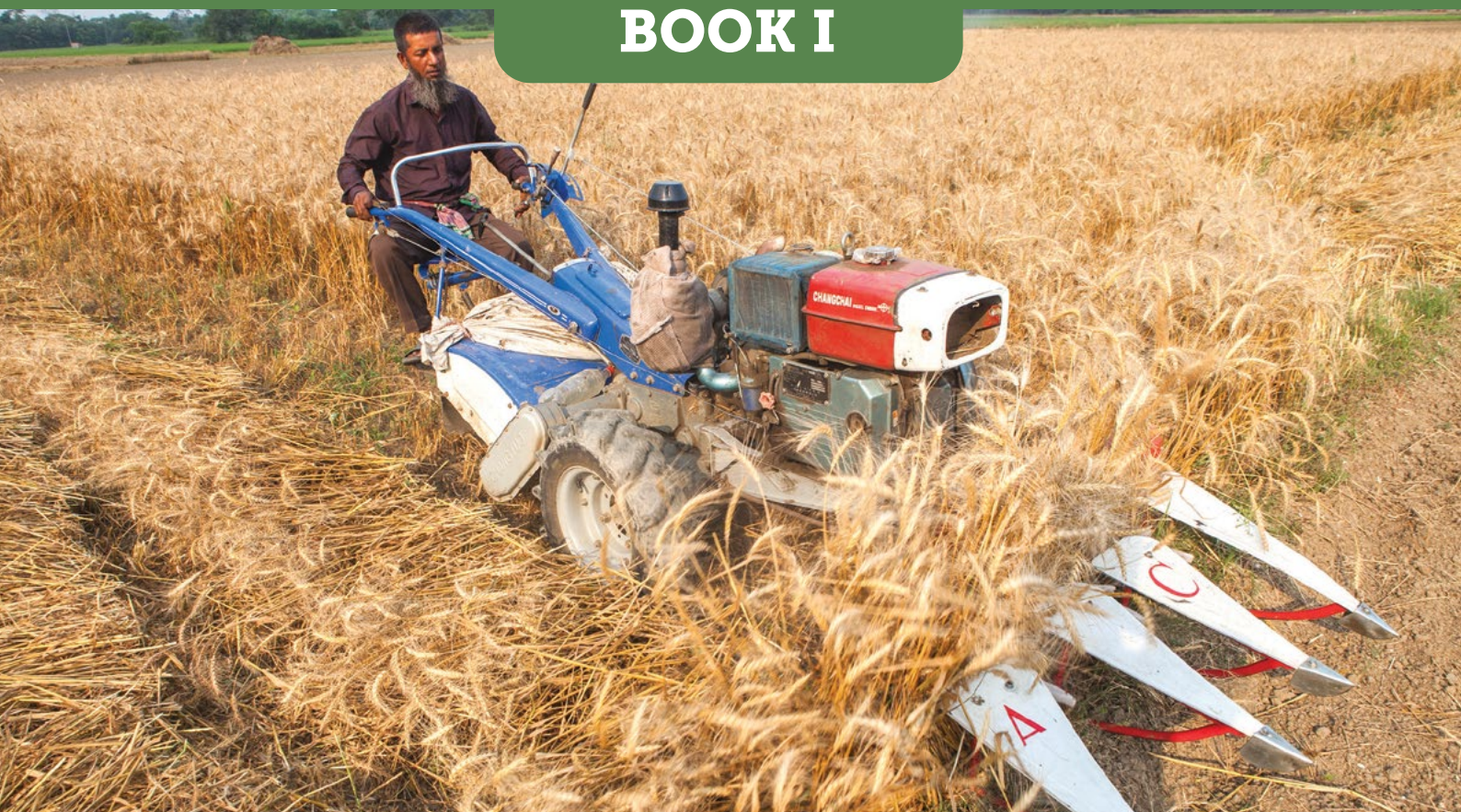


Self-propelled multi-crop reaper for service providers

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

BOOK I



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Cereal Systems Initiative for South Asia

SELF-PROPELLED MULTI-CROP REAPER FOR SERVICE PROVIDERS

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

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The International Maize and Wheat Improvement Center (CIMMYT) is the global leader in publicly-funded maize and wheat research and related farming systems. Headquartered near Mexico City, CIMMYT works with hundreds of partners throughout the developing world to sustainably increase the productivity of maize and wheat cropping systems, thus improving global food security and reducing poverty. CIMMYT is a member of the CGIAR Consortium and leads the CGIAR Research Programs on MAIZE and WHEAT. The Center receives support from national governments, foundations, development banks and other public and private agencies.

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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 that 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.

CSISA-MI emerged out of CSISA's ongoing efforts in the USAID/Bangladesh Mission-funded CSISA expansion project (2010-2015), and during CSISA Phase II. It continues to be strategically aligned with the broader CSISA Phase III program in Bangladesh, and is led by CIMMYT in partnership with [International Development Enterprises \(iDE\)](#). CSISA-MI is a five-year project (July 2013 – September 2018) that focuses on unlocking agricultural productivity through increased adoption of agricultural mechanization technologies and services.



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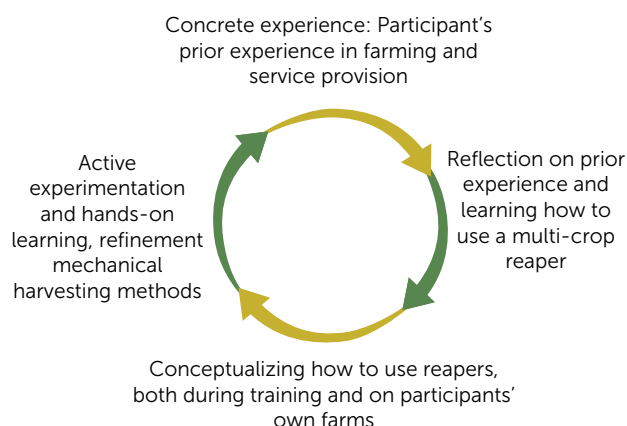
* PowerPoint files of the flip charts in 'ready to present' format can be downloaded from here: <https://bit.ly/2RGoHoW> (for English language) or here: https://csisa.org/wp-content/uploads/sites/2/2019/12/191204_Reaper-SP-AM-smh.pdf (for Bangla language).

Introduction

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 the 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 the participants' input, opinions and ideas, and use these interactively to shape discussion and learning. Each facilitator therefore should think of him/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 in-depth knowledge that the trainee farmers and agricultural machinery service providers already 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 experimenting. After this, the learning cycle is repeated. He further hypothesized that there are generally four types of adult learners and learning styles which should be accommodated. In the production of this manual, we have tried to account for these types of learners, which include those who learn by taking part in demonstration activities and critically thinking about them (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 discussion, reading or visual materials, hands-on experiential and experimental opportunities, and opportunities to watch demonstrations and to learn. This is thus the challenge given to training facilitators who use these modules: 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 (1984) experiential learning cycle as loosely applied in this training module.

At every step of the process, facilitators should therefore work to generate discussion and hands-on learning through practical activities, to provide opportunities to demonstrate the reaper 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 process, and facilitators should practice beforehand with their peers different techniques for eliciting discussion among participants.

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

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 if they use mechanical reapers?", ask "How can mechanical reapers help farmers to harvest 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 asking training participants "what happens if the reaper speed is not correctly set?", ask "if the reaper speed is not correctly set, what are the implications for the reaper jamming or breaking, and how might this cause reduced 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 them 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 to 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; rather, our goal is to engage training participants with the training materials so they can master mechanical reaping by applying a combination of what they already know and what they will learn.
6. **Provide space for under-represented students to speak.** In many training courses, men speak over women or dominate the conversation. Members of a particular economic or religious group or caste may also speak over those who are not part of their group. Facilitators are encouraged to

recognize this, and work to give space to under-represented 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 machine safely and effectively. It is only by calibrating the reaper for different crops that trainees can learn how to benefit from it. 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 do 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 mechanical reapers 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 multi-crop reapers.

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 multi-crop reaper
3. Main parts of a multi-crop reaper and their functions
4. How to use a reaper safely and effectively
5. Troubleshooting and maintenance
6. Starting a reaper service business
7. Review of key points, post-training evaluation and close of training

Instructions are then given to the individuals who are facilitating the training 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, so 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 for each of these presentations. Facilitators should simply follow the flipcharts and use the material presented to initiate discussion and make sure that all technical points are covered. Care should be taken to allow all participants to speak, and to make space for under-represented participants, specifically women, to speak and ask questions.

The pages of this book can 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 here as long as a reliable electricity source can be supplied, and as long as 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 should begin with a pre-training test of participants' knowledge, and end with a post-training test 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 test 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-tests a second time a week or more after the training, to gauge how much participants have retained in terms of information 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 aims of this training are to: (1) familiarize participants with multi-crop reapers and make sure they know how to use them in farmers' fields, (2) increase participants' knowledge of the common causes of reaper failure and breakdown experienced by farmers and service providers, and (3) improve their skills in repairing the machine effectively and efficiently, with emphasis on operating viable rural businesses providing reaper services to farmers.

- By the end of the training, participants should be able to:
- understand and explain the usefulness of self-propelled multi-crop reapers;
- identify the major mechanical parts of reapers and understand their functions;
- operate a reaper efficiently and safely;
- understand the causes of major failures and breakdown associated with reapers, and find solutions for how to fix them; and
- provide harvesting services to farmers efficiently and profitably.

Whom is this training designed for?

Agricultural machinery service providers who (1) have already procured a reaper machine and are providing services to farmers, or (2) are interested in procuring a self-propelled multi-crop reaper and starting up a business that offers these services. If possible, the focus should be on people who already have experience operating machinery such as power tillers, tractors or grain threshers. Gender balance should be maintained when selecting the participants.

Key considerations for training

Key considerations for planning, preparing and organizing are given below. The facilitator(s) should prepare well in advance, reading each section carefully to make sure 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 of trainees should be limited to a maximum of around 10-15 (although this depends on the number of reapers that can be arranged for the training: there needs to be 1 reaper available for each group of roughly 5 participants). When selecting participants, priority should be given to service providers who have procured a reaper (or are interested in doing so) and who are already providing services to the farmers. Ideally, at least 25% of the participants (i.e., 2-3 out of a group of 10, or 4 out of 15) should be women, preferably with leadership capability, who have at least a primary level of education, ideally with business experience, and able to work outside the household and run a rural business. Participants should be contacted well ahead (at least one week) of the training day to allow them to prepare.

Venue

Select the training venue carefully. It should have a classroom or similar facility out of the rain, with sufficient light, air, electricity and adequate space for the number of participants in each session to sit in a group and discuss the flipcharts. The training also includes a practical session: this needs a nearby mature wheat or rice field (with adequate space for operating three or four reaper machines for the harvesting training exercises). The space 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 field technicians and/or extension agents should be selected to facilitate the training, after having passed a training course to familiarize them with (1) the principles of experiential learning, and (2) the training module and sessions.

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. Each session contains different topics, implementation techniques and time allocation. Facilitators therefore 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. They will later move to a 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 reaper machines 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 reaper machine. Arrange any seating so these small groups can sit with one another. Participants will remain in the same group throughout the day, to 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 an emphasis on hands-on and experiential learning. This is why it is important to limit participant numbers relative to how many reapers are available, as each participant should get an opportunity to have hands-on experience operating the machine. The facilitator should utilize techniques designed 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 trainees 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 or 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.

Turn off mobile phones

Use of mobile phones causes distraction 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 training and post-training evaluation at the end are important and necessary 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 including discussion and review, and about demonstration and practical exercise. This is an intensive course; sessions are held in the field and 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). Times should be kept flexible depending on the needs of the participants – some sessions may be faster than allowed for, others may be slower. This is why it is important to remain flexible.

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

Session	Topic	Approximate duration (minutes)
1	Introduction, training objectives and pre-training evaluation	60
2	Introduction to the self-propelled multi-crop reaper	45
3	Main parts of a self-propelled multi-crop reaper and their functions	55
4	How to use the self-propelled multi-crop reaper	130
5	Troubleshooting and maintenance	60
6	Starting a self-propelled multi-crop reaper business	90
7	Review of key points, post-training evaluation and close of training	65

Planning and preparation for the training

Please review the 'Key considerations for training' section, above. Note that the training requires having a mature rice or wheat field to harvest, so advanced preparation of several weeks is required. In addition to the items listed there, prepare for this training by considering the following:

Required training aids

- ✓ multi-media projector and screen for showing video
- ✓ *Multi-crop reaper machines for rapid and low-cost rice and wheat harvesting* DVD² (see Annex 2)
- ✓ printed flipcharts for each session (see *Flipcharts and hand-outs*, pages 31-103)
- ✓ 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 1 printout of the pre-training and post-training evaluation questionnaire for each participant
- ✓ 3 or 4 self-propelled multi-crop reapers (depending on availability but no fewer than one per group of 5 participants)
- ✓ faulty or broken self-propelled multi-crop reaper parts (if available); spare parts (if available)
- ✓ demonstration field with a rice or wheat crop at maturity stage (i.e., ready for harvest)
- ✓ if possible, one successful service self-propelled multi-crop reaper provider to answer participants' questions

² Islam, K.S., Krupnik, T.J., Yasmin, S., Hoque, Md. A., Siddique, R. 2014. Multi-crop reaper machines for rapid and low-cost harvesting. CIMMYT. Dhaka, Bangladesh. 12-minute technical video. In Bangla with English subtitles. Available online: Click [here](#) (in Bangla) and [here](#) (with English subtitles).



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 trainers and the other participants
- state the anticipated objectives and content of the training
- understand the training guidelines for learning and cooperation
- assess their own knowledge level regarding the content of the training

Key messages to convey to participants during this session

1. The training day is composed of seven instructional sessions and takes about eight hours to complete, 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 reaping services to farmers, and to earn more profit at the same time.
3. The training is participatory and fun – trainers and trainees will learn from each other.
4. This training is mostly hands-on. Participants should learn by working with a self-propelled multi-crop reaper and using it to harvest a field, rather than just listening. Active participation works best.
5. Trainees should be attentive during the training and participate actively – either individually or as part of their group – in each task/assignment/exercise given to them.
6. There is a pre-training and post-training evaluation process, which is an essential part of the day.
7. All participants and facilitators should keep their mobile phone 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 materials³:

- the participant registration form
- the flipchart *Session 1: Introduction, training objectives and pre-training evaluation*
- A4 printed copies of the flipchart as a hand-out for each participant
- a notebook, pen and pre-training evaluation questionnaire for each participant
- several sheets of blank poster paper and marker pens, 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 can stimulate more entertaining and rich learning experiences.

³ Note: before Session 1 starts, the facilitator registers participants as they arrive. For this, you need a copy of the participant registration form.



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 group, 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 of the training. 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 they 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 experience in farming 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 or 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.

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

During this introductory session, after group formation, when it is time for participants to introduce themselves, 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 repair major problems with self-propelled multi-crop reapers, which reaper types can be used for different crops, and how we can make money providing harvesting services to farmers. Will we learn how to do that?"

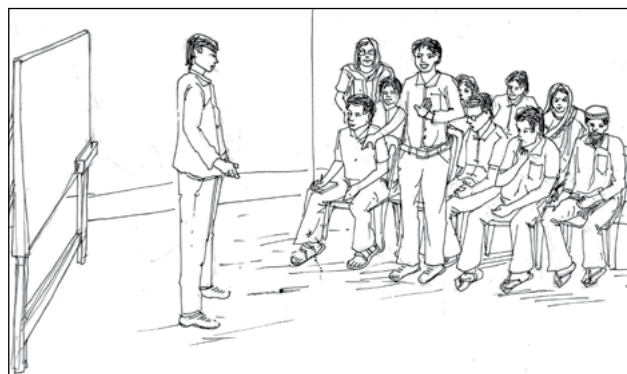
At the end of this session, review the list of expectations that the groups made. Discuss any points not covered in the course and explain whether or not (and if not, why) their expectations will be met.

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 the 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 self-propelled multi-crop reaper

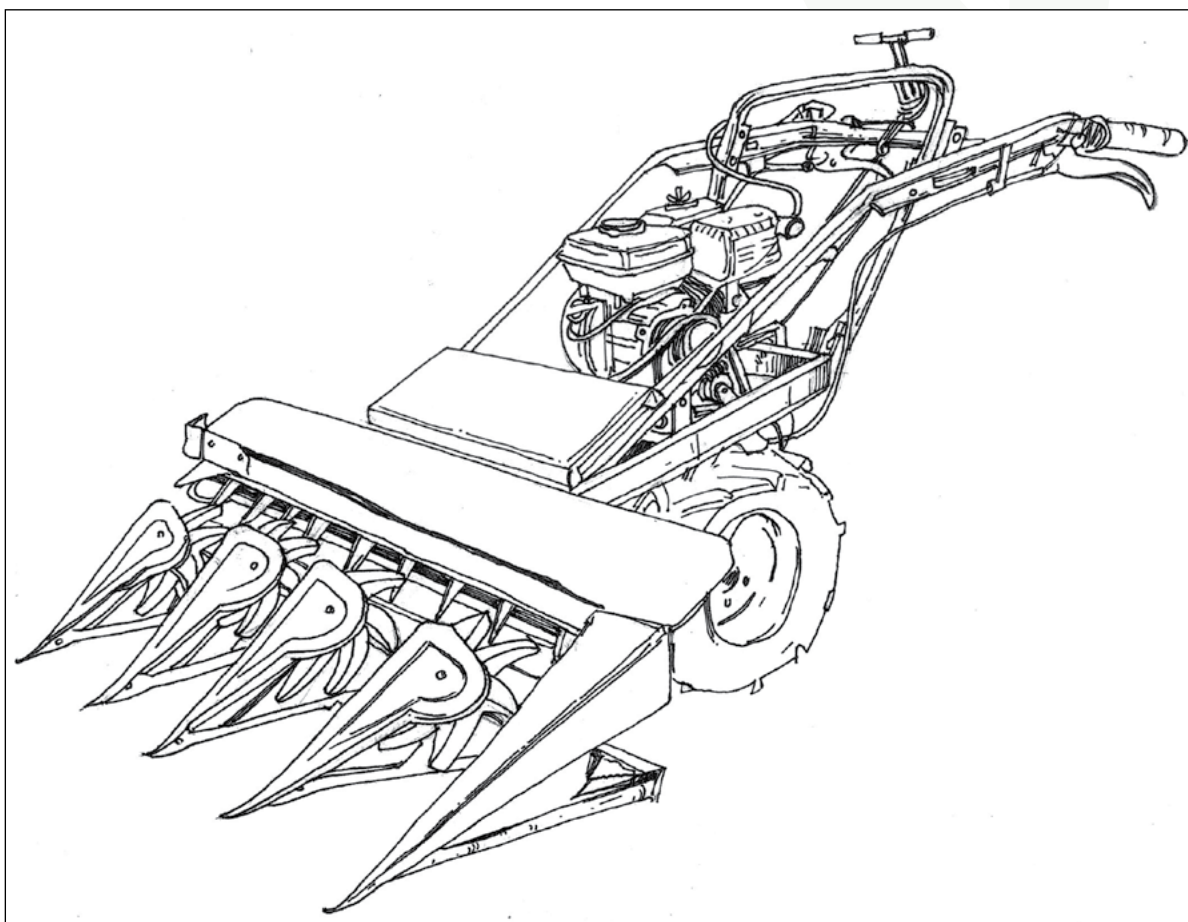
Learning objectives

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

- demonstrate awareness of the different types of reaper machines available on the market
- understand and state the function and usefulness of the different reapers for harvesting different crops
- explain the comparative advantages of the machine over manual harvesting

Key messages to convey to participants throughout this session

1. Self-propelled reapers are suitable for harvesting crops such as rice, wheat, mustard and barley – but this training focuses mainly on rice and wheat.
2. Different types of reapers are available on the market.
3. A single person can operate the machine easily – and it's easy to move from one place to another.



