2. Agricultural Tools

2.1 Activities During the Agricultural Season

SEASON	Pre-Sowing
OBJECTIVE	Provide an overview of FFBS activities throughout the agricultural season
USED TO	Familiarize staff and facilitators with key FFBS activities

Background

This session provides an overview of scope and format of FFBS activities to be completed for the agricultural season. The facilitator should prepare a work plan that will fit with seasonal agricultural activities within the structure of weekly/bi-weekly farmer workgroup meetings. This will serve as a basis for incorporating modules for other Pathways components (markets, nutrition, gender, and group empowerment) in the farmer workgroup meetings.

Components of the Program

Program and planning of season activities: A work plan should be prepared in advance of planting and FFBS sessions to guide the facilitator through the season's agricultural activities (see "Example of an Agricultural Seasonal Program for Cassava" on the next page). The program shows the timeline of the cropping season with developmental crop stages by anticipated number of weeks after sowing, in addition to the activities planned. This program will also serve as the basis for planning around the other Pathways components of markets, nutrition, gender, and group empowerment.

Weekly or bi-weekly meetings: The FFBS activities are based on crucial weekly or bi-weekly meetings depending on timing of the season and the crop. Every fortnight farmers exchange knowledge and learn something new about the crops, constraints, and ways to deal with these constraints. During these bi-weekly meetings, other trainings on gender, nutrition, markets, and community mobilization are delivered.

Planning the meetings: Meeting planning is an important component that involves creating a short list of activities such as: checking who is present /absent, work and observation in the field, identifying special topics to be discussed (see "Sample Daily Plan" found on the next page).

Observations: During each meeting, farmers will make observations in small groups on plants, weeds, diseases, insects, and climate. These observations are then presented and discussed with the larger group under the guidance of the facilitator. To standardize observations use a customized observation form (see "Sample Observation Form" found on the next page).

Discussions: During every meeting, farmers from each workgroup present their findings and observations to the entire group. This should lead to discussion, recommendations for action, and consensus regarding crop management.

Other topics: According to budget and availability, specialists/ scientists may visit the FFBS at different points throughout the season to discuss or present a special topic on agriculture, marketing, or nutrition. Topics could include germination tests, weeds and weed control, diseases, insect pests and their control, seed conservation practices, etc. for agriculture topics; child marriages, gender based violence, etc. for gender topics; relations with buyers, identifying markets, etc. for marketing topics; and exclusive breast feeding, choosing what to plant, etc. for nutrition topics. The topics may be deleted or added to the curriculum according to the wishes of the participants, emerging issues, and country specific circumstances.

Example of an Agricultural Seasonal Plan for Cassava

WEEKS BEFORE/ AFTER SOWING	DEVELOPMENT STAGE OF CROP	ACTIVITIES
6 wks prior	Preparation	Field preparation and layout
2 wks prior	Cuttings	Selection of planting materials
1 wk after	Cuttings	Planting
3 wks after	Sprouting	Gap-filling
4 wks after	Sprouting	Rouging (removal of the plants that have CMD, CBSD, and CGM)
4-18 wks after		Weed Control
4 wks after	Vegetative	1st weeding
8 wks after	Vegetative	Rouging
10 wks after	Vegetative	2nd weeding
12 wks after	Vegetative	Rouging
16 wks after	Vegetative	3rd weeding
18 wks after	Vegetative	Rouging
32 wks after	Maturity	Harvesting

Sample Daily Plan (to fill in timings for various areas/groups)

HOUR	ACTIVITIES
30 minutes	Greeting
	Attendance check
	Presentation of daily schedule
	Other important matters
60 minutes	Field work (Planting, weeding, thinning, manure application etc)
	Observations (using observations form)
	Discussions and recording of observations by work group
30 minutes	Plenary discussions of observations
	Determination of way forward
15 minutes	Short story, joke telling, or fun exercise for team building –use one of the group strengthening tools for this purpose
15 minutes	Special topic
30 minutes	Evaluation of the day's activities Planning of future meeting(s) Closure

Sample Observation Sheet

Name of FFBS:	
Date:	
Date planted:	
Treatment:	
Weather: *Sunshine (clouded or clear sky)* *Temperature (hot, moderate, cool)*	
Observations:	
Plant stand *(number of plants per plot)*	
Soil moisture: *(Dry, moist, very moist, flooded)*	
Diseases observed: *(List of all important for crop in area)*	
Insect pests observed: *(List of all important for crop in area)*	
Weeds observed: *(List of all important for crop in area)*	
Deficiency(ies): *(Yellowing for N, purple for K, etc.)*	
Weeds seen: *(List of all important for crop in area)*	
Predators:	
Recommended actions based on observations:	

2.2 Selecting the FFBS Plots

SEASON	Pre-Sowing
OBJECTIVE	To select a piece of land for the FFBS experimental plots
TIME FRAME	30 minutes
MATERIALS NEEDED	Flip chart paper and marker pens
IDEAL WORKSPACE	Enough space for all participants to sit

Background

Once participants have registered for the FFBS, a farm for the FBBS plots must be selected in consultation with participants and local leaders. Involving the community in this process will enhance their participation and ownership of the process as well as their willingness to attend lessons in the selected locations.

Steps to follow for the activity

▶ **STEP 1.** As a group, take the participants through some of the criteria for choosing FFBS plots. The selected farm should:

- Be situated in the community in which the growers live.
- Be representative of the area's farms in terms of the soil type, topography (slope), and presence of other crops/ trees.
- Have management problems common to the area to allow for participatory learning.
- Not have problems that will make it difficult to show positive results after implementing Pathways improved practices; avoid abandoned farms or farms with a poor history.
- Be close to the village and near a road for easy accessibility; if a road location is not possible, then the site should be along a well-travelled footpath so that non-FFBS farmers can observe operations.
- Have a total size of at least 1 hectare; if the farm is too small, the FFBS plots will cover a large area of the total farm and the farm owner may fear implementing new practices.
- Have an owner ready to release the plots to the FFBS by agreeing to apply all management/cultural practices on the plots without restriction and to all of the requirements and requests made by the FFBS; written contracts with farm owners may be helpful in some cases (see below).
- Be worked on by all participants of the FFBS.
- Have a size determined by the planned crop(s) and treatments that are to be evaluated.

