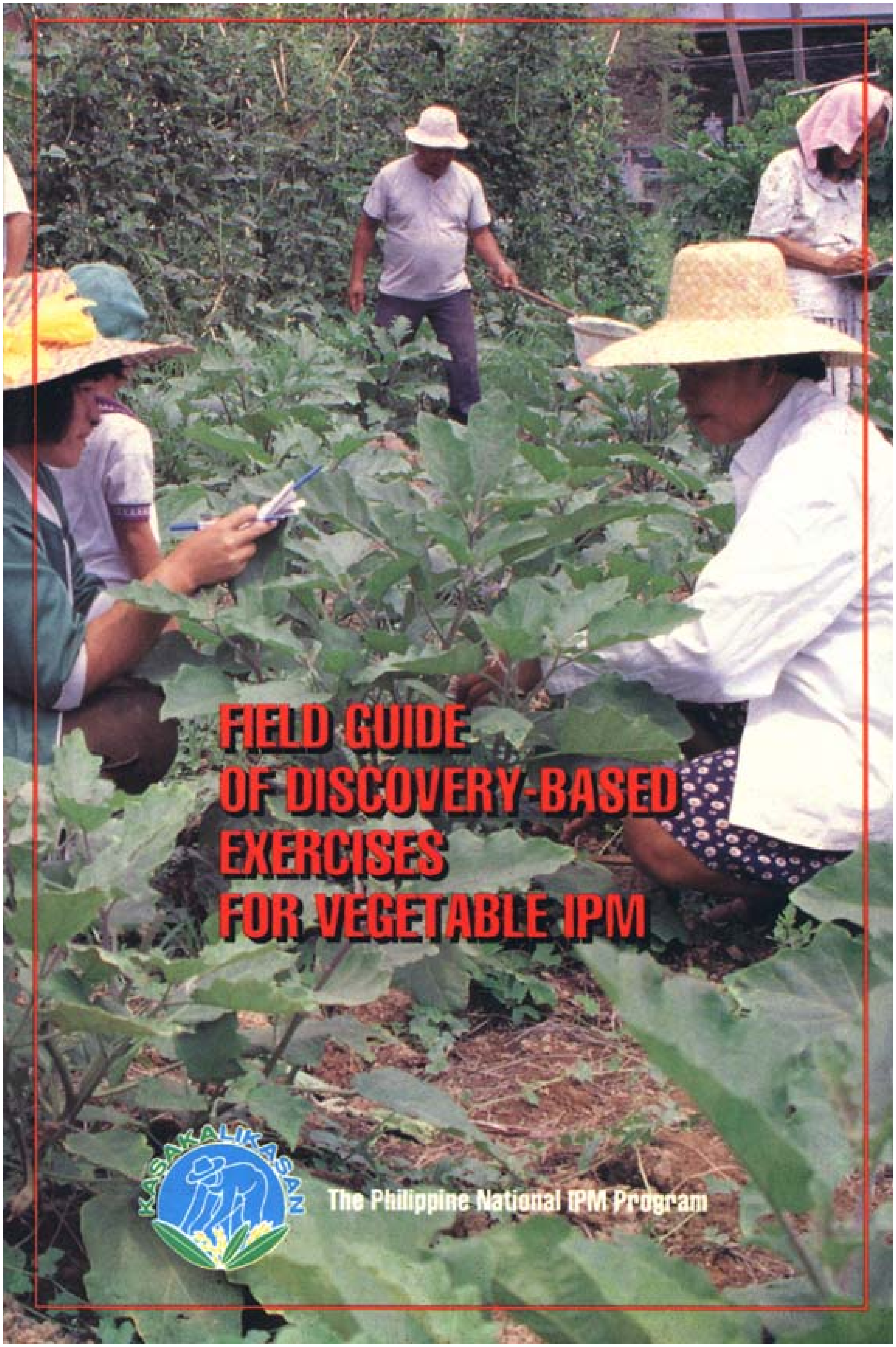
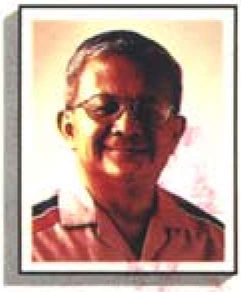


FIELD GUIDE OF DISCOVERY-BASED EXERCISES FOR VEGETABLE IPM

KASAKALIKASAN

The Philippine National IPM Program



From the
Secretary

IPM IS BY FARMERS, NOT FOR FARMERS.
IPM makes our farmers experts in their own vegetable fields by developing their ability to make critical and informed decisions that make their farming more productive, profitable and sustainable.

The ***Field Guide of Discovery-Based Exercises for Vegetable IPM*** is a valuable tool for farm technicians and extension workers in **KASAKALIKASAN**. This manual invites discovery, comparison and analysis that help our IPM field trainers stimulate the learning processes of farmers, sharpen their decision-making skills, and strengthen their capacity to apply IPM principles in vegetable production.

This Field Guide grew out of the experiences of our IPM field trainers from local government units and non-government organizations gained in the conduct of Farmer Field Schools nationwide. This manual has likewise been enriched by our IPM Specialists from the Department of Agriculture through the conduct of Training of IPM Trainers Courses.

We are pleased to note that **KASAKALIKASAN** is making a valuable contribution to the human resources development program of the Department of Agriculture, especially, in the empowerment of our farmers. We hope that this book will provide tangible help in guiding the country towards the path of sustainable agriculture.

SALVADOR H. ESCUDERO III
Secretary of Agriculture

FIELD GUIDE OF DISCOVERY-BASED EXERCISES FOR VEGETABLE IPM

Table of Contents

Section 3

Section 4

Section 5

Section 6

1 Introduction

ABOUT THE FIELD GUIDE

This *Field Guide of Discovery-Based Exercises for Vegetable IPM* is designed for use in vegetable IPM Farmer Field Schools (FFSs). The exercises in this field guide were based from the experiences shared by vegetable FFS facilitators from the Cordilleras and Canlaon City and resource persons from the Philippines' KASAKALIKASAN and FAO Intercountry IPM Programmes during a 4-day Technical Refresher Workshop for Vegetable IPM conducted at Sayangan, Atok, Benguet in June 1995 as well as by the participants of the Vegetable Specialist Training (VST) Course on IPM conducted at Canlaon City, Negros Oriental from July to November, 1995 and the IPM National Technical Workshop conducted at Baguio City in March 1996. Appropriate exercises were also adapted from the outputs of a series of Technical Refresher Workshops for Rice IPM conducted nationwide in October to November 1995 with rice FFS facilitators.

In the aforesaid workshops, we shared experiences from all IPM farmers' field schools that have been conducted in the Philippines so far. Together we used our resources to build the foundations of the exercises that are documented in this field guide. Some of these exercises are updated versions of exercises that we feel work well already, others are totally new.

This field guide is a collection of discovery-based exercises that facilitators like us, can use and adapt, when and where we judge them to be useful. We involved as many FFS facilitators as was possible in the design of these field exercises. So, the exercises belong to us and our farmers' field schools. This field guide will achieve nothing until our farmers' field schools start to put these ideas into action.

The field discovery-based exercises contained in this field guide are divided into several sections: (i) general; (ii) soils and agronomy; (iii) insects and natural enemies; (iv) rodents and rodent management; and (v) diseases topics.

With ownership comes responsibility. It is our responsibility to update and modify the field guide with the experiences and new ideas that come out of our own FFSs. Some additions had to be made to the exercises, because we did not have time to fill all gaps and refine all the steps. This means that for sure we will need to revise and redesign what is written here, based on your experiences and feedback.

What is a discovery-based exercise?

During our workshops we returned again and again to the questions "What do we really mean by a discovery-based exercise?" and "How can we make this exercise more discovery-based?".

There were no *ultimate* answers to these questions, but a number of patterns and ideas did emerge from our design sessions. These are described below. We hope that they give you some idea of what we were aiming for:

Go to the field

> The 'learning-field' provides the main learning-material for the farmers' field school and other fields in the barangay provide us with an extra resource when needed. Any exercise that we design should have its roots in the fields. This means that we need to go out to the fields and observe *before* we start any discussions or activities.

What is happening in the field today?

If the activities are rooted in the field, they are also based on what is happening in the field at this time. We can not generally discover something now if it either happened in the past, or will happen in the future. So, the activities described in this field guide are designed to be used in response to what is happening in the field NOW!

Share our experiences

We must never forget that farmers may already have plenty of experiences on the topic. We need to listen to and learn about farmers' experiences. We will gain new ideas and insights from local practices, as well as having a better idea of the areas where farmers are lacking in technical information or understanding.

What do farmers want and need?

The people who are discovering in the FFS are first and foremost the FARMERS!

People remember : **20% of what they HEAR**
40% of what they SEE
80% of what they DISCOVER FOR THEMSELVES.

Some of the things that the FFS group discovers will also be new to us. But the aim of the 'discovery-based' exercises is to help participants to remember more of what they are learning. So, we must choose the exercises based on what the FARMERS want and need to discover for themselves!

Discover, evaluate and understand!

We do not want to start any exercise with the assumption that there will be a *correct* answer or outcome. If we do this, then we can not expect participants to learn from what they have observed. Instead, they will just tell us what they think we want to hear, based on what we told them to say !

An example: If we want to run a session on Record Keeping, we can not start the session by saying "*Record keeping is important*, so what records do you think we should keep?" Even if this seems participatory, it is not discovery-based, because we have started by instructing the farmers that record keeping is important! Instead we need to guide farmers to *discover* that record keeping may be useful for them.

By discovering information ourselves and then evaluating if and how it could be useful, we can start to look more critically at what we observe or hear.

By thinking *critically* we are not being NEGATIVE, we are actually being *POSITIVE*. We do not just think what people *tell* us to think anymore. We are starting to build skills in *analyzing* what we observe. We can then base our decisions on our *own experiences and understanding*.

These skills of critical *questioning, discovery, analysis* and *evaluation* are what farmers take away from the FFS to use in tackling new problems on their own farms.

Thus, building farmers' DISCOVERY-BASED skills
WITH farmers' DECISION-MAKING skills
is what makes IPM farmers field school SUSTAINABLE!

Format for the exercises

Each of the exercises in this field guide has been arranged in a standard format of sub-sections. We hope that this will make it easier for you to find the specific information that you want to use. The various sub-section headings are listed below with a short description of the content :

Main topic, sub-topic and type of excercise

This gives a short description of the exercise, which we hope you can understand in an instant (e.g., when skimming through the book).

When is the exercise most approriate?

Some guidelines as to what might be happening in the learning field, and what experience the FFS group needs to have before starting this exercise.

How long will the exercise take?

An estimate of how long is the time between starting and finishing the exercise. Plus, how much time the exercise will take during FFS meetings and what extra time inputs are needed outside the FFS meetings.

Learning objectives

What we aim to discover from the exercise.

Materials

What equipment you will need to collect in advance.

Steps

A numbered list of steps that you will take to complete the exercise.

Some suggestions for processing discussion

Every exercise needs a processing discussion to evaluate observations and results, and to draw out a common agreement on what has been discovered. This section gives some suggestions for questions and ideas that your group may like to explore during your processing.

If the exercise is based on a guided discussion, the processing may already be included in the STEPS section.

2 *General Topics*

KASAKALIKASAN AND FFS ORIENTATION

MORE THAN ONE IDEA :
APPROACH AND CONCEPT

We had 2 different ideas about how you could start a discussion on the concept of KASAKALIKASAN. We concluded that there has to be some inputting in the discussions from the facilitators because farmers can not discover all of the ideas that we need to discuss. The 2 introductory activities are : (I) mental mapping; and (ii) the '9-dots' game. These activities are both followed by a guided discussion with explanations. The emphasis of each exercise is slightly different :

- The *mental map exercise* compares farmers' experiences and ideas of the old IPM with the new KASAKALIKASAN concept and approach;

- The *'nine-dot'* game emphasizes how the KASAKALIKASAN concept and approach aims to help farmers solve the most important field problems they face, and how this compares with our past IPM experiences.

You can use BOTH methods in one session. You will need to do the mental map exercise first to hear farmers ideas about IPM, then follow this with the nine-dot game and inputting from the facilitators. A final discussion is done to compare old ideas and experiences about IPM, with the new KASAKALIKASAN concept.

Exercise No. 2.01

MENTAL MAP EXERCISE : APPROACH AND CONCEPT

When is this exercise most appropriate?

- At the first FFS meeting.

How long will this exercise take?

- 1 - 2 hours of the FFS meeting.

Learning objectives

- To become aware of the concepts, objectives and approach of the KASAKALIKASAN program.
- To compare the KASAKALIKASAN concept, objectives and approach with farmers' previous ideas and experiences on IPM.

Materials

- manila paper for each group
- pencils, pens and crayons for each group
- tape

Steps

1. Ask the participants in their 5 working groups. Each group will work together to make a 'mental map' of any ideas that they have about what IPM is. They can write words, draw pictures, put down any ideas that they have about IPM. At the same time, the facilitators make a mental map of the KASAKALIKASAN concept and approach.

2. Each group makes a presentation to explain their mental map. The facilitators are the last group to present.

3. Facilitate a discussion comparing farmers' past experiences and ideas about IPM with the KASAKALIKASAN concept and approach.

Some suggestions for the processing discussion

- Do you think these ideas that we put in the KASAKALIKASAN mental map are any different from the ideas and experiences that you put in your mental maps? Why? How?
- Which things in the KASAKALIKASAN mental map do you think are not about pest management? Why is this?
- Which things about IPM do you think are missing in the KASAKALIKASAN way? Why is this?

Exercise No. 2.02

NINE-DOT GAME :
APPROACH AND CONCEPT

When is this exercise most appropriate?

- At the first FFS meeting.

How long will this exercise take?

- 1 - 2 hours of the FFS meeting.

Learning objectives

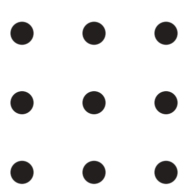
- To become aware of the concepts, objectives and approaches of the KASAKALIKASAN program.
- To relate the KASAKALIKASAN concept, objectives and approach to the problems and issues of farmers in the local area.
- To compare KASAKALIKASAN IPM with our past experiences of IPM.

Materials

- Manila paper, tape and pens

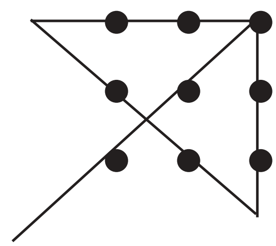
Steps

1. Draw 9 dots up on a piece of manila paper like this:



Ask the participants to try to join all of the 9 dots with only 4 straight lines, and without lifting the pen from the page.

2. Ask the farmers to share their results. The solution will be something like this:



3. Ask the farmers: Why was it difficult to find the way to do this at first? How did we overcome the problem? Discuss how this relates to solving other problems - very often we need to look outside the things that we think are the problem, to understand the real causes before we can go about solving them. In this game we had to look outside the square to find the solution.

4. Tell the farmers that the 9 dots can represent the 9 most important problems of farmers in this area. All of the problems begin with 'P'. Ask them to help you list them. Adapt what is discussed to fit it into 9 categories beginning with 'P' that are something like this:
   - Pests and diseases
   - Poverty (profits are low)
   - Pesticides (poisoning)
   - Program (that are no good)
   - Politicians (do not help us)
   - Public health
   - Pollution
   - Provision of water
   - Protection of forests

5. The facilitators then use each of the 9 problems to lead into an explanation of some of the central concepts and approaches of KASAKALIKASAN IPM. Here are some of the ideas that we talked about in our design session:
   - In the FFS, we explore ways to solve the problems of pests and diseases, low profits, pesticide resistance and pesticide poisoning.
   - The program is based on what farmers need and want to learn - farmers decide what we will do in the FFS.
   - The field school is based in farmers' fields and so looks at the real problems that are happening now.
   - We learn by exploring the problems together as a group. By working together we can discover how to start to work on problems that are too big for 1 person, the group can do much more than one.
   - By becoming a strong group, we will be able to get more support and attention from the local government or other organizations that we may want to influence.
   - The fields are a part of the local environment and the community, so we also look at the effects our actions have on things that are outside our fields.

6. The facilitators guide is a discussion on how this KASAKALIKASAN IPM differs from our past experiences and ideas of IPM.

Some suggestions for the processing discussion

- Do you think that these ideas about KASAKALIKASAN IPM are any different from our past experiences and ideas about IPM? How? Why?
- Which things in the KASAKALIKASAN IPM do you think are not about pest management? Why is this? Which things about IPM do you think are missing in the KASAKALIKASAN way? Why is this?

Exercise No. 2.03

ROLE PLAY :
GROUNDWORKING FOR FARMER FIELD SCHOOLS

Groundworking is a collective term for activities conducted at the barangay or municipal level with the end view of preparing or paving the way for the introduction of a new concept or program in the area. Ideally, the activities should begin a season before or at least a month prior to a planned farmer field school (FFS). The task of groundworking should be carried out by the local IPM team as a pre-training exercise. One of the primary objectives of groundworking is to determine the actual needs of the area, which will ultimately be the basis in developing an IPM program at various levels. To a great extent, the success of a local IPM program is directly related to the quality of groundworking activities conducted.

When is this exercise most appropriate?

- Ideally, a season before or at least a month prior to a planned farmer field school (FFS).
- It is suggested that this exercise be done towards the end of the course or when the participants in the TOT and VST are about to do groundworking activities.

How long will this exercise take?

- At least 1 whole week during the TOT and VST sessions.

Learning objectives

- Define groundworking.
- Explain the importance of groundworking.
- Discuss guidelines for groundworking.

Materials

- Briefing kit
- Guidelines
- Record book , pen

Steps

1. Ask for a group of 4-5 volunteers 1-2 hours before the session. Give the group instructions to do a role play presenting groundworking activities.

2. Start the discussion by drawing up a working definition of 'groundworking'. Elicit definitions from the group and list down whatever ideas are contributed. When there are no more ideas, try to come up with one working definition by combining ideas together. This will be the group's own working definition of 'groundworking'.

3. Ask who among the participants have done groundworking. Ask them why they did groundworking and what purpose their activity served. If no one in the group has done groundworking, ask people to refer to the working definition to explain the importance of groundworking.

4. Present the role play. Draw guidelines on what to observe for effective groundwokring from the presentation.

During the actual groundworking, the following activities may be considered:

1. Brief the local agricultural office heads regarding the IPM program and the mechanics of implementation at various levels;

2. Conduct courtesy call on local government officials, with the local agricultural office heads, to discuss the program, the mechanics of implementation, as well as the needs and possible commitments;
3. Conduct dialogue with barangay officials, leaders of farmers' organizations and non-government organizations, and selected farmers to explain the IPM program and to validate information gathered from the local agricultural offices and government units;

4. Consult with more farmers regarding the local needs and possible commitments in the implementation of the program;

5. Negotiate for field sites, shade or hall for processing of field activities and other necessary preparations, as part of the community's commitments, to implement a local IPM program; and

6. Invite and select the participants and facilitators.

Some suggestions for the processing discussion

Since one of the primary objectives of groundworking is to determine the actual needs of the area, then we should facilitate the discussions to point out that any data or information which will later help us plan the specific activities for our local IPM program should be considered as important. As such, the data or information to be gathered should be able to answer the question, "Do we need to conduct a TOT or an FFS?"

- Before we can answer the above question, we need to facilitate the discussions to answer several other questions like, *"Do we have enough agricultural technologists or extensionists to train in a provincial TOT? Do we have enough rice farmers in a barangay to compose an FFS?"*
- For us to answer the above questions, we will need to facilitate the discussions for the participants to consider the following points as their guide in planning : (a) we will need at least 25-30 agricultural technologists or extensionists as participants within a province to implement a provincial TOT; (b) we will need at least two (2) agricultural technologists or extensionists within a municipality to participate in a provincial TOT; and (c) we will need at least 25-30 interested farmer-participants in a barangay or sitio to operationalize an FFS.
- Above all, we will need to facilitate so that the participants will have a better understanding of the pest management problems in the locality, as well as a clear picture of the support and commitments from the local communities to insure the sustainability of the program once it is implemented.

Exercise No. 2.04

BRAINSTORMING AND PARTICIPATORY DISCUSSIONS : BARANGAY IMMERSION (HOW DO WE IDENTIFY THE NEEDS OF FARMERS IN THE FFS?).

When is this exercise most approriate?

In the TOT and VST sessions
During the first or second week of the FFS sessions.

How long will this exercise take?

At least 1 hour for small and big group participatory discussions.
At least 2-4 hours in the barangay.

Learning objectives

- To Improve skills of the participants in identifying farmers needs to ensure smooth implementation of the FFS.

Materials

- Manila paper, pentel pen,

Steps

1. Brainstorm for ideas or concepts of a barangay immersion in the big group. List down all ideas, consolidate and agree on a common understanding of what barangay immersion is all about.

2. Solicit ideas from the participants on how they will identify farmers' needs by visiting their barangays :
   - What can be learned from house to house visits?
   - What is the benefit of visiting farmers' fields in the barangays?

3. Agree on what information to get in the barangays, how to do a spot map of the barangay, and to make use of these information in the analysis their needs.
   - What shall be included in the spot map? Why?

4. End the session by coming up with a list of relevant activities to undertake during barangay immersion. Please remember that many other exercises are related to barangay immersion and these exercises could be a part of it.

Some suggestions for the processing discussion

- Can you make non-FFS members become interested in IPM? How?
- What is your role during the barangay immersion activities? Adviser? Teacher? Politician? Facilitator?
- Whom will you inform about your visit? Whom will you involve in your visit?
- How will the visit serve as planning for FFS?
- What is the situation in the learning field? Are the agreed recommendations from last week implemented?
- When is the best time to do barangay immersion in relation to the FFS weekly schedule?
- How often will you do barangay immersion activities?
- Are there any existing farmer's organizations in the barangay? What are they doing?
- Are farmers happy to be visited? When?
- Will you visit only upon request or according to a schedule?
- How can you make this activity more farmer oriented?

Exercise No. 2.05

BRAINSTORMING AND PARTICIPATORY DISCUSSIONS : MANAGING FARMER FIELD SCHOOL

When is this exercise most appropriate?

- In the TOT and VST sessions
- At least 1 week before the first FFS session

How long will this exercise take?

- 1 hour night time reading of handouts
- 1-2 hours of brainstorming in small group and participatory discussions in big group

Learning objectives

- Conduct brainstorming and participatory discussions on how to manage an FFS.
- Improve understanding of the methodologies and strategies in managing an FFS.

Materials

- Handouts on Guidelines in Organizing an FFS and Training Team's FFS Diary
- Manila papers, note book and pen

Steps

Option 1 :

1. Distribute handouts on Guidelines in Organizing an FFS the day before the schedule for the session to give enough time for the participants to read the material.

2. During the session, ask the participants to count off by 10's and get into their small groups. Ask a representative from each group to pick one guide question for brainstorming in their small group.

3. When all the groups are ready, participatory discussions in the big group may start with the presentation of ideas by the small groups.

Option 2 :

1. A day before the session, distribute the Training Team's FFS Diary so the participants have a chance to read it. (This exercise can also be done without distributing it but it requires more guidance).

2. On the day of the session, let each small group select at random and answer one of the following guide questions :
   a) If your group is to organize an FFS in a barangay, what will be the necessary preparations before you start the training? Explain briefly.
   b) What should an FFS in a barangay aim to achieve for?
   c) Explain the meaning of each of the following principles :
      - The field is the primary source of learning.
      - Experience forms the basis for learning
      - Decision making guides the learning process
      - It is season-long training
   d) List as many different ways of learning in an FFS. Explain each briefly.

e) How will you ensure the active participation of the farmers in an FFS?

3. Ask each small group to write their outputs in charts for presentation. Make sure that each facilitator guides their group in output preparation.

4. Let each small group present their output to the big group for further discussions. Since the participants will not be able to cover all details at this early stage of the training, it is expected that the facilitators will ensure active participation of everybody by asking more guide questions to cover all information.

Some suggestions for the processing discussion

Option 1 :

- If your team is to organize an FFS, how would you go about it?
- Explain training strategies employed in an FFS.
- Why is an FFS necessary? What should an FFS aim to achieve?

Option 2 :

- What does participatory learning mean?
- What FFS activities are appropriate to deal with through:
  a) Learning by doing?
  b) Discovery based learning?
  c) Experiential learning?
  d) Guide questions?
- When is it a good time to use role play?
- When is it a good time to use ice breakers?
- When is it a good time to use group dynamics?
- What is the difference between ice breakers and group dynamics?
- How will you keep the motivation high throughout the day?
- How will you keep the motivation high throughout the entire season?

- How can you make the training based on local conditions?
- How do you make farmers feel comfortable in the FFS?
- How do you create enthusiasm in the FFS?
- If a farmer tells you that ladybirds are friends is there still a need to conduct an experiment on it?
- How can you make farmers remember more?
- How can you make farmers understand more?

Exercise No. 2.06

LEVELING OF EXPECTATIONS : WHAT DO WE EXPECT FROM THE TRAINING AND FROM ONE ANOTHER?

When is the exercise most appropriate?

In the FFS, TOT and VST sessions.
During one of the first few days of the sessions.

How long will the exercise take?

1.5 hours brainstorming sessions

Learning objectives

- To develop a common understanding of what are expected from the training and from one another.

Materials

- Manila paper and pentel pen

Steps

1. The facilitators prepare guide questions (sample guide questionnaire are given below) which will be accomplished by the participants in either of the following :
   - Distribute one guide question for each small group to answer and then report their answers for participatory discussions in the big group. The big group discussion will enable everybody to give comments and suggestions; or

- The guide questions can be addressed at once to the big group one after the other for them to answer through participatory discussions; or
- Each guide question can be written on a manila paper and posted on the wall. Each group goes from one poster to another and writes comments or suggestions. Each group is given 2-3 minutes to answer a poster before proceeding to the next poster. The groups can change positions for 5-8 times, depending on how fast they can think of an answer. This procedure will require a lot of space so that the groups will not get mixed-up.

Sample guide questions :

- What do you expect to learn in this training?
- How do you expect this training to make you better at your job?
- How do you expect the facilitators to make it a successful training?
- Is leveling off expectations important in an FFS?
- How can you personally contribute to the success of the training and how do you expect others to contribute to its success?

2. After getting all possible expectations from the participants, the facilitators level off the discussions by doing the following :
   - Ask participants to elaborate vague statements by giving specific examples.
   - Clarify misconceptions about the training methods and approaches.
   - Discuss which among the expectations are attainable and unattainable.
   - Indicate and explain their own expectations from the participants.
   - Arrive at a consensus on how the training objectives will be best achieved.

3. Summarize the outputs in a manila paper and save for the group to look at them again as part of a mid-term evaluation. (Do they still have the same expectations?)

Some suggestions for the processing discussion

- Do you expect to become a technical IPM expert or expert IPM facilitator?
- What does your boss expect you to become after the training?
- How can you cooperate actively?
- How can the facilitators help you to be open minded and share your ideas?
- What shall we provide to get your 100% attendance?
- What do you mean when you say technology?
- How do you understand this: 'Through IPM, you can widen the horizons of knowledge technically, spiritually, physically and mentally'?
- Will self discipline be difficult?
- What is participation: to listen? to talk? or something else?
- Would you stay for the training if food is only served on Sundays and you have to eat something else the rest of the week?
- How will you do leveling off of expectations in an FFS?

Exercise No. 2.07

PARTICIPATORY DISCUSSIONS :
HOW TO ESTABLISH IPM PARTICIPATORY NORMS

When is this exercise most appropriate?

- During the first week in the FFS, TOT and VST sessions

How long will this exercise take?

- 1-2 hours of participatory discussions in big group

Learning objectives

- Identify participatory norms for the FFS, TOT or VST implementation.
- Define responsibilities based on the expectations shared by the participants and the facilitators.

Materials

- Manila paper and pentel pen
- markers and masking tape

Steps

Option 1 :

1. On the manila paper, present an illustration that will depict a situation or scenario in an FFS.

2. Facilitate participatory discussions by asking the following questions:
   - In this kind of set-up, how would the participants feel?
   - How will the group participate?

- What kind of group leader would there be?
- What kind of behaviors may take place?

3. Present the second illustration depicting another situation or scenario in an FFS.

4. Lead a participatory discussion again using the same set of questions asked above.

Option 2 :

1. In the big group, ask the participants to enumerate all they had for dinner the day before coming for the training. List all the different dishes mentioned. Then remind them that in a live-in training, the menu will be the same for everybody in a day for the entire season-long training. That inspite of personal differences, we will be doing many things together in a way that might be different from how we usually do before. Hence, one way to make the training work smoothly is to establish norms which we can together agree on.

2. Brainstorm in the big group, write down the norms in a chart and agree on how what to do so as not to forget them.

3. Since it is not always possible to foresee all situations at the early stages of the training, let the participants agree on how and when to follow up on the original list of norms set so that it can be revised to meet their needs if it is not working very well.

4. In the TOT and VST sessions, try to brainstorm on whether or not the setting of norms will be a relevant activity in the FFS. Try to ask how will they facilitate the activity in an FFS. Write down their suggestions on a chart so it can be used for future reference.

Some suggestions for the processing discussion

- Expect participants to express their ideas on difference between facilitator's roles.
- Expect them also to express their feeling about participants' behaviors as well as expected results based on the illustrations presented.
- Ask them what situation they would prefer.
- Ask them if they were placed in a non-formal, participatory situation, what they should do to get the most benefits from results.
- Lead them into the discussion of participatory norms (i.e., standards they would like to adopt to get the training program/farmers' field school going on smoothly).

<u>Sample guide in setting participatory norm :</u>

- When shall the training start? (Dates and time)
- When shall it end? (Dates and time)
- Are we Sirs or Joes? ID?
- Breaks?
- Smoking?
- Curfew hours?
- Attitude to others?
- Food?
- Attendance?
- Bathroom?
- Teamwork?
- Field work?
- Etc., Etc., Etc.

Exercise No. 2.08

THE BALLOT BOX EXERCISE :
EVALUATING KNOWLEDGE AND SKILLS IN IPM

When is this exercise most appropriate?

- In the FFS, TOT and VST as a pre- and post-training evaluation of the participants' ability in identifying crop growth stages, diseases, weeds, insect pests, the damage they cause and their natural enemies.
- It becomes meaningful because actual field situation or problems are presented.
- Participants need not know how to write to be able to participate in the activity. In cases where some participants cannot read, facilitators must make it a point to walk with those concerned and assist them by reading out the questions to them.

How long will this exercise take?

- At least 1 hour for collection of specimen (*e.g.*, as part of field regular activities)
- At least 2 hours for preparation, mounting, and set-up of the exercise (*e.g.*, during vacant periods)
- At least 1 hour for processing and participatory discussions on the results of the exercise

Learning objectives

- To measure participants' knowledge and skills in identifying crop growth stages, diseases, weeds, insect pests, the damage they cause and their natural enemies.
- To develop participants' skills in the preparation of Ballot Box questionnaires.

Materials

- fields at different stages near each other with different problems of pests, diseases and weeds
- pieces of Cartolina, cardboard or folders
- vials, rubber bands, marking tapes, pens, thread or plastic straw, thumb tacks
- bamboo sticks, glue, fertilizer samples
- actual, live or preserved specimens

Steps

1. In the TOT or VST sessions, let the participants take the 'Ballot Box' evaluation prepared by the facilitators in the field [1]

2. After the exercise, go through with the right answers in the big group. Ask the participants for the positive and negative points of the exercise.

3. Solicit their suggestions on how to improve the exercise for the FFS. For example :
   <u>In the manner of asking questions, which one is better :</u>
   - Which of the specimens is a *Lycosa pseudoannullata*?
   - Which of the specimens is a friend?

   <u>On what categories to include in the questions :</u>
   - Fertilizer (What is the cause of this deficiency symptom?)
   - Disease (What organism caused this disease?)
   - Weeds (Which weed is most difficult to control?)
   - Pests (Which one caused this damage?)
   - Natural enemies (Which natural enemy will eat this?)
   - Rats, Snails and Birds (What pest caused this damage?)

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1 Ballot box test is a field based test without pen and paper. It uses specimens and plants in the field. For each question there are three possible answers and trainees put their number in the box with the right answer. A question could refer to a plant in the field with a piece of straw, and three specimens could be the possible answers. Or a question could refer to one specimen and the possible answers are three plants (A, B and C) referred to with three pieces of straw.

4. Brainstorm on the right time to do the 'Ballot Box" in the FFS. Agree on when, how many and what questions to prepare for the FFS. Be sure that each question to be prepared will have a reference in the field.

5. Collect live, actual specimens and preserve insect pests and natural enemies in vials and mount the same on pieces of cardboard or folders.

6. Prepare questions focused on identification of crop stages, plant parts, diseases, insect pests, the damage they cause and their natural enemies. The questions should be in the dialect or vernacular.

7. Write the questions on the cardboard or folders. They should be of a selection type where participants only choose the letter of the correct answer. Questions may be as follows :
   - What insect causes this damage?
   - Which of these insects is a pest?
   - Which of these insects is a friend?

8. Mount the cardboard or folder on bamboo sticks with thumb tacks and set-up the "ballot boxes" in the field. Use vegetable plants in the field showing actual insect damages for the exercise.

9. During the exercise, the participants select only their answers by dropping a piece of paper with their assigned number in a corresponding "ballot box" attached to the cardboard or folders.

10. Process the activity to determine participants' performance and solicit comments on how to improve the exercise for future use.

Some suggestions for the processing discussion

- Are people trying to cheat? How? How can you avoid that people cheat?
- What if farmers do not know how to read and write?
- Did you conduct the exercise in the field? Why was it conducted in the field?
- Did you use examples from different growth stages?
- How many questions did you ask?
- How did you ensure that the specimens used were very clear?
- How did you avoid misunderstandings?
- How did you ensure that everybody have the same time in answering the questions?
- How useful is the exercise to you? Will it be useful to farmers?
- Are there substitutes for using actual, live or preserved specimen if these are not available? Do you think it will be as effective as using actual specimen?
- Do you think writing the questions in the vernacular will help improve the effectiveness of the exercise? What language did you use with farmers?
- Can you share some ideas on how to improve the exercise?

Exercise No. 2.09

PARTICIPATORY TECHNOLOGY DEVELOPMENT : THE PROCESS OF COLLECTIVE AND COLLABORATIVE INQUIRY

Participatory Technology Development (PTD) is the process of collective and collaborative inquiry with the purpose of initiating community actions on solving local problems. PTDs on Integrated Pest management (IPM) are being implemented to empower participants (both facilitators and farmers) with analytical ability and skills to investigate into the cause-effect relationship of problems in farming practices and thereby stimulate them to design a set of actions for solving their problems.

As a team, the participants learn from other farmers' response at each stage of intervention and draw lessons for future IPM program implementation strategies. In addition, the participants develop analytical skills and attitudes in working within participatory framework in planning, organizing and evaluating development activities.

PTD means that all relevant stakeholders do what only researchers usually do. It can be seen primarily as a learning strategy for empowering participants and only secondarily as producing research results in the conventional sense.

PTD as a learning process empower in three ways : (a) it empowers because of the specific insights, new understanding and new possibilities that participants discover in creating better explanation about their social world; (b) participants learn how to learn; and (c) it liberates when participants learn how to create new possibilities for action.

When is this exercise most appropriate?

- In FFS, TOT and VST sessions before the participants design and plan activities in their learning fields.
- During the first two weeks of sessions

How long will this exercise take?

- 3-5 planning sessions of 1-4 hours alternately in the barangays and in the 'classroom'.
- Season-long exercise with weekly field checking and decision making.

Learning objectives

- To identify local field problems that will be the basis for designing and planning activities in the learning fields.
- To initiate community action to solving local field problems.
- To improve individual and group decision making skills for crop management

Materials

- FFS farmers
- Baseline Survey Forms
- Manila paper, pentel pen, notebooks, ball pens

Steps

Introductory Activities :

1. One or two days before the session, distribute the handout : *"Considerations in establishing PTD activities in VST, TOT and FFS sites"*

2. Conduct participatory discussions regarding the topic and documented on manila paper all interactions in the big group for later reference. You can consider the following as useful guide questions :
   - What is the purpose of doing PTD?
   - What are the ways of identifying farmers' problems and needs?
   - Can you address all farmers' problems and needs during the FFS? How do we do it? Do we prioritize our activities? How?
   - What is the next logical step after the problems are identified and prioritized? Who will be involved in the problem solving process? Will the process be sustainable in the long run?
   - After designing and planning the PTD activities, what is the next logical step? Who will be involved? How will it be implemented?
   - After implementing the PTD activities, what is next?
   - Will the PTD end after data collection and interpretation?

3. Conduct a group exercise to draft a procedure to be followed in designing, planning and implementing PTDs in the FFS, TOT and VST sites based on the results of earlier participatory discussions.

4. Conduct a participatory discussion to determine which can be done now.

<u>Identify local problems :</u>

5. Before entering the barangay, let participants come up with a concrete list of things they want to do. This can include the following :
   - Establish rapport in the barangay by doing a courtesy call to officials, meeting and consulting with farmer-leaders, etc.
   - Identify varieties (why?), cropping pattern, and sequence
   - Know their area planted per cropping season, their production and income
   - Identify their pest problems and control strategies
   - Obtain information on soil fertility and fertilizer management

- Know their source of financing, marketing strategies, handling, packing, transport
- Know their sources of information on farming strategies (e.g., radio, technician, co-farmers, sales representative of chemical company, etc.)
- Find out their land tenure (e.g., owner , tenant, etc.)
- Know the type of irrigation or source of water system
- Get information of labor arrangements (e.g., hired, family, etc.)
- Know their harvest and post harvest activities

6. Design an appropriate Baseline Survey Form and conduct survey so that a more specific information in the area can be obtained on pest control strategies, fertilizer management and other cultural management practices.

7. Go to the barangays as often as possible in small groups for at least half day a week until all the information are finally gathered.

Validate initial information gathered :

8. Consolidate initial data gathered per small group and present them to the big group for validation.
9. Conduct participatory discussions to get all possible reactions from the big group. This activity is very important for :
   - Identifying lacking information that need to be gathered.
   - Prioritizing field problems in the community.
   - Determining the next activities to be undertaken in succeeding barangay visits.

10. List down all the major issues that came out during the participatory discussions with the big group for consideration as possible PTD activities.

11. Decide on when and what missing or additional data to gather for immediate designing and planning of succeeding PTD activities?

<u>Gather additional barangay information :</u>

12. Go back to the barangay in small groups and gather additional or missing data needed for immediate designing and planning of succeeding PTD activities.

<u>Prioritize problems and design activities :</u>

13. Consolidate additional data gathered per small group and present them to the big group for validation.

14. Conduct participatory discussions to get all possible reactions from the big group. This activity is very important for :
    - Completing lacking information needed for designing and planning of final PTD activities.
    - Validating priority field problems in the community.
    - Determining the PTD activities to be set up in the FFS, TOT and VST sites.

15. Plan and conduct additional visits to the barangay if needed.

16. Update initial data earlier consolidated small group and present them to the big group for final validation.

17. List down again all the major issues that came out during the participatory discussions with the big group for final consideration in designing and planning of PTD activities in the FFS, TOT or VST sites as follows :
    - Crop Protection Trials (CPT), where Integrated Pest Management (IPM) and Farmers' Crop Protection (FCP) practice is compared, will be established in all the sites (FFS, TOT or VST). The FCP practice,

which will be followed throughout the cropping season in all the sites, must be clearly defined during the groundworking activities. The IPM strategy is a decision making tool and not a package of technology. Farmers will usually be tempted to follow some of the new IPM strategies in the FCP plot if treatments are not well defined from the beginning. A clear definition of the treatments (IPM vs FCP) will secure a good comparison between old and new practices in crop protection.

- Other PTD activities, such as the Cultural Management Trials (CMT) are designed based from the outputs of the previous activities. Some examples of the CMT activities are as follows : (a) Fertilizer management (e.g., rate, kind, method, organic or inorganic materials); (b) Seedbed management; (c) Crop establishment; (d) Planting distance and method; (e) Varieties; (f) Soil Conservation.

18. Decide with the group how many vegetable varieties you are going to work with. Will it be the same number in the FFS, TOT and VST sites?
19. Conduct workshop in small group to draft a design and plan of their individual PTDs. Finalize the design and plan for the PTD activities in the TOT or VST through participatory discussions in the big group.

20. Draw a layout of the PTD and list down what data will be gathered throughout the season. Be very detailed! Present it to the big group for additional suggestions and comments.

    Note :
    Although this whole exercise is primarily to conducted to establish the PTDs in the TOT or VST learning fields, at the same time, it serves as a preparation for the establishment of PTDs in the FFS sites where farmers will be more directly involved. It will be nice also to consult with the TOT or VST participants when designing, planning and implementing the PTDs in the FFS sites with farmers.

Some suggestions for the processing discussion

- Is PTD learning or research? How big plots do you need? Do you need replication?
- How can PTD empower farmers?
- What is the difference between groundworking and village immersion?
- What are the criteria for prioritizing field problems?
- Does IPM mean no spraying? Is IPM a package of technology?
- Can IPM be done for all types and varieties of vegetables?
- Do you have to know all technology before doing IPM with farmers?
- Explain the following IPM terms . How are they related to PTD?
  a) Grow a healthy crop
  b) Observe fields regularly
  c) Conserve natural enemies
  d) Make farmers experts in their own fields
- How can PTD be community oriented?
- Can you teach farmers to teach themselves?
- What are the advantages and disadvantages of growing more than one variety?
- Can you design participatory technology development activities even if seedbeds are prepared before the start of the training?
- How can you then address seedbed problems?
- What are the disadvantages of giving pre-designed activities in the TOT and FFS?
- Are the designed PTD activities too complicated for you? For TOT? For FFS?
- Can you simplify the PTD activities to give clearer results?
- Can we do an economic analysis based on the PTDs conducted?

Exercise No. 2.10

THE FOLK MEDIA :
A SIMPLE WAY TO CONVEY IPM MESSAGE

Local songs, dances, poems, proverbs, stories, tales, legends and drama are forms of folk media. Folk media makes it possible to convey a developmental message using a medium which is familiar to a group of people. By doing so, the message becomes more easy to understand.

Folk media can be used in various ways. The extensionist can use it to explain complex concepts. Weaknesses in a culture or group may be approached in a non-threatening situation through a folk media presentation. It can create an awareness and lead to analysis of problems by the people in a community.

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions, at the latest, a month before the schedule for presentation (e.g., field day or graduation ceremonies) to give the participants ample time to prepare for the activity.
- This activity should be taken up as part of the module on extension communication.

How long will this exercise take?

- At least 30 minutes for brainstorming and participatory discussions
- At least 1 hour planning on respective folk media presentation
- At least 1 hour practice every week before presentation

Learning objectives

- Define ‘*folk media*’
- Discuss some forms of folk media
- Explain the advantages of using folk media
- Plan on respective group’s media presentation

Materials

- Video tape presentation on folk media
- Manila paper, pentel pen, masking tape, etc.
- Props during actual presentation

Steps

1. Present an example of folk media. This may be done either by viewing a tape or asking a member of the group who has the knowledge and skill to present one.