A typical self-propelled multi-crop reaper.

Advantages of the self-propelled multi-crop reaper

1. Self-propelled multi-crop reapers save time and money – but how much they save depends on the crop, and on how much the farmer usually spends on labor for manual harvesting (this is covered in detail in Session 6).
2. Self-propelled multi-crop reapers harvest the crop quickly – which is essential if there's a possibility of rain or storm.
3. A quick harvest allows early sowing of the next crop and so farmers are able to double- or triple-crop the same field multiple times during the year. This enhances the yields in farmers' fields on an annual basis.

Limitations of the self-propelled multi-crop reaper

1. Most reaper types can harvest crops that are partially lodged (that is, up to 60° but not fully lodged).
2. Self-propelled multi-crop reapers can harvest crops in slightly damp soil but not when a lot of moisture is present or where there is standing water, unless cage wheels are provided and the level of standing water is very low.

How to conduct the session on *Introduction to the self-propelled multi-crop reaper*

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

- the flipchart Session 2: *Introduction to the self-propelled multi-crop reaper*
- the video *Multi-crop reaper machines for rapid and low-cost rice and wheat harvesting*
- A4 printed copies of the flipchart as a hand-out for each participant
- blank poster paper/whiteboard, whiteboard stand, dry marker/whiteboard pens

Step 1 – Generate reflection and discussion (35 minutes)

Initiate the session by showing the video *Multi-crop reaper machines for rapid and low-cost rice and wheat harvesting* (see Annex 2).

Before the video, the facilitator should ask participants the questions below. Put them up before the video and suggest the participants make notes during the video, if helpful. After showing the film, use the questions to initiate a discussion to gain an understanding of what the participants have learned from it:

- What is a self-propelled multi-crop reaper?
- What are its specifications?
- What are the advantages of the self-propelled multi-crop reaper? Any disadvantages?
- What crops can be harvested with the self-propelled multi-crop reaper?

Encourage one or two participants to answer each question. Listen carefully and write down any points they are unable to answer properly on poster paper or the whiteboard.

Step 2 – Use the flipcharts to generate discussion and learning (10 minutes)

Next, lead a discussion by using the *Introduction to the multi-crop reaper* flipchart. Make a note of anything that participants find difficult and may not have fully understood, or questions that you are asked and cannot answer. Make a note of anything that you think should be incorporated into the training the next time you run it.

Session 3

Main parts of a self-propelled multi-crop reaper and their functions

Learning objectives

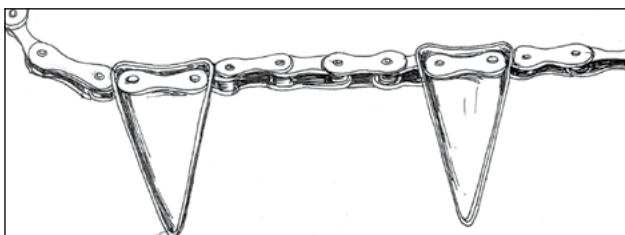
At the end of this session, participants should be able to:

- understand how a self-propelled multi-crop reaper works
- identify the main parts of a self-propelled multi-crop reaper
- understand and state the key functions of the main parts of a self-propelled multi-crop reaper

Key messages to convey to participants during this session

The main parts of a self-propelled multi-crop reaper include:

- splitting cover/divider
- splitting bracket
- pressure spring
- star wheels
- lug chain
- blade/cutter
- blade binder
- cutter bar
- bevel gearbox
- main gearbox
- wheel
- belt and pulley
- throttle lever
- turning clutch
- gear changing lever



Left: Blade/cutter

How to conduct the session on *Main parts of a self-propelled multi-crop reaper and their functions*

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

- the flipchart *Session 3: Main parts of a self-propelled multi-crop reaper and their functions*,
- A4 printed copies of the flipchart as a hand-out for each participant
- blank poster paper/whiteboard, whiteboard stand, dry marker/whiteboard pens
- 3 to 4 self-propelled multi-crop reapers (one per group of 5 participants)

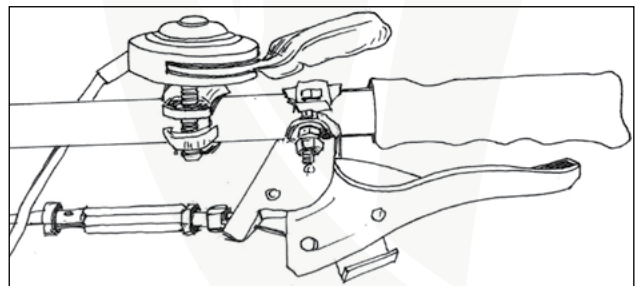
Step 1 – Ice-breaking exercises and brief visit to the field (15 minutes)

Take the participants to a nearby field (selected beforehand and containing a mature rice or wheat crop ready for harvesting) where self-propelled multi-crop reaper machines have been brought to demonstrate rice or wheat harvesting.

Initiate the session using ice-breaking exercises, and through questions and answers.

Ask: Can anybody name the main parts of a self-propelled multi-crop reaper?

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



Right: Brake and speed control handle

Step 2 – Use the flipcharts to generate discussion and learning (20 minutes)

Lead the discussion using the flipchart *Session 3: Main parts of a multi-crop reaper and their functions*, identifying the main parts and explaining their functions. Pay particular attention to those not identified correctly (or at all) by participants.

Quick review (20 minutes)

At the end of the session, bring the participants together in their groups next to the field and ask each group five to ten questions. If a participant can't answer a question, invite other members of their group to answer. If no one in the group can answer a question, pass the question on to the next group.

Name of part	Functions
Splitting cover/divider	Divides, compresses, guides and distributes a regulated quantity of the standing crop towards the cutter blades when the machine moves forward
Splitting bracket	Hitches the splitting cover firmly to the main frame of the machine
Pressure spring	Holds the stems of the crop being harvested upright and exerts pressure on them to enable precise cutting
Star wheels	Guide the harvested crop into the machine, to the gap between the mainframe and the pressure spring so it can be cut efficiently
Lug chain	Helps the rotating star wheels to move in a specific direction. It also throws the harvested crop to one side of the machine
Blade/cutter	Cuts the stems of the crop being reaped
Blade binder	Aligns the upper and lower cutter bars correctly
Cutter bar	Holds the cutting blades (these look like teeth and cut the stems of the crop being reaped)
Bevel gearbox	Transmits power from the engine to the cutter bar
Main gearbox	Transmits power from the engine to the wheels (which move the self-propelled multi-crop reaper forwards and backwards)
Wheels	Enable the self-propelled multi-crop reaper to be moved around
Belt and pulley	Supply power from the engine to the gearbox
Throttle lever	Controls the engine speed
Turning clutch	Turns the self-propelled multi-crop reaper to the left and right
Gear lever	Used to change gears when turning the self-propelled multi-crop reaper to the left or right

Session 4

How to use a self-propelled multi-crop reaper safely and effectively

Learning objectives

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

- check the engine fuel and water supply, check the belt tension, and verify the chain and any other components are working properly
- start the self-propelled multi-crop reaper machine and operate it in the field
- use the self-propelled multi-crop reaper safely

Key messages to convey to participants during this session

1. Do not wear loose-fitting clothing when operating a self-propelled multi-crop reaper machine.
2. Never use the self-propelled multi-crop reaper around children – they can get hurt easily.
3. Be sure that the quantity of fuel and engine oil is sufficient to finish reaping the field.
4. Keep the gearbox parallel to the ground when measuring the levels of lubricant.

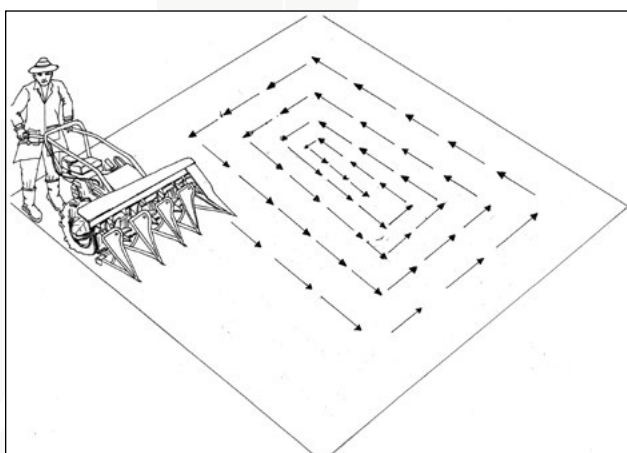


Never operate the self-propelled multi-crop reaper around children – they can be easily hurt. This reaper operator needs to stop his machine and ask the children to move out of the way.



Always make sure there are at least two meters between the machine and the nearest bystander. This smart reaper operator has asked interested villagers to stand outside the crop field.

- Use lubricant in the transmission and bevel gearbox.
- Check the star wheels, blades, brackets and lug chain before each use, and remove any straw and other materials that can jam the machine.
- It is better not to harvest if the crop is damp or there is dew on the crop – wait until it is as dry as possible. Wet crops tend to jam the self-propelled multi-crop reaper and can damage it.
- Do not run the machine if the soil is too wet or if there is standing water in the field.
- Begin by reaping around the edges of the field and then move inwards to the center in a spiral.
- When using the self-propelled multi-crop reaper, regularly check for straw jams in the splitting bracket and splitting cover, and clear them away.



How to conduct the session on *How to use a self-propelled multi-crop reaper safely and effectively*

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

- the flipchart *Session 4: How to use a self-propelled multi-crop reaper safely and effectively*
- A4 printed copies of the flipchart as a hand-out for each participant
- blank poster paper/whiteboard, whiteboard stand, dry marker/whiteboard pens
- an uncultivated field to demonstrate the self-propelled multi-crop reaper and for participants to practice starting the machine
- land with harvestable rice or wheat

- 3 to 4 self-propelled multi-crop reaper machines (one per group of 5)
- an experienced machine operator (if available) to demonstrate use of the machine

If an experienced operator is not available, the training facilitator should have sufficient understanding and ability to operate the machinery.

Step 1 – Introduction to the practice session (10 minutes)

The facilitator begins Session 4 in the field immediately after closing Session 3, assisted by an experienced operator/mechanic. Initiate the session through a 'question-and-answer' session.

Ask: How many of you can operate a self-propelled multi-crop reaper machine?

Listen to the responses and **ask:** What are the important considerations when starting and running a self-propelled multi-crop reaper?

Encourage one or two participants to answer the questions. Note the answers on poster paper/whiteboard if it helps facilitate discussion.

Step 2 – Operating a self-propelled multi-crop reaper (practical exercise) (2 hours)



Loose-fitting clothing can get caught in the moving parts of the machine.

The experienced operator/mechanic describes and demonstrates how to start up the self-propelled multi-crop reaper and run it safely, focusing on the essential things to be done before switching it on:

- Do not wear loose-fitting clothing – if it gets caught in the machine, you could be injured or even killed.

- Check the engine fuel and oil.
- Check the belt tension – make sure the belts are tight.
- Check that the chain, shaft and blades are well-lubricated.
- Check that the transmission gearbox and bevel gearbox are lubricated.

The facilitator or experienced operator/mechanic then starts the self-propelled multi-crop reaper and runs it for enough time to demonstrate the following:

- starting the self-propelled multi-crop reaper
- controlling its position in the field
- moving the self-propelled multi-crop reaper forwards smoothly
- moving the self-propelled multi-crop reaper backwards smoothly
- operating the cutter bar
- reaping rice or wheat

Each participant should then practice operating the self-propelled multi-crop reaper, making sure to:

- start reaping the crop around the edges of the field and move inwards in concentric straight lines
- clean and remove straw from splitting bracket, split cover, and star wheel (or other parts) if a jam occurs

Make sure that each participant takes a turn at starting up and operating the self-propelled multi-crop reaper, first on uncultivated land and then in a field of rice or wheat that is ready for harvesting. If available, an experienced operator should guide them; otherwise the training facilitator should do so. Monitor the activity to make sure that each participant (particularly the less-skilled ones) has a chance to run the machine for at least one successful pass across the field, and allow the experienced operator to point out any areas of improvement.

Session 5

Troubleshooting and maintenance

Learning objectives

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

- understand and explain common causes of failure and breakdown of the self-propelled multi-crop reaper
- make basic repairs and adjustments, and solve different operational problems
- ensure good reaper maintenance

Key messages to convey to participants during this session

1. The star wheel can break if it's mishandled, overloaded due to excessive use or used on excessively wet crops (crops on which dew drops can be seen, or that are immature), or because of equipment failure including corrosion, cracks or damage caused by foreign objects.
2. The cutting bar (also called a 'flat bar') which the cutting blades are riveted to can break due to jamming, material failure or sub-optimal clearance between the blade and ledger plate.
3. The cutting blade can break if hard objects (bamboo, wood or stones) come into contact with the teeth, the cutter bar jams, or the problems listed in points 1 and 2 occur.
4. The cutter bar can stop moving to the right and left if the chain in the transmission gearbox snaps. This will cause the complete breakdown of the self-propelled multi-crop reaper and render it inoperable.
5. The lug spring and associated wires can bend and alter the gap between the lug spring/wire and the lug chain cover, resulting in inefficient reaping. This occurs because of mishandling, loosening or aging of the nut bolts, or loosening of the spring.

How to conduct the session on *Troubleshooting and maintenance*

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

- the flipchart *Session 5: Troubleshooting and maintenance*
- A4 printed copies of the flipchart as a hand-out for each participant
- blank poster paper/whiteboard, whiteboard stand, dry marker/whiteboard pens
- faulty or broken self-propelled multi-crop reaper parts (we strongly suggest having these broken parts available for the training, although if they are not available the training can still continue without them)
- spare parts (the same applies here as to broken self-propelled multi-crop reaper parts)
- an experienced mechanic (if available)

Step 1 – Questions on self-propelled multi-crop reaper performance (20 minutes)

Begin Session 5 in the field immediately after Session 4, assisted by an experienced mechanic. Start with a question-and-answer session to warm up the participants.

Ask: What are the common failures/breakdowns of a self-propelled multi-crop reaper?

Allow one or two participants to share their experiences with self-propelled multi-crop reaper breakdowns or other malfunctioning problems. If they have not operated a self-propelled multi-crop reaper before, ask what problems they might expect. List important points on poster paper/whiteboard.

Next, discuss the most common types of failure and breakdown, and their causes and solutions, using the Session 5 flipchart. Cover the following points:

- the star wheel breaks
- the cutter bar breaks
- the cutting blade breaks
- the lug spring bends, altering the gap between the lug spring and lug chain guard
- the self-propelled multi-crop reaper does not cut crop while in operation
- the cut straw does not fall in a systematic or regular pattern

The flipchart material also reviews the importance of the maintenance and proper storage of the self-propelled multi-crop reaper, with emphasis on the points below:

- Remove and clean straw and other particles from blade, chain and shaft before each use and when putting it away.
- Apply lubricant regularly and properly to the blade, chain and shaft.
- Check the oil level in the gearbox and keep the gearbox parallel to the ground.
- If planning to store the machine for a long period (longer than a few days), keep it in the shade, and in a clean and dry place where dust and other materials will not come into contact with it.
- Store the self-propelled multi-crop reaper in a place out of the reach of children.

Step 2 – Demonstration of faulty self-propelled multi-crop reaper parts (40 minutes)

If available, an experienced mechanic should demonstrate faulty parts of the machine and the way to repair/replace them. He/she should also demonstrate/discuss maintenance and storage of the machine. If a mechanic is not available, engage an experienced local service provider. If neither is available, the facilitator should complete this part of the training.

Step 3 – Quick review (20 minutes)

At the end of Session 5, conduct a quick review of sessions 3 and 4, using the same procedure outlined above for sessions 1 and 2 at the end of Session 2. After completing Session 5, take the participants back to the training venue.

Session 6

Starting a self-propelled multi-crop reaper service business



Self-propelled multi-crop reapers can be profitable for service providers and farmers.

Learning objectives

At the end of the session, participants should know how to:

- explain the meaning of 'business' and 'business plan'
- work out how much it costs to operate a self-propelled multi-crop reaper for various crops
- develop a smart business plan so that both they and their clients can profit
- provide a self-propelled multi-crop reaper service to farmers efficiently and profitably
- record financial information (costs and benefits) and do a rough analysis of the profitability of providing a self-propelled multi-crop reaper service

Key messages to convey to participants during this session

Service providers use business plans to make the most money possible while keeping farmer-clients satisfied. Participants should be able to answer the following questions. If they have any trouble, the facilitator should assist them.

1. Where can you find farmer-clients who want you to use the machine to reap rice and wheat?
2. How much do farmers currently pay for harvesting by hand?
3. Do farmers pay additional costs for binding and carrying?
4. How much should a self-propelled multi-crop reaper service provider charge to make a profit, while also making sure the farmer profits too?
5. What does it mean to 'break even' on an investment? (Note: breaking even means you have made back through profits all the money you invested in a machine – in this case, a self-propelled multi-crop reaper).
6. What is my capacity to provide a self-propelled multi-crop reaping service? What more do I need to know or learn to start and run a self-propelled multi-crop reaper business?
7. What machinery and equipment do I need for my proposed self-propelled multi-crop reaper business?

How to conduct the session on Starting a self-propelled multi-crop reaper service business

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

- the flipchart *Session 6: Starting a self-propelled multi-crop reaper service business*
- A4 printed copies of the flipchart as a hand-out for each participant
- blank poster paper/whiteboard, whiteboard stand, dry marker/whiteboard pens
- a service provider who is already successfully marketing self-propelled multi-crop reaper services (if available)

Step 1 – Participants ask a self-propelled multi-crop reaper service provider about running a business (15 minutes)

If available, introduce a successful agricultural machinery service provider who uses the self-propelled multi-crop reaper to make money serving farmers, and ask him/her to share their reaper business experience, focusing on the following points:

- Why did you decide to start a self-propelled multi-crop reaper business?
- How are you running your business?
- What are the costs and benefits of the business?
- When did you break even on the cost of investing in the self-propelled multi-crop reaper (that is, when did the income gained equal the purchase cost)?
- Which activities/strategies make your self-propelled multi-crop reaper business profitable?
- What benefits do your farmer-clients obtain from using the service?

