Planning good crop-management practices

To apply good crop-management practices, it is necessary to know the various development stages and phases of the rice plant (Reference 8). For example, to know the appropriate transplanting time, it is important to know when the rice plant starts developing tillers and for how long. When transplanting is late, a good part of the tillering potential can be lost. Plant development also determines the 'right' time for weeding and fertilizer applications. This module deals with the links between plant growth stages and the appropriate timing of crop management practices. This module also links to References 6, 7 and 11.

Learning objectives

At the end of this session farmers will:

- Have an overview of the rice-plant developmental stages.
- Have a good knowledge of the critical stages in plant development, i.e. tillering, panicle initiation and flowering.
- Know the optimal management practices to be carried out at the different developmental stages, i.e. transplanting, weed control, fertilizer application and water management.

❶ Introduce the materials (e.g. cotton cloth, figures) and the principles used for constructing the calendar.

❷ Picture the rice-plant development cycle:
- Start with extreme stages—seed and rice plant at the maturity phase;
- Introduce successively the following stages: flowering, booting, panicle initiation, then seed germination, four-leaf, tillering initiation and maximum tillering stages;
- Introduce the three plant development phases;
- Make a metaphor with the construction and filling of a grain store.

❸ Develop the cropping calendar with a few representative farmers:
- Start with the extreme stages—nursery sowing and rice harvesting;
- Then introduce successively the following practices: transplanting, weed control and fertilizer application.

❹ Discuss the appropriate crop management practices, in particular timely transplanting, weed control and timely fertilizer application.

Procedure

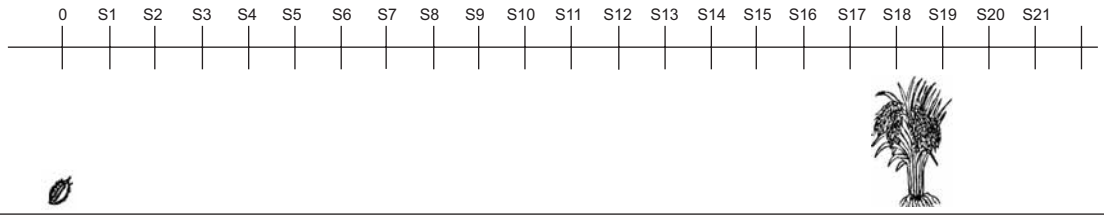
1. Farmers and the PLAR-IRM team meet at the PLAR-IRM Center. The facilitator briefly reviews the previous module and invites farmers' feedback.

2. One of the PLAR-IRM team members explains the learning objectives and procedures for the current module.

3. The facilitator displays a piece of cotton cloth with a horizontal line in the middle, graduated into 21 weeks of 7 days each and he/she explains that time is represented on the horizontal line. The facilitator explains that *below* the line, small 'figures' will be placed to represent the plant development stages and that *above* the line; figures will represent the major management practices[1].

4. First, the rice-plant development cycle is discussed using plants of different ages taken from the field and figures, which will be placed below the timeline:
   - The facilitator first shows the seed and the figure that represents the rice seed and explains that this rice development stage corresponds to point 0 on the timeline and that it is also the time for *nursery sowing*. The facilitator places the figure at point 0 below the timeline.
   - Then farmers discuss about the duration of the cropping cycle (in days or weeks) of the commonly grown lowland rice variety in the area. The facilitator presents a plant at maturity stage and the figure of the rice plant at *maturity*, and invites a volunteer farmer to put that figure at the week on the calendar corresponding to the duration of the rice cycle (below the line), i.e. the period coinciding, in general, with the harvesting time.
   - Then, the facilitator asks farmers about the stage prior to 'maturity' and thus presents the *flowering* stage, which usually takes place some four weeks before maturity. The facilitator shows a plant at the flowering stage and leads the discussion on the period between the

Step 1: Beginning and end of plant development cycle of rice



1. To efficiently 'set' the schedule with farmers, the facilitator must have some knowledge of the duration of the seedling (seed) development cycle up to the maturity stage for the most common variety.