▶ **STEP 2.** Based on the understanding of the key criteria (above) discussed during the training, help guide the assembled farmers' group through a selection of appropriate plots.

▶ **STEP 3.** If desired, the plot owner and the community should sign a mutually binding contract outlining the terms and conditions of their agreement. Use the contract found on the next page as an outline.

Example of a Contract with Plot Owner and FFBS

Contract between (please print names):

_____	_____
Farm owner	**Relevant authority e.g. farmer organization**

In relation to the Farmer Field and Business School (FFBS) that will take place in the village of XXX, the above mentioned parties agree to the following terms:

1. The farm owner agrees to let the Farmer Field and School use [a part of his farm…specify area] for the implementation of the FFBS.

2. The area to be used by the school will consist of ___ number of plots of ___ size (or specify area) chosen by the FFBS facilitator and participants. One or two plots will be used for implementing practices decided on by the FFBS participants. On the other plot(s), participants will implement management practices normally done by the farm owner or those agreed upon as common within the group. All work on the two or three plots will be carried out by the FFBS participants.

3. The farm owner agrees to allow the FFBS participants to carry out all practices as necessary for learning objectives. FFBS participants will be allowed to make observations on other parts of the farm (beyond the two plots mentioned in 2).

4. The farm owner agrees to respect all requests from the FFBS related to activities on the two/three plots.

5. The FFBS will supply all inputs used on the FFBS plots.

6. The farm owner agrees that he/she will not seek compensation from the FFBS _____ (project, farmer organization) even if he/she suffers loss in production due to vagaries of weather and other abiotic stresses.

7. The length of this contract will be _____ months, from _____to _____, ____ (year).

8. This contract can be ended without notification under the following circumstances:
    1. Failure by either party to respect their obligations as set out in this contract
    2. Failure to limit FFBS activities to the area/crops mentioned in this contract

Signatures: Plot owner, FFBS team leader, community representatives & authorities.

Plot Owner _____ Date: _____

FFBS Team Leader _____ Date: _____

Community Representative _____ Date: _____

Authority _____ Date: _____

2.3 Setting Up FFBS Demonstration Plots

SEASON	Pre-Sowing
OBJECTIVE	To set up the experimental plots for the FFBS; Determine plot size, experimental options, and materials required to conduct activities throughout the season
TIMEFRAME	1 hour
MATERIALS NEEDED	Flip chart and marker
IDEAL WORKSPACE	Enough space for both standing and sitting

Background

As part of the planning process for the FFBS, the demonstration set-up exercise will have facilitators and farmer workgroups consider the plot size and materials required to run their specific FFBS plots. Farmer workgroups should identify their priority constraints in production and possible solutions at a group level prior to this session. A comparison of Urea and Urea Super Granule fertilizers can be found on the next page for participants who may want more information.

Steps to follow for the activity

▶ STEP 1. **Determine plot size.** Together with farmers, determine the ideal demonstration plot size. The ideal FFBS plots should be 30 meters x 20 meters for the farmers practice and 30 meters x 20 meters for the experimental practices. Small side plots can be established for additional trials, up to a maximum of three topics per site.

These can differ per site according to the wishes of the farmers and the priority constraints of each crop. Plots that are too large may cause farmers to concentrate on working rather than learning, and those that are small may prevent the comparison of treatments.

▶ STEP 2. **Determine experimental plot practices.** In the group, pick 1-3 experimental plot practices. The number of plots will depend on the number of FFBS sites and the number of participating villages. Additionally, the number and type of experimental plot practices will vary based on the size of the plot(s) and the desires of the group. This can change from season to season as more collectives are brought into the program. Examples of this may include:

EXAMPLE PLOT 1	
Dry seed bed	Wet seed bed

EXAMPLE PLOT 2		
Use of compost	Use of chemical fertilizer	Use of both types of fertilizer

Different experimental plot practices can include:

- Use of organic fertilizer, alone or in combination with mineral fertilizer
- Local and improved varieties –early maturing, resistant to pests and diseases, etc.
- Different intercrops and sowi ng densities

▶ STEP 3. **Identify materials required for installing the experimental field.** Based on the size and type(s) of experimental plot(s), prepare a list of materials required to establish them. This list may include the following:

- Rope, measuring tape, sticks, pegs, name plate or tags for the each of the test plots
- Seeds of choice crops (local variety and improved resistant/ tolerant varieties) and intercrop (appropriate varieties for agro-ecology and farmers preferences)
- Organic fertilizer (compost, manure or farmyard manure) and/or mineral fertilizer (composite and/or nitrogen fertilizer)
- Optionally, a sprayer and insecticide to treat pests and diseases.

▶ STEP 4. **Fill out a table of the required materials for all the FFBS plots.** Be sure to include:

- Seed: Variety, Quantity, Quality (from germination-80% recommended)
- Organic fertilizer type: Compost (preferred), manure, farm yard manure (depending on availability)
- Organic fertilizer quantity: Rates and measures of application
- Mineral fertilizer type: composite, nitrogen
- Mineral fertilizer quantity: Rates and measures of application

Develop a list of materials needed for the facilitators and farmers for conducting evaluations through the season. Use the following as a guide and change as appropriate:

ITEM	USE	WHO USES IT?	NUMBER PER FFBS SITE	FREQUENCY (SEASON)	TOTAL
Measuring tape	Plot measuring delimitation	All participants	1	1	1
50-meter cord	Plot measuring delimitation	All participants	1	1	1
Name plates	Indication for the Farmer Practice and all other treatments	All participants	2-4 depending on number of treatments	1	1
Notebook	Observe and note	Farmers	20-30	1	20-30
Blue and red pen	Observe and note	Farmers	20-30	1	20-30
Pencil	Observe and note	Farmers	20-30	1	20-30
Eraser	Observe and note	Farmers	20-30	1	20-30
Document holder	Observe and note	Farmers	20-30	1	20-30
Measuring tape (2m)	Observe and note	Farmers	20-30	1	20-30
Scissors	Cut paper, tape etc.	Workgroups	4-5	1	4-5
Permanent marker set (1 blue, 1 black, 1 red and 1 green)	Present observations on flip chart	Workgroups	4-5	2 or 3	8-10 or 12-15
Poster-size paper sheets	Present observations	Workgroups	4-5	14 to 18	56-70 to 72-90
Bags of various sizes depending on crop volume	Harvest plots	All participants	10-depending on treatments	1	8-10