Encourage participants to interact with the service provider and discuss use of the self-propelled multi-crop reaper as a business.

If a successful service provider is not available, the facilitator should present a generic business model and cost-benefit analysis based on a successful service provider's practice, or on general material using the flipchart.

The next step is to work with participants to develop their own successful business model and cost-benefit analysis of self-propelled multi-crop reaper use, based on: (1) a successful service provider, or if not available, (2) the general material in the flipchart *Session 6: Starting a self-propelled multi-crop reaper service business*.

Step 2 – Participants work out the costs of running a self-propelled multi-crop reaper business (group exercise) (60 minutes)

Briefly discuss the following points, using the flipchart *Session 6: Starting a self-propelled multi-crop reaper service business*:

- What do we mean by a 'business'?
- What is a business plan?

The facilitator leads a participatory group exercise (participants should stay in the groups they formed at the beginning of the training) to develop a business plan and cost-benefit analysis. Use the flipcharts to calculate how to make a profit from the self-propelled multi-crop reaper while at the same time benefiting farmers.

Facilitate the discussion using the questions below. The training participants should discuss in their own groups and agree on an answer that makes sense to the group. Note down the decisions agreed to by all the groups and enter them in the respective boxes on the flipcharts. When all the boxes are filled out, the resulting information will give the participants a version of a self-propelled multi-crop reaper service business plan/model and its related costs and benefits.

Please remember that this model is likely to change in different locations and for different crops, machines, and so on. The goal is for participants to think carefully through the different aspects of running a service provision business in ways that benefit both themselves and farmers alike.

a. What is the cost of reaping a crop (e.g., rice or wheat) using the traditional method of harvesting by hand?

These exercises focus on reaping rice and wheat. First, participant groups should decide the 'unit area of land' based on which costs for reaping and harvesting services will be determined (this will be used for other calculations later on). For example, ask participants to agree upon a percentage of a hectare, or area in m² or local land unit to consider for this exercise. It is probably best to use the average unit size of a field for farmers in their area.

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

1. What is the labor cost of harvesting rice (or wheat) by hand?
2. Do farmers pay additional money for binding and carrying? If so, how much?
3. How do farmers determine the cost? Do they base it on time? On the size of the land? Or on the number of laborers?
4. What is the total cost of harvesting, binding and carrying per unit area of land (decimal/acre/hectare)?

Fill in Box A on the Session 6 flipchart with the sum of the costs agreed upon by three groups. Ask the same questions again for a wheat crop that's ready for harvesting and complete Box H.

b. How much does a self-propelled multi-crop reaper cost?

The facilitator writes down the purchase price of a self-propelled multi-crop reaper (as agreed upon by all the groups) in Box B, based on the local market price.

c. What are the costs to a service provider operating the self-propelled multi-crop reaper for rice or wheat?

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

1. How much oil and fuel would be needed to harvest the unit of land area for rice or wheat agreed upon by the participants?
2. How much time will it take for a service provider to harvest rice or wheat with a self-propelled multi-crop reaper on the same unit of land area? 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 for the value of the service providers' labor. However, if this is too complicated for the participants to understand (because it is an abstract economic concept), the facilitator can choose to simply value their time as zero (meaning no monetary expenditure will be counted for the service provider's labor and time).
3. Does oil and fuel costs and time requirement for harvesting differ for wheat compared to rice? How much?

Note down the oil-fuel cost + value of time for binding and reaping (if applicable) for harvesting one unit of land area (in Box C for rice and/or Box I for wheat).

If binding and carrying are taken into consideration, then the opportunity cost of labor can also be noted in Box D (for rice) and/or Box J (for wheat), based on the consensus of the three groups.

d. How much can a service provider charge for harvesting rice or wheat with a self-propelled multi-crop reaper?

Guide the participants to work out an amount that brings them profit, but which ideally is lower than the cost of traditional hand-harvesting the same area of land. *This is an essential point: the low cost of the self-propelled multi-crop reaper service, as well as the speed at which you can reap a field with the machine, are what will attract farmers to pay for self-propelled multi-crop reaper harvesting.*

Note (in Box E for rice and Box K for wheat) the service provider service charge per unit area, as agreed upon by three groups.

Note: it is also beneficial to discuss that the use of the self-propelled multi-crop reaper generally saves time for farmers compared to harvesting by hand. Self-propelled multi-crop reaper harvesting allows the early sowing of the following crop and can also save a mature crop from natural hazards.

e. How much does the service provider profit per unit area of harvested rice or wheat?

Calculate this by subtracting the 'oil-fuel cost' (plus the cost of binding and carrying opportunity costs, if applicable) per unit of land area from the money farmers pay as a service charge, as shown below (each letter corresponds to a box on the flipchart):

$$\text{Service provider profit per unit of land chosen} = [E - (C+D)]$$

Next, write the 'service provider's profit from unit of land chosen' in Box F as arrived at by consensus of the groups. Similarly, if wheat is considered, the service provider's profit per land unit is calculated as:

$$\text{Service provider profit per unit of land chosen} = [K - (I+J)]$$

f. How much does a farmer save per unit area of rice (or wheat) harvested with a self-propelled multi-crop reaper?

Work through this question as follows:

Subtract the money the farmer pays as service charge (for the chosen unit area) from the cost of harvesting by hand. The resulting value is the savings that farmers gain from using the self-propelled multi-crop reaper:

$$\text{Savings for a farmer using the reaper to harvest rice} = [A - E]$$

Write the savings in the correct place in Box G. For wheat, write the farmer's savings in Box M using this equation:

$$\text{Savings for a farmer using the reaper to harvest wheat} = [H - K]$$

Note again: care should be taken to consider the oil-fuel cost and labor cost: these may vary between wheat and rice.

g. How much land area (in units chosen collectively by the participants) do you think you can harvest with a self-propelled multi-crop reaper in a single day?

Encourage participants to agree on: (1) the total area (the sum of the area of all the fields harvested in a day) of rice or wheat that one can harvest with a self-propelled multi-crop reaper in one day, and (2) how many days of rice or wheat harvesting are possible in a single year. Next, note the area for each of the crops in the appropriate place on the flipchart -i.e., respectively, in Box N (Q for rice and R for wheat) and how much can be reaped in a single day, and in Box O (S for rice and T for wheat), how many days it is possible to harvest rice or wheat in a single year.

h. How much profit can a service provider make from harvesting rice and wheat with a self-propelled reaper in one year?

Multiply the land area of wheat that can be harvested in one day, and the number of days that a self-propelled multi-crop reaper service can be provided for wheat in one year, by the profit per chosen land area. Repeat these steps for rice. When combined (if wheat and rice are grown in the same areas in the same year), the result is the approximate annual profit from harvesting rice and wheat with a self-propelled multi-crop reaper (note: this may vary slightly if the service provider charges different farmers differently for their fields or if the field size varies; the point of this exercise is to give a general idea of the profitability potential). Use the formula below, and the calculations on the flipchart you have already completed. Write the result for rice in Box U.

$$\text{Potential annual profit from reaper harvesting of rice} = [Q \times S \times (E - (C + D))]$$

Similarly, to calculate the annual profit from wheat, use the following formula and write the result in Box U:

$$\text{Potential annual profit from reaper harvesting of wheat} = [S \times T \times (K - (I + J))]$$

In this way, participants in the three groups will arrive at a consensus about the total number of days a self-propelled multi-crop reaper service can be provided (for rice and wheat) in one year and the total yearly profit. Make a note of these figures.

i. "Breaking even" is the point at which a service provider has accumulated profits that equal the cost of investing in a self-propelled multi-crop reaper machine. How many days or how much area must be harvested by the reaper to break even?

Dividing the cost of purchasing the self-propelled multi-crop reaper by the total annual profit earned from self-propelled multi-crop reaper service sales to farmers will result in the time required to break-even. This can be calculated using the formula below; put the result in Box P.

$$\text{Time estimated to break even on investment in the reaper} = B / ((V + W))$$

Write the 'estimated time to break even' in the appropriate place on the flipchart based on the consensus of the three groups.

Note: this calculation only provides the estimated time needed to break even, considering the total profit for the whole year (all crops reaped within a year).

But how much area is required to harvest using the self-propelled multi-crop reaper to break even? To answer this question, use the following formula, replacing the letters with values decided by the groups, and write the result in Box P.

$$\text{Estimated total land area required to harvest using the reaper to break even} = \frac{B}{((S \times (E - (C + D))) + (T \times (K - (I + J))))}$$

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

If it takes too long to break even, ask participants how they could change their business models to profit more while still keeping the service charge lower than that of manual harvesting. The goal is to find ways for participants to make a profit quickly, while at the same time giving farmers the opportunity to harvest their crop at a reduced cost.

j. For more advanced participants, start a discussion about the cost of interest on the credit used to purchase the machine, and the time needed to repay these loans. Use additional calculations to determine how soon the loan and interest can be repaid.

k. Finally, ask each group to discuss whether there are any differences between the observed, real-world self-propelled multi-crop reaper business and the models they have developed, and suggest strategies/activities for a profitable self-propelled multi-crop reaper service business.

Each group should then present their assignment on a sheet of poster paper. If time does not permit, a single business model analysis can be presented.

Step 3 – Discussion (10 minutes)

Discuss the following points and record any important information/data about a self-propelled multi-crop reaper service business on the relevant Session 6 flipchart:

- primary investment
- monthly expenditure on and income from a self-propelled multi-crop reaper
- list of potential farmers to whom a self-propelled multi-crop reaper service could be provided
- (for advanced groups) cost of a loan, interest and any other considerations

Step 4 – Review of the session's key messages (5 minutes)

Review this session's key messages using the last page of the flipchart (*Review of key messages*). These flipcharts are self-explanatory and the facilitators can simply review each page in turn, continually emphasizing the importance of keeping detailed business records.

Session 7

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:

- the flipchart *Session 7: Review of key messages, post-training evaluation and close of training*
- the post-training evaluation questionnaire, hand-outs or other materials (e.g., machinery dealers' leaflets, and brochures from any relevant companies working in the country where the training is taking place)
- awards or certificates (should the facilitator wish to present them)
- a guest of honor could also be invited to attend

Step 1 – Question-and-answer session to review key points of the training (20 minutes)

The facilitator reviews each session by asking participants questions about the key messages, to be sure these have been understood.

These questions may be asked:

- What are the advantages of the self-propelled multi-crop reaper over conventional harvesting by hand?
- What are the main parts of a self-propelled multi-crop reaper?
- What are the important considerations for starting a self-propelled multi-crop reaper?
- What are the key safety points you need to remember when using a self-propelled multi-crop reaper?
- What are the most common causes of failure and breakdown of the self-propelled multi-crop reaper, and what are the solutions?

- What is a business plan?
- What is the minimum business volume needed to make a self-propelled multi-crop reaper business profitable?
- How can you profitably operate a self-propelled multi-crop reaper business while at the same time making sure that the farmer-clients profit?

Refer back to the 'Participant expectations' recorded by participants at the beginning of the training, to determine whether these expectations have been fulfilled. If not, try to fulfill them through additional discussion.

Step 2 – Complete the post-training evaluation questionnaire (30 minutes)

Distribute the post-evaluation questionnaire and allow about fifteen minutes to complete it. Calculate the scores, and check them against their pre-training evaluation. Give both pre- and post-training evaluations back to the participants for review, and record each participant's score in a training or project logbook. Take time to discuss any common errors with participants and to correct any misconceptions before closing the training.

Step 3 – Distribute additional materials (5 minutes)

Distribute hand-outs, leaflets, brochures and any other materials among the participants. Any awards or certifications can also be distributed at this time.

Step 4 – Close the training (10 minutes)

Thank participants and guests. Give positive feedback about the commitment and performance of the participants. Make sure participants have contact information for trainers and hand-outs. Close the training.



Flipcharts and handout materials*

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

Session 1

Introduction, training objectives and pre-training evaluation

**Self-propelled multi-crop reaper
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 to speak for the group.
- ◆ Take notes.

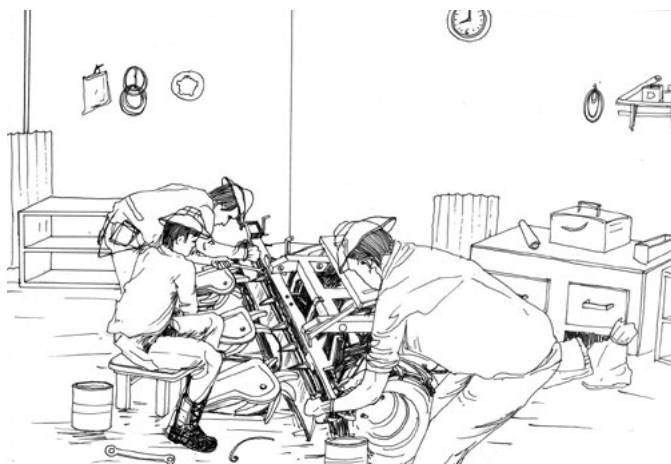
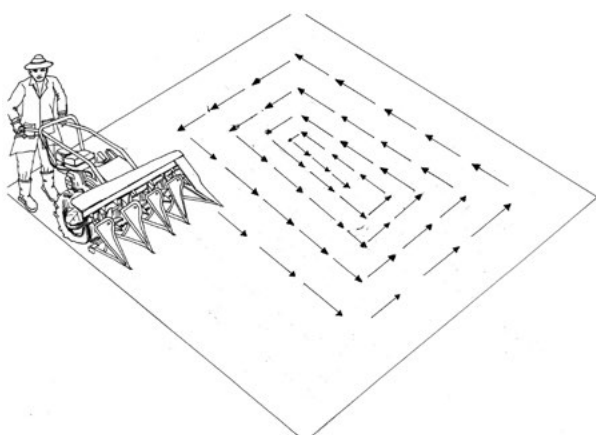
Today's sessions

- 1. Introduction and training objectives.**
- 2. Introduction to the self-propelled multi-crop reaper.**
- 3. Main parts of a self-propelled multi-crop reaper.**
- 4. How to use a self-propelled multi-crop reaper safely and efficiently.**
- 5. Maintenance and troubleshooting.**
- 6. Starting a self-propelled multi-crop reaper service business – how to profit from helping farmers to harvest their crops.**
- 7. 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 up.
 - ◆ Learn by experience: try operating the self-propelled multi-crop reaper yourself.
- ◆ Discuss each topic with your group.
 - ◆ Speak up when the facilitator asks questions – and ask questions yourself.



Session 2

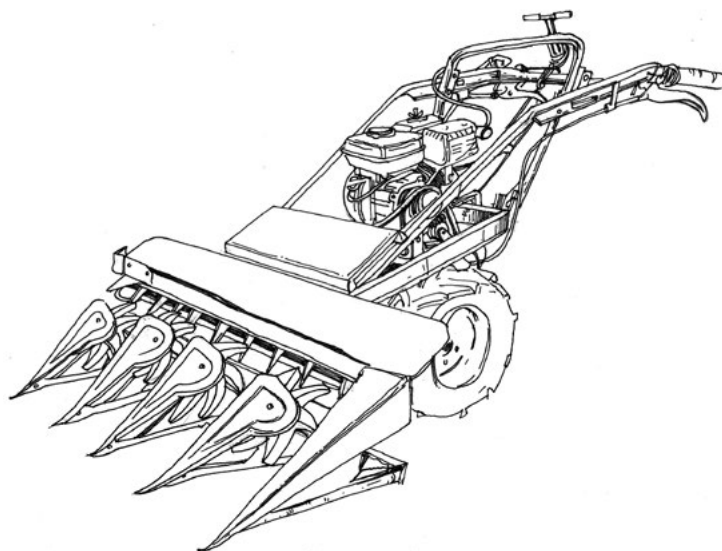
Introduction to the self-propelled multi-crop reaper

Self-propelled multi-crop reaper
one-day training flipchart



What is a self-propelled multi-crop reaper? (1)

Watch the video '*Multi-crop reaper machines for rapid and efficient rice and wheat harvesting*' and get ready to answer these questions.



- ◆ What is a self-propelled multi-crop reaper?
 - ◆ What are its specifications?
- ◆ What are its advantages and limitations?
 - ◆ What crops can it harvest?

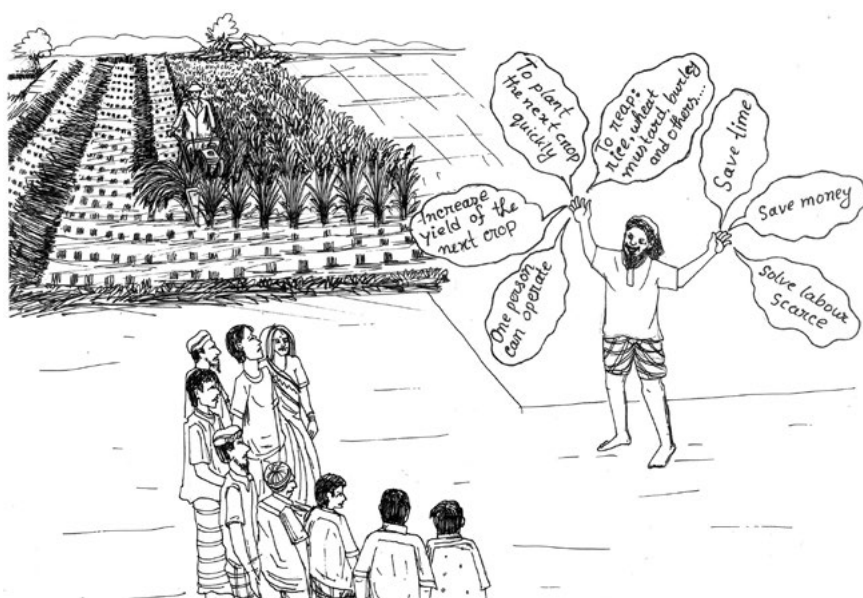
What is a self-propelled multi-crop reaper? (2)

A self-propelled multi-crop reaper:

- ◆ **is a mechanized reaping machine that replaces manual harvesting.**
 - ◆ **is fueled by gasoline or diesel.**
- ◆ **harvests rice, wheat, mustard, barley and other crops (this training focuses on rice and wheat).**
 - ◆ **only needs one person to operate it and move it around.**

Most self-propelled multi-crop reapers can harvest partially lodged crops.

Advantages of the self-propelled multi-crop reaper (1)



◆ Saves money and time.



Telling farmers
the good news:
Harvesting with a self-
propelled multi-crop
reaper costs less and
you need less time!

When labor is scarce, prices go up:
farmers are looking for low-cost
alternatives for rapid harvesting.