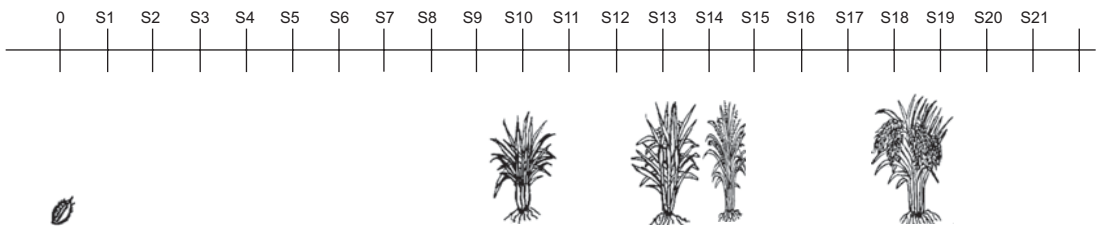
flowering and maturity stages and invites a volunteer farmer to identify the corresponding figure and to fix it on the calendar in the appropriate place below the timeline.

- Afterwards, the stage prior to flowering is introduced, i.e. *heading* stage. The facilitator shows a plant at heading; leads the discussion and invites a volunteer farmer to identify the corresponding figure and to fix it on the calendar below the timeline, i.e. about a week before flowering.

> Between panicle initiation and heading, the panicle is developing in the tiller, a stage that is referred to as booting.' Farmers usually know this stage and often call it 'pregnancy'; they generally know that the swelling of the leaf sheath contains the panicle that comes out shortly before flowering, a stage that is called 'heading.'

- Then, the *panicle initiation* stage is introduced. The facilitator takes a plant at panicle initiation stage and opens the leaf sheath lengthwise right above the base node to show the 'whitish cone,' which is the beginning of the panicle. The facilitator asks farmers their opinion on the duration between this stage and flowering, and explains that panicle initiation starts some four weeks before flowering and the corresponding figure is placed at the right location on the calendar below the line.

Step 2: Further development of cycle, including flowering, booting and panicle initiation

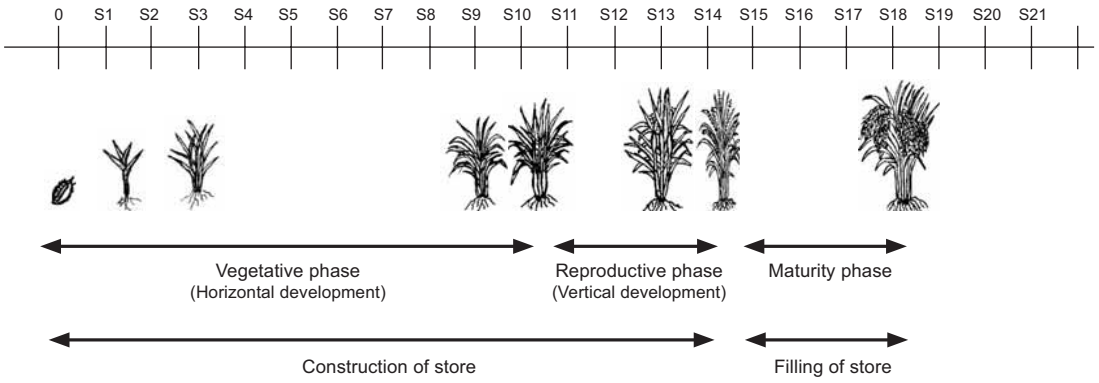


- Afterwards, the facilitator goes back to the first figure, i.e. 'the seed' and presents the stages of *seed germination* and *four-leaf seedling.* Farmers put the corresponding figures below the line, at locations corresponding to the stage after sowing.
- Then, the facilitator asks farmers about their knowledge of other development stages between 'four-leaf seedling' and 'panicle initiation,' and thus presents the phenomenon of *tillering initiation*. The facilitator asks farmers about the starting time of tillering. He/she shows a plant at tillering stage and the figure of tillering initiation is put at the corresponding location on the calendar below the line. Then, farmers discuss about the period when the tillering stage ends and the figure of *maximum tillering* is put at the corresponding location on the calendar below the line. He/she shows a plant during the maximum tillering stage.