Comparative analysis of Urea and USG (Urea Super Granule)

SL. NO.	BORO VARIETY			AUS/AMAN VARIETY			REMARKS
	LOWER DOSE	OPTIMUM DOSE	HIGHER DOSE	LOWER DOSE	OPTIMUM DOSE	HIGHER DOSE	
Urea (Kg/ha)		260-270	280-290	100-110	130-140		Generally farmers apply higher dose in Boro varieties and lower dose in Aus/Aman varieties. For both lower and higher doses, yield reduces up to 20%
USG (kg/ha)	165-170			110-115			Use of USG reduces 30% urea application and increases up to 25% yield

Reference: USAID-IFDC AAPI project

2.4 Compost Manure Preparation

SEASON	Pre-Sowing
OBJECTIVE	To encourage use of locally available materials to prepare organic fertilizer that is economically and environmentally sound in line with Pathways' approach to sustainable agriculture
TIME REQUIRED	3 hours
MATERIALS REQUIRED	Shovel, forked hoe, composting materials, yard waste and kitchen scrap, garden hose/buckets for water, finished compost or garden soil
WORKSPACE	Outdoor location that will be suitable for a long-term compost pile

Background:

There are two ways to prepare compost:

- *Fast composting:*
  - The pit is filled with thin layers of organic matter that release nitrogen, such as kitchen waste and grass clippings (green organic matter).
  - Water is added after each layer.
  - Soil can be added between these layers.
  - The pile is turned regularly to keep it aerated (10, 25, and 35 days after arranging the layers following the steps above).
  - Compost will be ready within 6 to 8 weeks.

- Slow composting:
  - Main ingredient is organic matter that is rich in carbon, such as paper, branches, and sawdust, (brown organic matter)
  - Fill half of the composting pit with carbon-rich organic matter.
  - Add kitchen waste or vegetable peelings daily.
  - Soil can be occasionally added along with the kitchen waste.
  - The pit content will gradually decompose and compost can then be harvested from the bottom of the pit.
  - Compost will be ready in up to 4 months

Why compost?

What is so special about compost? Why not use organic matter directly? The biggest advantage of using compost is that the organic matter is partially decayed and has a much smaller volume. Further, the microorganism activity has started in the compost before it is applied to crops, allowing for a very high concentration of these microorganisms. This makes the compost a concentrated, easy-to-absorb source of organic matter that benefits crops and reduces waste. By learning about the benefits of compost as well as how to construct and maintain a compost pile, members of the FFBS group will be able to transform their household waste into material that improves their crops.

A visual on the pit composting process, as well as an additional document on the benefits of composting, can be found on the next pages.

Steps to follow for the activity

▶ **STEP 1.** Clear a corner of the backyard by the fence or near the edge of the farm for your compost pit. It should be close to a water source and easy to reach (to throw in household waste), but out of the main traffic flow. Make sure the compost pit is out of the direct sunlight, but away from buildings.

▶ **STEP 2.** Prepare a pit of 1m height, 1m width, and 1m length. The length of the pit can be increased according to the space available in your garden and your compost requirement.

▶ **STEP 3.** Add :

- *Brown organic matter*, such as fallen leaves, woody matter (bark, twigs and branches, sawdust, wood chips), and other materials that contain carbon, such as shredded cardboard and paper. Composting fallen leaves is a much safer alternative to burning them.
- *Green organic matter*, like grass clippings, green garden waste, vegetable scraps, coffee grounds, eggshells, fruits, and other kitchen waste. These items release nitrogen as they break down.

There are different methods of combining the materials. One is to mix brown and green matter together, tossing kitchen or yard waste into the bin or onto the pile as you collect it. The other is to alternate layers of carbon-rich and nitrogen-rich materials, starting with a 6-inch layer of brown stuff topped by 3-inch layer of green stuff, followed by another 3-inch layer of brown stuff, and so on.

> **Tip:** *Avoid using meat and dairy products, including meat and fish bones, oils and grease, and carnivorous animal manure. Don't use grass or plant clippings that have pesticides on them, or pressure-treated wood. Lastly, don't use diseased garden plants or weeds.*

▶ **STEP 4.** Add safe animal manures to the compost heap if available. Use manure from grass, grain and hay eaters, such as cows, rabbits, and chickens.

▶ **STEP 5.** Moisten the pile periodically with water as you add to it. Sprinkle a shovel or so of finished compost (in subsequent seasons) or healthy garden soil over the compost materials to add live microorganisms that will begin to break down the trimmings and scraps.

▶ **STEP 6.** Watch for the pile to settle, a sign that the composting is working. Natural decomposition does the work of transforming the materials, heating up the pile to between 120 and 140 degrees Fahrenheit (49 and 60 degrees Celcius) in a few weeks. Speed things up by turning the pile with a shovel or forked hoe every week or two. Move materials on the outside of the pile into the center. This allows the material to decompose more evenly.

▶ **STEP 7.** Check for signs that the compost is finished in 1 to 4 months. If you layer material and regularly turn it, one or 2 months is sufficient. Your compost is ready to use when all the materials turn into a clean-smelling, crumbly, earth-like brown substance. Use it to enrich your farm soil-rates (See an example of ready-to-use compost on the next page).

Process of Pit Composting

Pit preperation

Shade on pits

Dumping of waste

Watering on waste

Compost ready to use

Benefits of Composting

Reduced use of Chemical fertilizers in different jute varieties when well decomposed cow dung/ compost is applied

JUTE VARIETY	UREA (KG/HA)		MOP (KG/HA)	GYPSUM (KG/HA)
	On Sowing)	45 Days after sowing	On Sowing	On Sowing
O-9897	100		60	95
	45		10	50
	55%		83%	47%
O-4 and CVL-1	83	83		
	27	88		
	64%	4.5%		
OM-1	88			95
	33			50
	59%			47%
OM-72	83			
	28			
	66%			

Reference: BJRI, 2008

Key

INDICATION	DESCRIPTION
	When planted without application of well decomposed cow dung
	When planted with application of well decomposed cow dung at the rate of 5 tons/ha
	Reduced use of chemical fertilizer (%)
	Increased use of chemical fertilizer (%)
	No change when well decomposed cow dung applied

2.5 Germination Test

SEASON	Pre-Sowing
OBJECTIVE	To verify the quality of the available seed and determine its viability to improve chances of good crop establishment
TIME REQUIRED	2 hours
DEVELOPMENT STAGE	Germination and establishment
MATERIALS REQUIRED	Flip Charts, Markers/pens, Containers, Soil, Seed, Water
WORKSPACE	A ready-to-use seedbed

Background

The germination test allows the farmers to check whether their seed is of sufficient quality for sowing and whether they are adequately prepared for the cropping season. The germination test can also be used to test the quality of several different seed lots, different varieties of a crop, and different seed treatments, as well as evaluate seed storage conditions.