Advantages of a self-propelled multi-crop reaper (2)

Using a self-propelled multi-crop reaper:

- ◆ **is much quicker than harvesting by hand.**
- ◆ **is much less expensive and difficult than harvesting by hand.**
- ◆ **helps farmers plant the next crop quickly.**
- ◆ **allows reaped crops to be easily picked up and removed from the field.**

Some self-propelled multi-crop reapers cut the crop – and bind it too!

Which crops can be harvested with a self-propelled multi-crop reaper?

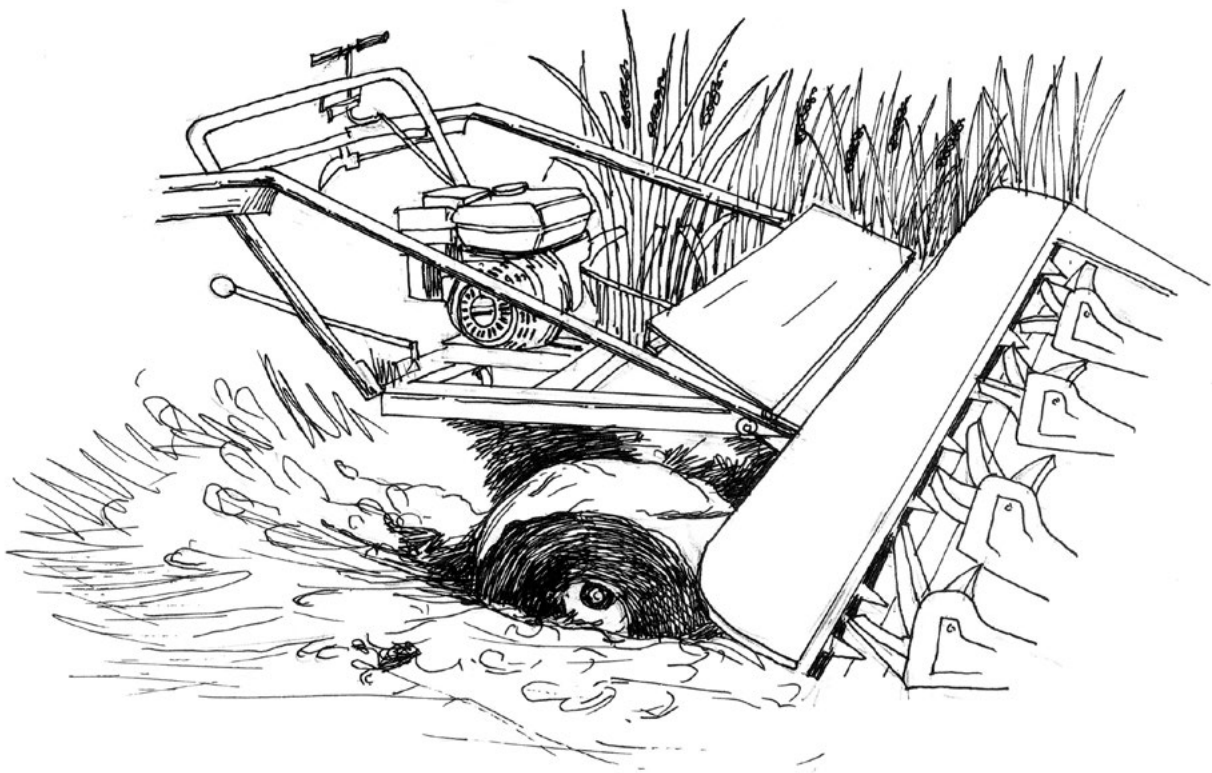
A self-propelled multi-crop reaper is used to harvest:

- ◆ mainly rice and wheat.
- ◆ other crops, including mustard, barley, oats and teff.



Any limitations?

The self-propelled multi-crop reaper has a few limitations that need to be considered:



- ◆ It can only harvest crops lodged up to 60°.
- ◆ It is difficult to use in fields with excessively moist clay soil or standing water.

Remember - this training is participatory!

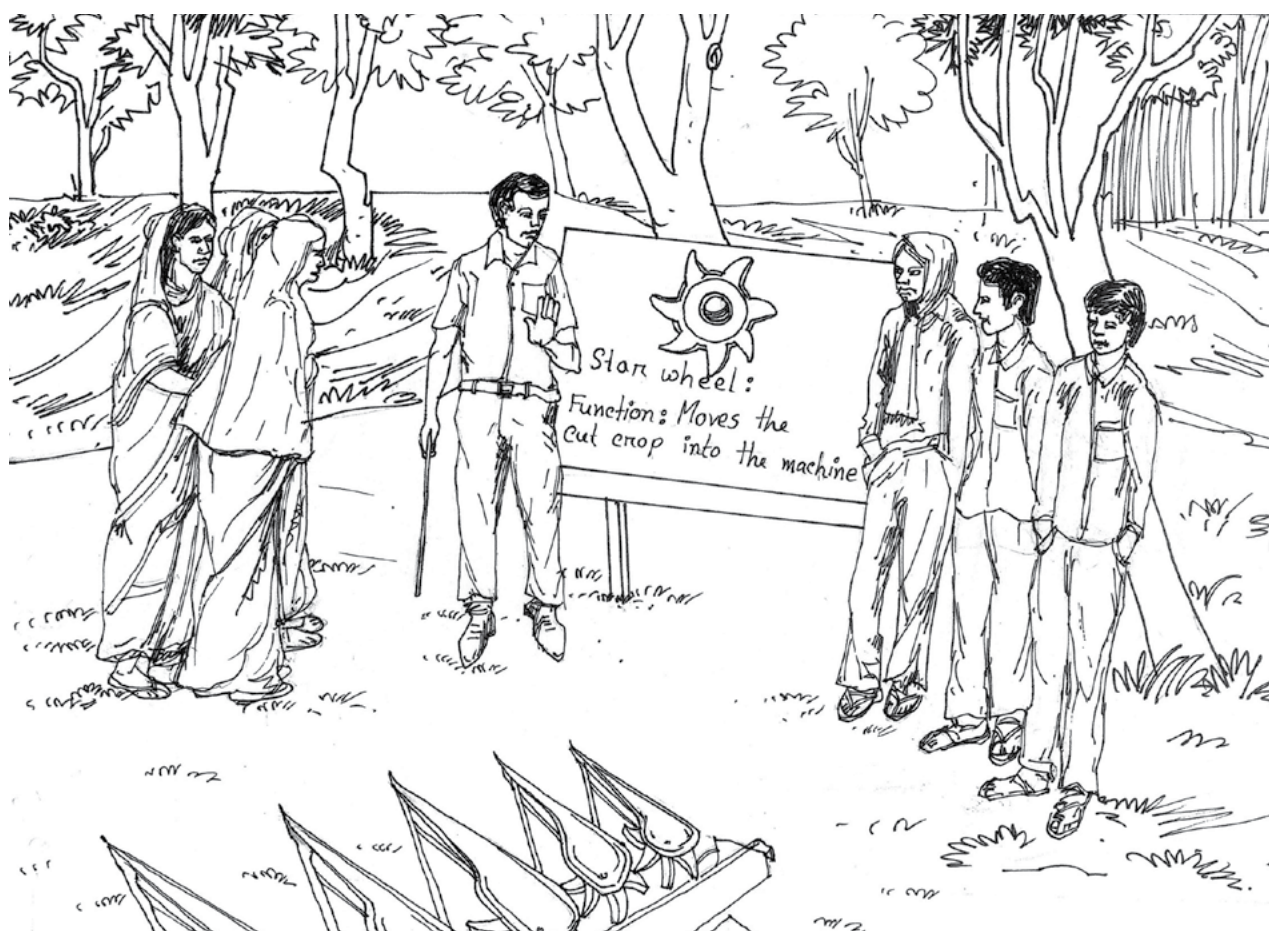
- ◆ Ask questions and contribute that replaces manual harvesting.
- ◆ Get hands-on practice in the field.
- ◆ Enjoy yourself today!



Session 3

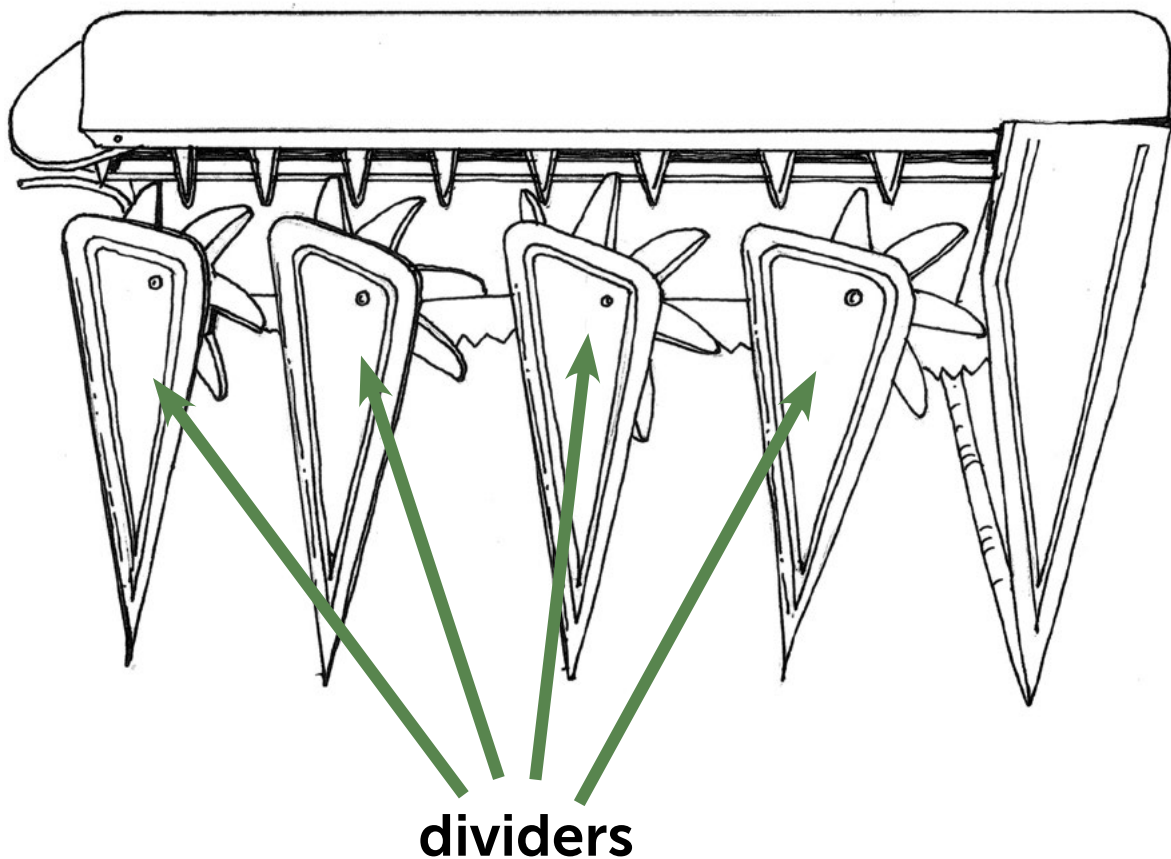
Main parts of a self-propelled multi-crop reaper and their functions

Self-propelled multi-crop reaper
one-day training flipchart



Parts that separate and divide the crop during reaping (1)

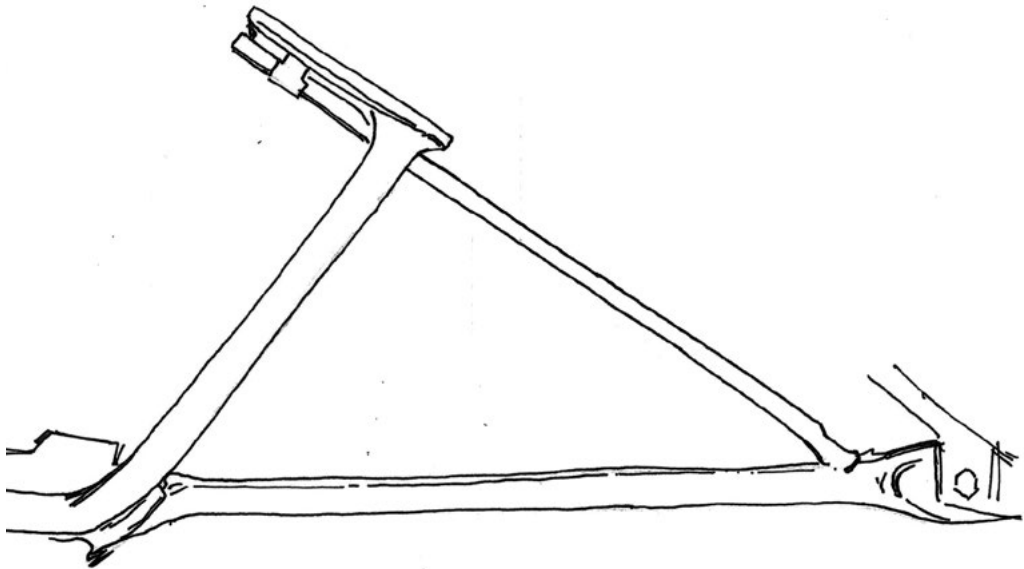
The dividers



Function: they divide the uncut crop into equal sections ready for cutting and move it towards the cutter bar.

Parts that separate and divide the crop during reaping (2)

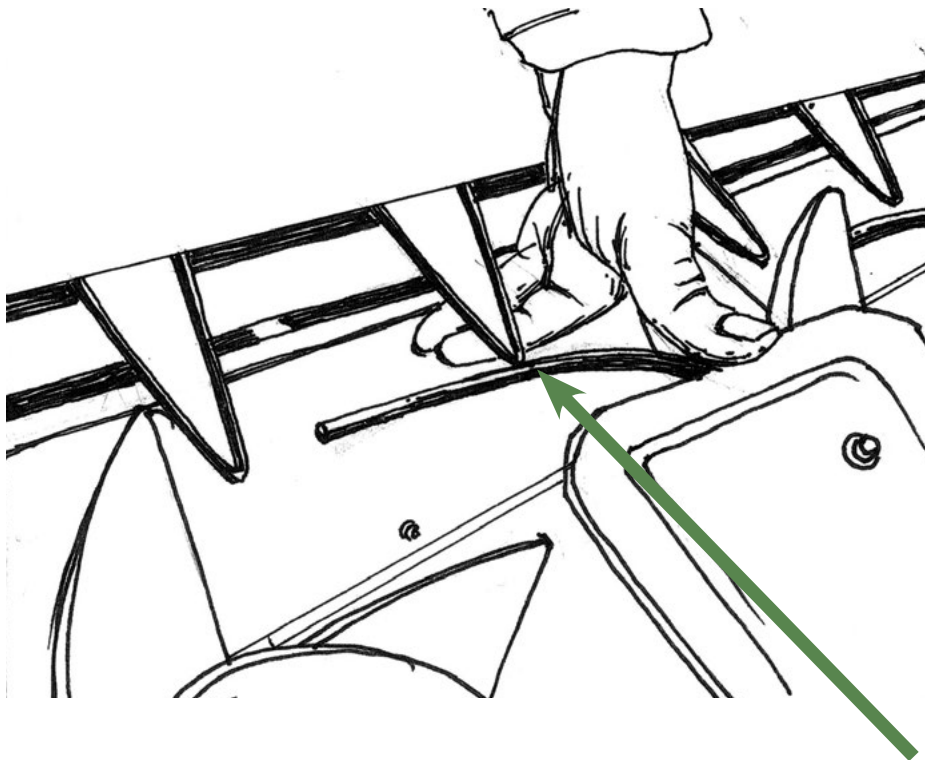
The splitting bracket



Function: supports the dividers, which are placed on top of it and fixed in place.

Parts that separate and divide the crop during reaping (3)

The pressure spring

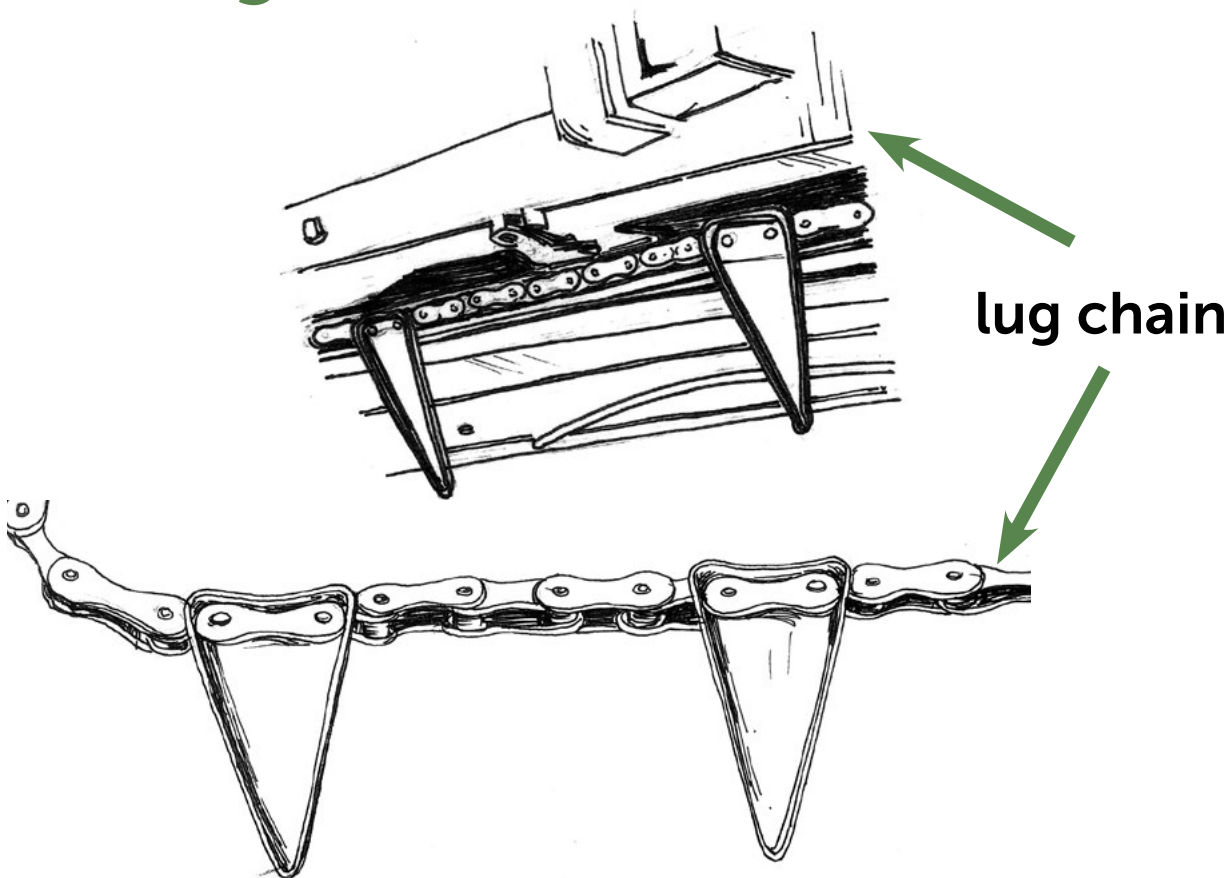


pressure spring

Function: exerts pressure on crop stems or tillers, aligning them upright for cutting.

