

Bed planters for service providers

*Experiential learning modules for sustainable
intensification and agricultural service provision*

BOOK VII



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Cereal Systems Initiative for South Asia

BED PLANTERS FOR SERVICE PROVIDERS

Experiential learning modules for sustainable intensification and agricultural service provision (Book VII).

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CSISA was established in 2009 with the goal of benefiting more than eight million farmers by the end of 2020. The project is led by the International Maize and Wheat Improvement Center (CIMMYT) and implemented jointly with the International Food Policy Research Institute (IFPRI) and the International Rice Research Institute (IRRI). Operating in rural 'innovation hubs' in Bangladesh, India and Nepal, CSISA works to increase the adoption of various resource-conserving and climate-resilient technologies, and improve farmers' access to market information and enterprise development. CSISA supports women farmers by improving their access and exposure to modern and improved technological innovations, knowledge and entrepreneurial skills. CSISA works in synergy with regional and national efforts, collaborating with myriad public, civil society and private sector partners.

CSISA's goals are to:

- Promote widespread adoption of resource-conserving practices, technologies and services which increase yields with lower water, labor and input costs.
- Support mainstreaming innovations in national-, state- and district-level government programs to improve long-term impacts achieved through investments in the agricultural sector.
- Generate and disseminate new knowledge on cropping system management practices which can withstand the impacts of climate change in South Asia.
- Improve the policy environment to facilitate the adoption of sustainable intensification technologies.
- Build strategic partnerships that can sustain and enhance the scale of benefits accrued through improving cereal system productivity.



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* PowerPoint files of the flip charts in 'ready to present' format can be downloaded from here: <https://bit.ly/2T7xcGj> (for English language) or here: https://csisa.org/wp-content/uploads/sites/2/2019/12/191204_BP-SP_190512-PP_BP-SP-smh.pdf (for Bangla language).

Introduction

This set of training modules focuses on ensuring that service providers are able to make repairs to bed planters efficiently and correctly. It builds on other books in this series, and is designed so that anybody who uses these materials can easily conduct training – even those with a limited background in and understanding of agricultural engineering or machinery. By the conclusion of the training module (which can be completed in a single day of intensive training or in a multi-day, multi-session format), participant service providers will be well equipped to repair bed planters as part of their ongoing agricultural machinery service business. However, users of this book should carefully read all the instructions on how to implement the training effectively in order to ensure the best learning experience possible for the participants. A key aspect of this is ensuring that the training is experiential and interactive, as discussed in the next section.

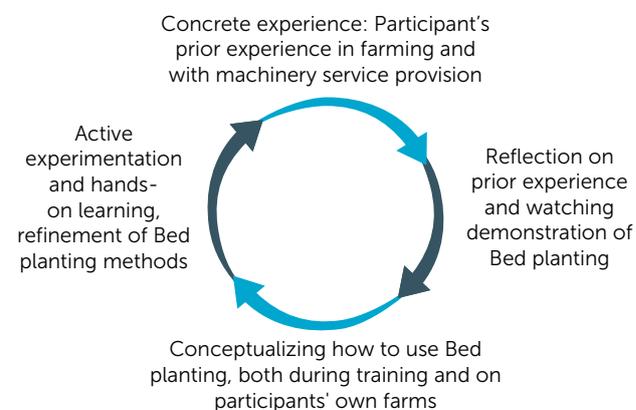
Experiential education and training format

This training uses an experiential and hands-on modular format. It is based on a foundation of experiential and hands-on work, combined with discussion and reflection among participants. This means that although the facilitator is instructed on how to carry out the training and how to present materials, the format in which this is done should be horizontal and participatory, with room for adaptation and modification. We also underscore that farmers and agricultural machinery service providers – who are the target of this training – are experts in their own fields. They work daily on farms and have considerably more experience than most university educated technicians, researchers or extension agents. Attentively listening to their opinions and working with them to respond to their needs and experiences will facilitate improved learning and enhance the quality of any given training session. In this sense, it is the responsibility of the training facilitator to elicit from participants their input, opinions and ideas, and to use these interactively to shape discussion and learning. Each facilitator therefore should think of him- or herself as a guide whose goal is to elicit insight and ideas from the trainees, in order to enhance their learning process. The technical materials included in this document should therefore be seen as a guide to supplement the already in-depth knowledge that the trainee farmers and agricultural machinery service providers have.

The training format presented in these modules is loosely based on the experiential learning cycle described by Kolb (1984)¹, who posited that adults learn differently from children, with learning based on cycles involving concrete experience, learners

reflecting on this experience, conceptualizing their experiences, and then doing experimentation. After this, the learning cycle is repeated. Kolb further hypothesized that there are generally four types of adult learners and learning styles which should be accommodated. We have tried in the production of this manual to account for these types of learners, which include those who learn by taking part in demonstration activities and critically thinking about them (those whom Kolb called divergers), those who learn by thinking, reading and watching (assimilators), those who learn by hands-on thinking and doing (convergers), and those who learn by doing (accommodators).

Well-designed training should accommodate each participant's individual learning style by providing a mixture of lectures and discussions, reading or visual material, hands-on experiential and experimental opportunities, and opportunities to watch demonstrations and to learn. The challenge thus given to training facilitators when using these modules is to accommodate different types of learners in an active learning process. Kolb's theories have been widely researched and validated in a number of contexts, and provide a solid foundation for educational programs aimed at experienced farmers and agricultural service providers, as well as farmer field, school-oriented and action learning. In this training, we loosely attempt to formulate Kolb's learning styles as shown below.



Kolb's (1986) experiential learning cycle as loosely applied to these training modules.

At every step of the process, facilitators should therefore work to generate discussion and hands-on learning through practical activities, to demonstrate the bed planter and show participants how to use it, and to encourage critical but constructive reflection among the training participants. There is a certain art to this

¹ Kolb, D.A. 1984. *Experiential Learning: Experience as the Source of Learning and Development*. Prentice-Hall, Englewood Cliffs, NJ.

process, and beforehand, facilitators should practice with their peers different techniques for eliciting discussion among participants.

Here are some examples of how to ask questions of the training participants in a way that will encourage them to think and critically reflect on the training materials:

- 1. Arrange seating in a circle, not like in a classroom.** Circular seating arrangements encourage participants and facilitators to interact as equals, and improve the potential for discussion.
- 2. Rather than ask closed questions, ask open ones.** For example, rather than ask "What are the financial advantages to farmers using a bed planter?", ask "How can a bed planter help farmers to sow more crops from the same plot of land within one year?" Participants may require some additional encouragement to discuss this question, but gently push them towards realizing the answer.
- 3. Prompt questions that have open and multiple answers.** For example, rather than ask training participants "What happens if one bed planter is not calibrated?" ask "If the bed planters are not calibrated, and how might this reduce profits for farmers and service providers?"
- 4. Pick a particular participant to give an answer.** Rotate among students, picking different ones and asking them individually or as a group to answer a question. It may take time for some trainees to answer, but allow them to work through the process of reflection and come up with a response. Engage with them and discuss their response, and ask others for their thoughts on the response. However, if a particular participant is naturally quiet or reserved, avoid asking him/her too many questions. The goal is to encourage an active learning atmosphere, but not make participants feel uncomfortable.
- 5. Most importantly, ask logical questions based on the training materials.** This seems like a simple point, but it is important to stay on topic and ensure that participants are equipped to respond to questions. The ultimate goal is *not* to make training participants identify what they *do not* know, but rather to encourage them to engage with the training materials so they can succeed at mastering bed planter operation by applying a combination of what they already know and what they will learn.
- 6. Provide space for underrepresented students to speak.** In many training sessions, men speak over women or dominate the conversation. Members of a particular economic or religious group or caste

might speak over those who are not part of that group. Facilitators are encouraged to recognize this, and work to give space to underrepresented groups to enable them to learn and speak out equally. This may require giving individuals an opportunity to contribute by asking other participants to wait to reply.

The field is the best classroom for farmers and service providers

Training sessions are to be held primarily outside and in the field, where participants are encouraged to learn with their own hands how to operate the bed planter safely and effectively. It is only by setting up the bed planter safely and operating them that trainees can learn how to benefit from them. To facilitate this, the flipchart material provided in this book can be printed on large paper and taken out into farmers' fields, where electricity for PowerPoint presentations or other learning formats may not be available.

Emphasis should be given to these participatory activities throughout the training. Last but not least, training and education does not end at the conclusion of the day. Participants should be encouraged to experiment with, learn from, modify and adapt the techniques they learn for using bed planters on their own farm, emulating the *cycle* of continual learning articulated by Kolb, as discussed above. For this reason, training facilitators should share their contact information with participants so they can backstop and assist with technical matters when needed over time. Similarly, trainers may wish to supply contact information of experienced extension agents with knowledge of bed planters.



Organization of this book

This book is organized as follows: after a general introduction to the training format and style, and materials needed for one day's training, six independent learning sessions are presented. Each session covers a different topic, as follows:

1. Introduction, training objectives and pre-training evaluation
2. Introduction to the bed planter
3. Major parts of the bed planter and their functions
4. Calibration of the bed planter
5. How to set up and use a bed planter safely and effectively
6. Troubleshooting and maintenance
7. Starting a bed planter service business
8. Review of key messages, post-training evaluation and close of training

The individuals who are facilitating the training are then instructed on how to implement each training session. This includes a review of the learning objectives, key messages, required materials and step-by-step instructions on how to conduct the session from start to finish. At each step of the process, training facilitators are expected to encourage experiential learning as articulated above. Most sessions include a component during which the facilitator will give a brief presentation on the topic. Presentations are intended to be discussion-oriented – the facilitator should allow time for participants to ask questions, and in turn elicit questions and feedback, especially if few participants are speaking.

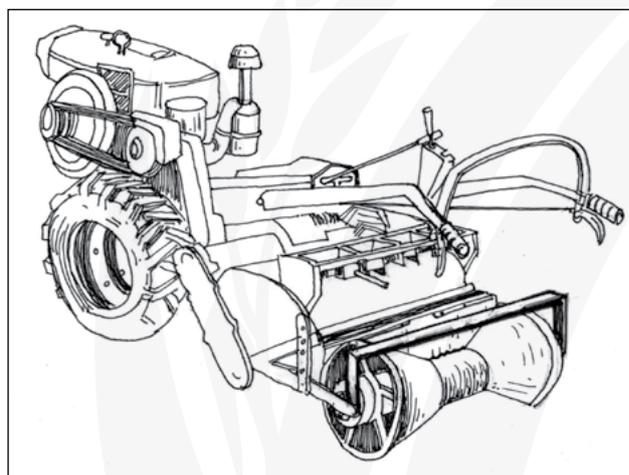
Flipchart materials are provided to guide the technical content of each of these presentations. Facilitators should simply follow the flipcharts and use the material presented to initiate discussion and ensure that all technical points are covered. Care should be taken to allow all participants to speak, and to make space for underrepresented participants, specifically women, to speak and ask questions.

The flipchart section of this book is designed to be printed out on large poster-sized paper and used as flipcharts. The same flipcharts are also intended to be printed on normal-sized paper, stapled together and provided as hand-outs and reference material for participants. In many countries, training facilitators may also choose to use the flipcharts as projected PowerPoint slides, which is encouraged as long as a reliable electricity source can be supplied, and participants are able to easily view the slides. Some trainers even prefer to use the flipchart materials as a base for PowerPoint slides, modifying them and adding relevant material as they see fit. We fully encourage this approach.

Lastly, training begins with a pre-training evaluation of participants' knowledge, and finishes with a post-training evaluation of their knowledge at the end of the day. The change in participants' scores provides an indication of their progress in learning. Ready-made pre- and post-training evaluation questionnaires and their answers are provided in Annex 1. Simply print them on regular-sized paper for use. Some training facilitators also like to give post-training evaluations a second time a week or more after the training, to gauge how much information participants have retained over time. We also encourage this, as it can be instructive for training facilitators to learn how to improve and emphasize particular parts of the training that some participants may forget as time passes.

Training aims and objectives: The bed planter

The aims of this training are to: (1) increase participants' awareness of bed planting options and ensure they know how to use them in farmers' fields; (2) improve their knowledge and skills in operating the bed planter safely, efficiently and profitably; (3) increase their knowledge of the common causes of bed planter failure and breakdown experienced by farmers and service providers, and (4) improve their skills in repairing the machine effectively and efficiently, emphasizing the operation of viable rural businesses providing bed planting services to farmers.



By the end of the training, participants should be able to:

- understand and explain the usefulness of the bed planter in different environments and with different soil types;
- identify the major mechanical parts of the bed planter and their functions;
- operate the machine efficiently and safely;

- list the potential causes of failure and breakdown associated with the bed planter and find solutions to fix them; and
- provide bed preparation, seeding and fertilizing services to farmers efficiently and profitably.

For whom is this training designed?

This training is designed for: (1) service providers who have already procured a bed planter machine and are providing services to farmers, or (2) those interested in procuring a bed planter. Gender balance should be maintained in the selection of participants; it is ideal to have a mix of women and men, with no less than a quarter being women.

Key considerations for training

Key considerations for planning, preparing and organizing the training are given below. The facilitator(s) should read each section carefully to ensure the training is implemented effectively and efficiently. The information presented here can be generalized for each training day in this series of books. More specific information pertaining to individual training days is also presented at the beginning of each module; be sure that you also review this material.

Participants

The number of participants per batch should be limited to a maximum of 10 to 15 (although this depends on the number of bed planters that can be arranged for the training: there needs to be one bed planter for each group of about five participants). Service providers who have purchased BP machines (or are interested in purchasing a machine) and are providing services to the farmers should be selected on a priority basis, above farmers or service providers who are less interested or may not be capable of purchasing or using a BP. Ideally, at least 25% of the participants (i.e., 2-3 out of a group of 10, 4 out of 15) should be female preferably with leadership capability, who have a primary level of education (at least), business experience (ideally), and are capable of working outside the household and running a rural business. Participants should be contacted well ahead (at least one week) of the anticipated training day to allow them to prepare and make arrangements for the training.

Venue

Select the training venue carefully. There should be a classroom or similar facility with sufficient light, air, electricity, and adequate space, tables and chairs,

and bathroom facilities for up to 20 participants and the training team. There should also be a sufficiently large unplanted field nearby, with adequate space for operating three bed planters for the practical tilling/ seeding session. Ideally, all training spaces should be free from outside distractions.

Training aids

At least one month before the training is due to start, please review the detailed list of training aids on the next page and make sure you get together all the materials needed before the training starts.

Facilitator(s)

Experienced bed planter users and/or extension agents with training in bed planter use should be selected to facilitate the training, after passing a training course which familiarizes them with (1) the principles of experiential learning, and (2) the training module and session. However, if not available locally, help may be provided by other institutes (such as national research institutes or extension agencies). Having at least two facilitators has been found to be optimal.

Facilitator's preparation

Well ahead of the training start date, the facilitator(s) should go through each module and its respective topics, and practice the implementation techniques as per the allocated time. Since each session contains different topics, implementation techniques and time allocation, facilitators need to read each module minutely and practice their delivery following the PowerPoint presentation/flipcharts to ensure a lively presentation that keeps to schedule.

Date of training

The date of the training should be decided following discussion and agreement with trainees to ensure their participation. It should preferably be during their weekly day off to avoid any financial loss to their business.

Registration

Participants should reach the training venue on time. On arrival, each participant should register his/her name and first take a seat in the classroom or similar covered area allocated for training. The participants will later move to the nearby crop field for practical exercises. Registration should be completed before training begins, after which no new participant can be allowed to join.

Group formation

As part of the introduction, the facilitator should divide participants into three groups. Ideally there should be five participants per group; however, the number of groups or number of participants per group may vary depending on (1) the total number of participants, and (2) the number of bed planters available. Working

in smaller groups ensures a more action-oriented, hands-on approach to learning. Generally, four to five people should be assigned to one pump. Arrange seating so these small groups can sit with one another. Participants should remain in the same group throughout the day, and take part in discussions, question and answer sessions, demonstrations and exercises. Do not set up the seats in classroom style; circular seating should always be used.

Participatory, experiential and hands-on learning

The training approach should be participatory, with emphasis on hands-on and experiential learning, and actual operation of the bed planter. This is why it is important to limit participant numbers relative to how many bed planter are available, as each participant should get an opportunity to have hands-on experience operating the machine. The facilitator should have been trained in these methods, and thus should utilize techniques that aim to motivate participants to get involved in the training, for example, question-and-answer sessions, experience sharing, group exercises, group discussions and group presentations. This guide explains how to do that.

Effective and enjoyable training

The training should be facilitated in such a way that the participants understand the key messages and information clearly, and find it useful and valuable, rather than a waste of their time. To achieve this, the facilitator should work to ensure that the training is enjoyable (using fun games, quizzes, sing-along sessions and other techniques to get trainees motivated and involved). One-way lecture formats are not acceptable and are discouraged, as they reduce participants' potential to learn effectively through discussion and experience. The facilitator should arrange a short break (about two minutes) after each ten minutes of presentation, discussion and/or exercise, during which they should ask questions to check whether participants are understanding the training well, and if necessary, adapt their teaching style.

Use of mobile phones

Use of mobile phones causes distractions and reduces the effectiveness of the learning experience. All participants, including the facilitator(s), should keep their mobile phones switched off during the training session. If they receive an urgent call, they should excuse themselves from the group to answer it.

Evaluation of participant progress

A pre-training evaluation questionnaire at the start of the day and a post-training evaluation at the end are important and essential to judge whether and to what degree the learning has been effective. These questionnaires are provided in Annex 1.

Course preparation, duration, materials and setting

This course is designed for a one-day training session of approximately eight hours excluding lunch and breaks, including six hours of discussion or review, and approximately two hours of demonstrations and practical exercises. This is an intensive course; sessions are held in the field, not in a classroom. The facilitator(s) can decide the best time to take tea and lunch breaks (these times are not included in the estimates below and so should be accounted for when planning the training). It is important to keep timings flexible, depending on the needs of the participants, some sessions may be faster than allowed for and others may be slower.

The content is divided into an introductory session plus seven instructional sessions, as follows:

Session	Topic	Approximate duration (minutes)
1	Introduction, training objectives and pre-training evaluation	60
2	Introduction to the bed planter	45
3	Major parts of the bed planter and their functions	45
4	Calibration of the seed meter	90
5	How to set up and use a bed planter safely and effectively	45
6	Troubleshooting and maintenance	45
7	Starting a bed planter service business	90
8	Review of key messages, post-training evaluation and close of training	45

Planning and preparing for the training

Please review the 'Key considerations for training' section at the beginning of this book. Note that you may wish to establish demonstration learning field plots before starting this training (detailed below in different sessions), so advanced preparation of several weeks is required. In addition to the items listed there, prepare for the training by considering the following.

Training venue

Provide space with adequate cover for 10-15 participants plus facilitator(s). The venue should be easily accessible and safe for any vulnerable or non-able-bodied participants. Bathroom facilities with appropriate privacy (particularly for women participants) should be provided.

Required training aids

- ✓ multi-media projector, sound equipment and screen for showing the DVD
- ✓ *Bed planter: time, water, labor and cost-saving crop production technology* DVD (see Annex 2)
- ✓ printed flipcharts for each session (see *Flipcharts and handouts*, pages 32 to 108)
- ✓ blank flipchart paper for group feedback (approximately 10 sheets)
- ✓ whiteboard and flipchart/whiteboard stand
- ✓ two or three whiteboard (dry erase) pens; two or three flipchart markers
- ✓ a notebook, pencil and spare paper for each participant
- ✓ participant registration form
- ✓ at least one printout of the pre-training and post-training evaluation questionnaires for each participant
- ✓ three bed planters (depending on availability, but no fewer than one per group of five participants)
- ✓ one power tiller (if the training is conducted on a heavy or very moist soil where pre-tillage is required before bed formation)
- ✓ toolboxes (ideally three sets, one per each bed planter)
- ✓ one tape measure, at least 30 m in length
- ✓ faulty or broken bed planter parts (if available)
- ✓ spare bed planter parts (if available) – these can be the same as the faulty or broken parts listed above
- ✓ an empty field or crop land to conduct the practical exercises running bed planters
- ✓ tables and chairs for participants
- ✓ if possible, one experienced bed planter mechanic or operator to discuss common causes of pump failure and breakdown (Session 4), and a successful bed planter service provider to answer participants' questions (Session 6).

Session 1

Introduction, training objectives and pre-training evaluation

Learning objectives

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

- state the names of the trainer(s) and the other participants
- state the anticipated objectives and content of the training
- understand the training guidelines about learning and cooperation, including the participatory approach and their expected contribution

Key messages to convey to participants throughout this session

1. The training is comprised of six instructional sessions and will take about xx hours excluding lunch, tea and other breaks. Get ready to learn plenty of new things – and please be patient: there is a lot of material to complete.
2. This training is important because it will enable participants to provide better bed planting services to farmers, and at the same time, earn more profit.
3. This training is participatory and fun – trainers and trainees will learn from each other.
4. The training is mostly hands-on. Participants should learn by working with bed planters and using them to prepare a field, rather than just listening. Active participation works best.
5. There is a pre- and post-training evaluation process, which is an essential part of the day.
6. Participants should be attentive during the training and participate actively – either individually or as part of their groups – during each task/assignment/exercise given to them.
7. The facilitator and participants should keep their mobile phones switched off or on silence. If they receive an urgent call, they should excuse themselves from the group and go elsewhere to answer it.