Steps to follow for the activity

▶ STEP 1. **Introduction:** Explain that to grow crops, you need three key elements: the seed, the soil, and the climate (which includes temperature, rainfall, and sunshine).

▶ STEP 2. **Preparation of the seedbed**: Explain that germination heavily depends on the preparation of the seedbed; proper preparation requires that the plot be clear of weeds, plant material, and debris and that the soil is tilled and evened out. The soil also needs to drain well to avoid water logging.

▶ STEP 3. **Planting:** Count out 100 seeds of the given crop species 4 times (a total of 400 seeds). Sow them in four 1-meter rows. Each row should have 100 seeds with 1 centimeter between holes and there should be 25 centimeters between rows. Wait for the plants to grow over the next 2 weeks. If there is no rain, make sure to water the plot well every 2 days.

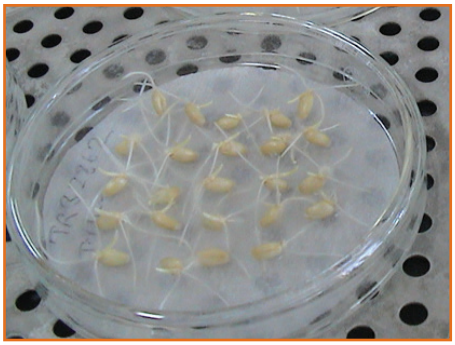
▶ STEP 4. **Determining germination percentages:** After 2 weeks, count and record the number of germinated (emerged) plants in each row. In order to determine the germination percentage, use the following formula:

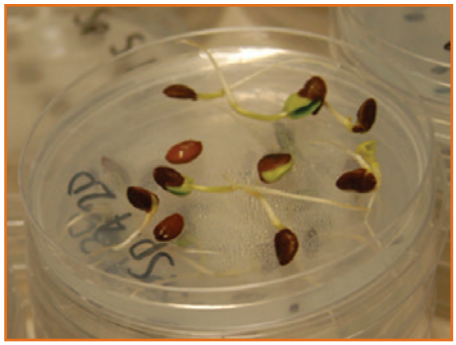
germination percentage = (total # of germinated plants/total # of rows)

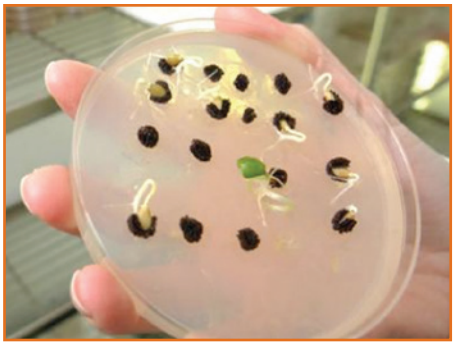
So, if 250 plants emerged from four rows, the germination percentage would be (250/4) = 62.5%.

▶ STEP 5. **Follow up:** Base future action on the following:

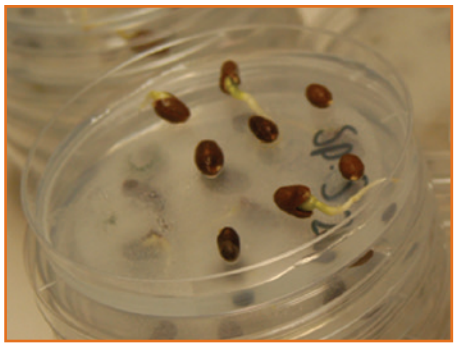
- If the seeds plot has about 70% or more germination and emergence (good seed quality), the seed lot can be used as planned (normally 3-5 seeds per planting hole).
- If the seed lot has between 50%-70% germination and emergence, it is advisable to search for another seed lot or to increase the number of seeds per hole (e.g. 5-8 seeds per planting hole).
- If the seed lot has less than 50% germination and emergence (poor seed quality), it is not advisable to use the seed lot (A visual of different germination rates can be seen below).



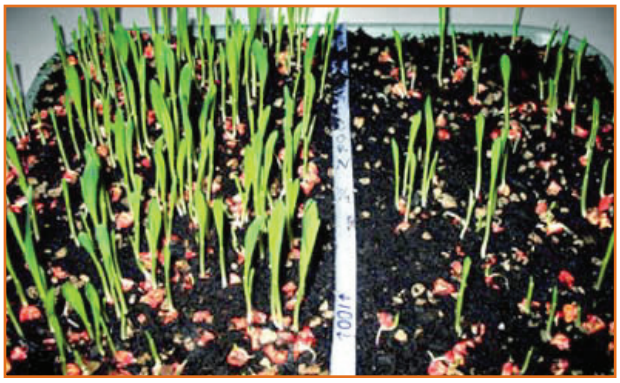




Germination Rate between 70% and 80%



Germination Rate Below 40%



Comparison between Good and bad germination

2.6 Farming Calendar

SEASON	Pre-Sowing
OBJECTIVE	To plan for seasonal activities and other Pathways component activities while being sensitive to the participant's farming commitments; identify and characterize annual agriculture, animal husbandry, forestry, and/or fishing activities.
TIME REQUIRED	2 hours
MATERIALS REQUIRED	Flip Charts, Marker pens
WORKSPACE	Enough room to sit and stand

Background

The farming calendar is a graphic that lists the production cycles throughout the year, including characteristics, activities, and production needs during each cycle. The information, generated in open dialogue between members and facilitators, can be varied and rich. The farming calendar will help guide activity throughout the agricultural seasons.