Parts that separate and divide the crop during reaping (4)

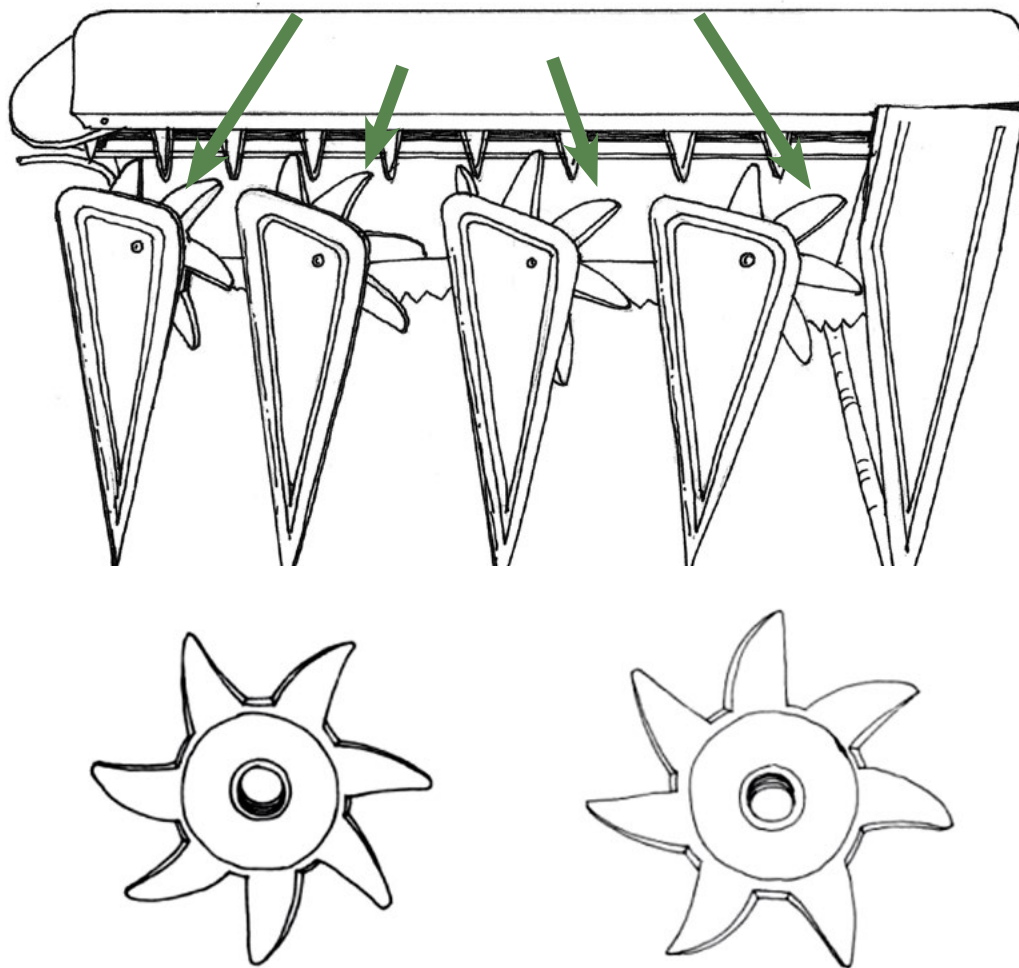
The lug chain



Function: keeps the star wheels moving in the correct direction; throws the cut crop to one side of the machine.

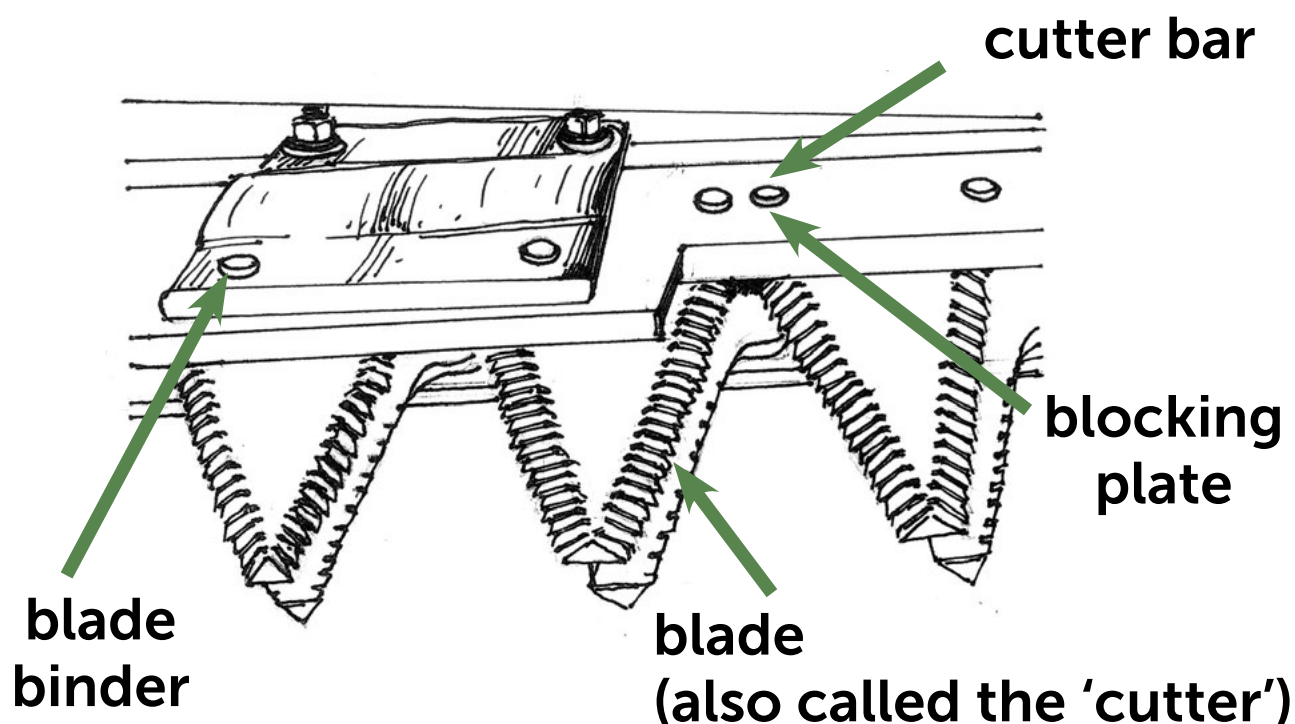
Parts that separate and divide the crop during reaping (5)

The star wheels



Function: guide the harvested crop into the machine to be cut.

Parts that cut the crop



Function:

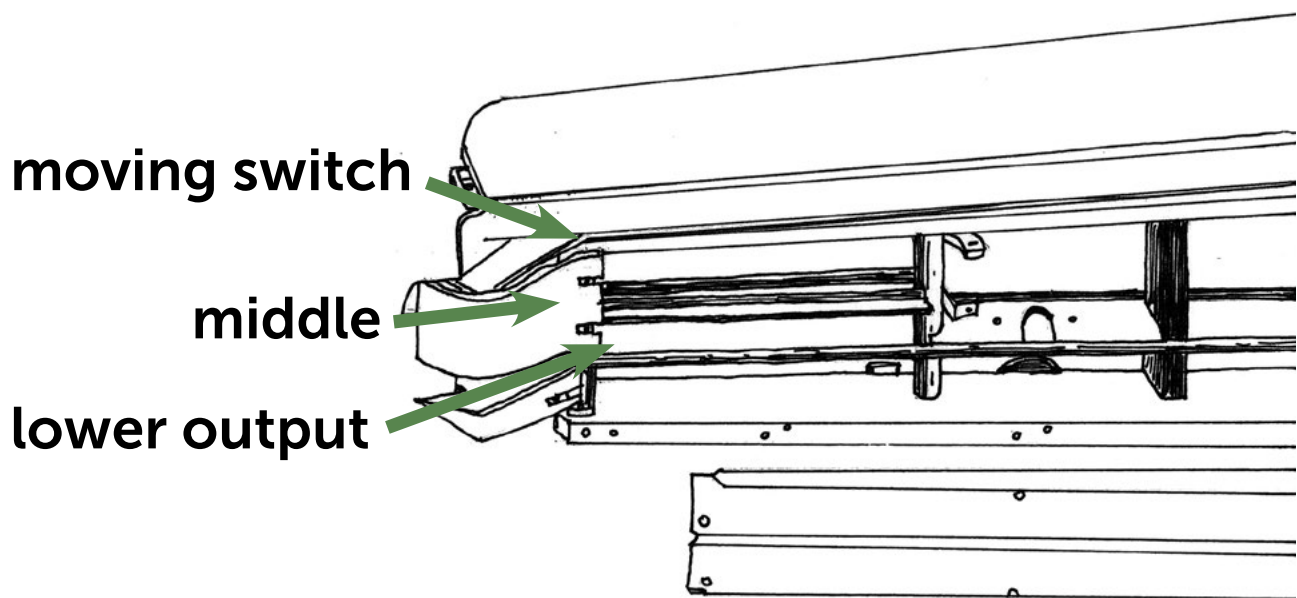
The blade (or 'cutter') cuts the crop.

The blade binder aligns the upper and lower cutter bars.

The blocking plate helps the blade binder to maintain a gap of 0.5 mm (maximum) clearance between two cutter bars.

The cutter bar holds the blades that cut the crop.

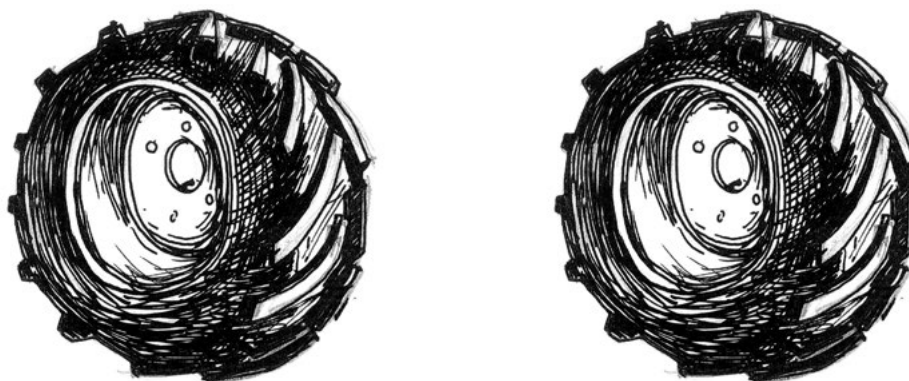
Output devices



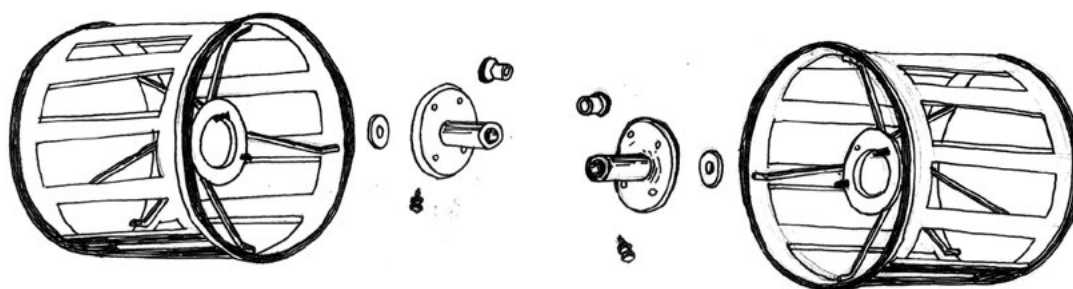
Function: these parts work together to enable the self-propelled multi-crop reaper to lay down the crop horizontally after cutting it (allowing it to be picked up easily).

Wheels

Rubber wheels

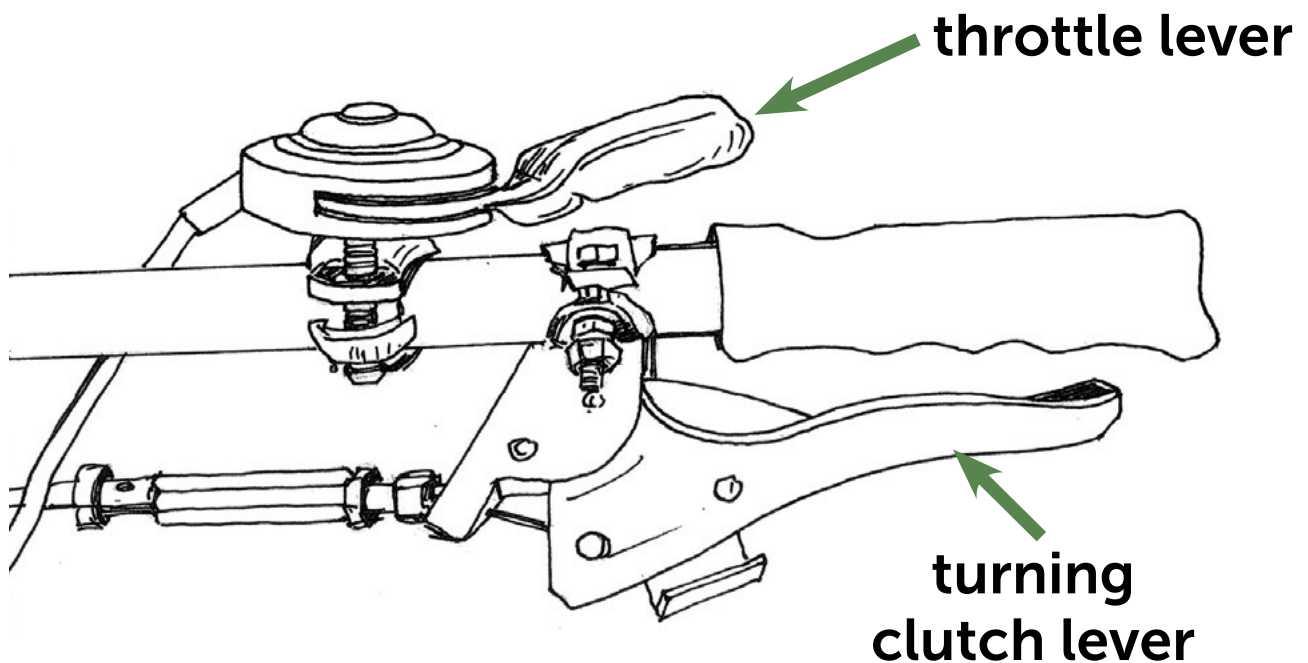


Cage wheels



Function: the wheels enable the self-propelled multi-crop reaper to move forwards or backwards. Note: it is essential to fit 'cage' wheels when using the self-propelled multi-crop reaper in standing water or on moist soil, as sometimes happens during the aus rice harvest. These keep the reaper from slipping or getting stuck.

Levers and switches (1)

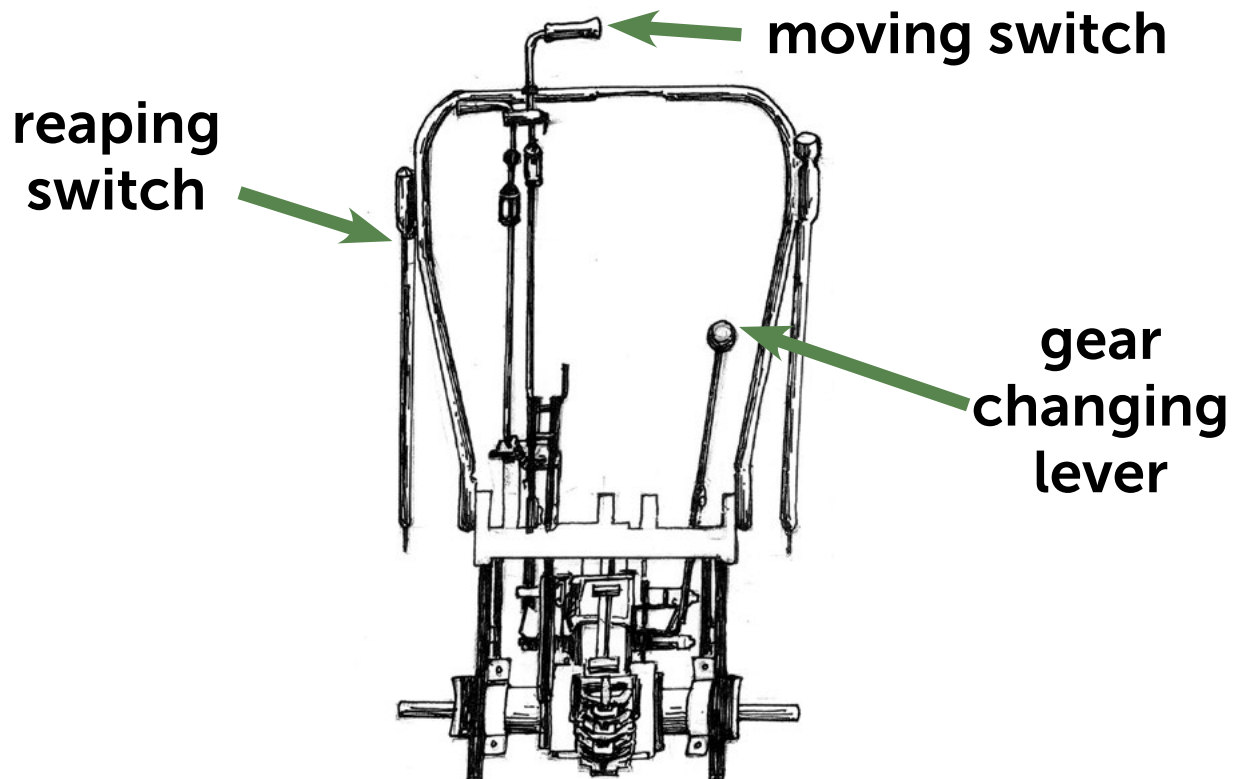


Functions:

The throttle lever helps control the speed of the self-propelled multi-crop reaper.

The turning clutch lever controls the clutch.

Levers and switches (2)



Functions:

The gear changing lever controls the gears.

The moving switch (or 'operation switch') sets the reaper to go forwards or backwards and is used to stop the reaper.

The reaping switch turns the cutter bar on or off.