2. Start the discussion by framing up a working definition of folk media. Elicit definitions from the group and list down whatever ideas are contributed. When there are no more ideas, try to come up with one working definition by combining the ideas together. This will be the group’s own working definition of folk media.

3. Using the earlier presentation, ask what people think are the advantages of using folk media.

4. Refer to the earlier presentation again. Ask the group what they call the form of folk media that was presented. If they are familiar with it, how do they do it in their respective regions.

5. Ask participants to move into their respective small groups and plan on the folk media they will present during the field day.

6. Practice and present the folk media during a field day or graduation ceremonies.

Some suggestions for the processing discussion

- What are the advantages of using folk media in conveying IPM messages over the other forms of media?
- What other forms of folk media do they have in their respective regions? When and where are they most appropriate to use to convey IPM messages?

Exercise No. 2.11

THE FIELD DAY :
HOW TO CONVEY IPM MESSAGE BY RESULT DEMONSTRATION

The field day is an occasion when farmers and trainers show other people or the community what they have learned and the results from their participatory technology development (PTD) activities. The best time to have a field day is when there is still a standing crop, nearing maturity. That is, unless there is an emergency situation and there is no choice but to harvest early.

The field day is the training-participants' affairs. This means that they plan for and implement the activity. For the farmers' field school (FFS), the farmer-participants may choose to invite co-farmers from the same or neighboring barangays. For training-participants, they may choose to invite their local chief executives or direct supervisors with the end view of orienting them on the program.

The field day may include such activities as field tour and a program where local officials deliver speeches. In the Philippines, the participants and the community also jointly prepare food as part of the event. The atmosphere a field day takes is a festival. Folk media prepared by farmers completes the celebration.

When is this exercise most appropriate?

- In the FFS, TOT and VST sites, at the latest, a month before the schedule for the activity to give the participants ample time to prepare.
- This activity should be taken up as part of the module on extension communication.

How long will this exercise take?

- At least 1 hour devoted each week for three weeks on planning, brainstorming and participatory discussions prior to the last week of preparation.
- At least 1 full week of whole day preparation before the schedule for the activity

Learning objectives

- Define *'field day'.*
- Discuss the reasons for holding field days.
- Discuss activities during a field day.
- Plan, conduct and evaluate the field days in the FFS, TOT or VST sites.

Materials

- 'Learning field' at least 2 weeks before harvest
- Video tape presentation on field day
- Props, preserved and live specimens, graphs of initial results, field labels, etc.
- Other supplies and materials for field day preparation

Steps

1. Present a video tape on a field day conducted in any FFS, TOT or VST group. On the basis of the presentation discuss the following with the group the following :
   - What is a field day?
   - What are the reasons for holding a field day?
   - What happens during a field day? (What are the parts of a field day?)

2. Write down the answers particularly to question #3 and make use of them as basis for planning the group's field day.

3. Plan the field day activities in the FFS, TOT or VST sites.

4. Conduct and evaluate the field days in the FFS, TOT or VST sites.

Some suggestions for the processing discussion

- Who should we invite during the field day? Why?
- How do we solicit the involvement and commitments of local leaders in the community through the field day?
- How do we sell our local IPM programs to our concerned government officials and politicians through a field day?

Exercise No. 2.12

THE FOLLOW-UP PROGRAM : HOW TO SUSTAIN IPM PROGRAMS IN LOCAL COMMUNITIES

The first phase of the IPM program focuses on capability and capacity building. This comes with the season-long training of specialists, trainers and farmers in farmers' field schools (FFSs). However, before the end of the first season, trainers must already look towards the direction of sustaining IPM in local communities. This means that after the initial activities in the FFS, farmers must already start planning for follow-up IPM activities in their communities. In so doing, barangay-based IPM organizations are strengthened. This is the goal of the follow-up program.

The following sessions walk trainers through some follow up activities. The activities may be considered both in the VST, TOT, as well as in farmer field schools.

Exercise No. 2.12A

ORGANIZING THE FFS FARMERS

When is this exercise most appropriate?

- The best time to discuss the topic is towards the end of the season when farmers start to think about what comes after the farmer field schools season.
- Discussions about IPM clubs or organizations should be done both in the FFS, TOT and VST sessions. Ideally, training-participants should go through the exercise first so that they can turn around and do the same exercise with farmers in the FFS.

How long will this exercise take?

- At least 1 hour brainstorming and participatory discussions with the TOT or VST participants
- At least 2 hours of the last two weeks sessions with FFS farmer-participants

Learning objectives

- Go through the exercise of organizing FFS farmers so that the participants can turn around and do the same exercise with farmers.
- Organize IPM trained farmers who will carry on sustaining IPM activities in their respective barangays after the initial FFS season.

Materials

- farmer-participants in an on-going FFS.

Steps

1. From the start of the training, it should be made clear with the farmers that they are expected to pass IPM on to other members of the community and to other farmers. To facilitate this process participants in the on-going FFS should sit together to plan what they will do upon completion of the season-long IPM training program. This activity is best done during the 12th week of the FFS session.

2. During the activity, IPM farmers are expected to discuss about getting organized into a club (e.g., select leaders and plan out activities), if they have not been formally organized yet. There are various reasons for organizing the group.

3. Among others, the farmers will identify a personality who can eventually transact business for their group. If the farmers belong to a cooperative or any existing group, they may already made plans for IPM which their group may implement. In the process, it should be emphasized that more important than structuring the organization is keeping the group alive. This is only possible if the members are serious about carrying on IPM related activities. Some suggested activities that IPM clubs can carry out are:
   - technical backstopping through home and field visits to IPM and non-IPM farmers;
   - networking of trained farmers in the different barangays in the community;
   - conduct of participatory technology development (PTD) activities to discover new management options;
   - conduct of farmers' field school (farmer-to-farmer); and
   - preparation and circulation of IPM newsletter to disseminate new and localized technologies and management strategies.

Some suggestions for the processing discussion

- How do we ensure the sustainability of the farmers' group that we organized in a barangay?
- What participatory technology development (PTD) activities will they start to work on? How will they go about these activities?
- What role will the local IPM team play to sustain local IPM program in the community?

Exercise No. 2.12B

FARMERS CONDUCTING FARMER FIELD SCHOOLS

When is this exercise most appropriate?

- Discussions about farmer-run field schools should be conducted both in the FFS, TOT and VST sessions.
- Ideally, trainers should go through the exercise first so that they can turn around and do the exercise with farmers.
- The best time to discuss the topic is towards the end of the season when farmers start to think about what comes after the farmers' field school season.

How long will this exercise take?

- At least 1 hour brainstorming and participatory discussions with the TOT or VST participants.
- At least 2 hours of the last two weeks sessions with FFS farmer-participants

Learning objectives

- Discuss the advantages and disadvantages of IPM farmer-graduates conducting farmer field schools;
- Brainstorm on how IPM farmer-graduates can organize farmer field schools; and
- Discuss on how to further equip IPM farmer-graduates to become IPM farmer field school facilitators

Materials

- farmer-participants in an on-going FFS.

Steps

1. Divide the group into two. Ask Group A to sit in the inner circle and Group B in the outer circle. While Group A discusses the advantages of FFS run by IPM farmer-graduates, Group B is supposed to listen and take down notes. Give the group fifteen minutes to discuss. After fifteen minutes Group B takes its place in the inner circle to discuss the disadvantages of FFS run by IPM farmer-graduates while Group A observes and takes down notes. List points being raised while presentations are going on.

2. Using the same groupings, ask members to discuss their experiences in organizing farmers' field schools. Ask each group to summarize their outputs for reporting to the big group. While they are presenting, note down the issues and concerns. After all groups have presented, check if there are common activities that the two groups went through. Summarize these. This process will give you and the group some common steps in organizing farmers' field schools.

3. Solicit suggestions from the big group on how IPM farmer-graduates can be further equipped to become farmers' field school facilitators.

Some suggestions for the processing discussion

- What will be the role of the local government unit (LGU) -based IPM training teams once an IPM farmer-graduate group is in place to do IPM training of farmers?
- How do we ensure training quality and standard once an IPM farmer-graduate group is utilized to do IPM training of farmers?

SOME USEFUL TRAINING TOOLS

Exercise No. 2.13

ROLE PLAY :
A WAY OF CONVEYING IPM MESSAGES

When is exercise most appropriate?

- In the TOT or VST sessions.
- Any time before introducing role-play in FFS session.

How long will this exercise last?

- At least 1 hour of the TOT or VST sessions.

Learning objectives

- To experience how and understand when will role-play be the most appropriate training tool in IPM.

Materials

- Manila paper and pentel pens
- Props (if deemed necessary only)

Steps

1. The facilitators performs a role play to illustrate the following statement from Galilee [2]: "*You cannot teach a man anything. You can only help him to discover it for himself*" . The facilitators has to prepare the role-play in advance.

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2 Galileo Galilee (1564 - 1642) was an Italian astronomer and physicist.

2. Process the activity by sharing everybody's ideas. Ask the group of what they learned from the role-play. Ask them if they believe on the statement. You may need to guide them to a probable conclusion.

3. Solicit from the group for some suggestions of things that can be or cannot be role-played. Find out if their suggestions are what they have heard, what they think or what they have discovered for themselves. The facilitators can also suggest the following :
   - Pesticide resistance
   - Disease triangle
   - Insect identification
   - Being an extension worker or teacher
   - Real situations versus abstract interpretations

4. Conclude the activity by asking the group for the advantages and disadvantages of a role-play in conveying IPM messages. List the answers in a matrix as follows :

ADVANTAGES	DISADVANTAGES

Some suggestions for the processing discussion

Answers to the questions should be given with examples :

- Who is learning, the actors in the role-play or the audience?
- What is the purpose of role-playing?
- Can a role-play help the participants to change attitude?
- Can a role-play help the participants to develop practical skills?

- Can a role-play help the participants to do a reality check of thoughts and ideas?
- Can a role-play help the participants to get feedback?
- Can a role-play help the participants to try the role of their clientele? (try to be a farmer)
- Can a role-play help the participants to become better trainers or trainees?

Exercise No. 2.14

WORKSHOP :
HOW TO DEVELOP A DISCOVERY-BASED EXERCISE?

When is the exercise most appropriate?

- In the TOT and VST sessions
- Between weeks 5 to 12 of the TOT and VST sessions
- When there are problems without answers, when the participants want to learn more about a problem or when no corresponding discovery-based exercise designed for a particular problem.

How long will the exercise take?

- At least 3 hours of the TOT or VST sessions

Learning objectives

- To build the participants' technical competence about a problem.
- To develop the capability of the participants to discover and design appropriate discovery-based exercises.

Materials

- Manila paper, pentel pens, crayons

Steps

1. During the barangay immersion and weekly FFS follow-up, find out if there are certain field problems in the FFS that need to be understood further (about 1-2 weeks before the exercise). [3]

2. List down all the field problems in every FFS. Facilitate a brainstorming session to solicit all ideas from the participants about the meaning of a discovery-based exercise. List down all ideas in a manila paper. Consolidate the outputs and agree on a common definition of a discovery-based exercise.

3. Find out if anybody have designed discovery-based exercises and how they did it before. Let him or her share his or her experience.

4. Determine what topics the participants want to work on. The best option is something relevant (need based) in their FFS.

5. Decide on the format to be followed for the presentation. (e.g., Title, When Appropriate, Time Requirement, Learning Objectives, Materials, Steps, etc.).

6. Give the small group participants enough time (1-1.5 hours) to plan and write down the steps of the exercise on a manila paper. The facilitators must be around to guide the participants.

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3 Previous examples met in training:

- **Farmers think earthworm is a pest that brings rotting in onions. A group designed a pot experiment. Some pots had healthy plants and earthworms some others no earthworms. Other pots had soft rot affected plants with or without earthworms. Farmers discovered that rotting does not come from earthworm even with many of them.**
- **Farmers disregard cabbage plants with many heads (broken apical dominance) and spray heavily against a few pest that can damage the growing point. Growing point was removed artificially at different weeks after transplanting. As soon as the cabbage compensated with many small heads, all of them except one were removed. Farmers discovered that the cabbage plant could still grow a marketable head if they removed excessive heads as soon as they appeared.**

7. Each small group shall present their outputs for comments and suggestions from the big group. Each small group shall Incorporate any additional suggestions from the big group where appropriate.

Some suggestions for processing discussion

- In what way is the exercise discovery-based?
- What is it that you discover?
- Can the exercise involve many farmers?
- Is the exercise based on instructions or questions?
- Shall it be done in small group or in the big group?
- When will be the right time to do the exercise?
- How long time will it take?
- What can farmers learn from the exercise? What problem does it solve?

Exercise No. 2.15

DEVELOPING AN FFS GUIDE :
WHAT ARE THE ACTIVITIES IN THE FFS?

When is the exercise most appropriate?

- In the TOT and VST sessions.
- Before first or second FFS session.

How long will the exercise take?

- At least 30 minutes for coming up with a relevant format.

Learning objectives

- To improve the quality of FFS preparation.
- To develop a tool to better management time, topics and responsibilities in the FFS.

Materials

- Manila paper, pentel pen

Steps

1. Brainstorm with the participants (big group) on what will be generally needed to prepare for the FFS. List down everything that were agreed upon.

2. Agree on an appropriate format that will be followed. The format may include the following information :
   - Time, activity, learning objectives, materials needed;
   - persons responsible; and
   - maybe strategy and remarks.

3. Draft a matrix of the agreed format on a manila paper . Below is an example :

TIME	ACTIVITY	LEARNING OBJECTIVES	MATERIALS NEEDED	PERSONS RESPONSIBLE

- After developing an appropriate format, brainstorm on Some Suggestions for the Processing Discussions given below.
- Start preparing an FFS GUIDE by using format developed in this exercise.

Some suggestions for the processing discussion

- Discuss the purpose for preparing a matrix. (It can include : improves time management; helps farmers to pay attention to all activities; reminds everybody of all the activities for the day; serves as an activity documentation for the bosses, for the Program Management and for the field day; reminds the facilitators of the materials to bring and their responsibilities; or even helps to hold the enthusiasm of the farmers, etc.)
- Discuss what language should be used in the FFS guide (e.g., usually in the vernacular and not in English).
- Discuss how useful the guide is. Is it useful only to the facilitators? Is it also useful to the farmers? Should it be posted in the FFS?

Exercise No. 2.16

PREPARING WEEKLY FFS GUIDE : HOW TO DECIDE ON WEEKLY FFS ACTIVITIES

When is the exercise most appropriate?

- In the TOT and VST sessions.
- As a weekly on the day before the conduct of an FFS.

How long will the exercise take?

- At least 1-3 hours early in the season (longer time) and about 1 hour later in the season (lesser time)

Learning objectives

- To improve skills of the participants deciding with farmers the weekly activities that will lead to high quality FFS.
- To improve skills of the participants in working together as a group.

Materials

- Manila paper, pentel pens, crayons, meter stick

Steps

1. Brainstorm with the big group on relevant topics for the week in the FFS. List down all answers on a manila paper.

2. Discuss the relevance of the topics based from previous experiences. Make sure that all options are carefully considered before deciding on a particular activity for the FFS. The farmers suggestions should be the foremost consideration.

3. Let the small group participants to prepare their respective FFS guide (see previous exercise). At first, draft the guide on bond paper, discuss it among the group members and with the facilitator before finally writing them on a manila paper

4. Each small group then presents their respective FFS guide to the big group for further discussion and finalization.

Some suggestions for the processing discussion

- As an example, the chronological sequence of the weekly FFS Guide can be as follows :
  a) Arrival and registration
  b) Opening prayer
  c) Recap of previous week's FFS
  d) AESA
  e) Break
  f) Fieldwork
  g) Group dynamics
  h) Icebreaker
  i) Special topic
  j) Evaluation and planning for next week
  k) Closing prayer
- Discuss the learning objectives. (Should be SMART).
- Do not over simplify the guide.
  (For example, **Activity** : *AESA*; **Learning Objective**: *To do AESA or To monitor pests and natural enemies*. A better way to describe the Learning Objective for AESA will be : *To be familiarized with the components of the agro-ecosystem and improve decision making skills*). Maybe you have an even better suggestion.
- Try to brainstorm on the following general questions.

a) Is the exercise possible? Are the materials available?
b) Do the farmers have enough background to do it now?
c) Should you do another exercise first?
d) Is the topic important for the farmers? Does it have his high priority? Is it need based?
e) What would the farmers like to do, or what did you agree to do in last week's planning with the farmers?
f) Have you addressed the problems met in previous AESAs?
g) Have you addressed the problems met in farmers' field during barangay follow-up?

- Brainstorm also on the methodology used :
  a) Are you going to lecture? Is it field-based? How can you make it more field-based?
  b) Is it theoretical or practical? Is it demonstration or do you involve farmers? All farmers?
  c) Is there something for the small and big groups to satisfy farmers' different learning pattern?
  d) Are the scheduled activities exciting enough to keep up the attention of the farmers for the duration of the FFS?
  e) Is the ice breaker scheduled at a time where it will benefit the most or when farmers need most to be perked up?
  f) Is it for farmers or by farmers? Who will speak the most, farmers or facilitators?
  g) Does the facilitator group (here TOT or VST participants) share the responsibilities?
  h) Remember that the TOT and VST is a learning opportunity. Is it the same person always facilitating AESA? Special topic? Ice breaker? Etc.?
  i) Does the facilitators group act as individuals or as a group?

Exercise No. 2.17

BRAINSTORMING AND GENERAL DISCUSSIONS : DEFINING AND CHOOSING APPROPRIATE EVALUATION METHODS FOR IPM

When is the exercise most appropriate?

- In the TOT and VST sessions
- During the first or second week of the training

How long will the exercise take?

- At least 1 hour of brainstorming and participatory discussions.

Learning objectives

- To develop the ability of the participants to choose the most appropriate evaluation methods for IPM training activities.
- To improve the skills of the participants in conducting useful evaluations for FFS activities.

Materials

- Manila paper, pentel pens,

Steps

1. Brainstorm in the big group on the purpose of evaluation. List down all ideas in a manila paper .

2. Let the participants share their experiences on the different methods of evaluation they have already tried. List down also all their answers in a manila paper.

3. Conduct a participatory discussions on the following :
   - advantages and disadvantages of each method.
   - evaluation method to recommend in the FFS
   - evaluation method to recommend in the TOT
   - how often the evaluation should be done (e.g., daily, weekly, monthly)

4. Consolidate all the ideas and agree on a common understanding of what an evaluation is all about.

Some suggestions for the processing discussion

- Is it about training quality? Is it about skills gained?
- Is it about the dynamics of the big group and or small group?
- What are advantages and disadvantages of big group oral evaluation?
- What are advantages and disadvantages of small group oral evaluation?
- What are advantages and disadvantages of using evaluation forms?
- What are advantages and disadvantages of using role play as an evaluation tool?
- What should be the outcome of the evaluation?
- What questions would you ask in big group oral evaluation?
- Discuss questions for a written evaluation form. Are many different ways of arranging these forms?
- Should personal comments be included? If yes, how can they be useful?
- What are advantages and disadvantages of an open evaluation?
- What are the advantages and disadvantages of a 'confidential' evaluation?
- How can you make more (or all) farmers contribute to the evaluation?
- What's good and bad about essay form evaluation?
- What's good and bad about multiple choice evaluation?
- How can you make evaluation comparable from time to time?
- Can the methods be combined?

Example 1 : Matrix for evaluating IPM topics or activities. (A matrix can be prepared in a manila paper as shown below.)

PARAMETERS	MOST RELEVANT	LESS RELEVANT	RELEVANT	NOT RELEVANT
Topic 1 : Methodology Facilitator Topic 2 : Methodology Facilitator Topic 3 : Methodology Facilitator				

Discuss the advantages and disadvantages for the following situations :

- Big group facilitated discussion.
- Evaluation form for each participant.
- Each participant indicate with a sticker on the manila paper their personal views.
- Who will participate? Who will be ignored?

Example 2 : Matrix for evaluating daily or weekly activities in IPM. (A matrix can be prepared in a manila paper as shown below.)

WHAT WENT WELL?	WHAT NEEDS IMPROVEMENTS?	RECOMMENDATIONS

Discuss the advantages and disadvantages for the following situations :

- Big group facilitated discussion.
- Evaluation form for each participant.
- Who will participate? Who will be ignored?
- When will this evaluation method be a good choice?

Example 3 : Matrix for evaluating an IPM group. (A matrix can be prepared in a manila paper as shown below.)

PARAMETERS	5	4	3	2	1
Do you find it valuable to be in the group?	VERY VALUABLE	MODERATELY VALUABLE	LESS VALUABLE	NOT VALUABLE	-
How do you find the group rhythm?	VERY FAST	FAST	MODERATE	SLOW	VERY SLOW
How do you find the interpersonal relationship in the group?	VERY WARM	WARM	LUKEWARM	COLD	VERY COLD
How do you find the exchange of ideas?	VERY STIMULATING	INTERESTING	ORDINARY	BORING	VERY BORING
Are your expectations met by the group?	ALL	SOME	NONE		

After getting an idea of the group profiles, ask the following questions :

- What changes do you think are needed to make the group functioning well? How will you do it?
- What will YOU be responsible for? Why?
- Will you deal with this evaluation in small group or big group?
- When will this evaluation method be a good choice?
- Please feel free to add or modify questions.

Example 4 : Questionnaire for monthly TOT or VST training course evaluation.

MONTHLY TRAINING COURSE EVALUATION

The value of the monthly training course evaluation includes : (a) seeing our successes; (b) assessing our weaknesses, and (c) clarifying what needs to be changed or strengthened as we progress in implementing the training course. Thus, we request you to answer all the questions as honestly as you can so that the training management staff can be of better assistance to everyone in the succeeding days to come. THANK YOU.

I. THE TRAINING METHODS AND CONTENTS

1. Can you summarize what has been most helpful to you during the course?
   a) About the training methods :
   b) About the training contents :
   c) About the FFS :

2. Can you summarize what has not been helpful to you during the course?
   a) About the training methods :
   b) About the training contents :
   c) About the FFS :

3. What FINAL suggestions do you have to improve the following ?
   a) About the training methods :
   b) About the training content :
   c) About the FFS :

II. THE PARTICIPANTS AND FACILITATORS

4. What FINAL comments and suggestions do you have to improve group participation ?
   a) Individual participation :
   b) Small group participation :
   c) Big group participation :

5. What FINAL comments and suggestions do you have to improve the roles of the facilitators in the future ?
   a) Name of facilitator 1
   b) Name of facilitator 2
   c) Name of facilitator 3
   d) Etc.

III. THE TRAINING MANAGEMENT

6. What are your FINAL comments and suggestions regarding the coordination and management of the training course ?
   a) The Training Management Staff :
   b) DA Regional Field Unit :
   c) ATI-RTC :

7. What FINAL comments and suggestions do you have on the logistic support of the training ?
   a) The Food :
   b) Supplies, Materials and References :
   c) The Training Venue and Lodging :
   d) Transportation and Mobility :
   e) Staff Support (e.g., DA-RFU and ATI-RTC)

8. What are your FINAL comments and suggestions regarding the following training activities ?
   a) Host Team Functions :
   b) Field Works :
   c) Field Day :
   d) Team Works :
   e) Quizzes and Examinations :

As a whole, how do you finally rate the training ?

Exercise No. 2.18

FEEDBACKING AND CRITIQUING :
HOW DO WE EVALUATE OURSELVES?

When is this exercise most apprpriate?

- In the TOT and VST sessions
- Every after an FFS session and before ending every weekly activities.

How long will this exercise take?

- At least 1-2 hours of the TOT or VST sessions.

Learning objectives

- To improve the participants' analytical, planning and facilitating skills through feedbacking and critiquing.

Materials

- Manila paper, pentel pen

Steps

1. Post the chart of 'Qualities of a Good Facilitator' from a previous session on the board. Give each small group 15 minutes to answer the following :

    - Did we do so?
    - Can you give concrete examples of how you did it in today's session?

2. Then discuss the evaluation process with the big group. Consider the following guide questions :
   - How efficient can feedbacking and critiquing be as an evaluation tool?
   - What information are useful to share for feedbacking and critiquing?
   - Why is it useful?

3. Based from the suggestions made, facilitate the big group to agree on a standard matrix that can be utilized for the weekly feedbacking and critiquing.

4. Once a matrix form is finalized, write it down on a board or manila paper and give each small group 15 minutes to fill up the relevant information in the matrix form.

5. Critique constructively the information provided by each small group in the big group. List down important problems, issues and experiences shared.

6. Discuss how the information shared can be useful in improving future IPM activities. Come up with concrete recommendations to be immediately undertaken. (Oftentimes, the activity becomes repetitive and the group forget to analyze the problems or challenges).

Some suggestions for the processing discussion

- Evaluate the FFS guide : Were the activities relevant? Did you use the FFS guide? Did farmers use the FFS guide?
- Evaluate the activities : Did the farmers like the activities? Did the farmers learn something? What did they learn? (headlines) What were the most successful activities? Why? What activities needed improvement? Why? What would You then recommend? Was it participatory? Give examples. Was it discovery based? Give examples.
- Evaluate the participation : Was it satisfactory? Explain why. Is it more or less as before? Why? Who were talking more, the farmers or the facilitators? Could you involve the farmers more? How?
- In the discussion with reference to the matrix below, you should try to use an improved version made by the participants : When can 'time arrived' be a useful piece of information? When can 'number of farmers' be a useful piece of information? When can 'time started' be a useful piece of information? When can 'time finished 'be a useful piece of information?
- Discuss how the highlights of activities can be useful information. Often, the activity is simply stated as : *We did AESA*. That statement is not learning. It is probably better to state it as : *Farmers discovered that 1 ladybird beetle eats 20 aphids per day in an insect zoo. Or, It was discussed if earthworm can cause rotting, we established a pot experiment to learn more.*
- Discuss how problems met can be useful information. Often it is just stated as: *Farmers do not cooperate*. A better way probably to state is : The *farmer cooperator did not apply the agreed pest control practice*. Are there recommendations for all problems met? Does the big group have other ideas to solve the problem?

Example of a matrix for feedbacking of weekly FFS activities :

PARAMETERS	GROUP 1	GROUP 2	GROUP 3	GROUP 4	GROUP 5
TIME ARRIVED TIME STARTED TIME FINISHED					
NO. OF FARMERS (MALE, FEMALE) PRESENT NO. OF FARMERS (MALE, FEMALE) ABSENT NO. OF FARMERS (MALE, FEMALE)					
HIGHLIGHTS OF ACTIVITIES					
PROBLEMS MET					
RECOMMENDATIONS					

Exercixe No. 2.19

FACILITATING :
THE QUALITIES OF A GOOD IPM FACILITATOR (ROLE-PLAYING)

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions.
- During the first few weeks of the TOT or VST sessions.

How long will the exercise take?

- At least 1 hour sharing of ideas and participatory discussions.

Learning objectives

- To improve the participants' understanding and skills in facilitating IPM activities.

Materials

- Manila paper, pentel pen

Steps

1. Distribute one guide questions to each small groups. Conduct a mini-workshop in small groups for 30 minutes as follows :
   - Prepare a role-play, where one of the group members will act as a facilitator and the other members as farmers in an FFS. Most of the farmers are not listening or are very passive but there is someone who is very dominant. There is another one who tries always to say something but is always dis- turbed by the very dominant farmer. The facilitator will try to solve the problem.

- Explain what is the importance of asking questions?
- To facilitate means. . . (Complete the sentence in different ways.)
- Explain schematically (in table form, if necessary) the difference between a teacher and a facilitator.
- A good facilitator must be. . . (Complete the sentence in different ways.)

2. Start role-play presentations one group after the other. Let the non-presenting groups to observe the following : (Write down the observations on a manila paper and post on the wall.)
   - How did the facilitator show that he was paying attention to the learners? (listening and attending skills)
   - How did the facilitator respond to the learners' feelings and behavior? (Observing skills)
   - How did the facilitator ask questions?
   - How did the facilitator answer questions?
   - Explain to the group not everything a facilitator does is correct. Let them understand that they can also learn from seeing things done wrong.

3. Then let also another group to do their own role-play.

4. After role-playing, let the other groups list down in charts all their reactions on the prepared sheets with the things to observe and then present them to the big group for comments.

5. Save the charts after presentation and use them later in the training (e.g., after 3-4 weeks later) to check if the group followed their own recommendations

6. Based on the presentations, try to brainstorm on the most common problems in training of farmers (usually, these are : passiveness, monopolizing farmers, philosophers and clashing personalities).

7. Finally, ask for volunteers to role-play or assign one problem to each small groups. In the new role-play, use all the qualities of a good facilitator earlier shared by the group. After the new role-plays, write down again on a manila paper how the problems were solved.

Some suggestions for the processing discussion

- How can a facilitator make farmers feel valued?
- How can a facilitator make farmers feel free to express themselves, to ask questions?
- How can a facilitator make farmers respond to them appropriately?
- How does the facilitator handle a situation when he does not know the answer to a question?
- How does the facilitator involve farmers more actively?
- How does the facilitator make learning easy?
- How can the facilitator speed up the process?
- What does it mean that the facilitator is approachable?
- How can a facilitator be the initiator in difficult situations?
- How can the facilitator clarify doubts?
- How can the facilitator lead the participants to discover the answers?
- How can the facilitator determine the level of understanding of the participants?
- What is the difference between teaching and facilitating?
- Why are the farmers not supposed to say 'Sir 'or 'Mam' to the facilitators?
- How can the facilitator make the learning participatory instead of lecture-based?
- How can the facilitator make the learning need-based?

THE ECOSYSTEM

Exercise No. 2.20

WHAT IS THIS? WHAT IS THAT?
(LEARNING TO ANSWER QUESTIONS WITH QUESTIONS)

The goal of discovery-based learning is to provide a more enlightened educational opportunity for participants. The methodology of learning is very important for achieving the goal of education. One important method is to ask questions that allow the participants to develop their own analysis and understanding. You are stealing an opportunity for education if you reply directly with an answer. Ask questions. Lead the participant to the answer by asking questions. In the rice field, a common question is: 'What is this'? (*Ano kaya ito?*).

There are many ways to answer the question : 'What is this'? For most of us, the natural response is to give the name of the object, often in a foreign language (Taglish or Latin). The question is often answered by saying 'Oh that is *Lycosa psuedoannulata'* or 'This is *Sclerospora philippinensis*'? The result of this answer is that an educational process has been stopped.

A better way to answer the question is to ask a question : "Where did you find it? What was it doing? Were there many of them? Have you seen this before?" The idea is promote learning by discovery and to lead the person toward their own analysis.

When is this exercise most appropriate?

- In the TOT and VST sessions
- During the first or second week of the sessions and before introducing the concept of an ecosystem and agro-ecosystem
- Before conducting the first AESA in the FFS
- After an introduction to adult non-formal education.

How long will this exercise take?

- About 45-60 minutes

Learning objectives

- To facilitate learning by discovery among farmers in the FFS.
- To guide farmers to critically analyze and make better decisions on their field problems

Materials

- vegetable fields
- plastic bags
- notebook and pen

Steps

Option 1 :

1. Go into a vegetable field in groups of two or three person per group.

2. In the group, take turns in the following roles :
   - The "farmer" should take anything in the vegetable ecosystem (pests, natural enemies, weeds, others) and ask, 'What is this'? The other member will act as a "recorder" and must write down questions and responses. The "technician" should respond with one of the following type of responses : 'That is a good question'. 'Where did you find it'? 'What was it doing'? 'Did you ever see it before'? 'What do you think it is'? (Keep asking questions). Use this especially when you know what the specimen is. Try not to give the answer!

- If the question is to be answered, the "technician" should avoid answers which give more emphasis to identification. Rather, the function of the organism should be emphasized. 'This is an insect that feeds on the plant'. 'It is not actually a problem insect until there are very many'. 'There are many organisms which eat this insect, including spiders and parasites'. OR, 'This is a spider that eats insects and is a friend'. 'It happens to be called a hunter because it moves around the field searching for insects'. OR, some other responses that only give biology/ecological information.
- *NEVER GIVE THE ANSWER WITH A NAME. THAT ONLY KILLS THE QUESTION. THE QUESTION IS A CHANCE TO LEARN!*

3. After the members had taken their turns, return to session hall or shade and process experiences.

Option 2 :

1. As a short introduction, two facilitators make two short role-plays. One of the facilitator acts as a farmer and the other as an extension worker :
   - Situation A. The farmer asks 'What is this'? holding a spider in his hands. The extension worker takes it and answers : *Lycosa pseudoannulata* and then throws it away.
   - Situation B. The farmer asks '*What is this*'? holding a spider in his hands. The extension worker answers with questions like : *Where did you find it? On the soil or on the crop? What was it doing? Were there many of them? Have you seen it before? Do you think it is a pest? Do you know what they eat? Where do they live?* The questions will of course depend on the answers of the farmer.

2. Conduct participatory discussion with the participants on which situation will the farmer learned the most.

3. Then, let the participants to go to the field in small groups. In the field, they should find specimens and do role-plays like in Situation B. Let one participant act as a farmer and another one or two act as extension worker. Request the other members of the group to observe and comment after the role-play. You can play a game as follows :
   - If somebody answer with a name, he pays 5 pesos.
   - Farmer's question can be answered with other questions or with ecological information or by asking, *How could we learn more about this? or, Are you interested in making experiments with this? or, Do you think it is a pest?* Etc.

4. Gather again as a big group and ask for two volunteers to role-play. The duo who asks the most number of relevant questions to a farmer's questions without saying a name wins.

5. Then, finally conduct participatory discussions and consolidate all ideas shared by the participants.

Some suggestions for the processing discussion

- How often do you usually give just a name for an answer? What is the importance of asking questions to farmers?[4] Do you think it is helpful in training to ask questions to assist in learning?
- In your usual job, is helping farmers learn an important aspect in day to day work? Do you think it would be useful to answer questions with questions to help farmers? What will the farmer think when you do not answer directly with a name?

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4 Facilitate the group to come up with something like this:

- **For extension workers**
  - **To get ideas, feedback, and become aware of issues**
  - **To determine the level of understanding of the topic**
  - **To gather relevant information**
- **For farmers**
  - **To clarify and evaluate**
  - **To discover and develop own understanding of the problem**
  - **Satisfaction**
  - **To be activated and get an opportunity to participate**

- Many field workers think they have to be smarter than farmers, even though the farmer is much older and more experienced. Do you think this method can help you in working with older farmers by facilitating educational process? Can you also learn from farmers by asking questions? Do farmers think respect, a desire to learn, or an instant answer is most important for a government worker?

Exercise No. 2.21

ROLE PLAY :
TROPIC LEVELS IN THE VEGETABLE ECOSYSTEM

Different insects and other organisms play different roles in a certain tropic level in the ecosystem of vegetables. The vegetable plant, which is at the producers level, provides food for the herbivores like the insects, diseases and rats which in turn provide food for the detritivores, the natural enemies and microorganisms. The absence of some of these elements will greatly affect the balance of the ecosystem.

When is this exercise most appropriate?

- After discussion on the concept of AESA and just before harvest time.

How long will this exercise take?

- 10-15 minutes for the game
- 30-60 minutes for processing

Learning objectives

- To create awareness and understanding of the ecological function of each tropic level.
- To aid facilitators in assessing the level of knowledge of the participants regarding the ecosystem.

Materials

- 30 specimens or 1 specimen per individual participant, broken down as follows :

* 12 insect pests
* 14 natural enemies (spiders, wasps, etc.) and neutrals (cranefly, mosquitoes, etc.)
* 1 fertilizer material preserved in vial
* 1 weed species
* 1 potted rice plant
* 1 animation of the sun

Steps

1. Place prepared specimens in a box or any suitable container.

2. Let all participants randomly pick one specimen for others to see.

3. Instruct the participants to position themselves in accordance to their perceived function within the ecosystem by touching the shoulder of the next level participant. Freeze movement after 30 seconds.

4. Facilitators check the positions of the participants and say “unfreeze” to allow the participants to make sure that their positions are correct. Freeze movements after 10 seconds.

5. Let the participants explain their individual perceived position in the ecosystem.

6. Process and discuss in big group.

Some suggestions for the processing discussion

• Ask about the feelings of the participants on the game in relation to the ecosystem.

Exercise No. 2.22

FIELD WALK AND BRAINSTORMING :
INTRODUCING THE IDEA OF AN ECOSYSTEM

In the activity, 'What is this'? learning to answer questions with questions was emphasized. The response could be any questions about the specimen. In the vegetable ecosystem, however, everything has a function, and the function is more important than the name. There are different levels of functions in all ecosystems.

The first level is the producer of organic materials : the plants. Plants include any vegetable crops and the weeds. The weeds have an additional function in the vegetable field. Weeds are also competitors for water, nutrients (N, P, K, and others), sunlight and space. "Weeds" are defined many ways, but one good definition is "a producer that is not wanted by mankind at that time and place".

The second level are organisms that feed on the plant. These include insects, rats and diseases. These are usually referred to as "pests". But "pests" are defined by their populations, not by their function. For example, when a population of diamond-backed moth (DBM) reaches a high level that damages the cabbage plant, then the DBM are a "pest". If the population is low, then they are not "pests". In fact, if there are no DBM at all, then the Diadegma wasps would have less food and their populations would be low. In this case, DBM at low populations are important to keep Diadegma wasp populations high.

The third level are organisms that feed on the second level. These include spiders, insects (predators and parasites), virus that attack plant fungi and bacteria, owls, cats, and other predators of rats. These organisms are usually called "natural enemies" or "friends of the farmers" because they attack things that could become pests. Preserving these organisms is important to keep the second level from increasing.

The fourth level in the context of the vegetable ecosystem are the decomposers. These include bacteria, fungi, and insects that feed on the dead plants, insects, spiders, rats, etc. that are in the vegetable ecosystem. These organisms cycle the nutrients in the system back into the soil.

In this activity, we will practice identifying the functions of the organisms found in the vegetable ecosystem. This is a good introductory activity for the study of ecology by farmer groups or facilitators as well.

When is this exercise most appropriate?

- 1 week before the first observation and decision-making of the 'learning-field' agro-ecosystem.

How long will this exercise take?

- 1.5 to 2 hours of the FFS meeting

Learning objectives

- To build awareness of the relationships that exist between so many of the living and non-living things that are found in our environment.
- To appreciate that if one thing in this network of interactions is changed, it can influence all of the components of the ecosystem.
- To become more aware of the things and interactions that make up the ecosystem of our fields - the 'Agro-Ecosystem'.
- To start to use our understanding and observations of the Agro-Ecosystem as a basis for decision-making about crop management.

Materials

- vegetable fields
- notebooks for each group
- manila paper for each group
- pens and crayons for each group
- tape

Steps

1. Ask the participants to divide into their working groups. The groups go outside and into the fields, making sure that they have a notebook and pen. Each group working together will : (i) Look around as far as the eye can see, and as close as the eye can see; (ii) List all the living and non-living things they see; (iii) and discuss how they are connected or how they affect each other. Facilitators move between groups to help in discussions where there are any problems. Guide the farmers to observe the crop as well as the wider environment.

2. After 10 minutes of observation, discussion and note-taking ask them to return to the ‘classroom’.

3. Each group now makes a picture showing all the things that they observed and draw lines to show which things are connected or affect each other. Facilitators move between groups to guide participants to explore more connections if and when they see it is needed.

4. Each group makes a presentation in which they explain what they have drawn to the big group.

5. After all presentations have been made the facilitators guide a big group discussion on the connections and relationships that have been observed by the group. How these links will affect the way the ecosystem changes, and why we need to be aware of this when we start to make changes in the ecosystems of our fields.

Some suggestions for the processing discussion

- How many connections did we find?
- What would happen to all the things if we started to remove one thing (e.g. trees, water, sunlight, birds, etc.)?
- What things do we often try to change in our fields?
- What other things in the environment would each of these changes affect?
- How often do we think of these connections and effects when we are deciding what to do in the field?
- We call all the things in the environment and the way they affect each other the 'ecosystem', what do the 2 parts of this word, '*eco'* and *'system*', mean?

Exercise No. 2.23

FIELD WALK AND BRAINSTORMING : INTRODUCING THE IDEA OF AN AGRO-ECOSYSTEM

Integrated Pest Management (IPM) is based on ecological interactions between the environment, plants, hervibores (diseases, insects, and rats), and natural enemies of herbivores (spiders, parasites, snakes, etc.). The health of the plant is determined by the environment (weather, soil, nutrients) and the herbivores. The herbivores are balanced by their natural enemies.

The adoption of input intensive agriculture has greatly influenced the interactions of the different components of the agro-ecosystem. For example, the indiscriminate use of pesticides has lead to resurgence of minor pests. We need to begin looking at the vegetable ecosystem from the viewpoint of maximizing profits without destroying the system. We need to understand the interactions and components. In this exercise we will look at the interactions of the different components of the ecosystem.

When is this exercise most appropriate?

- Before the first observation and decision-making of the 'learning-field' agro-ecosystem.

How long will this exercise take?

- 1.5 to 2 hours of the FFS meeting

Learning objectives

- To build awareness of the relationships that exist between so many of the living and non-living things that are found in our environment.
- Be aware of the existence and balance of components of the vegetable agro-ecosystem.

- To appreciate that if one thing in this network of interactions is changed, it can influence all of the components of the agro-ecosystem.
- To become more aware of the things and interactions that make up the ecosystem of our fields - the 'Agro-Ecosystem'.
- To start to use our understanding and observations of the Agro-Ecosystem as a basis for decision-making about crop management.

Materials

- vegetable field
- notebooks for each group
- manila paper and photocopy paper for each group
- pens and crayons for each group
- tape, glue and scissors

Steps

1. Go to the vegetable field for 30 minutes as small groups and record all kinds of plants, insects, and spiders seen in the field. Use a net to catch more small insects and see the smallest wasps.

2. Return to 'classroom' and write the names of things seen in the field on the photocopy paper: make paper 2 cm X 5 cm.

3. Add papers with names "sunshine", "rain", "high fertilizer", "low fertilizer".

4. Discuss with the groups how the parts interact. Paste the names of ecosystem components on the manila paper and draw lines between all components which interact. Explain what the lines means and present to the big group.

Some suggestions for the processing discussion

- Discuss the outcome of the following situations. Discuss what happens to each component over one season (the questions could be assigned to groups beforehand) :
  - a) A spray is used that kills all insects and spiders. Then pests migrate to field
  - b) The plant is resistant to all pests, so that no pest is in the field.
  - c) The plant has high fertilizer and sunny conditions
  - d) The plant has high fertilizer and cloudy conditions
  - e) The plant dies
- What is the relevance of these questions to a field crop and a farmer?

Exercise No. 2.24

AGROECOSYSTEM ANALYSIS (AESA) : MAKING A CROP MANAGEMENT DECISION

Each week during the season, you will study the components of the vegetable agro-ecosystem. You will study the plant morphology and agronomy, herbivores, and natural enemies of the herbivores. You will look at diseases and rats.

Agro-Ecosystem Analysis (AESA) is a way of assembling what we are studying and placing into a process useful for decision-making based on many factors. Old IPM practices relied on economic threshold levels (ETL) to make decisions. ETL's however, are extremely limiting and do not include the other factors in the agro-ecosystem or farm management.