How to conduct the session on *Introduction, training objectives and pre-training evaluation*

For this session, you will need the following resources and materials:

- the participant registration form
- the flipchart Session 1: Introduction, training objectives and pre-training evaluation
- A4 printed copies of the flipchart for each participant
- a notebook, pen and pre-training evaluation questionnaire for each participant
- several sheets of blank poster paper or a whiteboard, whiteboard stand and dry marker/whiteboard pens

Step 1 – Form groups (15 minutes)

Most adults learn best when they work in groups. Participants in a small group can interact and share ideas with each other, which allows peer-to-peer learning, and stimulates more entertaining and rich learning experiences.

An ideal size is a total of 10-15 participants, divided into smaller groups.

Divide the participants into groups of four or five by asking them to number themselves 1, 2, 3, 4, 5 recurring and asking those with the same number to rearrange their seats and sit together (all the 1s together in one group, 2s in another and so on). This splits up participants who are sitting with people they already know.



Next, ask each group to select a leader and choose a fun name for their group. It is helpful if the group leader can read and write, which is something the training facilitator can assess during the registration period. Also, try to ensure that someone in each group is competent in basic mathematics and calculations. This will be important later on, when learning about machine calibration and business models.

Ask each group to find five things group members have in common with every other person in the group, *and* that have nothing to do with work. Please, no body parts, as we all have legs and arms! Also, no clothing, as we all wear clothes. Focus on more interesting commonalities, such as where they were born and how many children they have, or how many years of farming experience they have, and so on. This helps the group explore shared interests more broadly.

Ask the group leaders to take notes and be ready to read their list to the whole group at the end of the session. This should generate discussion and a lot of laughter and fun, while encouraging each group to think more like a team.

Step 2 – What are the participants' expectations? (10 minutes)

This is one of the most effective tools for breaking the ice and enabling a new group of trainees to get to know each other. Each group member is an important source of knowledge. Each participant also has his/her own style of thinking and learning. This means that for effective learning it is important for the trainers to understand each participant's expectations of the training module. It will also help the facilitator(s) be better equipped to deliver a successful learning experience during the training.

Use an icebreaker approach during which participants can state what their learning expectations are at the beginning of the day. This will provide feedback from each participant about what they expect – and want – to get out of the training.



During the introduction of the training module, when it is time for participants to introduce themselves following group formation, the facilitator should explain that participants' expectations are very important, and that understanding them will be crucial for ensuring quality outcomes from the training. These expectations can later be compared with the module outline, and modifications and changes can be made where necessary.

Ask participants to:

- introduce themselves individually;
- share their expectations of the training course (which should be summarized and presented by the group leader after 2-3 minutes of discussion).

Here is an example:

"Hi, my name is Sudhanshu. Our group wants to know how to solve major problems with bed planters, and how we can make money providing bed planting services to farmers. Will we learn how to do that?"

Elicit one response from each group. Listen to the responses and list important expectations on blank poster paper or a whiteboard. At the end of this session, review the list of expectations that the groups made. Discuss any points not covered in the course and explain whether their expectations will be met, and if not, why.

Step 3 – Introducing the training (10 minutes)

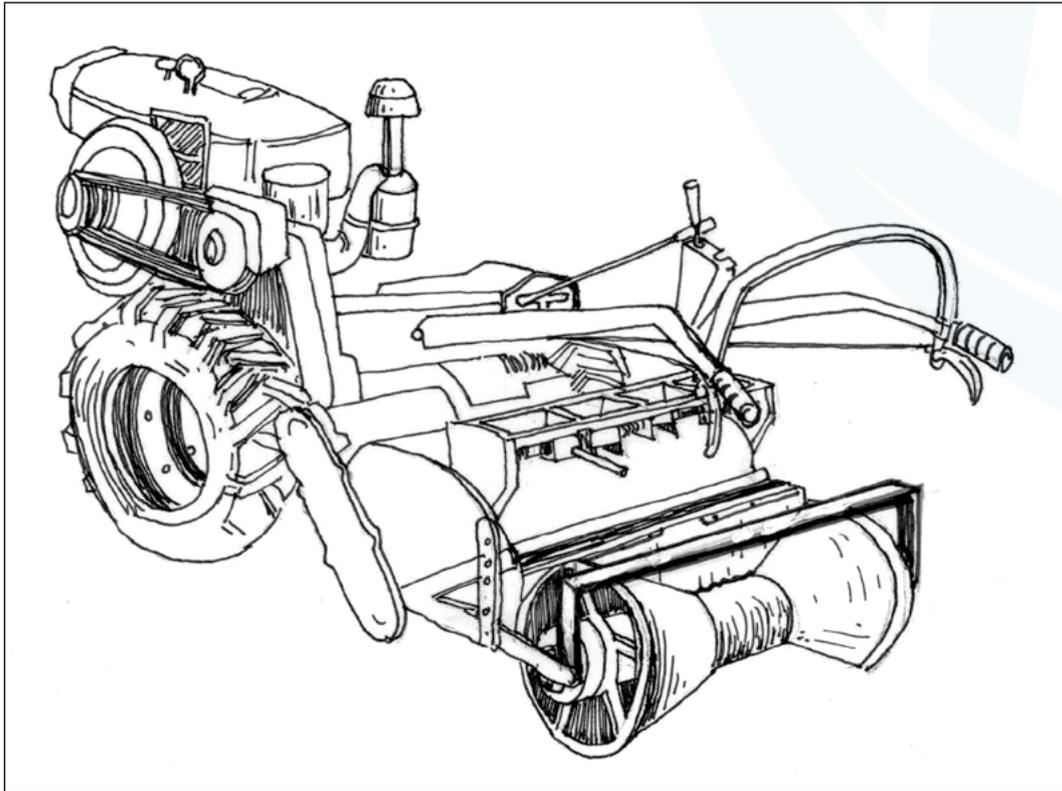
Use flipchart *Session 1: Introduction, training objectives and pre-training evaluation* to present a brief overview of the training course, the training methods the course uses, the rules, and the responsibilities of the participants. Allow time for both the trainer(s) and participants to ask questions.

Step 4 – Pre-training evaluation questionnaire (25 minutes)

Distribute the 'Pre-training evaluation questionnaire' (see Annex 1) to each participant and allow 20 minutes or so to complete it. If necessary, help less literate participants to understand and answer the questions. The questionnaire can also be printed and put up on flipchart paper. Collect the answers; they will be compared with the post-test evaluation answers at the conclusion of the training. They should be corrected before the end of the day, prior to the closing session, during which the evaluation scores will be given to all participants.

Session 2

Introduction to the bed planter



Learning objectives

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

- demonstrate awareness of the different types of bed planters available on the market
- understand and articulate the function and usefulness of the bed planter
- understand and explain the advantages of line sowing with a bed planter

Key messages to convey to participants during this session

- The bed planter considered in this set of training sessions is attached to a two-wheeled tractor, either a Sifeng or Dongfeng. It can be used for preparing the beds, sowing seed, and applying fertilizer at the time of field preparation.
- The bed planter reduces fuel, oil and labor costs.

- Use of machine seed metering can save seed by 10–40%.
- Under some circumstances, use of the bed planter can reduce the use of basal nitrogen fertilizer, because the fertilizer is placed into the soil directly by the machine, near the seeds that require nitrogen to grow.
- Bed planting facilitates intercropping of different crops.
- Bed planting facilitates irrigation and the drainage of water.
- Raised beds help to minimize problems of salinity and arsenic contamination. They also provide stronger support to plants and help prevent lodging.
- Compared to broadcast seeding, bed planting (for maize or wheat, for example) makes it easier to enter the crop field. This makes it easier to carry out proper weed control and other inter-cultural management.

- The bed planter can carry out line sowing on raised beds for wheat, maize, rice, pulses, mustard, sesame, lentil, potato and many other crops. Some farmers also like to use the bed planter to make beds, after which they transplant rice in the furrows while at the same time cultivating horticultural crops such as chilies on top of the bed.

How to conduct the session on Introduction to the bed planter

For this session, you will need the following resources and materials:

- the flipchart *Session 2: Introduction to the bed planter*
- A4 printed copies of the flipchart as a handout for each participant
- DVD of the film, *Bed planter: time, water, labor and cost-saving crop production technology* (see Annex 2, Video resources)
- electrical connection and multi-media facilities for showing the DVD *Bed planter: time, water, labor and cost-saving crop production technology* DVD, including speakers or small sound system
- several sheets of blank poster paper/whiteboard, flipchart stand, whiteboard stand, dry markers/whiteboard pens

Step 1 – Prepare participants for the DVD (5 minutes)

Display the following questions and ask participants to note down any answers they learn during the screening of the DVD, *Bed planter: time, water, labor and cost-saving crop production technology*. Before starting the DVD, ask the participants to read

through the questions and ask for clarification if there is anything they would like to be explained. Encourage them to make notes during the screening of the DVD, and to aim to have answers ready for discussion at the end.

- What is a bed planter?
- What two possible power sources can be used to operate the bed planter?
- What are the power requirements of these power sources?
- What are the advantages of bed planting? Any disadvantages?
- What crops can be sown on the beds?

Step 2: Screen the DVD and use the questions to generate discussion about the bed planter (30 minutes)

- Show the DVD, *Bed planter: time, water, labor and cost-saving crop production technology*, then go through the questions to find out what participants learned from the DVD presentation. Ask one person from each group in turn. Encourage the quieter participants to speak, without making those lacking in confidence feel uncomfortable. This requires sensitivity on the part of the facilitator, particularly when making sure that individuals do not dominate the group.
- Listen carefully to the participants' responses, and list on blank poster paper or a whiteboard the points they were unable to answer, or where new insight and ideas were uncovered by the participants. The latter will be particularly useful the next time you conduct the training.

Step 3: Generate discussion (10 minutes)

Use the flipchart to lead a discussion on the bed planter, focusing on the points listed on the poster paper or whiteboard.

Session 3

Main parts of the bed planter and their functions

Learning objectives

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

- identify the main parts of the bed planter
- understand and state the functions of these main parts

Key messages to convey to participants during this session

The major parts of the bed planter include:

- bed former
- mudguard
- tillage depth control lever
- furrow opener
- rotavator/rotavator
- rotary chain sprocket
- seed box
- seed meter
- fertilizer box (on specific bed planter models)
- fertilizer meter (on specific bed planter models)
- seed on-off lever/clutch
- bevel gear shaft
- power transmission chain

How to conduct the session on *Main parts of the bed planter and their functions* session

For this session, you will need the following resources and materials:

- flipchart *Session 3: Main parts of the bed planter and their functions*
- A4 printed copies of the flipcharts as a handout for each participant
- several sheets of blank poster paper/whiteboard, flipchart stand, whiteboard stand, dry markers/whiteboard pens
- spare bed planter parts
- 2 or 3 bed planters

Step 1: Familiarization with the bed planter (5 minutes)

Take participants to a nearby field (previously selected) where three bed planters have been placed to demonstrate how bed planters are used. Initiate the session with a question-and-answer session.

Ask: Can anyone name the main parts of a bed planter?

Encourage one or two participants to answer, and list the parts they mention on poster paper or the whiteboard.

Step 2: Discussion on the main parts of the bed planter (25 minutes)

Lead the discussion with a flipchart presentation on the main parts of a bed planter, stating and explaining the functions of different parts.

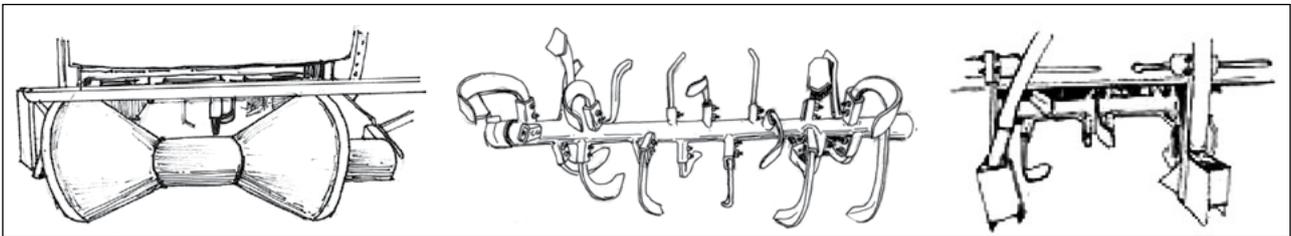
Name of part	Functions
Bed former	Makes raised beds of particular shape and size
Scraper	Cleans the soil or mud from bed former by scraping
Bearing housing	Holder or casing (housing) of the bearings engaged in rotation of the bed former
Mudguard	Prevents the soil from diffuse to log distance. Also used as a safety guard for operator against hit of soil clods
Tillage depth control lever	Controls tillage depth by selecting a specific hole in this perforated bar
Furrow opener	Makes the furrow and maintains line-to-line spacing and depth of seed placement during seeding, according to seed size
Rotavator	Rotates and tills the soil
Rotary chain-sprocket	Transmits power from the SFD gearbox to the rotavator/rotavator
Chain-sprocket cover	Protects the chain, sprocket and oil in the rotavator/rotavator chain housing from dust, straw and other foreign particles

Name of part	Functions
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Seed box	Seeds are placed in this box, ready for seeding
Seed meter	Meters the seed delivered to the seeding chute
Seed on-off clutch	Controls the on-off seed flow to the seed tube
Bevel shaft	Transmits power from the front wheel spindle to the seed metering device with the help of a chain
Power transmission chain	Transmits power to the bevel gear shaft from the front wheel spindle
Gear changing lever	Used to change gears when turning the machine to the left and right

Quick review (15 minutes)

At the end of Session 3, have participants of each group stand together, with the three groups side by side. Encourage each participant to answer 1 or 2 questions (depending on the total number of questions, i.e., 5 or 10). If one member of a group is unable to answer a question, elicit an answer from other members of the same group. If no one in a group can answer, pass the question on to the next group.



Bed former

Rotavator

Furrow opener

Session 4

Calibration of the bed planter

Learning objectives

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

- understand and perform the basic math needed to calibrate the seed meter to administer the correct rate. If they are not well versed in mathematics, participants should be able to estimate the calibration and understand the principles underlying the importance of calibration;
- calibrate the seed meter in order to obtain the correct rate for different seed types (that is, of different crop species);
- understand and perform the basic math needed for the fertilizer meter to administer the correct rate; and
- properly calibrate the fertilizer meter and rate.

Key messages to convey to participants during this session

- Calibration is the process of adjusting the machine so that it performs well and administers the right amount of seed and (when the machines have fertilizer boxes and meters) fertilizer for the crop which the farmer is bed planting.
- Seed or fertilizer *rate* refers to how much seed or fertilizer you want to put into the soil for a given area of land (e.g., wheat is often planted at a rate of around 120 kg of seed per hectare).
- Calibration is accomplished by fixing the length of the seed fluted metering roller to get a precise seed or fertilizer rate, before the machine is used to plant a farmer's field.
- Seed meter calibration should be done considering the type of seed metering device the bed planter uses (fluted or inclined), and also the type and size of the seed. This is important

because the rate at which seed is administered depends on the crop in question, and also because line-to-line spacing varies from crop to crop.

- Set the metering roller length by moving the metering nob to the right or left. This opens or closes the fluted rollers below the seed or fertilizer box. If they are more open, this means more seed or fertilizer, and vice-versa. Run the machine on a flat piece of land to check that the seed or fertilizer is dropping at the desired rate (either by checking the number of seeds, as is the case for maize, or the weight of the seed, as is the case for rice, wheat or mungbean) in each row. If necessary, adjust the knob again and repeat the process until the desired rate is achieved.

How to conduct the session on *How to calibrate a seed meter*

For this session, you will need the following resources and materials:

- flipchart *Session 4: How to calibrate a seed meter*
- A4 printed copies of the flipcharts as a handout for each participant
- several sheets of blank poster paper/whiteboard, flipchart stand, whiteboard stand, dry markers/whiteboard pens
- a piece of fallow land, 25-30 m long (this should be measured precisely with a tape measure)
- bed planters
- the required amount of seed
- small polythene bags (ideally transparent)
- rubber bands
- a quality balance (ideally electronic) for weighing seed and fertilizer
- an experienced mechanic/bed planter operator

Step 1: Open discussion about calibration (15 minutes)

Begin Session 4 in the field after closing Session 3. An experienced operator/mechanic should assist. Initiate the session with a discussion.

Ask: Does anybody know how to calibrate a bed planter?

Encourage one or two participants to answer the questions. Write the responses on the flipchart to help facilitate discussion.

Step 2: Generate discussion about calibration of the seed meter (30 minutes)

Lead the discussion using the calibration section of the flipchart (Annex 8.10.3). Explain the following:

- the principles of seed meter calibration;
- the difference between a fluted roller and inclined plate seed meters; and
- the basic math needed for both the fluted roller and inclined plate style of seed metering mechanisms.

Working with the sample calculation and procedure for wheat as shown in the flipchart, lead a group exercise on the basic math following the sample calculation in the flipchart.

Step 3: (45 minutes)

If available, an experienced operator or mechanic should demonstrate the complete procedure of seed and fertilizer calibration in the field. Emphasis should be placed on working with the participants to practice the method of calibration in the field, considering the following steps:

1. select the crop and seed rate
2. test run the machine
3. weigh or measure the rate
4. adjust rate
5. reweigh or measure until proper calibration is achieved

Session 5

How to set up and use a bed planter safely and effectively

Learning objectives

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

- check the engine oil and fuel, water, lubricant, belt pressure, tine setting and other components of the bed planter;
- attach the bed planter to a power tiller;
- start the machine and operate it in the field;
- select the appropriate furrow opener(s) and set it/them correctly;
- sow seed and/or apply fertilizer at the correct spacing and depth; and
- operate the machine safely.

Key messages to convey to participants during this session

- Wear tight-fitting clothing when operating a bed planter. Loose-fitting clothing can become caught in the machine, causing injury, dismemberment or even death.
- Do not allow children near the machine at any time.
- Be sure that there is sufficient fuel and engine oil to run the machine and complete the day's work.
- Check the (1) nut-bolts on both the power tiller and the bed planter, (2) belt pressure, and (3) tine settings.
- Make sure the seed box contains sufficient seed to finish the day's work.
- Check that the calibration of the seed and fertilizer meter has been carried out correctly.
- Keep the rotavator 'on-off' lever in the correct 'off' position.

- Set the required number of furrow openers at the correct distance apart, appropriate for the crop to be sown (the two-wheeled tractor bed planters we refer to in this training usually create a 60 cm-wide bed, measured from furrow center to furrow center). For example:
 - Row-to-row spacing for maize is 60 cm. For this, set one furrow opener in the middle of the bed planter, to plant one row of maize in the center of the bed.
 - Row-to-row spacing for wheat or mungbean is 30 cm. For this, set two furrow openers 30 cm apart to plant two rows on top of the bed, but near the edge.
- On lighter soils, beds can be made directly; however, two passes per bed are essential to ensure the bed is well-formed. In heavier soils, it is good to pre-till with a power tiller once or twice before making the bed; two passes are best to ensure the bed is well made.
- Stop the engine and rotavator, and remove any accumulation or jamming of excess grasses, straw or other materials.
- Take care to prevent clods of earth or straw from getting into the furrow openers or seed-fertilizer tubes, causing blockages. The best way to do this is to check visually at the end of each row of beds planted, when the operator picks up the rear of the machine and pivots on the two-wheeled tractor wheels to turn the machine around and plant the next row/bed.

How to conduct the session on *How to set up and use the bed planter safely and effectively*

For this session, you will need the following resources and materials:

- flipchart *Session 5: How to set up and use the bed planter safely and effectively*

- A4 printed copies of the flipcharts as a handout for each participant
- several sheets of blank poster paper/whiteboard, flipchart stand, whiteboard stand, dry markers/whiteboard pens
- a bed planter
- an area of crop land suitable for demonstrating bed planter operation
- if available, an experienced bed planter operator

- check the belt tension and make sure it is properly adjusted
- check that the chain and other working parts are sufficiently lubricated
- check for sufficient lubricant in the transmission gearbox and bevel gearbox
- check for grass or straw jams and clear away any that accumulate

check frequently that the furrow openers or seed tubes are not blocked by soil

Step 1: Generate discussion (5 minutes)

Begin Session 5 in the field after closing Session 4. If possible, an experienced operator/mechanic should assist with the session.

Use the ice-breaker technique to start the training in a lively way that generates questions and answers from the participants.

Ask: How many of you can operate a bed planter?

After listening to their responses, **ask:** What are important considerations for starting and running a bed planter? What safety concerns are important?

Encourage one or two participants to answer and write the answers on the poster paper or whiteboard, for this will help facilitate discussion.

Step 2: (15 minutes)

An experienced operator should describe in practical terms and demonstrate the procedures for starting the bed planter and safely operating it, focusing on the following:

Before starting the machine:

- wear close-fitting clothing
- make sure no one comes closer to the bed planter than two meters
- in particular, keep children out of the field
- check the engine fuel and oil

The experienced operator then starts the bed planter and runs it for some time to demonstrate the following:

- how to decide if pre-tillage with a power tiller is needed
- how to start the machine
- running the machine for 2-3 beds (made with at least two passes each)

While operating the bed planter:

- clear away any grass, straw or soil jam from the tines or other parts of the machine
- make sure the furrow opener and seed tubes do not become clogged with soil

Step 3: Hands-on practice for each participant (25 minutes)

Encourage one participant from each group to operate the bed planter in a fallow field and produce at least two small bed planter rows, with a double pass to ensure the bed is well-formed. An experienced operator/mechanic should guide them.