Session 4

How to use a self-propelled multi-crop reaper safely and effectively

Self-propelled multi-crop reaper
one-day training flipchart

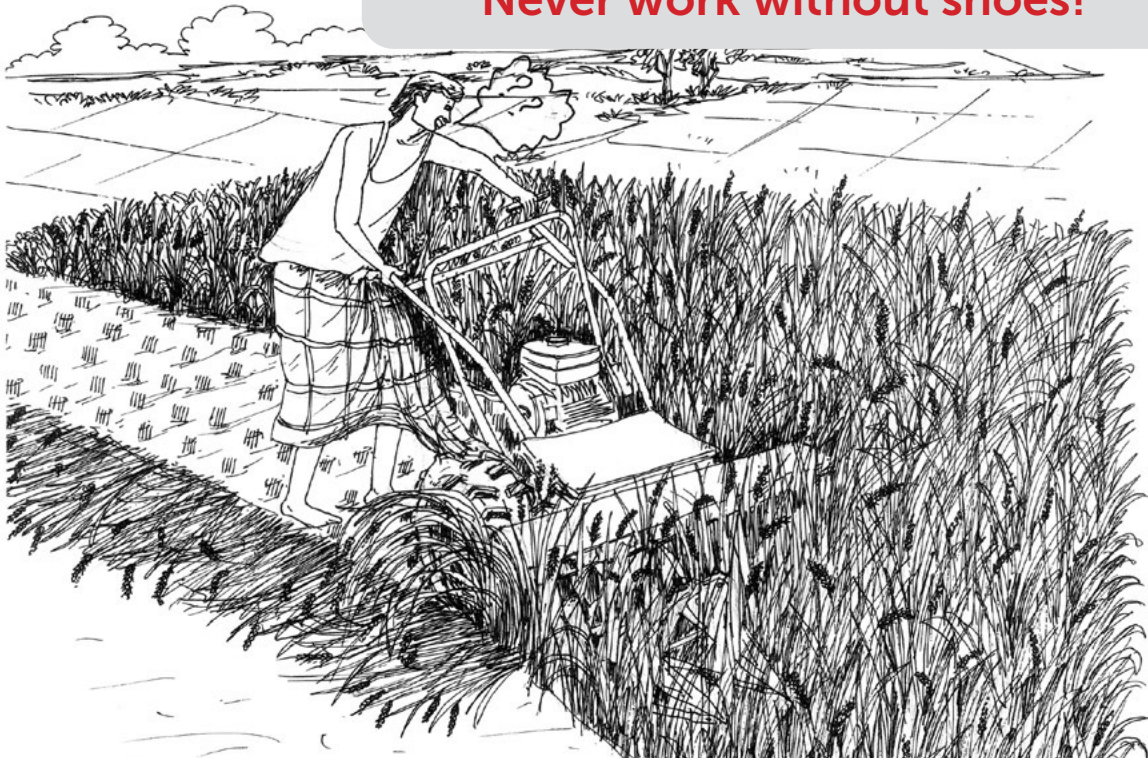


Safe operation of the self-propelled multi-crop reaper is a must!

- ◆ The self-propelled multi-crop reaper can also be dangerous – stay safe when using it.
- ◆ Wear suitable clothing.

Never wear loose-fitting clothing around agricultural machinery!

Never work without shoes!



How can you safely operate a self-propelled multi-crop reaper? (1)

UNSAFE



- ◆ Never operate a self-propelled multi-crop reaper around children! They can easily be hurt.
- ◆ If you wear a lungi or other loose-fitting clothing, be sure to tie it tightly.

How can you safely operate a self-propelled multi-crop reaper? (2)



- ◆ Always ask bystanders to keep at least two meters away while you use the self-propelled multi-crop reaper.
- ◆ Try to wear tight-fitting clothing that cannot get stuck in the self-propelled multi-crop reaper.

Get ready to operate the self-propelled multi-crop reaper by checking the following:

- ◆ **clothing.**
 - ◆ **lubricant levels.**
- ◆ **lubricated parts.**
 - ◆ **fuel/engine oil.**
- ◆ **filter, spark plugs, nuts.**

Now the self-propelled multi-crop reaper is ready!

To move the self-propelled multi-crop reaper forward and harvest the crop:

- ◆ **Put the self-propelled multi-crop reaper in forward gear (on some reapers this is labeled 'AA').**
 - ◆ **Start the cutter bar by shifting the cutter lever, which will allow the self-propelled multi-crop reaper to move forward.**
- ◆ **Run the machine at a normal walking pace.**
 - ◆ **The self-propelled multi-crop reaper starts to cut the crop as it moves forward.**

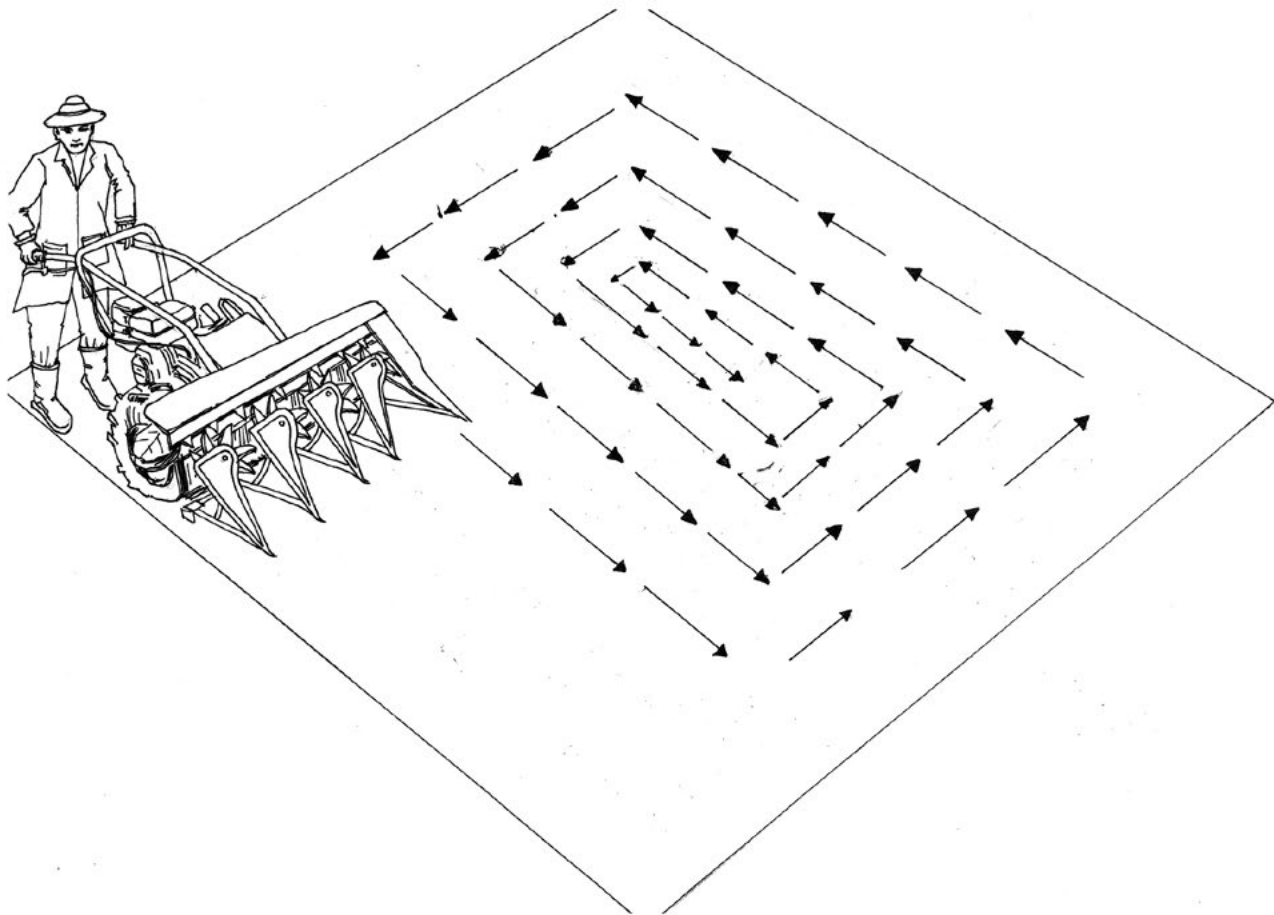
To move the self-propelled multi-crop reaper backwards:

- ◆ Put it in reverse gear (labeled 'EE' on some reapers).
 - ◆ Stop the cutter bar by pulling the cutter lever.
- ◆ The machine will move backward when you pull on the moving lever.

What if you don't want to move forwards or backwards?

- ◆ Put the machine in reverse gear (labeled 'EE' on some reapers).
- ◆ Start the cutter bar by pulling the cutter lever.
 - ◆ At this stage, the self-propelled multi-crop reaper will not move forward when the moving lever is pulled

Reap around the edges of the field – then move in towards the center

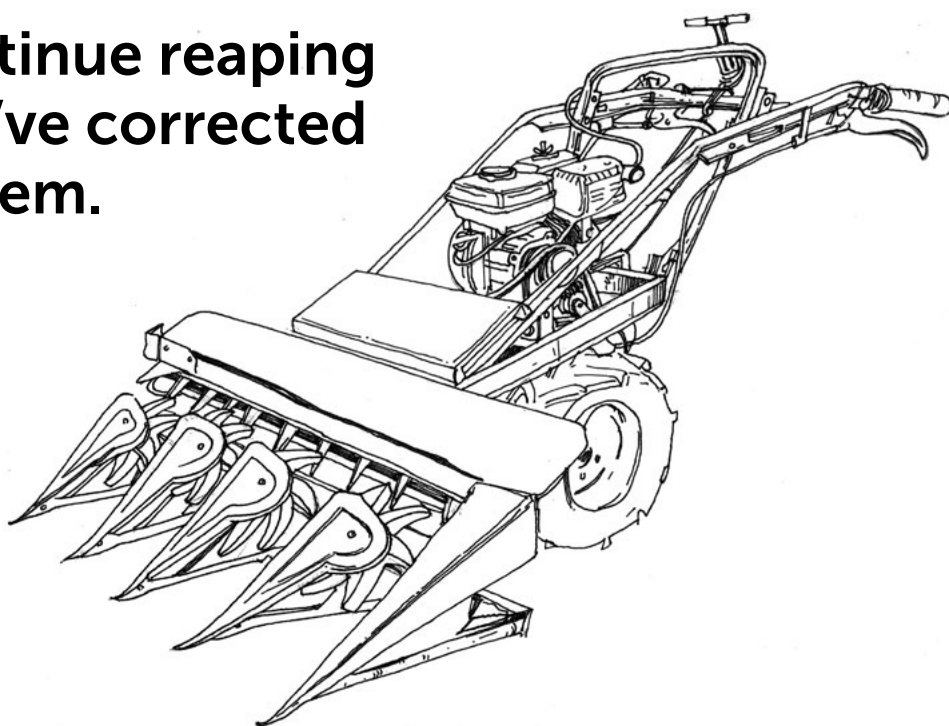


This is the most effective way to complete your work reaping a farmer-client's field.

Be careful when operating the self-propelled multi-crop reaper!

Take these precautions:

- ◆ Stop the self-propelled multi-crop reaper and turn it off immediately if it produces any cracking or other unusual sounds.
 - ◆ Check for straw that may have jammed in the splitting bracket and cover while you've been operating the machine – clear it away.
- ◆ Only continue reaping after you've corrected the problem.



Review of key messages

- ◆ Always wear tight-fitting clothing.
 - ◆ Check fuel and engine oil levels before starting.
- ◆ Keep lubricant in the gearbox level when checking it.
 - ◆ Apply lubricant before each use.
- ◆ Also before each use, clear away any straw/other dirt.
 - ◆ Don't harvest if the crop is damp.
- ◆ If the soil very wet or if there is standing water in the field, use cage wheels.
 - ◆ Reap around the edges of the field, then move inwards in a spiral.
- ◆ During use, stop the reaper and clear away any straw jams.

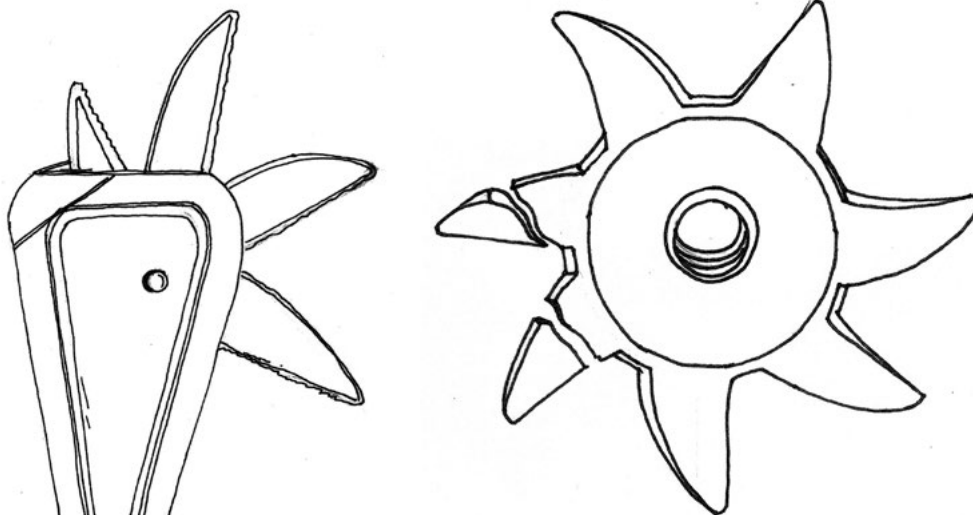
Session 5

Troubleshooting and maintenance

**Self-propelled multi-crop reaper
one-day training flipchart**



Problem 1: The star wheel breaks



Symptoms:

The star wheel is visibly broken.

Possible causes:

- 1) mishandling
- 2) overloading
- 3) damaged bearings
- 4) not clearing straw jams

Effects:

Crops jam more frequently and reaping has to stop.

Solutions:

- 1) buy a replacement star wheel or have a new one made at a local workshop;**
- 2) replace damaged bearings;**
- 3) clear away straw jams regularly.**

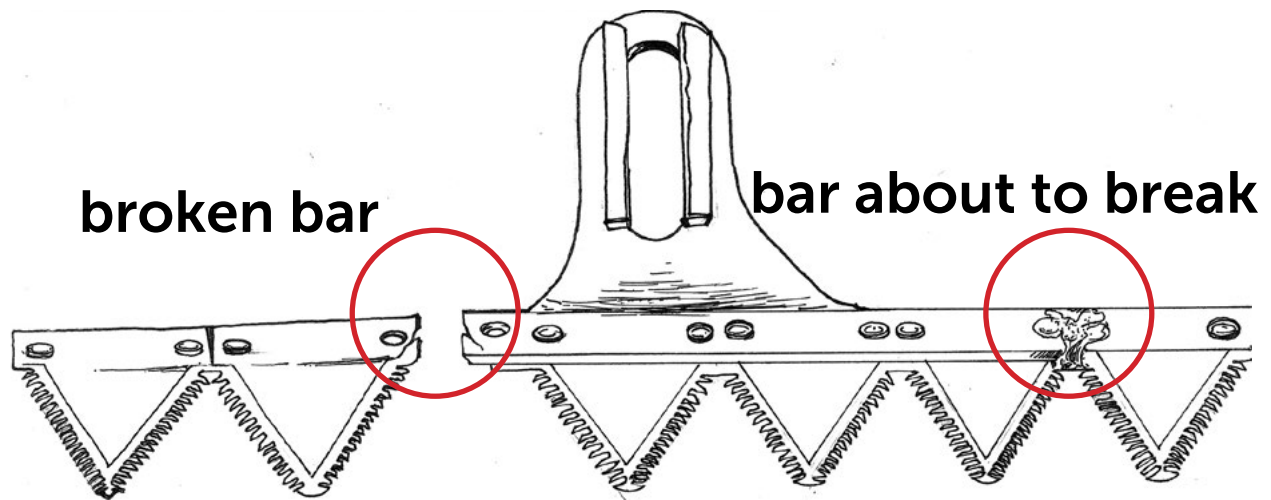
Spare part required: star wheel

Where to get spare/replacement parts: buy a new star wheel from a dealer or have a new one made at a local workshop.

Tools required:

Dual wrench, adjustable wrench, screwdriver.

Problem 2: The cutter bar* breaks



Symptoms: The cutter bar breaks and stops cutting the crop.

Possible causes:

- 1) the teeth have come into contact with a hard object;
- 2) the operator has failed to clear straw jams regularly, putting stress on the cutter bar and weakening it over time;
- 3) the gap between the blade and the ledger plate is less than optimum (0.5 mm).

Effect: The cutter bar stops working.

Prevention:

- 1) Do not let straw build up around the cutter bar, and clean it out regularly as needed.**
- 2) Adjust the gap between the blade and ledger plate to 0.5 mm before reaping.**

Solution: replace the cutter bar.

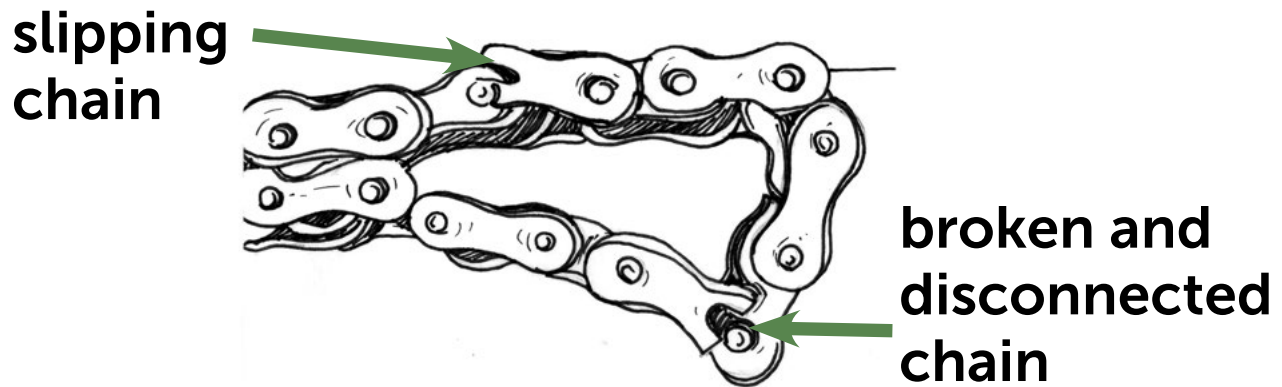
Spare parts required: cutter bar, steel rivets

Where to get spare parts replacement parts: buy from a dealer or have new ones made at a local workshop.

Tools required: dual wrench set, adjustable wrench, screwdriver, hammer, cutting disc, grinder and anvil (if part has to be reshaped).

*** The bar to which the cutting blades are riveted (also known as a 'flat bar').**

Problem 3: The chain in the transmission gearbox snaps



Symptoms: The cutter bar stops moving.

Possible causes:

- 1) lack of proper lubrication;
- 2) straw jams have overloaded the gearbox;
- 3) the chain is too tight;

Effects: The self-propelled multi-crop reaper stops completely.