The following activities will lead you through weekly set of questions and drawing. In the beginning, the analysis will take a lot of time. By the end of the season, however, you should be able to do a complete analysis while standing in the field.

When is this exercise most appropriate?

- As soon as there is a decision to make in the field, for example one week after planting in a vegetable field.

How long will this exercise take?

- 2 hours of the FFS

Learning objectives

- Improve decision making skills through a field situation analysis by observing, drawing and discussing.
- Improve decision making skills by presenting small group decisions to for critics in the large group.

Materials

- Vegetable field
- Notebook, ball pen
- Manila paper
- Crayons, pentel pens

Steps

1. If the participants are a little familiar with AESA, ask why they do AESA?

2. If they are unfamiliar with AESA, ask what sort of information they need to get in the field to make crop management decisions?

3. Discuss how many plants it is necessary to choose and how they should be chosen?

4. *Insects.* Discuss how the crop should be examined for insects, insect symptoms, egg masses, in plant, on plant, above plant, etc. How should this be recorded? Bring the specimens back for drawing. How shall they appear on the drawing? (pests, natural enemies, others, 'do not knows')

5. *Disease.* Discuss how the crop should be examined for disease, its symptoms, etc. How should this be recorded? How shall it appear on the drawing?

6. *Plant morphology and growth stage.* What is useful to record about the crop stage (*e.g.,* height, number of leaves, etc.). How shall it appear on the drawing?

7. *General observations.* What else is important to notice (e.g., weeds, water, fertilizer, weather influence)? Is it generally a healthy crop or not? How could this appear on the drawing?

8. Go to the field for 30 minutes and collect the data.

9. Go to the ‘classroom’/shade and draw the plant with the correct average number of leaves. Write the number of leaves and average height and other agreed information somewhere on the paper. The drawing of the plant could also show the situation of fertilizer, water, insect and disease symptoms, etc. Use color crayons to make it look real.

10. Draw the insect and non-insect pests looking at the actual specimens brought back from the field. They could be drawn, for example, on the left side of the plant. An arrow can clarify where on the plant they were found. Write how many of each were found on the sample plants and calculate the total. If local names are known they can be added for the insects.

11. Draw the natural enemies or friends on the other side of the plant as above.

12. Indicate the weather conditions, for example, by drawing a sun, clouds, rain, strong wind, etc.

13. Indicate with drawings or words the treatment and activities in the field since last week (fertilizer sacks, spray nozzles, watering, etc.).

14. At the bottom could be made a list of important observations and recommendations.

15. Each group present their poster to the large group. That can lead to sharing of experiences and discussion of any topic involved in decision-making. This sharing with other groups can make the group feel more comfortable with the decisions or might guide them to change it. The main thing is that all relevant aspects are taken into account. The poster should be kept for comparison when the AESA is conducted the following week. Remember to agree who is responsible for implementing the decision.

16. The poster can represent one or two treatments. Two treatments if the group is doing both AESA's, for example, IPM and farmers practice. That can help comparing the different treatments.

Some suggestions for the processing discussion

- This is very difficult to generalize. It is different from crop to crop, from season to season, from stage to stage and from place to place. It could include some of the following questions and a lot more :

  At Seedbed and Seedling Stage

  1. Do the plants have a good start?
  2. Is there any damping-off disease?
  3. If there are problems, will they follow the plants when they get older?
  4. Is there any yellowing? Is it fertilizer deficiency or disease?
  5. What is the effect of weather on the plant growth now?
  6. What kinds of natural enemies are present in the field?
  7. What are the numbers?
  8. Where did they come from?
  9. What do they eat or what did they eat before there were pests?
  10. Are there egg masses of pests? Are they parasitized?
  11. Are there egg masses of friendly insects?
  12. How does the natural enemy population compare with previous week? Was the field sprayed with insecticide or other pesticides?

13. What is the importance of many natural enemies now?
14. What kind of pests are seen?
15. What is their average population density in the field?
16. What is the main pest seen? Are there seedling maggots?
17. What sort of damage do the pests do at this stage?
18. Is there any way to prevent these from increasing in numbers in the field?
19. What is the condition of other fields in the area?
20. Do other fields influence your field?
21. How many pests can one spider eat in one day?
22. Are there any signs of rats? Any damage of rats? What can be done?
23. How does the condition of the field compare with the previous week?
24. What do you expect will happen next week?
25. Are there any specific pests to monitor more carefully?
26. Considering the density of friendly insects and the density of pests, is there a need to apply insecticide? If yes is there an alternative?
27. Are there many weeds? When is the right time to do weeding?
28. What is the management plan for the next week?
29. Is it generally a healthy crop?
30. Are any incidence of downy mildew now? If there are, what management strategy will you employ? How can spreading of the disease be prevented?
31. What records will you keep for future use?
32. If you have different treatments, compare. What treatment would you recommend in the future?
33. Were last week's decisions made effective?
34. Based on your observations, what experiments like insect zoo or disease culture would you make now to learn more?

<u>Early and Late Vegetative Stages</u>

1. Have the plants recovered from pest damages during the seedling stage?

2. Is there anything you will do different in the next season?
3. Are there missing hills?
4. Is the plant development as expected? (how many leaves, height, etc.)
5. Are some leaves dying? Why? Is this natural?
6. Are there defoliators? Can the plant compensate these?
7. Would defoliation studies be relevant in this crop now?
8. How is the color of the plant? Are there yellow leaves?
9. Is there a fertilizer deficiency?
10. What kind of fertilizer was applied? How much?
11. What was the method of application? (broadcasting, drenching, basal, plant specific, etc.)
12. Is there any disease in the field now? Are there mosaic and stunt diseases?
13. How can it be managed or controlled?
14. How can spreading be prevented?
15. Does it influence yield qualitatively or quantitatively?
16. What is the effect of the weather on the growth of the plant?
17. Is the rain needed now?
18. What kind of natural enemies are present in the field?
19. What are the numbers?
20. Where did they come from?
21. What do they eat or what did they eat before there were pests?
22. Are there egg masses of pests? Are they parasitized?
23. Are there egg masses of friendly insects?
24. How does the natural enemy population compare with previous week? Was the field sprayed with insecticide or other pesticides?
25. What is the importance of many natural enemies now?
26. What kind of pests are seen?
27. What sort of damage do the pests do at this stage?
28. What is their average population density in the field?
29. What is the main pest seen? Are there already diamond-backed moth (DBM)?

30. Is there any way to prevent these from increasing in numbers in the field?
31. What is the condition of other fields in the area?
32. Do other fields influence your field?
33. How many pests can one spider eat in one day?
34. Are there any signs of rats? Any damage of rats? What can be done?
35. How does the condition of the field compare with the previous week?
36. What do you expect will happen next week?
37. Are there any specific pests to monitor more carefully?
38. Considering the density of friendly insects and the density of pests, is there a need to apply insecticide? If yes is there an alternative?
39. Are the pest and natural enemy populations increasing or decreasing compared to previous weeks?
40. What is the management plan for the next week?
41. Is it generally a healthy crop?
42. What records will you keep for future use?
43. If you have different treatments, compare. What treatment would you recommend in the future?
44. Were last weeks decisions made effective?
45. Based on your observations, what experiments like insect zoo or disease culture would you make now to learn more?

At One Month Before Harvesting

1. Is the plant development as expected? (No. of leaves, height etc.)
2. Are some leaves dying? Why? Is this natural?
3. How is the color of the plant? Are there yellow leaves?
4. Is there a fertilizer deficiency?
5. Is there any disease in the field now?
6. How can it be managed or controlled?
7. How can spreading be prevented?
8. Does it influence yield qualitatively or quantitatively?

9. What will happen if one plant is less vigorous?
10. Can neighbor plants compensate for that?
11. What is the effect of the weather on the growth of the plant?
12. Is the rain still needed now?
13. What kinds of natural enemies are present in the field?
14. What are the numbers? (increasing, decreasing or the same?)
15. Where did they come from?
16. What do they eat or what did they eat before there were pests?
17. Are there insects that are neither pest nor natural enemies?
18. What are they doing?
19. Are there decomposers that eat dead materials in the soil?
20. Are there egg masses of pests? Are they parasitized?
21. Are there egg masses of friendly insects?
22. How does the natural enemy population compare with previous week? Was the field sprayed with insecticide or other pesticides?
23. What is the importance of many natural enemies now?
24. What kind of pests are seen?
25. Are there more parasitized larvae now?
26. What sort of damage do the pests do at this stage
27. What is their average population density in the field?
28. What is the main pest seen? Are there twig borers and cutworms?
29. Is there any way to prevent these from increasing in numbers?
30. What is the condition of other fields in the area?
31. Do other fields influence your field?
32. How many pests can spiders, ladybird beetles, parasitoids, hoverfly larvae and others eat in one day?
33. What does that say about balance?
34. What if the field is sprayed and all natural enemies die, and then there is an immigration of pests? What would happen?
35. Are there any signs of rats? any damage of rats? What can be done?
36. How does the field condition compare with the previous week?
37. What do you expect will happen next week?

38. Are there any specific pests to monitor more carefully?
39. Considering the density of friendly insects and the density of pests, is there a need to apply insecticide? If yes is there an alternative?
40. Are the pest and natural enemy populations increasing or decreasing compared to previous weeks?
41. Will spraying of insecticide be too close to harvest now?
42. What is the management plan for the next week?
43. Is it generally a healthy crop?
44. When is the expected harvest time?
45. How can you see that on the crop?
46. If you have different treatments, compare. What treatment would you recommend in the future?
47. Were last weeks decisions made effective?
48. Based on your observations, what experiments like insect zoo or disease culture would you make now to learn more?

Maturity and Harvest Stages

1. Select relevant questions mentioned above
2. How do you determine the right time for harvest?
3. What is the level of insects and diseases?
4. What can you do in your field from now to prevent insect problems next season?
5. What can you do in your field from now to prevent disease problems next season?
6. What can you do in your field from now to prevent weed problems next season?
7. Will you use the same variety next season?
8. If you have different treatments, compare. What treatment would you recommend in the future?
9. After harvest what will happen to the natural enemies?
10. What will be done different to rats next season? Is there a good community action program planned and ready to start after harvest?

11. What could you do different to improve yield next season?
12. What could you do different to improve profit next season?
13. From your agro-ecosystem analysis, can you do an economic analysis?
14. From your agro-ecosystem analysis, can you do an environmental impact analysis?
15. What records will you keep for future use?
16. How can you assist other farmers next season?

Exercise No. 2.25

COMING UP WITH A DECISION MAKING GUIDE : WHAT ASPECTS ARE IMPORTANT FOR DECISION MAKING?

When is this exercise most appropriate?

- Towards the end of the training, to review experiences and systematize how to make a decision
- This is a brainstorming 'classroom' exercise. It is expected that everybody have experience doing weekly AESA for almost a season.

How long will this exercise take?

- 1-2 hours of the TOT or VST session.

Learning objectives

- To improve decision making capabilities
- Improve understanding of the components of the ecosystem in relation to IPM
- To develop a decision making tool

Materials

- Manila paper, pentel pens

Steps

1. Ask the large group to brainstorm: What do we need to know about to make a crop management decision?

2. Keep in mind that it is not planning the next season, it is about the situation and options you have when you are doing your weekly AESA.

3. Write each major topic as a headline on a manila paper, for example:
   - Natural enemies
   - Pests
   - Diseases
   - Weather
   - Crop
   - Weeds
   - Cultural practices
   - General

4. Then, expand by asking "What do we need to know about natural enemies?" and add it on the manila paper.

5. Each comment should be supported by a field related example about when that is the case arising from the participants experience (see examples below).

6. In TOT or VST, ask whether it would be a good exercise in FFS? Does it need adjustment there?

Some suggestions for the processing discussion

- The comments should as much as possible come from the participants. The examples relevant in this exercise will be different from crop to crop and from location to location.

- *Natural enemies :*

  a) Are there many or few? Helps to estimate if they are sovereign to the pests.
  b) What is their prey? Ladybird beetles can better control aphids than DBM larvae.
  c) Consumption rate? One spider can eat many DBM adults.
  d) Stage? Adult lacewings do not eat leafhoppers while their larva does, meaning that the predator effect comes in next generation.

- *Insect pests :*

  a) Number of pests : If there are few aphids at the base of the cabbage plant, it might not be a problem. If many, it is a problem.
  b) The life stage : The adult moth is not a pest while the larval caterpillar is.
  c) The age or size : A small larva does not eat as much as a large, but many small larvae might soon grow big and then eat a lot.
  d) Kind of pest : Cutworms eats vegetable leaf but seldom to an extent that needs control
  e) Consumption rate : Could we afford to loose that for some days and then observe again?
  f) How does the pest eat : Sucking pests, like moth, can not make holes in the leaves like biting caterpillars. Observing mouth part can tell us about the potential damage.
  g) Disease vectors : Sucking piercing scale insects do more damage as virus vectors than by sucking the sap, for example in mosaic susceptible tomato varieties.

- *Disease :*

  a) Host plant resistance : Some carrot varieties are less susceptible to soft rot fungus than others. Pechay are less affected by DBM than the cabbage.
  b) Extent of damage : A few leaf spots are not severe in dry season but may be in wet season.
  c) Part of plant : On mature cabbage plant, leaf spots are not a problem on older leaves but they are if on the leaves nearest to the head.
  d) Way of spreading : Some fungicides can prevent wind borne diseases like purple blotch when it is present in the area, while spraying is useless for soil borne diseases.
  e) History : Is it a field where the disease usually cause problems?
  f) Stage of crop : Mosaic and other tomato viruses can be yield reducing if they come early but the plants get more resistant with age.

- *Weather :*

  a) Temperature : Hot weather slows down occurrence of diseases.
  b) Rain : Daily rain can suppress aphids. Foliar fungicides loose effect after rain.
  c) Field inspection : If it is late in the day when checking the field, many insects will not be seen, therefore observe early in the day.

  d) Humidity : Leaf spots are more frequent in wet and humid conditions.
  f) Wind : If there will be typhoon tomorrow, harvest today
  g) Clouds : Many clouds means less photosynthesis.

- *Crop :*

  a) Growth stage of crop : 100 aphids is a lot on a cabbage seedling, but not much on a mature headed crop.
  b) Part of the plant : Leaf spots in the younger active leaves is worse than on older leaves.
  c) Extent of damage : Phosphorus deficiency can affect the snap bean plant severely but often only few plants are affected.
  d) Healthy crops can compensate : This involves right amount of fertilizer, water, cropping system, rotations and a lot more. Healthy kids recover faster from disease than skinny ones.
  e) Age of plant : Old eggplants are more resistant to virus. Newly established crops should be insecticide free so NE's can establish also.
  f) Variety : In some vegetable varieties, leaf spots are not so threatening since they develop less than in other varieties.
  g) History of the previous crop or field : Club root disease of cabbage is soil borne, if it was not controlled since last time, it will appear severely in the field again if you use a susceptible variety.

- *Weeds :*

  a) Competition : Weeds steal too much water and fertilizer during *the critical period of competition.*
  b) Alternate host : Weeds can have negative effect when they host pests and diseases. Positive effect when they maintain the populations of natural enemies in or near the field.

- *General :*

  a) Calendar spraying : Avoid pesticide resistance by too frequent and unnecessary spraying.

b) Price : Can influence time of harvesting. With high price, more management or control is profitable.
c) Is it too late before harvest to spray safely?

Exercise No. 2.26

LIFE CYCLES AND FOOD WEBS

Life cycles of plants, insects and natural enemies are well known to us. The development from egg or seed to adult insect, spider or plant has been seen in the field and in the Insect Zoo.

Food chains are the interactions between plants, herbivores and natural enemies of the herbivores. The energy from one level of the ecosystem (plants) moves to another level (herbivore) along a chain of interaction.

As a facilitator working with farmers, you must begin to integrate these two motions together into a smooth acting dynamic ecosystem. Seeds germinate to be eaten by insects that lay eggs that are parasitized.

In this exercise, you will have to put the two systems together so that they are functional. This will help you to understand that interactions have a time frame. For example : the life cycle of leafhoppers all begin with an egg stage inside the plant. In the next stage, the nymphs feed on the stem or leaves by sucking. Finally, adults mate and lay eggs on the same plant or migrate to other fields. During each stage, different natural enemies attack the leafhoppers. During the egg stage, parasites complete their own egg/larva/pupa/adult in the leafhoppers' eggs and kill the eggs, and mirid bug predators suck on the eggs. During the nymphal and adult stages, hunting spiders, water striders, lady beetles, and other predators feed on the leafhoppers. Parasites and other natural enemies act the same.

This combination of interacting life cycles of the plant, leafhoppers and natural enemies is a good view of the dynamic system of the vegetable field. It shows also that balance is needed in the system to make each life cycle possible. For example, a spider life cycle depends on the leafhopper. If there are no leafhoppers then there will be no spiders to protect the field. In this system, insects such as leafhoppers at low population are actually very beneficial to the farmer because they are spider food; and spiders are what protect the beneficial insect from large population changes. Did you ever think that a leafhopper might be a beneficial insect to the farmer? It all depends on how many are in the field. This can be explained now by looking at how the system interacts.

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions
- After at least one AESA had been conducted

How long will this exercise take?

- 1-1.5 hours of the FFS, TOT or VST time

Learning objectives

- Develop a concept of the food webs and food chains.
- Understand the importance of the food webs and food chains in relation to ecosystem and pest management.

Materials

- 'learning field'
- paper, pen, crayons and pentel pen (colored)

Steps

1. Each group should choose a guild to analyze: aphids, leafhoppers, DBM, bean fly, white grubs, seedling maggots, leaf feeding caterpillars, leaf miner, rats, etc.

2. Draw a large circle and write in the general stages for insects of the guild around the circle.

3. On one side, make a list of the stages of the insects in one column. In the next column, make a list of natural enemies (by guild) which attack each stage. (Show that at each life stage of a pest, there is a corresponding natural enemy with its own life cycle.)

4. On the drawing, draw a circle for each natural enemy which attacks a particular stage of the insect. On the natural enemy circle, write the stages of the natural enemy's life cycle. If there are natural enemies of the natural enemies (example, a spider that eats another spider) then make a third level of circles for these natural enemies. Follow the chains until the last organism dies and its nutrients return to the soil and is consumed by the plant.

5. After finishing the diagram, do a short role play on natural enemies and insect pests, if possible, working through whole life cycles and describe parts of predators that are important for their function as killers!

Some suggestions for the processing discussion

- Explain life cycle, food chain and food web.
- How does food web relate to biodiversity?
- How do you group different organisms involved in a food web in relation to the amount of energy consumed?
- What will happen to natural enemies if there are no insect pests?
- What is the effect of pesticide application to the ecosystem?

Exercise No. 2.27

BUILDING A WALL-WEB : SUMMARIZING OBSERVATIONS FROM LIFE CYCLES AND FOOD WEBS

When is this exercise most appropriate?

- The activity should start as soon as you have results from the first agro-ecosystem analysis (AESA) or insect zoo and/or disease culture.

How long will this exercise take?

- About 1 hour of the first FFS, TOT and VST meeting and 1 hour for the final discussion meeting, plus a few minutes each week.

Learning objectives

- To reinforce our appreciation of the way that all living things in the ecosystem are linked.
- To become more aware of how our weekly discoveries in the field, in insect zoo and in disease culture, link into the whole ecosystem.
- To discover that if one thing is absent, or is changed, all of the other components of the ecosystem may be affected via the web of interactions.

Materials

- 15 sheets of Manila paper, tape
- pens, crayons, pencils for all groups.
- drawings that were made when recording insect zoos and disease culture.
- past Agro-Ecosystem Analysis presentations

Steps

If you have wall space that you can leave the poster on :

1. Ask the group if they would like to make a big record of all the living things that we have discovered in our AESA, insect zoo and disease culture, showing all the links and relationships that we have observed.

2. Gather together all the results of the insect zoo and disease culture. Have the AESA drawings available for the group to get information from.

3. Ask one small group to cover a wall with up to 10 sheets of manila paper to make a “wall-web sheet” (as many as you have space for!). Ask them to draw a level for the soil with pen and brown crayon - something like this:

4. Ask the other small groups to make large drawings of a vegetable plant (1 in seedling stage, 1 early vegetative stage, etc., as many stages as you have already observed in the ‘learning-field’).

5. Get the groups to stick the vegetable plants on the ‘wall-web sheet’, on the soil level, in a row starting with the youngest stage. Space them out along the whole length of the ‘wall-web sheet’

6. Ask the participants to cut out the pictures of the animals and diseases that have been observed in insect zoo and disease culture:

- Stick the drawings onto the wall-web at the stage that they first found them, try to put them near the thing that they eat (or another way if the group can find a better way to decide where to place them).
- Use the AESA reports as a reference for information that the group needs, such as when it was observed in the field and what part of the plant it is found on.
- The group may like to put the different stages of one animal or disease in a row or circle to show the order of development.
- The group could even put information about feeding rates, e.g. by putting a drawing or numbers to show how much each predator has been observed to eat in a day.
- Get the participants to use their imaginations and creativity to work out how to show the information in a clear way.

7. Draw lines on the wall-web to show the connections between the things. Get the group to discuss whether they want to use arrows : they could point from the food to what eats it, to show which stomach it goes into, or they could point from the insect-feeder/plant-feeder/pollinator, etc. to the thing that it eats. Get the group to discuss and decide.

8. As the group discovers more about the crop ecosystem, new information and drawings can be added to the wall-web. You could do this with all insect zoo and disease culture results, and any observations that have been made in the field. Facilitate the group to include only real discoveries, not guesses or speculations (*Yung segurado at hindi seguro lang!* If only *siguro lang* set up an observation to find out).

9. After around 8 weeks of AESAs, and insect zoo, and disease culture, when the crop is near maturity make the final discussion. The facilitators guide a discussion on the patterns that have been observed in the food webs of the crop ecosystem.

Some suggestions for the processing discussion

- Why do we call it a *web*?
- How many interactions did we discover in the web?
- What interactions did we leave out of the web? (people, animals, etc.)
- Take some examples of different things in the wall-web and see how many things would be affected if we removed it? (e.g., one small group could take 1 example each)
- How many things will be affected if we kill one stage of an insect?
- How many things would be affected if we sprayed the vegetable plant with a fungicide: Today? Later on in the season? Next season? (do not forget the helpful fungi, the ones which kill insects and the decomposers)
- How many things would be affected if we sprayed the vegetable plants with a pesticide: Today? Later on in the season? Next season?

Exercise No. 2.28

FOOD WEB OF PESTS AND NATURAL ENEMIES : BUILDING A FOOD WEB FROM OUR FIELD OBSERVATIONS AND INSECT ZOO DISCOVERIES

When is this exercise most appropriate?

- When participants are interested in starting to make a summary of their discoveries so that they can see all the linkages between insects in the ecosystem.
- The first session should be made when each group of participants has already made 2 or 3 discoveries about natural enemies and pests in their insect zoo and field observations.
- The final summary session should be as near as possible to harvest. It could be just before the field day or graduation, so that the outputs can be used as an exhibit.

How long will this exercise take?

- 1 to 2 hours for the first session.
- A few minutes each time a new insect zoo or field observation discovery is added to the web.
- 1 to 2 hours for the final summary session.

Learning objectives

- To encourage participants to make more insect zoo and field observations so that they can build a more complete ‘picture’ of the crop agro-ecosystem.
- To discover the complexity of the ‘food web’ (e.g., to see how many linkages there are between all of the insects in the ecosystem).
- To build awareness of how disturbances will affect the whole ecosystem.

Materials

For the first session :
- Manila paper, tape, pencils, pens and crayons for each group
- white paper (long or short size, 10 sheets per group)

For the final session :
- plenty of string
- tape
- drawing pins
- around 20 sheets of cartolina in 2 different colors

Steps for the first session

1. Explain that the objective of this exercise is to make a summary of all the linkages that we discover between all of the insects in the ecosystem - we will do this by building a diagram called a ‘food web’ which shows what each thing is eating by connecting it with an arrow to its food. It is called a ‘food web’ because it looks a bit like a drawing of a spiders web.

2. Get the big group to make a list of all the common pests for the crops that you are growing in the FFS, TOT or VST.

3. Ask the groups to choose which pests they will work on so that all pests are shared between groups (if you have 2 or more crops you may want each group to work on the pests in one crop instead).

4. Each group makes a poster for each of their pests showing information they have collected about the ecology of the pest and natural enemies which kill it. Make the drawings of the insects on white paper so that the colors can be more realistic. The suggested format for each ‘pest poster’ is - encourage the groups to improve on this with their own ideas:

- Make a drawing of the pest on the plant, showing where it feeds and what damage it makes. Place this in the center of the poster (Reminder: it is better to draw from a specimen using a hand lens to check details of the shape and color)
- Add pictures of any other stages of the insect you have discovered - be careful to show which stages are feeding on the crop, and what other stages are doing.
- Add any information about the ecology of the pest (life cycle, feeding rate etc.) in small boxes close to the drawing of the pest.
- Add pictures of natural enemies that feed on the pest (draw from a specimen!) - if you have seen it feeding, make the drawing showing what it looks like when it is feeding on the pest.
- Draw an arrow to the pest to show that the natural enemy is feeding on the pest - show which particular stage(s) of the insect it feeds on by drawing the arrow to those stages.
- Add any information about the natural enemy (feeding rate, life cycle, preferred environment etc.) in small boxes close to the relevant drawing.
- Ask other groups if they have any additional information to add - add these by making more drawings and boxes of information where appropriate.

5. Each group presents their outputs to the big group.

6. Any additional discoveries of new natural enemies or pests or natural enemy ecologies, made in field observations or insect zoo, should be added to the poster as the season progresses. This should not take much time each week, because you can use the drawings made for insect zoo in the poster and write in details little by little.

Steps for the final session

1. Explain to the group that in this session we will join all of the parts of the food web together by linking the parts that have the same pest or the same natural enemy.

2. Pin up all of pest posters on a wall or a large board.

3. Make a cartolina label for each type of pest and each type of natural enemy that occurs in MORE THAN ONE poster. Make the pest labels in one color and the natural enemy labels in a second color.

4. Pin each of these labels onto the wall and use string to make connections from the label to all of the pictures of that insect.

5. When the web is complete, have a processing discussion.

Some suggestions for the processing discussion

- How many different natural enemies are killing each kind of pest?
- What things might we do that could disturb the food web? What parts of the food web would be affected by this disturbance?
- How many links are there between the different crops on the farm : through shared pests? through shared natural enemies?
- How many links are there between the crop ecosystem and other types of environment on the farm? (Think back to the mapping exercise on environmental preference of natural enemies)
- How many links does the web have to other animals and plants that we find in the crop ecosystem? (Think about decomposers, pollinators, non-pests, plant-feeders, weeds, the soil ecosystem...we could go on for ever!)

THE HAZARDS OF CHEMICAL (AND BOTANICAL) PESTICIDES TO HUMANS, NATURAL ENEMIES AND OUR LOCAL ENVIRONMENTS

THE HAZARD OF SPRAYING

This exercise is generally used to be followed by an extensive inputting from facilitators: Giving details of the % absorption of pesticides by different parts of the body, discussion of 'safe-use' of pesticides, discussions on types of pesticides and what they kill, even pesticide calculations.

The central learning objective in this exercise is the HAZARD. That we cannot spray without getting contaminated; and that pesticides are POISONS, so there is NO 'safe-use' only HAZARD. Thus, it is felt that we need to redirect the discussion after the spraying exercise.

In the processing discussion on contamination, it is felt that giving details of % absorption by different parts of the body is very lecture oriented. It will be more experiential if we encourage farmers to share their own experiences of contamination and sickness. There are many examples in every FFS group.

Exercise No. 2.29

NEW DESIGN FOR INSECT EXPERIMENTS

Many facilitators have found that the old procedure for observing the effects of pesticides on natural enemies is too complicated for farmers field schools. There were so many things to observe and discuss, that it was difficult to focus on the main learning objective of the exercise.

The previous method in widespread use was to use up to 5 different pesticides of different color labels. The problem with this is that many people start to think that the pesticide label color tells us how safe the pesticide is for natural enemies. In fact the labels tell us which ones are relatively less poisonous to warm blooded animals and humans.

A much simpler exercise is presented here, which focuses on the most important learning objective of the insect experiment, that is:

"To discover that pesticides kill natural enemies."

The exercise uses a green-label insecticide to show that even though it is less toxic to humans and warm-blooded animals, it is designed to kill insects, and so it kills insect natural enemies!

The comparison of the effects of pesticides on pests and natural enemies is deleted, because the comparison is not really appreciated by farmers. They already know that pesticides kill pests!

Fungicide and botanical pesticides are also added to the exercise as a test materials, to allow farmers (and some facilitators!) to discover that fungicides and botanical pesticides can also kill insect natural enemies. It also helps us to remember that fungicides kill helpful fungi. If the farmers in your area also use herbicides on a regular basis, add HERBICIDE as a fourth treatment in the experiment.

When is this exercise most appropriate?

- When farmers are interested to discover more about pesticides (including botanicals) or where farmers use them or express interest in using them.
- When the group has already discovered in insect zoo that a number of insects are natural enemies.

How long will this exercise take?

- 3 hours of an FFS meeting, plus 5 minutes observation daily until the next meeting.

Learning objectives

- To discover how much pesticide we are contaminated with when spraying pesticides and botanicals.
- To share experiences and build awareness of the effect that these chemicals have on the health of farmers and their families.
- To discover that pesticides kill natural enemies.

Materials

Preparation (Collecting Insects for the Experiment) :

- 1 or 2 aspirators per group (do not forget the tissue in the base of the pot to stop the insects from being concussed!)
- fine hair paintbrush per group
- collection pots
- sugar solution soaked into small balls of tissue (for feeding parasites)

Part 1 (Spraying Exercise Using Dye) :

- knapsack sprayer
- water-based dye
- water
- container to mix dye and water in
- white crepe paper & tissue paper
- tape
- manila paper and pens (for processing discussion)

Part 2 (Insect experiment) :

- 15 plastic pots (large brittle jar size) with cotton/ rubber bands covers (this is in addition to the insect collecting pots)
- 3 hand-held sprayers (or 4 if you will include herbicide treatment)
- 2 pairs of gloves
- 2 protective aprons
- 2 eye masks
- 1 green-label pesticide that is commonly used by the farmers
- 1 fungicide botanical preparation that is commonly used by the farmers
- 1 herbicide that is commonly used by farmers (if they use herbicides)
- 1 milliliter (1 ml) dropper (bought from a pharmacy)
- an empty 1 liter bottle (coke or similar)
- plenty of water and detergent soap
- manila paper and pens (for processing discussion)

Steps before you do anything else

1. Collect insects in preparation for the insect experiment during the weekly observation of the ‘learning-field’.

2. Each group needs to collect 15 individuals of 1 kind of natural enemy. Arrange it that each group collects a different kind of natural enemy.

Reminders :

- Be gentle when collecting insects!
- Use aspirators for small delicate insects like parasites and fine hair paint-brushes for handling small soft insects like worms (caterpillars) and whorl maggot larvae.
- For crawling insects like lady bird beetles, the best way to collect is to knock them gently from the plant into a container.
- Do not forget to provide some food for the insects: Sugar solution for parasite adults, prey for the predators and fresh leaves for the plant feeders.
- Keep the insects in a cool place while you do the spraying exercise, or they will all be dying by the time you start the experiment!

Steps for spraying exercise using dye (Part 1)

1. Start this exercise in the field. Ask for 1 volunteer, who is happy to spray some water-based dye in some plants, and 2 others to help him or her. All that the other participants have to do is to observe carefully at all stages.

2. Cover the volunteer participant with white crepe paper and tissue from head to foot (including his or her face, hands and feet). Have a bit of space to breath and see through. Leave the hands as mobile as possible.

3. Get another participant to help the volunteer prepare the dye in water, and to fill the sprayer tank.

4. The ‘mummified’ volunteer sprays the dye onto some plants, first on the base of the plants to simulate sprays on DBM larvae, then on the upper portion of the plants to simulate sprays on other leaf feeding insects. Ask the spray volunteer to act just as if spraying a real pesticide, walking up and down, even to pretend that the nozzle is blocked, and to clear it. Make sure the whole tank of dye is used up before the spraying is stopped.

5. Get the observers to inspect the sprayer carefully and to note all the places where the dye has colored the paper. Take note also of the precautions observed by the volunteer during spraying.

6. Return to the 'classroom'/shade to process the groups' observations.

Some suggestions for the processing discussion (Part 1)

- Where did the dye contaminate the farmer who was spraying?
- At what stages of the spraying did the farmer get contaminated?
- What ways do local farmers use to protect themselves from the spray? Does this work?
- Is it possible, in practice, to protect yourself from contamination?
- Is 'safe-use' of pesticides possible?
- How do we feel after we have been spraying pesticides? Share as many experiences as possible.
- What effect does this pesticide contamination have on our health in the long term? (Are their any local experiences?)
- Who else is at risk of being contaminated by the pesticide when you spray the fields?
- Do any of the women in this area spray when they are pregnant? What effect could this have on the baby that she is carrying?
- What other ways can we think of that pesticides might be contaminating people or animals (e.g., drinking water, drifting sprays, etc.)?
- What effects do pesticides have on pigs, chickens and other warm blooded animals? (It may be appropriate to discuss the labeling of pesticides here : that the color banding tells us which ones are most dangerous to warm blooded animals and humans)
- What effects do pesticides have on other animals that we would like to conserve (e.g., fish, birds, etc. and natural enemies)? This leads us into the insect experiment to discover the effects of pesticides on natural enemies.

Steps for insect experiment (Part 2)

Important to Note : Please do this experiment outside in an open place with plenty of air movement to prevent the group from getting headaches and nausea as they may be poisoned by the fumes of the pesticides!

1. Ask the group if they want to do an experiment to see what happens when we spray the insects.

2. Ask each group to take 3 brittle jars. Put 5 individuals of their natural enemy species into each jar.
3. Each group labels 1 jar each: INSECTICIDE, FUNGICIDE, WATER plus the group name, and the type of natural enemy that is in the jar.

4. Get the big group to design a simple table in which they can note for each jar:
   - What kind of insect was put in the pot?
   - How many insects?
   - What they were sprayed with?
   - How long after spraying the insects are being observed?
   - How many are alive and healthy?
   - How many are alive but look sick?
   - How many are dead?
   - Any other observations.

5. All the groups need to do the water treatment first to prevent contamination with the pesticides. Simply spray the insects with the water, then put in an unsprayed dry leaf (so that the insects have somewhere dry to rest while they dry off) and some food (prey or sugar solution on a ball of tissue).

6. Now, prepare the insecticide and fungicide solutions. Remember to take extreme care with these poisons!!

Get 2 volunteers (or facilitators if you have no volunteers) to be the 'Poison Handlers'. They should wear gloves, a protective apron and a mask when handling the pesticides. Have plenty of soap and water for them to wash in afterwards. Keep the pesticides and pesticide contaminated water away from water sources and irrigation.

Take note that a simple way to work out the dilution for the pesticides might be :

- Ask the farmers how much of the pesticide they usually add to a 16 liter spray tank OR use the rate given on the pesticide bottle. You can let the group decide.
- Take the 1 liter bottle and fill it 1 quarter full with water. It now contains 250 ml water.
- The amount of pesticide to add to the hand sprayer is calculated by dividing the amount for a 16 liter tank by 64 (because there are 64 times 1 quarter liters in a 16 liter tank).
- Use the 1 ml dropper to measure the small volume of a liquid chemical.
- Make sure you wash the dropper very well before using for a second chemical.
- For powder chemicals 1 gram can be approximated to a heaped pile of powder about 1 cm x 1 cm on the base.

8. Get the 'Poison Handlers' to spray the FUNGICIDE labeled insects with fungicide. Then put in an unsprayed dry leaf and some food (prey or sugar solution on a ball of tissue).

9. Lastly, do the insecticide treatment. Get the 'Poison Handlers' to spray the INSECTICIDE labeled insects with insecticide. Then put in an unsprayed dry leaf and some food (prey or sugar solution on a ball of tissue).

10. Wash all poison-contaminated equipment, protective clothing and hands very carefully with detergent soap and water.

11. Observe the insects after 5 minutes, 1 hour and then after every hour until the FFS ends. At each monitoring time observe and note the following :
    - How long after spraying the insects are being observed?
    - How many are alive and healthy?
    - How many are alive but look sick?
    - How many are dead?
    - Any other observations.

12. Discuss what happened to the insects.

Some suggestions for the processing discussion (Part 2)

- What effect did spraying with WATER have on the natural enemies?
- What effect did spraying with FUNGICIDE have on the natural enemies?
- What effect did spraying with INSECTICIDE have on the natural enemies?
- Why did we look at the effect of the water spray as well as the chemical sprays? (to check that it really is the chemical that had the effect, rather than the way we handled the insects, or the effect of the water spray)

Exercise No. 2.30

GUIDED DISCUSSION AND SHARING ON THE 'WHY' AND 'WHAT' TO RECORD : KEEPING RECORDS OF FARM ACTIVITIES

The usual way to do this exercise in past FFSs was to start by asking farmers what records they think would be useful to keep. Although this is very participatory, it is not discovery-based, because the exercise starts by *assuming* that record keeping is useful.

In this exercise we try to start with the questions of what profit farmers made last year, this allows the farmers to share what records they usually keep. The sharing discussion allows farmers to decide whether they might find it useful to keep more records than they currently do.

When is this exercise most appropriate?

- Early in the FFS, so that farmers are aware of why they keep careful records of production and labor costs in the learning field experiments.

How long will this exercise take?

- 1 - 2 hours of an FFS meeting

Learning objectives

- To build awareness of the value of keeping records of production costs and market price, when they are used as a basis for calculating profit or loss, to see the results of your decisions.
- To agree on a list of inputs and costs to record in the learning field experiment, for use in assessing and comparing the profits from the 2 treatments (e.g., IPM and Farmers' Crop Protection).

Materials

- examples of records kept by the farmer participants (Note : Ask farmers to bring in any examples of records that they keep for their farm)
- manila paper
- pens and tape

Steps

1. Arrange the participants in a circle for sharing.
2. Start a discussion that explores how farmers estimate how much profit they make. Here are some suggested guide questions :
   - Who made a good profit last year?
   - How did you know that you made a profit?
   - Do you keep any written records of what your spending, earnings and profits? What kind of records do you keep?
   - How much money and time do you spend on production?
   - How do you calculate what you spend (e.g., by counting the PESOS or by counting the sacks of fertilizer and bottles of pesticide)?
   - How much did each of you get for your produce last year?

3. Guide the discussion to explore what profits might have been made if farmers had made different decisions about the amount of inputs they used. Here are some suggested guide questions :
   - How many kilos of vegetables did you have to sell to pay for the pesticides or fertilizers that you bought?
   - What else could you have used that money for?

4. Guide the discussion to explore what information the group will need to record in order to compare the profit that is gained for the IPM and the Farmers' Crop Protection (FCP) practice plots of the 'learning-field'. Make a list of all the information that the group wants to record.

Some suggestions for the processing discussion

- There is no extra processing, because the exercise is a discussion.

3 Soils and Agronomy Topics

Exercise No. 3.01

LAND PREPARATION :
THE 'HOWS', 'WHYS' AND 'WHATS' OF LAND PREPARATION

One of the factors that affect plant growth is land preparation. Properly prepared fields promote good root development and better weed, pest and disease management.

Thorough land preparation is a key to good crop establishment . It allows decomposition of plant residues, prevents weed growth and improves soil tilt for better root development and absorption of nutrients.

When is this exercise most appropriate?

- During the first three week of the FFS, TOT and VST sessions.

How long will this exercise take?

- 30 minutes for field observation
- 2 hours for hands-on exercises on land preparation
- 1.5 hours for brainstorming and participatory discussions in small and big groups.

Learning objectives

- To have a feel of how land preparation is actually done in the field?
- To improve understanding of land preparation in relation to growing a healthy crop
- To know advantages and disadvantages to land preparation practices

Materials

- Field ready for land preparation
- Tractor, carabao, plow and harrow
- Manila paper and marker pens

Steps

1. Each participant should individually do plowing or harrowing by the use of carabao or tractor-drawn implements to have a feel of the activity before proceeding to the succeeding activities.

2. Brainstorm in the big group about important things to observe on land preparation in the field. Make an agreement and write it down. It may include, but not limited to, the following :
   - How is the presence of weeds?
   - Is seed germination even?
   - Is the crop healthy? Is it well established ?
   - Is the field prepared in beds?
   - Does land preparation have influence on irrigation and drainage?
   - When was it prepared? Why at that time?
   - Is the weed, pest and disease management considered when planning for land preparation?

2. Go to the field and observe a newly planted area. Different groups might be assigned to different crops and areas.

3. Ask the farmers about their practices in land preparation.

4. Return to the ‘classroom’ or shade and give 30 minutes to prepare a presentation of the outputs.

5. Present the results to the big group and discuss it.

Some suggestions for the processing discussion

- What is good land preparation? What are the importance of thorough land preparation? What are the characteristics of a well prepared vegetable field?
- When is the best time to do the first plowing and succeeding harrowing? What is the importance of straight furrowing?
- What are the advantages and disadvantages of frequent or intense land preparation?
- How does land preparation influence the growth of weeds?
- How does land preparation influence crop germination?
- How does land preparation influence crop establishment?
- How does land preparation influence drainage?
- How does land preparation influence irrigation?
- How does land preparation influence soil erosion?
- What will timing of land preparation influence?
- How can land preparation help in weed management?
- How can land preparation help in pest management?
- How can land preparation help in disease management?

Exercise No. 3.02

SOIL STERILIZATION :
SHARING EXPERIENCES ON HOW TO MINIMIZE SEEDBED DISEASES IN VEGETABLES

When is the exercise most appropriate?

- Early in the FFS, TOT and VST sessions, when establishing seedbed.
- When farmers want to learn about solving seedbed disease problems.

How long will the exercise take?

- 1 hour for brainstorming and discussion
- 1 hour for the exercise proper

Learning objectives

- To know the importance of soil sterilization in minimizing disease occurrence in seedbed.
- To identify the most suitable soil sterilization method or technique in the locality.
- To develop the skills of the participants in using practical soil sterilization method or technique.

Materials

- Seeds and seedbed area
- Digging tools and black plastic
- Farmers indigenous materials
- Notebook and pen

Steps

1. Brainstorm and list down in manila paper the things to observe and the information to gather on local seedbed practices. Let the participants do a field walk to observe and to interview farmers about their local seedbed practices.

2. Facilitate a discussion about the local practices and activities in seedbed preparation :
   - What are the problems encountered?
   - What are they doing and why are they doing them?
   - Are the methods practical and efficient?
   - Are they interested to try soil sterilization differently?

3. Identify and write down on manila paper the steps locally used and new ways of soil sterilization :
   - What other methods could be used? Boiling water? Burning of leaves, trash? Solarization with or without black plastic?
   - What is the farmers practice? What are the steps to follow? What are the advantages and disadvantages of the methods? Do they kill pest organisms? Do they kill beneficial organisms?