Monitor unskilled participants in particular, to make sure they practice machine operation successfully, carrying out tillage and seeding. Point out areas of improvement.

Session 6

Troubleshooting and maintenance

Learning objectives

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

- understand and explain common causes of bed planter failure or breakdown;
- make basic repairs and adjustments, and solve different operational problems; and
- make sure the bed planter is well maintained.

Key messages to convey to participants during this session

Common causes of failure or breakdown include:

1. Poor meshing of the gear-pinion on the metering shaft due to jams in the metering system, causing poor/non-uniform seeding.
2. Hitching gears do not work because the gear pinion is overloaded as a result of (1) tilling in excessively heavy, dry or hard soil, (2) tilling too deeply, or (3) lack of gear oil. This may cause machine failure.
3. The seed/fertilizer on-off clutch does not work due to (1) excessive wear and tear, (2) the clutch ball is worn down, or (3) loosening/wearing down of the spring inside the clutch.
4. Rotavator chain and bearing break due to (1) inadequate gear oil, (2) excessive load, and (3) the bearing is worn down.
5. Bed former bearings can jam or become faulty due to rusting or damage to the bearing seal (this in turn is a result of soil gathering above the seal, and soil and dust particles getting inside the bearing housing), or the bed former shaft may bend.
6. The cone (that is, the conical part of bed former) may be displaced due to (1) size irregularity of the bed former, or (2) detached tie of the cone. This results in irregular bed size and shape.

7. The seed metering plate does not rotate or meter seeds properly, due to a change in the shape of the central hole of the metering plate.

How to conduct the session on *Troubleshooting and maintenance*

For this session, you will need the following resources and materials:

- flipchart *Session 6: Troubleshooting and maintenance*
- A4 printed copies of the flipcharts as a handout for each participant
- several sheets of blank poster paper/whiteboard, flipchart stand, whiteboard stand, dry markers/whiteboard pens
- faulty parts (if available)
- spare parts (e.g., impeller, inlet cage, shaft, v-belt, bearings, oil seal, pulley, bushing)
- an experienced mechanic (if available)

Step 1: Generate discussion (5 minutes)

Begin Session 5 in the field after closing Session 4. An experienced mechanic should be on hand to assist.

Initiate the session with a question-and-answer session to warm up the participants.

Ask: What do you expect the main causes of failure and breakdown of a bed planter to be?

Encourage one or two participants to share their experiences with bed planter breakdown or other malfunctioning problems. If they have not operated a bed planter before, ask them to predict what problems they expect to occur. List any significant points on blank poster paper or the whiteboard.

Next, referring to the flipchart, discuss the common causes of bed planter failure and breakdown, and their causes and solutions. The main points to emphasize include those listed in the 'key messages' section above.

The flipchart material also reviews the importance of maintaining and properly storing the bed planter with emphasis on the points below:

- Remove and clean straw and other particles from the machine parts, and tighten nut and bolts after each use.
- Refill lubricant for the rotavator chain-sprocket casing when it gets low.
- Regularly apply lubricant to each moving part, such as the bearings, bush and chain-sprocket.
- Before storing the bed planter at the end of the season, wash and clean it properly, and make any necessary repairs.
- Store the bed planter out of the rain, for example, under a shed or cover it with polythene sheets.
- Repaint the machine before storage if any parts are scratched. This reduces the likelihood that rust will form.
- Store the bed planter out of the reach of children, and on elevated blocks so it does not touch the soil.

Step 2: Practical session (30 minutes)

Next, if available, an experienced mechanic should demonstrate the faulty parts of the bed planter and discuss the best way to repair or replace them. The mechanic should also demonstrate and discuss maintenance of the bed planter, and the best way to store it. If a mechanic is not available, engage an experienced local service provider; otherwise, the facilitators should complete this part of the training themselves.

If participants wish to learn more about how to repair a bed planter, encourage them to attend mechanics' training on this topic.

Quick review (10 minutes)

Conduct a quick review of Sessions 3, 4 and 5 at the end of Session 5, using the same procedure outlined above for Sessions 1 and 2 (at the end of Session 2).

After completing Session 5, take participants back to classroom.

Session 7

Starting a bed planter service business

Learning objectives

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

- understand and explain what a business plan is;
- understand and follow a business plan/model for marketing bed planter services;
- explain how they would provide bed planter services to farmers efficiently and profitably; and
- record financial information (cost and benefit) and analyze the profitability of marketing bed planter services.

Key messages to convey to participants during this session

Service providers use business plans to make the most money possible while keeping client farmers happy so they will come back time and again to ask for the service provider's assistance. Ask participants to consider their potential role as a bed planter service provider and answer these questions:

1. For which crops do you think bed planting can be best marketed?
2. What is the demand for bed planting different crops?
3. How can farmers' demand for bed planting of different crops be increased?
4. What is my capacity to provide bed planting services? What more do I need to know or learn to run a business that makes me money by carrying out bed planting for farmers?
5. What machinery and equipment do I need to start a bed planting service?
6. What level of profit does my proposed business need to generate?

How to conduct the session on *Starting a bed planter service business*

For this session, you will need the following resources and materials:

- flipchart *Session 6: Starting a bed planter service business*
- A4 printed copies of the flipcharts as a handout for each participant
- several sheets of blank poster paper/whiteboard, flipchart stand, whiteboard stand, dry markers/whiteboard pens
- (if available) a service provider who is successfully marketing bed planter services

Step 1: Generate discussion with a bed planter service provider (15 minutes)

If available, introduce a successful bed planter service provider and invite him to share his business experience with the participants. Ask him the following questions:

- Why did he decide to start a bed planting business?
- How does he conduct the business, and for which crops?
- What are the costs and benefits of running a bed planting business?
- How long did it take to break even (that is, the point at which income from bed planting became equal to the start-up costs)?
- What activities and strategies does he follow to make his business profitable?
- Does he face any challenges when using the bed planter to run a business?
- What benefits do his client farmers get from his bed planting business?

Encourage participants to interact with the experienced service provider and discuss how to use a bed planter to run a business.

If a successful bed planting service provider is not available, present the generic business model and cost-benefit analysis of a bed planter service based upon a successful service provider. If this is not possible, base this part of the training on general material in the flipchart (Step 2, below). If a service provider is available, move to Step 2 after the discussion.

Step 2: Generate learning and discussion (60 minutes)

Briefly discuss the following point, referring to the flipchart:

- What do we mean by 'a business'?

Lead a participatory/group exercise (participants should stay in the groups they formed at the beginning of the training) to develop and analyze a business plan and cost-benefit analysis that describes how to make a profit from a bed planter while at the same time benefiting farmers.

The next step is to show participants how to make a profit selling bed planting services while at the same time benefiting farmers. Following the flipchart, guide the discussion using the questions below, and invite participants to discuss them in their groups to arrive at answers that make sense to everyone in the group. Make a note of the decisions agreed upon by all the groups and enter them in their respective boxes. When all the boxes are filled in, the resulting information will give one potential version of a bed planter service business plan (or model) and its related costs and benefits. Note: this model is likely to change in different locations and for different crops, time of year and so on. The goal here is to encourage the participants to carefully think through the different aspects of running a service provision business in ways that benefit both themselves and the smallholder farming households that purchase their services.

Note: the points for discussion below use maize as a case study crop. Use an alternative crop if participants wish (but note that for different crops, the types of tillage, sowing and fertilizing may be different).

1. What is the cost of tilling land (using a two-wheeled tractor power tiller)+bed making+manual seed sowing and fertilizing+re-tilling or laddering?

First, ask participants in their groups to agree upon a 'unit area of land' to use for this exercise and on which cost will be determined. This will help to make other calculations later. The unit area of land should be one that they feel most comfortable with – for example, one hectare or percentage of a hectare, or an area in m², or a local land unit. It is probably best to use the average size of a farmer's field in their area (in Bangladesh this would be *decimal*).

To make it easier to work through this question, ask about the cost of each operation separately and then combine all the costs:

- What is the cost of tilling land with a power tiller? Ask how many passes are typically required to prepare land for maize, wheat or mungbean if a traditional power tiller is used for full tillage. Note that providing tillage for maize or other crops usually requires several passes with a power tiller. In this case, decide on the cost of each pass and then add them up and record the *total* cost for the sum of all passes.
- What does manual sowing and fertilizer application usually cost? (Note: for this question, it is most accurate to include the value of family labor in the calculation.) This is called an *opportunity cost* and is an important consideration for family farmers and smallholders.
- What is the cost of re-tilling or laddering?
- How do farmers determine the cost? Do they base it on time? On the size of the land? Or the number of laborers?
- For maize, what is the total cost of tilling by power tiller+bed making+manual sowing+laddering and fertilizing a unit area of land (decimal/acre/hectare)?

On the flipchart, fill in Box A with the sum of the costs as agreed upon by all the groups for traditional tillage+bed making and hand sowing+fertilizing the crop.

2. How much does a bed planter cost?

In Box B, write down the purchase price of a bed planter, plus (for new service providers only) the cost of purchasing a two-wheeled tractor.

3. How much does it cost a bed planter service provider to till+bed-make+sow+fertilize the unit size of the land (as agreed on by participants) for maize?

To make it easier to work through this question, you can ask for the cost of each operation separately, and then combine the results:

- How much oil and fuel would be needed for the unit area of land agreed on by the participants, and how much would a single pass of a bed planter on this land area cost?

A bed planter needs only one pass to carry out tillage, bed making, seeding and applying fertilizer (which are done at the same time) – meaning that significantly less fuel is consumed compared to multiple passes using a power tiller. How much fuel do you think will be required for tilling+bed making? How

much do you think this will cost per unit of land area? Will this influence how much you would charge for bed planting?

- b. How much time will it take for a service provider to use a bed planter (which simultaneously tills, makes the bed, seeds, and applies basal fertilizer) to prepare the unit of land area decided on by the participants? What is the value of this time? This is known as the *opportunity cost* of the service provider's labor. It is usually best to use the average labor cost per hour or per day as the value of the service provider's labor. However, if this is too complicated for the participants to grasp (because it is an abstract economic concept), simply value their time as zero (meaning no monetary expenditure will be counted for the service provider's labor and time).
- c. Does this differ for maize in comparison to other crops (for example, wheat or mungbean) or for other alternative crops in your area (during this session, participants should choose and analyze the cost of at least 1-2 alternative crops which the bed planter can seed).

Note down the oil-fuel cost per unit area in Box C.

A bed planter performs tillage, bed making, seed sowing and fertilizer application simultaneously. This means that no additional labor cost is needed for these three operations. However, the facilitator needs to establish a value for the *opportunity cost* of the service provider's labor and time taken (or a value of zero, if the facilitator believes that calculating the opportunity cost is too complicated) to use the bed planter on a farmer's field. Write this in Box D, based on a consensus of the three groups.

4. On what basis should service providers charge a fee for tillage, bed making, sowing and fertilizing?

To make it easier to answer this question, work through it in stages:

- a. How much does it cost for one pass, carrying out tilling+bed making+seeding+ fertilizer application?
- b. How much would you charge farmers for a single pass of the bed planter (which includes tillage, bed making, seeding of the crop, and may also include providing the first dose of fertilizer) on the chosen land area? Does this differ for maize, wheat and mungbean (or an alternative crop that the participants choose)?

If the full cost of multiple passes by the power tiller (including all the passes the participants decide on above) + manual sowing and fertilizing + laddering (if performed) costs, say BDT X, then bed planting using the bed planter may cost BDT Y, as it carries out tillage, bed making, seeding and fertilizing, but in a single pass. However, the value of "Y" may change if the group decides that the service provider should bundle services and also apply herbicides.

Participants should agree to charge an amount which brings them a profit but that is ideally lower than the total cost of traditional power tiller plowing (which may require multiple passes in the same field)+hand sowing and fertilizing+re-tilling (or laddering, if applicable).

This point is very important, as it is the lower cost of bed planting services that will induce farmers to pay for bed planting, sowing, and fertilizing.

In Box E, make a note of the bed planter service provider's charge per unit area (as accepted by all the groups).

5. How much does the service provider profit per unit area of wheat land (tilling+bed making+sowing+fertilizing)?

This amount is arrived at by subtracting the 'oil-fuel cost' per unit land area from the money farmers will pay as a service charge:

Service provider profit per unit of land area = $[E - (C+D)]$

Write the service provider's profit per unit of land area as accepted by all the groups in the proper place " $[E - (C+D)] =$ " on the flipchart.

6. How much can a farmer save per unit area of maize land by using the bed planter to till+bed-make+sow+fertilize?

To make it easier, work through this question step-by-step:

- Subtract the money the farmer pays as a service charge (for the chosen unit area) from the cost of tilling using a traditional power tiller (which again may require multiple passes)+laddering+manual sowing and fertilizing. The resulting value represents the savings the farmer makes by using the bed planter:

Savings for farmers using the BP = $[A - E]$

- Record the savings on the flipchart as " $[A - E]$ " in Box G

7. If there is time and participants are sufficiently motivated, consider these additional calculations:

The bed planter can be used not only for maize but also to seed wheat, rice, mungbean, lentil, groundnut, potato, vegetables and many other crops (note: emphasize the need to take care in the process of calibration and seeding, which is different for different crops).

If the participants are interested in other crops besides maize, help them calculate the same information for these crops, and work out the profit for farmers and their service provision businesses, using the method described above.

Following the above procedure, help participants fill out the boxes for "Second crop (wheat)" (Box H through Box N) and "Third crop (say, mungbean)" (Box I through Box U) as shown on the flipchart. Be sure to include oil-fuel costs, which may vary with each crop.

8. How much area of land (using the unit chosen collectively by participants) can a service provider till and bed-make+sow+fertilize in a single day?

Participants should agree on the area of maize (or 'wheat' 'mungbean' or combination of crops) on which one can carry out tillage and bed making+sowing+fertilizing using a bed planter in a single day. Record the area for each of the crops on the flipchart [in Box V for maize (AA=), for wheat (AB=) and for mungbean (AC=), respectively].

Focus on the crops available in the area in which the training is taking place. For example, if maize is not commonly cultivated, choose another crop known to the local farmers which the bed planter can be used for.

9. How many days do you think you can till and make beds+sow+fertilize different crops using a bed planter in one year?

Participants should agree on the number of days a service provider can render bed planting services (tillage +sowing + fertilizing) for different crops (grown in the area where the training is taking place) in different cropping seasons in one year. Note the number of days a bed planting service can be rendered for each of the crops on the flipchart, that is, in Box W for maize (AD=), wheat (AE=) and mungbean (AF=), respectively.

10. How much profit can a bed planter service provider make from tilling+bed making+sowing+fertilizing maize, wheat, mungbean or other crops?

Multiply the maize land area that can be serviced in one day, and the number of days that bed planting services can be provided for maize in one year, by the profit per unit of land area. Write the result in Box X. This is the approximate annual profit obtained by using the bed planter to seed maize, wheat and mungbean (although this may vary slightly if the service provider charges farmers differently for their fields, or if field size varies. The point of this exercise is to give a general idea of the profitability potential). Use the formula below, referring to the calculations on the flipchart you have already done:

$$\text{Potential annual profit from PTOS tilling+sowing + fertilizing of maize (AG)} = [AA \times AD \times (E-(C+D))] + AG$$

Similarly, calculate the annual profit from other crops, using the following formula:

$$\text{potential annual profit from bed making+sowing + fertilizing wheat (AH)} = [AB \times AE \times (L-(J+K))] + AH$$

or

$$\text{Potential annual profit from bed making+sowing + fertilizing mung (AI)} = [AC \times AF \times (S-(Q+R))] + AI$$

In this way, participants should arrive at a consensus regarding the total profit obtainable in one year. Note this in Box Y.

11. To "break even" refers to the moment that a service provider accumulates profits which equal the cost of his investment in the bed planter. How many days (or how great an area) are required for tilling+bed making+sowing using the bed planter to breakeven?

Dividing the cost of purchasing the bed planter by the total annual profit earned from bed planting service sales to farmers will result in the time required to break even. This can be calculated using the formula below:

$$\text{Time estimated to break even on investment in the BP} = \frac{B}{((AG+AH+AI))}$$

Write the 'estimated time to break even' in Box Y on the flipchart, after arriving at a group consensus.

However, this calculation only provides the estimated time to break even, *when the total profit for the whole year (all crops seeded within a year) is taken into consideration.*

But to break even, how great an area may be required to carry out tillage and bed making+sowing+fertilizing using the bed planter? To answer this, use the following formula, inserting values decided on by the groups instead of letters:

$$\frac{\text{Total land area required to till+bed make+sow fertilize using the BP to break even}}{B} = \frac{B}{[(AA \times AD)+(AB \times AE)+(AC \times AF)]}$$

Write the 'required area to break even' in Box on the flipchart, based on the consensus of three groups.

- If the participants wish, help them repeat this exercise, to work out which crop, or mix of crops, may be most profitable for bed planting.
- If it takes too long to break even, ask the participants how they could change their business models to generate more profit, while keeping tilling prices lower than that of the traditional power tiller (including all the passes the participants decide on above) + manual sowing and fertilizing + laddering (if performed). The goal is to find ways for service providers to profitably make money quickly, while giving farmers an opportunity to grow the crop at low cost.

Ask each group to decide whether there are any difference(s) between an actual bed planting business and the presented business model/plan, and suggest strategies/activities for setting up a profitable bed planting service business. Each group should present their assignment on poster paper.

Step 3: Further discussion (10 minutes)

Refer to the flipchart to discuss the following points, and record any relevant information/data on running a bed planting service business:

- primary investment in the bed planter
- monthly expenditure and income from bed planting services
- list of farmers interested in bed planting services

Step 4: Review of key messages (5 minutes)

Use the flipchart to review the key messages of this session.

Powerpoint presentation of flipchart available at: URL

Session 8

Review of key messages, post-training evaluation and close of training

How to conduct the session on *Review of key messages, post-training evaluation and close of training*

For this session, you will need the following resources and materials:

- flipchart *Session 7: Review of key messages, post-training evaluation and close of training*
- A4 printed copies of the flipcharts as a handout for each participant
- several sheets of blank poster paper/whiteboard, flipchart stand, whiteboard stand, dry markers/whiteboard pens
- post-evaluation questionnaire (see Annex 1)
- handouts or other materials (e.g., leaflets, brochures, if available) for the participants

Step 1: Generate discussion to recap the important questions of the day (20 minutes)

Review all the sessions by asking the participants the questions listed on the Session 7 'Review of key messages' flipchart. This gives a good indication of whether all the participants have learned from the training, and to what extent.

Use the following questions to stimulate discussion:

- What are main functional parts of a bed planter?
- What are the benefits of bed planting? What might the disadvantages be?
- How would you define calibration?

- What are the potential causes of failure and breakdown that can be experienced using a bed planter? What are the solutions?
- For what types of crop can a bed planter be used?
- What do we mean by a 'business'? What is a business plan?
- Why is financial record-keeping important?
- How can you make bed planter services profitable, while also benefiting farmers?

Look back at what was written at the start of the day under "participants' expectations". Were most of their expectations fulfilled? If not, follow up with additional discussion to make sure any remaining questions are resolved.

Step 2: Post-training evaluation (10 minutes)

Hand out the post-evaluation questionnaire and allow 10 minutes for participants to complete it. Be available to answer questions and assist anyone who may need it.

Step 3: Distribution of any materials to take away (5 minutes)

Distribute any handouts, leaflets, brochures or other materials among the participants.

Step 4: Acknowledgments and close of training (10 minutes)

Thank all participants and guests and close the training with concluding remarks.

