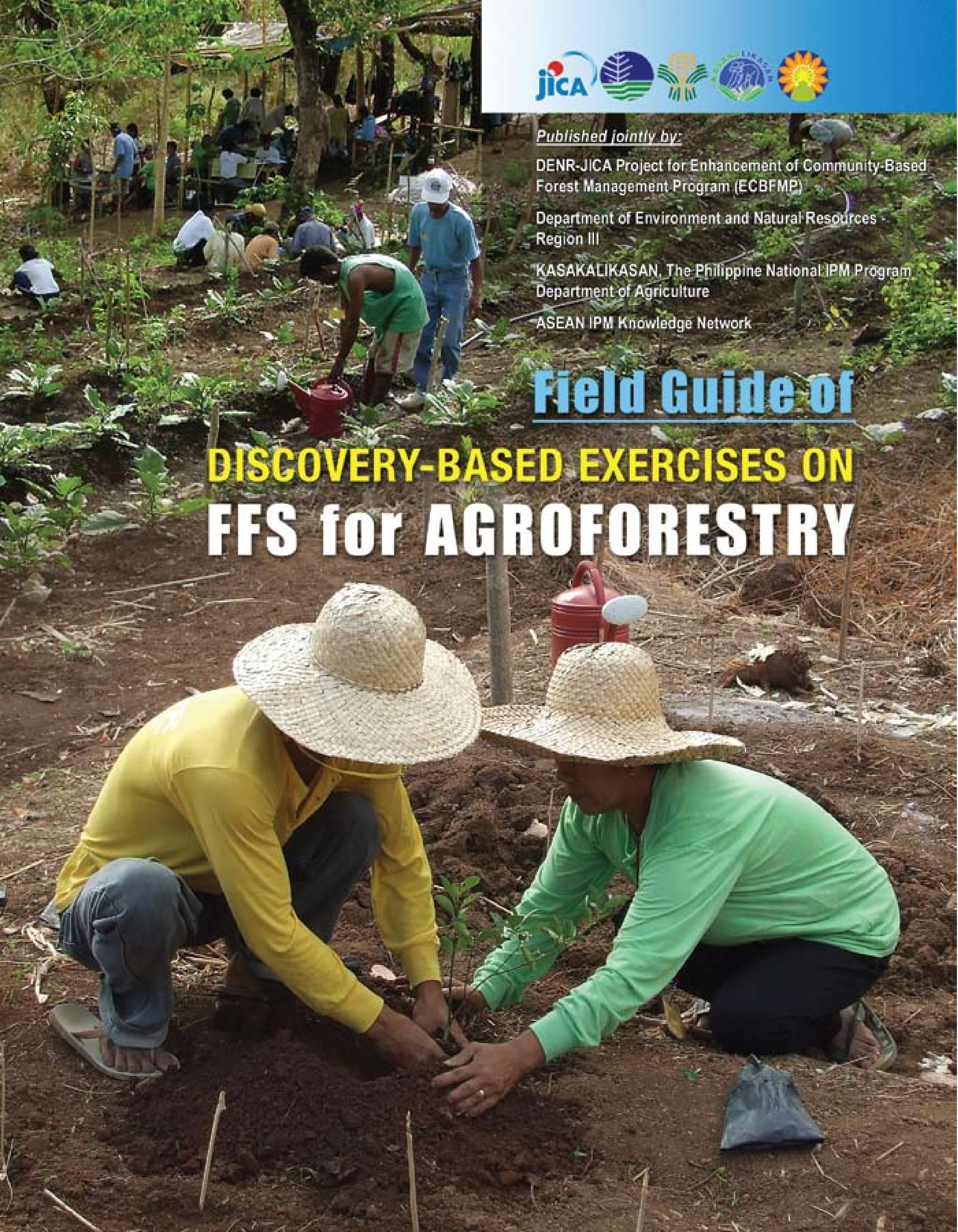

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ASEAN IPM Knowledge Network

Field Guide of DISCOVERY-BASED EXERCISES ON FFS for AGROFORESTRY

Foreword

The ***Field Guide of Discovery-based Exercises on FFS for Agroforestry*** is part of a series of handy training guidebook co-published by the Project for Enhancement of Community-Based Forest Management Program (ECBFMP), Department of Environment and Natural Resources-Region III, Department of Agriculture's National IPM Program (KASAKALIKASAN), and ASEAN IPM Knowledge Network (ASEAN IPM).

This field guide is a compilation of the best practices and learning experiences of farmer field school (FFS) facilitators and farmer-practitioners, as well as the lessons learned by technical experts on agroforestry practices in the Philippines and the Asia-Pacific region. It consists of useful exercises, which could enhance experiential, discovery-based, and participatory learning approaches among FFS farmer-participants on nursery management and forest plantation establishment; soil and nutrient management for the uplands; insect pests and diseases management; and livelihood and post production technologies.

This book has been enriched by extensive contributions of technical experts and practitioners of agroforestry and farmer education from Provincial Environment and Natural Resources Office (PENRO) Tarlac, Community Environment and Natural Resources Office (CENRO) Camiling, Regional Crop Protection Center (DA-RCPC III), Bureau of Plant Industry Crop Protection Division (DA-BPI-CPD), and from Local Government Units (LGU) of Municipalities of Mayantoc and Camiling, Tarlac, as well as from the Province of Tarlac and from other stakeholders.

We are exceedingly pleased to note that ECBFMP, DENR-RIII, KASAKALIKASAN, and ASEAN IPM are making enormous and valuable contributions in the promotion of sustainable agroforestry in the Philippines and within the ASEAN and Asia-Pacific regions.

JOSE L. ATIENZA, JR.
Secretary
Department of Environment and Natural Resources

FIELD GUIDE OF DISCOVERY-BASED EXERCISES ON FFS FOR AGROFORESTRY

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CHIHARU HIYAMA

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DENR-JICA Project for Enhancement of Community-Based Forest Management Program (ECBFMP)
Department of Environment and Natural Resources-Region III
The Philippine National IPM Program (DA-KASAKALIKASAN)
ASEAN IPM Knowledge Network (ASEAN IPM)

Field Guide of Discovery-based Exercises on FFS for Agroforestry. This field guide is based from best practices and learning experiences shared by participants in a series of workshops, namely: (a) *Curriculum Development Workshop on FFS for Agroforestry* held on 17-19 June 2008; (b) *First Assessment and Curriculum Modification Workshop on FFS for Agroforestry* held on 16-17 December 2008; (c) *Write-shop on Field Guide of Discovery-based Exercises on FFS for Agroforestry* held on 13-15 January 2009; and (d) *Second Agroforestry FFS Assessment and Field Guide Modification Workshop* held on 21-23 April 2009. Likewise, the exercises in this field guide were validated by FFS farmer-participants and facilitators in two (2) season-long *FFSs for Vegetable-based Agroforestry Production* conducted in Mayantoc and Camiling, Tarlac, Philippines on 27 June-28 November 2008 and 03 February-28 April 2009, respectively.

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Preface

The Department of Environment and Natural Resources (DENR) and Japan International Cooperation Agency (JICA) jointly implement the Project for Enhancement of Community-Based Forest Management Program (ECBFMP) to promote conservation, rehabilitation, and sustainable use of forest and land resources within CBFM areas. This objective is accomplished by empowering peoples' organizations and other local stakeholders through participatory and experiential methodologies, such as the farmer field school (FFS), so that they will be capacitated to eventually undertake sustainable development activities on their own initiatives.

For almost two decades now, the Philippine National IPM Program (KASAKALIKASAN) had accumulated tremendous learning experiences in using FFS approach to successfully implement local IPM programs nationwide. The approach develops farmers' ability to make critical and informed decisions that render their crop production systems more productive, profitable, and sustainable. On the other hand, ASEAN IPM Knowledge Network (ASEAN IPM) helps national government and non-government organizations within ASEAN region to improve effectiveness of program implementation by making knowledge sharing easy among national IPM programs and ensuring that information held is accurate, relevant, and up to date. Among the most notable tasks of ASEAN IPM is support to program development, which includes the packaging and reuse of knowledge capital for training methodology and curriculum development; program management and implementation; policy and advocacy; and project preparation and evaluation.

A concrete output along this line, **Field Guide of Discovery-based Exercises on FFS for Agroforestry**, is co-published by ASEAN IPM, DENR-JICA-ECBFMP, and KASAKALIKASAN. This field guide integrates best practices and learning experiences of FFS facilitators and farmer-practitioners, as well as the lessons learned by technical experts on agroforestry farming systems in the Philippines and the Asia-Pacific region. Among others, this field guide is a compilation of useful exercises on nursery management and forest plantation establishment; soil and nutrient management for the uplands; insect pests and diseases management; and livelihood and post production technologies, which could enhance experiential, discovery-based, and participatory learning approaches among agroforestry FFS farmer-participants.

We are very confident that this practical guidebook will be exploited, adapted, or modified by agroforestry farmer field school (AGF-FFS) facilitators in conducting season-long FFSs for agroforestry crops production not only in the Philippines but in other Asia-Pacific countries as well, when and where they judge them to be valuable.

KENSEI ODA
Project Chief Advisor, ECBFMP

Acknowledgement

We are exceptionally delighted to acknowledge all community-based forest management program (CBFMP) farmers and facilitators of agroforestry farmer field school (AGF-FFS), academicians, researchers, private practitioners, and other agroforestry stakeholders for their laudable efforts in moving forward to achieve the ultimate goals of their local community-based forest management programs through sustainable agroforestry interventions as enabling tools of people empowerment in the Philippines and other Asia-Pacific countries. The experiences they shared in various endeavors formed the basis of many AGF-FFS best practices and learning experiences compiled in this new field guide.

Our heartfelt appreciation goes to the technical experts from Philippine Department of Agriculture's National IPM Program (KASAKALIKASAN) and ASEAN IPM Knowledge Network (ASEAN IPM), headed by Dr. Jesus S. Binamira; Department of Environment and Natural Resources-Region III (DENR-RIII), headed by Mr. Antonio G. Principe; DENR-JICA Project for Enhancement of Community-Based Forest Management Program (ECBFMP), headed by Mr. Marlo D. Mendoza; Bureau of Plant Industry's Crop Protection Division (BPI-CPD), headed by Ms. Wilma R. Cuaterno; and Department of Agriculture's Regional Crop Protection Center 3 (DA-RCPC3) headed by Ms. Rosario C. Lizarondo, for their laudable support afforded, without which this field guide may not have been completed.

Likewise, unparalleled recognitions are given to many resource persons and practitioners of agroforestry farming systems from Tarlac College of Agriculture (TCA), Department of Agriculture's Regional Field Unit 13 (DA-RFU13) and Cordillera Administrative Region (DA-RFU-CAR), as well as from Local Government Units (LGU) of Bataan, Davao Norte, Tarlac, and Zambales for their wide-ranging and innovative contributions.

Moreover, this manual may not have been published without the concurrence and financial assistance extended by the Japan International Cooperation Agency (JICA) and Department of Environment and Natural Resources (DENR).

Acronyms and Abbreviatons

AGF-FFS	Agroforestry Farmer Field school
AFESA	Agroforestry Ecosystem Analysis
Ammophos	Ammonium Phosphate
Ammosul	Ammonium Sulfate
ASEAN	Association of Southeast Asian Nations
ASEAN IPM	ASEAN IPM Knowledge Network
AT	Agricultural Technologist (or Technician)
ATI-NTC	Agricultural Training Institute-National Training Center
AVDF	Alliance of Volunteers for Development Foundation
AVRDC	Asian Vegetable Research and Development Center
BCA	Biological Control Agent
BIOACT	*Paecilomyces lilacinus* (soil fungus' commercial preparation)
BOT	Bacterial Oozing Technique
BPI	Bureau of Plant Industry
BPI-BNRDC	BPI-Baguio National Research and Development Center
BPI-CPD	BPI-Crop Protection Division
Bt	*Bacillus thuringiensis* (bacterium)
BSF	Baseline Survey Form
BSU	Benguet State University
Ca	Calcium
CAR	Cordillera Administrative Region
CBDCP	Community Biodiversity Development and Conservation Programme
CBFMP	Community-Based Forest Management Program
CENRO	Community Environment and Natural Resources Office (or Officer)
CHARM	Cordillera Highland Agricultural Resources Management Project
CIED	Centro de Investigacion, Educacion y Desarollo
CO_2	Carbon Dioxide
CP	Calcium Phosphate
CSF	Contour Strip Farming
CSP	Certification Standards of the Philippines
CRA	Cost and Return Analysis
DA	Department of Agriculture
DA-CARFU	DA-Cordillera Administrative Regional Field Unit