4. Facilitate a discussion on how to identify suitable area for seedbed. If possible, go to the field to identify a suitable place for seedbed :
   - What are the advantages and disadvantages of using low area as seedbed? Of high area? Of sloping area? Of the same area every year? Of a new area every year?
   - When is using pots or seed box suitable? Where do you get the soil for these?

5. Do a hands-on on the preparation of the seedbed using the identified methods.

6. Facilitate a discussion for seedbed monitoring until transplanting stage. Write down all ideas on a Manila paper for later reference. It may include :

    - What to observe? (General stand, mortality, pests and disease occurrence, weeds , beneficials)
    - How shall the observations be quantified? (Per square, per row, other ways) How often shall it be observed? If more than weekly, how to do it in FFS?

7. After the exercise, conduct a participatory discussion on the comparison of the results of the treatments.

Some suggestions for the processing discussion

- Which treatment had the least damping off?
- Which treatment had the most healthy plants? Why?
- Which treatment had the strongest seedlings for transplanting?
- Did anything influence the experiment apart from the treatments?
- Which treatment would you prefer or recommend for the future?

INTEGRATED NUTRIENT MANAGEMENT

Exercise No. 3.03

HANDS-ON AND SHARING : SOIL SAMPLING AND ANALYSIS

Correct soil sampling and accurate soil analysis would help in attaining the right kind and amount of fertilizer to be applied to have good yield. However, this is not usually done by farmers because of its complexity. Hence, this exercise would let them know and acquire skills in proper soil sampling and soil analysis through rapid and reliable test like the soil test kit (STK).

When is this exercise most appropriate?

- In the FFS, TOT and VST sites before land preparation or at least before the last harrowing in the learning field.
- In the FFS site, where soil analysis has not been conducted during the last five years or when farmers want hands-on exercise on such activities.

How long will this exercise take?

- 1.5 hours for brainstorming and participatory discussions in small and big groups.
- 30 minutes sampling in the field and 1 hour analysis in the shade

Learning objectives

- To acquire knowledge, skills and experience on how to collect soil samples and analyze by using soil test kit (STK).
- To determine and compute fertilizer requirement in the area.
- To be able to know the right kind and amount of fertilizer needed by a particular crop.

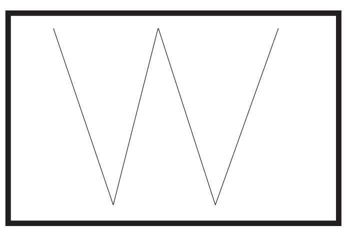
Materials

- soil test kit (STK) and soil samples
- bolo and shovel
- plastic pail and plastic bags
- pentel pen and ball pen
- manila papers , etc.

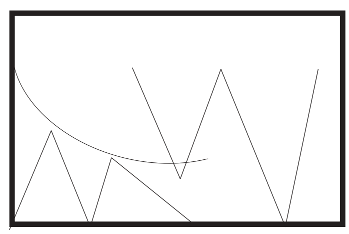
Steps

1. Each group will go to the field and randomly collect 20 sub-samples following the illustration. Get 1 kg. composite sample.

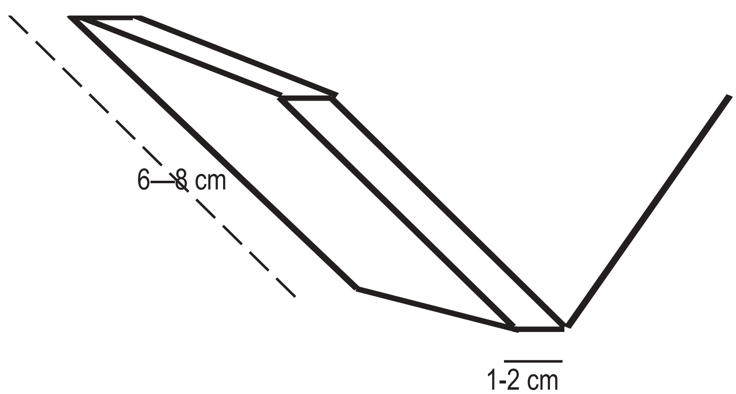
a. Flat area



b. Undulating area



1.0 Ha. = 20 samples to make 1 composite sample of 1 kg.



Notes on Soil Sampling :

- Conduct first a participatory discussion on how to get soil sample (steps, do's and don'ts). Ask the participants about how they are going to do the activity.
- Go to the field and have an actual exercise in getting soil samples.

2. Analyze the composite sample through soil test kit (STK). Refer to STK guide.

   Notes on Soil Analysis :

   - Each group will be given a soil test kit (STK) to be used for soil analysis
   - Follow the procedures as indicated in the guide
   - Compare the results to the colored chart in order to determine the result
   - Present the result for big group discussion

3. Compute the fertilizer requirement in bags per hectare based on soil analysis.

4. Present result to the big group.

Some suggestions for the processing discussion

- What are the steps in collecting soil samples?
- What are the materials needed?
- What is the importance of collecting soil samples?
- What are the do's and don'ts' in collecting soil samples?
- How will you get sample in an area having different slopes?

Exercise No. 3.04

HANDS-ON AND SHARING : USING THE SOIL TEST KIT AND UNDERSTANDING THE DIFFERENT TYPES OF FERTILIZERS

When is this exercise most appropriate?

- Early in the FFS season before the learning-field land preparation is started.
- When the farmers want to learn more about how they could decide how much fertilizer their soil requires.

How long will this exercise take?

- About 2 hours of an FFS meeting

Learning objectives

- To share experiences of using different types of fertilizers.
- To understand that different types of fertilizers contain different nutrient elements and have different effects on soil structure.
- To build awareness that different fields may have different fertility or acidity, so they would need different amounts of fertilizers or lime.
- To experience using the soil test kit to analyze the fertility and acidity of the soil.

Materials

- farmers' samples of different types of fertilizers that they use.
  (Note : Ask farmers to bring some samples of different types of fertilizers that they use)
- digging tools (e.g., shovel/bolo/grab hoe)
- 6 large plastic bags
- 5 Soil Test Kits
- manila paper and pentel pens

Steps

1. Ask farmers to show the samples of fertilizers that they have brought to the meeting. Get the farmers to share their knowledge about the different kinds of fertilizers. You could do this by small group discussions with presentations, or perhaps the Round-Robin technique (e.g., go around the circle of participants asking each farmer in turn if they want to say something). Some suggested guide questions :
   - What different kinds of fertilizers do we have? (The group could do this by sorting the fertilizer samples on some sheets of manila paper laid on the floor in the middle of the circle of farmers).
   - What nutrient elements do you get from each kind of fertilizer?
   - What are the differences between the natural (organic) and the chemical (inorganic) fertilizers?
   - How does the soil look after using chemical fertilizers? How does the soil look after using inorganic fertilizers?

2. Go on a field walk. Visit a number of different fields with different crops and different types of soil. Share farmers ideas and experiences of deciding how much fertilizer to use. Some suggested guide questions :
   - How much fertilizer would you use for this field?
   - How do you decide how much fertilizer to use?
   - Do different people use different amounts of fertilizers? Why?

- Would you use a different amount of fertilizer for the same variety in different fields? Why?
- Which of the soils that we have seen today is the most fertile?
- What things did you look for to assess the fertility of the soil?
- How much does fertilizers cost? How much money would you save if you found that you could use less fertilizers?

3. Ask the farmers if they want to try using the Soil Test Kit (STK) to find out how fertile their soil is, and to use this as a basis for deciding how much fertilizers to use.

4. Go to the 'learning field'. Explain that you will take a sample of soil from the field to measure the amount of fertility and acidity of the soil. Show the group how to take a sample, then let each group take their own samples for the whole 'learning-field' (If they prefer, the groups could take samples from different field so that they could see if there is any variation in fertility between fields).

5. Return to the 'classroom'/shade. Copy the steps for the soil analysis onto a manila paper. Distribute 1 Soil Test Kit (STK) to each group.

6. Facilitators guide the small groups to do the soil analysis by carefully following the steps from the manila paper or from the STK instruction leaflet.

7. Each group prints their results on a manila paper to share with the big group.

   <u>Reminder on how to take a soil sample :</u>

   a) You need a large plastic bag and a shovel.
   b) Dig a V-shaped hole, as deep as the shovel head.
   c) Cut a 10 cm thick slice of undisturbed soil at one side of the V.

d) Remove the side of the slice so that you keep only the middle portion of the sample.
e) Remove any large bits of stone and organic matters (e.g., twigs, leaves, roots, etc.).
f) Put your sample into the plastic bag.
g) Take 4 or more samples spread randomly across the whole field and put them into the same plastic bag.
h) Mix the soil samples thoroughly.
i) Label the plastic bag so you can remember where the samples came from.

Some suggestions for the processing discussion

- How much of each nutrient is found in the soil of the ‘learning-field’? Is the soil acidic (low pH) or alkaline (high pH)?
- If you went to another field do you think you would find the same result or a different result?
- Do you know what rate of fertilizer DA recommends for different types of crops? Show the group the list of nutrient requirements for different crops. Explain that now we know the amount of nutrient in the soil, we can work out how much extra to make up the total amount of nutrients that the recommendation says is needed by the crop. This will be done in the following week.
- If the soil is acidic or alkaline, what cultural or amelioration practices will you undertake? Facilitate farmers to share their own experiences in addressing soil acidity and alkalinity problems. Make a list of the aggravating factors leading to soil acidity and alkalinity based from farmers’ experiences and your own technical knowledge about the problem. Make also a list and agree on possible corrective measures that farmers can implement in their own farms.

Exercise No. 3.05

PARTICIPATORY DISCUSSION : GETTING IDEAS FOR INM FIELD TRIALS

When is the exercise most appropriate?

- In the FFS, TOT and VST sessions, before establishing field experiments.
- When nutrient deficiencies in the field are observed in the field.

How long will the exercise take?

- 2 hours initial participatory discussion.
- 2 hours of field activity.
- 2 hours final participatory discussion.
- In FFS, the exercise may be done within the first two weeks of sessions with less time in the field since they are familiar with the area.

Learning objectives

- To improve the participants' understanding of the importance of plant nutrients, different types of fertilizers

Materials

- Manila paper, pentel pens, crayons

Steps

1. Conduct a brainstorming session in the big group to answer the following questions :
   - What does integrated nutrient management or INM means?
   - What it is that has to be integrated in INM?
   - How do you integrate nutrients?

2. Distribute guide questions for another brainstorming session in small group :
   - First Group. What is an organic fertilizer? Give examples. What are the advantages and disadvantages using organic fertilizer? What is its nutrient content?
   - Second Group. What is an inorganic fertilizer? Define. What are the advantages and disadvantages using inorganic fertilizer?
   - Third Group. What are the advantages of integrating organic and inorganic fertilizers?
   - Fourth Group. What are the different methods of fertilizer application? What are their advantages and disadvantages?
   - Fifth Group. What are the functions of NPK in plants? What other nutrients are essential for plant growth and in what way? Is it useful to know? Why?

3. Allot each group 30 minutes for output preparations

4. Allot each group 1 hour for presentations and participatory discussions.

5. Find out what fertilizers farmers are using in the FFS ? If the information are not available, the participants should gather them by asking farmers during barangay immersion activities. Write down information on manila paper. It can include the following :
   - What inorganic fertilizers are used? What is the cost? Where do they buy?

- What organic fertilizers are used? Do they buy? What is the cost? If they buy, what is it made from, where did it come from? What is the nutrient value?
- What organic fertilizers or sources for compost are or could be locally available? Go and look for it? Do they burn organic materials? Where does the animal manure end? Can they gather nitrogen-containing leaves from trees? To what extent could organic fertilizer replace inorganic fertilizers? 10, 20, 50, 70 . . .or 100 %?
- Are there any crops or fields or areas with nutrient deficiencies? What do farmers do about it?

6. Agree on when to gather information. Use the information in later sessions to design relevant field exercises to learn more about INM. This could lead to another exercise about preparation of compost, use of soil test kit and other trials based on local needs.

7. Finally do some fertilizer calculations [5]. In FFS, ask farmers if they know how to do fertilizer calculations. Ask them to explain to the other farmers. The best thing will be when someone in each group knows how to compute for fertilizer requirement.

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5 Fertilizer calculation examples:

1) The fertilizer requirement is 120-28-58 kg NPK per ha. How many bags of 14-14-14 and 46-0-0 are needed?

Answer: K needed: 28 kg/14% = 28/0.14 = 200 kg 14-14-14

120 - 28 - 58	kg NPK needed
28 - 28 - 28	kg NPK satisfied with 200 kg 14-14-14
92 - 0 - 30	kg NPK to be satisfied
92 - 0 - 30	30 kg K/60% = 50 kg 0-0-60
92 - 0 - 0	kg NPK to be satisfied
	92 kg/46% = 92/0.46 = 200 kg 46-0-0
92 - 0 - 0	kg NPK satisfied with 200 kg 46-0-0
0 - 0 - 0	

14 -14 -14	:	200 kg	=	4 bags
46 - 0 - 0	:	200 kg	=	4 bags
0 - 0 -60	:	50 kg	=	1 bag

Some suggestions for the processing discussion

- What is basal application? What is top dressing? What is side dressing?
- What is granular application? What is drenching? What is split application?
- How do foliar fertilizers work?
- How do you solve deficiency problems when you do not know what is deficient?
- How does organic fertilizer influence on soil pH?
- How does inorganic fertilizer influence on soil pH? What about ammonium? and Nitrate?
- Is it economical to buy organic fertilizer? How do you estimate N, P and K value of organic fertilizer?
- Is all N, P and K in organic fertilizer plant available?
- Are there other sources of N than fertilizer? Plants? Rain? (20-30 kg/ha/year)
- Are there methods to know more about soil fertility?
- What information do you get from soil textural analysis?
- Can you grow crops without fertilizer?
- Why use fertilizers?
- How will the landscape influence your choice of fertilizer and application method?

Exercise No. 3.06

SIMPLE POT EXPERIMENT AND SHARING WITH FARMERS ON N, P, AND K FUNCTIONS : NUTRIENT AND PLANT HEALTH

When is this exercise most appropriate?

- After the exercise on different types of fertilizers and the use of the Soil Test Kit.
- When the farmers are interested to discover more about what plants use the nutrients for and what nutrient deficient plants look like.

How long will this exercise take?

- On the first FFS meeting, I hour for the field walk plus 1 hour to set up the pot experiment.
- A few minutes every day, for 2 or 3 weeks, to care for the potted seedlings.
- 1 hour of an FFS meeting for the final processing.

Learning objectives

- To familiarize farmers with the way in which plant health is affected by the nitrogen (N), potassium (K) and phosphorous (P).
- To familiarize farmers with the appearance (symptoms) of plants when they have sufficient or insufficient nutrients.

Materials

- Fields with healthy crops that have sufficient nutrients and other fields where the nutrients are deficient (try to find a vegetable field planted to several crop varieties or cultivars for this exercise). Facilitators will need to scout for suitable fields in advance of the FFS meeting.

- 25 healthy cabbage or tomato seedlings, as similar in sizes as is possible.
- 25 small plant pots or plastic bag/fun-juice bags suitable for growing seedlings in.
- Enough sand to fill the 25 pots. (You could choose to use an N, P and K deficient soil if you prefer, but you will probably find it difficult to find a K-deficient soil in the many vegetable growing areas).
- 5 pails or other containers to hold water for washing the seedlings.
- 5 containers to keep washed seedlings in so that their roots are under water.
- 25 small plastic or bamboo sticks, to make labels for the pots.
- Pentel pens

Steps

1. Go on a field walk to the different fields.

2. In each of the fields that you visit : Ask the participants to work in small groups for 10 minutes, discussing and recording what they can observe about the health of the plants (color, size, texture, other comments). After the observation, have a sharing of what the farmers observed. Some guide questions:
    - How healthy are the plants?
    - What things did you observe to help you decide how healthy the plants are?
    - Do you think the plants have enough nutrients?
    - If yes, what kind of fertilizer do you think the plants need?

3. When you have visited all of the fields and finished the sharing of farmers knowledge and experience, ask the group if they want to find out what a plant looks like if it does not have enough of a particular kind of nutrient?

4. Return to the FFS 'classroom'/shade to set up an experiment in which seedlings are grown in sand with one of the 3 main nutrients missing. Each group sets up one treatment. There will be 5 treatments :
   - seedlings potted in sand with P and K but no nitrogen
   - seedlings potted in sand with K and N but no phosphorous
   - seedlings potted in sand with N and P but no potassium
   - seedlings potted in sand with all nutrients (N, P and K)
   - seedlings potted in sand with no nutrients (total starvation)

5. Set up the pots with sand and fertilizers. You can use the recommended fertilizer rate in your locality as the basis for calculating the amount of fertilizer for your pot experiment. Simply calculate the amount of fertilizer required per square meter and the number of hills per square meter using the standard distance of 20 cm x 20 cm between hills so that you can calculate the amount of fertilizer required per pot or plant.

6. Dig the seedlings up very carefully. Try not to disturb the roots too much. Clean the roots by washing gently with clean water. Keep the seedlings with their roots in water until you are ready to plant them in the sand. Do not forget to label the pots!

7. Start assessing the growth response of the potted plants to the fertilizer treatment once a week until substantial observations are obtained to compare differences among the treatments.
8. Care for the seedlings can be done by either asking 1 volunteer farmer-participant (if not the cooperator) to look after all the seedlings at the FFS site (better experimental design), or each one to take home and care for potted plants (more participatory).

9. Process the results by letting the groups bring their plants and putting them at the center of the circle. Group the seedlings for each treatment. Make a visual assessment while the plants are in the pots. Compare the color of the seedlings, the size and the stage of development.

Rather than doing a lot of complex measurements and spending much time calculating means, get the group to come to a consensus about their assessment. If there are disagreements get participants to explain and discuss their ideas. Make a list of the group's observations on a manila paper that everyone can see.

10. Making a consensus about the big differences that we can see is often more useful than making lots of measurements and calculating averages. This is because it is the BIG differences we are interested in and not whether there is an average of 1 millimeter difference between the treatments. Some suggested guide questions :
    - Which treatments have the greenest leaves? Which treatments have the least greenness in the leaves?
    - Which treatments have the largest leaves? Which treatments have the smallest leaves?
    - Which treatment has the most leaves? Which treatment has the least number of leaves?
    - Which treatment has the thickest stems? Which has the thinnest stems?
    - Which treatment has the tallest plants? Which treatment has the shortest plants?
    - Which treatment has the most juicy/firm leaves and stems? Which treatment has the least juicy/firm leaves and stems?
    - Can you see any other differences between the appearance of the plants in the different treatments? What are these? It may be that for some of the questions, all of the treatments look the same. If so, then do not try to say which treatment is more or less, just note that they are 'ALL THE SAME'. Similarly if there are 2 treatments that are highest or 2 treatments that are lowest, then write down both of the treatments.

- You might find it useful to put the results in a table like this:

TREATMENT / OBSERVATION	Without N	Without P	Without K	Without N, P and K	With N, P and K
SIZE OF LEAVES	big	big	small	small	
GREENNESS	least green		least green		most green
STEM THICKNESS		all the same			
OTHERS	-	-	-	-	-

11. Carefully remove the plants from the pots and gently wash the sand from the roots. Lie the plants in rows on manila paper - label the treatments. Again, make a visual assessment by group consensus and list the group's observations.

    Some suggested guide questions:

    - Which treatment has the longest roots? Which treatment has the shortest roots?
    - Which treatment has the most 'bushy' roots? Which treatment has the least 'bushy' roots?
    - Which treatment has the most juicy/firm roots? Which treatment has the least juicy/firm roots?
    - Can you see any other differences between the appearances of the plants in the different treatments? What are these?
    - Use the table or list of observations in a summary/processing discussion.

Some suggestions for the processing discussion

- What was the appearance of the plants which had none of the 3 elements?
- What was the appearance of the plants which had all elements?
- What was the appearance of the plants which had no nitrogen? What does this tell us about what the plant is using the nitrogen for?
- What was the appearance of the plants which had no phosphorous? What does this tell us about what the plant is using the phosphorous for?
- What was the appearance of the plants which had no potassium? What does this tell us about what the plant is using the potassium for?
- How could we use these discoveries when we are monitoring the health of the plants in our fields?

Additional notes :

We could include micro-nutrients in this experiment, too. Perhaps by adding some compost or liquid compost extracted from composted materials (mix compost with water in a bucket and let it stand for a week). Then, the treatments would be :

- with compost, P & K but no nitrogen
- with compost, K & N but no phosphorous
- with compost, N & P but no potassium
- with N, P & K but no compost
- with all nutrients (compost, N, P & K)

The problem is working out how much compost to use, and knowing if the N, P and K in the compost are sufficiently low to see an effect of low N, P & K.

Exercise No.3.07

FIELD WALK AND EXERCISES ON SOIL CONSERVATION : PREVENTING SOIL EROSION AND CONSERVING SOIL ECOSYSTEM, STRUCTURE AND FERTILITY

When is this exercise most appropriate?

- In the FFS, TOT and VST Courses
- As a component of INM topic

How long will this exercise take?

- 30 minutes fieldwalk, 30 minutes small group discussion and another 1 hour big group discussion. Another 1 hour and 30 minutes may be utilized for follow-up exercises.

Learning objectives

- To build awareness of how we can conserve the soil fertility, soil ecosystem, and soil structure and prevent soil erosion.

Materials

- A number of different fields:
  a) Where you can see that the soil is being eroded in the field (e.g. where the plots are not contoured).
  b) Where large scale erosion can be seen (e.g., where you can see big slides and gully erosion, like valleys cut into the soil by the water).
  c) Where soil erosion is prevented (e.g., where the plots are contoured).
  d) Where soil structure is poor.

e) Where soil structure is good.
f) Where composted weeds, stubbles or rice straws are utilized as source of soil nutrients.
g) Where there is very little organic matter in the soil.

- Notebook and pen

Steps

1. Go on a field walk and ask the participants to observe the soil in a number of different fields.

2. Assign each small group to brainstorm and summarize observations in a field or several fields.

3. Present to the big group all observations by the small groups in each field for further brainstorming and additional inputting.

4. Summarize all observations

5. Design discovery-based exercises on soil conservation :
   - Simple percolation experiment in plastic cups with soil to measure the time taken for a fixed volume of water to percolate through and thus, show that better soil structure will holds more water).
   - Soil ecosystem observation to compare the diversity of living and non-living things of a well and not well conserved soils.
   - Green manuring and other organic fertilizer observation tour to understand their effects on erosion and soil ecosystem?

Some suggestions for the processing discussion

- Why is there soil erosions in some of the areas and there is none in some areas?
- Aside from contour farming, what other practices have you observed that can minimize or prevent soil erosion?
- What is soil fertility? Why are some soils very fertile and others are less fertile? What cultural practices did you observe that improved soil fertility?
- In your observation, how can the soil ecosystem contribute to conservation of soil fertility?

MORPHOLOGY AND GROWTH STAGES OF VEGETABLE CROPS

Morphology (or anatomy) and function are closely related. A nose has holes (morphology) so that air can enter the body (function). A vegetable crop morphology is important to study and understand the function. The vessels in the leaf (morphology) are important for transport of water, nutrients and systemic pesticides (functions). Each week during the crop growth, you will collect, observe and draw plants. Use a magnifying glass (or microscope if readily available) for better observations. The micro view of the leaf surface is fascinating as are all other parts of the plant. Drawing is a tool to assist in observation, remembering and for recording what you have seen. Try to spend time to make detailed and well labeled drawings.

You will find that a deep understanding of the morphology and growth stages of the different vegetable crops is the first step in understanding the effects of disease and insects on the crops. You will also find out why not all injury caused by diseases, insects and rats results in yield loss. Plant compensation is important for reducing the effects of injurious organisms (including farmers walking in the field).

Exercise No. 3.08

FIELD WALK AND BRAINSTORMING :
OVERVIEW OF THE MORPHOLOGY AND GROWTH STAGES OF VEGETABLE CROPS

When is this exercise most appropriate?

- Before the conduct of the first agro-ecosystem analysis (AESA)

How long will this exercise take?

- 1-1.5 hours of the FFS, TOT and VST meeting

Learning objectives

- To provide the participants an overview of the morphology and growth stages of the different vegetable crops.
- To provide the participants general ideas on changes that occur on the different vegetable crops at various stages of growth and development.

Materials

- Field with different growth stages of different vegetable crops
- Manila paper, pentel pens, and crayons for each group.
- Meter stick and magnifying lens for each group

Steps

1. Each group will be assigned a distinct vegetable crop to observe and collect in the field.

2. Brainstorming in small groups will be done on observations regarding the growth stages of a particular vegetable crop.

3. Each group list down their observations and draw all recognizable plant parts from the collected specimen.

4. Each small group present their output to the big group to compare and consolidate observations for the growth stages of each vegetable crop observed in the field.

5. Facilitate a discussion on understanding the changes in plant parts at different growth stages of the different vegetable crops and relate to cultural management practices

Some suggestions for the processing discussion

- Collect specimens of different vegetable crops at seedling and early vegetative stages and discuss their growth and development. Collect also specimens at late vegetative stages and discuss their growth and development.
- Collect different vegetable crops at about maturity or harvesting stages and discuss their growth and development.
- At what stage of the different vegetable crops is most sensitive to stress such as drought and flood or low and high temperature? Why?
- What are the pests that are commonly observed during the different growth stages of the different vegetable crops?
- What is the importance of knowing the morphology and growth stages of the different vegetable crops?

Note
The different plant parts at various stages of crop growth will be discussed in general including topics on critical phases of its growth and development. This field exercise will be reinforced by detailed discussion at the learning fields while the participants are exercising the weekly agro-ecosystem analysis (AESA).

Exercise No. 3.09

HANDS-ON AND PARTICIPATORY DISCUSSION :
THE SEED MORPHOLOGY OF SOME VEGETABLE CROPS

When is this exercise most appropriate?

- Best time is before sowing the seeds in the FFS,TOT and VST sessions.
- First week of the training sessions, before doing seed germination test

How long will this exercise take?

- At least 45 minutes for introduction and observations
- At least 15 minutes daily for observation
- At least 30 minutes for follow-up presentation

Learning objectives

- To familiarize the participants with the morphological structures of different vegetable seeds
- To improve the participants' understanding of the functions of the different parts of the seed in relation to germination performance

Materials

- Different kinds of vegetable seeds, different sizes, families, etc. preferably those to be used in the training
- Manila paper, pentel pens, crayons
- Pair of forceps
- Razor blade or scalpel
- Magnifying lens

Steps

1. Brainstorm with the participants to determine initial knowledge and understanding about seed morphology :
   - What is seed morphology?
   - How will knowing the different parts of the seed be useful to them or to farmers?

2. Distribute seeds of different vegetable crops assigned to each small group for their field trials and let them do the following :
   - Ask each groups to observe the seed and draw it with as many details as they have observed.
   - Cut some seeds with a razor blade and draw what is inside
   - Label the different parts of the seed based on what he group know

3. Let each small group present their outputs (Do not give the names of the different parts of the seeds yet, the participants may be able to do it later when they observe the germinating seeds again).

4. Brainstorm again with the participants to determine present knowledge and understanding about seed morphology.

Some suggestions for the processing discussion

- What is the function of the seed in crop production?
- What parts of the seed did you observed? What are their functions?
- Were you able to label the seed parts when you saw what came out of the seed?
- What is the importance of knowing the morphology of the seed?
- Why do seeds differ in size, shape and color? Is it related to the survival of the crop?
- By observing the seeds, how would you think they spread under natural conditions?
- Is this exercise relevant in an FFS? How would you do it there?

Exercise No. 3.10

HANDS-ON AND RESULT DEMONSTRATION : SEED QUALITY DETERMINATION

Seed is the foundation of a good crop. The use of high quality seed is a must in the production of high quality vegetables. Low quality seeds create production problem like population density, non-uniformity of crop stages, harvesting problem and the like. To minimize these problems, farmers should be equipped with technique in seed quality determination to guide them in seed selection.

When is this exercise most appropriate?

- Best time is before planting the seeds in the mainfield
- When seed of a questionable quality are used
- When seed, and seedling morphology exercises are done

How long will this exercise take?

- 1 hour for preparation and setting-up of the exercise
- 15 minutes for daily observation
- 1 hour for presentation and participatory discussions

Learning objectives

- To be able to determine the characteristics of high quality seeds.
- To conduct purity, germination and vigor tests.
- To improve knowledge on factors needed for seed germination
- To familiarize with simple methodology to determine the germination ability of seeds
- To learn how to compensate for reduced germination
- To determine whether there is sufficient seeds for the area

Materials

- Polyethylene bag, plastic box and germination paper
- Tissue paper, rubber bands, crayons, pencil and manila paper
- Vegetable seed lots
- Water
- Pair of forceps, weighing scale and magnifying lens

Steps for purity test

1. Segregate the good seeds from inert materials and other seeds in 50 - 500 gms per seed lot depending upon the size of the seeds.

2. Weigh the above separately, and compute for the % pure seeds.

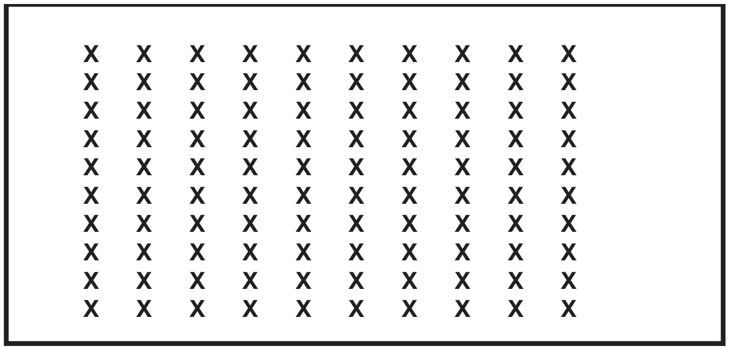
Steps for germination test

1. Ask the large group what is needed for seeds to germinate (e.g., temperature, moisture, oxygen and medium are some of the important issues).

2. Ask for suggestions to test the germination of seeds

3. Introduce tissue paper and polyethylene bags as the available materials and do the following steps :
   a) Soak germinating paper in clean water.
   b) Spread germinating paper on top of the table and scatter 100 seeds per germinating sheet. Make 2 sets per seed lot.

Germinating paper with seeds (x)



c) Cover with another sheet of germinating paper, roll and tie both ends with rubber bands then dip or soak in clean water, place inside plastic sheet bag and incubate at room temperature.

d) Initial evaluation will be done after 4 days of incubation. Count normal seedlings and remove moldy seeds or seedling.

e) Final evaluation will be done after 7 days of incubation. Count normal seedlings, abnormal seedlings and dead seeds.

f) Compute for the % age germination using the formula below :

$$\textbf{\% GERMINATION} = \frac{\textbf{TOTAL NO, OF NORMAL SEEDLINGS X 100}}{\textbf{TOTAL NUMBER. OF SEEDS SOWN}}$$

4. After one week, each small group presents the results including germination percentages to the big group and conduct participatory discussions to level of the perceptions of the participants.

Steps for vigor test

1. Measure the length (cm) of plumule and radicle of 10 normal seedlings.

2. Compare measurements with different seed lots. Seedlings with longer plumule and radicle indicates higher vigor.

Some suggestions for the processing discussion

- Each group will perform all the above mentioned tests using 3 contrasting seed lots and presentation of outputs will follow.
- Conduct participatory discussions on the importance of testing for purity and vigor in relation to crop management especially at the early stages of growth of the corn plants.
- Conduct participatory discussions if the tissue paper, water and polyetheline bag was able to provide the requirements mentioned in Step 1 for Germination Test.
- If germination is different from 95-100, conduct participatory discussions on how and when to compensate for that. [6]
- Conduct participatory discussions on what are the decisions if germination percentage is 95%, 80%, 40%?
- Conduct participatory discussions on what determines the germination percentage (e.g., age of seeds, maturity at harvest, small or deformed grains, grade of seeds, storage, diseases, selection)
- If 5 kg of snap bean seeds is needed for 0.25 ha., how much is needed for 2.25 ha? [7]
- If 20 kg is needed for 1 ha., how much is needed for 578 sqm? [8]
- If the weight of 1000 seeds is 120 g, the plants population per per ha is 80,000 and the germination percentage is 90%, how many g of seeds are needed for 700 sqm? [9]
- In the TOT or VST, ask if the exercise is relevant in the FFS and when. Does it need modification?

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6 **Exact compensation can be done like this: (seed rate / germination %) X 100. If the recommended seeding rate is 20 kg per ha and the germination % is 85%, the new seeding rate will be : (20 kg / 85) X 100 = 23.5 kg seeds per ha. Exact compensation is not always necessary since the seeding rate is not always very exact in the field, but it can show that by increasing seeding rate, a lower germination percentage can be compensated. Compensation is usually more relevant in direct seeded than in seedbeded crops and when germination percentage is very low.**

7 **If 1 ha is 10.000 sqm, then 0.25 ha is 2.500 sqm. If what is need per ha is : (5 kg/ 2.500) X 10,000 = 25 kg snap beans seeds per ha. Thus, the need per 2.25 ha is : 20 kg X 2.25 = 45 kg/ha.**

8 **The seed requirements for 578 sqm is : (578 sqm / 10,000 sqm) X 20 kg = 1.16 kg seeds.**

9 **The seed requirements for 700 sqm is : 80,000 plants/ha X (120g/1,000 plants) X (90/100) X (700 sqm/10,000 sqm/ha) = 604.8 g**

Exercise No. 3.11

HANDS-ON AND BRAINSTORMING EXERCISE ON SEED TREATMENT : THE LAST ALTERNATIVE FOR THE CONTROL OF SEED- AND SOIL-BORNE DISEASES IN VEGETABLES

When is the exercise most appropriate?

- In FFS, TOT and VST sessions.
- Before planting of vegetables only in high pressure areas for seed- and soil-borne fungal, bacterial and nematode diseases.

How long will the exercise take?

- 1-2 hours of an FFS, TOT and VST sessions.

Learning objectives

- To learn how to treat vegetable seeds with fungicide, nematicide or bacteriocide when it is the last alternative to control seed- and soil-borne diseases.
- To understand when and how seed treatment can ensure the growing of a healthy vegetable crop.

Materials

- container
- vegetable seeds
- slurry water
- chemicals

Steps

1. Conduct a participatory discussion by using the following guide questions :
   - Where is the source of seed materials?
   - Do farmers normally treat seeds against fungal, bacterial and nematode diseases? Why?
   - Is seed treatment the most practical way of controlling seed- and soil-borne diseases of vegetables? If yes, design a simple field exercise that will compare the performance of treated and un-treated seeds.

2. Discuss and agree on what data to collect, and how often.

3. If the decision is to treat the seeds, follow the following steps :
   a) Place the seed in a container.
   b) Add slurry water and mix the seeds thoroughly.
   c) Treat the seeds with chemical at the rate of 3-5 g/kg seeds.
   d) Mix the seeds thoroughly to distribute the chemical coat equally.
   e) Place the treated seeds in a close container and store it at ordinary room temperature.

4. Establish the field exercise comparing fungicide treated and untreated seeds.

5. Conduct participatory discussion regarding the result of the exercise at the end of the activity.

Some suggestions for theprocessing discussion

- In which treatment did you have the best germination percentage?
- In which treatment did you have the most seed- or soil-borne disease infection?
- Are there also non-chemical seed treatments?
- What diseases can be managed by seed treatment?
- What insect pests and or diseases were affected by seed treatment?
- Is there any side effect resulting from seed treatment to the environment?
- How can that be measured?
- Is there a side effect of seed treatment to man?
- How can it be avoided?
- Can you buy treated seeds?
- For what crops or in what environment can we recommend seed treatment?
- Is the exercise appropriate in the FFS? How will you go about it?

Exercise No. 3.12

RESULT DEMONSTRATION :
THE ROOTS AND PLANT VESSELS

Fertilizers and systemic insecticides, such as carbofuran, are often applied to vegetable crops. How do these nutrients and insecticides get into the plant and then move through the plant? To enter the plant, the chemicals must be dissolved in water. Without water, the compounds will not be able to move either in the soil from the surface to the roots, or from the soil into the roots. Once the chemicals are dissolved in water, they are absorbed into the plant with the water. Once the chemicals are inside the plant, the chemicals are able to move through the plant through a system of hose-like vessels between the roots and the top of the plant. Water moves up these vessels and sugars move down the vessels.

After the systemic insecticide moves to the leaves of the vegetable plant, water from the vessels is exuded each evening. This is the small droplet of water found on the tips of the leaves early in the morning. This drop of water on each leaf contains the systemic pesticide. The drop falls back in the soil surface and often on natural enemies or natural enemies drink from the drop of water and they will be killed by the systemic pesticides.

This exercise will show how water solutions move through the plant.

When is this exercise most appropriate?

- In the FFS, where farmers are regularly using granular pesticides (e.g., herbicides or insecticides)
- In the FFS, TOT and VST, to demonstrate the role of the roots and plant vessels in the uptake and movement of nutrients and water in plants.

How long will this exercise take?

- 30 minutes to collect specimen and set up exercise, 1 hour observation and small group discussion and 30 minutes presentation. (Whole time is not used. Best to run activity while doing another activity).

Learning objectives

- To demonstrate the role of the roots and plant vessels in the transport of water and nutrients in the vegetable plant.
- To describe how systemic insecticides move through the plant.
- To explain why insects pests (e.g., sucking or chewing on vessels) and natural enemies (e.g., plant moisture feeders) are controlled by systemic insecticides.

Materials

- water, red ink or dye, 4 cups and 4 straws per group
- plants (e.g., vegetable seedlings, weeds and other plants)

Steps

1. Go outside by group and find many kinds of plants including vegetable seedlings, kangkong, celery, grasses and other plants.

2. Add water to the 4 cups and place several drops of the red food coloring. The water should be dark red.

3. Place the plants in the 4 cups with the stems in the cups. Also place the 4 straws in the cups. Two straws should be flattened first. Place two of the plants in a bright place and the other two in a shaded area (with one flattened and one unflattened straws per treatment)

4. Wait 90 minutes and observe the plants. Observe the plants again the following early morning.

Some suggestions for the processing discussion

- What has happened to the color of the leaves? How has the red coloring moved in the plants?
- What do you think happens with vegetable crops in the vegetable field when systemic insecticides are used? Where is the insecticide in the plant? What kind of insects suck on the fluid in the plant vessels? What kind of insects chew on the plant vessels? What about insects that feed on the leaf edge? Do they also feed on the main vessels?
- What happens after the solution reaches the tip of the leaf? Have you noticed the water on the leaf tips in the morning? Where does this water come from and what does the solution contain? How might the solution affect natural enemies in the field? How about farmers walking in the early morning field?

Exercise No. 3.13

DEVELOPING A PRODUCTION GUIDE : THE MORPHOLOGY, GROWTH STAGES AND RELATED CULTURAL MANAGEMENT PRACTICES FOR VEGETABLES

When is this exercise most appropriate?

- In the TOT and VST sessions.
- First or second week of the training sessions.

How long will this exercise take?

- 2 hours for field visits and interview of farmers
- 1 hour for group preparations
- 1.5 hours for presentations

Learning objectives

- To gain a better understanding of the relevance of plant morphology in making cultural management decisions.
- To gain more knowledge about vegetable crops and farming practices in the area which can be validated and used as flexible guide for field activities in learning field.

Materials

- Farmers from the FFS and neighboring fields.
- Fields with different vegetable crops at different growth stages for every crop.
- Note books, pen, manila paper, pentel pens

Steps

1. Start in the classroom by brainstorming with the participants on :
   - What is plant morphology?
   - How can plant morphology be useful for farmers?
   - What are the growth stages of the crops they will work on?

2. Assign a vegetable crop presently grown in the locality to each small group to work on.

3. Let each group do a field walk, find an area planted with their assigned crop at different growth stages, visit and interview farmers to get the following information :
   - What are the different growth stages in the crops? Describe each stage briefly (e.g., 2-leaf stage, 5-leaf stage, flowering stage, heading stage, etc.). Avoid using Latin names like *primordia*, which is difficult for farmers to understand.
   - What is the approximate duration of the different growth stages?
   - Based from interview with farmers and from your own experience, what are the cultural practices applied at the different growth stages (e.g., seedbed [sterilization], transplanting [planting distance], 5-leaf stage [weeding], harvest [draining the field], fertilization [method of application, type of fertilizer and rate], pest and diseases and their control [methods, if chemicals give name, rate, concentration, and frequency], etc.).

4. Return to the classroom and let the participants consolidate their outputs. Remind them to be specific in their descriptions. (*Optimal planting distance* is not a good answer, while *50 cm between rows and 25 cm between plants* is).

5. Facilitate the group to prepare a chart of the information they gathered. The information should be as detailed as possible. Below is an example :

   Sample description of carrot morphology, growth stages and related cultural management practices.

0-10 DAS	10-20 DAS	20-50 DAS	50-60 DAS	60-80 DAS	80-110 DAS
0-2 leaf stage	2-5 leaf stage	6-10 leaf stage	flowering stage	ripening stage	harvest stage
Developed from seeds to have 2 small leaves, 0-2 cm high	The plant has 2-5 leaves and root starting to develop	Enlarged carrot root can now be seen	10-15 leaves, flowers first seen on upper part, fruits develop	Fruits grow big and begin to change color	Head is now big and hard
Broadcasting 1 kg seeds per ha. Control of cutworm with Cymbush x l/ha	Irrigate when dry	1st weeding and broadcasting of 90-60-90 kg NPK per ha	2nd weeding Observe root rot and leaf miners	Observe for the occurrence of blight. Spray x liter maneb per ha	Harvest when roots are big shiny sound hollow when knocking

6. Let each small group present their outputs. It is no shame not finding all details during this exercise. What is important is you identified the lacking information. Write down all missing details and agree on when to get them. (It could be during barangay follow-up).

Some suggestions for the processing discussion

- How many fields did you observe? How many farmers did you talk to?
- Is farmer's understanding of plant morphology sufficient? Why? Why not?[10]
- What are the most important stages for farmers to recognize? Why?
- What is the most useful way of naming and describing the parts of the plant?
- What is the most useful way of naming and describing the growth stages?
- How will you describe the methods sowing the seeds or establishing the seedbed?
- How will you describe their weeding practices?
- How will you describe their fertilizer management practices
- How will you describe their pesticide use and crop protection practices?
- How do you get the right information from farmers who answer questions indirectly? (Often, for example, they say they use 1 sachet per spray can. How do you convert that into concentration and kg per ha basis?)

10 In rice, farmers have to learn the panicle initiation stage. That can not easily be seen, but it is useful to know in timing of fertilizer application.

Exercise No. 3.14

FIELD WALK AND SHARING OF EXPERIENCES : WAYS TO DETERMINE PROPER TIME TO HARVEST VEGETABLE CROPS

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions.
- At least 1 week before the expected harvest time.

How long will this exercise take?

- 1 hour for field observation and interaction with local farmers
- 30 minutes for preparation of charts in small group
- 30 minutes for presentation in large group

Learning objectives

- To improve ability to determine proper time of harvesting and understand which factors affect the time of harvesting.