A decorative graphic in the top left corner shows a hand holding a plant, with a circular frame around it. The background is a dark teal color. The text is centered and reads:

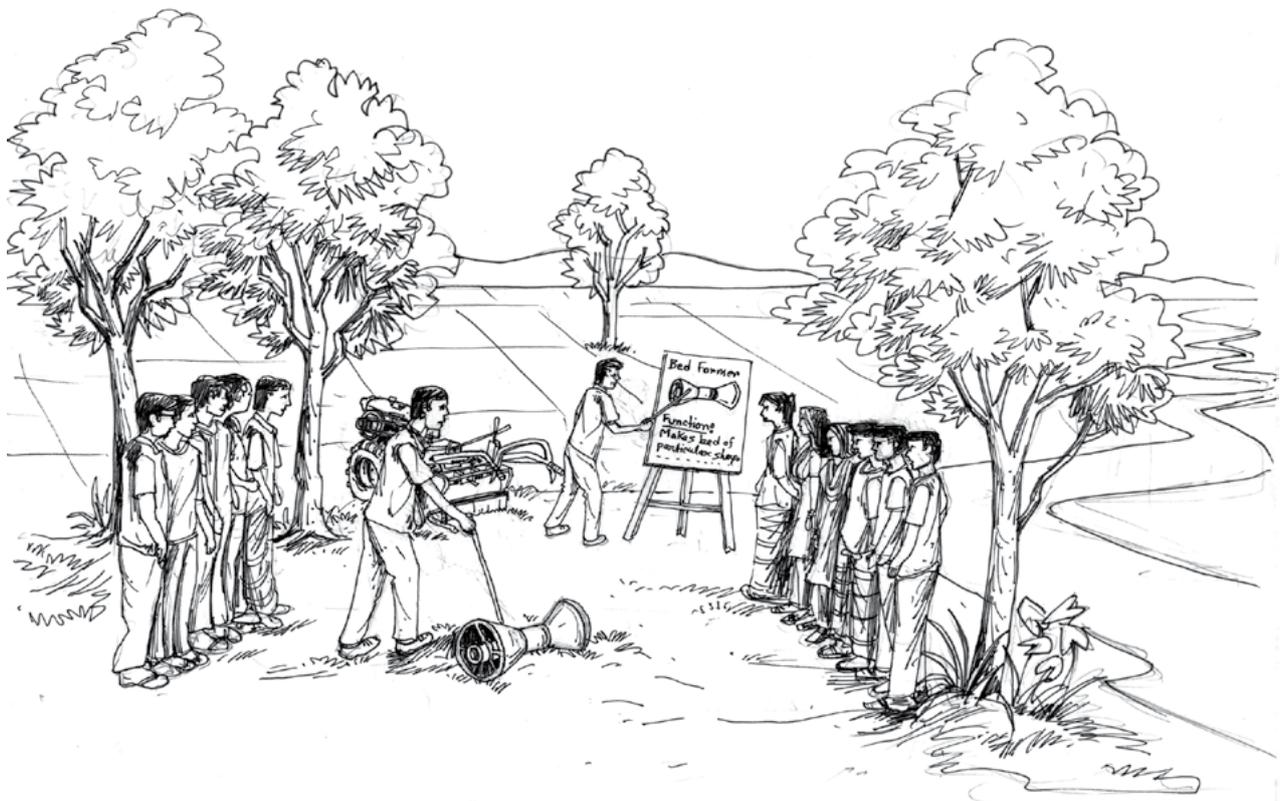
Flipcharts and handout materials*

* PowerPoint files of the flip charts in 'ready to present' format can be downloaded from here: <https://bit.ly/2T7xcGj> (for English language) or here: https://csisa.org/wp-content/uploads/sites/2/2019/12/191204_BP-SP_190512-PP_BP-SP-smh.pdf (for Bangla language).

Session 1

Introduction, training objectives and pre-training evaluation

Bed planter
one-day training flipchart



What do you expect to learn from this training?

- ◆ In groups, discuss what you think you'll learn today.



- ◆ Choose someone from each group to speak for the group.

- ◆ Take notes.



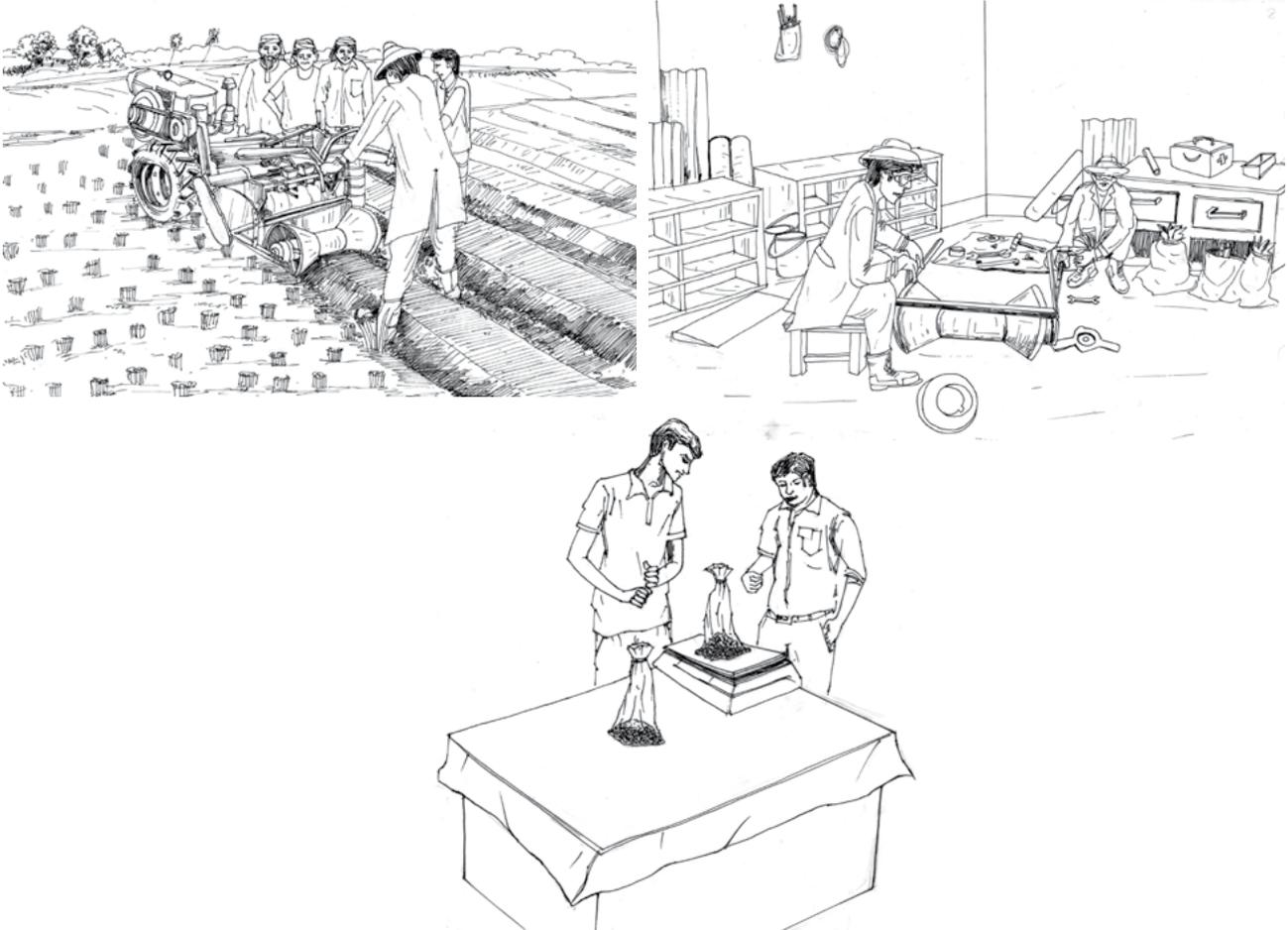
Today's sessions

- 1. Introduction, training objectives and pre-training evaluation**
- 2. Introduction to the bed planter**
- 3. Main parts of the bed planter and their functions**
- 4. Calibration of the bed planter**
- 5. How to set up and use a bed planter safely and effectively**
- 6. Troubleshooting and maintenance**
- 7. Starting a bed planter service business**
- 8. Review of key messages, post-training evaluation and close of training**

What kind of training is this?

This is *participatory* training, so:

- ◆ Ask questions and speak.
 - ◆ Learn through experience – run irrigation pumps yourself and learn how to operate them.
- ◆ Learn by discussing each topic with your group.
 - ◆ Speak up when the facilitator asks questions – and ask questions yourself. This way we can learn from each other.



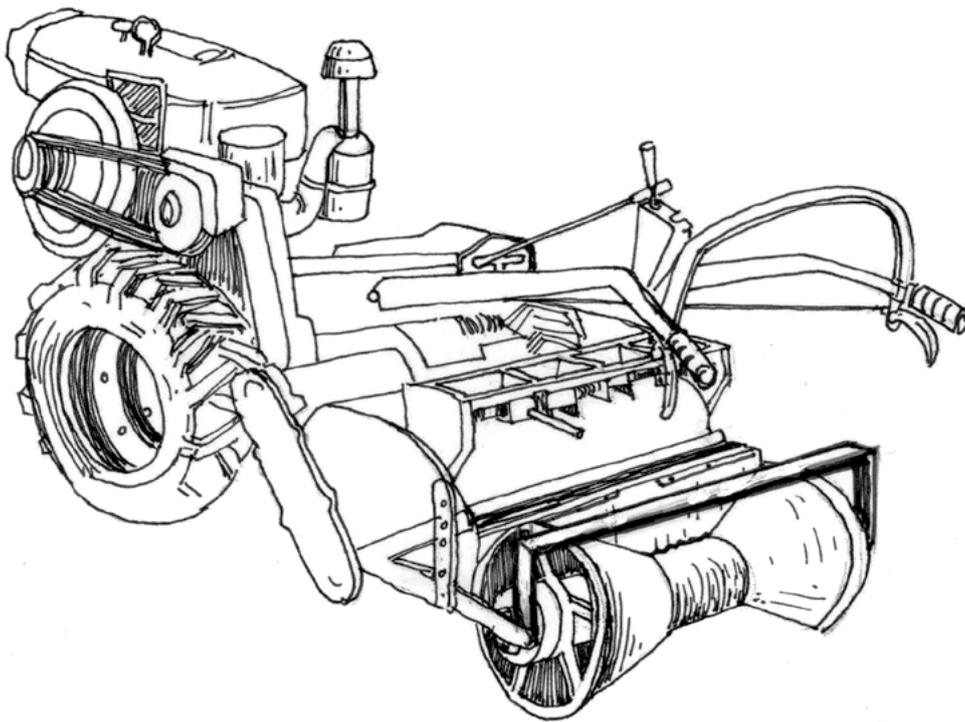
Please enjoy this training!

- ◆ **Feel free to ask questions and to contribute your knowledge!**
- ◆ **Make sure you get time to practice how to set up and operate the bed planter.**
- ◆ **Have fun!**

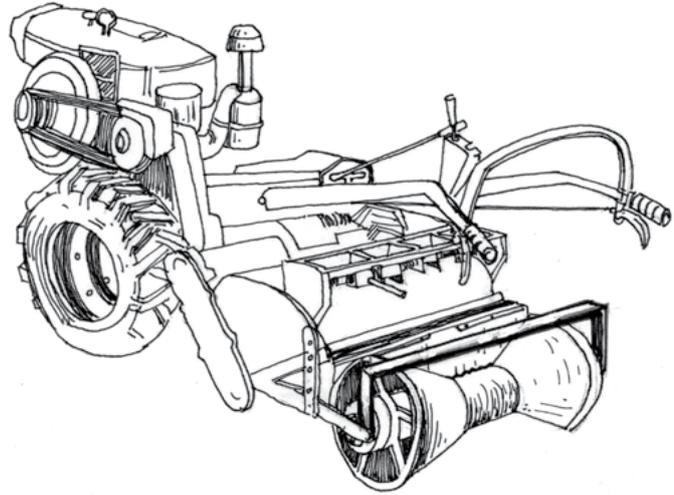
Session 2

What is a bed planter?

Bed planter
one-day training flipchart



What is a bed planter? (1)



A bed planter:

- ◆ Can be attached to a DongFeng or SiFeng two-wheel tractor.
 - ◆ Tills the soil and plants seed at the same time.
- ◆ Has 24 (16 specially made blades and 8 PTOS blades) used for tilling the soil.
 - ◆ Reduces the time needed to till and plant a field.
- ◆ Used to plant farmers' fields; can be profitable – both for the machine owner and the farmer!

What is a bed planter? (2)

- ◆ Most bed planters are 60 cm wide.
- ◆ The depth of tillage is adjustable.
- ◆ A BP usually weighs about 120 kg.
- ◆ A bed planter needs only one pass to complete tillage and sowing (a power tiller needs 2-4 passes).





What crops can be sown with a bed planter?

- ◆ wheat
- ◆ maize
- ◆ rice
- ◆ pulses (legumes)
- ◆ jute
- ◆ sesame
- ◆ sunflower
- ◆ barley
- ◆ vegetables, such as potato
- ◆ many other small and medium-sized crops

With a bed planter, different seeding mechanisms can be used for different crops.



What are the advantages of bed planting? (1)



- ◆ It can be used to plant raised beds.
 - ◆ It allows full tillage.
- ◆ Crops are sown or planted in a line, enabling more efficient crop and weed management.
 - ◆ One pass is enough for bed formation.

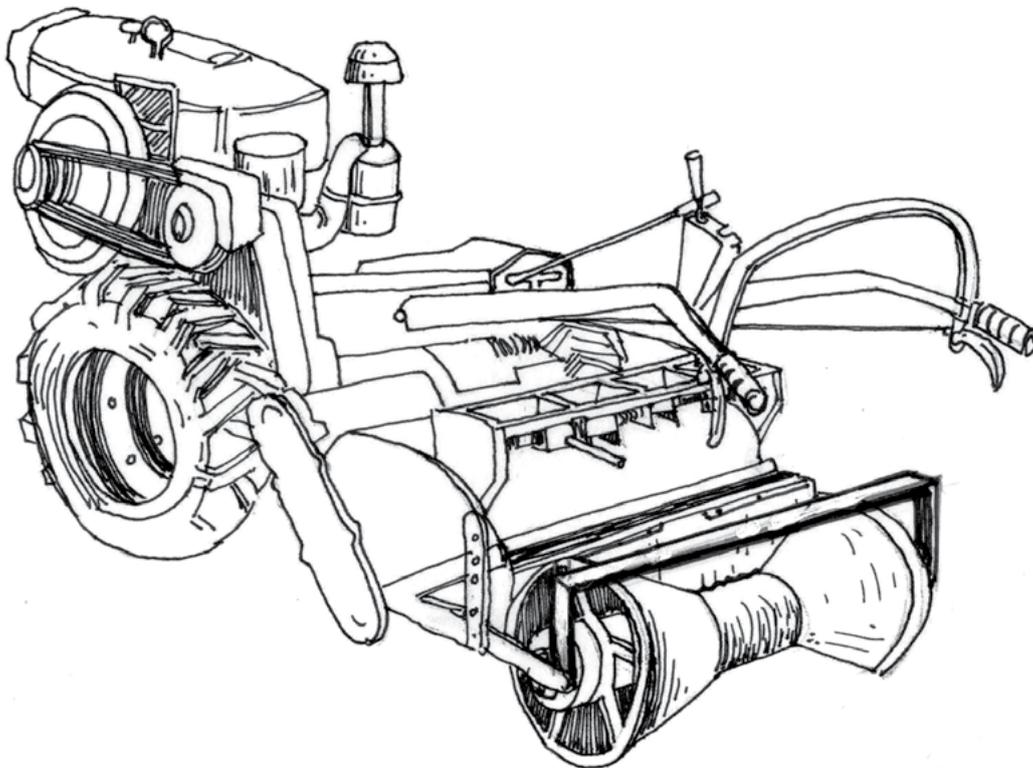
What are the advantages of bed planting? (2)

- ◆ It prevents short-term waterlogging of the plants.
 - ◆ It saves time, seed and money.
- ◆ It facilitates judicious water use and drainage.
 - ◆ It reduces turnaround time/ advanced sowing.
- ◆ Seeding depth is uniform, which means better seed germination and crop establishment.

Session 3

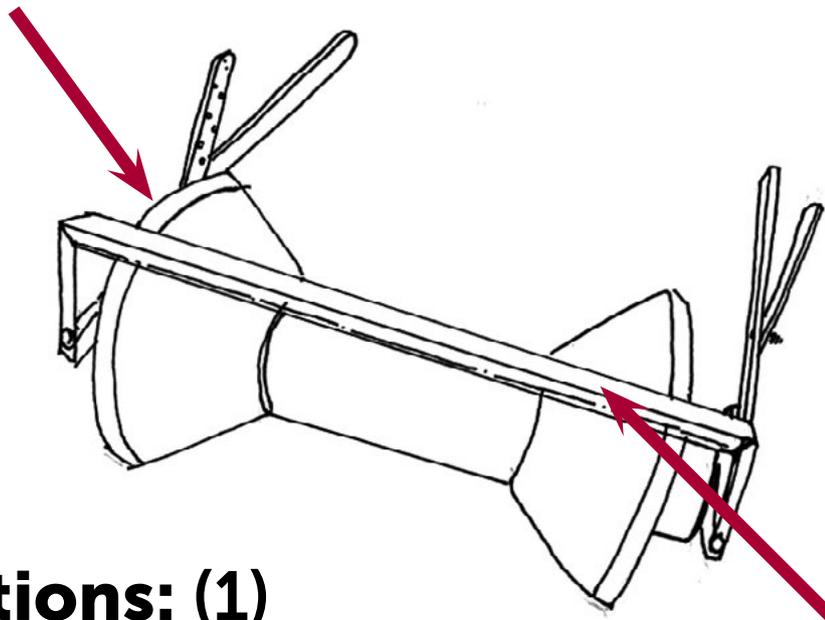
Main parts of a bed planter and their functions

Bed planter
one-day training flipchart



Main parts of a bed planter and their functions (1)

The bed former



Functions: (1) makes beds to a specific shape and size (55-60 cm wide, 12-15 cm high); (2) covers seeds in the furrows (made by the furrow opener) with soil, then levels and compacts the soil.

The scraper

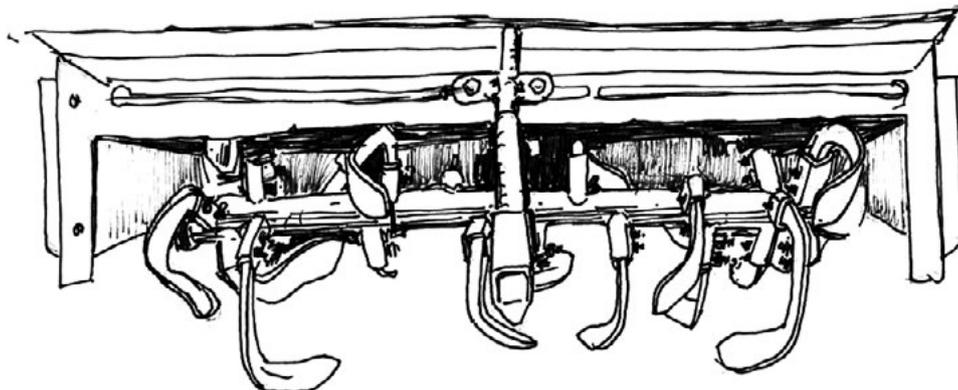
Function: cleans the soil/mud from the bed former with a scraping action.

Main parts of a bed planter and their functions (2)

Tillage depth control bar: controls the depth of tillage by selecting the specific hole in this perforated bar.

Mudguard: (1) prevents soil from diffusing over a wide distance; and (2) acts as a safety guard to prevent the operator from being hit by clods of soil.

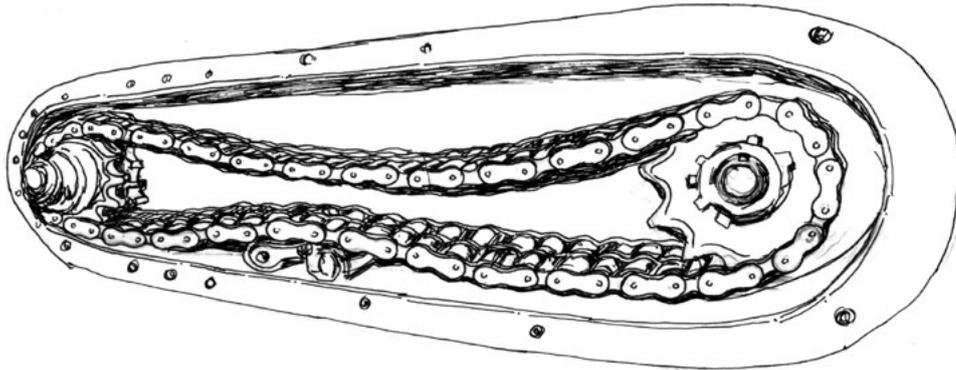
Rotavator



Function: rotates and tills the soil.

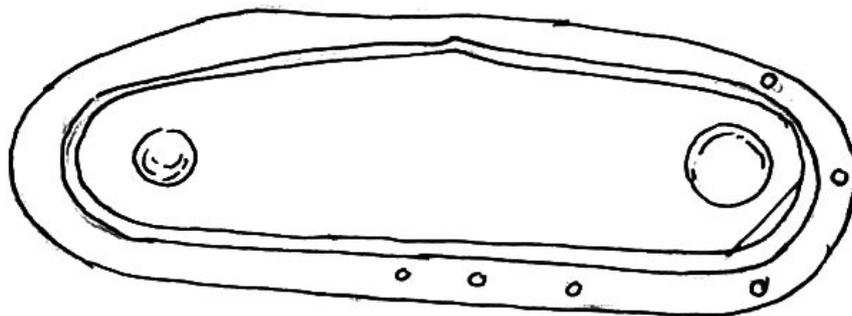
Main parts of a bed planter and their functions (3)

Rotavator chain sprocket



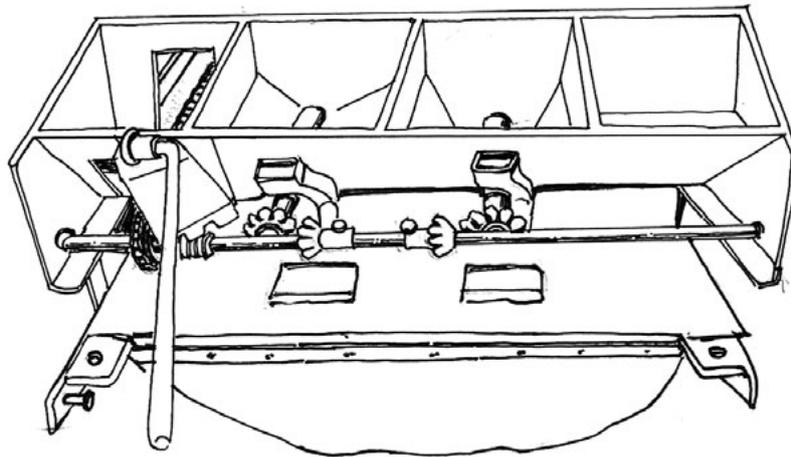
Function: transmits power from the Seeder Fertilizer Drill gearbox to the rotavator.