DA-CECAP	DA-Central Cordillera Agricultural Project
DBM	Diamondback Moth
DENR	Department of Environment and Natural Resources
ECBFMP	Project for Enhancement of Community-Based Forest Management Program
EYCO	Egg Yolk + Cooking Oil spray mixture
FARM	Farmer-centered Agricultural Resources Management Project
FAO	Food and Agriculture Organization
FCP	Farmers' Crop Protection
FFS	Farmer Field School
GLM	Green Leaf Manuring
GMF	Green Muscardine Fungus (*Metarhizium anisopliae*)
GMO	Genetically Modified Organisms
GOP	Government of the Philippines
GR	Gross Return
HARRDEC	Highland Agricultural Resources Research and Development Consortium
ICM	Integrated Crop Management
IDM	Integrated Disease Management
IIBC	International Institute for Biological Control
IFAD	International Funds for Agricultural Development
IFOAM	International Federation of Organic Agriculture Movements
IMO	Indigenous Micro-organisms
IPM	Integrated Pest Management
IRM	Integrated Rodent Management
ISNM	Integrated Soil Nutrient Management
JICA	Japan International Cooperation Agency
K	Potassium
KASAKALIKASAN	Kasaganaan ng Sakahan at Kalikasan (National IPM Program)
LGU	Local Government Unit
Limestone	Calcium or Magnesium Carbonate
MAD	Man-Animal Days
MAO	Municipal Agricultural Office (or Officer)
MBF	Microbial-based Fertilizers
MD	Man-Days
Mg	Magnesium

MI	Maturity Index
MMD	Man-Machine Days
N	Nitrogen
NAFC	National Agricultural and Fishery Council
NCT	Non-aerated Compost Tea
NE	Natural Enemies (e.g., predators, parasitoids, insect pathogens)
NFB	Nitrogen-fixing Bacteria belonging to genus *Azospirillum*, isolated from roots of 'talahib' [*Saccharum spontaneum*] grass
NFE	Non-formal Education
NGO	Non-government Organization
NPO	National Program Office (or Officer)
NPV	Nuclear Polyhedrosis Virus
NR	Net Return
OCCP	Organic Certification Center of the Philippines
OFS	Organic Foliar Sprays
OPA	Office of the Provincial Agriculturist
OSF	Organic Solid Fertilizers
O_2	Oxygen
P	Phosphorus
PA	Provincial Agriculturist
PCARRD	Philippine Council for Agriculture and Resources Research and Development
PEDIGREA	Participatory Enhancement of Diversity of Genetic Resources in Asia
PENRO	Provincial Environment and Natural Resources Office (or Officer)
PGCPP	Philippine-German Crop Protection Programme
pH	Negative logarithm of hydrogen ion concentration in soil solution (log 1/[H])
Phil-Organic	Philippine Organic Agriculture Information Network
PPB	Participatory Plant Breeding
PTD	Participatory Technology Development
Quicklime	Calcium or Magnesium Oxide
RCPC	Regional Crop Protection Center
RCT	Refresher Course for Trainers
RKN	Root-knot Nematode
ROI	Return on Investment
RST	Rice Specialist Training
S	Sulfur

SALT	Sloping Agricultural Land Technology or Sloping Agroforestry Land Technology
SEAMEO	Southeast Asian Ministers of Education Organization
SEARCA	SEAMEO Regional Center for Graduate Study and Research in Agriculture
SEARICE	Southeast Asia Regional Initiative for Community Empowerment
Slaked Lime	Calcium or Magnesium Hydroxide
STK	Soil Test Kit
STT	Sap Transmission Technique
TLC	Total Labor Cost
TMC	Total Material Cost
TOS	Training of Specialists
TOT	Training of Trainers
Trichoderma	*Trichoderma* sp. (e.g., *pseudokoningii, parceramosum* and *harzianum* species)
TVD	Tymo Virus Disease
UPLB	University of the Philippines Los Baños
VST	Vegetable Specialist Training
WHC	Water Holding Capacity
WHO	World Health Organization
WMF	White Muscardine Fungus (*Beauveria bassiana*)

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Annexes

Section 1

INTRODUCTION

Section 1

INTRODUCTION

ABOUT THE FIELD GUIDE

This *Field Guide of Discovery-based Exercises on FFS for Agroforestry* is designed for use in agroforestry farmer field schools (AGF-FFSs). The exercises in this field guide were based from best practices and learning experiences shared by FFS facilitators and farmer-practitioners, as well as by technical experts (**Annexes A** and **B**) during a *Curriculum Development Workshop on FFS for Agroforestry* and an *Assessment and Curriculum Modification Workshop on FFS for Agroforestry* held on 17-19 June 2008 and 16-17 December 2008 at Camiling, Tarlac, Philippines, respectively. A number of these exercises were either updated versions or totally new ones enriched by experienced AGF-FFS facilitators and specialists (**Annex C**) during a *Write-shop on Field Guide of Discovery-based Exercises on FFS for Agroforestry* held on 13-15 January 2009 at San Fernando, Pampanga, Philippines. Appropriate exercises were likewise adapted from *Field Guide of Discovery-based Exercises for Vegetable IPM [Volumes I*[1] and *II*[2]*]*, which were based from experiences by FFS farmer-participants and IPM facilitators during the past one and a half decades of their local IPM program implementations. In a most recent volume, many applicable exercises integrated in this new field guide were shared by participants, facilitators, and resource persons (**Annex D**) in a previous one-month intensive *Refresher Course for Trainers of Integrated Pest Management in Crucifers and Other Highland Vegetable Crops* held in Benguet, Philippines on 27 September to 17 October 1998.

To further ensure aptness and practicability, the exercises in this field guide were validated by participants, facilitators, and technical experts (**Annexes E** and **F**) in season-long *FFSs for Agroforestry (vegetable-based)* conducted in Barangay Maniniog, Mayantoc, Tarlac and Barangay Papaac, Camiling, Tarlac, Philippines, on 27 June to 28 November 2008 and 3 February to 28 April 2009, respectively. As a result, a number of exercises were simplified or new ones were integrated in this field guide by participants, facilitators, and technical experts (**Annex G**) during an *Assessment and Field Guide Modification Workshop on FFS for Agroforestry* held on 21-23 April 2009 at Camiling, Tarlac, Philippines. `

This new field guide is a collection of discovery-based exercises that facilitators can use and adapt, when and where we judge them useful. We involved as many agroforestry stakeholders as was possible in compiling

1 Philippine National IPM Program. 1997. Field Guide of Discovery-based Exercises for Vegetable IPM (Volume I). National Agricultural and Fishery Council, Department of Agriculture, Diliman, Quezon City, Philippines. 1-1/6-40p.

2 Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. 366p.

and redesigning these field exercises. While these exercises belong to us, this field guide will achieve nothing until we start to put new ideas into action. The discovery-based exercises contained in this field guide are divided into seven wide-ranging sections, namely: (i) introduction; (ii) general topics; (iii) nursery management and forest plantation establishment; (iv) forest ecology and agroforestry (v) integrated soil and nutrient management for the uplands; (vi) integrated pest management for agroforestry crops; and (vii) post production and livelihood technologies for agroforestry system.

With ownership comes responsibility. It is our responsibility to update and modify this field guide as new experiences and ideas come out of our own FFS activities in vegetables and other agroforestry crops production. Some additions have to be made to these exercises, because we did not have enough time to fill all gaps and refine all steps. This means that we might need to revise and redesign what is written here as often as necessary, based on feedback and future experiences.

WHAT IS A DISCOVERY-BASED EXERCISE?

During our previous workshops we returned repeatedly to these 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 ideas of what we were aiming for:

Go to the field

The field provides main learning material for FFS and other fields in barangay (village) 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 activities are rooted in the field, they are also based on what is happening in the field at *this time*. We cannot generally discover something *now* if it either happened in the past, or will happen in the future. Therefore, 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 a particular 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 areas where they are lacking in technical information or understanding.

What do farmers want and need?

The people who are discovering in FFS are primarily FARMERS!

People remember[3]: 20% of what they HEAR
40% of what they SEE
80% of what they DISCOVER FOR THEMSELVES.

3 Hope, A. and Timmel, S. 1994. Training for Transformation 1: A Handbook for Community Workers. Mambo Press, Gweru, Zimbabwe. pp99-120.

Some of the things that FFS group discovers are also new to us. Nevertheless, 'discovery-based' exercises aim to help participants remember more of what they are learning. Therefore, we must choose exercises based on what 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 cannot 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 cannot 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 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 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* farmer field school *SUSTAINABLE*!

GENERAL GUIDELINES FOR DISCOVERY-BASED EXERCISES!

In consideration of the above, participants in recently concluded curriculum development workshops[4],[5],[6], as in previously conducted IPM refresher course[7], agreed on some general guidelines in conducting discovery-based exercises for FFS on vegetables and other agroforestry crops production namely: (a) exercise should be preceded by a field activity (e.g., field walk, field observation, field visit, etc.); (b) procedure should enhance participatory, discovery-based, and experiential learning; (c) exercise should be designed to facilitate regular FFS activities, such as agro-ecosystem analysis (AFESA), field studies, cultural management practices, and special topics; (d) exercise should encourage use of biological control and discourage indiscriminate use of pesticides; and (e) exercise should use appropriate non-formal education techniques (NFE) as learning tools.

Format for exercises

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

When is this exercise most appropriate?

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

BACKGROUND AND RATIONALE

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

How long will this exercise take?

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

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4 Callo, Jr., D.P. 2008. Highlights of Outputs. Workshop on Designing Farmer Field School Curriculum on Integrated Pest Management for Organic Vegetable Production held on 28-30 April 2008 at the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development Council (PCARRD), Los Baños, Laguna, Philippines.

5 Callo, Jr., D.P. 2008. Highlights of Outputs. Write-shop to Develop A Field Guide of Discovery-based Exercises for FFS of IPM on Organic Vegetable Farming conducted in the Philippines on 17-19 June 2008 at the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development Council (PCARRD), Los Baños, Laguna, Philippines.

6 Callo, Jr., D.P. 2009. Highlights of Outputs. Write-shop on Field Guide of Discovery-based Exercises for FFS on Agroforestry held on 13-15 January 2009 at San Fernando, Pampanga, Philippines

7 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp1-30.

Learning objectives

- What we aim to discover from an exercise.

Materials

- What equipment, supplies, and materials you will need to collect or prepare in advance.

Methodology

- A list of non-formal education methods or approaches used to facilitate an exercise (e.g., field walks and observations, sharing of experiences, brainstorming, participatory discussions in small or big groups, role-playing, hands-on or simulation exercise, and others).

Steps

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

Some suggested questions 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 an exercise is based on a guided discussion, processing may already be included in the STEPS section.

FFS CURRICULUM ON AGROFORESTRY

The agroforestry farmer field school (AGF-FFS) brings farmers together to carry out an intensive training on integrated production and pest management (IPPM) methods and issues over the life cycle of agroforestry crops. The AGF-FFS trains farmers to become experts in their own fields. The AGF-FFS training team (e.g., composed of facilitators) is assisted by agricultural technicians and foresters assigned in an agroforestry area where the AGF-FFS is located[8].

The principles that guide an AGF-FFS learning process are:

- *The field is the primary learning resource.* All learning activities take place in the field and are based on what is happening in the field.

- *Experience forms the basis for learning.* The activities that take place in the field and their farms form the basis for discussions and analyses by farmers who arrive at concepts which they test and improve through further field activities.

- *Decision-making guides the learning process.* Training focuses on analysis of agroforestry ecosystem of agroforestry crops. The combination of analytical methods, ecological principles, and basic IPPM methods helps farmers gain insights into the ecological interactions in an agroforestry field and provide them with greater confidence in making crop management decisions.

- *The training curriculum is based on local conditions of the AGF-FFS.* The AGF-FFS curriculum and materials are based on their appropriateness, the local conditions, problems, and needs of farmers in the AGF-FFS.

- *Training last the entire cropping season.* Farmers acquire a firm understanding of relevant IPPM concepts for each growth stage of agroforestry crops as well as the factors that influence crop management decision-making at all stages of plant's growth.

An AGF-FFS (vegetable-based) consists of 25-30 farmers meeting for half day each week, during 23 weeks. The field school has at least 1,000 sq. meter 'learning field' containing a farmer-run comparative study of IPPM and other relevant field experiments.

8 Callo, Jr., D.P. 2008. Accomplishment Report: Season-long Training of Trainers (TOT) for Facilitators of Farmer Field Schools (FFS) on Integrated Pest Management (IPM) for Corn-based Production System. Local Government Support Program to ARMM (LGSPA) of the Canadian International Development Agency (CIDA), Davao City, Philippines. 94p.

The actual activity guides used in recent farmer field schools for agroforestry (vegetable-based)[9] are shown in **Annexes H**, **I**, and **J**. A typical profile of an IPM farmer field school for rice, corn, cotton, coconut, vegetables, mango, and other crops at any given day is[10]:

- *Field observation: 07:00-08:00 am.* Farmers form small groups, makes observations of the whole field, and then examine 5 staked plants per plot, recording agronomic data per plant, type and number of insects, and any other details.

- *Agro-ecosystem analysis: 08:00-09:00 am.* Each group prepares drawing of their field observations including information on the condition of plants, pests and diseases; natural enemies of insect pests; weather, soil and water conditions.

- *Presentation and discussion: 09:00-10:00 am.* Each group presents drawings of their drawings and discusses their observations and conclusions. The whole group reaches consensus about crop management practices that they will carry out during the coming week.

- *Break: 10:00-10:15 am.* A short break allows participants and facilitators to refresh and invigorate themselves in preparation for the succeeding activities.