Materials

- Vegetable field with crops at near harvest time.
- Notebook, pen, manila paper, pentel pen, crayons.

Steps

1. Select a site where there at vegetable crops at near harvesting stage. It does not have to be the learning field itself.

2. For the TOT and VST, it will be important to go to the field and to interview farmers. Before going to the field assign different crops to each group.

3. Give the following guide questions :
   - What are the characteristics of the vegetable crop when it is ready for harvest? (field appearance, size, age, shape, etc.)
   - Is it necessary to harvest the whole field at once or is it better to do selective and flexible time of harvesting?
   - When do you think will be the harvesting time in your learning field? How can you see that now?
   - After spraying pesticides, how long time do you have to wait before harvesting the crop? (deadline)
   - What is the appearance of the vegetable crops that the market will appreciate?

4. Let the participants to observe different vegetable crops in the field (e.g., go for a field walk), to interview farmers and if possible to try their own experiences.

5. Each small group prepares a chart and presents it to the big group for participatory discussions.

6. In the TOT and VST sessions, brainstorm to find out if this exercise is needed in the FFS. List down their suggestions for doing the exercise with farmers.

Some suggestions for the processing discussion

- In the beginning of the season, we often say something like : *It takes 90 days to grow a cabbage crop in our area*. Is it the same duration every season?
- Why is it not sufficient just to know or determine the right time for harvest?
- Which factors influence the duration of a growth season?
- Is the market preferred appearance of a vegetable crop the same in all locations?
- Where do you usually find a chemical's deadline for last spraying before harvest? (It is specific for each chemical and should be indicated on the packet or bottle)
- How does the weather or weather forecast influence harvest time?

VEGETABLE CROP VARIETIES AND VEGETABLE SEED PRODUCTION

Exercise No. 3.15

FIELD EXERCISE AND PARTICIPATORY DISCUSSIONS : CHOOSING THE MOST APPROPRIATE VEGETABLE CROP VARIETY

Farmers are particular about choosing varieties. Different vegetable crop varieties differ in resistance to pests and diseases, length of maturity, adaptability, etc. There are imported crop varieties and local crop varieties produced by research institutions. There is no perfect guarantee that crop varieties that have passed the screening requirements of seed laboratories will be of the best quality and give the highest profits. Choosing the most appropriate variety for one's field will be determined by a farmer's understanding of the ecosystem.

When is this exercise most appropriate?

- Before planting and harvesting in the FFS, TOT and VST sessions.
- When the participants want to have a better understanding of how to go about selecting the most appropriate crop varieties for their localities.

How long will this exercise take?

- At least 30 minutes participatory discussions before conducting a 1 hour field observation and hands-on exercises.
- At least 1 hour sharing of ideas and experiences before planting and harvesting of the learning fields.

Learning objectives

- Conduct field observations and hands-on exercises on choosing the most appropriate vegetable crop variety for a locality.
- Conduct participatory discussions and sharing of ideas and experiences on selecting vegetable crop varieties for a locality.

Materials

- Standing crops of different vegetable crop varieties at early vegetative stage
- Standing crops of different vegetable crop varieties at physiological maturity stage
- Record book, pen and meter sticks

Steps

1. Divide the group into four and assign them to the following vegetable fields :
   - vegetable field planted to a locally produced certified seed of a vegetable crop variety
   - vegetable field planted to an imported certified seed of a vegetable crop variety
   - vegetable field planted to a farmers selection of a locally produced vegetable crop variety
   - vegetable field planted to a farmers selection of an imported vegetable crop variety

2. Small groups conduct field observations, collect samples from the field and interview farmers about their preference for vegetable crop varieties in the areas they are assigned.

3. Big group conduct participatory discussions and sharing of ideas and experiences on selecting vegetable crop varieties for local conditions.

Some suggestions for the processing discussion

- How do the different vegetable crop varieties differ from each other? What is the difference between an imported and locally produced vegetable crop varieties?
- When is it more appropriate to use an imported vegetable crop variety over a locally produced vegetable crop variety and vice versa? Explain.
- What factors are considered by farmers in choosing the most appropriate vegetable crop variety in their locality?
- Why do farmers resort to using their own seed selections? (e.g., F2 seeds of hybrids or seed selections from open pollinated varieties)
- Are there differences in yields and incomes between using certified seeds and the farmers' selections?

Exercise No. 3.16

SELECTING A MATE :
HOW DO WE MAKE DECISIONS FOR IPM?

Selection is the essence of plant and animal improvement and has played an important role in the history of living beings. From the day the potential of certain crop species as food source was recognized, selection has been practiced for more productive plant types. It is the oldest way and one of the most effective methods of variety maintenance and improvement if properly executed.

Selection of appropriate vegetable crop variety for a locality requires certain decision making process. A set of criteria is often required to arrive at a decision. In this exercise, the participants define some criteria they use for making decision in selecting a mate and then relate the same decision making process in choosing an appropriate vegetable crop variety for a local condition.

When is this exercise most appropriate?

- The activity is most appropriate when used for in the TOT and VST sessions on decision making.
- The activity is also appropriate before starting a topic on : "Choosing the most appropriate vegetable crop variety'.
- Do not use the exercise in Farmers' Field Schools.

How long will this exercise take?

- 1-2 hours of the TOT and VST session.

Learning objectives

- Practice making individual and group decisions
- Discuss factors that determine individual and group decision making.
- Relate the decision making process when choosing the most appropriate vegetable crop variety for a locality.

Materials

- male and female groups
- record book, notebook and pen
- manila paper and pentel pen

Steps

1. Divide the group into two : males and females (the groups sit in two separate areas).

2. Ask for five volunteers from each group to sit in the inner circle while the rest sit in an outer circle.

3. From the five female volunteers, the male volunteers each select a partner.

4. From the five male volunteers, the female volunteers each select a partner.

5. Each writes down the reasons for choosing the respective person as a partner.

6. The persons in the inner circle then discuss their individual decisions while those in the outer circle take note of the processes that take place.

7. On the basis of individual decisions, the entire group of women formulate a set of criteria for selecting partners. The group of men do the same.

8. The men and women then compare their process of setting criteria for decision making.

9. The facilitators summarize and record the criteria in a manila paper and the big group conduct a participatory discussions about the criteria set. At the end, the facilitators level off the discussions by relating it to the topic : 'Choosing the most appropriate vegetable crop variety'.

Some suggestions for the processing discussion

Ask the following questions to process the activity as a structured learning experience for decision making :

- How did individuals arrive at their decisions? What were the steps the groups went through to arrive at their decisions?
- Did all the group members agree with the decision?
- What factors influence individual and group decision making?
- What are the differences and similarities between individual and group decision making?
- Can we apply the same decision making process when we choose an appropriate vegetable variety for our locality? Explain your answer.

Exercise No. 3.17

HANDS-ON AND PARTICIPATORY DISCUSSIONS : PRODUCING QUALITY VEGETABLE SEEDS IN FARMERS' FIELD

Quality seeds are a must in vegetable crop production. However, in areas where a farmer can not avail of certified seeds or if he wants to be in another phase of vegetable production, he can use his harvest as source of seeds for the next crop. A farmer may try producing quality vegetable seeds in his farm for a number of vegetable crop varieties by following some steps. Participants are encouraged to try it out in the following exercise.

Management practices in vegetable seed production field are in general similar to those used in commercial vegetable production. However, there are some additional requirements unique to vegetable seed production. *First*, remember that the value of good seeds is higher than that of the ordinary vegetable seed. Therefore, a vegetable seed crop warrants greater care than a commercially grown vegetable crop. *Second*, recognize the goal of obtaining the maximum number of high quality vegetable seeds while minimizing the risk. *Third*, realize that care shown in the most uniform growing conditions possible will greatly facilitate identification of off-type (mixture) plants in future rouging operations.

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions when the participant want to learn about the practical techniques of producing quality vegetable seeds in farmers' field.
- In the FFS, when farmers find the cost of certified seed very prohibitive or when farmers want to make use of their existing vegetable crop as seed source for the next cropping season.

How long will this exercise take?

- At least 30 minutes participatory discussions on the field procedure.
- At least 30 minutes weekly hands-on activities related to field maintenance for the duration of the season.
- At least 1 hour brainstorming session at the end of the season.

Learning objectives

- Conduct participatory discussions and brainstorming sessions on how to go about producing quality seeds for some vegetable crops in farmers' field.
- Conduct hands-on exercises in producing quality seeds for some vegetable crops in farmers' field.

Materials

- Existing farmer's field with standing vegetable crop.
- Bamboo sticks, plastic twine, etc. (for marking the field)

Steps

1. Lead a participatory discussion to determine the area for the farmer's vegetable seed requirements :
    - Ask for their regular vegetable seed requirement per hectare (e.g., 500 g for a tomato variety or 20-25 kg for snap bean variety, etc.)
    - Ask for their regular yield levels per season (e.g., 5 tons fresh snap beans during the wet season or 7.5 tons fresh snap beans during the dry season, etc.)
    - Ask participants to compute for the area needed to produce their seed requirements per hectare per season (e.g., if yield level is 5 tons fresh snap beans per hectare and 500 kg fresh snap beans can give more or less 25 kg dry snap bean seeds, then

approximately 25 kg seed is produced per 1000 sqm, thus the area required is about 1000 sqm to produce 20-25 kg seeds)

2. Facilitate a participatory discussion in the farmer's field for the selection (from a farmer's field with standing vegetable crop) of an area where seeds can be sourced for the succeeding season :
   - Is the area near the source of irrigation water?
   - Is the area relatively flat and accessible?
   - Is the vegetable crop stand relatively uniform?
   - Is the area planted at least 2 weeks ahead or later than the surrounding areas?
   - Are there no pest and disease incidences?

3. Facilitate a participatory discussion in the field for the necessary considerations in maintaining the quality of the vegetable seeds to be sourced from existing farmers standing vegetable crop :
   - Are there any off-types or varietal mixtures?
   - Are there any differences in plant height, plant vigor, prolificness, color of the base, etc. during the early stages of the vegetable crop?
   - Are there any differences in plant height, leaf length and angle, fruit length, shape, color and size of the seeds, date of flowering?
   - Are there weeds at various stages of the vegetable crop?
   - Is there a need to do rouging? When do we start to rogue?

4. Facilitate the group to conduct hands-on exercises regarding the results of all the participatory discussions conducted in the 'classroom' and in the field :
   - Actual identification of the seed source site from existing farmer's standing vegetable crops.
   - Actual measurement and marking of the boundaries of the seed source site.
   - Actual rouging at various stages of the vegetable crop.

- Actual maintenance of the seed source site until the vegetable crop is finally harvested and stored.

Some suggestions for the processing discussion

- Why is site selection important in vegetable seed production?
- What is the importance of planting at least 2 weeks before or after planting in the surrounding areas?
- Can we do seed selection from F2 of hybrid varieties? When is this appropriate?
- Why is rouging necessary?
- Why should the seed crop be harvested when 80% are in physiological maturity stage? Why is it necessary to harvest ahead of the surrounding fields?
- What is the role of sanitation in shelling, drying and storage to produce quality vegetable seeds?

WEEDS AND WEED MANAGEMENT IN VEGETABLES

Exercise No. 3.18

HANDS-ON AND PARTICIPATORY DISCUSSIONS : IDENTIFYING, CLASSIFYING AND MANAGING WEEDS

Weeds reduce vegetable crop yields by competing with the vegetable crops for sunlight, moisture, and soil nutrients. Weeds may affect farming in many ways. For example, fertilizer applied may not increase yields in weedy fields because weeds absorb nitrogen more effectively than the vegetable crops. Also, weeds are harmful because they may be alternate hosts for insect and disease pests of vegetables, and provide shelter for rodents. Usually weed problem is more serious in uplands than in lowlands. If weeds are left to grow in vegetable field, they can reduce vegetable crop yields by as much as 50-80%.

When is this exercise most appropriate?

- In the first two weeks of sessions in the FFS, TOT and VST sites.
- During the first two week from seed emergence.

How long will this exercise take?

- 30 minutes field activity and brainstorming in small groups
- 1 hour presentation and participatory discussions in the big group.

Learning objectives

- Classify weeds according to economic significance.
- Identify factors that contribute to severe occurrence of weeds in the field.
- Develop management strategies for weeds.

Materials

- Different kinds of weeds
- pentel pen, crayon, pen
- Manila paper and notebook

Steps

1. Each group should assess weed population in different areas in the vegetable fields.

2. Each group should collect as many different species of weeds from the vegetable fields.

3. Each group should classify weeds collected according to their gross morphology (e.g., grass, sedge and broadleaf weeds) and other qualifying characteristics (e.g., perennial or annual) and distribution.

4. Process data.

5. Distribute discussion question to each group.

6. Present and discuss answers with the big group.

7. Consolidate output and design weed management strategies.

Some suggestions for the processing discussion

- How did you classify the weeds you collected? Among the weeds collected, which weeds are difficult to control? Why?
- Based on your experiences, on what stage of the vegetable crop is critical to weed competition? Give specific vegetable crop.
- What weed management practices can you recommend for the different vegetable crops?
- What are your general consideration in designing your weed management strategies?
- How will you justify that weeds are also useful to farmers?

Note :
Each participant can be required to submit a herbarium to reinforce their knowledge about weeds.

Exercise No. 3.19

FIELD OBSERVATIONS AND BRAINSTORMING : WEED CHARACTERISTICS IN RELATION TO WEED MANAGEMENT

Weeds are more effectively controlled by a combination of practices than by one practice employed singly. The type of combination depends on the weed species present (weed characteristics), availability and comparative cost of labor for a particular practice in the farms.

Good cultural practices will produce healthy, vigorous and uniformly-spaced seedlings that compete well with weeds. The canopy of such plants interlaps earlier thereby depriving weeds growing between the rows with sunlight.

Uprooting or burying the weeds reduces the weed density thus avoiding or minimizing its competition with the crop.

Inter-row cultivation is the most common and the cheapest method of controlling weeds because it utilizes only farmer's labor. However, this cannot control weeds between the rows which can reduce yield by 33%. To control weeds between the rows, square planting (dama-dama) may be used. This enables farmers to do off-barring (turning the soil away from the base of the plant to cover the weeds in the row) twice. The second off-barring is done at the right angle to the first. This practice increases yield by as much as 20%. Off-barring should be done 14-18 days after planting and hilling up, 26-34 days after planting. As much as possible, do not delay the cultivation that can result to luxuriant weed growth. Late removal may seriously damage vegetable roots.

High yielding leafy vegetable varieties require adequate fertilizer for proper nutrition and high yields. Large amounts of fertilizer applied to the vegetable crop go to waste if weeds are left uncontrolled. Consequently, good weed management improves fertilizer efficiency. Thus, weeding the field prior to fertilization maximizes the benefits from fertilizers.

When is this exercise most appropriate?

- In FFS, TOT or VST sessions
- When it is time for weeding in the 'learning field'
- When participants want to learn about weeds

How long will this exercise take?

- 30 minutes in the field
- 1 hour for processing and participatory discussion

Learning objectives

- To brainstorm on the advantages and disadvantages of different weed management strategies for different vegetable crops.
- To understand how weeds are spreading and relate it to management strategies.
- To encourage participants to observe the characteristics of weeds and practice skills in exploring knowledge of how their way of spreading can be used in weed management.
- To familiarize the participants with "critical period of vegetable crop-weed competition"

Materials

- different kinds of weeds
- plastic bags
- magnifying lens
- pen and manila paper

Steps

1. Go to the field and ask participants to collect at least 10 different weeds per group.

2. In the TOT and VST sessions, interview farmers about which weeds they find most difficult to manage for the different vegetable crops and why.

3. Go to the 'classroom'. Observe each weed and see how it spreads or completes its life cycle (e.g., by seeds, by runners, by rhizomes)

4. Brainstorm in small and big groups on when will weeds usually multiply (e.g., cast the seeds or produce runners) to an extent that they will cause problems (e.g., during cropping season or rest period) and when will be the best time to control them or how do we manage them to prevent economic loss for the different vegetable crops.

Some suggestions for the processing discussion

Can be done as guide questions for initial discussion in small groups and then followed up in the big group. Or it can be done as a brainstorming in the big group :

- What is your definition of weeds?
- What is the critical period of vegetable crop-weed competition?
- Is weed management easiest in vegetables, corn or rice? why?
- How can we manage or control weeds?
- What is the difference between management and control?
- Suggest a way of classifying weeds that is most practical for farmers

Exercise No. 3.20

SIMPLE WEED DENSITY EXPERIMENT : WEED SEED BANK

Weeds reduce vegetable crop yields by competing with vegetable plants for factors necessary for growth, primarily sunlight, nutrients and water. Studies on vegetable crop-weed competition show that it is not necessary to keep vegetable fields entirely weed-free during the season to avoid yield reduction due to weeds. Optimum yields can be obtained by keeping vegetable fields weed-free during the first month after planting. Few weeds present in the field during the critical stage of vegetable growth can still reduce yield considerably. In an experiment, for example, one aguingay per sqm germinating at the time the vegetable crop was planted reduce yield by 5%. When the weed density was increased to 13 plants per sqm, yield was further reduced to 25%. On the other hand, weed that grow after this critical period of competition cannot reduce yield significantly.

When is this exercise most appropriate?

- During discussion on land preparation in the FFS, TOT and VST sessions.
- One week before the special topic on weed management.

How long will this exercise take?

- 1 hour for set-up
- 30 minutes observation per week for 6 weeks
- 1 hour final for processing (e.g., brainstorming and participatory discussions

Learning objectives

- To create awareness that the soil is a weed seed bank.
- To determine the volume of weed seeds per unit area before crop establishment.
- To emphasize the importance of a well-prepared land in reducing weed density.
- To create awareness that heavy weed seed deposit will breed serious vegetable crop-weed competition.
- To identify predominant weed species for a particular environment.

Materials

- soil samples (20x20x15 cm)
- spade or shovel
- plastic sheet
- wooden frame (2x2 cm border)
- water sprinkler (optional)

Steps

1. Get soil samples from an undisturbed field in the site. Secure also soil samples from soils frequented by stray animals and children.

2. Spread the soil samples on plastic sheets at 2 cm thickness.

3. Sprinkle the samples with water as needed to keep the soil moist.

4. Allow weeds to germinate for two weeks. Observe, identify, count and record germinating weeds.

5. Pull out the weeds which have been identified after every observation.

6. Observe weekly until 6 weeks after emergence.

7. Report and discuss the results in small and big groups.

Some suggestions for the processing discussion

- What is the importance of having a well prepared vegetable field in the reduction of vegetable crop-weed competition?
- What are the factors in the dispersal of weed seeds?
- What are the predominant weed species? Why?
- What are the factors which hasten the germination of weeds?
- How does heavy weed deposit relate to vegetable crop-weed competition?
- What is the estimated weed population density per unit area?

4 Insects and Natural Enemies Topics

Exercise No. 4.01

COLLECTION AND SORTING EXERCISE :
INSECTS AND NATURAL ENEMIES IDENTIFICATION AND RECOGNITION

When is this exercise most appropriate?

- When the participants already have 3 or 4 weeks experience of observing insects in the field.
- When participants want to know more about “how to identify” insects and other small animals.

How long will this exercise take?

- 30 minutes for collecting animals in the field
- 1 to 2 hours for sorting and discussions

Learning objectives

- To build skills used in observing and recognizing the shapes, colors and functions of the insects that we find in the crop ecosystem.
- To encourage participants to look at ‘unknown’ insects and to practice skills in exploring what they look like and what they do in the field.
- To build awareness that for IPM decision-making, it is most important for us to be able to discover what does the animal DO in the ecosystem (its function), and to remember how it looks, rather than to learn details of scientific names and traditional entomology identification.

Materials

- collecting equipment per group (e.g., plastic bags, jars, sweep net, aspirator, fine hair paintbrush)
- alcohol to kill insects
- white plates or trays to spread insects on for sorting
- hand lenses, at least 2 per group
- manila paper and pentel pens
- enough candies for all participants (as prizes)

Steps

1. The groups go to the field to observe and collect small animals in the vegetable crop and weedy areas. Observe and note what the small animals are DOING for later sorting into groups. Have a COMPETITION with prizes for the group that can collect :
   - the largest number of different kinds of animal
   - the biggest animal
   - the smallest animal

2. Return to the ‘classroom’. The groups kill the insects by putting in a bag with a little alcohol and quickly sort them on the white trays/plates into groups of different types of insects.

3. While the groups are sorting the animals, the facilitators draw up a matrix/table on manila paper for the competition results :

GROUP	HOW MANY KIND	LARGEST	SMALLEST	TOTAL
1				
2				
3				
4				
5				
TOTAL				

5. Fill in the competition results and give candies to the winning groups and all other groups for working so hard.

6. Facilitate the group to make a list of all the different ways that we could group the insects that are useful when we are observing the crop ecosystem and making decisions about management :
   - What does it eat? (e.g., plant-feeders, insect-feeders, nectar-feeders, decomposers)
   - Where is it found? (e.g., on leaves, stem, fruits, soil, weeds)
   - What stage is it? (e.g., egg, larva, nymph, pupa, adult)
   - How does it feed? (e.g., chewing, sucking, piercing, rasping)
   - How does it move? (e.g., flying, jumping, crawling)
   - How many are there? (e.g., in groups, single)
   - What type of insect/animal? (e.g., spider, fly, beetle, butterfly, bug, wasp, frog, slug, etc.)

7. Each group makes a table/matrix with all the different ways of grouping listed like this :

WAYS OF GROUPING	GROUPS	TALLY/CHECK	TOTAL NUMBER
what does it eat?	unknown	IIIII	
plant-feeder	IIIII-IIIII-IIIII-III		
insect-feeder	IIIII-IIIII-IIIII-IIIII-IIIII-III		
decomposer etc.	IIIII-I		
unknown	IIIII-I		
what stage is it?			
egg	IIII		
larva	IIIII-IIIII-III		
etc.			
etc.			

8. Each group takes each animal that they have collected, goes down the list and makes a check against each group that it belongs to.

   VERY IMPORTANT! The facilitators must go from group to group and GUIDE the participants as they observe and explore the insects that they have found. Use the ‘What is this’? questioning process to help this exploration.

Some suggestions for the processing discussion

- How many insects did we have difficulty in grouping? How many 'unknowns'?
- What characteristics did we use to be able to group the small animals that we DID know? If we did not know the insect, how did we find out if it has that characteristic? Draw up a table and fill in with big group discussion :

way of grouping group	characteristics used to decide its group	how to discover if it has this	characteristics
e.g. what it eats	plant feeder	it feeds on plants	field observation and/ or insect zoo
field observation and/ or insect zoo	it feeds on insects	field observation and/ or insect zoo	

- Which way of grouping do you think is most useful when you are trying to make IPM decisions?

ASSORTED EXERCISES: NATURAL ENEMIES OF INSECT PESTS OF VEGETABLE CROPS

There are so many indigenous natural enemies of vegetable insect pests present in the farmers' fields. Very often, these farmers' friends are taken for granted or worst, are even considered pests of vegetable crops. The inability of the farmers (and even field extension workers) to identify and appreciate these insects always lead to the indiscriminate use of pesticides. This unwarranted action causes imbalance in the vegetable ecosystem and eventually lead to more serious problems, such as pest resurgence and pesticide hazards to humans and the environment.

By familiarizing the participants (and eventually the farmers) with the characteristics of these tiny insects and understanding their contribution in maintaining a balanced vegetable ecosystem, then the problems mentioned above will be avoided and a more sustained vegetable production system will be realized.

When is exercise most approriate?

- In the TOT and VST sessions when the participants want to improve their knowledge and skills in identifying and classifying vegetable pests and their natural enemies.

How long will exercise take?

- 1 hour per week for 14 weeks

Learning objectives

- To familiarize the participants with the different natural enemies of vegetable pests.
- To familiarize the participants with the different natural enemies attacking the various life stages of different vegetable crops.
- To enable the participants to classify the different natural enemies of vegetable pests.

Materials

- vegetable crop pests and their natural enemies
- rearing jar (ball jars, nescafe glass, etc.)
- alaskin cloth, cutter, sweep net, magnifying lens.
- rubber band, pentel pen, masking tape, denatured alcohol
- notebook, record book, pen

Steps

For Parasites :

1. Collect various stages of insect pests of different vegetable crops suspected to be parasitized.

2. Place the collected specimens in rearing jars to observe parasite emergence.

3. Classify parasites as to whether they are egg, larval or pupal parasites.

4. Preserve other specimens using denatured alcohol in vials and ampules.

For Predators :

1. Collect predators of insect pests of different vegetable crops.

2. Preserve other specimens using denatured alcohol in vials and ampules.

For Insect Pathogens :

1. While collecting specimens on parasites and predators, collect also dead insect pests infected with pathogens (e.g., fungus, bacteria and virus).

2. Place the specimens in vials or test tube, petri dishes for observation.

For All the Natural Enemies :

1. Describe the characteristics of the natural enemies and draw.

2. Brainstorm in small groups on the observations made regarding the characteristics of the natural enemies.

3. Present the results to the big group and conduct participatory discussions to clear gray areas during observations.

4. Conduct insect zoo follow-up activities in small groups if necessary and share results to the big group.

Some suggestions for the processing discussion

- How many different natural enemies did you collect and observe in the field? How many are parasites? Predators? Insect Pathogens?
- What insect pests did they attack? What stage of the insect pest did they attack?
- Are the natural enemies host specific (attack only one specific pest)? Are they non-host specific or polyphagous (attack many kind or species of pests)?
- Are there natural enemies that are pest also at the same time? Explain how.
- What will happen if pesticide is sprayed on them in the vegetable field? How do we conserve them in the field? Do you think they can be mass-reared at farmers' fields? Can you offer some suggestions on how to do this?

Exercise No. 4.02

PARASITIC WASPS :
WHY ARE THEY FARMER'S FRIENDS? ARE THEY IMPORTANT?

When is this exercise most approriate?

- In the FFS, TOT, and VST sessions.
- Start early in the training and continue up to the end of the season
- As a follow-up of the weekly AESA when parasitoids are observed

How long will this exercise take?

- 1 hour for field collection
- 1.5 hours for presentation and discussions
- Daily follow-up for observation and recording

Learning objectivs

- To familiarize and improve the participant's understanding of parasites and their occurrence in the field.

Materials

- Unsprayed vegetable fields
- Manila paper, pentel pen,
- Few plastic containers (1-2 liters capacity)
- Many transparent plastic film containers
- Tulle (fine meshed mosquito netting)
- Rubber bands
- Tissue paper

  Fine hair brush

Steps

1. Brainstorm on the participant's knowledge about the parasitic wasps. What are the characteristics of a parasitoid? What can they suggest to estimate the percentage of parasitized egg masses, larvae or cocoons (pupae) in the field? What instar of a larva is parasitized? Is that important? Write down all the comments :
   - A good entry point to this exercise will be to ask participants if they know what will come out of a parasitized egg mass, larva or cocoon found in the field. To see a wasp coming out later from an egg, a larva or cocoon will probably surprise them if they are not familiar with parasitic wasps.
   - Another entry point is when the participants have already heard of parasitoids and they want to learn more about them.

2. Go to the field, collect larva and conduct a simple exercise as follows :
   - Assign one or two species of larva for each small group. Try to include as many species but make it need-based and let each small group make their own choice.
   - Prepare 15-30 plastic tubes as small insect zoos (see other exercise) with tissue paper, leaf for food and tulle for cover.
   - Carefully collect larvae with a fine hair brush directly in an unsprayed vegetable field into the small plastic tubes. One in each. Try to collect at least 5 each of small, medium and large larvae of same species.
   - Draw the specimens to show differences in appearance.
   - Observe each tube daily and replace tissue paper and food when needed. Write your observations (e.g., pupation, emergence of the adult wasp, change in color, etc.).
   - Keep the live wasps for further studies after reporting the results of above study (e.g., provide honey water solution).

3. If you collected egg masses or cocoons (pupae) in the field (e.g., DBM in crucifers), observed and find out what will come out after sometime (e.g., parasitic wasps or moths).

4. Report the results of the small groups exercise weekly in the big group (at least until or wasps or moths emerge). Include in the reporting the following:
   - What is the percentage parasitism for the small, medium and large larvae? If sampling is done for more than one occasion (e.g., when doing weekly AESA), report the percentage parasitism at each occasion.
   - Do you think the degree of parasitism has an important influence on the size of the pest population? Why?
   - How can we learn more about parasitic wasps?

5. Let the participants set-up an insect zoo to demonstrate parasitism using the parasitic wasps they reared in the exercise before doing the same in the FFS.

6. In the TOT or VST, brainstorm on how the exercise can be useful for farmers in the FFS.

Some suggestions for processing discussion

- Where do the parasitic wasps live?
- Where were they before you grow your vegetable crops?
- When do they come out of the egg masses, larvae, or pupae?
- How many parasitic wasps live in each egg, larva or pupa?
- What do the parasitic wasps eat (e.g., eggs, larvae or pupae)?
- What is the degree of parasitism in the field?
- Do you find it high or low? Is it an important part of natural control?
- Can you improve efficiency of the parasitic wasps in the field? How?
- How do you know in the field if a DBM larva is parasitized?

- How do you know in the field if a DBM cocoon is parasitized?
- Which larva will eat more, a parasitized or a non-parasitized one?
- Are parasitoids killed by insecticides? Are parasitoids killed by other natural enemies (e.g., Bt, virus and other biological control agents)?

Examples of Insect Zoo from VST sessions from Canlaon City

The following insect zoo were designed and tried out and the results were reported 3 days after the insect zoo were set-up :

- Does the hover fly larva (syrphid fly) eat aphids? How many per day? (One hover fly larva and 30 aphids were observed in a jar on damp tissue and a fresh leaf. The larva ate 27 aphids and then pupated)
- Does the lady bird beetle eat aphids? How many per day? (One lady bird beetle and 13 aphids were observed in a jar on damp tissue and a fresh leaf.)
- Dragonflies were found to be too big for jar zoos and plastic cylinders (they die within hours). A participant suggested that we try a family-size mosquito net as cage.
- Does the big wasp eat worms? (One wasp and various worms were observed in a jar with a fresh leaf. Some worms disappeared but they may have escaped!)
- What does a preying mantis like to eat? (A potted plant and a preying mantis was put in a cylinder cage with worms and moths. The mantis stayed at the top of the cage and ate only the moths. It also laid an egg mass.)
- What do red ants eat? (Ants were put in a jar and observed to feed on any weakened or dead insects. The group did not yet try any live insect pests as their prey.)
- What do earwigs eat? (Separate insect zoo was made with 3 earwigs in each jar with a) leaves, b) cabbage head worm, c) diamondback moth larvae, d) cutworm. The jars had a layer of moist soil in the base and fresh leaf for the plant-feeders. The earwigs ate all of the worms but did not touch the plants.)

- What does the beetle larva eat? (One beetle larva was placed in each jar with a) aphids, b) hoppers, c) diamondback moth larva. Leaf for the plant-feeders to eat and moist tissue paper lining were placed at the base of the jar.).

Observations :

- Most of the zoos gave fast and clear results. The earwig experiment was considered the 'model' for answering the question, "Is it a predator?", because the group remembered that it does NOT eat plants, and that it can feed on a range of different preys. Each part of the exercise was done in a different jar so it was very easy to conclude what had happened.
- The group find out that some insects are not suitable for insect zoos, especially dragonflies. They highlighted the fact that it is also good to observe the insects in the field, and that the insect zoo is good for supplementing the field observations.
- A group also set-up an insect zoo of fungus infected insect pest larvae, and the other groups set-up a zoo to rear a parasitized looper larvae and some parasitized aphids.

Exercise No. 4.03

FIELD RELEASE OF DIADEGMA PARASITES

When is the exercise most apprpriate?

- In the FFS, TOT and VST sites when the area is historically a diamond-backed moth (DBM) infestation area.
- In the neighboring cabbage fields in the FFS area if there are impending early DBM infestation as evidence by the presence of unparasitized DBM larvae in cabbage or other crucifer fields.

How long will the exercise take?

- A least 30 minutes field monitoring every week for at least 14 weeks.
- At least another 30 minute Diadegma cocoons or adults releasing every week depending upon the result of field monitoring.
- At least 30 minutes brainstorming sessions at the start and end of implementation.

Learning objectives

- To actually experience and understand the technique of Diadegma release using the cocoons or adults in cabbage or other crucifer fields with impeding DBM infestation.
- To acquire skills in close monitoring of parasitized and unparasitized DBM larvae and use the result as basis for mass release of Diadegma in cabbage or other crucifer fields.

Materials

- Diadegma cocoons or adults
- vegetable or other crucifer fields (e.g., start monitoring in neighboring cabbage or other crucifer fields and releasing at least 1 week before planting in the learning field).
- Record book and pen

Steps

1. Brainstorm in big group on how to go about monitoring of DBM larvae and mass releasing of Diadegma cocoons or adults.

2. Go to the field, conduct monitoring and decide on whether to release or to delay the release of Diadegma parasites.

3. Prepare about 500-750 Diadegma cocoons or adults for release in at least one (1) ha cabbage or other crucifer field. You will need to prepare a releasing box if you use Diadegma cocoons for releasing.

4. Release the Diadegma parasites following the procedure agreed upon in the brainstorming session. Normally, the following steps are followed:
   - Place 100-150 Diadegma cocoons in each of the 5 release boxes strategically distributed in 1 ha cabbage or other crucifer field (e.g., usually, 100-150 Diadegma cocoons are placed in a plastic container).
   - Release Diadegma adults in 5 strategic points in 1 ha of cabbage or other crucifer field.

5. Closely monitor the field one (1) week after the first release and determine the percentage of parasitation.

6. Release another 500-750 Diadegma cocoons or adults per ha if parasitation is less than 25%.

7. Monitor one (1) week, thereafter and undertake 3rd release if necessary.

8. Consolidate the results in small groups, present and conduct participatory discussions in big group and come up with an improved system of monitoring and mass releasing of parasites based from the lessons learned from the exercise.

Note :

Each participant must actually experience the releasing of Diadegma cocoons or adults and monitor the percentage (%) parasitation for them to actively participate in the discussions.

Sharing of experiences in small groups must be followed by a participatory discussion in big group.

Some suggestions for the processing discussion

- Is the monitoring system employed effective? Was the Diadegma parasites released able to bring down the population of diamond-backed moth (DBM)? Was it practical (effective and efficient)?
- Is there any initial Diadegma population in the field at the time of release of the parasite? What was the initial level of parasitation at the time of release of parasite?
- What was the level of parasitation one week after the release of parasites through? After 2 weeks? After 3 weeks?
- How many times did you release Diadegma cocoons or adults? Why?
- Can farmers develop their own DBM larvae monitoring and Diadegma field releasing system with lesser dependence from RCPCs and RFUs? Can you propose an alternative?

ASSORTED EXERCISES : UNDERSTANDING THE MOST COMMON PESTS OF VEGETABLE CROPS

Pest occurrence regardless of density is the major factor that leads to indiscriminate spraying among farmers. A persistent belief among farmers without IPM knowledge is to use prophylactic sprays with the thinking that it will minimize pest problems.

It is very important for extensionists as well as farmers to know the role of insects referred to as "pests" from an ecological point of view. It is observed that in most cases, 90 percent of insecticide use are not necessary. Studies have also shown that indiscriminate use of pesticides does not accrue economic benefits. Rather this phenomena has led to pest resurgence, pollution of the environment, bad effects to non-target organisms, and cases of poisoning among vegetable farmers.

Knowledge on the life cycle, function in the ecosystem and ecology of a particular pest is essential for selecting an effective pest management strategy.

Exercise No. 4.04

FIELD EXERCISE FOR DIAMOND-BACKED MOTH (DBM) OF CRUCIFERS

Infestation of the diamond-backed moth (DBM) starts as early as the seedbed stage and continues almost up to the maturity of the crucifers. It is thus important to know and understand the DBM behavior, biology and ecology to manage them effectively, hence this exercise.

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions starting from 1 week after emergence in the seedbed.
- In the FFS sites, where DBM is historically a pest problem and therefore a potential release area for the Diadegma parasite.

How long will the exercise take?

- About 30 minutes field activity and small group discussions
- At least 1 hour preparation, presentation and participatory discussions in the big group on the outputs of the small groups.

Learning objectives

- To know and familiarize the participants with the life stages of the DBM.
- To familiarize the participants with the damages caused by the DBM.

Materials

- rearing jars (ball jars, nescafe glass, etc.)
- alaskin cloth, cutter, sweep net, magnifying lens
- rubber band, pentel pen, masking tape
- denatured alcohol

Steps

1. Conduct a field walk and collect live specimen of different stages of DBM (egg, larva of the different instar, pupa and adult).

2. Collect also crucifer plants showing different degree of DBM damages.

3. Place the collected specimen in rearing jars for observation :
   - egg to first and succeeding instars
   - last instar to pupa
   - pupa to adult

4. Preserve other specimens using denatured alcohol in vials and ampules.

5. Distribute guide question to each of the small groups.

6. Brainstorm in small group, illustrate and describe the different damages caused by DBM.

7. Present observations of the small group to the big group and conduct participatory discussions.

Some suggestions for the processing discussion

- In what part of the crucifer plants did you actually observe the different life stages of the DBM?
- At what growth stage of the crucifer plant did you find each life stage of the DBM?
- Are all the life stages of the DBM damaging to the crucifers? At what growth stages of the crucifer plant is the DBM most damaging? Can you characterize the damage?
- How long is the time from one life stage of the pest to the next?
- Can you propose an alternative management strategy for the DBM that will avoid the use of pesticides?

THE INSECT ZOO

Insect zoo exercises can be one of the Participatory Technology Development (PTD) activities that may be done by participants in the FFS, TOT and VST sessions to help them learn about insects and their natural enemies by direct observation and manipulation. Insects and spiders are more interesting when seen alive and active. Imagine a spider sucking the juices from a first instar diamond-backed moth (DBM) larva or leaffeeding by an armyworm. A living organism is much more than what is seen in an alcohol filled jar.

In fact, some things can only be recognized when living, the tiny hover fly larvae, is an example. The movement of the hover fly larva as it cross a leaf surface with a colony of aphids is its most distinguishing characteristic. The activity and behavior of insects and natural enemies can only be seen in live specimens. The insect zoo will give you many living specimens for demonstration that will keep farmers more involved (while watching spider females eat their mating partners) and help them remember better something about the message that predators and parasites are friends in the field.

The insect zoo will also help you learn about the biology of the animals. Life cycles, egg laying, feeding, mating, growth and behavior can be learned directly through the process of rearing insects and their natural enemies.

There are many ways to rear insects and their natural enemies. Many parasites can be obtained directly from their host by collecting eggs, mature larvae, and pupae from the field and placing them in any plastic, glass or paper container. Place the collected specimens in the container and merely watch. If the specimens were parasitized, small wasps will emerge. Preying mantis egg cases, stemborer egg masses, large caterpillars, and hopper eggs are the easiest and most often parasitized specimens to rear.

For other insects and spiders, collecting young hopper nymphs, adult moths or spiders is the best way to begin rearing. However, for nymphs and for adult moths, you must have prepared plants ahead of time. For spiders, it is best to have lots of insect prey in a rearing cage before beginning to rear.

For parasites that are not collected from hosts, it is sometimes possible to put "sponge plant" in the field. This means that from reared insects you have plants in pots with eggs masses or larvae. These plants with the host are placed in the field for up to four days to attract the parasites. The parasites will lay their eggs in or on the host. The "sponge" is then brought back to the pot and kept in a cage.

When is this exercise most appropriate?

- In FFS, TOT and VST sessions
- When agro-ecosystem analysis (AESA) is started as a regular activity

How long will this exercise take?

- Each week at least two hours is needed specially for the Insect Zoo. Each day, however, some time must be spent caring for plants and collected insects and spiders.

Learning objectives

- Observe parasitization, predation habits of natural enemies.
- Observe life cycle of pests and natural enemies.
- Observe infection rate of pathogens of pests.

Materials

- vegetable crops
- mylar film, tulle, scotch tape
- pots of varying sizes, aspirator, scissors, bamboo sticks
- plastic bags, rubber band, small bottles

Steps

1. With the given materials set up insect zoos.

2. Let each group decide on what to study for the week. This should coincide with the different stages of the vegetable crops.

3. Each group should follow rearing procedures, observations and recording of results.

4. Results of the insect zoo activities are to be reported to the big group.

5. For other activities, the following rearing methods maybe observed :
   - Bottles and plastic bags are very useful rearing tools. If egg masses, larvae or nymphs are found in the field, collect and place in the bottle or plastic bags. The bottle should have a piece of netting over the mouth of the bottle. Add plant material daily for hervibores. Transfer to larger cages if necessary. Try to collect older larvae that will quickly pupate. Parasites will also emerge from egg masses, larvae and pupae.
   - Simple cages can be made using waste materials such as transparent grass or plastic bottles. Place leaves and stems in the bottles with insects and cover with netting.
   - Field Cages are useful to cover infestations of large larvae, hoppers and other insects. Make cages from large plastic bags, or netting materials. Use bamboo sticks to hold cages above the plant.
   - Potted plants and cages are useful especially for demonstrations and exhibitions. Grow your own plant in the pot, or transplant from field grown plants. For cages use netting suspended string or frames, or use plastic bags with netting glued over one end. Expensive thick stiff plastic is also very useful.

Some suggestions for processing discussions

- What is an insect zoo? What are the uses of the insect zoo?
- Can you describe the most appropriate activity for each type of insect zoo you prepared?
- Are these the most practical set-up for FFS? Do you have any other idea of how to improve each type of insect zoo you prepared?
- Which among these set-up is most appropriate for studying parasites? For predators? For insect pests?
- Which among these set-up is most appropriate for 'classroom' exercises? For field exercises?

Exercise No. 4.05

INSECT ZOO DESIGN :
'TAKING CARE OF A BABY' (A MENTAL MAP EXERCISE TO HIGHLIGHT ALL THE THINGS THAT INSECTS MAY NEED)

When is this exercise most appropriate?

- In FFS, TOT or VST sessions
- When participants have some experience already of the insect zoo.
- When participants want to make their insect zoo more successful.

How long will this exercise take?

- 30 minutes to 1 hour of an FFS, TOT or VST meeting.

Learning objectives

- To build awareness of all of the different things we can do to make an insect zoo in which the animals are as happy and healthy as possible. Thus, making insect zoo more likely to be successful.

Materials

- Manila paper
- 1 black pentel pen
- 1 colored pentel pen (e.g., different color from black)

Steps

1. Post the manila paper in a place where the participants can all gather around and see easily.

2. Ask one of the participants to quickly draw a baby in the center of the manila paper using the black pen.

3. Ask all other participants to think of all the things that we need to provide for a baby so that it will become as healthy and strong as possible. All ideas are accepted. Any person who has an idea is asked to take the black pen and add a picture or some words to represent their idea.

4. Continue adding ideas until the group feels that they have completed the mental-map.

5. Take the colored pen. Lead the group to discuss and evaluate which of these things are also needed by insects. Highlight those things that are needed by insects with the second color.