Solutions:

- 1) try to re-join links that have come apart;
- 2) replace any broken links;

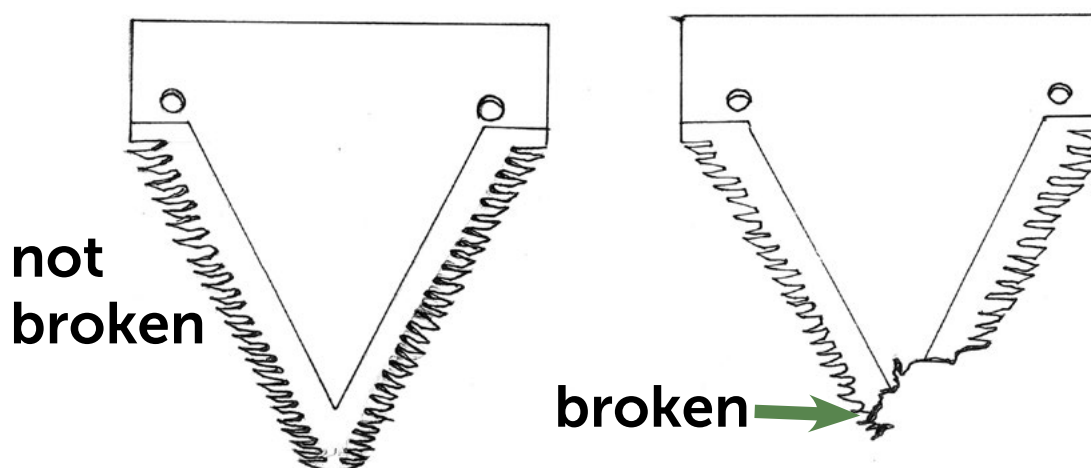
3) if the chain needs to be replaced but complete chains are unavailable on the market, replace the sprockets with sprockets available on the market or that you have as spare parts. Make sure the replaced or repaired chain is the same length and has the same sprocket size.

Spare parts required: chain link, sprockets, or chain.

Where to get spare parts or have parts repaired: shops that deal in pump or engine spare parts – chains and chain links are common.

Tools required: dual wrench set, adjustable wrench, screwdriver, hammer, cutting disc and/or grinder (depending on the severity of the break and your level of mechanical skills for repairs).

Problem 4: The cutting blade breaks



Symptoms:

The cutting blade is clearly and visibly broken.

Possible causes:

- 1) the teeth of the blade come into contact with hard objects (e.g., stones, bamboo, wood) during reaping;
- 2) the operator doesn't clear straw jams regularly enough;
- 3) the gap between the blade and the ledger plate less is than required (maintain a gap of no less than 0.5 mm).

Effects:

- 1) the blade stops cutting;**
- 2) the crops jam.**

Prevention:

- 1) clear straw jams from the cutter bar as soon as they occur;**
- 2) check the gap between the blade and the ledger plate regularly - keep it at 0.5 mm.**

Solution: replace the blade.

Spare part required: cutting blade

Where to get a spare part or have a new one made: buy from a dealer or have a new one made at a local workshop.

Tools required for installing or making a new cutting blade: dual wrench set, adjustable wrench, screwdriver, hammer, cutting disc and grinder.

Problem 5: The lug spring bends



Symptoms:

The crop gets bunched up and the self-propelled multi-crop reaper slows down.

Possible causes:

- 1) the operator has mishandled the reaper;
- 2) the nuts and bolts connecting the lug spring to the reaper have worked themselves loose;
- 3) poor spring tension.

Effects:

- 1) the self-propelled multi-crop reaper will harvest the crop more slowly;**
- 2) clogging of the cut stalks/straw will occur.**

Solutions:

- 1) adjust the gap between the lug spring and lug cover, and/or**
- 2) tighten the nuts and bolts, and/or**
- 3) replace the lug spring.**

Spare parts required: lug spring

Where to get a spare part:

from a dealer or have a new one made at the local workshop.

Tools required: dual wrench set, adjustable wrench, pliers.

Maintenance of the self-propelled multi-crop reaper (1)

A. Before each use.

- ◆ Check the level of lubricant in the engine gearbox and bevel gearbox. Add more as required.
 - ◆ Clean the spark plug.
- ◆ Apply lubricant to the lug chain, cutting blade, bearings and other moving parts.
 - ◆ Check you have enough fuel and engine oil to run the machine for a full day's work.

Maintenance of the self-propelled multi-crop reaper (2)

B. After every 10 hours of operation.

- ◆ If you have been reaping in wet fields, or in dry fields with a lot of dust, clean the air filter and change the engine oil.

C. After every 50 hours of operation

- ◆ Check the fan belt tension and keep its flexibility to 10-20 mm.
 - ◆ Check the transmission oil level.
- ◆ Clean the dirt or water that has accumulated at the bottom of the fuel filter.
 - ◆ Clean the spark plug and replace it if it shows any damage, is very old, or the engine does not start easily.

Maintenance of the self-propelled multi-crop reaper (3)

D. After every 120 hours of operation.

- ◆ Check the engine oil – make sure it is still fluid and has not started to solidify or thicken.
 - ◆ Change the engine oil if the oil has started to solidify or is at all dirty (if the quality is not good, change it after 60-70 hours, even if it is still fluid and appears clean).
- ◆ Change the fuel and oil filter (if necessary).
 - ◆ Apply grease to the reaper's moving parts.

Maintenance of the self-propelled multi-crop reaper (4)

E. After every 750 hours of operation

- ◆ Change the transmission oil.
 - ◆ Change the gearing house oil.

F. After one year

- ◆ Clean the wheel's axle bearing. If the bearing shows sign of wear or tear, replace with a new one.
 - ◆ If necessary, consider completely overhauling the machine by installing a new engine and new parts. A mechanic will usually have to assist in this.

Storage at the end of each season (1)

- ◆ **Wash and clean the self-propelled multi-crop reaper thoroughly using water and a brush. Store all engine belts in a dry place.**
 - ◆ **Throw away the used oil from transmission box and replace. Apply grease at the points where needed.**
- ◆ **After drying the self-propelled multi-crop reaper, apply oil to the metal parts to protect them. Before applying oil to cutter blades, make sure they are well-dried.**

Storage at the end of each season (2)

- ◆ Rotate the blades while applying oil to make sure each one is well-lubricated.
 - ◆ Store the machine in a dry place – in a shed, or at least protected from the sun and rain.
- ◆ Apply grease to the other mechanical parts and cover them with a polythene sheet to guard against rust and protect them from dust.

Review of key messages (1)

- ◆ **Star wheels can break if they are mishandled, overloaded because of excessive use, or used on excessively wet crops, or because of material failure.**
 - ◆ **The cutting bar (or flat bar) can break if it jams, because of material failure, or if the clearance between the blade and ledger plate is sub-optimal.**
- ◆ **The cutting blade can break if its teeth come into contact with hard objects (e.g., stones, bamboo, wood) during reaping, if the cutter bar jams, or due to any of the problems listed above.**

Review of key messages (2)

- ◆ If the chain in the transmission gearbox snaps, the cutter bar will not move right or left and the self-propelled multi-crop reaper will break down completely.
 - ◆ The lug spring and associated wires can bend, altering the gap between the lug spring/wire and the lug chain cover, which will result in poor reaping.
- ◆ This happens because of mishandling by the operator, loosening or aging of the nuts and bolts, or loosening of the spring.

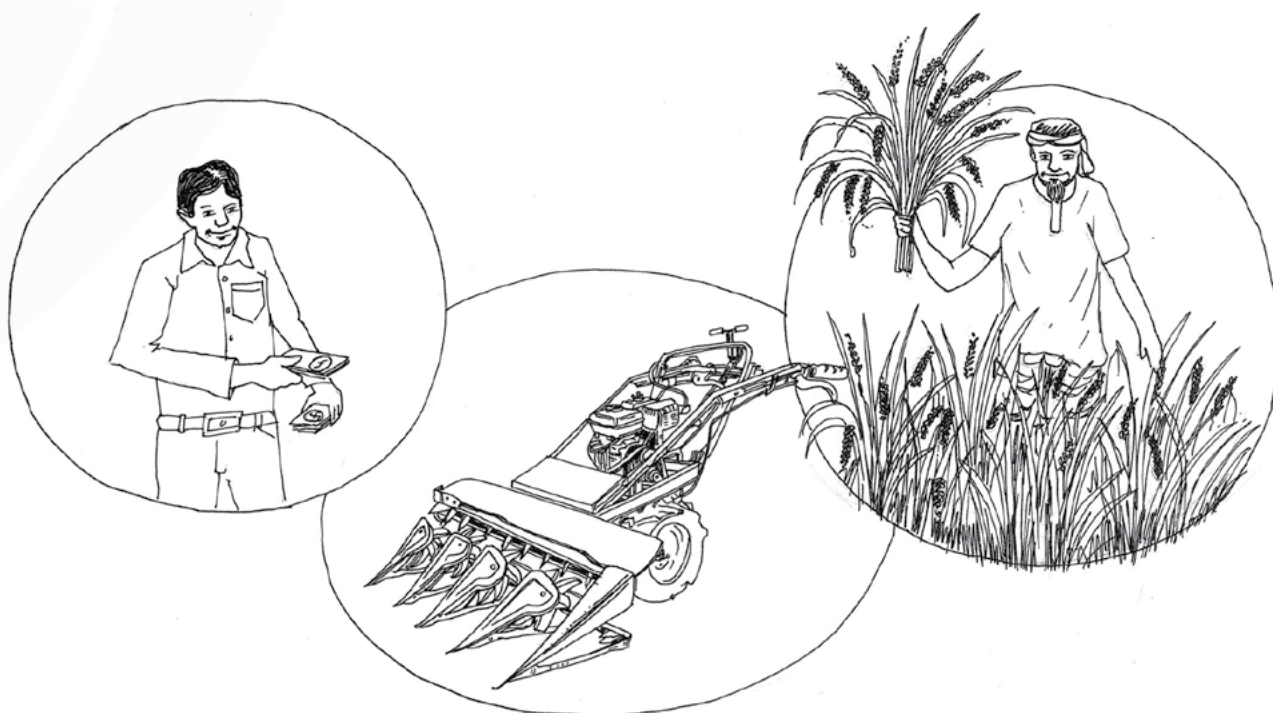
Review of key messages (3)

- ◆ Check regularly during reaping for any straw and other objects in the blades, chain and shaft, and remove them.
 - ◆ Apply lubricant to the blades, chain and shaft regularly and correctly.
- ◆ Check the oil level in the gearbox before you begin reaping each field and keep the gearbox parallel to the ground.
 - ◆ If storing the reaper for more than a few days, keep it in the shade, and in a clean, dry place where it will not come into contact with dust and other materials.
- ◆ Store the machine out of the reach of children parallel to the ground.

Session 6

Starting a self-propelled multi-crop reaper service business

Self-propelled multi-crop reaper
one-day training flipchart



What do we mean by a 'business'? (1)

- ◆ **the activity of making, buying or selling goods, or providing a service in exchange for money or for other goods and services.**
- ◆ **any activity/occupation run by an individual or group to obtain a profit and satisfy customer needs.**

Most farmers who buy a self-propelled multi-crop reaper do not only reap their own fields - they use it to set up and run a business.

What do we mean by a 'business'? (2)

Farmers also use the self-propelled multi-crop reaper to run a business – they make money by selling the use of the reaper to other farmers. This way, everyone benefits.

Some types of businesses are:

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



What is a business plan?

- ◆ It sets out a sales and marketing strategy.
 - ◆ It identifies possible profits and losses.

A self-propelled multi-crop reaper business plan asks (1):

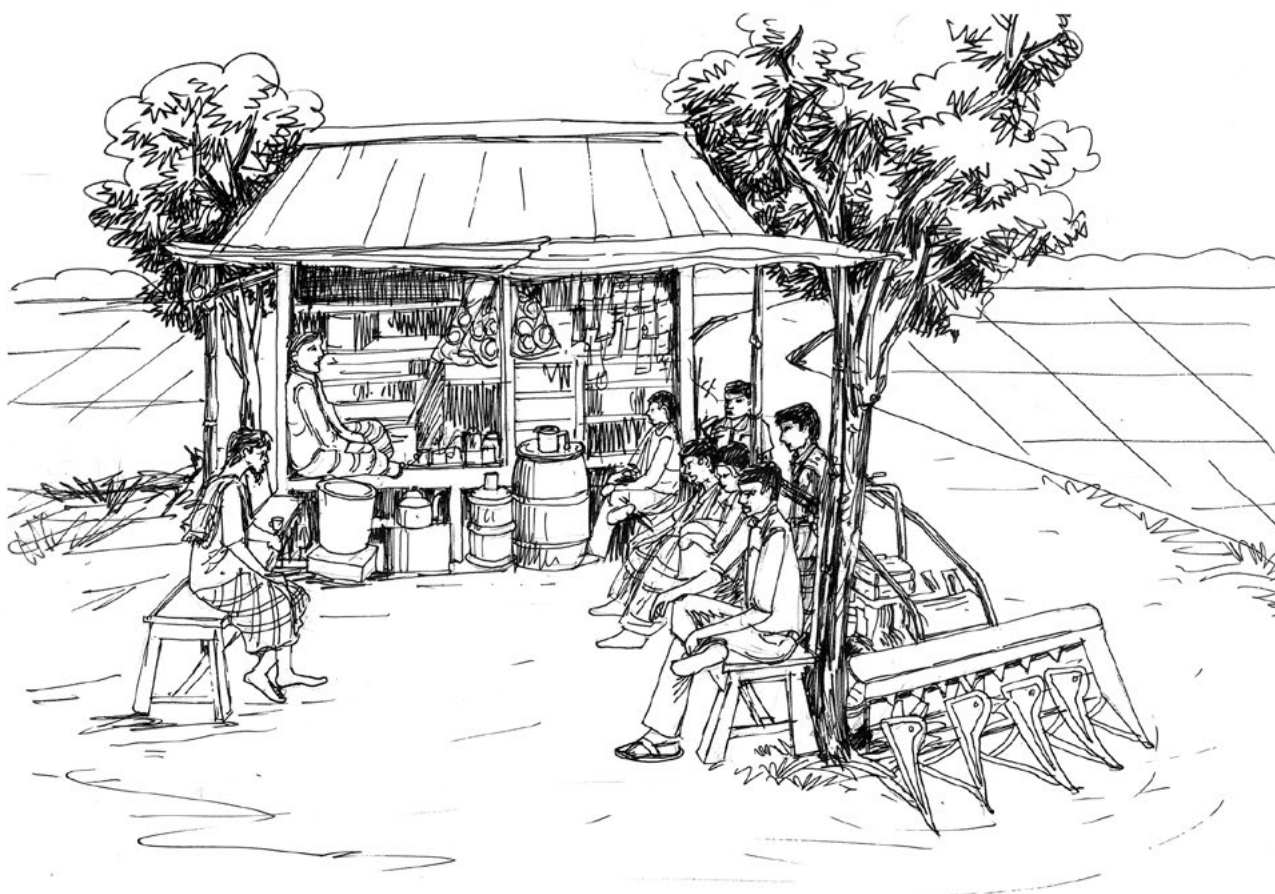
- ◆ **Where will farmers pay for self-propelled multi-crop reaper harvesting.**
 - ◆ **What is my capacity to provide a self-propelled multi-crop reaper service?.**
- ◆ **What machinery and equipment, fuel and spare parts are needed to run a self-propelled multi-crop reaper business?.**
 - ◆ **What is my source of capital and how can I afford to buy a self-propelled multi-crop reaper?.**



A self-propelled multi-crop reaper business plan asks (2):

- ◆ **What profit can I obtain from my self-propelled multi-crop reaper business?.**
- ◆ **How can I get as many farmer-clients as possible to pay for the use of the self-propelled multi-crop reaper?.**

Service provider experience sharing



Do you know a successful self-propelled multi-crop reaper service provider? (1)

Ask him/her some questions!

- ◆ **Why did you start a self-propelled multi-crop reaper business?**
 - ◆ **How are you running your business?**
- ◆ **What are the costs and benefits of running a self-propelled multi-crop reaper business?**
 - ◆ **How long did it take to break even – or how long do you think it'll take?**

Do you know a successful self-propelled multi-crop reaper service provider? (2)

Ask him/her some questions!

- ◆ **What activities/strategies make your business profitable?**
 - ◆ **What challenges do you face?**
- ◆ **What benefits do the farmers (your clients) obtain?**



Do you know a successful self-propelled multi-crop reaper service provider? (3)

Ask him/her some questions!