Rotavator chain sprocket cover



Function: protects the chain, sprocket and oil in the rotavator chain housing from dust, straw and other foreign particles.

Main parts of a bed planter and their functions (4)

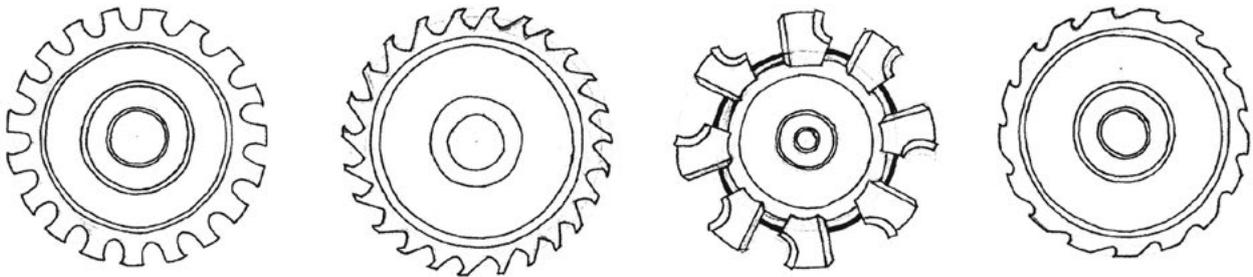


Seed-fertilizer boxes: hold the seed and fertilizer during the bed planting process.

Seed-fertilizer on-off clutch/lever: used to switch on and off the flow of seed and fertilizer to the seed and fertilizer tubes, respectively.

Main parts of a bed planter and their functions (4)

Seed-fertilizer meter



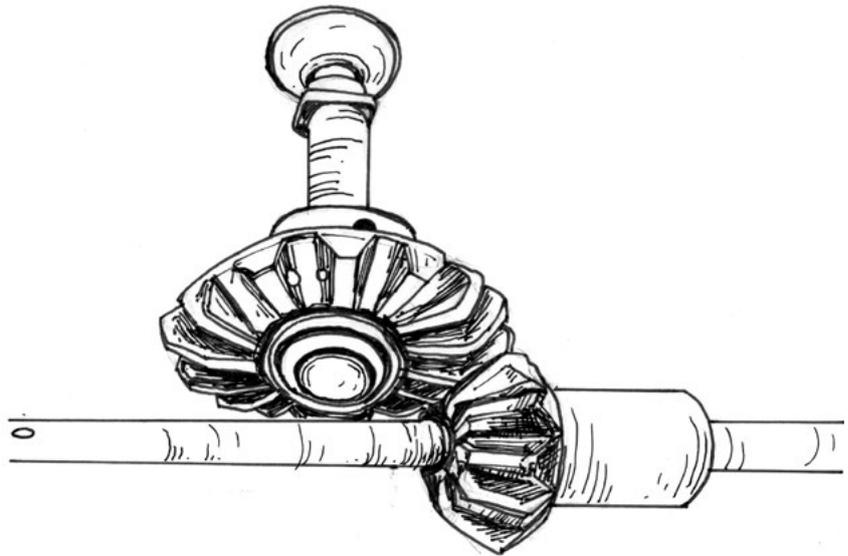
Above: inclined plate-type meter

Function: meters the seed/fertilizer and delivers it to the seed or fertilizer chute.

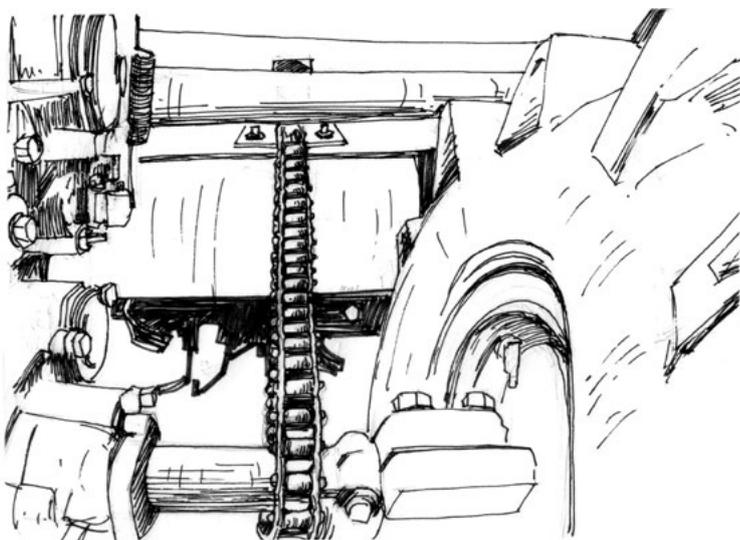
Main parts of a bed planter and their functions (5)

Seed metering/bevel gear shaft

Function:
meters
the seed/
fertilizer and
delivers it to
the seed or
fertilizer chute.



Power transmission chain



Function:
transmits
power to the
bevel gear
shaft from the
front wheel
spindle.

Review of key messages

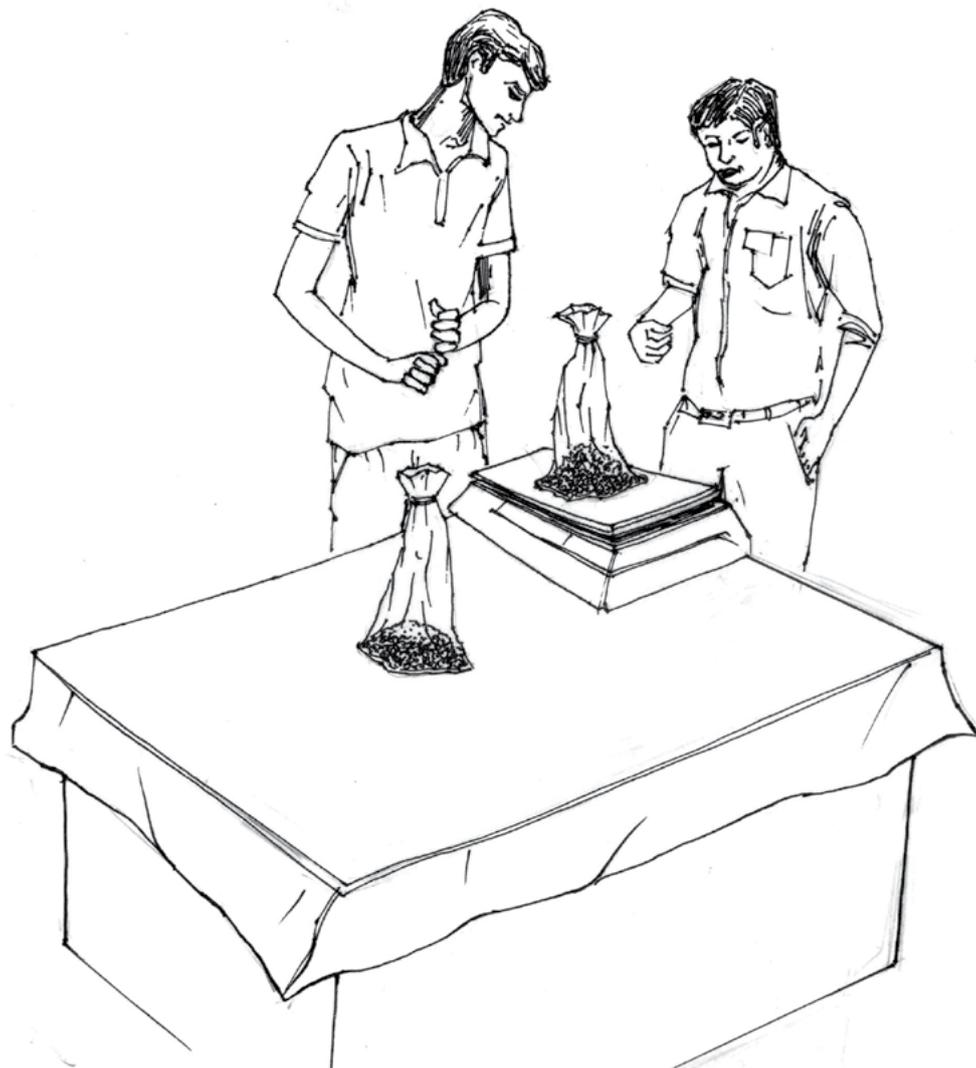
The main parts of a bed planter are:

- ◆ bed former/shaper
 - ◆ mudguard
- ◆ tillage depth controlling lever
 - ◆ furrow opener
- ◆ rotavator
 - ◆ rotavator casing
- ◆ rotavator chain sprocket
 - ◆ chain sprocket cover
- ◆ seed box
 - ◆ seed meter
- ◆ seed on-off lever
 - ◆ seed metering shaft
- ◆ power transmission chain

Session 4

Calibration of the bed planter

Bed planter
one-day training flipchart



What is calibration and why is it important? (1)

Calibration is *essential* to ensure that the bed planter meters the correct rate of seed to be sown per unit of land area (for example, 100 kg of wheat seed per hectare, or 0.40 kg of seed per *decimal*).

Calibrate the bed planter by setting up the seed metering inclined plates to provide more (or less) seed. Do this by changing: (1) the degree of inclination of the inclined plates, and (2) the sprocket size (big or small) tagged with the seed metering bevel gear shaft.



What is calibration and why is it important? (1) cont'd...

For example: to calibrate the bed planter for wheat (at a seed rate of 100 kg/ha, or 0.40 kg/*decimal*), set up inclined seed metering plates which have 32 slots or teeth (these channel seed into the seed tubes and furrow openers), by increasing or reducing the amount of inclination of the inclined plates so that the machine will sow 100 kg seed per hectare (in the case of machine-sown wheat).

What is calibration and why is it important? (2)

Calibration must be done before sowing the seed, by considering the (1) seed size (small? medium? large?) and (2) type of seed.

It is best to calibrate your bed planter (1) at least once at the beginning of every season, and (2) if you are changing from sowing one crop type to another!

To calibrate a bed planter, what materials do you need?

- ◆ a bed planter and two-wheel tractor**
- ◆ a small piece (25-30 m long) of land on which to run the bed planter**



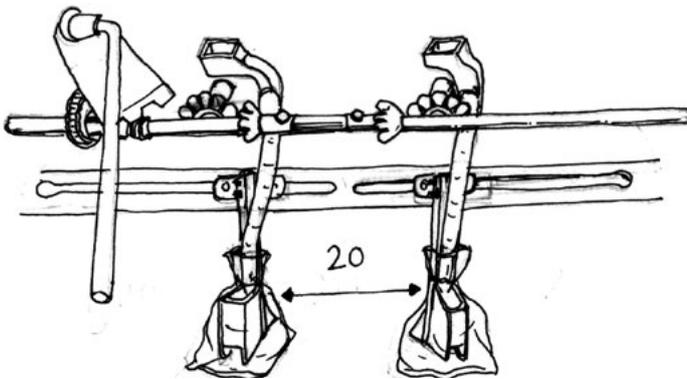
- ◆ a measuring tape
 - ◆ seeds of the crop for which you want to calibrate
- ◆ at least two plastic bags to collect the seeds – transparent bags are best
 - ◆ rubber bands to attach the polythene bags to the furrow opener
- ◆ a balance (scale) (1 g sensitivity is ideal, although some farmers use a simple balance bought in the local market)
 - ◆ pencil and paper

How to calibrate the bed planter (1)

Remember, 1 ha = 7.5 *bigha*, around 247 *decimals* or 10,000 m²

- ◆ The recommended seed rate for wheat (when machine sowing) is 100 kg/ha (16 kg/*bigha* or 0.40 kg/*decimal*)
 - ◆ Choose the correct line distance for the crop being sown (for wheat this is 20 cm from row to row)
- ◆ Set the position and number of furrow openers, starting from the middle point of the machine.

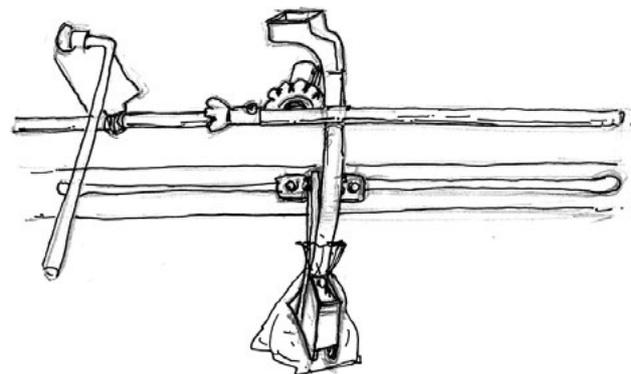
How to calibrate the bed planter (2)

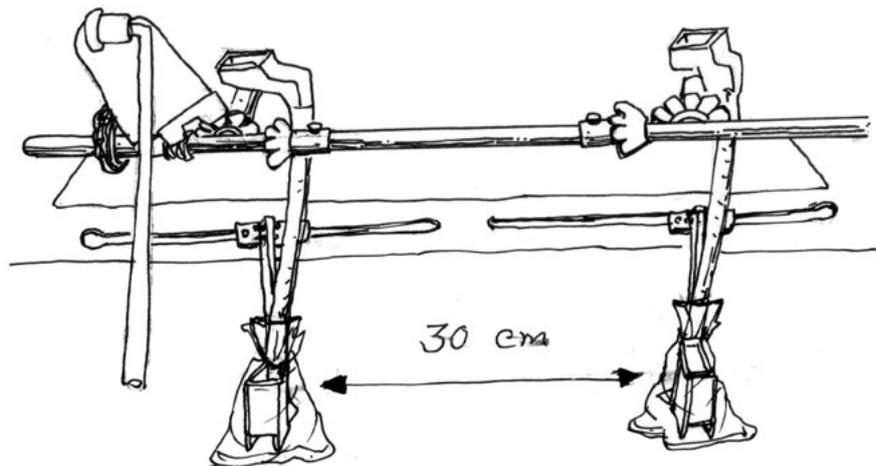


For wheat, set two furrow openers to provide a line-to-line average

distance of 20 cm (0.2 m), and a full length of 60 cm (0.6 m). The top width of the bed should be set at 30 cm (0.3m) and the bottom width at 30 cm (0.3m). The furrow openers are therefore placed from the center of the machine (0.3m). Use a 32-cell seed metering plate.

For maize, set a single furrow opener in the center to provide a line-to-line average distance of 60 cm (0.6m). Use a 9-cell seed metering plate.





For mungbean and other pulse crops, set furrow openers to give a line-to-line average distance of 30 cm (0.3 m). Set the two furrow openers on the left and right 15 cm from the center (0.3 m apart) on both sides. Keep in mind that the bed former cones should be set so that the top width of the bed should be 40 cm and bottom width 60 cm; furrow opener (line-to-line) spacing should be maintained at 30 cm. Use a 32-cell seed metering plate.



How to calibrate the bed planter (3)

Remove any unused furrow openers and attach plastic bags to the remaining ones (unless sowing maize or sunflower).

If you are now sowing a single row of maize:

1. Remove one furrow opener.
2. Detach the metering plate from the seed box to which the furrow opener/seed delivery tube is not connected – this prevents seed from being delivered onto the ground.
3. Attach a plastic bag to the end of the seed delivery tube (by first removing the tube from the furrow opener to be used) with a rubber band. Make sure it is large enough to collect the seed.

Calibration calculation (1) –

Smaller sized seeds

To meter seed at the right rate we first need to know how much seed is required in each line's plastic bag before running the machine in the field. This can be determined through a simple generic calculation (a trial plot 20 m in length):

Required wheat seed quantity in plastic bag (kg)

$$\text{Seed rate} \left(\frac{\text{kg or No. of seed}}{\text{ha}} \right) \times \frac{\text{Width of cut of bed planter (m)}}{\text{Line number of bed planter (covered with single pass)}} \times \text{Trial length (m)}$$

$$= \frac{\quad}{10,000 \text{ m}^2 \text{ (equal to 1 hectare)}}$$

For example, for wheat sown at a rate of 120 kg/hectare on a trial plot 20 m in length with a line-to-line distance of 20 cm (2 lines), the resulting calculation is:

Required wheat seed quantity in plastic bag (kg)

$$\frac{120 \left(\frac{\text{kg}}{\text{ha}} \right) \times \frac{0.6 \text{ (m)}}{2} \times 20 \text{ (m)}}{10,000 \text{ m}^2 \text{ (equal to 1 hectare)}}$$

which produces this result:

$$\frac{120 \left(\frac{\text{kg}}{\text{ha}} \right) \times \frac{0.6 \text{ (m)}}{2} \times 20 \text{ (m)}}{10,000 \text{ m}^2 \text{ (equal to 1 hectare)}} = 0.072 \text{ kg (or 72 grams) per plastic bag for each line of 20 m trial length.}$$



Calibration calculation (2) –

Bigger sized seeds (1)

For crops like maize where the number of seeds per unit of land area is more important than the weight, the calculation is different. Irrigated maize is often seeded at a rate of 83,333 plants per hectare, using 60 cm line-to-line spacing.

To calibrate for this rate using the same 20–m-long trial plot, do not use plastic bags. Instead, allow seed to fall onto the ground, and count the number of seeds per 1-m length (do this along several 1-m lengths to ensure consistency).

Here is the formula for maize, using this seed rate:

Number of seeds per 20 m length for 1 line (kg)

$$= \frac{83,333 \left(\frac{\text{seeds}}{\text{ha}} \right) \times \frac{0.6}{1} \times 20 (m)}{10,000 \text{ m}^2 \text{ (equal to 1 hectare)}}$$

= 100 seeds (per 20 m line) or 5 seeds for 1 m length

**Now try to calculate:
how many seeds would you count in a
1-m length?**

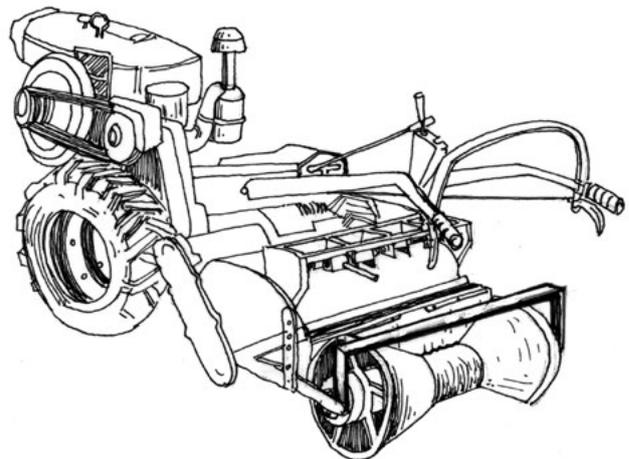
Calibration calculation (3) –

Bigger sized seeds (2)

For maize, the formula on the previous page gives the following result:

$$= \frac{83,333 \left(\frac{\text{seeds}}{\text{ha}} \right) \times \frac{0.6 \text{ (m)}}{1} \times 20 \text{ (m)}}{10,000 \text{ m}^2 \text{ (equal to 1 hectare)}}$$

= 100 seeds (per 20 m line) or 5 seeds for 1 m length

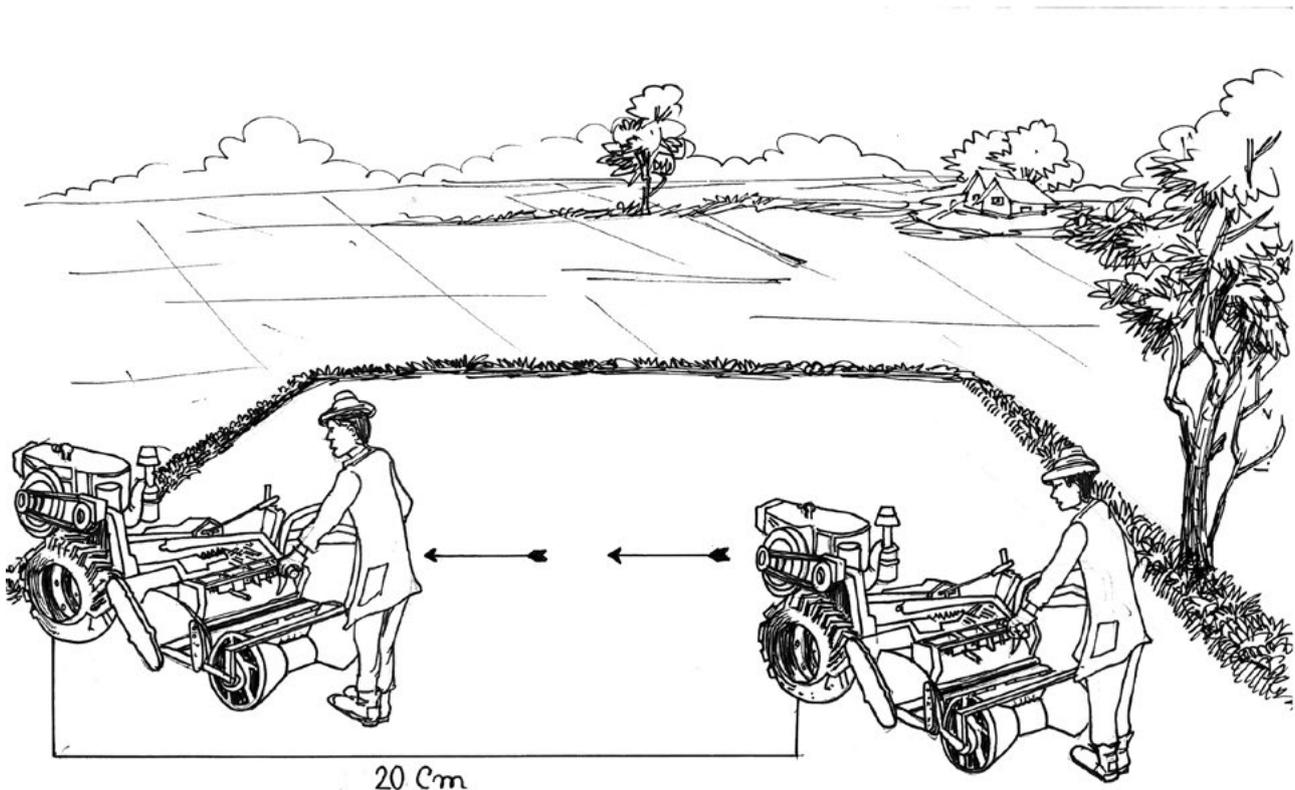


**Was your calculation correct?
Congratulations – you are now almost a
calibration expert!**

Now you just need practice.