Steps to follow for the activity

▶ **STEP 1.** Ask the group members to build consensus on and list the key crop and livestock enterprises in the community. If ranking was undertaken as part of a mobilization exercise these key enterprises can be derived from that exercise.

▶ **STEP 2.** Draw a vertical diagram in which the months of the year are indicated along the top of the sheet and the enterprises are listed down the left hand side (see example on next page).

▶ **STEP 3.** Ask group volunteers to speak about their monthly seasonal activities for key crops and Pathways crops. On the diagram, record the monthly activities for each enterprise underneath the corresponding month. It is important to cover the key crops, as they influence decisions on time and resource allocation for all crops.

▶ **STEP 4.** With the information collected, lead discussions about some key issues around the seasons and crops that give further insights into the farming system. Some examples are: seasonal needs for and availability of labor; seasonality of rainfall and drought; availability of irrigation; incidence of crop diseases.

▶ **STEP 5.** Together with the farmers, try to match periods of several important constraints with the different stages of the crop during the season. Write the name of these constraints along the bottom row of the chart in the appropriate month(s). Examples of these constraints are: weeds, insects, diseases, drought, and soil fertility.

▶ **STEP 6.** Try to draw attention to and explain the Pathways approach to possible solutions for these constraints. Stress the importance of future observations in the experimental field and the farmers' own fields.

Example Farming Calendar

GROUNDNUT	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Seed selection												
Germination test												
Land preparation												
Fertilizer application												
Planting												
1st weeding												
2nd weeding												
Fertilizer application												
Pest and disease mgt												
Harvesting												
Post-harvest mgt												
Constraints	1. Seed access/poor seed 2. Insufficient rainfall 3. Marketing-low prices				1. Labor 2. Pests and diseases 3. Weeds 4. Insufficient rainfall				1. Labor 2. Storage 3. Aflatoxin			

2.7 Integrated Soil and Water Management

SEASON	Before, during, and after harvest depending on specific practice and crop; throughout the agricultural cycle
OBJECTIVE	To create favorable conditions for good crop growth, seed germination, emergence, root growth, plant development, crop maturity and formation, and harvest; give participants an increased understanding of soil and water management options for smallholder farmers.
TIMEFRAME	2-4 hours depending on session
MATERIALS NEEDED	Paper and marker pens
IDEAL WORKSPACE	Enough room to sit and stand

Background

To maximize the quantity and quality of crops, farmers must learn how to manage both soil and water resources in an integrated manner. This tool helps farmers identify their current soil and water management practices, reiterate the importance of improved practices, and discuss combination techniques to improve crop yield and resulting revenue.

Steps to follow for the activity:

▶ **STEP 1.** Brainstorm with farmers on their current soil and water management practices, helping them to outline their understanding of the benefits and challenges of each, e.g. labor for making ridges.

▶ **STEP 2.** Take participants through the basic guidelines for the development of integrated soil and water management systems by following up on one of the topics from the brainstorm. If you have many farmers, divide them into groups and have them discuss the benefits of the topics below:

- Increasing soil cover is the most important process for: reducing water and wind erosion, increasing water infiltration rates and reduction of moisture loss, improving germination rates due to reduced temperatures and moist environment, improvement of soil organic matter and biological activity in the soil and suppressing weed growth. This is accomplished by:
  - Leaving crop residues in the field
  - Utilizing conservation tillage
  - Using organic materials for manure or as mulch
  - Increasing the production of biomass in the field by sowing cover crops, intercrops, or relay crops
  - Applying fertilizers and organic manures in order to produce more biomass and enhance chemical fertility

- Increasing the soil organic matter content
- Increasing infiltration and water retention, reducing runoff to prevent loss of soil, water, nutrients, fertilizers, pesticides, and increasing the moisture available to the crop; this will consequently grain yield and biomass production. This is accomplished with:
  - Crop residues and mulches that prevent the formation of hard crusts that prevent infiltration; the cover also slows down run off and gives time for the rain water to infiltrate

    - Fallow periods to rest the land and allow for infiltration where and whenever possible
    - Application of organic fertilizer to increase the moisture retention capacity of the soil, especially for sandy soils; remember that large amounts are required, when compared to non-organic fertilizer
    - Construction of bench, orchard, or other terraces to reduce the slope in order to reduce runoff

- Improving the rooting conditions to foster root development and growth, for the crops to absorb moisture and nutrients, as well as reduce the effects of drought on crops. This is accomplished by:
    - Carrying out deep tillage to loosen any compacted or hardened layers that are impeding root penetration.
    - The use of drainage channels where soils are not well drained, and use of raised beds and ridges to increase root depth even where there are no drainage problems

- Improving the soil fertility and productivity to achieve increased yields and crop biomass. This is accomplished through a combination of the following activities:
    - Soil sampling to determine the nutritional state of the soil
    - Establishing the most economic fertilizer application rate, the rate corresponding to maximum yield, and the most appropriate method and time of application
    - Using locally available organic materials for manure to cut costs and increase organic matter of soil (see compost FFBS tool)
    - Utilizing crop rotation to rejuvenate the soils that are exhausted
    - Avoiding nutrient waste; do not allow burning of residues or stubble, nor the export of nutrients out of the farm (and preferably not out of the field), except for those nutrients in the harvest.
    - Increasing soil's organic matter content, particularly in sandy soils with generally low fertility. This may be done by: applying large amounts of organic manures and mulches, sowing legumes and cover crops, intercropping, relay cropping, crop rotations, increased plant densities and through an increase of chemical fertility to encourage a high production of biomass.
    - Substituting the use of nitrogenous fertilizers by sowing legume crops as part of the rotation, as intercrops, relay crops or as cover crops.
    - Taking advantage of the processes of nutrient recycling, particularly in zones suffering serious leaching problem; introduce crops with deep rooting systems that absorb nutrients from the deeper layers which are normally beyond reach of most crops. This will allow nutrients to be brought to the surface in the dead leaves and stubble to be used later by the roots of other crops.