- *Group dynamics exercise: 10:15-10:30 am.* This activity aims to stimulate attention and participation, as well as strengthen group communication and increase solidarity.

- *Special topics: 10:30-11:30 am.* The facilitator guides the group in experiments, lessons, exercises, and discussions on special topics related to what is actually occurring in agroforestry field.

- *Evaluation and planning: 11:30-12:00 nn.* This activity allows the group to identify 'what went well' and 'what needs improvement' of the day's activities and plans activities to be undertaken in the coming week.

9 Esteban, I. D. 2008. JICA Report: Agroforestry-Farmers Field School. Department of Environment and Natural Resources (DENR) Region 3, San Fernando, Pampanga, Philippines.

10 Bruan, A.R., G. Thiele, and M. Fernandez. 2000. Farmer Field Schools and Local Agricultural Research Committees: Complementary Platforms for Integrated Decision-Making in Sustainable Agriculture. Agricultural Extension Network Department for International Development (DFID), Overseas Development Institute (ODI), London, United Kingdom. 15p.

Section 2

GENERAL TOPICS FOR FARMER FIELD SCHOOLS

Section 2

GENERAL TOPICS FOR FARMER FIELD SCHOOLS

The discovery-based exercises under this section were compiled to help participants better understand and apply agroforestry principles through farmer field schools[11]. Compiled here are general and introductory topics based from experiences shared by farmer field school (FFS) facilitators in implementing local vegetable IPM programs since two previous field guide volumes were published in 1997[12] and 2002[13], respectively. Included in this section are exercises tried and proven by our FFS facilitators to be effective in enhancing participants' understanding of integrated pest management (IPM) concepts and principles, which are likewise relevant in vegetables and other agroforestry crops production, such as:

- *What is in a box: Non-formal education versus formal education.* This exercise was designed to enhance participants' understanding of concepts and principles of non-formal education as it apply to FFS for agroforestry.

- *Gathering and using baseline data for impact evaluation of farmer field schools on agroforestry.* This exercise was designed as a run through of exercise on 'Ground-working' and 'Barangay Immersion' for Farmer Field Schools.

- *Facilitating problems of absenteeism in farmer field schools for agroforestry.* This exercise was designed as follow-up exercise on 'Managing Farmer Field Schools' and 'How to Establish Participatory Norms'.

- *'Ballot box' for farmer field schools on agroforestry: Developing functional questionnaires for pre- and post-evaluations.* This exercise is valuable for developing an evaluation instrument to assess pre- and post-training knowledge and skills gained by FFS participants in agroforestry.

- *Agroforestry ecosystem analysis for farmer field schools on agroforestry: Establishing minimum data for decision-making.* This exercise is useful for developing a tool for making a crop management decision in vegetables grown with agroforestry crops.

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11 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp1-30.

12 Philippine National IPM Program. 1997. Field Guide of Discovery-based Exercises for Vegetable IPM (Volume I). National Agricultural and Fishery Council, Department of Agriculture, Diliman, Quezon City, Philippines. pp2-1 to 2-124.

13 Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp11-54.

- *Field layout and agroforestry ecosystem analysis format for farmer field schools on agroforestry.* This exercise is worthwhile for designing appropriate field layout of participatory technology development (PTD) studies in FFS learning field.

- *Keeping records of farm activities: Guided discussions on 'why' and 'what' to record for an agroforestry farming enterprise.* This exercise was designed so that farmers will be aware of why they keep careful records of production and labor costs in learning field studies and in their own farms.

- *Cost and return analysis of agroforestry farming enterprise.* This activity was designed as a follow-up of exercise on 'Keeping Records of Farm Activities: Guided Discussions on *Why* and *What* to Record for Agroforestry Farming Enterprise'.

- *Folk media presentation: A simple way to convey innovative agroforestry messages.* This activity was designed as one of culminating activities to highlight FFS results during 'Simultaneous Field Day and Graduation Ceremonies for FFS on Agroforestry'.

- *Simultaneous field day and graduation ceremonies: Conveying innovative agroforestry messages by results presentation.* The conduct of simultaneous field day and graduation ceremonies is an occasion when farmers and facilitators show other people or the community what they have learned and the results of their participatory technology development (PTD) activities.

Exercise No. 2.01[14]

WHAT IS IN A BOX: NON-FORMAL EDUCATION VERSUS FORMAL EDUCATION

When is this exercise most appropriate?

- In TOT and TOS sessions, when supplemental or additional exercise is needed to further enhance participants' understanding of concepts and principles of non-formal education.

BACKGROUND AND RATIONALE

Non-formal education (NFE) methods and approaches, as knowledge management strategies, bring about sharing of knowledge and creation of new knowledge, and in this process empowers participants. Activities focus on allowing participants to observe, discuss, interact, brainstorm as well as perform analysis, make decisions, and solve problems[15].

Essentially, NFE is a participatory educational process based on assumptions of adult learning. When adult learners decide to participate in any learning activity, they bring along a wealth of experience, knowledge, and skills. They are armed with their own beliefs, values, and convictions. They have their own perceptions, biases, and feelings. With such a background, an adult learner is the richest resource in a learning process[16].

NFE methods and approaches encourage participants to see themselves as source of information and knowledge about a real world. When they are encouraged to work with knowledge they have from their own experience, they can develop strategies together to change their immediate situations. This learning experience takes place in several ways as described below[17]:

- *Existing popular knowledge is recognized and valued.* Learning process starts with an assumption that participants already possess some knowledge. Participants do not start with a clean slate. In this approach, synthesis of popular knowledge with existing scientific knowledge strengthens learning experience of participants.

- *New knowledge is built on existing knowledge.* In a learning process, a starting point for creating new knowledge is an existing knowledge that people have particularly authentic elements of it. As people

14 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp13-16.

15 Callo, Jr. D.P., W.R. Cuaterno, and H.A. Tauli (eds). 1999. Handbook of Non-Formal Education and Team Building Exercises for Integrated Pest Management. SEAMEO Regional Center for Graduate Study and Research in Agriculture, College, Laguna, Philippines. pp5-7.

16 Ortigas, C.D. 1997. Training for Empowerment. Office of Research and Publication, Ateneo de Manila University, Loyola Heights, Quezon City. p13-26.

17 Society for Participatory Research in Asia. 1987. Participatory Training for Adult Educators. Society for Participatory Research in Asia Publication, New Delhi, India. p7-9.

begin to appreciate what they already know, they are more open to seek new information. This desire to seek new information and knowledge enhances learning process.

- *Participants learn to exercise control.* A learning process puts emphasis on active participation of participants in generating their own knowledge. This encourages them to take responsibility for their own learning. It is this active posture which constitutes a powerful impetus for learning and for learners to exercise control over their learning.

- *Learning becomes a collective process.* One of the elements of NFE is a promotion of collective responsibility for seeking new knowledge. As a result, participants learn to get together, collectively seeking and analyzing information.

- *Learning creates informed options.* The very process of collectively analyzing a given situation throws up various alternatives. As part of a process of analysis, options are debated based on concrete information. As a result, participants are able to accept and reject options on an informed basis. This creates a sense of empowerment, which is based on confidence that information has been understood and interpreted.

- *Actions emerge out of this analysis.* The very act of involvement in a process of analyzing a given reality creates a sense of ownership of that knowledge and willingness to transform that situation. Participants are then able to take concrete actions.

Thus, where possible, facilitators should create a learning situation where adults can discover answers and solutions for themselves. People remember things they have said themselves best, so facilitators should not speak too much. They need to give participants a chance to find solutions before adding important points a group has not mentioned. Likewise, it was mentioned earlier that people remember 20 percent of what they hear, 40 percent of what they see, and 80 percent of what they discover for themselves[18].

In this regard, this exercise was designed primarily to enhance participants' understanding of concepts and principles of non-formal education (NFE) as they apply to farmer field school (FFS) in agroforestry.

How long will this exercise take?

- At least 30 minutes for simulation game; and
- At least 30 minutes for brainstorming and sharing of experiences.

18 Hope, A. and Timmel, S. 1994. Training for Transformation 1: A Handbook for Community Workers. Mambo Press, Gweru, Zimbabwe. pp99-120.

Learning objectives

- To differentiate non-formal education from formal education techniques; and
- To further enhance participants' understanding of concepts and principles of non-formal education.

Materials

- Manila paper, marking pens, notebooks, and ball pens

Methodology

- Simulation game, brainstorming, and sharing of experiences

Steps

1. A facilitator fills a box with 10 different objects and asks each small group to choose three representatives from among themselves;

2. A first set of representatives (one from each group) is asked to stand in front and beside a facilitator who then shakes the box for about two minutes while each representative listens. Representatives are then requested to take their seats, then try to list down the contents of above box based from what they heard while box was being shaken, without conferring with each other;

3. A second set of representatives (one from each group) is again asked to stand in front and beside a facilitator who again shakes the box for about two minutes while each representative listens. Afterwards, each representative is asked to touch the contents of the box, one after another, without looking what is inside. Representatives then take their seats and try to come up with their own list of contents of the box, without conferring with each other;

4. A third set of representatives (one from each group) is again asked to stand in front and beside a facilitator who again shakes the box for about two minutes while each representative listens. Afterwards, each representative is asked to touch and see the contents of the box, one after another. Representatives then take their seats and try to come up with their own list of contents of the box, without conferring with each other;

5. Remaining participants are instructed to observe ongoing activities; and

6. A facilitator will then request each set of representatives from each small group to read their lists before the big group. A facilitator compares the lists made by each set of representatives and process the activity.

Some suggested questions for processing discussion

- ❑ Which set of representatives listed more objects? Why?
- ❑ What learning principles characterize each game as exemplified by each set of representatives?
- ❑ Which learning principles can we adopt in a farmer field school on agroforestry?
- ❑ What is non-formal education? How do you differentiate it from formal education?
- ❑ Which form of education is more relevant for agroforestry farmers? Why?

Exercise No. 2.02[19]

GATHERING AND USING BASELINE DATA FOR IMPACT EVALUATION OF FARMER FIELD SCHOOL ON AGROFORESTRY

When is this exercise most appropriate?

- In TOT and TOS for agroforestry, one to two weeks on or before a session on Agroforestry; and
- After a community land-use map has already been prepared and validated.

BACKGROUND AND RATIONALE

The local agroforestry farmer field school (AGF-FFS) training team, as a pre-FFS activity, carries out task of ground-working. Ground-working determines actual needs in an area, which will ultimately be used as basis in developing local AGF-FFS programs on agroforestry crop production. Thus, largely, success of a local AGF-FFS program is directly related to quality of ground-working activities conducted.

One very useful component activity of ground-working is gathering of baseline data from AGF-FFS farmer-participants. Baseline data are important for comparison with current data when stakeholders review and assess impact of local AGF-FFS programs to farmer-participants and their communities. The formulation of appropriate recommendations, which will form courses of actions or interventions, will depend on accurateness of baseline data gathered.

Hence, usefulness of baseline data is contingent on accurate gathering of pertinent agroforestry data. AGF-FFS facilitators must regularly share their experiences in gathering and using baseline data to continuously evolve better FFS approaches relevant for agroforestry crop production. This exercise was designed as a run-through of exercises on ‘Ground-working’ and ‘Barangay Immersion’ for AGF-FFS on agroforestry crop production.

How long will this exercise take?

- One to two hours for field walks and farmers’ interviews one week before starting an AGF-FFS session;
- Thirty minutes to one hour for brainstorming session in processing area; and
- Thirty minutes to an hour of additional farmers’ interviews on first week of an AGF-FFS session.

19 Adopted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp17-25.

Learning objectives

- To make participants aware and understand importance of proper gathering and using baseline data for designing and evaluating AGF-FFS programs; and
- To learn innovative approaches and do hands-on of gathering and using baseline data for designing AGF-FFS programs on agroforestry crop production.

Materials

- Community spot or soil map indicating farm sites of prospective AGF-FFS participants;
- Farmer-validated baseline survey form for agroforestry crops growing (see Form A)[20]; and
- Office supplies (e.g., Manila papers, notebooks, ball pens, and marking/pentel pens).

Methodology

- Field walks, observations, farmers' interviews, and brainstorming.

Steps

1. Review farm sites of prospective AGF-FFS farmer-participants from a community spot or soil map earlier developed by AGF-FFS training team members;

2. Divide participants in small groups and each group secure enough copies of farmer-validated baseline survey forms for agroforestry crops;

3. Using a community spot or soil map, go to prospective AGF-FFS farmer-participants, explain objective of survey, interview as many farmers as possible, and fill up baseline survey forms (e.g., personal information, farm profile, farm management, and production data);

4. Return to processing area and brainstorm in small groups on initial data gathered and methods used in data gathering. Present observations and experiences of small groups in a big group following:

   ☑ Who and how many additional farmers to interview;
   ☑ Items to exclude, include, or clarify in succeeding surveys;

20 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp56-59.

- ☑ Approaches and methods to use in gathering additional data; and
- ☑ How and when to use all baseline data gathered.