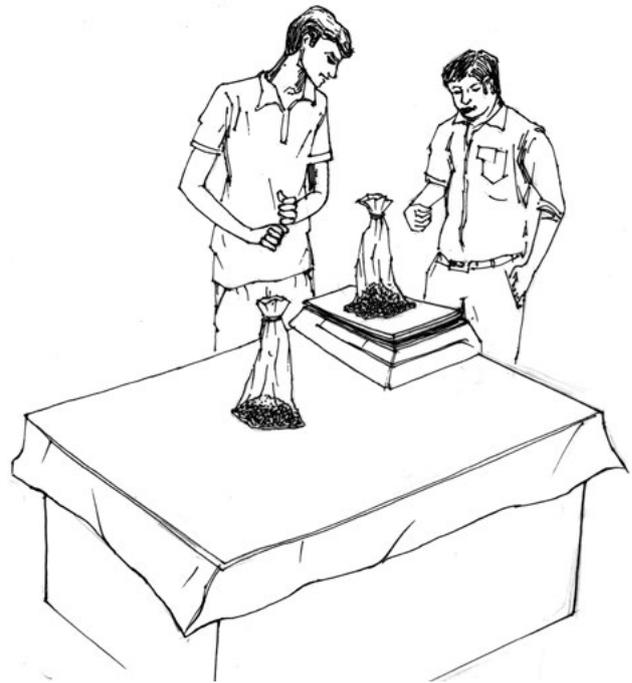
Calibration practice (1)

- ◆ Put the seed into the seed box.
 - ◆ Select the uppermost hole of the tillage depth control bar so that the tines do not touch the soil.
- ◆ Run the machine for 20 meters.



Calibration practice (2)

- ◆ Weigh the seed in each plastic bag separately using a digital balance, or (for maize or sunflower, and bigger seeded crops) count the number of seeds. Observe whether an equal amount/number of seeds was dropped in each line.
- ◆ If the lines are not equal or the seed rate incorrect, adjust the bed planter by setting the metering plates of similar type and maintaining the exact inclination of the seed meters.





Calibration practice (3)

- ◆ If you are using a particular seed metering plate and the amount of seeds is found to be more (or less) than required, adjust the amount of inclination by selecting/changing the specific hole in the inclination adjustment bar to one which is higher (or lower). This will increase (or reduce) the quantity of seed dispensed.
 - ◆ Repeat the process until you achieve the correct seed rate.
- ◆ Use a permanent marker to indicate on the bed planter where to set the desired seed rate for each crop (check this calibration at the beginning of each season).

Calibration practice (3) (cont'd...)

- ◆ **Bed planters that use inclined plate seed meters do not need much adjustment – each plate is made specifically for the type of seed so that it will be metered at the correct rate.**
 - ◆ **For these seed meters, the seed rate depends on: (1) the number of cells on the periphery of the plate; and (2) the number of revolutions per minute the plate turns.**



Seed calibration: Key messages

- ◆ Calibration means setting up the bed planter to get a specific seed rate before operating the machine.
 - ◆ Carry out seed meter calibration by considering (1) the style of the seed metering plate (that is, inclined), and (2) the type and size of the seed.
- ◆ It is best to calibrate (1) at the beginning of each season, and (2) before and after changing crops.
 - ◆ Mark the hole in the inclination adjustment bar according to the mathematics and procedure given in this module.

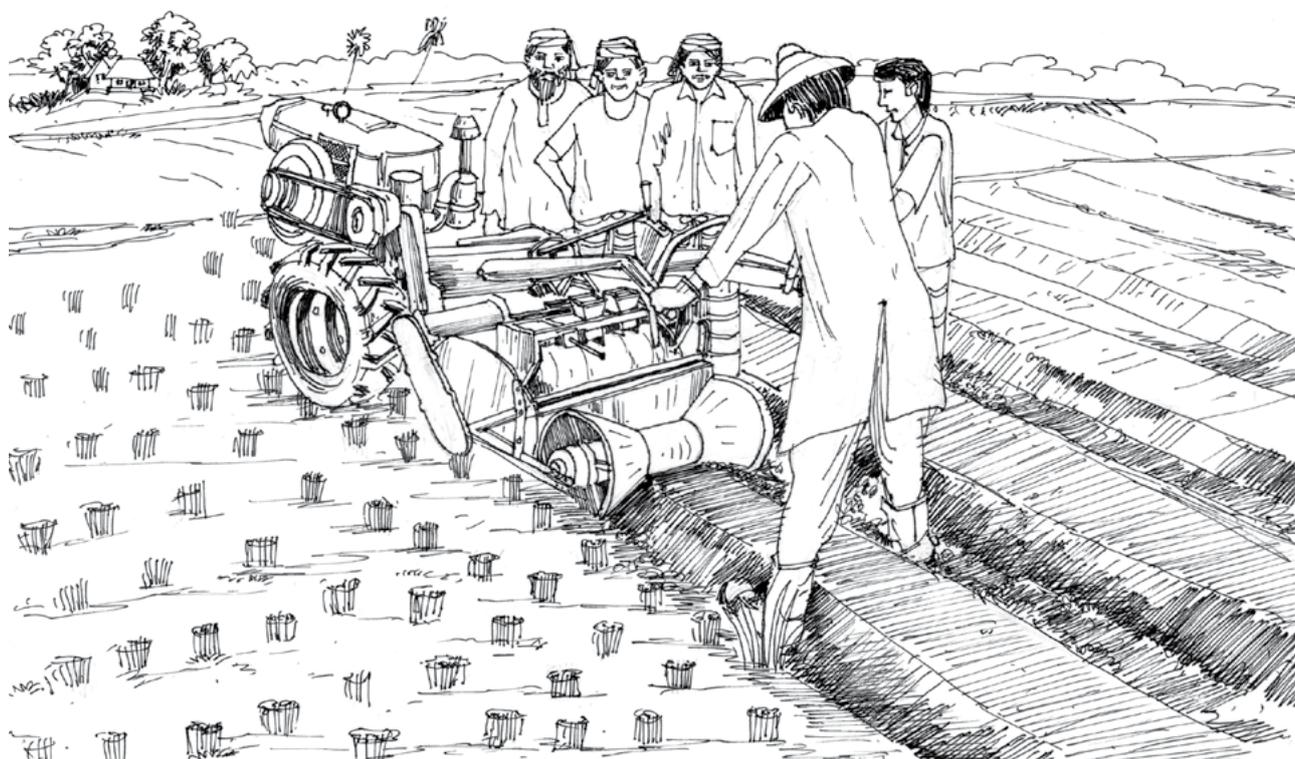
Seed calibration: Key messages (cont'd...)

- ◆ Set the metering plate to specific cell numbers on the basis of seed size and rate.
- ◆ To change the amount of seed, change the plate and degree of inclination before the seeds are dropped onto the soil.

Session 5

How to operate a bed planter safely and effectively

Bed planter
one-day training flipchart

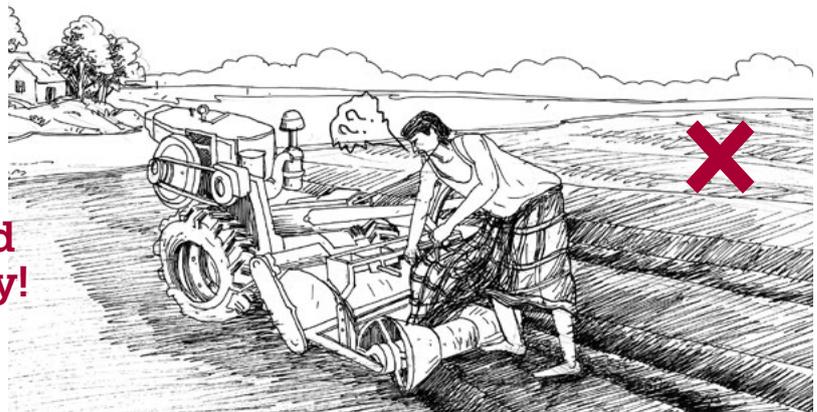


Safe bed planter operation is a must! (1)

- ◆ A bed planter can be a dangerous machine. It is important to stay safe when using it.
- ◆ Wear tight clothing when operating a BP, so that your clothing will not become tangled in the moving parts of the machine, which can cause injury or even death.

Never wear loose fitting clothing around agricultural machinery!

Never work without shoes!



UNSAFE OPERATION



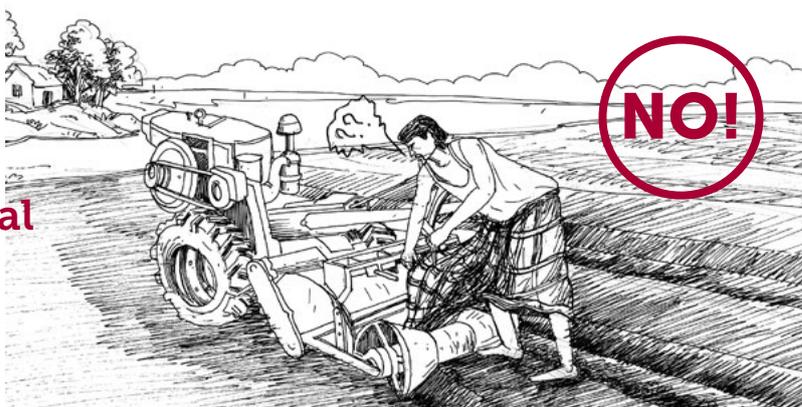
SAFE OPERATION

Safe bed planter operation is a must! (2)

NEVER use the bed planter around children, who can easily get hurt – or even killed.

Never wear loose fitting clothing around agricultural machinery!

Never work without shoes!



UNSAFE OPERATION



SAFE OPERATION

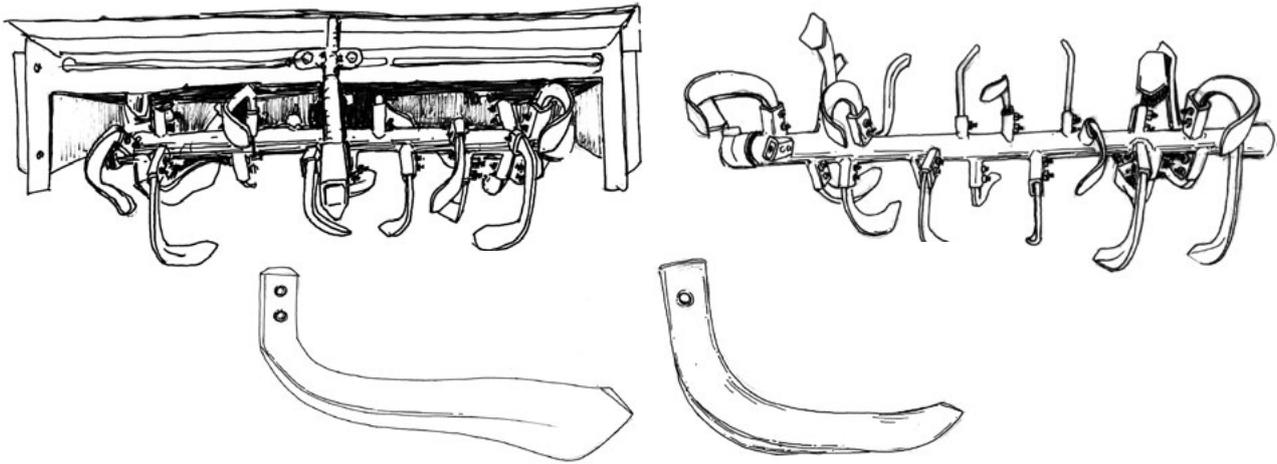
NEVER use the bed planter around children: they can easily get hurt – or even killed!



How to prepare the bed planter for use in a farmer's field

- ◆ **Make sure there is sufficient fuel, engine oil and water in the radiator to run the machine and complete the day's work.**
 - ◆ **Check the (1) nuts and bolts on the power tiller and seeding parts of the bed planter, (2) belt pressure, and (3) tine setting. Make sure all the nuts and bolts are tight.**
- ◆ **Check the tine settings and make sure they are correct for a raised bed tillage system (8 specially made tines on both sides out of 16 specially made tines and 8 PTOS tines are set at the center of the rotavator) and that you have the right blades for your soil type.**

How to prepare the bed planter for use in a farmer's field (cont'd....)



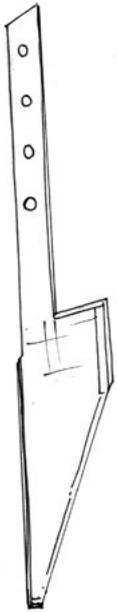
- ◆ **Keep the rotavator 'on-off' lever in the off position until starting the machine.**

How to prepare the bed planter for seeding

- 1. First, calibrate the machine. Select the uppermost hole of the tillage depth-control bar so that the tines do not touch the soil.**
- 2. Move the power tiller (and bed former) to the field, and place it where the field is flat and crop-free.**
- 3. Select the appropriate furrow opener and place it on the machine for the correct seeding depth considering (1) the type of seed (e.g., maize, wheat, mungbean, lentil), and (2) the soil moisture level.**



Types of furrow openers



V/triangular shaped furrow openers: also used for full tillage. Better than rectangular shaped openers– they go deeper into the soil, and so there is less ‘air dropping’ of seed. This type of furrow opener can therefore be used on a bed planter without any trouble only for seed placement.



Rectangular ‘shoe’ shaped furrow opener (only for seeding): this old version is usually used for full tillage. It is not good in high-moisture soil, and nor for strip tillage because it pushes soil out of the furrow. There is little problem, however, when used with a bed planter for sowing seed/planting in a raised bed crop cultivation system.

Setting the correct sowing depth according to seed size is very important!

For small seeds like mustard, onion, sesame and red amaranth: select the lowest hole on the depth control bar to sow seeds 2.0 to 2.5 cm deep. When there are three pairs of holes, select the lowest pair.

For medium sized seeds like wheat, lentil, mungbean, rice and black gram: select the middle hole on the depth control bar to sow seeds at a depth of 2.5-4.0 cm (when there are three pairs of holes, choose the middle pair).



Setting the correct sowing depth according to seed size is very important! (cont'd....)

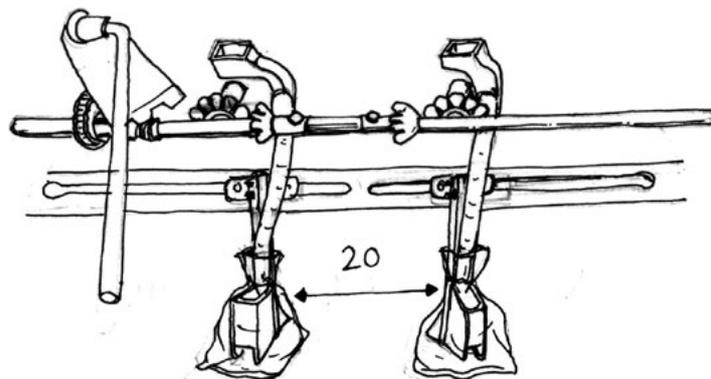
For large seeds like maize, sunflower and chick pea: select the uppermost hole in the depth control bar at 4 to 6 cm deep (when there are three pairs of holes, choose the uppermost pair).

Always sow seed into the soil layer where there is sufficient moisture.

This means that you need to use this guide flexibly – adjustments may be needed.

Setting up your furrow openers

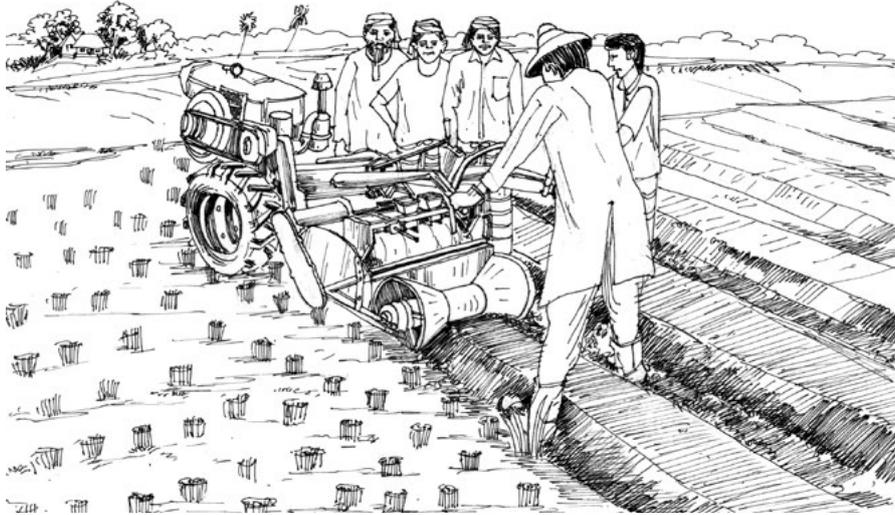
1. One furrow opener is required for each line of seed.
2. Measure from the middle point of the machine, based on a crop's line-to-line distance.
3. For example, for rice and wheat, the line-to-line distance is 20 cm (0.2 m) and two furrow openers are needed.



Two furrow openers with a line-to-line average distance of 20 cm (0.2 m) for wheat.

4. Pour sufficient seed into the seed box.
5. Check if the seed metering plate has been calibrated properly. If not, recalibrate.

Sowing the crop



- 1. Place the bed planter at one end of the test field and start it up.**
- 2. Move the rotavator 'on-off' lever to the 'on' position.**
- 3. Move the seed meter 'on-off' lever from the 'off' to the 'on' position.**
- 4. Run the machine in first gear (if the soil is hard and dry and there is too much crop residue) or in second gear (if the soil has the ideal soil moisture 'zoe' condition).**
- 5. Move the machine across the field during sowing according to instructions provided on the next page.**

Important precautions while seeding

- ◆ Before sowing the whole field, double check that you are seeding at the correct depth.
 - ◆ At the end of each pass, it is best to turn 'off' the seed 'on-off' lever to avoid dropping seed when turning the machine. After turning the machine around, turn the lever to 'on' and continue sowing.
- ◆ While sowing, observe the seed boxes and seed tubes to make sure they are seeding continually.
 - ◆ Stop the engine and rotavator regularly, and remove/clean any accumulation of excess grass, straw or other materials from the tines.



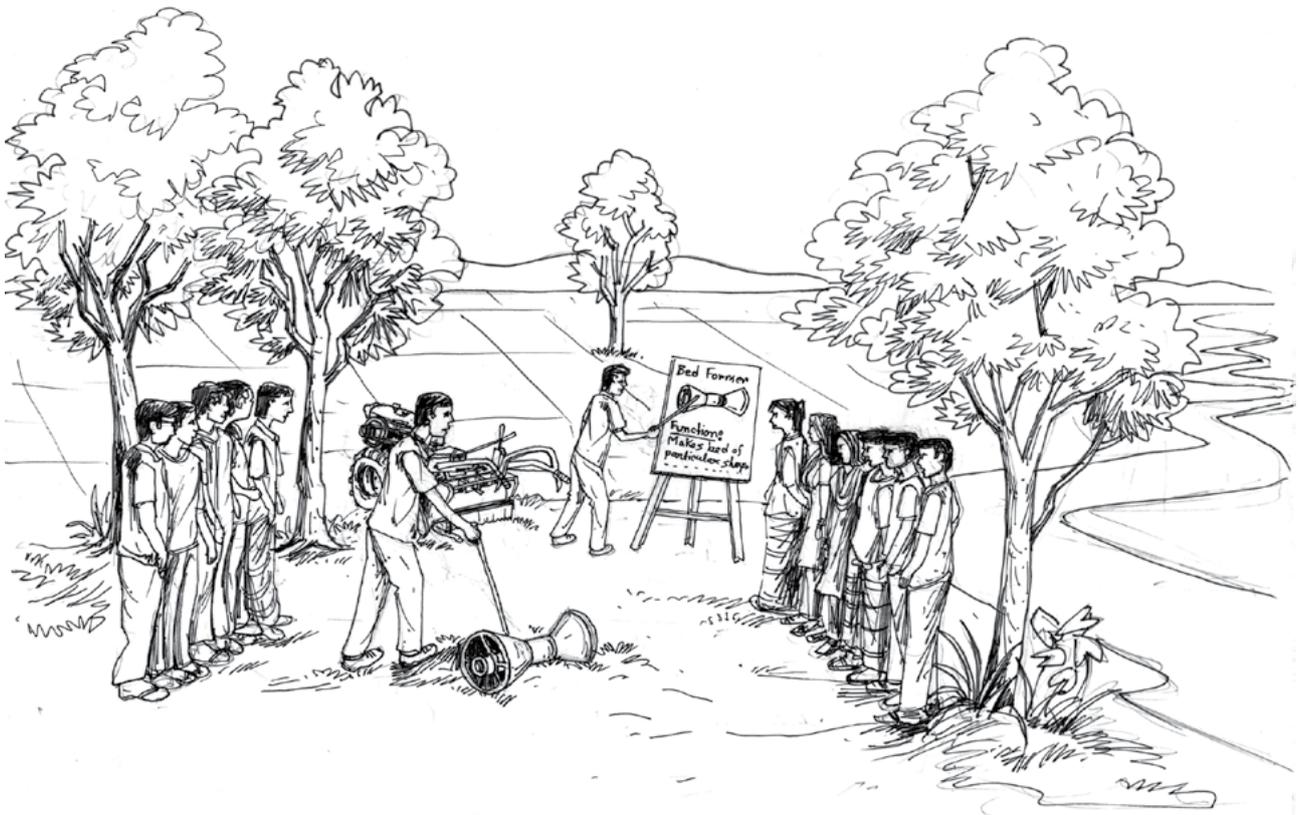
Important precautions while seeding

- ◆ At the end of each pass on the field, check that the furrow openers are not blocked by soil (this can be a problem if the soil is moist, especially for soils with a lot of clay).
 - ◆ Care should be taken to prevent straw or clods of earth from getting into the seed tube and causing blockage.
- ◆ And remember – safety first! Never operate the machine while wearing loose fitting clothing, or around children!