- Reducing production costs
- Protecting the field
- Reducing soil and environmental pollution

2.8 Evaluation of FFBS Plots

SEASON	Sowing/Weeding → during germination and establishment
OBJECTIVE	Enable farmers to make observations on both the farmer practice and FFBS plots, collect and record data
TIMEFRAME	2 hours
MATERIALS REQUIRED	Flip Charts, Marker pens, Containers, Soil, Seed, Water
WORKSPACE	FFBS plots for observation and additional space to sit and stand as a group

Background

Learning in the FFBS process is seen as a four-stage cycle: first-hand experience and action, reflection, generalization of lessons, and application of lessons. Evaluation of the FFBS plots will elicit full involvement from the farmer, empower farmers to create concepts that integrate their observations into logically sound theories, and enable them to use these theories to make decisions and solve problems in their farms and lives.

Steps to follow for the activity

▶ STEP 1. **Workgroups:** During each session, divide the farmers into groups of 5-6 people; each group will carry out observations on a different section of the farm. Ensure that the entire farm is covered by these groups by creating smaller groups or assigning larger sections. Provide each group with an observation sheet (on the next page) and create a large observation table (based on the sheet) with lines for each farm section on the flip chart.

▶ STEP 2. **Observations in the field:** Instruct groups to carry out observations on crop plants on each of the FFBS plots and the environment in accordance with the form shown below. Make sure to note the following before the observations are made:

- Develop specific data collection protocols for pest and disease surveillance for each crop/pest; use for data collection purposes.
- Observe & record growth parameters of the crops (plant height, number of leaves) in a given number of plants per plot (about 10-15 depending on crop) per group. These plants should be randomly picked while the participants walk in the farm in a Z- or M-shape.
- Collect samples of pests, insects and weeds that cannot be identified & seek guidance from agricultural extension/ research facilitators. If anyone one has a camera, please take photos.
- List names in local language for translation later if not found

▶ STEP 3. **Data processing:** After observing and notating of all the important parameters, the group should come together to record their farm section information onto the flip chart.

▶ STEP 4. **Group presentation and discussion:** Select someone from each group to present findings at a plenary discussion as well as discuss recommendations for future actions. Ask a few questions to find out how group dynamics and leadership have evolved during the observation period. Note that:

- Although farmers are free to criticize one another, this criticism needs to be constructive and restricted to the observations and the presentation itself.
- It is important that everyone should have a say, even if some of the presentations and discussions are be lengthy.

Sample Observation Sheet

Name of FFBS: _____ **Village:** _____ **District:**_____

Observation Number:	
Farm Section:	
Crop(s) planted:	
Section Size:	
Date planted:	
Treatment:	
Crop growth:	
Weather: *Sunshine (clouded or clear sky)* *Temperature (hot, moderate, cool)*	
Plant stand: *(number of plants per plot)*	
Soil moisture:	
Diseases observed:	
Insect pests observed:	
Deficiency(ies) observed:	
Weeds observed:	
Predators:	
Members attended (M,F)	
Recommended actions based on observations:	

2.9 Weeds and Weed Management

SEASON	Pre-Sowing
OBJECTIVE	To enable farmers to identify different types of weeds, competition mechanisms, and appropriately manage
TIMEFRAME	2 hours
MATERIALS REQUIRED	Flip chart and marker
IDEAL WORKSPACE	Enough room to sit and stand

Background

Weed and weed management lessons are important, as they enable farmers to understand: the concepts of competition between crops and weeds and the mechanisms through which weeds hinder crop growth; how competition between crop and weeds can be influenced to the advantage of the crop; and weed-free periods. By using this tool, farmers will be able to improve their weed management skills and have more positive outcomes.

Steps to follow for the activity

▶ STEP 1. **Define and Identify "Weeds":** Remind participants that weeds, in a broad sense, are all plants other than the crops specifically sown by a farmer. Certain plants are not sown by the farmer but are left in the field for other uses and needs, such as amaranth and wild watermelon. These are often not considered weeds by farmers.

In the group, determine the different weeds that occur in the farmers' fields. List these weeds on the flip chart.

▶ STEP 2. **Why do weeds have a negative effect on crops?** Explain that weeds produce negative effects on crops because:

- There is competition for resources between weeds and the crop for: water, food (nutrients/elements in the soil), air, light, and space
- Weeds may host diseases and animals; some weeds act as hosts or attractants to pests while others may provide a safe haven for animals such as rabbits and rats and certain plants are particularly good vectors for crop-impacting disease
- Parasitic weeds such as *Striga* don't just compete with crops for resources, they actually extract water and nutrients through connections between their roots and those of the crop
- Some weeds produce substances that are toxic to crops and humans
- Weeds may reduce yields and crop quality in the short- and long-terms, affecting income.

▶ STEP 3. **Understanding the critical weed-free period of the crops:** Most crops are sensitive to weed competition during the early developmental stages (first 3-4 weeks after emergence). With the group, outline the sensitive crop development stages for each of the crops in a table like the one listed below:

CROP	STAGE	SENSITIVITY TO WEEDS

▶ STEP 4. **Serious problem weeds:** With the farmers, observe and/or list the most problematic weeds for each crop in the location. Collect samples and write the names (in local language) and periods when they occur, as follows:

NAME OF WEED	CROPS AFFECTED	TIME OF APPEARANCE (CROP STAGE)	MEASURES FARMERS TAKE TO MANAGE THEM

▶ STEP 5. **Control options for weeds:** Regardless of crop and weed type, there are standard weed control mechanisms that farmers can apply to avoid major losses due to weeds. After going through the options highlighted in the last step, take the farmers through following measures and their discuss contribution to weed management:

- Prevention through good quality crop seed that is devoid of weed seeds and with high germination potential
- Agronomic measures including crop residue management, number of crop varieties, intercropping, rotation of crops, and composting; all of these kill the weed seeds
- Mechanical control, including weeding, tillage, ridging, and creation of plant hills
- Chemical control (use of herbicides) with emphasis on minimal use and as a last resort; some farmers in areas may consider costs of herbicides to be less than those of mechanized weed control or of labor so discussions should be around safe use of pesticides

2.10 Integrated Pest and Disease Management

SEASON	Pre-sowing; sowing/weeding; vegetative; post-harvest
OBJECTIVE	To ensure that integrated pest and disease management practices follow the principles of sustainable agriculture
TIMEFRAME	2 hours
MATERIALS NEEDED	Flip chart, pens, pencils, colored pencils, eraser, permanent markers (black, blue, red and green), measuring tape
IDEAL WORKSPACE	Enough space to sit and stand

Background

Pests and disease are an unavoidable component of agriculture, but they can and should be managed as early as possible in order to prevent harmful impacts on crop quantity and quality output. This tool is a guide to explain pest and disease management, identify relevant causes and impacts, and effectively monitor and manage crop pest and disease challenges to mitigate crop damage and improve yields.