5. Complete baseline data gathering from at least 25-30 actual AGF-FFS farmer-participants on first week session;

6. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from exercise;

7. Use output of exercise on baseline data gathering in planning AGF-FFS program on agroforestry crop production in a community, such as:

   - ☑ Problems to be addressed (e.g. crop, pest, silvicultural problems, among others);
   - ☑ Number and schedule of AGF-FFS to be conducted; and
   - ☑ Type and schedule of follow-up activities to sustain AGF-FFS program on agroforestry crop production.

Some suggested questions for the processing discussion

- ❑ What is a baseline survey? What is a baseline survey form?
- ❑ Why do we need to conduct baseline survey? Who are respondents of baseline surveys? What data do we need to gather in a baseline survey?
- ❑ What method or approach is most appropriate for gathering baseline data in farmer field schools on agro-forestry crop production?
- ❑ Can we use baseline data to plan present and future AGF-FFS activities on agroforestry crop production? How?
- ❑ When do we gather baseline data in farmer field schools? How often do we gather baseline data for AGF-FFS program implementation on agroforestry crop production?

FORM A

KASAKALIKASAN BASELINE SURVEY FORM FOR AGROFORESTRY

A. PERSONAL INFORMATION

1. **Name of Farmer:** ____________________
2. **Address:** ____________________
3. **Age:** __________ 4. **Sex:** [ ] Male [ ] Female
5. **Status:** [ ] Single [ ] Married [ ] Widow/Widower
6. **Education:** [ ] Elementary [ ] High School [ ] College
   [ ] Others: ____________________
7. **Name of Spouse:** ____________________
8. **Land Ownership or Possession:** [ ] Public Forest [ ] Private
9. **Tenural Status:** [ ] Owner/Cultivator [ ] Leaseholder [ ] Tenant
   [ ] Others (please specify): ____________________
10. **Size of Farmland holding:** ____________________
11. **No. of household members involved in farming:** ____________________
12. **Membership in community organizations:**

Organization	Position

13. **Last two trainings attended:**

	Sponsored by:	When

B. FARM PROFILE

1. **Farm Area (ha):** (a) major crop: __________ (b) other crop: __________
   area: __________ area: __________
2. **Soil Type**: ____________________
3. **Irrigation/Water Source:** [ ] NIA [ ] Communal [ ] Pump
   [ ] Rain-fed [ ] Others (Specify): __________
4. **Sources of income other than farming:** ____________________
5. **Source of Capital:**

	Dry Season	Wet Season
a. Credit		
Production Loan (Pesos)		
Percent per annum		
Source		
b. Self-financed (Pesos)		

6. Upland Crop Combination (arranged from largest area planted):

DRY SEASON	AREA (Ha.)	WET SEASON	AREA (Ha.)
1.			
2.			
3.			
4.			
5.			

C. FARM MANAGEMENT

1. Upland Crop Planted (Season ____________):

CROPS	AREA (Ha.)	VARIETY	SEED CLASS	RATE/HA	COST/HA
A. Trees					
1.					
2.					
3.					
4.					
5.					
B. Cash Crops					
1.					
2.					
3.					
4.					
5.					

2. Cost of Land Preparation:

CROPS	LAND PREPARATION		WEEDING/BRUSHING				
	Plowing	Harrowing	First	Second	Third	Fourth	Fifth
A. Trees							
1.							
2.							
3.							
4.							
5.							
B. Cash crops							
1.							
2.							
3.							
4.							
5.							

3. Seedbed Preparation, Planting and Fertilization:

CROPS	COST (Including Labor)		FERTILIZER USED			
	Seedbed	Planting	Quantity	Kind/Brand	Unit Cost	Appl'n Cost
1.	1.	1.	1a.	1a.	1a.	1.
			1b.	1b.	1b.	
			1c.	1c.	1c.	

2.	2.	2.	2a.	2a.	2a.	2.
			2b.	2b.	2b.	
			2c.	2c.	2c.	
3.	3.	3.	3a.	3a.	3a.	3.
			3b.	3b.	3b.	
			3c.	3c.	3c.	
4.	4.	4.	4a.	4a.	4a.	4.
			4b	4b.	4b.	
			4c.	4c.	4c.	
5.	5.	5.	5a.	5a.	5a.	5.
			5b.	5b.	5b.	
			5c.	5c.	5c.	

Have you been using organic fertilizers (e.g., animal manure, rice straw, compost, azolla, etc.) in your farm? [ ] Yes [ ] No If yes, since when? ______________________

4. Biological Pesticide Use

CROPS	INSECT PATHOGEN			BOTANICAL INSECTICIDE			MICROBIAL FOR DISEASES			O T H E R S		
	Qty	Kind	Unit Price	Qty	Kind	Unit Price	Qty	Kind	Unit Price	Qty	Kind	Unit Price
1.												
2.												
3.												
4.												
5.												

How many times did you spray your crop with biological pesticides? What was the cost of application?

CROPS	INSECT PATHOGEN		BOTANICAL INSECTICIDE		MICROBIAL FOR DISEASES		O T H E R S	
	No. of times	Cost of Appl'n	No. of times	Cost of Appl'n	No. of times	Cost of Appl'n	No. of times	Cost of Appl'n
1.								
2.								
3.								
4.								
5.								

What was your basis for spraying? Please check.

[ ] Farmer friend told me so
[ ] Technicians/pesticide dealer told me so
[ ] Following the calendar spraying
[ ] Others (please specify) ______

What were the common pest and other problems you have encountered ?

CROPS PLANTED	PEST PROBLEMS ENCOUNTERED	OTHER PROBLEMS ENCOUNTERED	ACTIONS/ MEASURES TAKEN
A. Cash crops			
1.			
2.			
3.			
4.			
5.			
B. Perrenial crops			
1.			
2.			
3.			
4.			
5.			

What insects/animals would you consider as friend or enemy of the farmer in your area ?

FARMER'S FRIEND	ENEMIES

D. PRODUCTION

(Season ________________):

CROPS	COST (Pesos)		YIELD PER HECTARE	
	Harvesting	Hauling	Kg/Cu. M. etc.	Amount (P)
A. Cash crops				
1.				
2.				
3.				
4.				
B. Perrenial crops				
1.				
2.				
3.				
4.				

Date Interviewed: __________________________ *Interviewer:* ____________________________

BALLOT BOX SCORE: PRE-TEST _______________ POST-TEST ________________

Exercise No. 2.03[21]

> **When is this exercise most appropriate?**
>
> - In TOT and TOS sessions, or by local AGF-FFS team, when absenteeism among farmer-participants of an on-going FFS is a problem.

FACILITATING PROBLEMS OF ABSENTEEISM IN FARMER FIELD SCHOOLS FOR AGROFORESTRY

BACKGROUND AND RATIONALE

In a previously concluded refresher course for trainers (RCT) of integrated pest management (IPM) in the Cordilleras[22], some positive experiences and lessons learned were shared by participants in facilitating and managing farmer field schools (FFSs). The most notable observations shared are: (1) protocols conducted by facilitators to involve local government unit (LGU) officials, consult with farmers right at beginning, and continuously feedback activities enhance local IPM program sustainability; and (2) facilitators' skills and perseverance contributed largely to FFS successes as farmer-participants try to replicate what facilitators practice.

However, one of the recurring problems experienced by facilitators is still absenteeism. The most common reason mentioned for absenteeism was attendance in community occasions and meetings. A number of recommendations were offered by FFS facilitators to solve absenteeism, such as: (1) proper orientation about FFS activity must be done right at the beginning; (2) facilitators should make weekly topics interesting; (3) absenting farmer-participants should be required to send advance notice of their absences and proxies should not be allowed for them; (4) absenting farmer-participants should be given importance by doing follow up on them and avoiding overemphasis on processing of absenteeism; and (5) FFS farmer-participants should be facilitated to organize themselves so that they can apply peer pressure to absenting farmer-participants.

The FFS facilitators can regularly share their learning experiences in solving problems of absenteeism among farmer-participants to further improve their individual facilitating skills and thus ensure sustained local FFS implementation on agroforestry. Thus, this forgoing exercise was designed as follow-up exercises on 'Managing Farmer Field Schools' and 'How to Establish Participatory Norms.'

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21 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. Pp26-28.

22 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp1-30.

How long will this exercise take?

- One to two hours for field walks to follow up absenting AGF-FFS farmer-participants anytime during an AGF-FFS session;
- Thirty minutes for brainstorming session; and
- Another one-two hour for field walks to follow up absenting AGF-FFS farmer-participants in succeeding AGF-FFS session.

Learning objectives

- To make participants aware and understand the importance of facilitating problems of absenteeism among farmer-participants of AGF-FFS to ensure sustained local agroforestry program implementation; and
- To learn innovative approaches from other facilitators and do hands-on of facilitating problems of absenteeism among AGF-FFS farmer-participants.

Materials

- Barangay spot or soil map showing farm sites of farmer-participants of an ongoing AGF-FFS; and
- Office supplies (e.g., Manila papers, notebooks, ball pens, and marking pens).

Methodology

- Field walks, farmers' interviews, and brainstorming.

Steps

1. Review farm sites of ongoing AGF-FFS farmer-participants from a barangay spot or soil map earlier developed by TOT and TOS participants, or by AGF-FFS training team members;

2. Divide big group in small groups and let each small group design their own strategy to facilitate absenteeism. Using a barangay spot or soil map as a guide, each small group goes to absentee AGF-FFS farmer-participants and implements designed strategy on how to:

   ☑ Show absentee farmer-participants that they are important in the success of ongoing AGF-FFS;
   ☑ Make absentee farmer-participants share their own problems in agroforestry;

- ☑ Convince absentee farmer-participants that regularly attending AGF-FFS will help them solve or better understand their problems in agroforestry; and
- ☑ Get assurance from absentee farmer-participants to continue attending succeeding AGF-FFS sessions;

3. Return to processing area and brainstorm in small groups on initial experiences in using designed strategy to facilitate absenteeism. Present observations and experiences of small groups in a big group;

4. Synthesize and summarize outputs of small groups into one big group outputs. Draw up conclusions and recommendations from exercise;

5. Use outputs of exercise to facilitate problems of absenteeism among farmer-participants in succeeding AGF-FFS sessions; and

6. Repeat steps 3-5.

Some suggested questions for the processing discussion

- ❑ What were the commonest causes of absenteeism among AGF-FFS farmer-participants?
- ❑ What strategies did you employ to facilitate problems of absenteeism among AGF-FFS farmer-participants? Which of the strategies employed worked best?
- ❑ What pre-FFS activities should be undertaken by an AGF-FFS training team to ensure regular attendance of AGF-FFS farmer participants?
- ❑ How can a facilitator ensure that topics are interesting in every AGF-FFS session?
- ❑ Did follow-up of absentee farmer-participants help solved problems of absenteeism in an on-going AGF-FFS?
- ❑ How did you show absentee farmer-participants that they are important in the success of the ongoing AGF-FFS?
- ❑ How did you make absentee farmer-participants share their own problems in agroforestry? How did you convince absentee farmer-participants that regularly attending AGF-FFS will help them solve or better understand their problems in agroforestry?
- ❑ How did you get assurance from absentee farmer-participants to continue attending succeeding AGF-FFS sessions?

Exercise No. 2.04[23]

'BALLOT BOX' FOR FARMER FIELD SCHOOLS ON AGROFORESTRY: DEVELOPING FUNCTIONAL QUESTIONNAIRES FOR PRE- AND POST-EVALUATIONS

When is this exercise most appropriate?

- In TOT and TOS, before pre- and post-FFS evaluations of participants' knowledge and skills in agroforestry system.

BACKGROUND AND RATIONALE

'Ballot Box' test is a field-based test administered to participants without using pen or pad papers. It uses specimens (e.g., materials, objects, plants or animals) in agroforestry system. Questions in a 'Ballot Box' evaluation dealt mainly on knowledge and skills in identification of plants and forest tree species pest and pest damages, disease symptoms, arthropod pests and their natural enemies, fertilizers and chemicals, as well as soil, irrigation, and environmental stresses in agroforestry[24].

For each question, there are three 'ballot boxes' representing possible correct answers to choose from and where participants put a replicate of their numbers corresponding to a correct answer. A question may refer to a plant indicated by a string attached to three specimens in an agroforestry system as possible answers. In another instance, a question may refer to a specimen indicated by a string attached to three plants in an agroforestry system as possible answers[25].

Past experiences showed that for a 'Ballot Box' test to be effective, questionnaires should be framed to focus on functions of organisms or specimens rather than on their technical definitions. This particular exercise was designed to develop functional 'Ballot Box' questionnaires for farmer field schools on agroforestry. This exercise is valuable for developing an evaluation instrument to assess pre- and post-training knowledge and skills gained by FFS participants in agroforestry.

23 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp29-37.

24 Callo, Jr. D.P., W.R. Cuaterno, and H.A. Tauli (eds). 1999. Handbook of Non-Formal Education and Team Building Exercises for Integrated Pest Management. SEAMEO Regional Center for Graduate Study and Research in Agriculture, College, Laguna, Philippines. pp179-180.