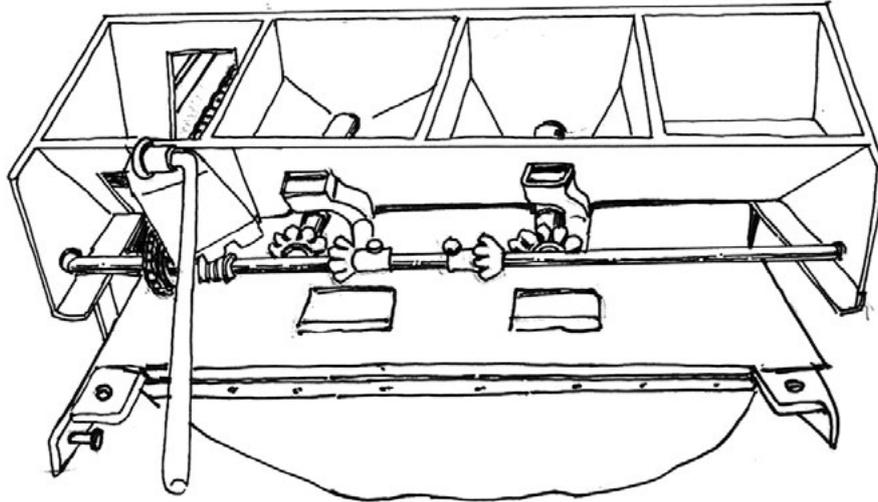
Session 6

Troubleshooting and maintenance

Bed planter
one-day training flipchart



Problem 1: poor meshing of the gear pinion on the metering shaft



Symptoms:

(1) metering plate does not rotate properly; (2) there is an unusual gap between the gear and the pinion

Causes:

(1) jam in the metering system;
(2) long-term use

Effects:

poor or no seeding

Problem 1: poor meshing of the gear pinion on the metering shaft (cont'd...)

Solution:

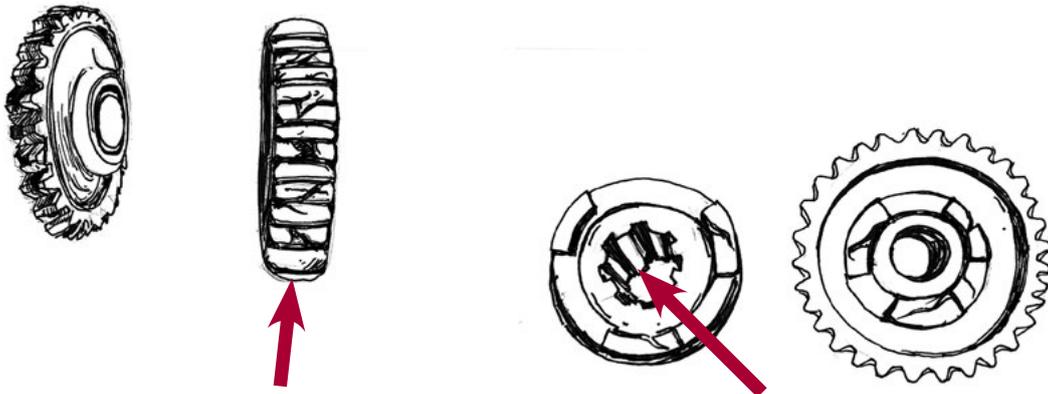
- (1) clean the metering system using diesel and apply lubricant as required;
- (2) straighten or change the shaft

Spare parts required:
shaft

Where to get or make/repair spare parts: collect a new one from a specialist machine parts dealer; have one made or repaired in a local workshop

Tools required: hammer, pliers, dual wrench, adjustable wrench, screwdriver, flat/round file

Problem 2: the gear teeth break and the gear sleeve becomes ineffective



unbroken teeth broken teeth

ineffective sleeve

Symptoms:

(1) the gear pinion slips and makes noise; (2) gear engagement is interrupted

Causes:

(1) overload on the gear pinion (due to tilling hard soil or tilling too deeply); (2) insufficient gear oil; (3) ineffective gear sleeves

Problem 2: the gear teeth break and the gear sleeve becomes ineffective (cont'd...)

Effects:

the bed planter fails completely and cannot be used

Solution:

(1) replace gears/pinion; (2) replace shaft/casing; (3) lubricate gears appropriately

Spare parts required:

oil seal, bearings

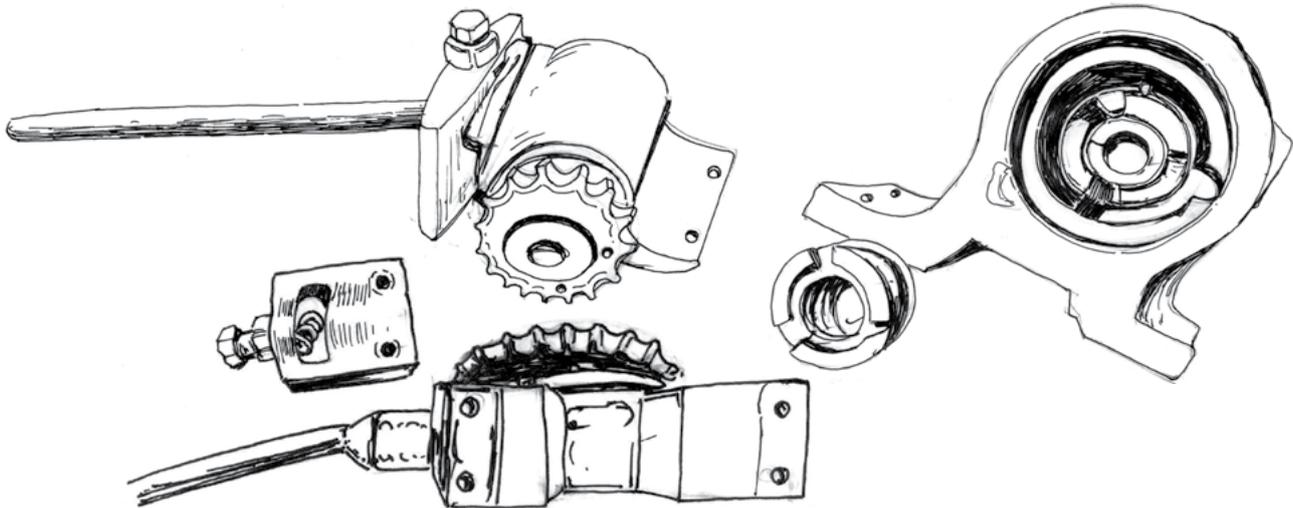
Where to get spare parts:

shop dealing in bed planter/engine spare parts

Tools required:

dual wrench, adjustable wrench, screwdriver

Problem 3: the seed on/off clutch does not work



Symptoms:

- (1) unable to run or stop seed dropping;
- (2) seed quantity in seed box doesn't decrease

Causes:

- (1) clutch is worn out/broken;
- (2) clutch ball is worn out;
- (3) spring inside the clutch has loosened;
- (4) dogbush sleeves inside the pillow block are ineffective

Effects:

seed metering plates cannot be switched on or off

Problem 3: the seed on/off clutch does not work (cont'd...)

Solution:

(1) repair the faulty part and reset; (2) replace the faulty part and reset; (3) fit a new ball and spring

Spare parts required:

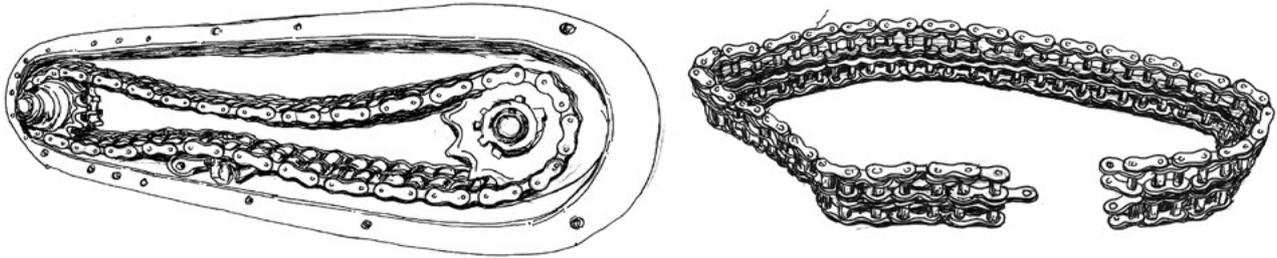
clutch ball, spring or clutch lever

Where to get spare parts or have them made: a specialist dealer, or shop dealing in power tiller parts; can be made in a local machinery workshop

Tools required:

duel wrench set, Phillips head or flat head screwdrivers, adjustable wrench, Allen key

Problem 4: the rotavator chain and bearing break



Symptoms:

(1) rotary shaft does not rotate; (2) strange noise in the rotavator chain casing

Causes:

(1) inadequate gear oil in the rotavator chain casing; (2) excessive load; (3) the bearing is wearing out; (4) incorrect chain tension

Effects:

(1) the rotary shaft stops rotating; (2) if not repaired in time, the rotavator chain casing may break

Problem 4: the rotavator chain and bearing break (cont'd...)

Prevention:

(1) make sure the gear oil level is maintained correctly at all times and replace as needed; (2) never overload the engine; (3) replace a worn or broken bearing immediately; (4) always maintain the correct chain tension using the chain tensioner

Spare parts required:

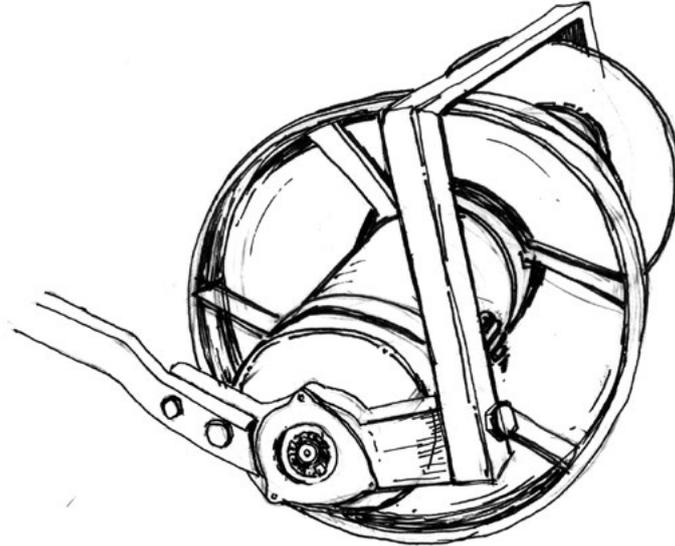
chain-link, chain, bearing, gasket

Where to get or make/repair spare parts: from a dealer or shop dealing in spare power tiller parts

Tools required:

dual wrench, ring wrench, adjustable wrench, screwdriver, hammer, chisel

Problem 5: the bed former's bearings jam or become faulty



Symptoms:

the bed former does not move properly

Causes:

(1) rusting; (2) damage to the bearing seal; (3) bed former shaft is bent

Effects:

(1) the bed former does not rotate freely, or (2) soil accumulates in front of the bed former during tillage resulting in a rough looking bed

Problem 5: the bed former's bearings jam or become faulty (cont'd...)

Solution(s):

(1) remove the bearing and clean in diesel grease/oil (lubricant/Mobil), and (2) reset or replace bearing

Spare parts required:

bearing, circlip, paper gasket

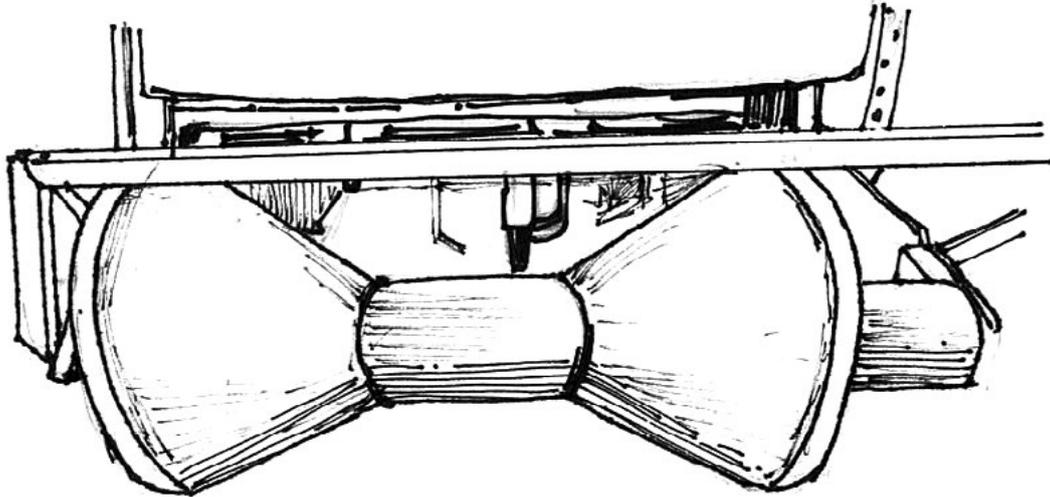
Where to get spare parts:

local dealer

Tools required:

duel wrench set, adjustable wrench, screwdriver, art paper cutter

Problem 6: displacement of the bed former cone



Symptoms:

odd-looking, unexpectedly narrow or wide bed

Causes:

- (1) size irregularity of the bed former;
- (2) the tie of the cone is detached

Effects:

irregular bed shape and size

Problem 6: displacement of the bed former cone (cont'd...)

Prevention:

- (1) re-adjust and tighten;**
- (2) replace if necessary**

Spare parts required:

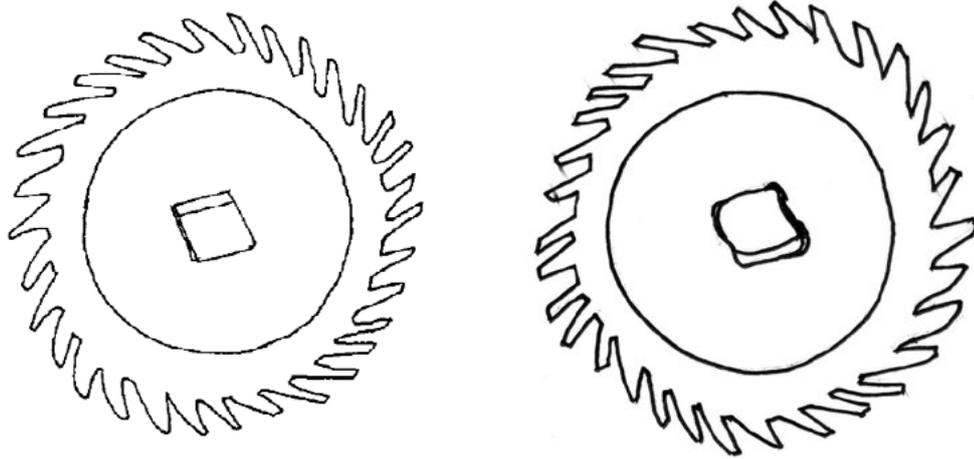
mild steel (MS) sheet; MS flat bar

Where to get or make/repair spare parts: purchase a replacement bed former from a selective dealer; repair/have a new one made at a local workshop

Tools required:

dual wrench set, adjustable wrench, hammer

Problem 7: the seed metering plate does not rotate and the seed fails to drop



Symptoms:

- (1) the metering plate stops rotating;
- (2) the seeds do not drop

Causes:

the central hole in the metering plate changes from rectangular to circular

Effects:

the operator is unable to meter the seed

Problem 7: the seed metering plate ... (cont'd...)

Solution:

(1) replace the defective plate and set a new one; (2) bind a metallic pressure plate or plate-type washer with wire, by drilling the plate

Spare parts required:

wire, pressure plate/plate type washer, new plate

Where to get spare parts:

from a specialist plate supplier. Have the plate drilled locally and then join the pressure type washer with a wire hook

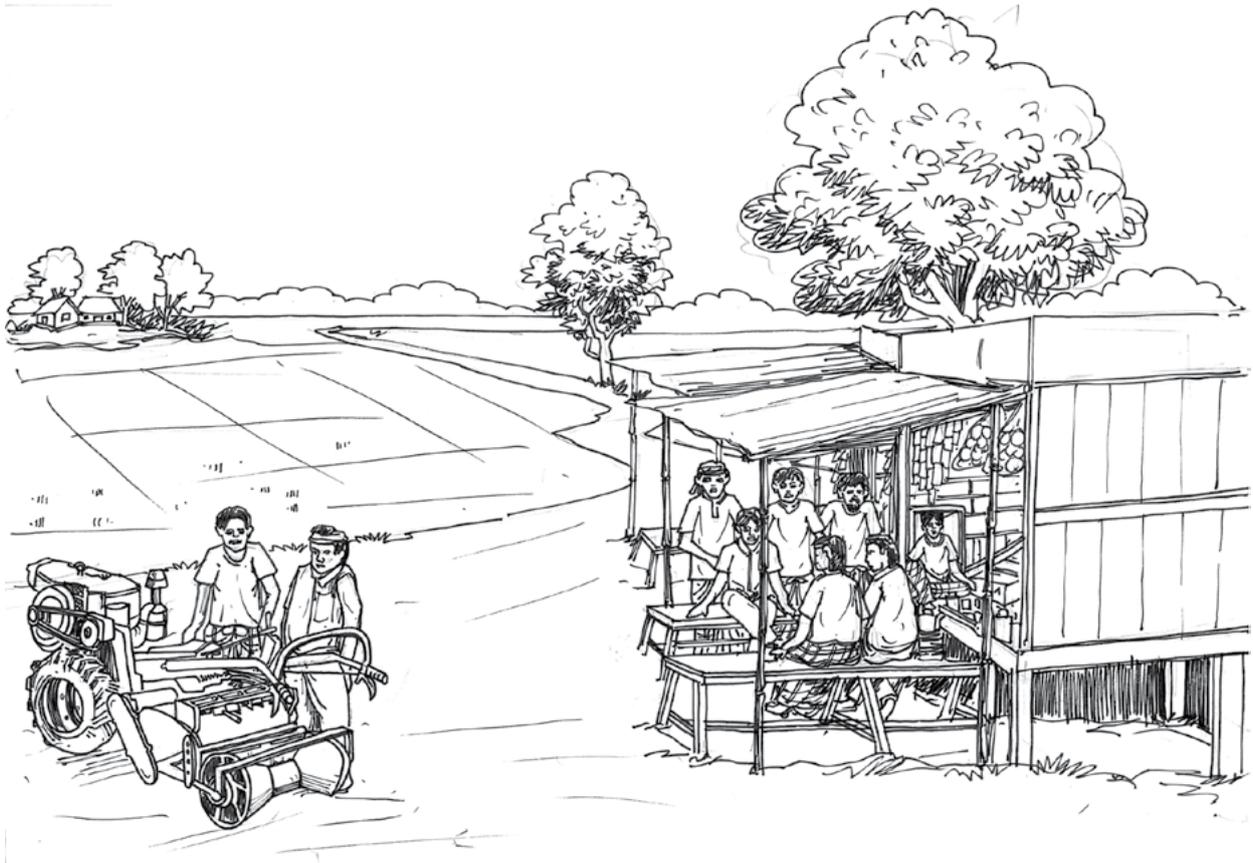
Tools required:

drilling/punching machine, pliers, chisel

Session 7

Setting up a bed planter business

Bed planter
one-day training flipchart



What do we mean by 'a business'?

Most farmers who buy a bed planter use it to run a business and make money.

A business is an activity that includes making, buying or selling goods, or providing a service in exchange for money or other goods and services.

In other words, any activity or occupation run by an individual or group to obtain a profit and satisfy customer needs is a business.

Some types of businesses:

- ◆ manufacturing
- ◆ trading
- ◆ running a store
- ◆ farming
- ◆ providing agricultural machinery services to farmers



What is a business plan?

