara, Bye Pass Junction Po: Bahadur Peta, Dist - Ganjam, Odisha-760007 Mobile 8908589085, 9337500337 E-mail: krishnamotors@gmail.com
12	Bihar	VST	Sales Office No.13/2 Binod Bhawan, Opp. Bhoomi Vikas Bank budh Marg, Patna - 800 001, Bihar Ph: +91-61-22224570
13		Kubota	Tribeni Enterprise, Opp Transport Nagar, Jakariyapur, Badi Pahari, Patna Bihar 800007, tribeni.enterprise75@gmail.com, tribeni75.kubotapatna@gmail.com Ph: +91 9334159512
14		Kubota	Gautam Trading, South of Police Line,Chora Bagicha, NH- 31, Biharsharif, Nalanda, Bihar 803101, gkumar.1711@gmail.com Ph: +9334138278
15		Class	M/s. Kosi Auto & Farm Equipments Pvt. Ltd., Near-Bus Stand, Behind-Vikas Bazar, Purnea - 854301 (Bihar), Phone / Fax 06454-242665 Mobile 9431230054 E-mail KAFEPurnea@claasservice.com kosi.auto@gmail.com
16		Class	M/s. Tirupati Tractors , R.K College gate Madhubani- 847211 Phone 9431080716 E-mail: TTMadhubani@claasservice.com tirupatitractors@yahoo.in

Sr. No	State	Company	Address
17		Class	M/s. Dev Krishi Kendra, Saidpur, Lakhisarai, Bihar- 811311 Phone 9939952577 Email DKKLakhisarai@claasservice.com
18		Class	M/s. Kisan Agricultural Machinery, Station Road, Near Jyoti Chowk, Buxar, Bihar-802101 Phone/Fax 9934252308 E-mail kisan.agricultural@gmail.com
19		Class	M/s. Kisan Engineering Works, Bela Industrial Estate, P.O : MIC Bela, RK Ashram, Mujaffarpur, Bihar Phone/Fax 9931436950 E-mail kisan.mahesh1972@gmail.com
20	West Bengal	VST	P-383, Keyatala Lane, Ground Floor, Kolkata - 700 029 West Bengal Ph:+91-33-24656054, +91-33-40623271,
21		Kubota	Bengal Agro Machinery Corporation, SK SARWAR 20, Pay Mental Garden Lane, Kolkata West Bengal 700015, bengal.agro.mc@gmail.com Ph: 033-23298461 +91 9836136476 / 9830007660
22	Madhya Pradesh	VST	Lentus Agro Equipments, B-72, Rani Avantibai, Transport Nagar, Kokta Raisen Road, Town/City: Bhopal Madhya Pradesh- 462022, Ph: +91 9407406241 / 8889511195
23	Gujrat	VST	Ganadevi Taluka Khedut, Sakari Sangh Limited, P.B.No - 31, Post & Tuluk - Ganadevi , Via Bilimora (WR) - 396 360 DT- Avsari, Bulsar Gujarat +91-2634-262322 / 262522
24	Maharashtra	VST	Padalkar Agro Agencies. Plot No - 269/4, Opp: Mahalaxmi Steel Industries, Hupari Road, Gadmodshingi Phata Unchagaon, Kolhapur Maharashtra Ph: +91-231-2664189
25	Assam	VST	Sales Office, Sethi Trust, Unit 3 P.O, Bangarh, Guwahati - 781 00 Ph: +91-361-2529407
26	Andhra Pradesh	VST	Peddi Reddy Pidapa, Survey NO.27/1, Booty Road, Behind Vidyuth Kala , Bharathi, Bukkarasamudram (V) & (M), Anantapur-505 001 Andhra Pradesh Ph: +91-9440683484
27		VST	Mr N.V.S. Rajaram8/468, Near Kappu Kalyana Mandapam, Vedireswaram Road, Ravulapalem, East Godavari, Pin - 533 208. Andhra Pradesh, Ph: +91-9948165555
28	Chhattisgarh	VST	S.S.Stell Centre 1/10, Nehru Complex, Vyapar Vihar, Bilaspur - 495 001 Chhattisgarh Ph: +91-7752-423733
29	Uttar Pradesh	VST	Plot no.791, New Aryanagar, Opp: Ghookana More, Delhi - Meerut Road, Ghaziabad 201 001, Uttar Pradesh – Ghaziabad Ph: +91-120-2834086
30		Class	M/s. Visen Sales Corporation, Godhra Bazar, Udiyawan, Tal- Laiganj, Dist. Azamgarh, Uttar Pradesh- 276301, Phone/Fax 9450116235 E-mail VSCAzamgarh@claasservice.com, aa50947@gmail.com
31		Class	Mayfield Tractors, 26/2, B.N. Road, Opp. Islamia College, Daya Bhawan, Lucknow - 226 001 (UP) Phone/Fax 9415517860 E-mail MTLucknow@claasservice.com
32		Class	M/s. Shree Paramhans Agro Supplier, Bye Pass, Opposite Anaj Mandi, Kosi Kalan, Mathura - 281403(U.P) Phone/Fax 05662 – 231314 Mobile 09410813794/ 09812755050 E-mail- SPASMathura@claasservice.com vijaypal.kosi@rediffmail.com
33	Karnataka	KissanKraft	Sri Huchhanna Tower, # 4, 1st Main, 7A Cross Maruthi Layout, Dasarahalli, H.A.F. Post Hebbal, Bangalore-560024 (Karnataka) INDIA Ph:+91-80-22178200
34	Tamilnadu	Kubota	Kubota Agricultural Machinery India Pvt. Ltd., No.15, Medavakkam Road, Sholinganallur, Chennai - 600 119. Ph: 044-6104-1500
35	Kerala	Redland	Redlands House, Karikath lane, M.G.Rd, Thrissur, Kerala - 680 001 INDIA. Landline : +91 487 2427392, +91 487 3207252, +91 487 3207337

The Cereal Systems Initiative for South Asia (CSISA) is a regional initiative to sustainably increase the productivity of cereal-based cropping systems, thus improving food security and farmers' livelihoods in Bangladesh, India and Nepal. CSISA works with public and private partners to support the widespread adoption of resource-conserving and climate-resilient farming technologies and practices.



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www.cimmyt.org

International Rice Research Institute (IRRI)

DAPO Box 7777, Metro Manila 1301, Philippines.

www.irri.org

International Food Policy Research Institute (IFPRI)

1201 Eye St, NW

Washington, DC 20005 USA

www.ifpri.org