25 Philippine National IPM Program. 1997. Field Guide of Discovery-based Exercises for Vegetable IPM (Volume I). National Agricultural and Fishery Council, Department of Agriculture, Diliman, Quezon ci5ty, Philippines. pp2-23 to 2-26.

How long will this exercise take?

- At least 30 minutes for field walks and observations;
- At least 30 minutes for brainstorming and participatory discussions for development of questionnaires in small groups; and
- At least one hour for presentation and participatory discussions in big group.

Learning objectives

- To familiarize participants with commonest field problems of agroforestry;
- To improve participants' knowledge and skills in identifying field problems of agroforestry; and
- To improve participants' skills in developing appropriate and functional 'Ballot Box' questionnaires for AGF-FFS evaluation of farmers' knowledge and skills in agroforestry system.

Materials

- Fields of agroforestry crops at different stages near each other where commonest field problems can be observed;
- Cartolina cardboard or folders;
- Vials, rubber bands, marking pens, masking and scotch tapes, ball pens, threads or plastic straws, thumb tacks;
- Bamboo sticks, glue, fertilizer samples (e.g., inorganic and organic fertilizers); and
- Actual, live or preserved specimens.

Methodology

- Field walks and observations, brainstorming or participatory discussions

Steps

1. Divide big group in five smaller groups, assign each small group to a specific group of agroforestry interventions, go to an agroforestry area, as shown below:

   ☑ Forest species (e.g., trees and non-trees species)
   ☑ Hedgerow species (e.g., legumes, grasses, and others)
   ☑ Shade-tolerant crops (e.g., high, middle, and low under-story species)
   ☑ Vegetable crops (e.g., legumes, cucurbits, and solanaceous vegetables)
   ☑ Livestock (e.g., cattle, goat, and pig) and poultry (e.g., chicken and ducks)

2. Conduct field walks to identify, observe, and record the commonest field problems of agroforestry interventions in learning and adjoining fields, such as:

   ☑ Pests and diseases
   ☑ Deficiencies and toxicities
   ☑ Environmental stresses and other physiological disorders

3. Collect specimens of pests and their natural enemies, pest and disease damages, other abnormalities and physiological disorders of agroforestry interventions;

4. Go back to processing area or session hall to further observe and characterize collected specimens;

5. With guidance from a facilitator, brainstorm in small groups to develop functional 'Ballot Box' questionnaires for identifying commonest field problems of agroforestry interventions based on field activities conducted by:

   ☑ Focusing on functions of organisms or non-organisms in an ecosystem
   ☑ Avoiding questions requiring technical definition of specimens (e.g., organisms or non-organisms)

6. Present outputs of small groups to big group and conduct participatory discussions to improve questionnaires developed for each small group of agroforestry interventions. A sample shopping list of validated functional 'ballot box' questionnaires for pre- and post-evaluation of FFS on some important agroforestry interventions (*Note: Correct specimens are indicated by bold, underlined words.*) are shown below[26]:

   Forest species (e.g., timber and non-timber species)

   ☑ Which of these planting materials is a forest timber species? (specimens: **<u>agoho seedling</u>**, bamboo cutting, and rattan seedling)
   ☑ Which of these seedlings is a forest non-timber species? (specimens: **<u>rattan seedling</u>**, agoho seedling, and narra seedling)
   ☑ Which of these forest non-timber seedlings is not considered a palm? (specimens: anahaw palm seedling, **<u>rattan seedling</u>**, buri palm seedling)
   ☑ Which of these forest non-timber planting materials is not considered a grass species? (specimens: rattan seedling, **<u>buri palm seedling</u>**, bamboo cutting)

26 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp42-47.

- ☑ Which of these forest timber seedlings is considered a medium tree species? (specimens: teak seedling, **banaba seedling**, gmelina seedling)
- ☑ Which of these forest timber planting materials is considered a tall tree species? (specimens: ipil-ipil seedling, **gmelina seedling**, kakauwate cutting)

Hedgerow species (e.g., legumes, grasses, and others)

- ☑ Which of these legumes is not a hedgerow species? (specimens: **peanut**, ipil-ipil, and kakawate)
- ☑ Which of these legumes is a hedgerow species? (specimens: **morning glory**, mungbean, and cowpea)
- ☑ Which of these hedgerow grass species is not a good source of fodder or livestock? (specimens: Napier grass, **lemon grass**, Guinea grass)
- ☑ Which of these hedgerow grass species is not a good source of fodder or livestock? (specimens: citronella grass, **elephant grass**, lemon grass)
- ☑ Which of these contour crop planting materials is not considered a permanent crop species? (specimens: coffee seedling, **pineapple**, banana sucker)
- ☑ Which of these contour crop planting materials is considered a permanent crop species? (specimens: taro, **cacao seedling**, ginger)

Shade-tolerant crops (e.g., high, middle, and low under-story species)

- ☑ Which of these legumes is not a hedgerow species? (specimens: **peanut**, ipil-ipil, and kakawate)
- ☑ Which of these legumes is a hedgerow species? (specimens: **morning glory**, mungbean, and cowpea)
- ☑ Which of these hedgerow grass species is not a good source of fodder or livestock? (specimens: Napier grass, **lemon grass**, Guinea grass)
- ☑ Which of these hedgerow grass species is not a good source of fodder or livestock? (specimens: citronella grass, **elephant grass**, lemon grass)
- ☑ Which of these contour crop planting materials is not considered a permanent crop species? (specimens: coffee seedling, **pineapple**, banana sucker)
- ☑ Which of these contour crop planting materials is considered a permanent crop species? (specimens: taro, **cacao seedling**, ginger)

Legumes (Cowpea and String Bean):

- ☑ Which is a sucking insect pest? (specimens: **aphids**, cutworm, semi-looper)

- ☑ This insect pest (specimen: pod borer) attacks this crop (cowpea or string bean) at what stage? (specimens of three crop stages: flowering stage, **fruit setting stage**, seedling stage)
- ☑ Which of this specimen is considered a legume pest? (specimens: hover fly, **pod borer**, ladybird beetle)
- ☑ What caused this damage (specimen: cowpea or string bean plant with leaf-miner damage)? (specimens: **leaf miner**, aphids, mites)
- ☑ What cause this damage (specimen: cowpea or string bean seeds damaged by seed weevils) (specimens: **seed weevil**, aphids, mites)
- ☑ Which of these specimens is infected by bean rust? (cowpea or string bean plants infected by: **bean rust**, fusarium wilt, anthracnose)
- ☑ Identify which of these specimens is infected by fusarium wilt? (cowpea or string bean plants infected by: damping-off, **fusarium wilt**, powdery mildew)
- ☑ Which of these specimens is infected by anthracnose? (cowpea or string bean plants infected by: bean rust, leaf spot, anthracnose)
- ☑ Which of these diseases leaf removal and proper disposal can control? (cowpea or string bean plant infected by: bacterial wilt, **bean rust**, virus)
- ☑ Wind can spread the causal organism of which of these diseases? (cowpea or string bean plant infected by: **bean rust**, bacterial wilt, virus)
- ☑ Which of these specimens is a solid organic fertilizer? (specimens: compost-tea, **compost**, microbial-based fertilizer)
- ☑ Which of these specimens is a microbial-based organic fertilizer? (specimens: **Bio-N**, 46-0-0, 0-17-0)
- ☑ Which of these soils is fertile? (specimens: black loamy soil, red clayey soil, sandy soil)
- ☑ Which of these specimens is a farmer's friend? (specimens: **spider**, pod borer, aphids)
- ☑ Which of these specimens is a legume pest? (specimens: lady beetle, hover fly, **mites**)
- ☑ This (specimen: hover fly) is a natural enemy of which of these pests? (specimens: **aphids**, leaf miner, pod borer)
- ☑ Which of these specimens is a predator? (specimens: **preying mantis**, diamondback moth, *Diadegma sp.*)
- ☑ Identify which of these specimens is a natural enemy. (specimens: **ladybird beetle**, white fly, aphids)

Solanaceous Vegetables (Eggplant, Pepper, and Tomato):

- ☑ Which of these specimen is a vector of this (specimen: virus infected eggplant, pepper, or tomato plant) disease? (specimens: **aphids**, semi-looper, cutworm)
- ☑ What caused this (specimen: pinhole damage on eggplant fruit) damage? (specimens: pod borer, **fruit fly**, leaf miner)

- ☑ What caused this (specimen: tomato leaf damaged by cutworm) damage? (specimens: **cutworm**, aphids, thrips)
- ☑ This hole (specimen: tomato fruit with a hole caused by fruit worm) indicates the presence of what pest? (specimens: pod borer, aphids, **fruit worm**)
- ☑ Which of these specimens causes this (specimen: dried branches or twigs of eggplant) damage? (specimens: cutworm, **twig borer**, mole cricket)
- ☑ What disease does this pest (specimen: aphids) transmit? (specimens: bacteria, **virus**, fungus)
- ☑ Which of these diseases is not enhanced by humid weather conditions? (specimens: eggplant, pepper, or tomato plant infected with late blight, **virus**, damping off)
- ☑ Soil treatment and crop rotation can control which of these diseases? (specimens: eggplant, pepper, or tomato plant infected with blossom end rot, **fusarium wilt**, virus)
- ☑ Which of these diseases do bacteria cause? (specimens: **tomato plant infected with bacterial wilt**, tomato plant infected by fusarium wilt, tomato plant infected by mosaic)
- ☑ Which of these diseases does a fungus cause? (specimens: eggplant infected with bacterial wilt, **tomato plant infected by fusarium wilt**, tomato plant infected by mosaic)
- ☑ Which of these organic fertilizer materials enhance faster vegetative growth? (specimens: dried chicken dung, **microbial-based organic fertilizer**, fresh cow manure)
- ☑ Which of these soils is acidic? (specimens: **red clayey soil**, black loamy soil, sandy soil)
- ☑ Which of these materials improves soil texture? (specimens: **compost**, plain garden soil, commercial inorganic fertilizer)
- ☑ Which of these specimens is a predator of aphids? (specimens: ants, **hover fly**, thrips)
- ☑ What is most voracious stage of this (specimen: ladybird beetle) predator? (specimens: egg, **larva**, adult)
- ☑ Which of these animals is a farmer's friend? (specimens: cutworm, **frog**, aphids)
- ☑ Which of these animals is a natural enemy of aphids? (specimens: whitefly adult, cutworm larva, **syrphid fly larva**)
- ☑ Which of these stages is best time to do weeding? (specimens of eggplant, pepper, or tomato plants at: flowering stage, seedling stage, **vegetative stage**)

Parsley (Carrots and Celery):

- ☑ Which among these pests damaged this crop (specimen: carrot at vegetative stage damage by cutworm) at this stage? (specimens: aphids, **cutworm**, leaf miner)
- ☑ Which among these animals caused this (specimen: carrot modified root damaged by rodent) damage? (specimens: **rodent**, aphids, flies)
- ☑ Which of the following insects damage (celery plant damaged at basal portion by a mole cricket) the crop? (specimens: **mole cricket**, aphids, cutworm)

- ☑ Which among these animals is a farmer's friend? (specimens: leafhopper nymph, cutworm larva, **hover fly larva**)
- ☑ Which of these insects is considered as beneficial? (specimens: **ladybird beetle**, semi-looper larva, cutworm larva)
- ☑ Which of these soils is suited for this (specimen: healthy carrot plant)) crop? (specimen: clayey, sandy, **sandy loam**)
- ☑ What stage of crop is best to conduct hand weeding? (specimens showing carrot plant at: three weeks after sowing, **one month after sowing**, two months after sowing)
- ☑ Which of these specimens is a foliar organic fertilizer? (specimens: Bio-N, **fermented plant juice or FPJ**, vermi-compost)
- ☑ Which among these materials corrects soil acidity? (specimens: **lime**, chalk (powdered), urea)
- ☑ Which of these soils is a clay loam? (specimens: clay, **clay loam**, sand)
- ☑ Which of these materials is an inorganic fertilizer? (specimens: ash, ammonium sulfate, chicken dung)
- ☑ Which of these diseased specimens does a fungus cause? (specimens of carrot plants showing symptoms of: **powdery mildew**, root-forking, stem cracking)
- ☑ Which of these specimens is a physiological disorder? (specimens of carrot plants showing symptoms of: powdery mildew, **root-forking**, soft rot)
- ☑ Which of these diseased specimens is caused by nematodes? (specimens of carrot plants showing symptoms of: root knot nematodes, **powdery mildew**, stem cracking)
- ☑ Which of these disorders is caused by water stress and boron deficiency? (specimens showing symptoms of: soft rot, **stem cracking**, root-knot nematodes)
- ☑ This animal (specimen: preying mantis) is a predator of what insect pest? (specimens: flea beetles, **mole cricket**, aphids)
- ☑ Which of these parsley crops cannot be transplanted? (specimens: **carrot**, celery, parsley)
- ☑ In which of these soils will you normally have root-forking problem? (specimens: **gravely soil**, clay loam soil, sandy loam soils)
- ☑ Which of these specimens does not belong to parsley family? (specimens: carrot, celery, **green onion**)
- ☑ Which of these soils contains high organic matter? (specimens: clayey soil, **clay loam soil**, sandy soil)