A business plan describes a sales and marketing strategy, and possible profits and losses. A bed planter business plan considers these types of questions:

- ◆ Where is there a market for bed planting services? Where will farmers pay for bed planter sowing?
- ◆ What is the demand for a bed planter service in my area? Other areas?
- ◆ What is my capacity to provide a bed planter service?
- ◆ What machinery and equipment are needed for a bed planter service?
- ◆ What is my source of capital? How can I afford to buy a bed planter?
- ◆ What profit will I obtain from my future bed planter business service?
- ◆ How can I get as many farmer-clients as possible to pay for the use of the bed planter?

Service provider experience sharing

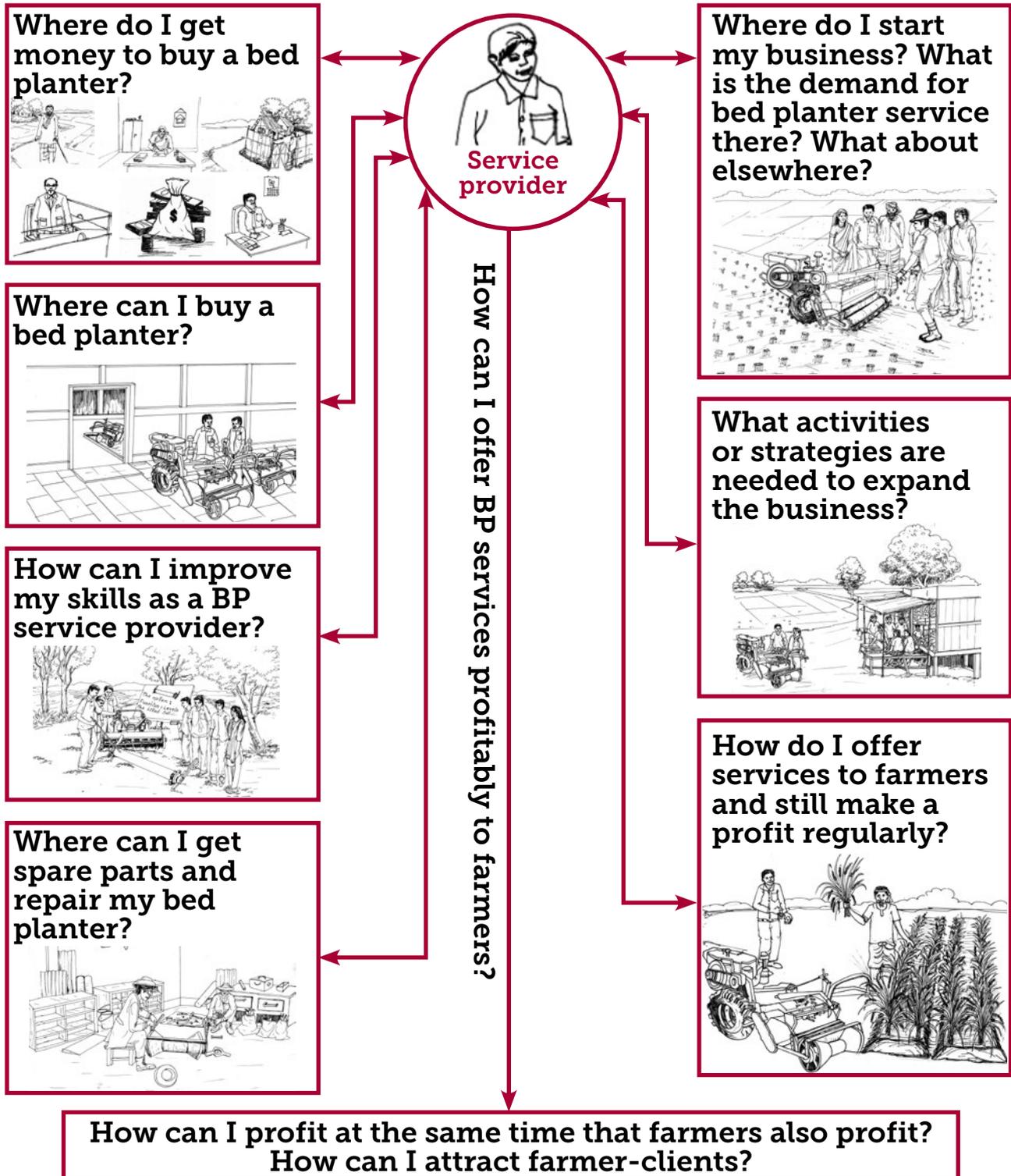




If successful service providers who use a BP are available, ask them some questions!

- ◆ **Why did they start a bed planter business?**
- ◆ **How do they run their business?**
- ◆ **What are the costs and benefits of a bed planter business?**
- ◆ **When did they break even (that is, when their profit equal the cost of a bed planter) – or when do they expect to break even?**
- ◆ **What activities/strategies make their bed planter business profitable?**
- ◆ **What challenges do they face when using the bed planter?**
- ◆ **What benefits do their farmer-clients obtain from the bed planter business?**

Questions to ask before becoming a bed planter service provider (group exercise)



To attract farmer-clients to use your bed planter business, it is essential to advertise and 'sell' the idea of the benefits of a bed planter to farmers in your village and in villages nearby.



Remember the benefits of a bed planter?

Benefits of a bed planter

- ◆ A single pass is all that's needed for tillage, bed forming, seeding and basal fertilizing.
 - ◆ The bed planter reduces fuel, oil and labor costs.
- ◆ Use of machine seed metering can save 10–40% of seed.
 - ◆ Under some circumstances, use of a bed planter can reduce the amount of basal nitrogen fertilizer applied because it is placed into the soil directly by the machine, near the seeds that require nitrogen to grow.
- ◆ Bed planting facilitates intercropping of different crops.
 - ◆ Bed planting facilitates irrigation and drainage of water.
- ◆ Raised beds help minimize salinity and arsenic problems. They also give stronger support to plants and help prevent lodging.



BP Cost-benefit analysis (group exercise)

Traditional tillage + hand sowing and fertilizing + sowing		Tillage + bed forming + sowing + fertilizing with bed planter		
A – (Traditional tillage + sowing cost) Maize: Area = Tillage (Multiple-passes) = Bed forming = Seed sowing = Fertilizing = ----- Total=	B – (capital cost) Bed planter cost = Cost of a two-wheeled tractor (only for new buyers) =	C – Maize (cost of consumables) Fuel + oil cost for tillage+bed =	D – Maize (opportunity cost of service provider's labor) =	E – Maize (bed planter service charge to farmer for till+bed+sow+fertilize) =
	F – SP profit (Maize) = [E- (C+D)]	G – Farmer's savings (Maize)		
H – Wheat (Traditional tillage + sowing cost) Area = Tillage (Multiple-passes) = Bed forming = Seed sowing = Fertilizing = ----- Total=	J – Wheat (cost of consumables) Fuel + oil cost for tillage =	K – Wheat (opportunity cost of SP labor) =	L – Wheat (bed planter service charge to farmer for till + sow + fertilize) =	
	M – SP's profit (Wheat) = [L- (J+K)]	N – Farmer's savings (Wheat) = [H- L]		
I – Mungbean (Traditional tillage + sowing cost) Area = Tillage (multiple-passes) = Bed forming = Seed sowing = Fertilizing = -----	Q – Mungbean (cost of consumables) Fuel + oil cost for tillage =	R – Mungbean (opportunity cost of service provider's labor) =	S – Mungbean (bed planter service charge to farmer for till + sow + fertilize) =	
	T – SP profit (Mungbean) = [S- (Q+R)]	U – Farmer's savings (Mungbean)		
Y – to break even Time (years) required = $\frac{B}{((AG+AH+AI))}$ Area to till + sow + fertilize = $\frac{B}{[(AA \times AD) + (AB \times AE) + (AC \times AF)]}$	V – Area you can till + sow + fertilize in 1 day Maize (AA) = Wheat (AB) = Mungbean (AC) =	W – No. of days to till + sow + fertilize per year Maize (AD) = Wheat (AE) = Mungbean (AF) =		
Z - 1 bigha = 33 decimal = 0.33 acre = 0.134 ha				
X – SP's yearly profit Maize: $AG = [AA \times AD \times (E-(C+D))]$ Wheat: $AH = [AB \times AE \times (L-(J+K))]$ Mungbean: $AI = [AC \times AF \times (S-(Q+R))]$				

The importance of financial record-keeping

Keeping careful records of how much you spend and profit as a bed planter service provider is important for working out how long it takes to break even, and to figure out ways to profit more. Here are some examples you can use:

A) Primary investment

Item	Date	Quantity/No.	Unit price	Own money	Credit
1. Two-wheeled tractor					
2. Bed planter					
3. Transportation					
4. Other					
Total investment =					

B) Example of monthly income-expenditure information

Month (for example, November 2018)

Month	Expenditure (for operating the BP)			Income (as service charge)		
	Item	Quantity/no.	Money paid (in BDT)	Farmer	Area/crop	Money paid (in BDT)
November	Diesel	10 liters	400	Abdul Jalil	0.25 ha (Maize)	800
	Mobile/grease	500 ml	100	Rahimuddin	0.45 ha (Wheat)	1000
	Spare parts	2	60	Mafiz sarder	0.25 ha (Maize)	1200
	Transportation		50	Shafiullah	0.5 ha (Maize)	1600
	Labor	1	300			
	Other					
Total cost =			910	Total income =		4600
Total profit (total income – total cost)						3690
October						
Total cost =				Total income =		
Total profit (total income – total cost)						



Keeping a list of farmer-clients also helps profits

Sample form

List of farmers who will receive bed planter services next month

Farmer's name, address, mobile no.	Crop	Land area	Date (tentative)	Time

Review of key messages (1)

Now that we have learned that service providers use business plans to make the most money possible while keeping farmer-clients satisfied, can you answer the following questions:

- ◆ Where can I develop a market using a bed planter to plant different crops?
 - ◆ What is the demand for bed planting of different crops? How can this demand be increased?
- ◆ What is my capacity to provide bed planting services? What more do I need to know or learn to start and run a bed planting business including line sowing of different crops?
 - ◆ What machinery and equipment do I need for bed planting different crops?



Review of key messages (2)

- ◆ What does it mean to break even on an investment?
 - ◆ How can I provide bed planting services profitably?
- ◆ What profit can I expect to make from my proposed bed planting business?
 - ◆ How much time (in months or years) may be required to break even?
- ◆ What benefits do farmer-clients obtain from using a bed planter?

Session 8

Review of key messages, post-training evaluation and close of training

**Bed planter
one-day training flipchart**



Review of key messages

- ◆ What are the main functional parts of a bed planter?
 - ◆ What are the benefits of using a bed planter for line sowing?
- ◆ What is calibration? How do you do it?
 - ◆ What are the potential major failures or breakdowns of a bed planter? What are their causes? What are the solutions?
- ◆ What is a business plan?
 - ◆ How can you make bed planting services profitable while benefiting farmers at the same time?
- ◆ Why is financial record-keeping important?

Annexes

Annex 1 :

Evaluation questionnaires and answers

Pre-training evaluation questionnaire

Venue:

(to be completed by the facilitator)

Batch:

Date:

Name: _____

Please tick (✓) or circle the correct answer

Total time: 10 minutes

Question	Answer		
1. Which crops can be sown with a bed planter?	wheat, maize, rice, pulses-legumes, jute, vegetable-potato, sesame, sunflower, barley	All types of crops	sugarcane, sorghum
2. What are the advantages of bed planting?	-It saves time, seed and money -It prevents short-term waterlogging of the plants	-Crops are sown or planted in a line -Seedling depth is uniform, which means better germination and crop establishment	both answers are correct
3. What kind of tractor is needed to pull the bed planter?	4-wheeled tractor	2-wheeled tractor	both types of tractor
4. What is the function of a rotavator?	rotates and thus tills the soil	covers seeds in the furrows with soil, then levels and compacts the soil	cleans the soil/mud from the bed former with a scraping action
5. What is the correct distance for mungbean and other pulse crops sown with a bed planter?	20 cm	30 cm	40 cm
6. What is the correct seed sowing depth for mustard, onion, sesame and red amaranth?	2.0 – 2.5 cm	3.0 – 3.5 cm	3.0 – 4.0 cm
7. What are the causes that might break the gear teeth?	-the gear pinion slips and produces noise; -gear engagement is interrupted	-overload of the gear pinion (due to tilling hard soil or tilling too deeply) -insufficient gear oil - ineffective gear sleeves	-the bed planter fails completely and cannot be used
8. What might indicate that the bed former's bearings have jammed or become faulty?	the bed former does not move properly	damage to the bearing seal	the bed former shaft is bent
9. Where do you get the spare parts when the seed on/off clutch does not work or break?	repair it yourself	from the nearest electrician	from a specialist dealer, or a shop dealing in power tillers; can be made in a local workshop
10. What are the operator's safety needs when operating a bed planter in the field?	wear tight clothing and shoes	wear shoes and loose fitting clothing	wear loose fitting clothing and no shoes

Post-training evaluation questionnaire

Venue:
(to be completed by the facilitator)

Batch:

Date:

Name: _____

Please tick (✓) or circle the correct answer **Total time: 10 minutes**

Question	Answer		
1. Which crops can be sown with a bed planter?	wheat, maize, rice, pulses- legumes, jute, vegetable- potato, sesame, sunflower, barley	all types of crops	sugarcane, sorghum
2. What are the advantages of bed planting?	-It saves time, seed and money -It prevents short-term waterlogging of the plants	-crops are sown or planted in a line -seedling depth is uniform, which means better germination and crop establishment	both the answers are correct
3. What kind of tractor is needed to pull the bed planter?	4-wheeled tractor	2-wheeled tractor	Both both types of tractor
4. What is the function of a rotavator?	rotates and thus tills the soil	covers seeds in the furrows with soil, then levels and compacts the soil	cleans the soil/mud from the bed former with a scraping action
5. What is the correct distance for mungbean and other pulse crops being sown by the bed planter?	20 cm	30 cm	40 40 cm
6. What is the correct seed sowing depth for mustard, onion, sesame and red amaranth?	2.0 – 2.5 cm	3.0 – 3.5 cm	3.0 3.0 – 4.0 cm
7. What are the causes that might break the gear teeth?	-the gear pinion slips and produces noise; -gear engagement is interrupted	-overload of the gear pinion (due to tilling hard soil or tilling too deeply) -insufficient gear oil -ineffective gear sleeves	-the bed planter fails completely and cannot be used
8. What might indicate that the bed former's bearings have jammed or become faulty?	the bed former does not move properly	damage to the bearing seal	bed former shaft is bent
9. Where do you get the spare parts when the seed on/off clutch does not work or break?	repair it yourself	from the nearest electrician	It can be from a specialist dealer or shop dealing in power tillers; can be made in a local workshop
10. What are the operator's safety net when operating a bed planter in the field?	wear tight clothing and shoes	wear shoes and loose fitting clothing	wear loose fitting clothing and no shoes
Overall training feedback from the participants			
• Did you understand all the messages delivered by the facilitator(s)?	Yes/No	Partly	Fully
• How do you rate the training?	Not very useful	Useful	Very useful
• Do you feel confident that you could use a bed planter profitably while also saving money for your farmer-clients?	Yes	Partially	Unsure

Answers to questions 1 to 10

- 1. wheat, maize, rice, pulses-legumes, jute, vegetable-potato, sesame, sunflower, barley**
- 2. both answers are correct**
- 3. 2wheel tractor**
- 4. rotates and thus tills the soil**
- 5. 30 cm**
- 6. 2.0 – 2.5 cm**
- 7. overload of the gear pinion (due to tilling hard soil or tilling too deeply), insufficient gear oil, ineffective gear sleeves**
- 8. the bed former does not move properly**
- 9. a specialist dealer or shop dealing in power tillers; can be made in a local workshop**
- 10. wear tight clothing and shoes**

Annex 2: Video resources

Several training videos are included with this compendium of experiential learning and modular training resources. We encourage their use as an audiovisual learning aid to improve the quality of training. The appropriate video of a specific module is indicated in each chapter and module. Descriptions of the videos can be found at the link given below.

<https://www.youtube.com/watch?v=oHEdjjPulq4>

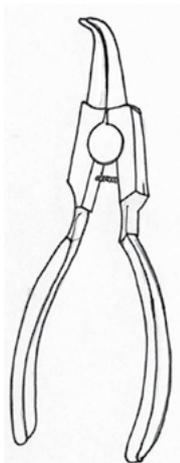
Annex 3: Common tools used to repair bed planters (1)



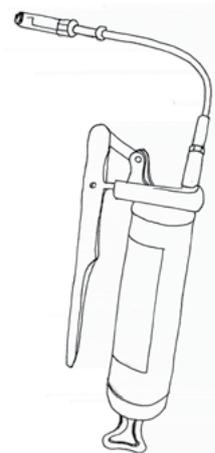
Adjustable wrench: An adjustable tool for gripping hexagonal nuts with an adjusting screw.



Hammer: A hand tool with a heavy head used for striking objects.

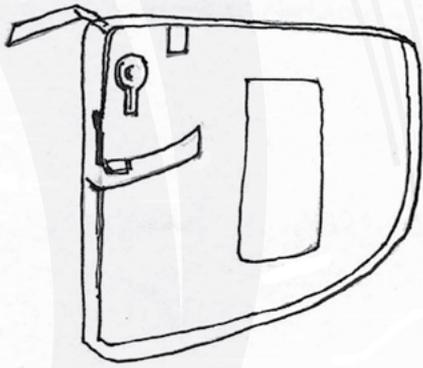


Pliers/cutting pliers: Used to grasp small objects, and to insert/extract or turn them. Pliers often have small cutting blades that can also be used to cut wire or other materials.



Grease gun: A common workshop and garage tool used to apply lubricant to machinery.

Common tools used to repair bed planters (2)



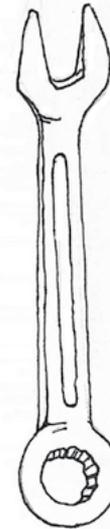
Measuring tape: A flexible scale used as a common measuring tool.



Screwdriver (star/Phillips head): Used to screw in or out screws with a + shape at the head of the screw.



Screwdriver (flat head): used to screw in or out screws with a – shape at the head of the screw.

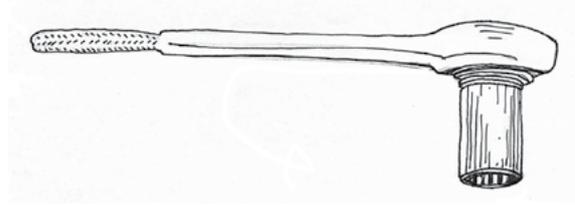


Dull wrench: Used to turn bolt heads to the left or right. This one has two ends, the circular end has the best grip.

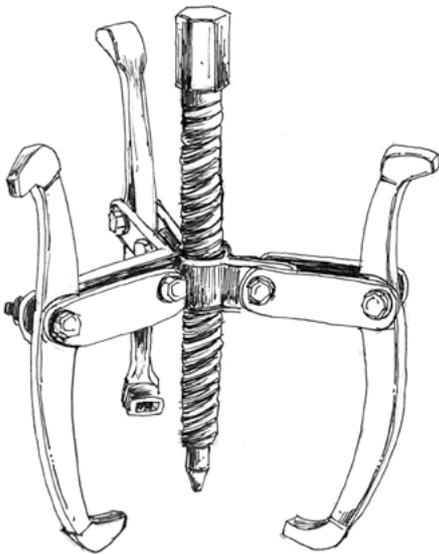
Common tools used to repair bed planters (3)



L-duel wrench: used to grip bolt heads. This wrench has two gripping areas at each end.



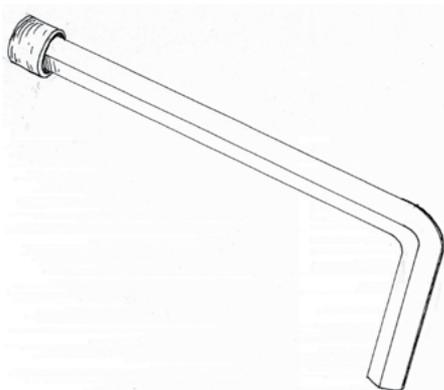
Ratchet: used to turn the head of a bolt in one direction but not the other. It makes it easy to tighten or loosen bolts without having to take off and remove the tool each time (as with pliers or a wrench).



Three-jaw puller: useful for removing components such as gears, pulleys, or a bearing from a shaft.



Files (flat/round): used to grind or file different metal parts to the shape required. They can be useful in difficult repair jobs.



Allen key (hex key) wrench set: a six-edged wrench used to tighten or loosen bolts that have an x shape at the head of the bolt.



This set of training modules focuses on ensuring that local service providers are able to make repairs to bed planters efficiently and correctly. This booklet is designed so that anybody who uses these materials can easily conduct training – even those with a limited background in and understanding of agricultural engineering or machinery. This training uses an experiential and hands-on modular format. It is based on a foundation of experiential and hands-on work, combined with discussion and reflection among participants. This means that although the facilitator is instructed on how to carry out the training and how to present materials, the format in which this is done should be horizontal and participatory, with room for adaptation and modification.

The technical materials included in this document should therefore be seen as a guide to supplement the already in-depth knowledge of the trainee farmers and agricultural machinery service providers. By the conclusion of the training module, participant service providers will be well-equipped to repair bed planters as part of their ongoing agricultural machinery service business. Nonetheless, users of this booklet should carefully read all the instructions on how to implement the training effectively in order to ensure the best learning experience possible for the participants.

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