Steps to follow for the activity

▶ STEP 1. **What is Integrated Pest and Disease Management?**

Explain that in integrated pest and disease management, one tries to establish the relation between the environment and the development of crops. By observing the field and the crops, farmers become more conscious about the interaction between the environment and the crop. This knowledge will allow them to identify constraints on crop growth, to make informed decisions, and to adapt strategies that minimize negative effects.

▶ STEP 2. **The four principles of integrated pest management.** Explain that the FFBS approach is based on 4 principles of integrated pest management:

- *Grow a healthy plant*: Strong, vigorous plants are better able to tolerate insect and pest damage.
- *Conduct regular field observation and analysis*: Farmers can only make good decisions if they have good information. Insect pests, natural enemies, diseases, the growth stage of the crop and the weather are among the factors that should be observed and analyzed.
- *Protect and help natural enemies of pest and disease*: Many natural enemies of pest and disease live within the crop field. Others live in wild plants in nearby fields. Natural enemies must also be managed so that they become abundant and effective.
- *Farmers become experts*: Farmers must have confidence in their own knowledge and ability to make decisions. If not, they may unintentionally cause harm; ex, if they use too much pesticide.

▶ STEP 3. **Ranking of key pests and disease of each crop.** Ask the farmers to list down the names of the pest and disease challenges of the specific crop. List these in local names for translation later. If possible, use samples to demonstrate the diseases/pests. Once these diseases/pests are identified, have the group rank them from most important to least important (in terms of management priority using numbers or another ranking system (such as placing a certain

number of stones or other small items) to designate an order. An example of integrated pest management for rice can be found on the next page.

▶ **STEP 4. Revisit crop guides/plans made earlier in the season.** The following information should be included in these guides; if some components are missing, fill in with the appropriate information:

- How to examine the pest/disease on the crop
- Pest/disease symptoms
- How to score for incidence and severity
- How to record that information
- How to collect and preserve samples
- How to represent pests/diseases in drawings if necessary
- What else is useful to mention (e.g. weeds, water, fertilizers, weather conditions, etc.)
- Traditional agricultural practices done the previous week (fertilizers, spraying, watering, etc.)
- Important observations and recommendations

▶ **STEP 5.** Divide participants into groups of 4-5, depending on the total number of participants. To make the working time as short as possible, have different groups work on each of the FFBS plots. The same work groups should be maintained throughout the season, but the plot they observe should be changed.

▶ **STEP 6.** Have each group select one person to record all data for a given time period (this can be rotated among group members). Have participants collect data on various aspects such as growth, diseases, pests, and predators, and enter the information in sheets developed for each crop (since each one has unique characteristics and challenges). For example, cassava has Mosaic Disease (CMD) and Brown Streak Disease (CBSD). The corresponding information sheet should score of disease incidences and severity of CMD and CBSD on leaves, at 6 weeks - 3 months after planting and at harvest:

- Disease incidence is done by counting the number of plants in each plot that exhibit disease symptoms; divide this by the total number of plants in the plot and multiply by 100 to arrive at the percentage incidence.
- Disease severity scores on leaves will be done on a scale of 1-5 where a score of 1 means no disease symptoms were observed, and a score of 5 means the most severe infection was observed.
- At harvest, scores of root CBSD will be done on the scale of 1-5 where:
  - 1 = no apparent necrosis;
  - 2 = less than 5% of root necrosis;
  - 3 = 5-10% of root necrosis;
  - 4 = 10 - 25% of root necrosis, mild root constriction; and
  - 5 = >25% of root necrosis and severe root constriction.

▶ **STEP 7. Discussion.** After the evaluations are completed at each point of observation, each group should calculate and record averages and discuss and synthesize findings for presentation to the larger group.

Small groups should present findings from their own plots to the group in plenary.

With the help of the facilitator, the groups then hold discussion on actions to take to manage any challenges encountered. Make sure that the group comes up with actionable items and set timelines for undertaking activities.

Benefits of Integrated Pest Management (IPM) and example of IPM in Rice

Benefits of IPM Techniques

Different IPM techniques like Piercing, Light Trap, and Clipping etc. increases yield up to 15% and reduce use of pesticides up to 10%.
Reference: Bangladesh Agriculture University research paper, Mymensingh
N.B. Basically it is a thumb rule. So there is scope to find out more authentic data by searching research papers and learning from demonstration plot.

Benefit of seedling management in Rice

1. Generally farmers use 5-6 seedlings per hill; even sometimes they use 7-8 seedlings per hill whereas 2-3 seedlings per hill are standard. This causes excessive use of seedlings as well as lower yield for increased competition among seedlings for nutrients, light, air etc.
N.B. Basically it is also a thumb rule. So there is scope to find out more authentic data by searching research papers and learning from demonstration plot.

2. Dry seed bed can also effective for flood prone areas. It is climatically and economically effective than wet seed bed.
Reference: WtRF project, CARE Bangladesh

3. Proper line sowing by following proper spacing between line to line and hill to hill increases both land use and yield. It also helps in ease intercultural operations like weeding, spraying, top dressing of urea.
Reference: WtRF project, CARE Bangladesh

4. Different stress tolerant rice varieties like BINA dhan 11 and 12, BRRI dhan 51 and 52 can be cultivate as flood tolerant;BINA8 and 10, BR23,BRRI dhan 40,41,47,53,54 etc. can be cultivate as saline tolerant and BRRI dhan 48,56,57 can be cultivated as draught tolerant.
Reference: BRRI and BINA

2.11 Farmer Field Days

SEASON	Vegetative Stage; possibly multiple times throughout the season depending on objectives of the Field Day
OBJECTIVE	To introduce the improved varieties/management options to the rest of the community to stimulate their interest for the collective engagement learning agenda
TIMEFRAME	2 hours
MATERIALS REQUIRED	Flip Charts, Marker pens, seed, crop and other relevant samples
IDEAL WORKSPACE	Enough space for movement, a space for community members to sit

Background

Farmer Field Days are events where farmers evaluate the performance of their crops/livestock using a range of criteria determined by the farmers and facilitators. Field Days are attended by the farmers, community members who are not FFBS participants, extension staff, other NGOs working in the area, and other interested stakeholders. Field Days can be held during different times of the season to teach about different seasonal topics.