> Farmers generally do not have a clear idea of the end of the tillering stage and may think that tillering can last until flowering. It is necessary to indicate that maximum tillering takes place just before panicle initiation. It can be useful to show a plant at maximum tillering stage and to indicate its age.

- After viewing the main plant development stages, the facilitator introduces the three development *phases*: the *vegetative phase* (sowing to panicle initiation), the *reproductive phase* (panicle initiation to flowering) and the *maturity phase* (flowering to maturity). The facilitator explains that the reproductive and maturity phases each last about one month. The vegetative phase lasts longer and is more variable depending on variety, sowing time and weather conditions. The facilitator explains to farmers that, as a 'rule of thumb,' only the duration of the vegetative phase varies in rice and accounts for the differences in growth cycle between varieties.

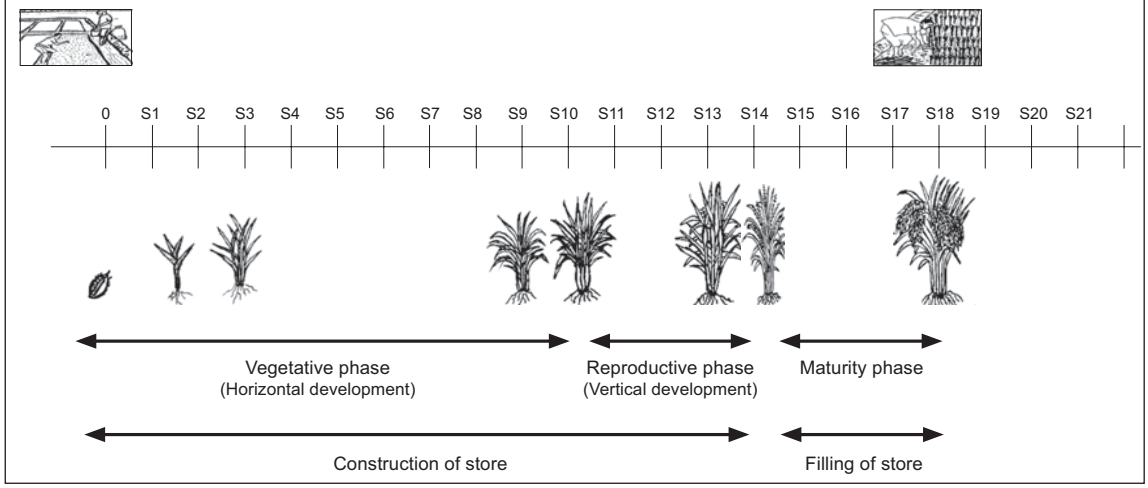
Step 3: Further development of cycle, including four-leaf stage, beginning of and maximum tillering



- Then the facilitator introduces a metaphor to compare the rice-plant development phases with the construction and filling of a grain store:
  - The vegetative and reproductive phases are compared to the construction of the store: the vegetative phase—which corresponds to the 'horizontal' development of the plant—is likened to the laying of the foundations for the grain store, and the reproductive phase—which corresponds to the 'vertical' development of the plant—is likened to the construction of the store walls and roof;
  - The maturity or grain-filling phase (when seeds are filled) is compared to the filling of the store;
  - The facilitator explains that it is important to build a store adequately, i.e. a well-built big store should stand on a solid foundation (vegetative phase) with adequate space inside, solid walls and roof (reproductive phase) that will allow the stockpiling of a lot of rice grains (maturity phase). If, on the contrary, the foundation and walls of the store are not well laid and raised, no matter what is done afterwards (i.e. after the vegetative and reproductive phases), there will never be a lot of space to store the rice.

5. Next, the crop management practices are displayed on the calendar by fixing the figures above the timeline. The facilitator can choose a few scenarios with farmers who have contrasting practices. The scenarios are addressed one after another:
   - The facilitator first takes the figures for *nursery sowing* and *rice harvesting* and invites one farmer to put them above the timeline.