6. Make a summary list of what your group has recommended for keeping a healthy insect zoo.

Some suggestions for the processing discussion

- Are there any extra things that we might need to do which are particular to keeping insects?
- What different kinds of environment do we collect insects from? How can we provide these different kinds of environment in our insect zoo?
- Which of these things did we remember to provide in the Insect zoo that we made before?
- Which of these things did we forget to provide in the insect zoo that we made before?
- When taking care of a baby, we generally keep records (e.g., photos, height, weight, etc.). What kinds of records might be useful to keep for our insect zoo?

Exercise No. 4.06

INSECT ZOO DESIGN : ‘KEEPING A FIGHTING COCK’ (A MENTAL MAP EXERCISE TO HIGHLIGHT ALL THE THINGS THAT CAGED INSECTS MAY NEED)

When is this exercise most appropriate?

- In FFS, TOT or VST session.
- When participants have some experience already of the insect zoo.
- When participants want to make their insect zoo more successful.

How long will this exercise take?

- 30 minutes to 1 hour of an FFS, TOT or VST meeting.

Learning objectives

- To build awareness of all of the different things we can do to make an insect zoo in which the animals are as happy and healthy as possible. Thus making insect zoo more likely to be successful.

Materials

- Manila paper
- 1 black pentel pen
- 1 colored pentel pen (e.g., a different color from black)

Steps

1. Post the manila paper in a place where the participants can all gather around and see easily.

2. Ask one of the participants to quickly draw a fighting cock in the center of the manila paper using the black pen.

3. Ask all other participants to think of all the things that we need to provide for a fighting cock so that it will become as healthy and strong as possible. All ideas are accepted. Any person who has an idea is asked to take the black pen and add a picture or some words to represent their idea.

4. Continue adding ideas until the group feels that they have completed the mental-map.

5. Take the colored pen. Lead the group to discuss and evaluate which of these things are also needed by insects. Highlight those things that are needed by insects with the second color.

6. Make a summary list of what your group has recommended for keeping a healthy insect zoo.

Some suggestions for the processing discussion

- Are there any extra things that we might need to do which are particular to keeping insects?
- What different kinds of environment do we collect insects from? How can we provide these different kinds of environment in our insect zoo?
- Which of these things did we remember to provide in the insect zoo that we made before?
- Which of these things did we forget to provide in the insect zoo that we made before?
- When keeping a fighting cock, we generally keep records. What kinds of records might be useful to keep for our insect zoo?

Exercise No. 4.07

CAN WE REALLY DO INSECT ZOO WITH FARMERS? (A DEBATE ON THE REAL POSSIBILITIES OF A DISCOVERY-BASED APPROACH)

When is this exercise most appropriate?

- In TOT and VST sessions
- When participants have already had some experience of making insect zoo with farmers.
- When some participants are asking whether it is really useful to try to get farmers to make insect zoo.

How long will this exercise take?

- 1 hour

Learning objectives

- To give participants a chance to voice their concerns about facilitating farmers to conduct insect zoo.
- To help participants to share experiences and feelings about how farmers in their FFSs have reacted to making insect zoo.
- To build further awareness of the value and practicalities of using a discovery-based approach.

Materials

- none

Steps

1. Spit the group into 4 small groups representing the following :
   - farmers who don't like to make insect zoo
   - farmers who do like to make insect zoo
   - trainers
   - bosses of trainers

2. Allow the groups to discuss what their group 'feels' about the question : *Is it appropriate and practical for farmers to make insect zoo?* Remind them that this is a role play, so they should forget personal views for now!

3. Hold the debate :
   - Each group elects one member to make a short presentation of their views to the big group.
   - 0ne facilitator acts as the chairman who introduces each speaker formally.
   - After all 4 presentations are finished the debate is 'open to the floor'. Participants can make comments and questions to any other group.
   - The chairman is responsible for making sure that participants speak in turn. They must raise their hand and wait until they are signaled to speak.

4. Let the debate continue until all views have been explored and discussed.

5. Ask each group to make a short final summary of their ideas.

6. Close the debate formally by thanking all speakers and participants.

7. Process the discussion.

Some suggestions for the processing discussion

- Did anybody change their views during the debate? How?
- What general conclusions could we make about the value and practicality of using a discovery-based approach with farmers.

Exercise No. 4.08

INSECT ZOO FOR PARASITES : PARASITATION OF DIAMOND-BACK MOTH (DBM) LARVA BY THE DIADEGMA PARASITE

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions when the participants need to understand how Diadegma parasitizes the larvae of DBM.
- In the FFS to familiarize the farmers with the actual appearance in the field of Diadegma parasitized DBM larvae and cocoons (pupae).

How long will this exercise take?

- At least 30 minutes small group discussions and field activity.
- At least 30 minutes output preparation by the small groups and 1 hour presentation and participatory discussions in the big group.

Learning objectives

- To actually see and understand how Diadegma parasitize DBM larva.
- To familiarize the participants with the actual appearance in the field of Diadegma parasitized DBM larvae and cocoons (pupae).

Materials

- rearing jar (ball jars, nescafe glass, etc.)
- alaskin cloth, rubber band, pentel pen, masking tape, cutter
- female Diadegma adults or cocoons about to become Diadegma adults.

Steps

1. Collect different instar of DBM larvae and female Diadegma adults or cocoons about to become adults.

2. Put inside the rearing jars or test tubes (e.g., 2 rearing jars or 1 for parasitation and 1 for control).

3. Introduce female Diadegma adults (e.g., 5 female Diadegma adults : 10 DBM larvae)

4. Cover rearing jars with alaskin cloth and secure with rubber bands

5. Preserve other specimens using denatured alcohol in vials and ampules.

6. Describe and Illustrate how the Diadegma wasps actually parasitized DBM larvae.

7. Describe and Illustrate also the actual appearance in the field of Diadegma parasitized larvae and cocoons (pupae).

8. Brainstorm and prepare presentation in small group.

9. Present output to the big group and conduct participatory discussions in the big group to consolidate learning experiences.

Some suggestions for processing discussions

- Did you actually see how the Diadegma wasp parasitized a DBM larva? Did you observe what instar it parasitized and how long it took to parasitize a larva?
- Did you collect field Diadegma parasitized DBM larvae and cocoons? How did they look like?

- Did you try to observe what came out of the suspected field Diadegma parasitized DBM cocoons? Are they wasps or moth?
- Can the Diadegma wasps really control DBM?
- Is it practical for farmers to mass rear and release parasites in the field to control DBM? Can you offer better alternatives?
- Can we conserve the Diadegma wasps in the field? What will happen if we spray insecticides in the field?
- What happen to the Diadegma wasps if there are no crucifers in the field? What happen to the wasps during the dry season?

Exercise No. 4.09

INSECT ZOO FOR PREDATORS :
IS IT A PREDATOR OR PLANT FEEDER?
(SMALL GROUP DESIGN TASK)

When is this exercise most appropriate?

- In the TOT and VST sessions.
- When participants already have some experience in making insect zoo.
- When participants want to make more insect zoo to discover which insects are predators.
- When the facilitators feel that participants need to become more aware that predators can often eat a wide range of different prey types.
- When participants want to design insect zoo that they can use with farmers in the FFS to help them discover more about predators.

How long will this exercise take?

- 1 hour collecting insects in the field
- 2 to 3 hours designing and making and presenting designs of insect zoo
- 1 hours reporting results of insect zoo a few days after the design session

Learning objectives

- To encourage participants to think about what they need to observe to be sure that an insect is a predator.
- To build awareness of the fact that predators are often able to feed on many different types of prey.
- To practice and build awareness of the steps that we will need to explain when guiding farmers to make an insect zoo.

Materials

- equipment for collecting insects for each group (plastic bags, containers with gauze covers, sweep nets, aspirators, fine hair paint-brushes, hand-lenses, etc.)
- jars, with fine-gauze covers for each group to make insect zoo (at least 5 jars per group)
- tissue paper for lining insect zoo
- sugar or honey (to make 'nectar' solution for feeding adult insects such as moths, wasps and hover fly adults)
- pens and tape for labeling insect zoo
- manila paper and pentel pens for each group presentation

Steps in planning and collecting insects

1. Have a planning meeting with the participants - ask them to list as many different insects that they have seen in the field which might possibly be predators.

2. Ask each group to choose 2 different insects which they will test.

3. Give the following instructions for the collection of insects :
    - Each group needs to collect 10 of each of the 2 types of predators they have chosen.
    - For each type of predator, they need to collect at least 20 individuals of each of 3 different kinds of insects that it might prey on (if the prey are very small you will need to collect a lot more than 20 individuals!)

    So, each group will collect :
    - 10 individuals of predator A plus 20 individuals of each of 3 different kinds of prey that they think predator A will eat
    - 10 individuals of predator B plus 20 individuals of each of 3 different kinds of prey that they think predator B will eat
    - Each group should also collect fresh healthy plant materials for plant-feeding insects

Steps in the design session

1. Make insect collections after AESA or similar morning field activity.
   REMEMBER TO HANDLE INSECTS VERY GENTLY!
   Protect insects from hot sunlight, use brush for small worms, and do not pick delicate insects by hand.

2. Each small group designs and makes insect zoo to answer the question: "Is it a predator or a plant-feeder?" , using each of their 2 predators and the 6 kinds of prey that they have collected.

3. Each group prepares the following for presentation :
   - Answer the question : "Why did you think that the predator would eat these 3 kinds of prey?"
   - Each group makes a set of step-by-step instructions which any other participant could use to guide a farmer to make each of their insect zoo (include the question that the zoo will try to answer, *how to make the zoo, how to care for it, what to observe, and when to observe*)

4. Groups present their outputs and the big group discusses the areas for clarification.

Some suggestions for the processing discussion

- Most of the points for discussion should come from the small group presentations. Some things to look out for are :
  1. Did any group remember to include a test to check that 'predator' does not eat plants, even when it is starving?
  2. Did the groups give clear instructions about what should be observed and when to make the observations?
  3. Did the group remember to make a suggestion about where would be a good place to keep the insect zoo?

4. Did the groups remember to provide plant-feeding ‘prey’ insects with fresh food regularly?
5. Did the insect zoo ask a clear question, and would the proposed observations really answer that question?

Steps in the presentation of insect zoo results

1. Make time for presentation of insect zoo results 3 or 4 days after they have been made.

2. Ask the group to suggest any improvements that they would make to the insect zoos.

Exercise No. 4.10

INSECT ZOO FOR SPIDERS

There are many insects and spiders found in vegetable plants, on the bunds, canals and irrigation ditches. Most of the insects are not pests or even potential pests. In fact they are beneficial to the vegetable farmers because natural enemies such as spiders feed on these non-pest insects. This is how spiders can survive even when pest populations are low.

In this activity, we will search for spiders and their prey. You should be able to explain where the spiders are living in and around the vegetable field, and what kind of spiders can be found.

When is this exercise most appropriate?

- When at least one agro-ecosystem analysis (AESA) has been conducted in FFS sessions

How long will this exercise take?

- 1 hour and 30 minutes

Learning objectives

- Describe spiders in and around vegetable fields.

Materials

- vegetable fields, bunds, irrigation ditches, etc.
- Spiders
- Newsprint, pentel pens, test tubes

Steps

1. Each group counts spider population in a square meter area of a vegetable field:
   - emergence stage
   - early vegetative stage
   - late vegetative stage
   - mature stage

   Or of any other area :
   - canal or irrigation ditch
   - side of the bunds
   - grassy area near the vegetable field (2 meters from the vegetable field)
   - newly harvested vegetable field

2. Identify the kinds of spider species seen.

3. Consolidate and present data to the big group. Use the matrix below :

Some suggestions for the processing discussion

- Where can you find the highest spider population in the 4 areas and why? The lowest, why?
- What are the kinds of spiders found in the different areas?
- What will happen to spiders when there are no pests present?
- In what part of a vegetable plant are spiders commonly found?
- How many insects does a spider eat in 1 day? (PTD)
- What are the characteristics of spiders?
- Differentiate spiders from insects?
- How does a spider eat insect pests? Do a role play.
- What is a pest? If at low populations, spiders survive on some insects, are these insects pests? Does 'pest' refer to an insect, a damage or an intensity of insect?
- Get the average no. of spiders in the different ecosystems surveyed and extrapolate population into per hectare basis. How many spiders are there in a hectare? If one spider can eat 5 - 10 pests in one day, how many pests will they eat in one day? For FFS activities seeds could be used to determine the dynamics of spider population using the following assumptions :
  * Ratio of male and female = 50:50
  * Birthrate = 30 spiderlings
  * Survival rates = vary
  * Group 1 = 0. 1 percent
  * Group 2 = 0.3 percent
  * Group 3 = 0.5 percent
  * Group 4 = 0.7 percent
  * Group 5 = 0.9 percent
- Compute for 3 generations. How many pests are consumed by spiders in each generation. Make a graph of the different survival rate data from each group.

Exercise No. 4.11

FIELD EXERCISE FOR LADY BEETLE

Most farmers perceive that predatory lady beetles (coccinelid beetles) are major pests of vegetables (e.g., at flowering stages of the vegetable crop). This is one of the reasons why unnecessary sprayings are done at this stage. To disprove this claim a caged study may be done.

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions.
- In the FFS, where farmers in the area generally percieve that lady beetle is a pest at flowering stages (e.g., snap beans, tomato, eggplant, etc.) and it consequently reduces vegetable yield.
- When the vegetable crop (e.g., snap beans, tomato, eggplant, etc.) is at flowering stages and there is high lady beetle population density.

How long will this exercise take?

- 1 hour setting up, with regular observations from flowering to harvest.

Learning objectives

- To demonstrate the predatory habit of the lady beetle.
- To determine the effect of coccinelid beetle on the yield of some vegetable crops (e.g., snap beans, tomato, eggplant, etc.).

Materials

- Vegetable (e.g., snap beans, tomato, eggplant, etc.) field at flowering stage.
- Plenty of lady beetles
- Caging materials (e.g., tulle, bamboo sticks, etc.)
- Record book, pen

Steps

1. Cages with the dimension of 40x40x200 cm will be used in the study. The treatments will be done in two stages of the vegetable crop as below :

VEGETATIVE STAGE		FLOWERING STAGE	
TREATMENTS	NO. OF COCCINELID	TREATMENTS	NO. OF COCCINELID
1	0	1	0
2	20	2	20
3	40	3	40

2. Preferably, 3 replications per treatment will be established. Aphids should also be introduced to the treatments with coccinelids to serve as food.

3. Monitoring maybe done biweekly. Note defoliation, DBM and disease damages, etc. At the end of the season, measure yields.

4. Compare yields from the different treatments.

Some suggestions for the processing discussion

- Was there significant yield differences between treatments?
- What was the yield difference between treatments with coccinelid and the control? What general interpretation can you give about the experiment?

Follow-up activity

Each group conducts three pot studies (e.g., predation or parasitization, life cycles, damage symptoms) :

- Predation studies may be conducted in smaller pots.
- Life cycles should be done in standard pots. There maybe life cycles studies which require the pots to be in the field.
- Sensitive insect specimens such as aphids and others should be handled with extra care. Use sweep net carefully and aspirator when introducing them to pots.
- In using spiders as predators, they should be starve for 2-3 days before introducing them to pots.
- Never handle spiders with bare hands. Use vials when catching or handling them.
- At FFS, be careful in setting up predation or parasitization studies. For example, lycosa and mature grasshopper may not be successful. Lycosa predates only 1st and 2nd instars of grasshoppers. If predator and prey combination is not given proper attention, farmers may lose interest in the activity that usually does not provide immediate results.

Exercise No. 4.12

INSECT ZOO DESIGN : THE CASE OF THE MISSING WORMS, WHAT CAN WE REALLY CONCLUDE? (SMALL TO BIG GROUP CASE STUDY)

When is this exercise most appropriate?

- In the TOT and VST sessions.
- When the participants already have some experience of making insect zoo.
- When the facilitators feel that participants could benefit from planning and analyzing the results of insect zoo more critically.

How long will this exercise take?

- About 30 minutes to 1 hour.

Learning objectives

- To build awareness of the range of possible conclusions we could make from a seemingly clear and simple insect zoo experiment.
- To encourage participants to plan carefully when designing an insect zoo, so that they are clear about what they need to observe in order to answer the questions that they are asking.

Materials

- Manila paper
- Pentel pen

Steps

1. Tell the participants that they will be detectives in 'The Case of the Missing Worms'. You will give them all the clues that they need to solve the case. They will have 10 minutes to discuss the evidence in small groups first, then there will be a big group sharing.

2. Outline and illustrate the following case on the manila paper :
   - A lady bird beetle and 20 worms were put into a jar with several nice fresh green cabbage leaves. The jar was covered with a fine-net and secured with a rubber band. The jar was put on the windowsill for 1 week.
   - After 7 days, the lady beetle was still living, the leaves were wilted and dry, there were just 5 worms left in the jar. All of these 5 worms were dead.
   - What can we conclude?

3. Ask each group to call out their conclusions and list these on the manila paper.

4. Discuss any differences and addition to the conclusions of the small groups, and explore what warnings this exercise might give for other insect zoo that we make.

Some suggestions for the processing discussion

- How many different conclusions could be made from 'The Case of the Missing Worms'?
- What would we need to observe to be sure that the lady bird beetle did eat the worms?
- Do we have experiences in our own insect zoo where the conclusions were not clear?
- What suggestions can we make that would help us to avoid these problems in the future?

Exercise No. 4.13

DISCOVERING BENEFICIAL INSECT DISEASES WITH THE INSECT ZOO

This exercise is made up of 3 short insect zoo, which are best done one-by-one in sequence. They should be good for any kind of disease. Notes are made on differences where there is some variation in details for bacterial, viral or fungal diseases, or for the insects that they attack.

When is this exercise most appropriate?

- When insects killed by an insect disease are present in the fields.

How long will this exercise take?

- 30 minutes to 1 hour of an FFS meeting
- 15 to 30 minutes follow-up time at the next meeting
- Some follow-up time at the third or fourth meeting

Learning objectives

- To build awareness of the fact that there are diseases that are killing insects in the fields.
- To discover how the insects look as the disease develops and kills them.
- To discover which kinds of insects the disease can kill.
- To discover whether the development of the disease is favored by dry or wet conditions.

Materials

- insects killed by an insect disease
- 1 plastic jar per group for field collections and insect zoos
- hand lenses
- tissue paper
- net covers, rubber bands and plastic lids for jars

Steps

1. During the weekly field observation for AESA, the facilitators will point out insects that have died from disease by asking : "What do you think happened to this insect?" Do not tell them the answer!

2. Ask each group to collect some of the dead insects so that they can show to the big group and share in a participatory discussion after the AESA.

3. The facilitators collect healthy specimens of the kinds of insects that have been found with disease, and fresh healthy vegetable leaves for use in an insect zoo.

4. After the AESA discussions, facilitate the group to discuss what might have happened to the dead insects. Some suggested guide questions :
   - What could have caused this insect to die? One output of this discussion should be that the insects might have died of a disease.
   - If the insect died of a disease, how can we prove that it is a disease that killed it? (By contaminating another insect with the remains of the dead insect and seeing of it dies with a similar appearance)
   - Ask the group if they want to make an experiment to see if it is a disease.

5. To make the insect zoo, line the base of a jar with slightly damp tissue paper. Put in some fresh vegetable leaves for the healthy insects to feed on. Add 2 healthy insects and 1 insect that is suspected to have died from a disease.
   - *For diseases.* You only need to get the spores of the fungus onto the body of the insect but for viral and bacterial diseases, the insects will need to eat some contaminated vegetable leaves or part of the dead insect. You could try mashing the dead insect in water and sprinkling some of the contaminated water over the insect and the plant material.
   - *For plant sucking insects.* For aphids or planthoppers, you will generally need to use a potted-plant insect zoo instead of a jar zoo. This is because plant sucking insects will usually die within a few days if they are not kept on a live plant.
   - *Reminder.* Remember to use a dampened hair paintbrush for moving delicate insects like aphids and small worms.

6. Each group can make their insect zoo. Ask one volunteer per group to take the insect zoo home to check daily :
   - Remove waste (wilted plant material, insect deposit)
   - Replace wilted plant/leaves with fresh leaves
   - Observe and make notes on the appearance and health of the insects. it might be easier to make a drawing of the insects instead of describing color and shape in words.
   - Observe and make notes about the behavior of the insect. (How much has it eaten since yesterday? How much is it moving?)

7. At the next FFS meeting, ask the participants to share their observations and have a processing session.

Some suggestions for the processing discussion

- Did the contaminated insects die?
- Was the appearance of the insects that died different or similar to that of the 'suspected-diseased' insect? (e.g., the dead insect that we put into the insect disease zoo)
- How did the diseased insect look : a) before it died? b) after it died?
- What other information would we like to discover about the disease? Some suggestions for follow-up questions and explorations are given in the succeeding exercises on beneficial insect diseases.

Exercise No. 4.14

KNOW THE TYPES OF INSECTS KILLED BY BENEFICIAL INSECT DISEASES AND THE CONDITION THAT FAVORS INFECTION WITH THE INSECT ZOO

When is this exercise most appropriate?

- As a follow-up to the diseases of insects 1 exercise
- When participants are interested to discover : 'What different types of insects the disease can kill'? or 'What conditions favor infection by the disease'?

How long will this exercise take?

- A few minutes (5-10) to discuss the questions that participants would like to explore.
- A few minutes (5-10) to set up the insect zoo.
- A few minutes (5-10) observation and maintenance of the insect zoo daily.
- About 15 to 30 minutes reporting and discussion at the next FFS meeting.

Learning objectives

- To discover whether the beneficial insect disease can kill other types of insects (other than the type of insect it was originally collected on).
- To discover whether wet or dry conditions are more favorable for the disease infection.

Materials

- notebook, pens, crayons per group
- pentel pens and labels per group
- 1 jar per insect zoo per group
- tissue paper
- fine hair paintbrush for handling delicate insects

Steps

1. This is a follow-up to the exercise ‘Discovering Beneficial Insect Diseases With the Insect Zoo’, so the preliminary discussion is really a part of the processing discussion from that exercise. We can share what we have observed in the field about the question(s) that participants are interested to explore. Some suggested guide questions:
   - What have we observed in the field? Did any of the groups find any other insects that have died with a similar appearance to the diseased insects in our first insect zoo?
   - What have we observed in the field? In what conditions or environment do we see less diseased insects? In what conditions or environment do we see more diseased insects? Does the amount of moisture in the environment seem to affect the amount of infection in the field?

2. Set up insect zoo as described in ‘Discovering Beneficial Insect Diseases With the Insect Zoo’ with the following modifications :
   - Substitute the type of healthy insect used in the first beneficial insect disease zoo for other insects that are found in the field. You could try some more pests, and some natural enemies as well. Put just a few insects per insect zoo, and the same kind per insect zoo so that they do not eat each other. Remember to provide natural enemies with food (e.g., prey insects for predators, flowers and honey solution on cotton for adult parasites).

- Make 2 insect zoos for comparison with the same set-up as in the first beneficial insect disease zoo, but this time make one 'wet' condition and one 'dry' condition. The 'wet' condition insect zoo should have plenty of damp paper in the bottom (not too wet or your insects will drown). Make a small hole only for aeration. Cover the rest of the top of the jar with plastic. For the dry condition, a small amount of moisture can be provided from the fresh plant material and cover with tulle secured by a rubber band.

3. Ask volunteers to take the insect disease zoo home for daily observation. For the first exercises, the participants should make the same observations as listed in the first insect disease zoo. For the second exercise, the participants should observe and care for the insect zoo daily and make a note of *when* the insects became sick and *how long* it took for the insects to die.

4. In the next week's session, ask the participants to share their observations and have a processing discussion.

Some suggestions for the processing discussion

- Did the group have any further observations in the field on what type of conditions that favor the disease, or what different kinds of insects seem to be infected by the disease?
- What did we observe in the insect disease zoo?
- What do our observations and discoveries tell us about what the disease can do in the field ecosystem?
- Is there anything else that we would like to explore about the disease and what it does in the field ecosystem? See the succeeding exercise for some suggested field studies.

Exercise No. 4.15

SHARING OF EXPERIENCES AND HANDS-ON EXERCISE : FUNGUS AGAINST LARVAE OF VEGETABLE INSECT PESTS

There are naturally occurring predators, parasitoids and insect pathogens attacking eggs, nymphs and adults of vegetable insect pests. Among insect pathogens, the most common fungus attacking larvae of vegetable insect pests is the white fungus or *Nomuraea* fungus. It has been known to attack armyworms, cutworms, and semi-loopers, to name a few.

The white fungi can be easily conserved by not using chemical pesticides, which will normally kill them. The fungi can also be introduced to augment existing natural enemies in areas where they are not present.

When is this exercise most appropriate?

- In areas where lepidopterous pests are prevalent.
- At vegetative to physiological maturity stages of the vegetable crop when lepidopterous pests are presently prevalent in the area.
- In areas where fungus infected larvae of vegetable insect pests observed.

How long will this exercise take?

- 30 minutes set-up
- 15 minutes daily observation for one week
- 30 minutes participatory discussion after 1 week of observation

Learning objectives

- Create awareness on naturally occurring biological control agents against lepidopterous pests of vegetables.
- To assess the effect of insect pathogen (white fungus or *Nomuraea* fungus) on the population of lepidopterous pests of vegetables.
- To find out if white fungus or *Nomuraea* fungus concoction is effective against lepidopterous pests of vegetables.

Materials

- different vegetable plants
- hand sprayer, water, bottle with cap, wide-mouth, transparent jar and petri-plates
- white fungus- or *Nomuraea* fungus-infected and healthy lepidopterous pests of vegetables.
- insect zoo set-up

Steps

1. Set up insect zoo with different instars of different larvae of vegetable insect pests.

2. Collect white fungus- or *Nomuraea* fungus-infected and healthy lepidopterous pests of vegetables from the field.

3. Place white fungus- or *Nomuraea* fungus-infected lepidopterous vegetable pests in bottle with cap, add enough water and shake vigorously until water has whitish tint.

4. Pour suspension into hand sprayer through a sieve to separate solids.

5. Set up petriplates with healthy lepidopterous pests of vegetable

6. Spray suspension on healthy lepidopterous pests of vegetable in petriplates to multiply the white fungus- or *Nomuraea* fungus.

7. Incubate for 1-2 days under room temperature.

8. Observe for fungal growth.

9. If exposed lepidopterous pests of vegetable are totally colonized by the fungus, repeat procedures 3 and 4.

10. Spray spore suspension from white fungus- or *Nomuraea* fungus-infected to healthy lepidopterous pests of vegetable in the insect zoo.

11. Observe daily until at least 1 week.

12. Present observation and conduct participatory discussions.

Some suggestions for the processing discussion

- What are the signs and symptoms exhibited by white fungus- or *Nomuraea* fungus-infected larvae of vegetable insect pests? Characterize.
- How long did it take to kill the host larvae of vegetable insect pests?
- Why do we need to do this exercise?
- Which of the stages was more affected by white fungus- or *Nomuraea* fungus? Explain.
- What was the effect of white fungus- or *Nomuraea* fungus on other insects?
- Are there any other biological control agent observed?
- If the method used is successful, can white fungus- or *Nomuraea* fungus be recommended to farmers?
- How can we relate it to the ecosystem?

Exercise No. 4.16

FIELD STUDIES :
ASSESSING THE IMPACT OF BENEFICIAL INSECT DISEASES AND HELPING IT SPREAD

When is this exercise most appropriate?

- These exercises are possible follow-up explorations from "Discovering Beneficial Insect Diseases With the Insect Zoo" and "Know the Types of Insects Killed by Beneficial Insect Diseases" and the" Conditions that Favors Infection With Insect Zoo".
- When participants are interested to discover more about : 'How many insects the beneficial insect disease is killing in the field'? or 'Can we help the beneficial insect disease to kill more insects in the field'?

How long will this exercise take?

- A few minutes (5-10) to discuss the questions that participants would like to explore.
- About 15-30 minutes field walk to discover new information about the beneficial insect disease.
- A few minutes (5-10) to set up the insect zoo.
- A few minutes (5-10) observation and maintenance of the insect zoo daily.
- About 15 to 30 minutes reporting and discussion at the next FFS meeting.

Learning objectives

Depending on what questions the group want to explore :

- To discover how many insects can be killed by the beneficial insect disease in the field.

- To discover how the beneficial insect disease is distributed in the field.
- To discover how many insects could be dying per week from infection of the beneficial insect disease.
- To discover whether we can manipulate the field environment to make it more favorable for the beneficial insect disease.
- To discover whether we can help the beneficial insect disease to spread by collecting and spraying it in the field.

Materials

Depending on the exercise :

- notebooks and pencils, manila paper or,
- sprayer (no chemical residues), water, notebooks, pencils, manila paper, and pentel pens per group or,
- jars for collecting diseased insects, sprayer (no chemical residues), notebook, pencils, manila paper and pentel pens per group

Steps

1. This exercise is designed to be a follow-up from earlier exercises, 'Discovering Beneficial Insect Diseases With the Insect Zoo' and 'Know the Types of Insects Killed by Beneficial Insect Diseases and the Conditions that Favors Infection With Insect Zoo', so that the preliminary discussion is really a part of the previous processing discussion(s).

2. It will be important to discuss questions that the participants would like to explore before doing a field walk to discover new information about the beneficial insect disease in the field.

3. When appropriate, follow the steps from the earlier exercises, 'Discovering Beneficial Insect Diseases With the Insect Zoo' and 'Know the Types of Insects Killed by Beneficial Insect Diseases and the Conditions that Favors Infection With Insect Zoo'.

4. Every week, process new information gathered in the field by brainstorming in small group and by participatory discussions in the big group.

5. At the end of the season, summarize all experiences and lessons learned from the exercises.

Some suggestions for the processing discussion

- Aside from the information gathered in the previous exercises, did you discover how many other insects can be killed by the beneficial insect disease in the field?
- Based from your observations in the AESAs and field walks, how is the beneficial insect disease distributed in the field?
- Can you have an estimate of how many insects could be dying per week from infection of the beneficial insect disease?
- What are the field conditions that favors the spread of the beneficial insect disease? Can we manipulate the field environment to make it more favorable for spread of the beneficial insect disease?
- Can you suggest a practical method of preparing spray material from the beneficial insect disease for field application?

Exercise No. 4.17

MAPPING EXERCISE :
ENCOURAGING NATURAL ENEMIES IN THE FARM
(WHAT ENVIRONMENTS DO NATURAL ENEMIES PREFER?)

When is this exercise most appropriate?

- When participants have already discovered a number of natural enemies through insect zoo observations and weekly Agro-Ecosystem Analysis.
- When participants want to discover more about how they can encourage natural enemies on the farm.

How long will this exercise take?

- 1 to 1.5 hours of the FFS, TOT and VST sessions.

Learning objectives

- To discover which type of environment favors different kinds of natural enemies.
- To build awareness that the field ecosystem can interact with the other parts of the farm environment.

Materials

- a vegetable field for observation of natural enemies
- manila paper, pencils, pens and crayons for each group

Steps

1. Ask each group to choose 1 kind of natural enemy to study (a different one for each group).

2. Each group spends 30 minutes in the farm area making a map which shows:
   - All of the different kinds of environment on the farm (e.g., weedy area, pond, canals, different crops, compost areas or other rotting vegetation, trees, under stones, in the soil, between plants, etc.).
   - Which of these places they found their type of natural enemy?
   - How many of their natural enemy they found in each place?

3. Return to the 'classroom' to brainstorm in small group draw the maps on manila paper.

4. Each small group presents their map to the big group.

5. The big group conduct participatory discussions on the findings.

Some suggestions for the processing discussion

- When there is a newly planted crop in the field, where do natural enemies come from?
- Which kinds of environment do the natural enemies prefer?
- Why do they prefer these kinds of environment? (e.g., adult parasites and lady beetles feed on nectar and pollen of flowering plants; hunting spiders, predatory earwigs and predatory rove beetles eat decomposed insects in composting areas; web spiders need suitable plants to build their webs between)
- What things that we might do that would reduce the numbers of natural enemies in these environment?
- What things could we do to increase the numbers of natural enemies in these environment?

Exercise No. 4.18

NATURAL ENEMIES PREFERRED ENVIRONMENTS AND CULTURAL PRACTICES : CAN WE INCREASE NATURAL ENEMIES BY EMPLOYING SUITABLE CULTURAL PRACTICES?

When is this exercise most appropriate?

- When participants have already done the exercise on mapping of natural enemy environment.
- When participants are interested to explore whether they can increase the numbers of predators in the crop (e.g., if farmers are suggesting that we should mass-rear and release predators, like what is done for the parasite, Diadegma)

How long will this exercise take?

- 30 minutes to 1 hour planning discussion.
- Depends on the exercise, you may need to wait about 1 month before sampling and completing the exercise.
- 1 hour sampling in the fields.
- 1 hour processing.

Learning objectives

- To explore whether there are cultural practices (e.g., locally and or other alternatives) that can help to increase the numbers of natural enemies in the crop.

Materials

- *If the group decides to sample current farmers' fields.*
  Notebooks, pencils, hand lens, sampling materials (e.g., sweep nets, plastic cups for pit traps, depending on what the group decides to do)
- *If the group decides to make an experiment.*
  Materials for setting-up the cultural practice treatment will depend on the cultural practice that is chosen and the same materials as above can be used.

Steps

1. Facilitate the group to recap on the findings of the exercise on mapping natural enemy environment :
   - Which environment favored which kinds of natural enemies?
   - Why were the environment good for these natural enemies?
   - *If the farmers have been asking about the possibilities of mass rearing and releasing predators, you might also want to ask :*
     'Which do you think would be easier and more economical, to mass rear predators for release, or to help them increase in numbers in the field by providing a favorable environment?'

2. Ask the group to brainstorm on what kinds of cultural practices we could use that would make these favorable environment in or near our fields. Make one list of *local practices* and another list of *any additional ideas* for both :
   - *When the field is empty.*
     That is, after harvest and before the next planting.
   - *When the crop is in the field.*
     That is, when mulching, planting flowering plants or crops, 'green manure's [11], 'undersowing' [12].

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11 **e.g. Planting *Sesbania* between croppings. This harbors beneficial insects, helps to suppress weeds and fixes nitrogen. It is plowed-in before the next crop is planted.**
12 **Planting a non-competitive plant like *Sesbania* on the edges of the rows to harbor natural enemies like spiders and predatory beetles.**

3. The next thing to do will depend on the suggestions that you have listed:
   - *Field Comparison.* If there are local fields with the suggested cultural practices, you can go to the fields and compare the number of natural enemies in an area where the cultural practice is being used versus the number of natural enemies in an area where the cultural practice is not being used. For example, you might compare the number of parasites and lady beetles in a field with flowering plants versus the numbers of these natural enemies in a field where there are no flowering plants. Another example is you might compare the number of spiders and predatory earwigs in a field where mulching is used versus the numbers of these natural enemies in a field where there is no mulch.
   - *Field Experiment.* If there are no fields in the local area where the suggested cultural practices are used, your group can discuss whether they want to make an experiment. For example, planting a fast-maturing flowering plant (such as pechay), or adding a mulch cover to bare soil, would not take much preparation time. After about a month, you can sample the area and compare with an area where the cultural practice is not used.

4. Get the groups to share the sampling by having each group do 2 samples in each area. This means that any differences in how different people sample with, will happen in both fields.

5. Make your samples representative of the whole field (e.g., spread samples randomly across the whole field and do not just concentrate in one area.

6. Use the same method in the 2 fields that you will compare. Here are some suggested sampling methods :
   - *FLYING INSECTS :* Use a sweep net. Sweep 10 times while walking along one plot of 5 meters length. Sample 10 areas in this way, in random places, that are spread across the whole field.

Count the numbers of wasps and lady beetles caught after each sweep, release them before you start the next sample.

- *PREDATORS :* Choose 20 plants randomly, making sure that they are spread across the whole field. Count the numbers of predators on the plant and on weeds, or on/in the soil within a diameter of 50 cm around the plant. Remember that predator earwigs are most active at night, so they are usually hiding in the weeds or in small holes in the soil during the day. So you will need to dig around in the top few centimeters of the soil surface to look for earwigs.

7. When the sampling is complete, return to the 'classroom' and make a summary of the numbers of each kind of natural enemy in each type of field before the group tries to analyze the results.

8. Have a group discussion to analyze the results of the comparison.

Some suggestions for the processing discussion

- Did the cultural practice increase the numbers of natural enemies in the crop?
- If yes : How much time and money did it cost to use this cultural practice?
- Was it worth the effort and investment?
- What other benefits might this cultural practice have?
- What disadvantages might this cultural practice have?

Exercise No. 4.19

GAME AND INSECT ZOO : PESTS-NATURAL ENEMIES INTERACTION (CAN NATURAL ENEMIES CONTROL PESTS?)

When is this exercise most appropriate?

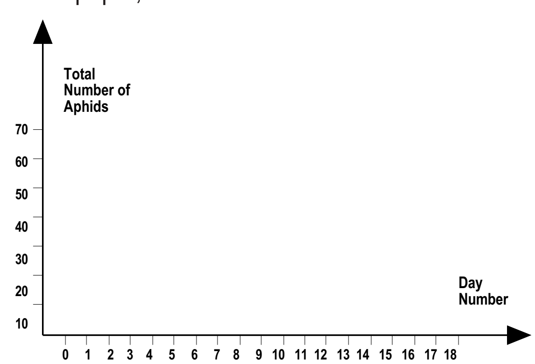
- When participants have seen aphids and hover fly larvae interacting in the field, and have done some observations of the hover fly larvae feeding on aphids.

Learning objectives

- To reinforce, or suggest the idea that natural enemies can control or reduce the numbers of pests in vegetable fields.
- To stimulate participants to make observations and experiments that will help them to understand how this process might work in real vegetable fields.

Materials

- 80 small wrapped candies, plus 1 big candy bar
- 1 cabbage plant drawn in 1 sheet of manila paper.
- Pentel pens and tape
- 1 empty chart, drawn on I sheet of manila paper, like this :



Steps

1. Gather all the participants in a semi-circle. Put the cabbage leaf on the floor in the middle of the group, and put the graph on the wall where everyone can see it.

2. Explain the following to the group :
   - The big candy bar is a female aphid who has just arrived on the cabbage plant. Put it on the cabbage plant.
   - Every day the mother aphid will make 8 baby aphids. Show the group the small candies that represent the baby aphids.
   - After some time a predatory hover fly larva will arrive and start to eat the aphids. The participant will take it in turns to be the predatory hover fly larva.
   - The hover fly larva eats a few aphids every day. Remember it can only eat baby aphids.
   - Everyone must be very careful to eat only as much as the you say, because the predatory hover fly larva gets (full) after a certain number of aphids. Leave the empty candy wrappers on the cabbage plant because they looked like the empty skins that a hover fly larva 'spits out' when it has finished sucking all the juices out of an aphid.
   - We will count the number of aphids that remain after each day of baby-making and aphid-eating. Record the total number on the chart.

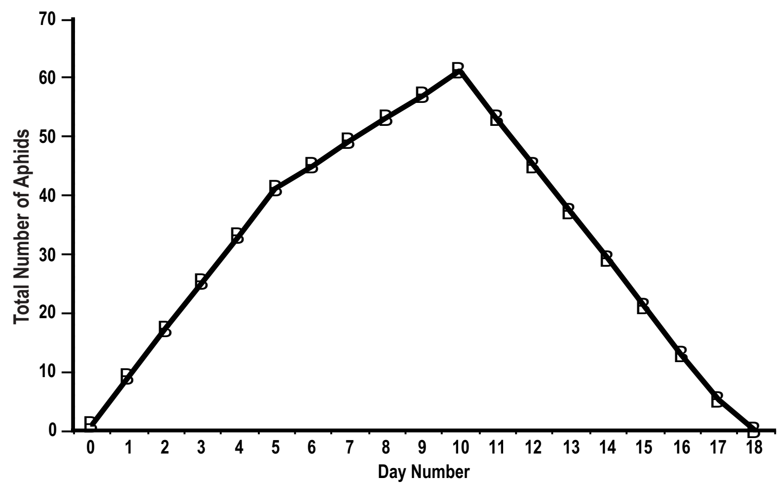
3. Ask for 2 volunteers to help count the aphids and put the daily total number on the chart.

4. Start the game! The number of baby aphids made, the number of aphids eaten, and the resulting total per day are given in the table below. As the game progresses, you will need to explain why the numbers of new and eaten aphids are changing.

DAY NUMBER	NUMBER OF BABY APHIDS HATCHED	NUMBER OF BABY APHIDS EATEN	TOTAL NUMBER REMAINING
0	the 'mother' aphids arrives	0	1
1	8	0	9
2	8	0	17
3	8	0	25
4	8	0	33
5	8	a small hungry hover fly larva arrives and eats 4 aphids per day	41
6	8	4	45
7	8	4	49
8	8	4	53
9	8	4	57
10	8	4	61
11	the mother aphid dies (or is eaten by the hover fly larva)	the hover fly larva molts so it can now eat 8 aphids per day	53
12	0	8	45
13	0	8	37
14	0	8	29
15	0	8	21
16	0	8	13
17	0	8	5
18	0	the hover fly larva eats 5 aphids, then it needs to find another group because it is still hungry!	0

Some suggestions for the processing discussion

- The chart that is produced during the game should look something like this :



- As for any exercise we need to share our observations and ideas about what we have done to clarify and emphasis the learning points. These are some of the main the main questions and discussions that may result from our processing :
  - * <u>What would have happened if the 'mother' aphid had died or been eaten by the hover fly larva earlier?</u> (The aphid population would have been reduced even faster).
  - * <u>How many other natural enemies do we know of that eat aphids? (For</u> example : lady bird beetle adult, lady bird beetle larva, spiders, predatory ants, brown or pink fungi, all of which would help to reduce the number of aphids even faster).
  - * <u>What other things could affect the numbers of aphids?</u> (Rainfall or 'rainbird' overhead-sprinkler watering washes or knocks the aphids off the plant. The population is reduced because aphids die before they can get back onto the plant. This may be because they get eaten by ground predators such as hunting spiders, ground beetles, or rove beetles).

* <u>Some predators do not eat the whole prey insects, they eat a bit and then move on. How would this affect the number of prey?</u> (It might reduce even faster, because the predators could kill more prey each day).
* <u>Are the numbers that we used in the game realistic?</u> (We do not really know. Two participants in previous games have measured the feeding rate of a final instar hover fly larva to be over 150 aphids in 12 hours. They were also seen eating small leaffolder larvae. We did not have any other information or experiences on aphid or lady beetle ecology).