Cucurbits (Ampalaya, Squash and Bottle Gourd):

- ☑ Which of these pests caused this (specimen: ampalaya, squash, or bottle gourd plants with cut leaves) damage? (specimens: mites, leaf miner, **cutworm**)
- ☑ Which of these pests caused this (specimen: ampalaya, squash, or bottle gourd plant showing dried vines) damage? (specimens: **vine borer**, cutworm, caterpillar)

- ☑ Which of these is a major pest of bottle gourd at this stage (specimen: cucumber at early vegetative stage) of crop? (specimens: **flea beetle**, thrips, fruit worm)
- ☑ Which of these pests caused this (specimen: fruit fly damaged fruit of ampalaya, squash, or bottle gourd) damage? (specimens: caterpillar, flea beetle, fruit fly)
- ☑ Which of these pests caused this (specimen: fruit worm damaged fruit of bottle gourd) damage? (specimens: caterpillar, flea beetle, **fruit worm**)
- ☑ Which of these animals is a friend of farmers? (specimens: cutworm, aphids, **coccinilid beetle**)
- ☑ Which of these pests can be controlled by overhead irrigation? (specimens: cutworm, **aphids**, semi-looper)
- ☑ Which of these disorders is aggravated by infertile soils? (specimens showing symptoms of: **flower abscission in ampalaya**, fruit rot in squash, virus-infected plant in ampalaya)
- ☑ This disease (specimen: bottle gourd plant with symptoms of a virus disease) is transmitted by which pest? (specimens: cutworm, **aphids**, rodent)
- ☑ Which of these pests flooding can control? (specimens: **cutworm**, aphids, semi-looper)
- ☑ Which of these disorders can be minimized by crop rotation? (specimens of bottle gourd showing symptoms of: flower abscission, **damping off**, nitrogen deficiency)
- ☑ Which of these specimens is a solid organic fertilizer? (specimens: **compost**, compost-tea, fermented fruit juice or FFJ)
- ☑ Which of this plant is suffering from lack of nitrogen? (specimens of ampalaya plants showing: **general yellowing**, curling of leaves, leaf spots)
- ☑ Which of these cucurbits is more resistant to virus diseases? (specimens: squash, **ampalaya**, bottle gourd)
- ☑ Which of these disorders is best controlled by uprooting and proper disposal? (specimens: **virus infected squash plant**, abscised flower of ampalaya, and aborted fruit of bottle gourd)
- ☑ Which of these cucurbits can be grown without trellis? (specimen seedlings of: **native ampalaya,** squash, and bottle gourd)
- ☑ Which of these bugs is a predator? (specimens: true bug, **assassin bug**, and green soldier bug)
- ☑ Which of these is a symptom of virus disease? (specimens: **rosetting of ampalaya leave**s, presence of powdery substance on squash leaves, and bottle gourd fruit damaged by fruit fly)
- ☑ Which of these materials contains high organic matter? (specimens: urea, solophos, and **compost**)

Some suggested questions for processing discussion

- ❑ What are some of commonest field problems of organically-grown vegetables observed in learning and adjoining fields?

- ❑ What problems are common to ampalaya, squash and bottle gourd vegetables?
- ❑ What do we mean by functional questionnaires? Why do we need functional questionnaires for 'Ballot Box' evaluation?
- ❑ What do we mean by technical definition of specimens? Why should we avoid questions requiring technical definitions of specimen in "Ballot Box' evaluation?
- ❑ What are some other considerations in developing effective 'Ballot Box' evaluation questionnaires?

Exercise No. 2.05[27]

> **When is this exercise most appropriate?**
>
> - In TOT and TOS, before conducting first AFESA in AGF-FFS of agroforestry species and vegetable crops; and
> - When other vegetables, in addition to crucifers, will also be addressed in a season-long AGF-FFS training activity.

AGROFORESTRY ECOSYSTEM ANALYSIS FOR FARMER FIELD SCHOOLS ON AGROFORESTRY: ESTABLISHING MINIMUM DATA FOR DECISION-MAKING

BACKGROUND AND RATIONALE

Agroforestry ecosystem analysis (AFESA) is a way of assembling what participants are studying and placing into a process useful for decision-making based on many factors[28]. An AFESA, therefore, must look into various elements of an agroforestry crop ecosystem, how these elements, in one way or another, affect a crop and what are those elements that work interdependently or separately for a particular agroforestry species and vegetable crops. This exercise, therefore, provides a holistic approach in monitoring agroforestry species and vegetable crops in question.

In previous volumes[29]-[30], minimum data necessary for decision-making had been established in farmer field schools of crucifers and other vegetables that are not organically-grown. For this volume, minimum data necessary for decision-making in farmer field schools of agroforestry species (e.g., forest, hedgerow, and shade-tolerant) and vegetable crops (e.g., legumes, solanaceous vegetables, parsley, crucifers, and cucurbits) will have to be established as well. Thus, this activity will be undertaken to address this particular concern.

How long will this exercise take?

- At least 30 minutes for field walks and observations;
- At least 30 minutes for brainstorming in small groups to determine minimum data necessary for decision-making in farmer field schools of agroforestry species and vegetable crops; and
- At least one hour for presentation and participatory discussions in big group to fine-tune minimum data necessary for decision-making in farmer field schools of agroforestry species and vegetable crops.

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27 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp38-42.

28 Callo, Jr. D.P., W.R. Cuaterno, and H.A. Tauli (eds). 1999. Handbook of Non-Formal Education and Team Building Exercises for Integrated Pest Management. SEAMEO Regional Center for Graduate Study and Research in Agriculture, College, Laguna, Philippines. pp190-191.

29 Philippine National IPM Program. 1997. Field Guide of Discovery-based Exercises for Vegetable IPM (Volume I). National Agricultural and Fishery Council, Department of Agriculture, Diliman, Quezon City, Philippines. pp2-1 to 2-124

30 Callo, Jr., D.P., Teofilo, L.B. and Tauli, H.A. 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp13-16.

Learning objectives

- To familiarize participants with commonest agroforestry species and vegetable crops in AGF-FFS learning and adjoining fields;
- To improve participants' knowledge and skills in identifying morphological characteristics at different growth stages of agroforestry species and vegetable crops; and
- To establish minimum data necessary for decision-making in farmer field schools of commonest agroforestry species and vegetable crops in AGF-FFS learning and adjoining fields.

Materials

- Learning and adjoining fields of agroforestry species and vegetable crops near each other where morphological characteristics at different growth stages can be observed;
- Manila paper, notebook, pencil, crayon, and ball pen; and
- Actual or live plant or plant parts.

Methodology

- Field walks and observations, brainstorming or participatory discussions

Steps

1. Divide big group in four smaller groups, assign each small group to a specific group of agroforestry species and vegetable crops, go to agroforestry fields, as shown below:

    ☑ Forest species (e.g., trees and non-trees species)
    ☑ Hedgerow species (e.g., legumes, grasses, and others)
    ☑ Shade-tolerant crops (e.g., high, middle, and low under-story species)
    ☑ Vegetable crops (e.g., legumes, cucurbits, and solanaceous vegetables)

2. Conduct field walks to identify, observe, and record morphological characteristics of commonest agroforestry species and vegetable crops in FFS learning and adjoining fields, such as:

    ☑ Adaptability to local conditions
    ☑ Morphological structures at various growth stages
    ☑ Resistance to pests and diseases
    ☑ Tolerance to deficiencies, toxicities, and other environmental stresses

3. Collect plants or plant parts at various growth stages showing morphological characteristics and reactions to pests, diseases, and environmental stresses of agroforestry species;

4. Go back to processing area or session hall to further observe and characterize collected specimens;

5. With guidance from a facilitator, brainstorm in small groups to establish minimum data necessary for decision-making in farmer field schools of commonest agroforestry species and vegetable crops in AGF-FFS learning and adjoining fields, such as:

   ☑ For all agroforestry species (e.g., general data needed)
   ☑ For specific agroforestry-based vegetable crops (e.g., additional data needed)

6. Present output of small groups to the big group and conduct participatory discussions to fine-tune established minimum data necessary for decision-making in farmer field schools for each group of agroforestry species and vegetable crops. A sample of minimum data required for decision-making in AFESA for FFSs on agroforestry species and vegetable crops is shown below[31]:

   For all agroforestry species and vegetable crops (e.g., general data needed):

   ☑ Insects, other pests, and their natural enemies (e.g., numbers on a weekly basis)
   ☑ Diseases and physiological disorders (e.g., percentage incidence of total area)
   ☑ Weather conditions (e.g., sunny, cloudy or rainy day)
   ☑ Background information (e.g., variety, sowing or planting date, seeding rate, soil type, planting distance, fertilizer rate, etc.)
   ☑ Agronomic data (e.g., plant height, number of leaves and total yield)
   ☑ General observations (e.g., water, weeds and cultural management practices)

   For specific agroforestry-based vegetable crops (e.g., additional data needed):

   Legumes (Cowpea and String Bean)

   ☑ Number of leaves (e.g., until tendril initiation only)
   ☑ Number of nodes (e.g., additional nodes every week)
   ☑ Plant height (e.g., until tendril initiation only)
   ☑ Number of flowers or pods developed or aborted
   ☑ Others (e.g., date of tendril initiation, flowering, pod setting, pod maturity, frequency of pod priming)

31 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp48-49.

Solanaceous (Eggplant, Pepper, and Tomato)

- ☑ Number of branches
- ☑ Number of fruits
- ☑ Number of flowers or fruits developed or aborted
- ☑ Others (e.g., date to flower, fruit setting, fruit maturity, frequency of fruit priming)

Parsley (Carrot and Celery)

- ☑ Methods of sowing (e.g., celery and carrot), planting (e.g., celery and carrot), or pricking-off (e.g., celery)
- ☑ Root elongation and development (e.g., quantitative and qualitative observations for carrot)

Cucurbits (Ampalaya, Squash, and Bottle Gourd)

- ☑ Number of leaves (e.g., until tendril initiation only)
- ☑ Number of nodes (e.g., additional nodes every week)
- ☑ Number of branches (e.g., additional branches every week)
- ☑ Number of flowers or fruits developed or aborted
- ☑ Others (e.g., date of tendril initiation, flowering, fruit setting, fruit maturity, frequency of fruit priming)

Some suggested questions for processing discussion

- ❑ What are some of commonest agroforestry species and vegetable crops observed in FFS learning and adjoining fields? In what group do these agroforestry species and vegetable crops belong?
- ❑ Are there common morphological characteristics, which distinguish each group of agroforestry species and vegetable crops?
- ❑ What are the minimum data required for decision-making in AFESA for FFSs on agroforestry species and vegetable crops?

Exercise No. 2.06[32]

> **When is this exercise most appropriate?**
>
> ❧ In TOT and TOS, or during actual implementation of AGF-FFS, before laying-out of learning field where agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) will be simultaneously addressed.

FIELD LAYOUT AND AGROFORESTRY ECOSYSTEM ANALYSIS FORMAT FOR FARMER FIELD SCHOOLS ON AGROFORESTRY

BACKGROUND AND RATIONALE

In previous vegetable integrated pest management (IPM) farmers' field schools (FFSs) in the Cordilleras, field layout and Agro-Ecosystem Analysis (AESA) format considered only one crucifer crop. Such format had been modified in current FFSs, which now involve IPM studies of agroforestry species and more than one type of agricultural crops. Depending upon elevation, types of agroforestry species planted and types of agricultural crops grown may vary considerably.

On the other hand, a field layout and agroforestry ecosystem analysis (AFESA) format for AGF-FFS where agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) are simultaneously addressed will have to be developed as well. This activity will focus on this particular concern.

How long will this exercise take?

- At least 30 minutes for field walks and observations;
- At least 30 minutes for brainstorming in small groups to design layout and reporting format for AFESA where agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) will be simultaneously addressed in the AGF-FFS learning field; and
- At least one hour for presentation and participatory discussions in big group to finalize layout design and reporting format for AFESA where agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) will be simultaneously studied in the AGF-FFS learning field.

32 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp43-50.

Learning objectives

- To determine what type of agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) in areas for AGF-FFS learning fields;
- To design field layout for AFESA of agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) in areas for AGF-FFS learning fields; and
- To develop reporting format for AFESA of agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) in areas for AGF-FFS learning fields.

Materials

- Learning field ready for planting of agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) for AGF-FFS;
- Manila paper, notebook, marking pens, ball pen; and
- Meter stick or tape, plastic twine, bamboo sticks, and labeling materials.

Methodology

- Field walks, site preparation and observation, brainstorming, or participatory discussions
- Actual layouting of the AGF-FFS learning field

Steps

1. Divide big group in four smaller groups and assign each of these to a specific agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) which were previously chosen during the ground-working activity;

2. In the learning field, conduct field walks, observe and design field layout for AFESA of different agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) [Assumption: The learning field has already been prepared for contour farming],

3. Go back to processing area or session hall and with guidance from a facilitator, brainstorm in small groups to develop field layout and reporting format for AFESA of different agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) in the AGF-FFS learning field; and

4. Present outputs of small groups to big group and conduct participatory discussions to finalize field layout and reporting format for AFESA of different agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) to be planted in the learning field.