Step 4: Visualizing farmer practices, beginning and end



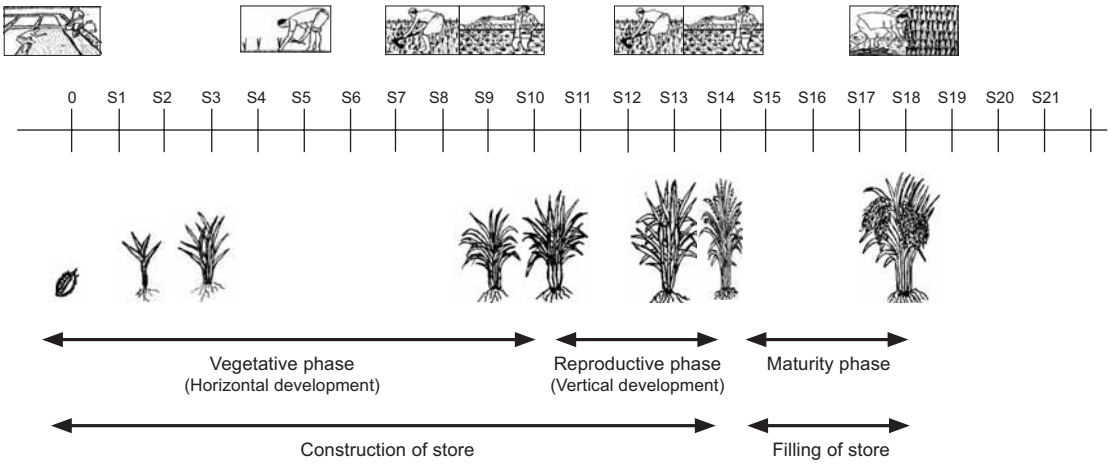
   - Afterwards, the facilitator shows the figure for *transplanting* and farmers discuss about the transplanting period. The farmer puts the figure at the location corresponding to the time when he/she transplants.

> It is very important to differentiate between what farmers know (consider as optimal) and what they actually do. Farmers often know the optimum transplanting period (2 to 3 weeks after sowing), but observations in the field will often show that only a few actually transplant at that time. At the beginning of the discussion, farmers may claim that they do everything the optimal way; however, it is obvious that in fact this seldom happens. The facilitator must then explain clearly the importance of presenting the field reality so as to discuss afterwards about the constraints that prevent them from applying optimal management practices.

   - Next, the facilitator addresses weed management practices. The facilitator leads the debate, asking the following questions:
     – why is it important to weed? Think of competition for light, water and nutrients, the air circulation, hindrance to tillering, accumulation of heat—weeds are often more competitive than rice plants,
     – what are the indicators for weed control? How are weeds controlled: through herbicide application, manual and mechanical weeding; when are these activities conducted and why at these specific moments? Are there constraints to their implementation?

- Farmers are invited to place the figures for *manual weeding*, *chemical weed control*, *mechanical weed control, mineral fertilization*, and *organic manuring*. It is important that the farmer represents his or her own management practices and does not represent an 'ideal' scenario.
- The facilitator addresses fertilizer practices in rice cultivation. The facilitator leads the discussion using the following questions:
  - why is it important to fertilize rice? Think of the nutrient requirements,
  - what are the indicators that the plant should be 'fed'? Which types of mineral or organic fertilizers are used? When are they used and why are these activities conducted at those stages? Are there any constraints to optimal fertilizer application?
- The farmer is invited to put the figures for fertilizer application at the appropriate locations on the calendar, on the same line as the figures for weed control.

Step 5: Further developing the cropping calendar, including transplanting, weed management and fertilizer application