• The group can make a list of insect zoo, that can be used to discover the other information that we wanted to know). For example :
  * <u>How many babies can 1 mother aphid make in 1 day?</u> Put 1 or 2 adult aphids on a single cabbage leaf of a potted plant. Use an aspirator to move them. Use a cabbage seedling because you will be able to move the leaves more easily to see your aphids. Count the number of baby aphids made each day. Try removing the new baby aphids after a few days if you find it too hard to count a big number. Do this observation a few times with different aphids in case 1 of the aphid is unusually fast or slow at hatching their youngs. Calculate the average number of aphids a mother aphid made in 1 day.
  * <u>How long does it take for a baby aphid to develop into an adult and start hatching its own babies?</u> Put 1 or 2 adult aphids on a small potted plant (as for 1). The next day, remove the adults and leave the babies. Now you have a group of baby aphids which you know were all born in the last day. Observe them every day to see how long it takes for them to start hatching their own babies.
  * <u>What and how do hover fly larvae eat?</u> In the game, the smaller hover fly larva only ate smaller aphids, and aphids were the only prey available for it to eat. It is very easy to observe the feeding habits of a hover fly larva, even in the open, because when they are feeding they do not move far.

a) To observe a hover fly larva feeding on aphids, put it on a cabbage leaf with some aphids and watch. Use a lens if you like. Watch the larva sucking the insides of the aphid out until only the skin remains!

b) Try feeding it some small semi-looper larvae or other small caterpillars. What else do you think it could feed on? Try it.

c) Observe and describe how the hover fly larva searches for the next prey. How different does it look when it is actually eating? Some people find it difficult to recognize the difference between a hover fly larva and a small seedling maggot larva. Compare the way the movement of the hover fly larva with the movement of other small insect larvae.

d) To see how much the larva can eat in 1 day, either : Put it in a pot with a known number of prey on several cabbage leaves, count how many prey are left after 24 hours; or : Watch one larva feeding for as long as you can (30 minutes, 1 hour, etc.) and see how long it takes to eat 1 prey, then calculate how many it could eat in 12 hours.

e) Do they feed more at night or day? Do the same observation described in d for a 12 hour daytime period and a 12 hour night-time period.

f) Try collecting hover fly larvae of different sizes, and observe to see if there is any difference in what and how much they can eat.

* <u>How long does it take for a hover fly larva to develop into an adult?</u> Collect the smallest sized hover fly larvae that you can find (use an aspirator when it is necessary to handle them). Rear them in separate pots (or they might eat each other). Add clean fresh food

when needed. Handle the larva as little as possible. If you do need to handle them use aspirator. Observe the changes in size, color and shape as the larva develops. Note the changes every day in your notebook, draw anything new that you observed. How does the pupa look? What kind of animal is the adult? (HINT: look at the wings).

* How many aphids does it take to damage a cabbage plant?
When the plant is nearing maturity and the aphids are on the lower leaves, there is no obvious damage to the plant. If the aphids get onto the younger plants before heading stage in cabbage, they can cause 'aphidburn'. Nobody knew whether the plants could or could not recover from this kind of early damage. The group suggested in previous exercises that a field experiment could be designed to test this question.

Exercise No. 4.20

HUMAN PREDATOR GAME :
UNDERSTANDING ECOLOGICAL FUNCTIONS AND RELATIONSHIPS

Basic understanding on the ecological functions and relationships among organisms in the ecosystem would explain their behavior, distributions, and the fluctuation of their densities. The predator-prey relationship among organisms is one of the example that would explain these phenomena.

When is this exercise most appropriate?

- In the FFS, TOT and VST, when participants want to understand better some ecological functions and relationships.
- In demonstrating insect predator and food preference of insect predators.

How long will this exercise take?

- 1 minute for searching
- 5 minutes for set-up
- 60 minutes for participatory discussion

Learning objectives

- To demonstrate the searching behavior of predators in relation to their feeding capability.
- To create awareness on the population distribution of insects in the field.
- To create awareness on the population regulation of one species or another.
- To demonstrate the food preference of predators.

Materials

- one participant and one table
- handkerchief, watch with a second hand, thumbtacks
- different sizes of grains and pebbles
- goat droppings

Steps

1. Ask one volunteer from each group to act as a predator.

2. Instruct participants to use 2-3 fingers to pick up pre-arranged objects on the table. Emphasize that this is not a contest.

3. Blindfold each volunteer with a handkerchief.

4. Arrange 20-25 assorted objects (thumbtacks, pebbles, grains, etc.) in randomly positioned scattered and clustered groups.

5. Human predator searches and picks up objects for 1 minute while the rest of the group observes.

6. Process observation in big group.

7. Make one human predator report his experience while in blindfold.

Some suggestions for the processing discussion

- In what kind of distribution did the human predator pick up the most object from?
- What were the behaviors demonstrated by the human predator in handling the different objects?
- Is the exercise related to insect ecology? Explain.

- How is insect population density related to the searching and feeding capacity of a predator.
- How is the low or high population of pests related to predator population density?

Exercise No. 4.21

BIOLOGICAL PESTICIDES :
BACILLUS THURINGIENSIS
(WHAT DOES B.T. KILL AND DOES NOT KILL? HOW DOES B.T. KILL? WHAT CAN STOP B.T. FROM WORKING)

When is this exercise most appropriate?

- When farmers want to learn more about : "What B.t. kills?" "What B.t. does not kill?" "How B.t. kills?" and "What can prevent B.t. from working?"
- When farmers decide that they need to spray to reduce a large population of 'worms' (caterpillars); When they have already analyzed that plant recovery, natural-enemy control and hand picking will not be sufficient; When the group is unconvinced to try using B.t. instead of a chemical pesticide because they think it does not work.

How long will this exercise take?

- 1-2 hours of an FFS meeting, plus a few minutes observation every day until the next FFS meeting.

Learning objectives

- To discover that B.t. can kill many different kinds of 'worms' (caterpillars).
- To discover that hot, bright, sunlight can reduce the effectiveness of B.t.
- To discover that B.t. only kills 'worms' (caterpillars) and it does not kill not other types of plant eaters.
- To discover that we can make a simple test to see if B.t. can kill a type of 'worm' (caterpillar), when we need the information to make a decision about whether or not to spray B.t.

Materials

- B.t. of different brands and period of stockings
- A potted cabbage plant at early vegetative stage (about 6-8 leaf stage would be ideal)
- Different kind and sizes of worms (caterpillars)
- Hands sprayer and water
- Notebook, pen, pentel pen and manila paper

Steps for the orientation

1. Ask the farmers to share their experiences of using B.t. Some suggested guide questions :
   - Who has used B.t.?
   - What insects did you use B.t. against?
   - How did you use the B.t.?
   - What did you observe after you sprayed the B.t.?
   - Did anyone ever experience that B.t. did not work? When was this? Why do you think this is?
   - When did the B.t. work? Why do you think this is?

2. Ask the farmers if they want to learn more about how B.t. works and what might stop it from working.

3. Ask the big group to divide into 2 small groups :
   - One group of 12 participants will find out what effect hot sunlight and cool shade have on the effectiveness of B.t. on either cutworms or armyworms (Group A).
   - All of the other participants will find out which other pests can be killed by B.t. (Group B).
   - Both groups (Groups A and B) will observe how B.t. kills pests.

4. Group A will follow STEPS FOR GROUP A with at least one facilitator guiding, while Group B will follow STEPS FOR GROUP B with another facilitator guiding.

Steps for Group A

1. Each of the participants cuts 4 clean fresh cabbage leaves, 4 cm in length, then washes the leaves with clean water and put them to dry on a piece of tissue paper (not in direct sunlight, or it will wilt).

2. Each participant takes a plastic jar and writes on the treatment that they will do :
   - 3 people do................. spray B.t. + expose to HOT SUNLIGHT
   - 3 people do ....spray WATER + expose to HOT SUNLIGHT
   - 3 people do..................spray B.t. + keep in COOL SHADE
   - the last 3 people do.....spray WATER + keep in COOL SHADE

3. The participants who will spray B.t. now make up 250 milliliters of water with B.t. Then the spray their own leaves on both sides using one hand sprayer. The other group fill their hand-sprayer with water and spray their own leaves on both sides also.

4. The sprayed leaves are air dried once again, in a cool shaded place.

5. The participants who will expose their leaves to HOT SUNLIGHT should each take a plastic jar to put in their leaves. Then they put them in a hot sunny place for a period of 30 minutes. The other participants put their leaves also in a plastic jar and put them in COOL SHADE for the same period of time.

6. During the 30 minutes waiting period, the facilitators guide the participants to design and draw up a simple table in which they can record what they observe. They will need to record the following :
   - How long is it since the insects were put in the jar?
   - How many insects are dead?
   - How many insects are alive and feeding or moving?
   - How many insects are alive and not feeding or moving?

- Describe the color and any other observations about how the insects looks like.
- Draw the leaves and show how much has been eaten and how much 'take' (shit) there is.
- Make note if the leaves is eaten completely and so you add another leaves as necessary.
- Any other observations?

7. After the 30 minute period, each person carefully moves 5 armyworm or cutworm larvae into their jar. Choose smaller larvae, because we do not want the ones which are about to pupate. Use a wet fine hair paintbrush and be very gentle. Cover the jars with cotton covers and secure with rubber bands

8. Make the first set of observations 1 hour after the larvae were put in the jars. Do not poke the larvae, just observe. If you have to move them, use a wet fine hair paintbrush and be gentle!

9. The participants each take their own jar home and make an observation every morning until the next FFS meeting.

Steps for Group B

1. Participants pair up. Each pair chooses one type of plant-feeder to test. Facilitate it so that some groups test insects that are not 'worms' (caterpillars) to compare with all the tests with worms. Here are some suggestions for insects to test :
   - web worms
   - flea beetles
   - armyworms
   - aphids
   - cabbage worms (white butterfly larvae)
   - potato weevil
   - small black cutworms

- big black cutworms
- small light cutworms
- big light cutworms

2. Each of the participants cuts 15 clean fresh cabbage leaves. For the large insects (large worms, bugs), prepare 10 clean fresh cabbage leaves, 10 sq cm. For the small insects (flea beetles, aphids and small worms), prepare 4 clean fresh cabbage leaves, 4 sq cm.

3. Each participant washes the leaves with clean water and put them to dry on a piece of tissue paper (not in direct sunlight, or it will wilt).

4. They then take 2 plastic jars and write on the 2 treatments that they will do. One person does treatment a (Spray B.t.), the other does treatment b (Spray water).

5. The participants who will spray B.t. now make up 250 milliliters of water with B.t., then spray their own prepared leaves on both sides using one hand sprayer. The other group fill their hand-sprayer with water and spray their own prepared leaves on both sides also.

6. The sprayed leaves are air dried once again, in a cool shaded place.

7. While the leaves are being dried, the facilitator guides the participants to design and draw up a simple table in which they can record what they observe. They will need to record the following :
   - How long is it since the insects were put in the jar?
   - How many insects are dead?
   - How many insects are alive and feeding or moving?
   - How many insects are alive and not feeding or moving?
   - Describe the color and any other observations about how the insects look.
   - Draw the leaves and show how much has been eaten and how much 'take' (shit) there is.

- Make note if the leaves is eaten completely and so you can add some more leaves. Note also other observations.

8. Each person puts leaves into their jar and carefully moves 5 of their type of insects into the jar. For small worms use a wetted fine hair paintbrush and be very gentle. For hoppers, use an aspirator and again be gentle. Cover the jars with cotton covers and secure with rubber bands.
9. Make the first set of observations 1 hour after the larvae were put in the jars. Do not poke the insects, just observe. If you have to move them, use a wetted fine hair paintbrush and be gentle.

10. The participants each take their own jar home and make an observation every morning until the next FFS meeting.

11. For next week, facilitate each small group to put the results for their exercise together, and conduct some participatory discussion and general observations within the small group. Get each group to summarize their observations on one sheet of manila paper.

12. Organize the sharing of the results of the 'WHAT ELSE DOES B.t. KILL?' exercise so that it is presented and discussed completely before starting the presentations and discussion of the 'EFFECTS OF SUNLIGHT ON B.t'. exercise. This should help the group to focus more clearly on the objectives of the 2 exercises.

Some suggestions for the processing discussion on 'WHAT IS THE EFFECT OF SUNLIGHT/SHADE ON B.T.?' (GROUP A)

- How many larvae died in the water/shade and water/sunlight treatments? What does this tell us?
- How many larvae died when they had been fed on leaves with sunlight-exposed B.t.? How many larvae died when they had been fed on leaves with B.t. that was kept in shade? What does this tell us?

- We have discovered that B.t. is a living thing which can be damaged by heat and light. In the fields, it dies when it is exposed to heat and sunlight. What time of the day do you think would be best to spray B.t.?
- What other ways can we care for B.t. to maintain it's effectiveness? How do we store it? How do we transport it? How was it stored by the dealer? How long do you keep it once you have opened the packet?

The group may want to discuss whether or not cocktailing with chemicals could also stop B.t. from working. Cocktailing should not happen in IPM, because we do not need to cocktail. If you use B.t,. why spray another insecticide? What season will it be if you need to spray a fungicide? In which season are 'worms' a problem?}

Some suggestions for the processing discussion on 'WHICH INSECTS CAN B.T. KILL?' (GROUP B)

- How many larvae died when they were sprayed with water? What does this tell us?
- Which plant-feeders did the B.t. kill? Which plant-feeders did the B.t. not kill? Why do you think this is? (B.t. can only kill larvae of moths and butterflies. B.t. can not kill beetles, leafhoppers or any thing that is not a caterpillar)
- When the B.t. kills a plant-feeder, how long after spraying does the insect stop feeding? How long does it take before it dies? Why do you think that it stops feeding some time before it dies? (It feels sick because the stomach is paralyzed by a poison from the B.t. bacteria)
- Did the appearance of the insects change when they are killed by B.t.? How?

Exercise No. 4.22

ROLE PLAY FOR INSECTICIDE RESISTANCE : UNDERSTANDING HOW RESISTANCE BUILDS UP

When is this exercise most appropriate?

- When one of more farmers share the experience that some pesticides stop working after sometime.
- When farmers are interested to know more about why pesticides 'stop working' or pests 'become immune' to pesticides after sometime.

How long will this exercise take?

- 1 hour of an FFS meeting

Learning objectives

- To understand how populations of insects become resistant to pesticides.

Materials

- 1 hand sprayer with water in it

Steps

1. Ask farmers to share their experiences of pesticides that have stopped working after sometime. Some suggested guide questions are as follows :
    - Who has had the experience of a pesticide working well in the first applications but it stops working after sometime? Why do you think this happened?

- Why did farmers start using 'cocktailled' insecticides to control diamond-backed moth (DBM)? How many different pesticides had stopped working for DBM? Why do you think this happened?
- How long did it take for the pesticides to stop working?
- Do you want to do an exercise which looks at how pesticides stop working?

2. Organize the group for the role play game. You will need the following volunteers :
   - 1 story teller
   - 1 farmer who will spray ‘worms’ with his ‘poison-sprayer’ (Do not worry if it only has water inside)
   - 7 farmers, to be Ordinary Worms, who wear short sleeved tops only.
   - 14 farmers, to be Super Worms, who wear long sleeved tops.
   - A group of Documentors (all the remaining FFS participants), who will observe and take notes of what happens.

3. Put the Ordinary Worms on one side of the ‘classroom’ and the ‘Super-Worms on the other side. The middle of the room is the Farmer’s Field. (You can draw a boundary around the edge of the field area with chalk if you like).

4. The game story starts. The story teller explains the story and gives instructions to the group with the help of the facilitators
   (instructions are given in italics) :

   - In the first week of the season, the farmer went to the field and he found 5 worms. He did not know it, but 1 of these, a Super Worm, was resistant to the pesticide that he usually use. All the rest were Ordinary-Worms.

     (1 Super Worm and 4 Ordinary Worms go into the field).

- The farmer was very worried that his crops would be eaten, so he decided to spray poison immediately. One lucky Ordinary Worm managed to escape the poison by hiding

  (The Farmer gets the water spray and sprays all worms except one its forearm).

- All but 1 of the Ordinary Worms died of poisoning, but the Super Worm lived because he/she was protected from the spray

  (Ordinary Worms die and Super-Worm shows his/her protection to the observers).

  Now the farmer was happy, so he went away for a week. In that week, the remaining worms pupated for a few days, became adults and then got down to their natural habit of baby-making. Each adult can make 3 babies. One of the adults was a Super Worm, and one was an Ordinary Worm. So in the next generation of worms, there were 3 Ordinary Worms and 3 Super Worms. After making babies, as is natural for many insects, the adults died.

  (Worms rest, emerge as adults and get babies, 3 Super and 3 Ordinary, then the adults die).

- The next week the farmer came to the field and found 6 worms. Again he was worried so he decided to spray. This time he mixed the poison spray a bit stronger, and took care to cover all areas of plants where the worms could be hiding.

  (Farmer looks carefully around the field and sprays all worms on their forearms).

- The Ordinary Worms died of the poison spray, but the Super Worms were protected and lived

  (Ordinary-Worms die and Super-Worms again show his/her protection to the observers).

- Again the remaining worms pupated and emerged as adults and got down to baby-making. As before, each adult makes 3 babies and then dies. This time the parents are all Super Worms. So there are 9 Super Worms in the next generation.

  (9 Super Worms come into the field and the adults die).

- The next week the farmer came to the field again. Now he found 9 worms. He sprayed again with stronger pesticide. But none of the insects died.

5. What should he do now?

6. Get the observers to report their observations to lead the processing by participatory discussions.

Some suggestions for the processing discussion

How many worms died out of how many in each generation?
How did this change between the generations? Why was this?
What will happen if the farmers continues spraying the same pesticide?
Or a different pesticide?
Why did the numbers of Super Worms and Ordinary Worms change in each generation? (You might want to discuss how this is similar to selecting different characters in rearing animals like pigs and fighting cocks)

SIMULATION STUDIES ON CROP COMPENSATION

Exercise No. 4.23

DEFOLIATION SIMULATION STUDY :
CAN VEGETABLE CROPS COMPENSATE FOR LOST LEAVES?

When is this exercise most appropriate?

- One week after transplanting in the FFS, TOT and VST sites.
- In the FFS, if and when the farmers perceive defoliators as a problem.
- In the FFS, once we observe defoliators in early AESAs and in neighboring fields through barangay immersions.

How long will this exercise take?

- 1 hour participatory discussion on the design of the simulation study.
- 1 hour field work to set-up the exercise.
- 15-30 minutes weekly observation and data gathering (can coincide with the conduct of AESA)
- 1-2 hours data consolidation, preparation and presentation (at least once during the season and once at the end of the study).

Learning objectives

- Gain knowledge on plants ability to compensate for lost leaves at different levels of damage and at different growth stages
- To determine the critical growth stages of different vegetable crops to defoliators and crop loss caused by defoliators.

Materials

- Different vegetable plants
- Pair of scissors and puncher
- Manila paper, pentel pens
- Sticks and Labels
- Notebooks and ball pen

Steps

1. Design a simulation study in the 'classroom'. Answer the following questions that may lead us attain the learning objectives and thus, serve as our entry point to the exercise :
   - Why do you want to do simulation studies on crop compensation?
   - How can we learn about the effects of defoliators by simulation studies?

2. Brainstorm with the big group to define the procedures that will be followed in conducting the simulation study :
   - Ask how much we shall cut off the leaves. To find out, you could ask how much the participants have seen defoliators eat in the field based from their own experience. There could be 2-3 levels and one should exceed the realistic extent of damage. Remember to set aside some control plants.
   - Ask when we cut off the leaves. It could be at 15, 30, 45 and 60 days after planting or at vegetative, flowering and fruiting stages of the vegetable crop and for cabbage, please see table below.
   - Ask where we cut off the leaves. If they do not know, we can observe in the field. Often, the defoliators would cut off the leaves or leave only the midribs).

- Ask how many we cut off the leaves. Do not make it too many and complicated. At least 3-4 treatments representing at least 3-4 growth stages also will be practical enough. The table below is an example of when to defoliate, what to simulate and the degree of simulation :

GROWTH STAGE	INSECT PEST	DEGREE OF SIMULATION
SEEDLING (30-45 DAP)	SEEDLING MAGGOT	10-25% OF THE PLANTS IN A PLOT
EARLY VEGETATIVE (10-15 DAT)	WEBWORM	10-25% OF THE YOUNGEST LEAF IN A PLOT
PRE-HEADING (25 AND 30 DAT)	CUT WORM AND ARMYWORM	25% OF LEAF AREA OF 3 LEAVES BELOW THE HEAD
HEADING (35 AND 50 DAT)	DBM AND CABBAGE WORM	25 % OF LEAF AREA OF 3 LEAVES BELOW THE HEAD
HARVEST	ALL DEFOLIATORS	REFER TO THE ABOVE MENTIONED DEFOLIATORS

- Ask what data we collect before, during and after the exercise to be able to make conclusions. The weekly plant assessment could include : plant height, number of leaves, number of pods or fruits, number and weight of heads, pest and natural enemies population dynamics, pest damages, yield data, and even economic data, etc.

3. Write down the agreed procedures on a chart or manila paper.

4. Go to the field and set-up the study. The following is a simple guide :
   - Select and assign the plots at random. At least two sample plots should be assigned per treatment. Remember to assign control plots.
   - Cut off or punch the leaves with a pair of scissors or a puncher . Simply simulate the % total leaf area or leaf number usually damaged by defoliators by cutting off, for example, 1/3, 1/2, 3/4 or 25%, 50%, 75%, etc., of the total leaf area, or the whole leaf.
   - Label the plant with date and treatment.
   - Make sure that the plants (the field) has enough water and the required fertilizer.

5. Observe plants and collect data weekly.

6. Brainstorm and consolidate reports in the small group for presentation to the big group. For the TOT and VST presentation, the following may be done :
   - If possible, prepare bar or line graphs for each weekly observation. (e.g., x-axis is weeks after treatment and y-axis is number of leaves or weight of head or plant height, etc.).
   - Each group presents their results to the large group and discuss it for example at least once during the season and once after harvest.
   - Afterwards, the big group can brainstorm on how presentation and discussion should be carried out with farmers. Should they draw bar graphs also? Should they draw plants instead? Is discovering in the field enough? How can you then make sure that all of them discover and not only the one or two gathering the data?

Some suggestions for the processing discussion

- How is the plant development in different treatments?
- Is the crop able to compensate lost leaves?
- What species of defoliators is not damaging? why?
- At what level of attack by the defoliators can the plant compensate?
- At what stage(s) are defoliators most critical?
- Among the simulation studies, what defoliator is likely to cause highest yield loss? Why?
- Are there other important aspects than yield?
- How can crop management decisions be influenced by the plant's ability to compensate?
- Can conclusions be made on just counting leaves and measure plant heights?
- How useful can this exercise be with the FFS farmers?

Exercise No. 4.24

WEBWORM SIMULATION STUDY : CAN VEGETABLE CROPS COMPENSATE FOR DAMAGED GROWING POINTS?

When is this exercise most appropriate?

- One week to two weeks after transplanting in the FFS, TOT or VST sites.
- In the FFS, if and when the farmers perceive pests that damage the growing point of a crop as a problem (e.g., webworm of cabbage)
- In the FFS, once we observe webworm damage in cabbage at early AESAs and in neighboring fields during barangay immersions.

How long will this exercise take?

- 1 hour participatory discussion on the design of the simulation study.
- 1 hour field work to set-up the exercise.
- 15-30 minutes weekly observation and data gathering.
- 1-2 hours data consolidation, preparation and presentation (at least once during the season and once at the end of the study).

Learning objectives

- Gain knowledge on plant's ability to compensate when growing point is damaged at the early growth stages of the vegetable crop.

Materials

- Cabbage plants at one week to two weeks after planting
- Knife
- Manila paper, pentel pens
- Sticks and Labels
- Notebooks and ball pen

Steps

1. Design a simulation study in the 'classroom'. Answer the following questions that may lead us attain the learning objectives and thus, serve as our entry point to the exercise :
   - Why do you want to do simulation studies on crop compensation?
   - How can we learn about the consequences of webworm damage in cabbage by simulation studies?

2. Brainstorm with the big group to define the procedures that will be followed in conducting the simulation study :
   - Ask how we shall simulate the pest damage at the growing point. To find out, you could ask them to go to the field and observe, or you could brainstorm from their previous experiences and observations. Remember to set aside some control plants.
   - Ask what growth stages will the cabbage webworm damage the growing point. That will be the best time to do the simulation study. It could be at seedling emergence, at one week, two weeks or even three weeks after planting.
   - Ask how we can see that the growing point has been damaged. Observations on the degree or presence of wilted or dead growing points will be very important in drawing up the conclusions.
   - Ask for farmers practices when their cabbage crop has been damaged by webworm. The idea is to discover that when the growing point is damaged, the crop can still compensate. In the early stages, webworm damage are replaced by additional

emerging shoots. In the later stages, the damage is compensated by higher yield due to heavier heads of the adjacent cabbage plants. Thus, we can demonstrate to farmers that the problem can be managed without insecticide.

- Ask how many plants to simulate the damage on. Do not make it too many and complicated. At least 3-4 treatments representing at least 2 growth stages will be practical enough.
- Ask what data to collect before, during and after the exercise to be able to make conclusions. The weekly plant assessment could include : plant height, number of leaves, number of shoots, number and weight of heads that developed, pest and natural enemies population dynamics, pest damages, yield data, and even economic data, etc.

3. Write the agreed procedures on a chart or manila paper.

4. Go to the field and set-up the study. The following is a simple guide :
   - Select and assign the plots at random. At least two sample plots should be assigned per treatment. Remember to assign control plots.
   - Cut off growing points (shoot) with a sharp knife to simulate the damages.
   - Simply simulate the % total shoots damaged normally caused by cabbage webworm by cutting or pulling off the growing points , for example, 1/3, 1/2, 3/4 or 25%, 50%, 75%, etc., of the total plants.
   - Label the plant with date and treatment.
   - Make sure that the plants (the field) has enough water and the required fertilizer.

5. Observe plants and collect data weekly.

6. Brainstorm and consolidate reports in the small group for presntation to the big group. For the TOT and VST presentation, the following may be done :

- If possible, prepare bar or line graphs for each weekly observation. (e.g., x-axis is weeks after treatment and y-axis is number of leaves or plant height, etc.).
- Each group presents their results to the large group and discuss it, for example, at least once during the season and once after harvest.
- Afterwards, the big group can brainstorm on how the presentation and discussion should be carried out with farmers. Should they draw bar graphs also? Should they draw plants instead? Is discovering in the field enough? How can you then make sure that all of them discover and not only the one or two gathering the data?

Some suggestions for the processing discussion

- How is the plant development in different treatments?
- Is the plant zero value if the growing point is damaged?
- How does the crop compensate damaged growing points?
- At what growth stage will the pests not be able to kill the growing point
- At what stage(s) are the pests most critical?
- If the damaged plants can still compensate, is there a yield difference compared to the control?
- Are there other important aspects than yield?
- How can crop management decisions be influenced by the plant's ability to compensate?
- Is the exercise useful to FFS farmers?

OTHER IMPORTANT INSECT TOPICS

Exercise No. 4.25

COLLECTION AND PRESERVATION OF INSECTS (AND SPIDERS) : A SEASON-LONG COLLECTION OF FIELD AND INSECT ZOO SPECIMENS

When is this exercise most appropriate?

- In FFS, TOT and VST sessions.
- When participants have started field monitoring.
- When participants would like to keep record specimens of the insects that they have discovered as future reference.

How long will this exercise take?

- 30 minutes to 1 hours in the FFS session, plus a little time each week throughout the season.
- 1-2 hours in the TOT and VST session, plus a little time each week throughout the season.

Learning objectives

- To help participants become more familiar with the physical appearances of different kinds of insects and spiders.

- To help participants record and remember what they have discovered about the biology and/or ecosystem function of the animals.

Materials

‘Farmer’ Method (For FFS, TOT and VST).

Materials to used will depends on the method chosen :

- field collecting equipment (e.g., plastic bags, jars, sweep net, aspirator, fine hair paintbrush)
- clear glass vials (at least 20 per group)
- denatured alcohol
- bamboo sticks or cartolina to attach vials to
- rubber bands
- 1 pair of scissors per group

‘Entomologist Method’ (For TOT and VST).

- field collecting equipment (e.g., plastic bags, jars, sweep net, aspirator, fine hair paintbrush)
- clear glass vials (at least 20 per group)
- denatured alcohol
- cartolina to attach vials to
- 1 cartolina, plastic or wood box per group (plenty of space for your collection, with lid that can keep ants out, and a sheet of polystyrene in the bottom for sticking pinned insects)
- 1 pack of tailor's pins per group
- 10 index cards (to make labels and triangles for mounting small insects)
- 1 pot of clear nail varnish per group
- 1 pair of scissors per group
- 1 pair of forceps per group
- 1 syringe per group (for filling vials with alcohol)
- 1 record book per group
- pentel pens, ball pens, pencils

Steps for preliminary preparations

1. Conduct participatory pre-discussions with the participants about why it may be useful to make a collection and preservation of insects and spiders. Some suggestions for the discussion are as follows :
   - Is the collection and preservation of insects/animals important?
   - What is the importance of having an insect/animal collection?
   - What kinds of insects/animals do you want to include in your collections?
   - Would you use the collection in the future? How?
   - What kind of information would you want to record about the insects that you collect?
   - How will you make this information easy to find and clearly presented?

2. Choose between the 'FARMERS' and the 'ENTOMOLOGIST' methods depending on the aims and needs outlined by the participants.

3. Secure the necessary materials.

Steps for 'Farmers' method

1. Ask the participants to collect insects and spiders regularly during the regular weekly field activities.
   - Before collecting animals try to observe and keep records of what they are doing in the field.
   - Also, observe and keep records of reared specimens in the insect zoo.

2. Kill the animals in a plastic bag or other container, with a small amount of alcohol.

3. Sort insects and spiders by grouping identical ones. Put one or a few samples of each type in a separate vial. Add alcohol until the specimen is completely covered and then close the vial.

4. Conduct small group participatory discussions on your observations of the animals :
   - Are they ‘pests’, or ‘natural enemies’?
   - If you are unsure put them into a third group ‘not yet known’

5. Attach the vials to a cartolina or bamboo sticks, one card or stick for each group of ‘pests’, ‘natural enemies’ and ‘not yet known’. To attach vials to cartolina :
   - cut 2 slits in the cartolina
   - push rubber band through from the back to make 2 loops
   - secure the vial in the 2 loops

6. At the next session, add any new animals to the collection and have another look at the animals already in the collection :
   - Are there any new observations about the animals?
   - Are the animals in the correct groups? If necessary move the vials to a new group.

Steps for 'Entomologists' method

1. Make a killing jar by following these procedures :
   - Secure the following materials : a glass jar with a screw top lid, some potassium cyanide crystals, sawdust, cartolina, scissors and plaster of Paris mixed to a paste
   - Work outdoors in a breezy place.
   - Take the glass jar and put a cm layer of potassium cyanide in the base (DO NOT inhale the poisonous fumes)
   - Add 2 cm layer of sawdust.
   - Cut a circle of cartolina to fit the diameter of the jar and place on top of the sawdust layer.

- Seal the edges of the cartolina to the jar using plaster of Paris paste.

2. The participants collect insects and spiders regularly during the regular weekly field activities.
    - Before collecting animals try to observe and keep records what they are doing in the field.
    - Also, observe and keep records of reared insects and animals in the insect zoo.

3. After you have observed the live insects and animals, kill them carefully:
    - Kill soft bodied insects and animals (e.g., larvae, eggs, spiders) in a plastic bag or other containers, with a small amount of alcohol.
    - Kill moths and butterflies by gently but firmly squeezing the head and thorax.
    - Kill hard bodied insects by placing in a killing jar for 5 to 10 minutes, or by placing in a freezer for about at least 1 hour.

4. Preserve the insects/animals, either by placing in vials with alcohol or by pinning in appropriate containers, depending upon the kind and stage of the insects/animals :
    - Keep soft-bodied insects and spiders (which are all soft bodied) in vials covered with alcohol, put a cartolina label (not colored), written in pencil, inside the vial with the animals.
    - Large hard-bodied insects can be pinned directly through the body. Add a label with important information underneath the insects.
    - Small hard-bodied insects can be glued onto a small triangle of index card that have been put onto a pin. Place a small drop of glue (clear nail varnish) on the point of the card, leave to dry for a few seconds. Use forceps to put the insect on the glue, so that the middle part of the body sticks to the point, and insect is hanging off the point with all parts of the body visible. Add a label underneath the insect.

- Some large but slender insects can be more easily preserved by gluing them to the pin. Lie the insect on its side. Put a drop of glue on the pin. Lie the pin onto the insect so that the glue sticks to the middle part of the insect's body. Leave lying until the glue is dry. Add a label.
- To allow you to see wings of butterflies you might want to 'spread' them out as you preserve the insect. Make a v-shaped groove in a piece of polystyrene board and allow plenty of space on either side for spreading the wings. Push a pin through the middle part of the butterfly's body. Pin the butterfly onto the board with the body in the groove. Take a strip of paper and gently spread one of the wings out underneath it. Use the blunt end of a pin to move the wings ONLY pushing at the wing-base which is attached to the body. When the wing is spread, pin the paper strip down to hold the wing in position. Leave to dry for at least 1 week, in an ant-free area. When it is dry and firm, remove from the board and add a label.

Some suggestions for the processing discussion

- This exercise is not processed, it is an ongoing activity with discussions happening during field observations, insect zoos and sorting of insects.

Suggested TOT and VST evaluation breakdown

- 50% of points for the number of different kinds of insects/spiders in the collection. Take note that all the insects/animals animals should have been discovered in fields with crops that the group was working on.
- 25% on how clearly laid out, and how easy it is to find the information that you have discovered about the animals.
- 25% on how much information has been gathered in the field and insect zoo observations about the animals in the collection.

Exercise No. 4.26

NAME GAME : 'SCIENTIFIC' VERSUS 'COMMON-DESCRIPTIVE' INSECT NAMES (WHAT IS MOST APPROPRIATE FOR IPM?)

When is this exercise most appropriate?

- In TOT and VST sessions.
- When some participants are insisting on using scientific (Latin) names during sessions.
- When facilitators feel that it would be good for the group to discuss what types of names can be appropriate to different types of situations.

How long will this exercise take?

- 1 to 2 hours of the TOT and VST session.

Learning objectives

- To build awareness that scientific names are very difficult to learn and pronounce because the words have no meaning for us and because they are not useful to farmers.
- To experience how much more easy it is to remember names that are either in a language that we speak or descriptive of something that we can observe about the animals.

Materials

- 1 picture per person (facilitators and participants) drawn on cartolina (about letter sized) with 2 names written on the back of each picture:
  a) 1st name is a Latin-sounding name; and the
  b) 2nd name describes what is drawn in the picture.

Steps

1. The participants sit or stand in a circle (split into 2 groups if there are more than 20 in the group).

2. Distribute one cartolina picture per person.

3. Explain the general process of the 'Name Game', which can be a fun way for the facilitators and the participants to learn the names of the members in a newly formed group :
   - The first person says "I am (e.g., DAMES), who are you?" to the person on his/her left........
   - The person on the left says "If you are (e.g., DAMES) and I am (e.g., LUZ) then who are you?" turning to the person on his/her left........
   - The next person says "If you are (e.g., DAMES) and (e.g., LUZ) and I am (e.g., JHUN) then who are you?" turning to the person on his/her left.
   - ....and so on until the last person in the circle has to say all of the names of the group before he/she says her own name.

4. Explain that in this version of the name game we will not use our own names, instead we will use the names written on the back of our picture:
   - for the first time around, we will use the 'scientific' names
   - for the second trial, we will use the 'common-English' names

5. Play the games. You may have to give up the 'scientific' name game after about 4 restarts and trials, because it will be so difficult. But let the group try enough times to get frustrated and worried.

6. Have a processing discussion.

Some suggestions for the processing discussion

- How did you feel when we were using the 'scientific' names?
- How did you feel when we were using the 'common-English' names?
- Why was it easier to use the 'common' names? (e.g., the words are in a language that we understand, the names describe what we can see in the picture)
- Which kinds of names would the group recommend for use in FFS, TOT and VST? Why? (e.g., often you do not need a name, you have a specimen anyway) But for general group discussions, names are easiest to remember if they describe the animal, and are in a locally understood language.)
- What happens if we find that a local name is the same for a number of different species which are doing different things in the ecosystem? (e.g., we need to make a new name, based on the local name but add another describing word to define which particular type of insect it is).

Some ideas for names

Note :
These names are all made-up, the game is NOT designed as a way to learn names of animals. You could use the same 'scientific' names and change the English descriptive names if you prefer to draw some other kinds of animals.

- *Astra stellatus* - Starry apple bug
- *Praetalus grandipennis* - Squash leaf-miner
- *Viperus viperus* - Green snake
- *Scirus purpurea* - Purple cabbage worm
- *Crassipula pilipino* - Red predatory mite
- *Agorantha magnatha* - Red predatory ant
- *Homo americano* - American man
- *Dansota cremillata* - Crested field lizard

- *Vivita grandegnatha* - Big toothed beetle
- *Canis happius* - Happy dog
- *Lantora rufusnigra* - Black and red banana worm
- *Macadenia veridula* - Green leaf beetle
- *Cleptidia punctella* - Yellow-spotted black beetle
- *Aspidastrum follicum* - Small purple ant
- *Bovus locoloco* - Crazy cow!
- *Colla tridetalinum* - Green predatory beetle
- *Crispulantha caelescus* - Blue-backed mosquito
- *Macripes calamansi* - Calamansi mealy-bug
- *Maripuntha aurata* - Yellow bean moth
- *Betulina poranta* - Pink carrot worm
- *Brachyserestum bimasticus* - Brown praying mantis
- *Lipulinus piscivorum* - Fish-eating dragonfly
- *Poultra pilipina* - Native pilipino chicken
- *Senturina rufuscus* - V-striped tomato moth
- *Basticollis trifundata* - Brown hunting spider
- *Arginopus atrifaces* - Black-faced jumping spider
- *Scarabus viridis* - Green dung beetle
- *Tsetses azulababoyus* - Blue pig fly
- *Avispulatrum secundus* - Pink pollen beetle
- *Rana blancofatis* - White-bellied frog
- *Mesanthabroma carrota* - Purple carrot butterfly
- *Blatta nigra* - Black cockroach
- *Pollascus crinthula* - Yellow cut worm
- *Musca balayensus* - House fly

5 Rodents and Rodent Management Topics

Rodents are one of the most consistent and serious pests of vegetables. The main problem of rodent control is that rodents must be managed through community action, and organizing communities is not an easy task. In this set of activities, we will study the rodent biology, different effects of rodenticides, baiting and rodent burrow digging, but mostly, we will learn activities that are helpful in organizing communities for more effective rodent management .

There are a few differences between rodents and insects that make implementation of management different. First, is the ability of rodents to stay in one area even though there is no crop. This means that we can use damage caused in one season to initiate controls in the next season. The other difference is the methods of management. Rodent management must be organized over
a wide area to be very effective. Rodent drives, baiting, digging and any other method of control is most effective when done as a community action.

One last note, is that in many communities, rodent drive campaign success is determined by how many rodents have been killed. A large pile of rodents
is considered a big success. In fact, the opposite is true. A large pile of rodents really means that there is a lot more rodents out in the fields ready to feed on the crops. The number of dead rodents is not very important.

The number of rodents alive and eating the crop is more important.

Exercise No. 5.01

RODENT POPULATION DYNAMICS : A GROUP DYNAMICS EXERCISE AS WELL

Rodent populations increase very rapidly because rodents have many offspring very often. Rodents can live for one year or longer. Females may reproduce up to 4 times a year and have an average of 6 offspring in a litter. This exercise is designed to visualize simple population growth for one year.

When is this exercise most appropriate?

- Immediately after crop establishment in the FFS, TOT and VST sites.
- In the FFS sites, where farmers in the area historically experience rodents as a problem.

How long will this exercise take?

- At least 30 minutes small group activity and another 30 minutes brainstorming and report preparations.
- At least 1 hour big group participatory discussions

Learning objectives

- To show rodent population growth over several months using nails, seeds or other items.
- To brainstorm about rodent populations and bring out two management points :
  (1) It does not matter how many rodents were killed, it only matters how many rodents remain in the field; and
  (2) continuous rodent management is important to keep populations always low.

Materials

- 2050 corn seeds per group (or any similar materials)
- manila paper, marker pen, pencil

Steps

1. On the manila paper, draw 12 lines to divide into 13 sections.

2. On the first section place 2 seeds. One seed represent one female rodent, and the other represents a male rodent.

3. Move to the first month. Add 6 seeds for 6 offsprings from the original pair of rodents. Three rodents are females and 3 rodents are male.

4. Move to the 4th month. Add 6 seeds for 6 offsprings from the original female, then add 18 seeds for the 3 females in first month (3 females times 6 offspring each). Half of the seeds are female rodents.

5. Move to the seventh month. Add 6 seeds for 6 offspring from the original female, then add 18 seeds in first month (3 females times 6 offspring each). Add 72 (12 females with 6 offspring each) for offspring from females in the fourth month. Half of the seeds are female rodents.

6. Continue this process for the l0th and 13th months.

7. Write on the manila paper the total number of rodents for each months, and the cumulative total from month to month.

Some suggestions for the processing discussion

- How many rodents are produced in one year? (e.g., one section is three month).
- If half of the rodents are killed in the seventh month, how many rodents will be produced by the end of twelve months?
- If there are 10 female rodents in the first month, how many rodents will be produced in the 13th month? If you organize a rodent drive and kill this many rodents, will you be very excited and call your rodent drive a success? How many rodents are remaining in the field? Do you think the rodent drive was success still? How many rodents will be in the field considering reproduction? (Note that reproduction is even greater after many rodents are killed because of less competition for food and space)
- What is the meaning of the saying “It does not matter how rodents were killed, it only matters how many are left in the field to reproduce”.
- Many farmers say that if you kill rodents, they will bring their friends and completely destroy a field? Can you explain why fields are destroyed after one rodent drive? (e.g., remember reproduction, and that reproduction is faster when the population is lower).
- Why is it important to begin killing rodents at the early stage of the crop? Why is it important to keep killing rodents all season long? What would be the population of rodents after 6 months if only 1 female from each group of six offspring survived? (Totals by month; 1st month - 6; 4th month-24, 7th month - 96; l0th month - 384; 13th month - 1536. Total 2046).

Exercise No.5.02

HANDS-ON EXERCISE :
RODENT PREGNANCY INCIDENCE

Rodents are nocturnal animals which can cause heavy devastation in rice, corn and even vegetable crops. Evident signs of their presence are gnawing, nibbling, cut seedlings, damaged fruits and the presence of runways and burrows in the field. Rodents readily multiply in areas where there is abundant food.

Female rodent specimen can be dissected to determine the incidence of pregnancy. This process can be used to predict probable rodent population outbreaks even before the establishment of the crop.

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions after discussing the special topic on rodents.

How long will this exercise take?

- At least 30 minutes brainstorming on the procedures
- At least 1 hour field activity
- At least 30 minutes 'classroom' activity
- At least 1 hour participatory discussion

Learning objectives

- To create awareness that the rodent pregnancy incidence can be used as an indicator to forecast rodent population build-up.
- To come up with an action plan for rodent management.