Steps to follow for the activity:

▶ **STEP 1.** The Field Day date(s) should be decided upon. They can be done at multiple points during the crop season, depending on the objective(s). A program and list of invitees should be developed for each planned Field Day, with number of invitees limited to the capacity of the field to avoid overcrowding.

▶ **STEP 2.** The facilitator and FFBS participants should ensure a good layout of field-day activities, with easy access and facility of movement around the field. Plots should be labeled clearly.

▶ **STEP 3.** The facilitator should guide the FFBS participants to develop a simple evaluation sheet to score each of the important attributes for that Field Day objective (sample on next page). This sheet will be unique to each crop since attributes vary across crops. Make sure to have this form translated to the local language, and provide one form to each Field Day participant.

▶ **STEP 4.** During the Field Day the facilitator should:

- *Provide* suitably large visual material and also, if necessary, a loudspeaker, to ensure that all can hear. Check that extension literature and other material are available for consultation and take-away.
- *Encourage* the farmers in the FFBS to take most of the initiative; be ushers to ensure flow and guide the visitors by allocating roles to teach the invitees on what they have been learning on each of the plots

▶ **STEP 5.** Conclude the Field Day by bringing all the participants together, reviewing the day's proceedings and the main items seen and discussed, conducting a question and answer session, and explaining any future relevant Pathways and extension activities.

Remember to distribute any dissemination materials prepared to the community.

For help in planning future field days, a simple questionnaire can be administered to a sample of farmers (see example on the next page).

Sample Field Day Evaluation Form

1.Name (Optional): _____

2. Sex : [ ] Male [ ] Female

3. Education level: [ ] None [ ] Primary [ ] Secondary [ ] College

4. Are you a member of a Pathways group? [ ] Yes [ ] No

5. If member, what is your main activity? _____

6. What time did you arrive at the field day?_____

7. How far is the Field Day location from home (or time taken to walk)? _____

8. How did you find out about the Field Day (select one)? [ ] Neighbor or [ ] friend

[ ] Pathways Group [ ] Public announcement (write which): _____

9. Which are the three key lessons (practices) you have learned today?

1. _____

2. _____

3. _____

10. Which lesson will you apply on your farm as soon possible (name one)?

_____

11. Is there any practice you would like to apply but feel unable to apply?

If yes, which one? _____

Why?_____

12. Do you think this field day is a good way to share information? [ ] Yes [ ] No

13. Is there another information-sharing method that you think works better for you?

If yes, which one? _____

14. What did you like about the Field Day? _____

_____

15. Which aspects of the Field Day could we improve on to meet your needs?

_____

_____

Thank you very much for your time and participation in the Pathways Field Day.
Your feedback is very important!

2.12 Harvest and Post-Harvest Management

SEASON	Vegetative; Harvest; Post-Harvest
OBJECTIVE	To establish a shared understanding of the significance of harvest and post-harvest management
TIMEFRAME	2 hours
MATERIALS NEEDED	Flip chart, marker pens
IDEAL WORKSPACE	There should be enough space for both standing and sitting

Background

Effective management during the post-harvest period is the key in reaching the desired objectives. There are many interrelated steps involved in all postharvest management, as produce is often handled by many different people, and transported and stored repeatedly between harvest and consumption. While particular practices and the sequence of operations will vary for each crop, there is a general series of steps in post-harvest handling systems that will be followed for the purposes of this toolkit.

Steps to follow for the activity

▶ **STEP 1.** Ask farmers why they think post-harvest losses are important and to share some of their experiences around such losses. Allow them to come up with their own ideas, but make sure that they include the following topics in the discussion:

- Food safety
- Quality assurance
- Better storage
- Better protection from pests
- Reduce losses (quantity & quality)
- Better marketing opportunities

▶ **STEP 2.** Take the farmers through a brainstorming session on the causes of post-harvest losses. Allow them to come up with their own ideas, but make sure that they include the following topics in the discussion:

- Inefficient harvesting and handling methods
- Lack of technical knowledge on different components of harvest (i.e. processing)
- Labor shortage during harvest season
- Harvesting immature and over-mature crops
- Poor processing techniques
- Limited drying facility
- Excess rain-fall exposure
- Lack of storage facilities
- Rough transportation/loading/unloading
- Little or no access to new technology
- Lack of farmers friendly business model

STEP 3. Take the farmers through the three main objectives of applying post-harvest technology and proper management practices to produce. These are applied to:

- Maintain quality (appearance, texture, flavor and nutritive value)
- Protect food safety
- Reduce losses between harvest and consumption

STEP 4. Take the group through the crop specific post-harvest management practices on the three main objectives. Guide the conversation by discussing the following pieces of information:

- The importance of: harvesting the crop at the right maturity; and ensuring the right moisture content at harvest and during drying and storage (using crop specific measures for moisture content)

- Use of recommended harvesting practices and methods of preparation for specific crops, e.g. curing of root, tuber and bulb crops before further handling or storage. Note that harvesting practices should cause as little mechanical damage to produce as possible; gentle digging, picking and handling will help reduce crop losses

- When sorting for rejects, remove any product that is decayed, damaged, or too small to avoid contamination from aflatoxin and other pathogens

- Use of simple technologies for packing, ranging from a simple shed in the field or a separate structure with cooling and storage facilities

- Use of simple and appropriate packing methods and packaging materials that can help to maintain product quality and reduce mechanical damage during handling, transport, and storage

- Post-harvest insect pest control methods that offer alternatives to chemical treatments for insect and disease control, such as the use of indigenous technical knowledge. Note that sometimes produce must be chemically treated to control insects or decay-causing organisms

- Indigenous technical knowledge plays a key role in post-harvest management. As the farmers to list some of the practices that they have traditionally used that are effective for postharvest insect and disease management. Encourage them to keep applying these methods

- Use of storage structures, methods for ensuring adequate ventilation, and simple technologies for modified atmosphere storage for each crop

- Transport practices that can reduce losses and methods for handling at destination (wholesale or retail markets)

- Simple methods for processing fresh produce such as adding value by drying (e.g. cassava)