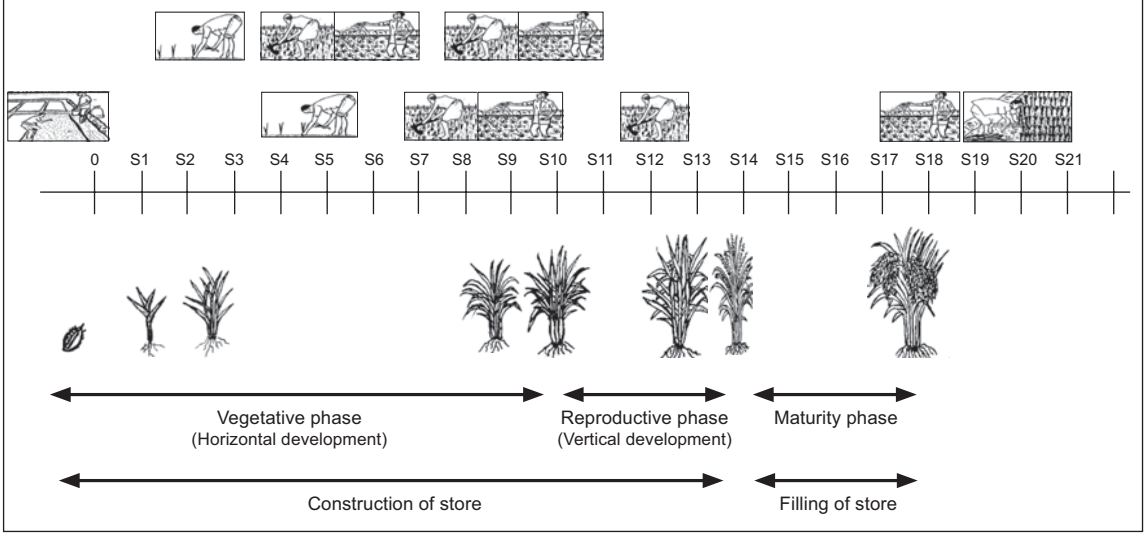
6. Discussion of appropriate practices necessary to allow the rice plant to develop well (vegetative and reproductive phases):
   - Timely transplanting: when the seedling has four leaves and before tillering; on the calendar, this means 2 to 3 weeks after sowing:
     - On a point above the lines on which farmers indicate practices, the figure for transplanting (usually in a different color from the one representing farmer practices) is put at the appropriate location (i.e. two to three weeks after sowing);
     - Farmers discuss factors preventing them from transplanting on time; this can highlight a need to design a specific module focusing on these topics.

Transplanting is stressful to the plant—the plant will experience a 'transplanting shock,' which usually lasts for at least four days; during that period, the young plant must produce new roots to settle in the soil—the younger the plant at transplanting the better its ability to withstand transplanting shock, because it will require fewer roots to settle. An older plant has a lot of roots that are going to die after transplanting and a lot of new roots are needed for an older plant to recover from transplanting shock (a comparison can be made with someone who breaks his leg: a young person will recover more quickly than an older person).

Given that the tillering period is restricted to the vegetative phase, everything should be done so that the plant can grow normally and in a condition to produce tillers; this is not possible in the nursery because there is not enough space. When transplanting is carried out late, there is little time for the plant to produce enough tillers. For example, if transplanting is carried out at six weeks after seeding and given that the plant requires almost a week to recover from shock after transplanting, there would be only two weeks left to produce tillers[2]; it will not be a surprise if such plants develop only a few tillers.

Late transplanting is often associated with organizational issues. For instance, when water management is an issue, farmers can be prevented from transplanting young seedlings because of the risk of flooding. Improving the water distribution (irrigation and drainage) system can solve part of the issue. This requires cooperation among the farmers or within the local organization. Similarly, the problem of timely land preparation may be the issue. This may be due to poor organization to arrange timely arrival of the land-preparation equipment.