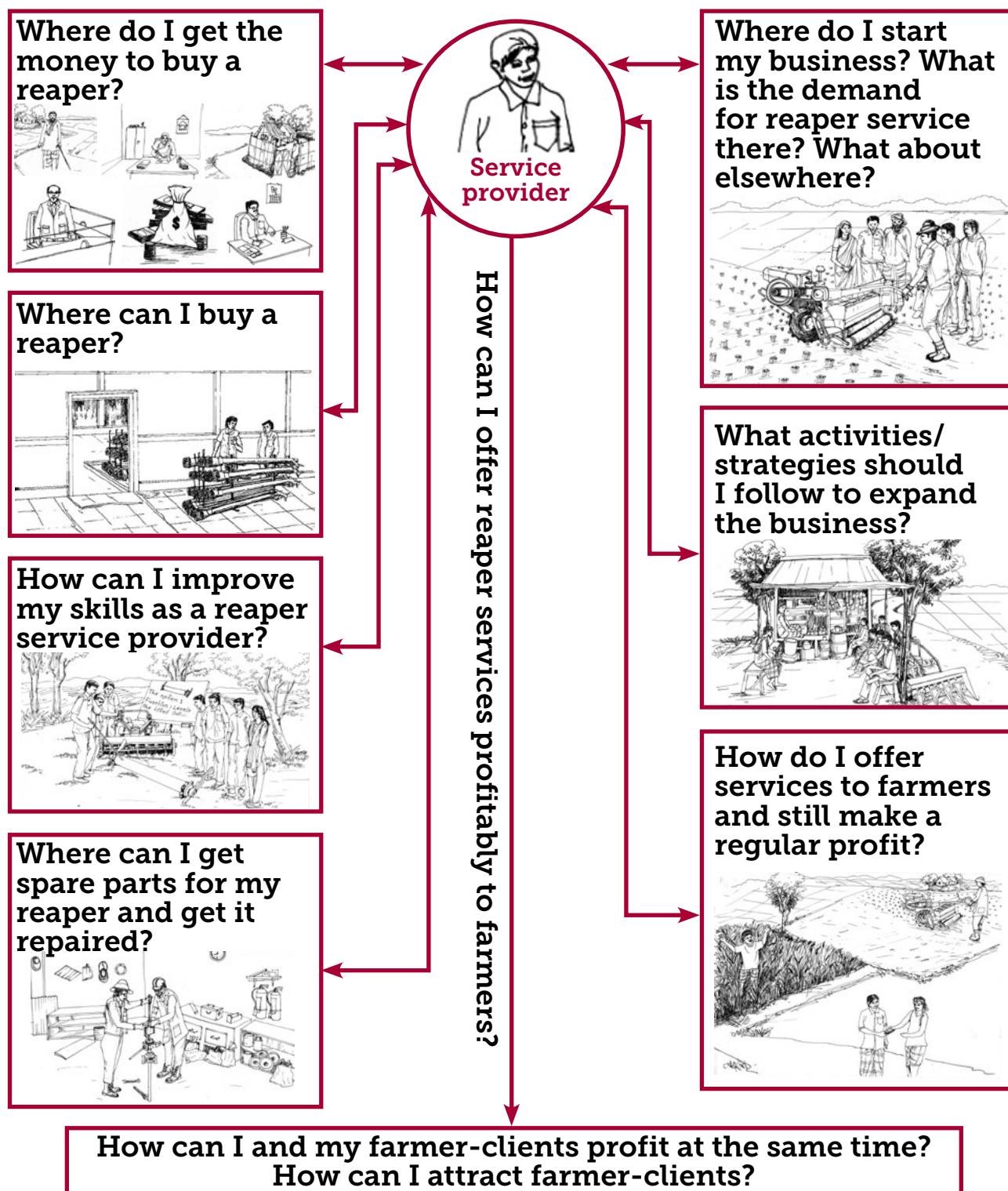
- ◆ **Why did you start a self-propelled multi-crop reaper business?**
 - ◆ **How are you running your business?**
- ◆ **What are the costs and benefits of running a self-propelled multi-crop reaper business?**
 - ◆ **How long did it take to break even – or how long do you think it'll take?**

Do you know a successful self-propelled multi-crop reaper service provider? (4)

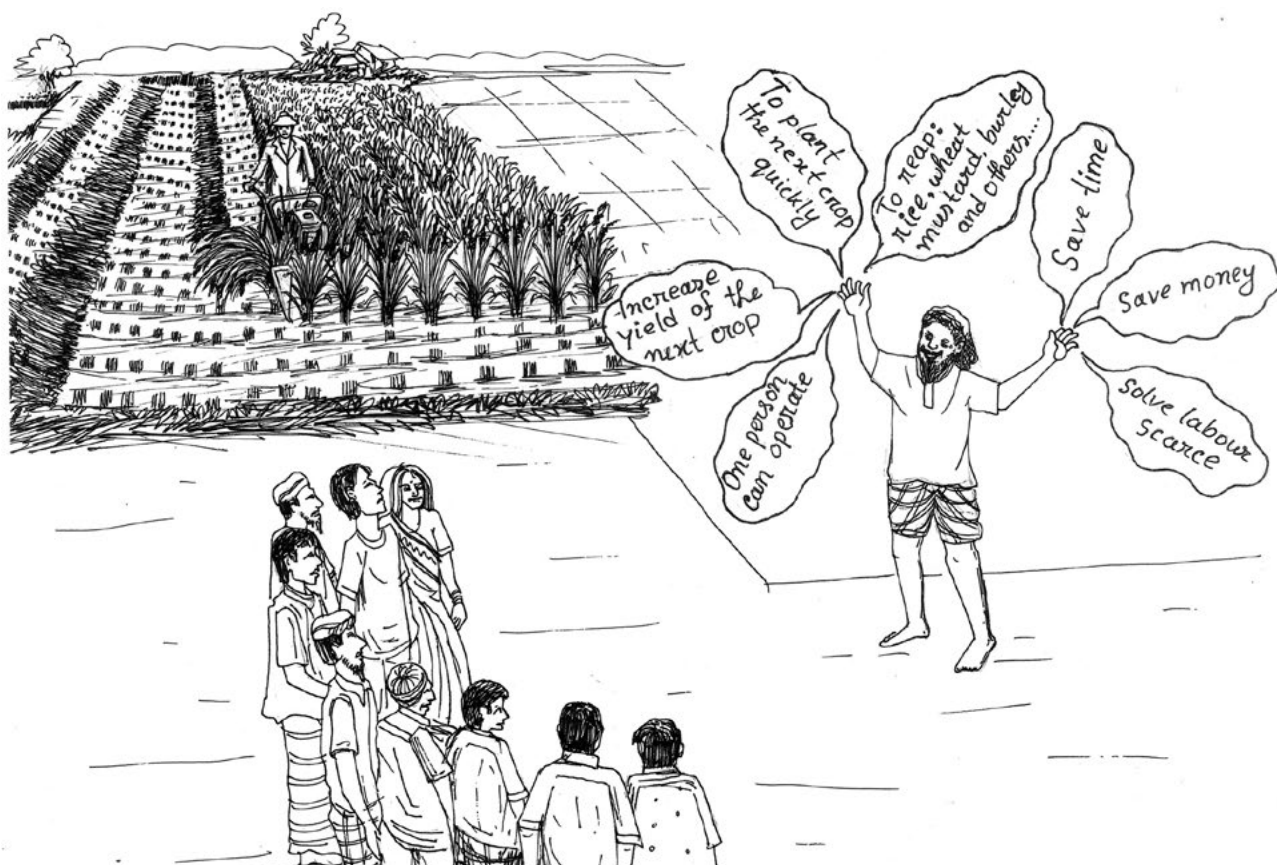
Ask him/her some questions!

- ◆ **What activities/strategies make your business profitable?**
 - ◆ **What challenges do you face?**
- ◆ **What benefits do the farmers (your clients) obtain?**

Questions to ask yourself before becoming a reaper service provider



To attract farmer-clients, you must advertise – ‘sell’ the idea of a self-propelled multi-crop reaper to farmers in your village and in villages nearby



Remember the benefits of a self-propelled multi-crop reaper?

Benefits of the self-propelled multi-crop reaper

- ◆ A single person can operate the self-propelled multi-crop reaper easily and it's easy to move from place to place.
 - ◆ Self-propelled multi-crop reapers save money and time – how much time and money are saved depends on the crop harvested and how much the farmer-client pays in labor costs for manual harvesting.
- ◆ If rain or a storm is expected, a self-propelled multi-crop reaper can help get the crop harvested and out of the field quickly.
 - ◆ A quick harvest means you can sow the next crop early, which usually increases crop yield.

A self-propelled multi-crop reaper business cost-benefit analysis

(Group exercise: 60 minutes)

Manual harvest	Mechanical harvest using a self-propelled multi-crop reaper				
Box A: Rice: reap+(bind+carry) (cost to farmer) Area = Reaping = Bind+carry = Total =	Box B: Reaper (capital cost) Reaper =	Box C: (consumables cost)(rice) Fuel+oil cost of reaping = Bind+carry cost (if any) =	Box D: SP labor (opportunity cost)(rice) =	Box E: Reaper service charge (cost to farmer) (rice) Till+sow+fertilize =	
	Box F: Reaper service profit (rice)		Box G: Farmer savings (rice)		
Box H: Wheat: reap+(bind+carry) (cost to farmer) Area = Reaping = Bind+carry = Total =	Box I: (consumables cost) (wheat) Fuel+oil cost of tillage = Bind+carry cost (if any) =	Box J: SP labor (opportunity cost) =	Box K: Reaper service charge (cost to farmer) (any crop) = Till+sow+fertilize (any crop) =		
	Box L: SP profit (wheat)		Box M: Farmer savings (wheat)		
Box P: Time/area required to break even Time (in years) Area (in =	Box N: Area that can be reaped in 1 day Rice (Q) = Wheat (R) =		Box O: No. of days that harvest can be carried out per year Rice (S) = Wheat (T) =		
X: 1 bigha = 0.33 decimal/acre = 0.13 ha hectare	Box U: SP yearly profit Rice: Wheat:				

Importance of keeping financial records (1)

Keep records of your profit and how much you spend. This will help you decide the answers to these two questions, which are essential to running a business:

- ◆ How can you break even on your self-propelled multi-crop reaper investment?
- ◆ How can you increase your profit?.

Here are some examples of records to keep, which you can use:

A) Primary investment

Item	Date	Quantity/No.	Unit price	Own money	Credit
Self-propelled multi-crop reaper					
Transportation					
Other					
Total investment =					

Importance of keeping financial records (2)

B) Monthly income-expenditure (for example, March)

Month	Expenditure (for operating the PTOS)			Income (as service charge)		
	Item	Quantity/ no.	Money paid (BDT)	Farmer	Area and crop	Money paid (BDT)
March	Gasoline	10 liters	550	Abdul Jalil	0.25 ha (wheat)	800
	Mobil/ grease	500 ml	100	Sahab- uddin	0.45 ha (wheat)	1000
	Spare parts	2	60	Malek Mia	0.25 ha (wheat)	1200
	Trans- portation		50	Shafiq Mia	0.4 ha (wheat)	1600
	Labor	1	300			
	Other					
Total cost =			1060	Total income =		4600
Total profit (total income – total cost)						3540
Total cost =				Total income =		
Total profit (total income – total cost)						

Keep a list of farmer-clients. This also helps your profit

Sample:

Farmers due to receive self-propelled
multi-crop reaper services next month

Farmer's name, address, mobile no.	Crop	Land area	Work start time/date	Work end time/date
Shahidul Khan. Dumuria sub-district, Khulna. +88017648892	Wheat	1 <i>bigha</i> (0.13 hectare)	8 a.m	11:15 a.m

Review of key messages (1)

- ◆ **Where can I find a market for reaping farmers' crops with a self-propelled multi-crop reaper?**
 - ◆ **How much do farmers currently pay for harvesting by hand?**
- ◆ **Do they pay additional costs for binding and carrying?.**
 - ◆ **What is my capacity to provide a reaping service?**
- ◆ **What is the likely profit from my proposed self-propelled multi-crop reaper business?**

Review of key messages (2)

- ◆ What does it mean to 'break even'?
 - ◆ To break even, what size area do I need to reap each season and with which crops?
- ◆ How much time (in months or years) do I need to break even?
 - ◆ What benefits do farmer-clients obtain from a self-propelled multi-crop reaper business?



Session 7

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

**Self-propelled multi-crop reaper
one-day training flipchart**



End of training, review of key messages (1)

- ◆ What are the advantages of the self-propelled multi-crop reaper?
 - ◆ What are its main parts?
- ◆ What are the important considerations when starting a self-propelled multi-crop reaper?
 - ◆ What are the key safety points to remember?

End of training, review of key messages (2)

- ◆ **What are the most common types of failure and breakdown? What are their causes and solutions?**
 - ◆ **What do we mean by a 'business'?**
- ◆ **How can you make self-propelled multi-crop reaper services profitable for yourself and at the same time benefit farmers?**
 - ◆ **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 check (✓) or circle the correct answer **Total time: 10 minutes**

Question	Answer		
1. Which crops can be harvested using a self-propelled multi-crop reaper?	All types of crops	Wheat, rice, mustard	Maize, sugarcane, sorghum
2. What is the function of the star wheel?	It helps operate the machine	It helps to cut the crop	It helps move the machine forward
3. Can the self-propelled multi-crop reaper be used in a field with wet or damp clay soil or standing water?	Yes	No	It can only be used in these conditions with a cage wheel
4. How big an area of wheat can a reaper harvest in one hour?	0.2-0.4 hectares or the equivalent	0.2-0.5 hectares or the equivalent	It depends on the speed at which you operate the machine and the conditions in the field
5. Why might the star wheel break?	Due to an excessive load on the engine	The straw and stems of the crop being cut are wet, or the amount is too large, causing jamming	The star wheel is not in contact with the cutting blades
6. Why might the flat bar break?	Its nuts and bolts are not properly tightened	Insufficient lubricant	The cutter bar hasn't been cleaned properly
7. What happens if the cutting blade breaks?	The blade will not cut the crop	The machine jams	Both answers are correct
8. Why might the cutter bar not move?	The chain in the transmission gearbox has snapped	One or more star wheels have broken	There is a jam near the pressure spring
9. How can you repair a bent pressure spring?	Press it straight	Loosen the nuts and bolts and straighten the spring	Replace the pressure spring with material you can find on your farm
10. What are the characteristics of the crops you can harvest with the self-propelled multi-crop reaper?	Crops that have fallen over	Straight crops that are standing upright	Long-duration, local varieties of rice

Post-training evaluation questionnaire

Venue:
(to be completed by the facilitator)

Batch:

Date:

Name: _____

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

Question	Answer		
1. Which crops can be harvested using a self-propelled multi-crop reaper?	All types of crops	Wheat, rice, mustard	Maize, sugarcane, sorghum
2. What is the function of the star wheel?	It helps operate the machine	It helps to cut the crop	It helps move the machine forward
3. Can a self-propelled multi-crop reaper be used in a field with wet or damp clay soil or standing water?	Yes	No	It can It can only be used in these conditions with a cage wheel
4. How big an area of wheat can be reaped by a self-propelled multi-crop reaper machine in one hour?	0.2-0.4 hectares or the equivalent	0.5-0.2 hectares or the equivalent	It depends on at which speed you operate the machine and the conditions in the field
5. Why might the star wheel break?	Due to an excessive load on the engine	The straw and stems of the crop being cut are wet, or the amount is too large, causing jamming	The star wheel is not in contact with the cutting blades
6. Why might the flat bar break?	Its nuts and bolts are not properly tightened	Insufficient lubricant	The cutter bar hasn't been cleaned properly
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9. How can you repair a bent pressure spring?	Press it straight	Loosen the nuts and bolts and straighten the spring	Replace the pressure spring with material you can find on your farm
10. What are the characteristics of the crops you can harvest with the self-propelled multi-crop reaper?	Crops that have fallen over	Straight crops that are standing upright	Long-duration, local varieties of rice
• Did you understand all the messages delivered by the facilitator(s)?	No	Partly	Fully
• How do you rate the training?	Not very useful	Useful	Very useful
• Do you feel confident that you can use the reaper profitably while also saving money for your farmer-clients?	Yes	No	Unsure

Answers to questions 1 to 10

- 1. Wheat, rice, mustard**
- 2. It helps to cut the crop**
- 3. It can only be used in these conditions with a cage wheel**
- 4. It depends on at which speed you operate the machine and the conditions in the field**
- 5. The straw and stems of the crop being cut are wet, or the amount is too large, causing jamming**
- 6. The cutter bar hasn't been cleaned properly**
- 7. Both answers are correct**
- 8. The chain in the transmission gearbox has snapped**
- 9. Loosen the nuts and bolts and straighten the spring**
- 10. Loosen the nuts and bolts and straighten the spring**

Annex 2

Self-propelled multi-crop reaper machines for rapid and low-cost rice and wheat harvesting



Islam, K.S., Krupnik, T.J., Yasmin, S., Hoque, Md. A., Siddique, R. 2014. Multi-crop reaper machines for rapid and low-cost harvesting. CIMMYT. Dhaka, Bangladesh. Twelve-minute technical video. In Bangla with English subtitles. Available online: [Click here](#) (in Bangla) and [here](#) (with English subtitles).

The self-propelled multi-crop reaper is an innovative machine that facilitates the rapid and low cost harvesting of rice and wheat. Its small size and ease of operation and movement makes it ideal for Bangladesh's small fields. Rice or wheat reaping efficiency is about 5 hours per hectare, compared to 240 hours per hectare if performed by hand. The majority of the rice and wheat grown in Bangladesh continues to be harvested manually. Where farmers are unable to find or afford sufficient labor for harvesting, crop losses can occur before the crop even leaves the field. In addition, late rice harvesting also sets back dry season planting, and can cause large yield losses of the subsequent crop – up to 57 kg/hectare lost per day of late planting in wheat, for example. Use of the self-propelled multi-crop reaper can thus save farmers time and money, and accelerate the turnaround time between crops.



Annex 3

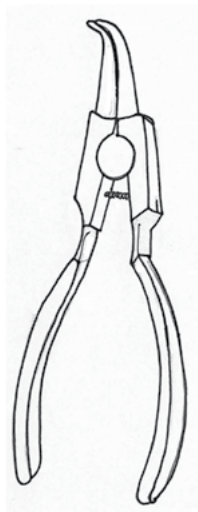
Common tools used to repair multi-crop reapers



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.

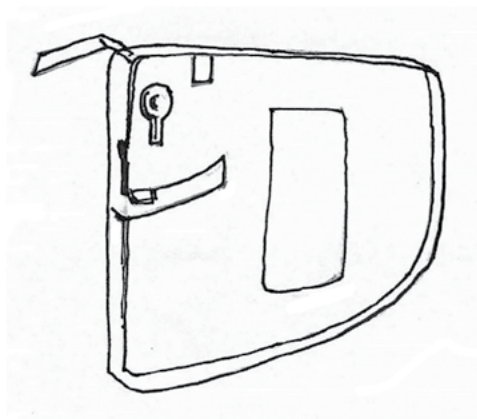


Pliers/cutting pliers: Used to grasp small objects, and to insert/extract or turn them. Pliers often have small cutting blades that can also be used to cut wire or other materials.



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

Common tools used to repair multi-crop reapers (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 one has the best grip.

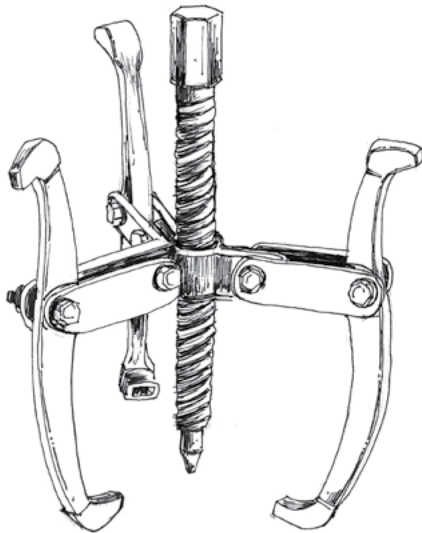
Common tools used to repair multi-crop reapers (3)



L-dull wrench: Used to grip bolt heads. This one has two gripping areas at each end.



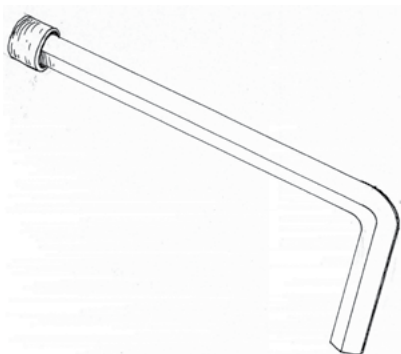
Ratchet: Used to turn the head of a bolt in one direction but not the other. It makes it easy to tighten or loosen bolts without having to take off the tool each time (as with pliers or wrenches).



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



Files (flat and 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: Used to tighten or loosen bolts that have an 8-sided hex 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 self-propelled multi-crop reapers 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 the 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 in-depth knowledge that the trainee farmers and agricultural machinery service providers already have. By the conclusion of the training module, participant service providers will be well-equipped to repair self-propelled multi-crop reapers 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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