Field layout and group assignments. An area of at least 1,000-sq.m. from a portion of either a farmer-participant's farm or communal farm, representing average field condition of AGF-FFS community, should be selected (see *Agroforestry Farmer Field School Planting Model*). The area may be increased depending upon availability and willingness of farmer-participants. A sample field layout and AFESA format for AGF-FFS is shown below[33]:

FIELD LAYOUT IN CONDUCTING AESA FOR AGF-FFS

CROP A		CROP B		CROP A or B
PLOT I	PLOT II	PLOT III	PLOT IV	PLOT V
GROUP I	GROUP II	GROUP III	GROUP IV	BIG GROUP

FCP	**IPM**	**FCP**	**IPM**	**SIDE STUDY**

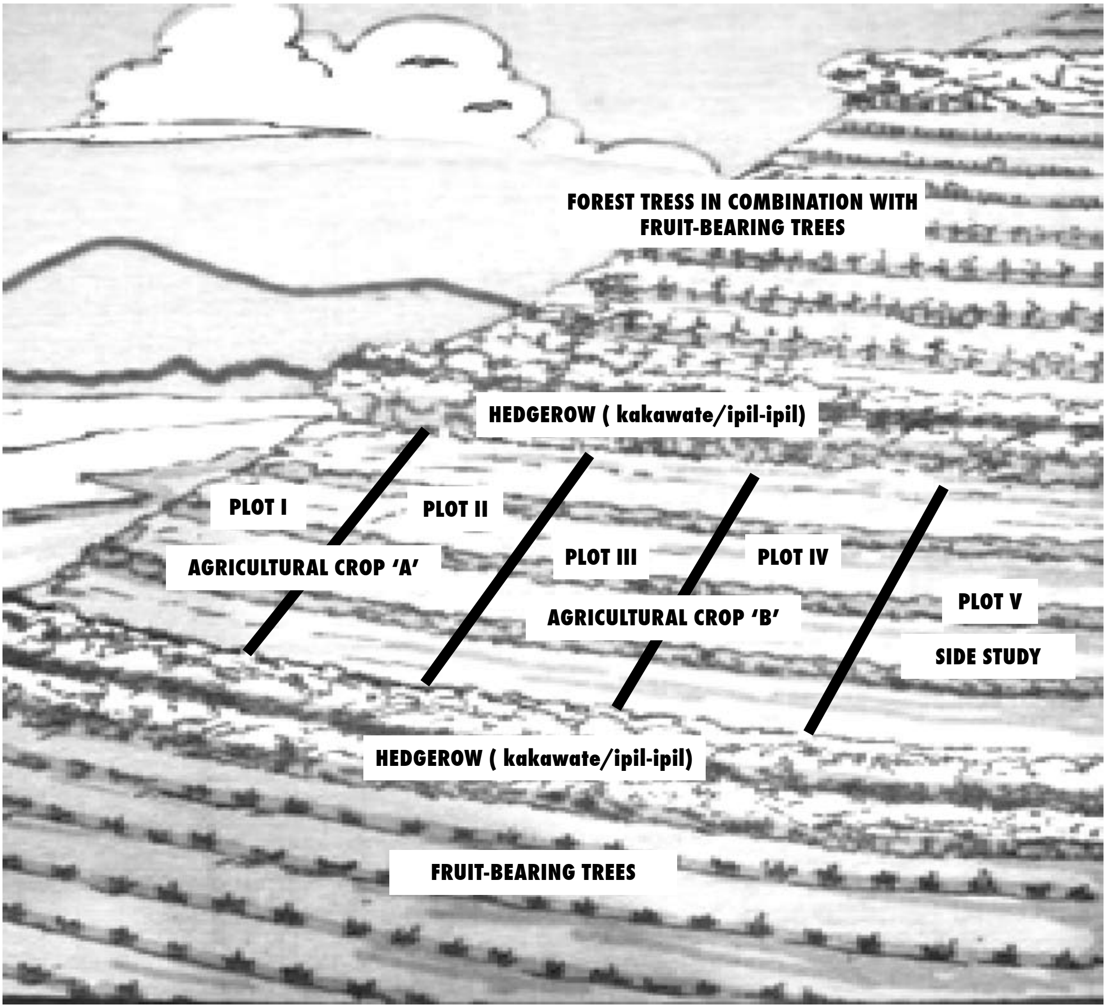
The farmer-participants, through an appropriate participatory process or sharing of experiences, should select two major agricultural crops to be grown with fruit and forest trees. The area will be divided into four or five plots and crops will be assigned in plots as follows:

- Plot I will be assigned to Group I for farmers' crop protection (FCP) practice study of Crop A (e.g., first major agricultural crop) to be grown with fruit and forest tree species;
- Plot II will be assigned to Group II for integrated pest management (IPM) practice study of Crop A (e.g., first major agricultural crop) to be grown with fruit and forest tree species;
- Plot III will be assigned to Group III for farmers' crop protection (FCP) practice study of Crop B (e.g., second major agricultural crop) to be grown with fruit and forest tree species;
- Plot IV will be assigned to Group IV for integrated pest management (IPM) practice study of Crop B (e.g., second major agricultural crop) to be grown with fruit and forest tree species; and

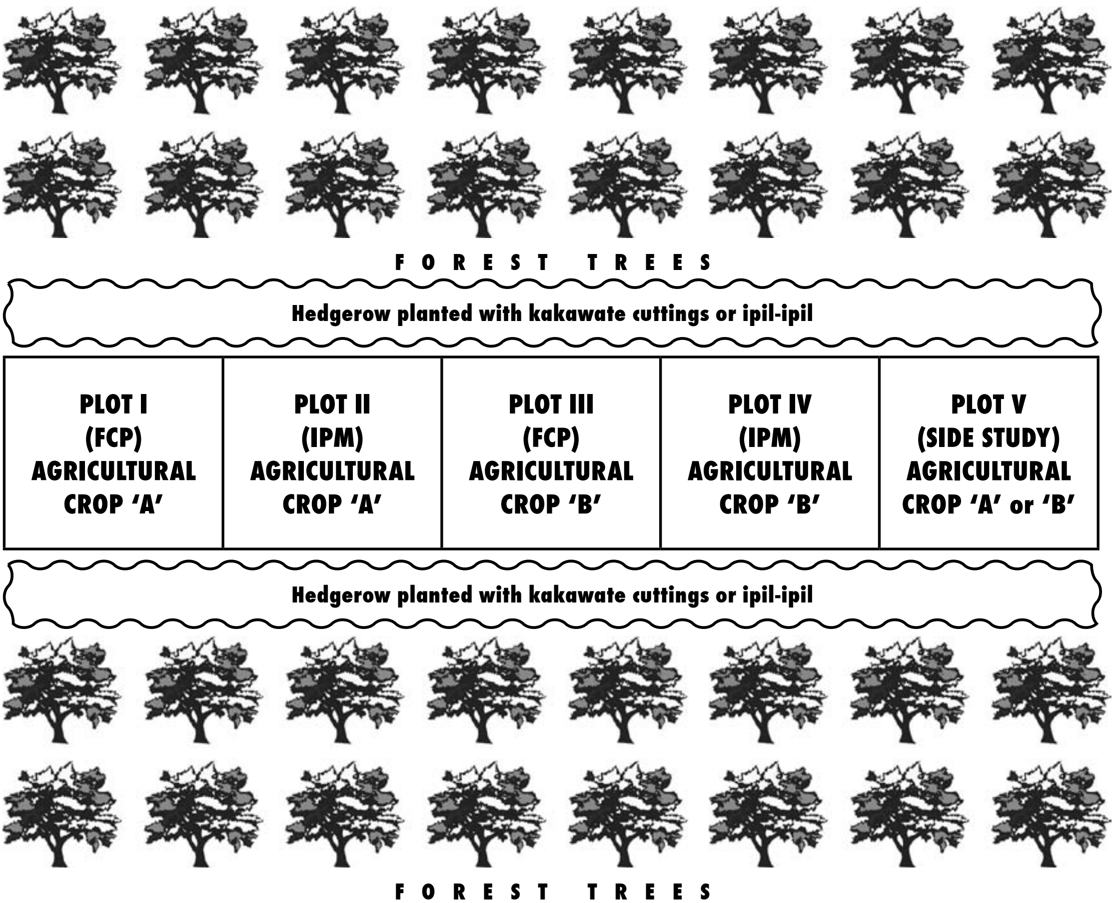
33 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp50-55.

- Plot V will be assigned to the big group (e.g., Groups I-IV) as a communal plot for side study on related technical concern about Crops A (e.g., first major agricultural crop)or B (e.g., second major agricultural crop) to be grown with fruit and forest tree species.

AGROFORESTRY FARMER FIELD SCHOOL • PLANTING MODEL



FIELD LAYOUT FOR AGROFORESTRY FARMER FIELD SCHOOL



<u>Format of AFESA presentation</u>. The AFESA presentation is described as follows:

1. Each small group conducts AFESA only in either a farmer crop protection (FCP) or an integrated pest management (IPM) practice plot. This means that only one set of observations is required per small group. Each group's set of observations is compared with other groups' set of observations. This option will require lesser time for processing in small groups but will not allow direct comparison of FCP and IPM treatments per group.

2. *AFESA on Agricultural Crops*. The assigned group will select five (5) permanent sample plants at random for gathering of agronomic data. However, each small group will select another 5 sample plants at random for general observations. Each small group will conduct AFESA on agricultural crops using an agreed format on a weekly basis to include observations and recommendations on fruit and forestry trees. Small group outputs will also be presented to big group weekly.

3. *AFESA on Fruit and Forest Trees*. Each small group will select specific fruit and forest trees to be observed and recorded for tree data. These trees will be observed weekly. However, AFESA will be conducted and presented only on a monthly basis.

Minimum Data for Agroforestry Ecosystem Analysis. The minimum AFESA data for agricultural crops (e.g., vegetables) [see *Minimum Data for AFESA of Agricultural Crops*] will be taken, which will include general observations and recommendations on fruit and forestry trees and presented weekly, to enhance participants' decision-making skills on agricultural crops (e.g., vegetables) grown with fruit and forestry trees. On the other hand, the minimum AFESA data for fruit and forest trees (see *Minimum Data for AFESA of Fruit and Forest Trees*) will be taken every week but will only be presented monthly, as it is expected that no significant changes will occur on observations or measurements done within a very short span of time, to further reinforce participants' decision-making skills as well on fruit and forest trees. These data are recorded in appropriate forms as shown on the succeeding pages.

Minimum Data for AFESA of Agricultural Crops

Group Name/No.		Date		Study	
AFESA/Week #		Time started		Time finished	

GENERAL INFORMATIONS		AGRONOMIC DATA		
Parameters	Descriptions	Parameters	Previous	Present
Crop		Ave. height of crop		
Variety used		Ave. # of leaves		
Age of crop		Ave. # of branches		
Stage of crop		Ave. # of flower buds		
Date sown		Ave. # of flowers		
Date transplanted		Ave. # of fruits		
Weather condition				
Soil type				
Soil Topography				
Soil condition				

NATURAL ENEMIES			DRAWING	INSECT PESTS		
Name of insect/s	Previous	Present		Name of insect/s	Previous	Present
Total				Total		

OBSERVATIONS	RECOMMENDATIONS

Minimum Data for AFESA of Fruit and Forest Trees

Group Name/No.		Date		Study	
AFESA/Week #		Time started		Time finished	

GENERAL INFORMATIONS		TREE DATA		
Parameters	Descriptions	Parameters	Previous	Present
Specie		Ave. height of crop (m)		
Type/Kind of Planting Material (seedling, grafted, cuttings, base-root, etc.)		Plant diameter (cm) (root collar/ DBH)		
Variety		Number of branches		
Initial Plant Height and Diameter (cm)		Crown Width (m)		
Date of Planting		Ave. # of branch with flowers		
Age of Tree (from out-planting)		Ave. # of flower per branch		
Fertilizer Used		Number of fruits		
Spacing (m)		Ave. # of fruits per branch		
Hole Size (cm)				
Land Preparation (Plowing)				
Cultural Operations				
Time/Duration of Observation				
Soil type				
Topography/slope				
Result of Soil Analysis (if any)				
Soil Condition (previous and present condition)				
Weather Condition (previous and present condition)				

NATURAL ENEMIES			DRAWING	DISEASES	
Local Name	Previous	Present		Previous diseases	
TOTAL				TOTAL	
INSECT PESTS				PRESENT DISEASES	
Local Name	Previous	Present			
TOTAL				TOTAL	

OBSERVATIONS	RECOMMENDATIONS

Some suggested questions for processing discussion

- ❑ What agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) will be planted in AGF-FFS learning field? What factors were considered in selecting these agroforestry crops?
- ❑ What are some considerations in designing field layout for AGF-FFS learning fields?
- ❑ What are the important information included in AFESA reporting format?
- ❑ How often do you gather data for AFESA of agroforestry crops? Why?
- ❑ What is best time in gathering data for AFESA of agroforestry crops? Why?