Step 6: Elaboration of cropping calendar with appropriate practices

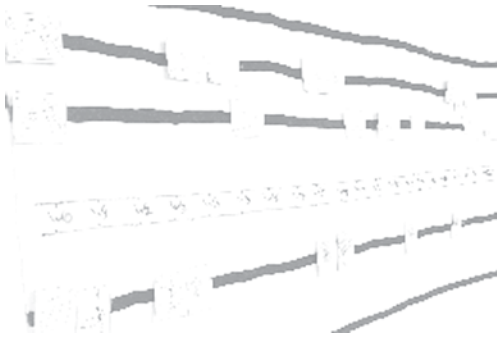


2. In this example, the period between sowing and panicle initiation was estimated at nine weeks.

- Weed control and fertilizer application:[3] The following topics are addressed:
  - the importance of regularly inspecting the field,
  - the most harmful period for weed infestation—note that weeds can especially be detrimental during the tillering stage,
  - the importance of removing weed spikes after rice flowering so as to avoid weed seeds falling to the ground and causing more problems in the future,
  - the period of fertilizer application (just after weeding). Otherwise, fertilization has little or no effect on rice growth. The most important nutrient for rice is nitrogen (N), which is very water-soluble and therefore lost quickly through leaching or volatilization (gaseous losses to the air),
  - there are two important times for urea (N) application: after weed control (i.e. 3 to 4 weeks after transplanting) and at the beginning of panicle initiation (7 to 8 weeks after transplanting),
  - applying fertilizer after flowering will often be a waste,
  - fertilizer application during or before it rains should be avoided, because the fertilizer can be washed away by water;
- Above the lines that indicate farmer practices, fix figures for weed control and fertilizer application (in a different color from those representing farmer practices) at the appropriate spots;
- Farmers discuss the factors that prevent them from controlling weeds and applying fertilizers in a timely manner.

7. Evaluation: the facilitator asks what the farmers appreciated (or did not appreciate), what they learnt, and what they intend to do with their newly obtained knowledge.

8. The facilitator asks volunteer farmers to conclude the session, and then invites farmers to the next session.



3. There are specific modules focusing on soil fertility and weed control.

Time required

- Three hours

Materials required

- Cotton fabric to represent the schedule.
- Figures.
- Markers of several colors.
- Rice plants at various development stages.

Box 6

After a detailed discussion of the cropping calendar with farmers from Bamoro, we asked them what should be done to build a good 'grain store':

- Farmers said that a good location should be found for the nursery, and that appropriate land preparation and seed priming (Module 5) are necessary. (There will be a specific session on nursery establishment.)
- Thereafter, the discussion focused on transplanting in relation to the tillering period. Farmers were familiar with the idea of transplanting at more than 30 days after sowing, but admitted that this was more a wish than reality. In fact, transplanting was often conducted at 50 or even 60 days after seeding. The ideal is between 15 and 20 days, but farmers knew that this is difficult in their lowland with poor water management, because the young seedlings may be submerged. The following elements were discussed in relation to transplanting at 20 to 30 days after sowing:
  - Transplanting gives a shock to the seedlings, lasting for at least four days; during this period, the young seedling must produce new roots to re-anchor in the soil—a younger plant will withstand this transplanting shock better than an older plant, because it will need to produce fewer roots to become secure in the soil. On the other hand, an old plant has a lot of roots that are going to die after transplanting and a lot of new roots are needed for it to recover from the shock (a comparison was made with someone who breaks his leg—a young person will recover more easily than an old person);
  - Because the tillering period is limited, everything should be done so that the plant grows normally to attain the best tillering conditions: adequate tillering is not possible in the nursery, because there is not enough space. When transplanting is conducted late, there is little time for the plant to produce enough tillers needed for a good grain yield; for example, if transplanting is conducted at 40 days and given that the plant needs almost five days to recover from stress after transplanting, there will be only 10 days left (days 45 to 55) to produce tillers, it will therefore not be a surprise that such a plant will produce only a few tillers.
- A third way of building a sound 'grain store' was discussed related to weeding and fertilizer application. Farmers first explained the reasons for timely weeding: allowing air movement between rice plants, avoiding rodents and pests, and ensuring tillering. They did not talk about competition for nutrients, water or sunlight. Weeds are often more efficient at capturing solar energy and extracting soil nutrients, to the detriment of rice plants. The following comparison was made: there are people who were not invited but who come to eat from your plate; in this case, there will be less for you. Farmers indicated that they start weed control about 20 days after transplanting, which corresponds to about 50 days after sowing, as they indicated that transplanting is conducted at 30 days.
- The discussion focused on the detrimental effect of weeds during tillering and panicle initiation until flowering.
- The case of *Echinochloa* was discussed—the importance of removing the spikes after rice flowering was stressed to avoid *Echinochloa* seeds shattering, causing more problems in the future.