Materials

- traps, pail and empty sack
- scalpel or blade and alcohol
- live rodents
- paper, pen and record book

Steps

1. Brainstorm on the procedures to be followed for the exercise.

2. Collect and kill 10 live female rats before land preparation.

3. Dissect abdomen and assess incidence of pregnancy.

4. Count number of embryos per female rat being dissected.

5. Record and conduct participatory discussions.

6. Repeat activity at a later stage if desired.

7. Develop an action plan for your community.

Some suggestions for the processing discussion

- How is the number of embryos related to the population build-up of rodents in the next cropping season?
- How is the incidence of pregnancy related to the stage of the crop?
- What are the factors that contribute to pregnancy? Enumerate and discuss.
- Develop an action plan for your Local Government Unit (LGU) to create awareness and generate participation in rodent management activities.

Exercise No.5.03

HANDS-ON AND PARTICIPATORY DISCUSSION : RODENT DAMAGE AND CROP LOSS ASSESSMENT

When is this exercise most appropriate?

- When the participants want to have an idea of the extent of rodent damage in the field in terms of yield and cost.
- In the FFS, when there are actual rodent damage and we want to demonstrate to farmers the need to manage rodents by community actions rather than individual farmer's action.

How long will this exercise take?

- 30 minutes to 1 hour brainstorming sessions to define rodent damage and design crop loss assessment procedures;
- 1 hour field activity to observe rodent damage and assess crop loss; and
- At least 1 hour to brainstorm on the result of the field activity.

Learning objectives

- To observe and characterize actual rodent damage in a given vegetable field.
- To practice crop loss assessment of rodent damage in actual field condition.

Materials

- vegetable field with actual rodent damage
- meter stick, weighing scale and calculator
- manila paper, notebook, pentel pen and pen

Steps

1. Brainstorm in big group on rodent damage and develop procedures for crop loss assessment.

2. Go by group to your assigned field.

3. Observe and characterized rodent damage and conduct crop loss assessment following the procedure developed by the big group.

4. Return to the session area and compute for the crop loss due to rodent damage in your assigned area. Compute also for the percentage of damage due to rats.

5. Report data to the big group.

Some suggestions for the processing discussion

- What is the percentage of rodent damage in your area.
- What is the value of crop loss due to rodent damage in your area in terms of yield and cost?
- What would you recommend for rodent control for the next crop season?

Exercise No.5.04

HANDS-ON AND PARTICIPATORY DISCUSSION : RODENT MANAGEMENT

As previously discussed, effective rodent management requires a community effort. For the group to be effective, they must also learn how to identify presence of rodents, runways, understand rodent burrow structures and suggest practical rodent management strategies. Group sharing of experiences is very important in understanding rodent occurrences in different areas. In this exercise, the experiences shared by the group will be critically analyzed in coming up with options or strategies for rodent management.

When is this exercise most appropriate?

- In the FFS, TOT and VST sites, when existing rodent control strategies failed to bring down rodent population to manageable levels.
- In the FFS, when farmers already understand the population dynamics of rodents.

How long will this exercise take?

- At least 30 minutes field activity to identify presence of rodents, prepare rat baits, construct and install rat baiting stations, etc.
- At least I hour brainstorming activity to design a rodent management strategy based on previous activities.
- At least 10-15 minutes follow-up activities every week to refine the management strategy designed earlier.
- At least another 1 hour to assess the effectiveness of the rodent management strategy at the end of the season.

Learning objectives

- To practice identifying the presence of rodents by their runways, live rodent burrows, rodents caught by digging burrows, etc.;
- To practice preparing rodent baits, constructing and installing rodent baiting stations; and
- To design, refine and assess management strategies for rodents in the area.

Materials

- bamboo, bolo, crisscut saw
- rodenticides, rodent bait materials
- manila paper, marker pens
- vegetable field
- plastic pale, spade, sacks

Steps

1. Each group should prepare rodent baits, construct 2 rodent baiting stations and install them in strategic areas in the vegetable field.

2. Each group should do the following around the FFS, TOT or VST sites :
   - Practice identifying the presence of rodents by their runways, live burrows, etc.
   - Dig live rodent burrows to understand its structure.
   - Experience catching live rodents from the burrows.

3. Return to the session hall and process the field activity. Provide guide questions which each group should answer and report to the big group and thus become the basis for participatory discussions.

4. Design a management strategy for rodent management and implement in the area.

5. Regularly assess and refine the management strategy during the cropping season and redesign a more permanent management strategy for implementation in the area in the next cropping seasons.

Some suggestions for the processing discussion

- The province of Benguet has a rodent damage index which range from 5-17% last cropping season, as submitted by agricultural technologists. Draw up your management plan to protect the next cropping from the ravages of the pest. What if there is no available acute poison?
- Presently, the province of Mountain Province has a rodent outbreak. The neighboring province Ifugao has a damage index which ranges from O. 1 to 1.2%. What are your indicators that there is an impending outbreak in the latter province? What are your recommendations to protect the vegetable crops in the said province?
- The provinces of Kalinga and Apayao has an endemic problem of rats. What are your recommendations to contain such problem to lessen the population build-up?
- There is a confusion in the identification of rodents in Benguet. Some said they are *Rattus rattus mindanensis* and *Rattus exulans*. Others said they are *R. norvegicus* and *R. argentiventer* that ravaged their crops. Due to this confusion, the Regional Director ordered the group to identify them. How do you identify those species of rodents by their physical appearance?
- Based on your field observations, draw up and explain your rodent management for the FFS, TOT and VST sites. Include farmers practices in your locality that can help in managing rodents.
- What stages of the different vegetable crops are most susceptible to rodent damage? Why is this so?

6 Diseases Topics

UNDERSTANDING COMMON DISEASES OF VEGETABLE CROPS

(GENERAL EXERCISES ON UNDERSTANDING ASPECTS OF PLANT DISEASES)

A disease is an abnormal condition that injures the plant or causes it to function improperly. Diseases are readily recognized by their symptoms (e.g., associated visible changes in the plant).

Various agents, acting either singly or in combination, cause diseases. The agents can be biotic (living) or abiotic (nonliving). Living disease-inciting organisms are called *pathogens*.

The pathogens of vegetable diseases are bacteria, fungi, nematodes, viruses, and mycoplasma-like organisms. These pathogens cause visible disease symptoms on the entire plant, or on individual plant parts such as leaves, stems, leaf sheaths; etc..

In this section, the general concept of a disease will be studied. The most common diseases that infect vegetables at different stages will be discussed. A number of diseases attack vegetables and reduce its yield and quality. About 112 infectious diseases of vegetables are recorded. however, only three of them are highly destructive. The others are potentially destructive only if conditions are right for their development.

Exercise No.6.01

SHARING OF IDEAS :
THE DISEASE TRIANGLE RELATIONSHIP

For the participants to effectively manage common diseases in vegetable , they must develop a conceptual definition of a disease. The concept of a disease and the factors associated with their occurrence are important tools in developing management strategies for diseases.

This activity is aimed at developing the participants' basic knowledge on diseases and their occurrence.

When is this exercise most appropriate?

- As a starting activity of the topic on diseases in the FFS, TOT and VST sessions.

How long will this exercise take?

- About 30 minutes sharing of ideas on the subject.

Learning objectives

- Develop a conceptual definition of a disease by sharing individual ideas.

Materials

- newsprint and pentel pen
- plastic bags and plant disease samples
- record book and pen

Steps

1. Each group collect diseased vegetable plants in the field at different stages of growth.

2. They should also note crop stand and surrounding factors that may have favored the occurrence of the disease.

3. Return to session area or shade and process observations.

4. Distribute discussion questions to each small group.

5. Present and discuss answers to the big group.

Some suggestions for the processing discussion

- What is a plant disease? Give specific diseases of vegetables?
- Are signs and symptoms the same? Defend your answer by giving examples.
- Can a disease occur considering the following :
  a. presence of susceptible host;
  b. presence of pathogen;
  c. unfavorable environment.
- Is man a factor in the severity or development of a disease? Support your answer.
- Can you consider physiological disorder a disease? Explain.

Exercise No.6.02

ROLE PLAY :
THE DISEASE TRIANGLE RELATIONSHIP

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions after the exercise on defining and developing the concept on diseases
- When discussing a special topic on disease.

How long will this exercise take?

- At least 30 minutes preparation and conduct of the role play.
- At least 30 minutes for processing of the activity.

Learning objectives

- To show the relationship between the different factors that enhance the development of a disease.

Materials

- participants (8 volunteers)
- manila paper, masking tape and stapler
- water
- crayons and pentel pens
- chalk and black board

Steps

1. Get 8 volunteers to do a role play.

2. Prepare labels for every role of participants.

3. Do role play showing possible effects and reactions of the different factors in the development of a disease.

4. Process and discuss the results.

Some suggestions for the processing discussion

- What are the factors that enhances the development of a disease? Why?
- Can a disease occur in the absence of any one of the factors? Explain.
- How do climatic factors affect the development of a disease?

Exercise No.6.03

FIELD WALK AND BRAINSTORMING EXERCISE : INTRODUCTION TO PLANT DISEASE

When is this exercise most appropriate?

- In the FFS, TOT and VST sessions when there are already diseases in the field.
- When the participants ask *"What is this?"* about disease symptoms.

How long will this exercise take?

- 15-30 minutes for field walk.
- 1-2 hours for processing and participatory discussion

Learning objectives

- To familiarize the participants with symptoms.
- To improve the participants' ability of interpreting symptoms.
- To realize that there are aspects where we do not yet have the correct answer readily available.

Materials

- Plastic bags
- Manila paper, pens, crayons, notebook
- Suspected diseased specimens

Steps

1. Brainstorm about all different methods to control diseases and document on manila paper.

2. Ask the participants to collect disease plants in the field.

3. Write on manila paper what was found in the field. Each group could work on an group of diseases (e.g., fungal, bacterial or viral diseases) so all diseases will be dealt with.

4. Post a manila paper with guiding questions :
   - How can you identify the disease? What are the symptoms? Where are they located?
   - Where does the disease come from? How does it spread? How does it enter the plant?
   - At what stage of the plant can you identify the disease?
   - What factors stimulate or /inhibit disease development?
   - What damage does it do to yield or quality of the crop? Why? How?
   - How important is the disease for farmers? Why?
   - What additional information do you need to make a decision on control or management of the disease? How can you obtain this additional information?
   - If there are questions that you can not answer, how can you then find the answer?

5. Ask also each group to observe symptoms of at least one disease closely and make a color drawing of it with crayons.

6. Each group make a presentation to the big group and the facilitators try to summarize and integrate the outputs of the small group and arrive at one common understanding.

7. Facilitate the groups when they try to answer the questions. Make sure that they feel that they do not have to answer all questions if it is not possible by now. Ask how they can do to find out (interviews, disease cultures, etc.) and give the time in future sessions.

Some suggestions for the processing discussion

How can you identify a disease?
How do you know if it is a disease symptom or something else?
What are the symptoms you observed?
Where are they located?
Where on the plant do you have to look for symptoms?
At what stage of the plant have you observed the symptoms?
Is it important to know early symptoms? Why? or Why not?
How important is the symptom to you? Why?

Additional suggestions for the processing discussion

- The following could be discussed when it comes to sources of disease:
  a) soil, planting materials and seeds
  b) water (irrigation, rain, ground)
  c) insects, animals and people, wind, tools, etc.

- The disease triangle have to be there and favorable for disease to develop. This relationship can be explained :
  a) host
  b) pathogen
  c) environment

- What is the difference between control and management? Among control and management tactics the following could be discussed :
  a) sanitation, rouging, leaf removal, proper disposal, crop rotation, quarantine
  b) land preparation, fertilizer (amount, kind and method of application) and water (irrigation and drainage) management
  c) resistant varieties and fungicides

- In TOT and VST sessions, ask if the exercise would be appropriate in FFS or if it needs to be simplified or adapted.

Exercise No.6.04

DISEASE CULTURE :
HOW TO LEARN MORE ABOUT VEGETABLE DISEASES

Disease culture is a simple method to identify disease, see how it can spread and understand how the climate influence the development of a disease.

Diseases caused by living organisms are hard to explain. Thus, this simple activity could make or help the participants to understand how diseases can spread or create problems in the vegetable crop.

When is this exercise most appropriate?

- When there are diseases in the 'learning' field
- When the participants have existing diseases in their own fields
- When disease symptoms are confused with other symptoms
- Making disease cultures is a continuous activity in the FFS. There should be regular sessions for presentation of results every 2-3 weeks.

How long will this exercise take?

- At least 30 minutes in the field
- At least 1 hour in the session hall
- At least 15 minutes daily for observations
- At least 1 hour for follow up presentations

Learning objectives

- To learn a practical and simple method to distinguish disease from deficiencies, mechanical or chemical damage.
- To discover that some diseases can spread through the air or direct contact.

- To discover what wet or dry, cold or warm climate has on development on disease.

Materials

- water
- plastic bags, tissue paper and hand lenses
- plants or leaves with suspected disease symptoms
- pen, paper and crayons

Steps

1. Go to the field and collect plants with abnormal leaves, spots or other symptoms. Or ask farmers to bring fresh leaves with suspected disease from their own fields.

2. Ask the farmers what they want to know about the disease. In disease culture, they can distinguish between some diseases, between diseases and other symptoms, and learn that some diseases can spread through air or physical contact.

3. Ask what is disease culture. (You subject the disease -infected plant to extreme conditions to speed up the process which will make you able to see what it is faster in the field).

4. Draw the symptoms as they appear on actual specimen.

5. The facilitator guides each group to work on one relevant study in the groups mentioned below :

Exercise No.6.04A

For identification

Is it disease or not? Is it fungal or bacterial?

a) Put the leaf with disease in a plastic bag or jar with some wet tissue paper
b) Put it in a warm dark place over night
c) Observe for development of mycelia (white hair-like structures) on the symptoms, or wet plant tissues, or foul odor and observe if the symptoms have spread.

Exercise No.6.04B

For influence of climate

What climate favors this disease?

a) Ask farmers what climate you can make in a disease culture (e.g., wet, dry, warm or cold if a refrigerator is available).
b) Measure the size of the symptoms.
c) Prepare two or four plastic bags or jars. One jar with wet tissue paper and one (1) with dry tissue paper and a leaf with symptoms. One jar with wet tissue paper kept in a cold place another kept in a warm place.
d) After one night observe if there is any visible development of the disease and compare treatments.

Exercise No.6.04C

For spreading disease

Does the disease spread through air or contact?

a) Ask farmers how diseases can spread and how they can see that in a disease culture.
b) Put a healthy leaf and a leaf with symptoms in a jar or plastic bag with wet tissue paper without contamination.
c) Put a healthy leaf and a leaf with symptoms in a jar or plastic bag with wet tissue paper after rubbing them to each other.
d) First observation after one night . Has the disease transferred from sick to healthy leaf?

6. Continue observation for some more days if answer is not yet given. Success of disease culture can be compared to insect zoo. Keeping a fighting cock or taking care of a baby exercise

7. Each group present the result of the disease culture to the large group for participatory discussion. The short presentation should answer the following :
   - Why did we do the experiment?
   - How did we do the experiment?
   - What was the result and what did we learn?

Some suggestions for the processing discussion

- Discuss the general symptoms of fungus and bacterial diseases. Can virus disease easily be detected in disease culture?
- What if the leaf has fungus as well as bacterial diseases? How to interpret the result?
- What happens with symptoms over time?
- What is the difference between dry and wet and between warm and cold?

- How can you distinguish primary and secondary attack? Is the control leaf needed?
- What field conditions will favor development of disease?
- How does the disease spread? Is there more than one way?
- How does disease enter the plant ?
- How long did it take before spores or mycelia were visible (fungus diseases)?
- Can you now recognize disease at an earlier stage?
- Is it necessary to distinguish between fungus and bacterial diseases (in relation to control)?
- What diseases in your crop is it useful to be able to distinguish?
- Where on the plant do you find the symptoms?
- Is the disease a problem for the crop? Why? (quantity, quality)
- How can you get or discover additional information you need for decision making?

Exercise No.6.05

DISEASE CULTURE :
RECOGNIZING DISEASE SYMPTOMS OF POTATO BLIGHT AND WILT

When is this exercise most appropriate?

- In FFS, TOT and VST sessions.
- When potato blight and bacterial wilt are present in local potato fields.
- When farmers are interested to discover and recognize more vegetable diseases.

How long will this exercise take?

- 1-2 hours of an FFS meeting to start, 1 hour of the following FFS meeting.
- 1 hour of observation by farmers on the day following the first FFS meeting.

Learning objectives

- To discover how a disease culture can help farmers to observe and recognize different vegetable diseases.
- To observe the symptoms of the diseases in detail.
- To discover that high humidity encourages the growth of the disease.

Materials

- potato fields with bacterial wilt, early blight and late blight (the facilitators will need to scout for these in advance of the FFS meeting)
- samples from diseased plants
- 50 plastic bags and 50 pieces of tissue paper
- water
- pentel pens to write labels on bags
- manila paper
- pencils, pens and crayons

Steps

1. Go for a field walk to the potato fields with the FFS participants. During the field walk ask the farmers to share their experiences about potato diseases commonly observed in their fields. Some suggested guide questions:
   - What diseases can we recognize in this field? What do the different disease symptoms look like? Are there any disease symptoms that are difficult to identify?
   - What things caused the different diseases that we find here? When do the diseases usually appear in the fields? When do they not appear?
   - Why do the diseases appear? Why do they not appear?

2. Lead the farmers to work in small groups and collect a few samples of each kind of potato disease they can find. Request all facilitators to take part and guide the each small group in the exploration. Make sure that each group is able to collect examples of all the different diseases.

3. Return to the FFS 'classroom'. Ask each group to choose 5 examples of disease symptoms that they find difficult to recognize. Guide each small group to have at least 1 example of each disease. Split each sample into 2 sub-samples.

4. Let the participants draw and describe each pair of samples using their hand lenses to look closely at the color and texture of the samples. Each small group should be responsible for 1 pair of samples. Ask them to record the following: the size, color, shape, texture, and smell, etc.

5. Give each small group 10 plastic bags, and 10 pieces of tissue paper. Put 1 sample of each pair onto a piece of moistened tissue paper in one plastic bag, the other onto a piece of dry tissue paper in the second plastic bag. Seal the plastic bags with a knot and label the bags with the name of the group and what was put in. Be sure to properly identify which of the drawings and descriptions made earlier relates to it.

6. Let each participant take home their pair of samples and keep them in a dark place until the next morning. Provide each with a piece of bond paper on which they can make a second drawing and description of each sample. Require them to record the following: size, color, shape, texture, any development of the disease symptom, any growth on the surface of the disease symptom, any distinctive smell, etc.

7. At the next weekly meeting, let each participant to make a presentation of what they have observed. Discuss the observations in the big group.

   Notes on symptoms :

   After 12 hours in dark in 'wet tissue' Disease Culture the following characteristics should be observed for late and early blights:

LATE BLIGHT	EARLY BLIGHT
Clear, pale, white zone of mycelia growth along the edges of the leaf spot.	No clear, pale, white zone along the edges of the leaf spot. If there is some mycelia, it will be all across the spot

Some suggestions for the processing discussion

- How many different types of disease symptom did we find?
- How did the different types of disease symptom look (color, shape, texture) and smell?
- What changes were observed in the different types of disease symptoms when they were put in the disease culture overnight?
- Was there any difference in these changes between the 'moistened tissue' and the 'dry tissue' disease cultures? - What can we conclude from these observations?
- Was it useful to make the disease cultures? Why?

Exercise No. 6.06

DISEASE CULTURE : HUMIDITY AND DEVELOPMENT OF LEAF SPOT IN CABBAGE

When is this exercise most appropriate?

- In FFS, TOT and VST sessions.
- When leaf spot is abundant in the field (e.g., wet season!)
- When the farmers are interested to know more about how and when leaf spot develop.

How long will this exercise take?

- 30 minutes in the field
- 30 minutes in "classroom" for preparation of presentations.
- 10 minutes daily observation for at least 1 week.
- 1-2 hours follow up session.

Learning objectives

- To discover what environments favor leafspot occurrence and development in cabbage.
- To describe the symptoms of leafspot at various stage of the disease development in cabbage.

Materials

- Cabbage plants in the field with leaf spots
- Petri dishes
- Plastic bags and rubber bands
- Tissue paper
- Paper and crayons
- manila paper, bond paper, pencils, pens and crayons

Steps

1. Go to the cabbage field where leafspots are present. Collect leaves with leaf spot. Keep them fresh for the next activity. (They can also be collected when the farmers do their AESA).

2. Brainstorm to gather relevant information from farmers. Some suggested guide questions:
   - When does leafspot occur?
   - When does it not occur? (e.g., hot season)
   - What factors make it occur or not occur?

3. Go back to the "classroom". Cut two leaf portions with small leaf spots and place each into a petri-dish.
   - Mark a leaf spot on the leaf portion in each of the petri-dish with a pentel pen or any marker.
   - Place one of the leaf portion in a petri-dish with moistened tissue paper and label it WET.
   - Place the other leaf portion in a petridish with dry tissue paper and label it DRY.
   - Draw the leaf spot found in the leaf portions in each of the petri-dish for later reference
   - Cover the petri-dishes with a lid.

4. Use two whole leaves with small leaf spots
   - Mark a leaf spot on each with a marker
   - Place one of the leaves in a plastic bag or jar with dry tissue paper
   - Place the other leaf in a plastic bag or jar with moistened tissue paper
   - Draw the leaf spot for later reference
   - Close the plastic bag or jar tightly

5. You may use also any of the following : 2 potted plants with small leaf spots; or place 2 leaves with small leaf spots in 2 vases; or try it on live plants in the field.
   - Mark leaf spots on each with a marker.
   - Add water with sugar for the leaves to be placed in the vases.
   - Label one treatment dry and label it DRY.
   - Draw the leaf spot for later reference
   - Moisten one treatment, cover it with a big transparent plastic bag and label it WET.

6. Brainstorm in big group to find out what's important to observe. Write down all the ideas and agree on a common set of observation to do. Observe daily as long as the leaves are fresh, the size of the leaf spots in the different treatments and write the observations in your note book. Make a new drawing of the leaf spots when or if it changes. It could be someting like this:
   - Are the leaf spots growing bigger?
   - Is any small cotton or hair-like structures developing on the spots (mycelium or spore houses). Use a hand lens.
   - Are there differences between treatments?

7. Give each small group 30 minutes to prepare a presentation to the big group about the observations. How can you explain what you see? Include your drawings. The drawings are very important in the discovery process because the observations go through the hand, the eyes and they can be compared. Drawings also do not require that you can be a good writer or speaker.

Some suggestions for the processing discussion

- What happens with a leaf spot over time? (e.g., color, structure, area around spot)
- What is the effect of "wet" and "dry" conditions on the leaf spots?
- How can you use this information in your crop management weekly? When planning?
- How can you recognize that a leaf spot is beginning to develop?
- How long did it take before spore houses were visible?
- What is the size of a spot that carries spores?
- What field conditions will favor development of the disease?

Exercise No. 6.07

FIELD WALK AND SHARING OF IDEAS : VIRUS DISEASES OF VEGETABLES

When is the exercise most appropriate?

- In FFS, TOT and VST trainings
- When there are suspected virus disease symptoms in the field.

How long will exercise take?

- 1 hour for introductory participatory discussions
- 1.5 hours in the field
- 2 hours for presentation and follow-up participatory discussions.

Learning objectives

- To understand more about how virus disease are spread and how to avoid them.

Materials

- Vegetable field with suspected virus disease
- Manila paper, pentel pens, crayons,
- Syringe without a needle
- 6 transparent glasses
- Strong dark coffee or other colorful liquid

Steps

1. Lead the participants in sharing their experiences and ideas about virus diseases:
   - What are the symptoms of virus diseases? Explain.
   - What other symptoms can virus diseases be confused with?
   - Are there are simple methods to distinguish virus diseases? Why is it useful to distinguish virus diseases? [13]

2. Conduct field walk in a vegetable field with suspected virus infections and let the participants collect specimens with the following instructions:
   - Before uprooting the suspected specimens or breaking the leaves off describe them. They will look different after a while when removed.
   - Note how are the plants with symptoms distributed in the field?

3. Before leaving the field, look for farmers in FFS or neighboring fields and ask for the following :
   - What is the disease history of the crop and the field where the virus disease was observed?
   - Is it a new or a regular problem in the field?
   - Where did the farmer get his seeds?
   - When did the problem become first visible?
   - Have there been sucking insects or scale pests? If yes what did he do then?

4. Each group selects different plants that are suspected to have virus and Make a drawing of the symptoms. Be specific about where on the plant the symptoms are located. Answer the following questions :

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13 Virus disease is very difficult to deal with, to identify and to distinguish. It can easily be confused with some deficiencies and physiological disorders. The distribution of the symptoms could in some cases be a help. Deficiencies are usually not single plants but in plots. Virus could be single plants scattered over the field. Correct fertilizer can cur deficiencies in early stages.

- Where does the disease come from? (e.g., soil, air, other plants, etc.)
- How does it spread?(If you do not know how might it spread, based on the information you got from the farmer)
- How does it enter the plant?
- At what stage of the plant does it enter?
- At what stage will symptoms be visible?
- How important is the disease for the farmer?

  Note :

  Nobody knows all viruses, nobody can distinguish between all viruses based on symptoms and different viruses have a different lifecycles. Therefore, the above questions can only be answered by expectations based on what have been observed and what information comes from the farmer. It is very important to realize that we might only guess some of the answers and might be wrong. But the answers will help us to develop a general knowledge and understanding of virus diseases. They can also help us designing experiments that can confirm or disprove our theories.

5. While the participants prepare their presentations, the facilitator prepares one paper chart for each of the questions with the respective headings.
   - Conclude each group presentation with adding the information on these charts. You will then end up with a description of different symptoms, different sources, different ways of spreading, etc.
   - After all presentations, ask the participants if they have something more to add.

6. Usually, farmers know that sucking or scaling insects can spread some diseases. Ask if they know how sucking or scale insects can spread virus diseases.

7. Illustrate it using five glasses of clean water (representing the healthy plants), one glass of dark strong coffee (representing a plant with virus) and a syringe (representing an aphid or a sucking insect).
   - Suck on the virus plant (filling the syringe half with coffee)
   - Go to a healthy plant but now before sucking empty some of the coffee. The dark coffee will be clearly seen in the clean water
   - Go to the next healthy plant and repeat again... and again. Usually less and less "coffee virus" will be seen, but more than one glass (plant) will be contaminated with the coffee 'virus'.
   - Discuss the nature of winged aphids. They move between several plants before they settle down. Before they suck they first spit out what they have in the stylet (mouth parts)
   - The facilitator should try the demonstration before the session to gain confidence with the experiment

8. If there is still enough time, one group or the facilitator group can role play what will happen when the aphids are sprayed with insecticide as a control measure.
   - First the aphids sit permanently on one plant and will therefore not spread virus.
   - When they are sprayed they try to get away from the insecticide and leave their previous host plant. While getting weaker they suck on a couple of plants transferring the virus.
   - The day after insecticide application a few aphids from other fields come through the field, testing a few plants.

9. Brainstorm with the participants on what will likely happen and whether they believe that insecticides will control the spread of the virus.

10. If you feel tempted and in very high spirit (or need) you can also brainstorm on how to set up an experiment (e.g., a pot experiment) to learn more about virus.
    - One aphid safe cage with a healthy and a sick plant and no aphids
    - One aphid safe cage with a healthy and a sick plant and aphids

Some examples of exercises:

In potatoes, you could select healthy and virus-infected seeds tubers from the previous season. The development of plants should be observed for the whole season. There is a high risk for failure since some viruses are also transmitted by contact. You also have to consider if you need replicates and how many, etc.

Another experiment could be a comparison of the farmers own seeds (tomato) taken from a previous crop and certified seeds. Grow them in pots in insect safe cages. Be aware that only few viruses are transmitted by seeds. Also, that certified seeds are not a guarantee for virus-free seeds. There are some tolerances.

11. In the TOT and VST, ask the participants how they would do this exercise in FFS.

Some suggestions for the processing discussion

Note : Examples should support the answers.

- Will sick plants always have symptoms? If one percent of the plants have symptoms, what will you do? If 50 percent of the plants have symptoms, what will you do?
- Do plants have resistance to virus? Which stage is more resistant, old plants or young plants?
- What pesticides can control virus? Does spraying of sucking insects help to control virus? Why not? Do aphids die immediately after spraying? What are they doing until they are dying?
- What aphids are most problematic, the many that are established in colonies on the plants or the few that are searchers and take a journey through your field sucking on different plants to find a good host?
- Can seeds carry virus? Is there any chemical treatment for seeds? Is there any physical treatment for seeds?

- Can virus survive in the soil? Can virus be soil borne? If yes, give examples Can virus be wind borne?
- How can spread of virus by man be minimized?
- How long does a sucking insect have to suck a virus-infected plant to be contaminated? How long time does a contaminated aphid have to suck a healthy plant to infect it?
- What is a persistent, semi persistent and a non persistent virus? (with farmers no clear definition is needed but the understanding that not all sucking insects are equal problematic).

Exercise No. 6.08

POT EXPERIMENT :
LIMING, pH AND CLUBROOT CONTROL IN CABBAGE

When is this exercise most appropriate?

- In FFS, TOT and VST sessions
- In barangays where club root is present.
- When farmers are interested to discover how liming works.
- Early during the FFS season (e.g., it will take a total of 3 months to complete the activity).

How long will the exercsie take?

- Up to 3 months - it depends on how mature you want the plants to be when you make the final assessment of clubroot damage.
- 2-3 hours on the 1st day, daily care of seedlings for 1 month, daily care of developing cabbages for 2 months, 2-3 hours final processing.

Learning objectives

- To understand that lime changes the acidity (pH) of soil.
- To discover by how much the local soil acidity is changed with different amounts of lime.
- To understand that it is the change from high to low soil acidity that suppresses clubroot.
- To discover at what pH the clubroot is suppressed in the soil.
- To estimate how much lime is needed (and what is the cost) to make a pH change that is sufficient to suppress clubroot in the local soil.

Materials

- cabbage fields with clubroot and without clubroot infestations (facilitators need to scout for these in advance of the FFS meeting).
- 5 plants heavily infested with club root (collect during the Field Walk-Step 1).
- clay pots, or plastic bag pots suitable for 1 full sized cabbage plant per pot.
- lime
- local soil
- 6 sacks or large plastic bags for mixing treatment samples of soil.

Steps

1. Go on a field walk with the FFS participants. Observe the fields both with clubroot and without clubroot. During the field walk, ask farmers to share their experiences about clubroot in a big group discussion. Some suggested questions:
   - Where do you find clubroot? Where do you not find clubroot? Why do you not find it in these places?
   - How does the clubroot spread? What can you do about clubroot when it is in your field?
   - What does the lime do? How many farmers use lime? How well does it work? Do you want to find out some more about how liming works?

2. Collect at least 10 clubroot infested plants from a field that already has clubroot and take them to the processing area.

3. Collect and measure desired volume of soil into the pots from a pile of clubroot infected soil, break-up any lumps and mix them well. Add fertilizer and chicken dung according to a pre-determined rate.

4. Divide the participants into small groups and get each group to use the STK to measure the pH of the soil, lime and vinegar requirements. Get the farmers to discuss what will happen when they add lime to the soil, or what would happen if they added vinegar to the soil.

5. Prepare the pots with clubroot infected soil depending on how many treatments (e.g., 2, 3, 4, or 5 for each group), replications (e.g., can we have as few as 3?), Label the bags to say what treatment they will be given.

6. Chop up the clubbed roots (size?) and mix together. Divide the mixture evenly into each pot of soil.

7. Calculate and add lime to each pot of soil and mix well (e.g., how much per treatmet?). Measure the pH before starting the experiment and during pre-determined period of crop growth.

8. Label the pots with soil for each treatment. Measure also the soil pH every week.

9. When the limed pots are prepared, let it stand for at least a week before planting. Water the soil when it gets dry. Discuss in the big group whatever changes in acidity were observed.

10. Plant at least 2 seeds per pot. Monitor daily and water as needed.

11. At least a week after seeding emergence, plant new seeds in pots without germinating seed or thin if there are more than two seedlongs in a pot. Count the number of clubroot infected seedlings at this stage.

12. Take care of the potted plants until they are desired. Measure the pH weekly and get other relevant data observed.

13. At harvest time, measure the final pH of the soil and assess the degree of clubroot infection? Put the plants in a row and get each small group to do a visual assessment. Measure the size of the clubbed root. Weigh the cabbage heads. Describe the quality of harvest or product.

Some suggestions for the processing discussion

- How many replicates and treatments do we need to be practical?
- How can we predict the level of pH to come out of a certain amount of lime applied?
- Will it be possible to measure the change in the acidity of the soil if it is in a pot?
- Which treatment had the greatest degree of clubroot damage? Which had the least?
- How did the pH change in the different lime treatments? How did the amount of clubroot relate to the pH? Why do we need to add lime 1 month before planting?
- How much lime would you need to treat a whole field of cabbages to get a good control of club root? How much would this cost per head of cabbage?
  How often would you need to apply lime? How much is the average cost over X years per head of cabbage?

Exercise No. 6.09

FIELD EXPERIMENT FOR BACTERIAL WILT OF POTATOES : HOW DO THE BACTERIA SPREAD?

When is this exercise most appropriate?

- In FFS, TOT and VST sessions.
- When bacterial wilt is present in local potato fields.
- When farmers are interested to discover more about how the disease spreads.

How long will the exercise take?

- 2 - 3 hours of an FFS meeting to start the exercise, regular (daily during the first week and weekly thereafter) monitoring of the growing plants (about 5 minutes each time), 2-3 hours of an FFS meeting to do the final processing.
- Usual care of potato plants during development.

Learning objectives

- To discover that the most common way to spread bacterial wilt is through contamination of wet, damaged tubers by a diseased tuber.

Materials

- 20 pieces of dry, uncontaminated, undamaged, healthy seed tubers
- 2 small plots, side-by-side in one field (in an area where bacterial wilt is already present) each of sufficient size to plant 10 tubers
- 1 tuber infected with bacterial wilt
- 1 bucket or other container big enough to put in 10 seed tubers
- I knife, clean dry tools for preparing land and planting potatoes
- staked labels for each field plot (e.g., DAMAGED, NO DAMAGE, CONTAMINATED, and NON-CONTAMINATED)

Steps

1. Go on a field walk to a potato field which has bacterial wilt infected plants. Ask the farmers to share their ideas about how the bacterial wilt disease spreads. Ask them if they would like to do an experiment to see whether seed tubers can be infected before planting.

2. Go to the plots where the experimental seeds will be planted.

3. Get farmer volunteers to plant 10 healthy, dry, undamaged tubers in one plot BEFORE anybody handles the infected tuber. Make sure that the plots are clear of infected materials. Don't damage the tubers, or get them wet, during the planting.

4. Get the farmers to damage the other 10 tubers (e.g., by scraping or scratching with the knife or a stick, or making other damages that they think could be made during planting).

5. Let the farmers place the damaged tubers in bucket with the infected tuber. Sprinkle a little water over the tubers to dampen them. Shake the tubers around well so that they are all contaminated by the infected tuber.

6. The farmers now plant the infected tubes in the second plot. Again, make sure that the plot is clear of other infected materials (e.g., we want to see if the infection can be caused by the contamination and damage).

7. Take care for the potato seedlings as necessary.

8. Observe the plants regularly as they grow. Let the farmers record the following information:
    - Make a note of when the first wilt symptoms occur..
    - When the plants are at early, mid-growth and mature stages or as desired, assess the amount of infection in both plots. Agree as a group on how to do this.

9. Discuss what the small groups has observed with the big group.

Some suggestions for the processing discussion

- When did the first wilt symptoms occur? Was this the same or different for each treatment? Why do you think this is so?
- What was the level of wilt damage for the 2 treatments? Was this the same or different for each treatment? Why do you think this is so?
- What do our discoveries tell us about the way in which bacterial wilt spreads?
- How can we use this information in our management of bacterial wilt?

Exercise No. 6.10

FIELD WALK AND BRAINSTORMING : POTATO CYST NEMATODES

When is this exercise most appropriate?

- In FFS, TOT and VST sessions.
- In areas where potato cyst nematodes are present.
- When farmers are interested in learning more about nematodes.
- When facilitators find that farmers oversee an important problem.

How long will the exercise take?

- At least 2.5 hours of the FFS, TOT and VST sessions.

Learning objectives

- To understand and learn how to avoid or manage nematode problems in vegetable fields.

Materials

- Potato field with cyst nematode infections
- Manila paper, pentel pen, crayons
- Hand lenses
- Plastic bags for specimens
- Wheat flour
- Rubber boots
- Farming tools
- Balance

Steps

1. First step will depend on the entry point for the topic. If there are symptoms found in nearby fields, it would be best to go there and study the symptoms right in the field.

Before going to the field:

2. Ask participants if they know the symptoms of cyst nematodes. List down all answers and synthesize in big group. Brief the participants on the following:
   - Observe how is the distribution of the disease in the field.
   - Uproot suspected plants and look at the roots with a hand lens.
   - If they find cyst on the roots, bring samples in a plastic bag to the 'classroom'
   - Clean their boots before leaving the field.

In the field after observations:

3. Ask where the nematodes live.

4. Demonstrate with the participants how cyst nematodes can spread with the soil (this will be most successful in wet season when the soil is wet), as follows:
   - Empty a 1 kg bag of wheat flour between the rows.
   - Walk through the flour with wet rubber boots.
   - Observe, take notes of the soil and wheat flour on the boots and conduct participatory discussions in big group.

5. Demonstrate also how to spread the nematodes with farm tools:
   - In a piece of land without crops, put some wheat flour on the ground.
   - Use the tools where the flour is spread and see how they spread. (This will be most successful in wet season when the soil is wet).
   - Observe, take notes of the soil and wheat flour distribution and conduct participatory discussions with the big group.

6. Demonstrate also how to spread the nematodes with water:
   - On sloping land you can often see where the water runs. Spread some wheat flour there.
   - Next day observe and take notes of how far it has gone with the water. It can be a little difficult to see when it "dilutes". The more the flour you use the easier to see.

7. Measure how many nematodes a man can spread:
   - In a non-infected wet field, ask one from each group to walk in loose soil with wet rubber boots.
   - Bring back the boots in a plastic bag with the adhering soil, observe and conduct participatory discussions wih the big group.

<u>In the Classroom :</u>

8. Give the following instructions for each small group to work on :
   - Draw the symptoms on the plant.
   - Draw the symptoms on the roots.
   - brainstorm in small group and indicate as many ways of spreading the disease you can think of.
   - If there are 2 cysts per 1 g of soil (it may be unrealistic) and there are 400 eggs in each cyst, how many nematodes did you then bring back from the field on the rubber boots? Brush off the soil and use the balance to weigh it.

9. Present the group work results.

10. Discuss in big group some nematode management strategy to stop it from spreading. Use the list that came out of an earlier group presentations for inspiration.

11. Discuss also for ways of managing nematodes not related to how they spread in the field.

12. Based on the above discussions, ask where farmers are not following sound or appropriate practices. In the TOT and VST sessions, you might want to find out with farmers during next barangay immersion.

Some suggestions for the processing discussion

- How many eggs are there in one cyst?
- How long can they survive in the soil?
- When will the eggs in the cyst hatch?
- Is crop rotation good nematode management strategy? What are its limitations?
- Are there other hosts of cyst nematode aside from potatoes?
- Will you put your eggplant nursery in an infested field?
- Will it be good to wash seed potatoes to avoid nematodes? Why not?
- What is the relationship between resistant varieties and potato cyst nematodes?[14]
- Will you stop growing potatoes?
- How can plant quarantine and certified seeds help you?
- Where did you store the potatoes?
- How did you carry the potatoes to the store room?
- Is there anywhere they can analyze soil samples for nematodes in the area?
- Are nematodes available? economical? Safe? Banned?

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14 Resistant varieties are attacked, but the nematodes can not complete their life cycle. Therefore the number of cysts and eggs in the soil will be reduced.

Exercise No. 6.11

FIELD EXPERIMENT :
WILL LEAF REMOVAL WORK FOR LEAFSPOTS OF CABBAGE?

When is this exercise most appropriate?

- In FFS, TOT and VST trainings
- When leaf spot is abundant in the field
- When the farmers are using leaf removal for the management of leaf spot, and they want to see how well it works.
- When farmers are interested in experimenting with leaf removal, for the management of leaf spot.

How long will exercise take?

- From the time leaf spots are observed in the field until harvest.

Learning objectives

- To gain skills on leaf removal as a management strategy for leaf spots and increase knowledge on the profitability of the strategy when used in cabbage production
- To improve understanding of the function of leaves. (e.g., when are they needed and when not?)

Materials

- learning field
- Note book, ball pen

Steps

1. Brainstorm with farmers about their usual practices in leaf spot control. Take note that the leaf removal trial is not a recommendation but a method to validate, if the method is practiced or suggested by some farmers.

2. Agree how big areas are needed in the experiments (e.g., how many plants? rows? or beds?)

3. Discuss how often it is necessary to remove affected leaves and what to do with the leaves afterwards.

4. Observe plant development weekly in the different treatments (e.g., number of leaves or plant height). Compare yield by harvest.

5. Conduct participatory discussions, synthesize output and make some concrete recommendations.

Some suggestions for the processing discussion

- Is there a better yield in the plot with leaf removal?
- Is there a better quality in the plot with leaf removal?
- If yes, is it profitable when the cost of leaf removal is considered?
- Are leaves with spots not good for the plant at all? What does that depend on?
- What will you do about your field if: 1% of the plants have spots? 75% of the plants have spots?
- What happens to the disease inoculum when leaves are removed? (does it disappear or does it spread?)
- What would be your future recommendation about leaf removal?

KASAKALIKASAN, the Philippine National IPM Program, aims to make IPM the standard approach to crop husbandry and pest management in major rice, corn and vegetable areas in the Philippines. The Program adheres to a common vision shared by farmers, extension workers and policy makers:

- *As an ecological approach,* **KASAKALIKASAN** promotes sustainability by helping farmers apply IPM principles in crop production while learning to optimize the use of resources through the management of the agro-ecosystem. Analysis and action revolve around three basic principles: (1) growing a healthy crop through the use of resistant varieties, better seed selection processes, efficient nutrient, water, soil and weed management; (2) conserving beneficial predators and parasites; and (3) observing fields regularly to determine management actions necessary to produce a profitable crop.

- *As a human resource development program,* **KASAKALIKASAN** seeks to assist farmers in developing their ability of making critical and informed decisions that render their farming systems more productive, profitable and sustainable. Training helps farmers to make their own decisions, to organize themselves and their communities, and to create a strong working network with other farmers, extension workers and researchers. Through season-long Farmer Field Schools, farmers become experts in their own fields. Training methods become tools for continued inquiry and improvement by farmers.

On May 3, 1993, President Fidel V. Ramos issued Memorandum Order No. 126 instructing the Department of Agriculture to implement **KASAKALIKASAN** in collaboration with Local Governments and Non-Government Organizations. **KASAKALIKASAN** is the Philippine Government's commitment to Agenda 21 of the United Nations Conference on Environment and Development in promoting sustainable agriculture and rural development.

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