Exercise No. 2.07[34]

KEEPING RECORDS OF FARM ACTIVITIES: GUIDED DISCUSSIONS ON 'WHY' AND 'WHAT' TO RECORD FOR AN AGROFORESTRY FARMING ENTERPRISE

When is this exercise most appropriate?

❧ This exercise is most appropriate early in an AGF-FFS season, so that farmers will be aware of why they keep careful records of production and labor costs in learning field studies and in their own farms.

BACKGROUND AND RATIONALE

Record is a matter of history; it cannot predict a future. However, it can furnish valuable information about past performance in specific areas of farming operations that can be used together with other data in determining future operations. Keeping in mind elements of risk and uncertainty inherent in agroforestry farming, this will at least systematize farm management. In general, record keeping is important because[35]:

- It increases farmer's efficiency by providing him a basis in deciding where to put his resources (e.g., whether it should be better to make compost instead of buying commercial organic fertilizer);
- It can be used for planning and budgeting. Financial records answer *how much*, while physical records answer *how many* questions;
- Profitability of various operations can be evaluated. By comparing costs and returns among different operations, a farmer will be able to know the comparative profitability of each enterprise in his farm;
- It shows where a farmer's money comes from (e.g., return) and where it goes (e.g., costs);
- A farmer's capacity to pay is best shown by his farm records. Financial records provide evidence that will show solvency or financial stability of his enterprise; and
- Settling questions becomes easy if all transactions are well recorded, especially between landlords and tenants.

34 Adapted from Callo, Jr. D.P., A.G. Castillo, and C.A. Baniqued (eds). 2001. Field Guide of Discovery-based Exercises for Corn Production. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp94-96.

35 PCARRD. 1975. The Philippines Recommends for Vegetable Crops. 1975. Philippine Council for Agriculture and Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. pp136-139. As cited in: Callo, Jr. D.P., A.G. Castillo, and C.A. Baniqued (eds). 2001. Field Guide of Discovery-based Exercises for Corn Production. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp94-96.

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 for the reason that an exercise starts by assuming that record keeping is useful.

In this exercise, we will try to start with a question what profit farmers made last year. This will allow 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. Thus, this activity was designed to deal with such particular concern.

How long will this exercise take?

- One to two hours of an AGF-FFS meeting

Learning objectives

- To build awareness among farmers on value of keeping records of production costs and market prices, especially when they are to be used as basis for calculating profit or loss; and
- To agree on a list of inputs and costs to record in a learning field for use in assessing and comparing profits from treatments of studies on agroforestry crops (e.g., agricultural crops as well as fruit and forestry trees).

Materials

- Examples of records kept by farmer-participants (Note: Ask farmers to bring in any examples of records that they keep for their own agroforestry farming enterprise); and
- Manila paper, pens and masking or Scotch tapes.

Methodology

- Guided discussion and sharing of experiences

Steps

1. Arrange participants in a circle for sharing;

2. Start a discussion that explores how farmers estimate how much profit they make in their agroforestry farming enterprise. Here are some suggested questions:

- ☑ Who made a good profit last year or last season?
- ☑ How did you know that you made a profit?
- ☑ Do you keep any written records of your spending, earnings, and profits? What kind of records do you keep?
- ☑ How much money and time do you spend on agroforestry crops production?
- ☑ How do you calculate what you spend (e.g., by counting PESOS or by counting sacks of organic fertilizers and packs of agroforestry seeds)?
- ☑ How much did each of you get for your agroforestry products last year or last season?

3. Guide a discussion to explore what profit might have been made if agroforestry farmers had made different decisions about amount of inputs they used in their own agroforestry farms. Here are some suggested questions:

   - ☑ How many kilograms of each product and by-product of agroforestry crops did you have to sell to pay for organic fertilizers and seeds or seedlings that you bought?
   - ☑ What else could you have used that money for?

4. Guide a discussion so that all needed information for recording can be explored to compare profits that are gained by farmers in their agroforestry farming venture; and

5. Make a list of all information that the big group wants to record.

Some suggested questions for processing discussion

- ❑ <u>Note:</u> There is no extra processing needed because this exercise is a guided participatory discussion.

Exercise No. 2.08[36]

COST AND RETURN ANALYSIS OF AGROFORESTRY FARMING ENTERPRISE

BACKGROUND AND RATIONALE

Finding a market for agroforestry products is one of the most important activities of an agroforestry farmer. Always remember that no price should be considered fixed. A price is simply an offer or a suggestion to test prevailing market rate. If a buyer accept an offer, it is fine. If he or she rejects, price usually may be changed as quickly as possible. But one should see to it that there is a profit. Farmers should understand meaning and importance of pricing. A price offered to a buyer depends largely on quality of an agroforestry product[37].

When is this exercise most appropriate?

- This exercise is most appropriate toward end of an AGF-FFS season; and
- When farmers want to learn and understand how records of their production and labor costs in learning field experiments and in their own fields can be used for cost and return analysis of their agroforestry crops production.

After farmers had successfully learned and understood what records would be useful to keep, a guided discussion and sharing on cost and return analysis of their agroforestry crops production can be undertaken. Data obtained from an earlier exercise on 'why' and 'what' to record will be very useful for this next activity. A cost and return analysis can be a useful tool in project planning and in predicting how a business would operate under a set of assumptions[38].

In this exercise we will try to start with a question 'What profit farmers will make now?' This will allow them to share useful records they keep for this current season. This sharing discussion will allow farmers to find out whether they will now make profit or not. Thus, this activity was designed to take on such particular concern.

How long will this exercise take?

- One to two hours of an AGF-FFS meeting

36 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp51-54.

37 Tabinga, G.A. and A.O. Gagni. 1985. Corn Production in the Philippines. Department of Development Communication, University of the Philippines at Los Baños, College, Laguna, Philippines. pp94-102.

38 PCARRD. 2007. Profitability analysis: 1-ha organic tomato production. (Profitability Analysis No. 09/007). Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. 14p.

Learning objectives

- To build awareness on value of cost and return analysis for understanding profit or loss in agroforestry crops production; and
- To learn and understand how records of production and labor costs can be used for cost and return analysis of agroforestry crops production.

Materials

- Records kept by farmer-participants (Note: Ask farmers to bring in all current records that they keep for learning field and their own agroforestry farms); and
- Manila paper, pens and masking or Scotch tapes.

Methodology

- Guided discussion and sharing of experiences

Steps

1. Arrange participants in a circle for sharing;

2. Start a discussion by asking some volunteer-farmers to share their records on production and labor costs of their own agroforestry farms for this current season. Here are some records needed:

   ☑ Records of production
   ☑ Records of man and animal labor
   ☑ Records of equipment used in agroforestry farming enterprise
   ☑ Costs and return

3. Guide a discussion to obtain accurate figures of production and labor costs of volunteer-farmers' own agroforestry farms and those in learning field. Here are some suggested guides:

   ☑ Production records (e.g., indicate date, kind, amount and value of each product and by-product of agroforestry farming venture)
   ☑ Labor records (e.g., labor used in enterprise including man, animal and implement hours for each farm operation plus all expenses for hired work animals, implements and all 'bayanihan' labor)

- ☑ Cash receipts records (e.g., cash accounts of all receipts from agroforestry enterprise indicating date items were received and their value)
- ☑ Cash return records (e.g., subtract from cash account all expenses incurred aside from labor such as seeds or seedlings, organic fertilizers, biological control agents, etc.)
- ☑ Equipment records (e.g., equipment is not use for agroforestry enterprise alone, hence, charge only a certain percentage of depreciation to agroforestry farming venture)

4. Guide a discussion so that accurate figures of total expenses, expected yield (e.g., per hectare basis), gross income (e.g., based on current price per kg), and net income to compare profits that is gained from farmers' crop protection (FCP) and integrated pest management (IPM) practice plots;

5. Make a list of all information that the big group wants to record; and

6. Calculate costs and returns for agroforestry farming enterprise and for the whole farm. The following is a procedure you may want to consider in analyzing costs and returns[39]:

   - ☑ *Labor and Power Costs.* The amount of labor and power spent in each operation for every enterprise should be expressed in man-days (MD), man-animal days (MAD), or man-machine days (MMD). Calculate total power cost for each enterprise and then for the whole farm. This is calculated using formula below:

TOTAL LABOR COST = Total labor (MD) x Wage rate + Total power (MAD/MD/MMD) x rate

   - ☑ *Material Input Cost.* Total cost of all materials used in each enterprise (e.g. seeds/seedlings, organic fertilizers, biological control agents, etc). This is calculated as:

TOTAL MATERIAL COST = (Quantity material 1 x Price of material 1 + ... + Quantity of material N x Price of Material N)

   - ☑ *Gross Return.* The product type, production volume, and product price are important components in calculating gross returns. Calculate gross returns using this formula:

39 Binamira, J.S. 2000. The Search for the National Filipino Corn Farmer Award (Draft Guidelines). National Agricultural and Fishery Council, Department of Agriculture, Diliman Quezon City, Philippines. pp7-9.

GROSS RETURNS = (Volume of product x Price of product)

☑ *Net Return*. Calculate net return of agroforestry farming enterprise and for the whole farm, if applicable. This is computed as:

NET RETURN = Gross Return - [Total Labor Cost + Material Costs]

☑ *Return on Investment (ROI).* This is a measure of return for every monetary unit in a farm. A higher ROI indicates a better economic performance of an enterprise. This ratio is calculated as:

ROI = Net Income ÷ Total Costs

Some suggested questions for processing discussion

- ❑ If you have a big profit, would you say then that you have been successful in your endeavor?
- ❑ What would you do so that cost of production of your agroforestry farming enterprise will give good returns?
- ❑ How much do you have to sell your agroforestry products? How much profit can you get?

Exercise No. 2.09[40]

FOLK MEDIA PRESENTATION: A SIMPLE WAY TO CONVEY INNOVATIVE AGROFORESTRY MESSAGES

When is this exercise most appropriate?

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

BACKGROUND AND RATIONALE

Local songs, 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, a message becomes easier to understand[41].

Folk media can be used in various ways. An extension agent (facilitator) can use it to explain complex concepts. Weaknesses in a culture of group may be approached in a non-threatening situation through a folk media presentation. It can create awareness and lead to analysis of problems by people in a community.

The differences and uniqueness of culture and values from one region to another or from one village to another suggest that selection of most appropriate folk media to convey a desired message for particular group be treated with utmost importance. In an AGF-FFS field day or graduation ceremonies, farmers can use appropriate folk media presentation to generate needed institutional and financial supports from various stakeholders to sustain local agroforestry endeavor. Thus, this activity was designed to deal with such particular concern.

How long will this exercise take?

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

40 Adapted from Callo, Jr. D.P., A.G. Castillo, and C.A. Baniqued (eds). 2001. Field Guide of Discovery-based Exercises for Corn Production. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp42-43.

41 Callo, Jr. D.P., W.R. Cuaterno, and H.A. Tauli (eds). 1999. Handbook of Non-formal Education and Team Building Exercises for Integrated Pest Management. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp5-32.

Learning objectives

- To define and discuss some forms of 'folk media';
- To learn and understand the advantages of using folk media in conveying innovative agroforestry messages; and
- To plan for respective group's folk media presentation.

Materials

- Video tape of folk media presentation;
- Manila paper, marking pens masking or scotch tape; and
- Props for actual folk media presentation.

Methodology

- Role playing, guided discussion, and sharing of experiences

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 knowledge and skill to present one;

2. Start a discussion by drawing up a working definition of folk media:

   ☑ Elicit definitions from the big group;
   ☑ List down whatever ideas are contributed;
   ☑ When there are no more ideas, try to come up with one working definition by integrating all contributed ideas;
   ☑ This will be the big group's own working definition of a folk media;

3. Using an earlier folk media presentation, ask the big group:

   ☑ What are the advantages of using folk media?
   ☑ What form of folk media presentation was made?
   ☑ If they are familiar with it, how do they do it in their respective regions or communities?

4. Ask participants to move back to their respective small groups and plan on the type of folk media they will present during their field day or graduation ceremonies;

5. Practice and present folk media during participants' field day or graduation ceremonies; and

6. Summarize and synthesize all learning experiences after folk media presentation.

Some suggested questions for processing discussion

- ❑ What are the advantages of using folk media presentation in conveying innovative messages in agroforestry?
- ❑ What other forms of folk media presentations do you have in your respective regions or communities, which can be used to convey innovative messages in agroforestry?
- ❑ When and where are these folk media presentations most appropriate to convey innovative messages in agroforestry?

Exercise No. 2.10[42]

> **When is this exercise most appropriate?**
>
> - In AGF-FFS, TOT, or TOS sessions at least a month before a simultaneous field day and graduation ceremonies to give participants ample time to prepare for the activity; and
> - This activity should be taken up as part of the module on extension communication.

SIMULTANEOUS FIELD DAY AND GRADUATION CEREMONIES: CONVEYING INNOVATIVE AGROFORESTRY MESSAGES BY RESULTS PRESENTATION

BACKGROUND AND RATIONALE

The conduct of simultaneous field day and graduation ceremonies is an occasion when farmers and facilitators show other people or the community what they have learned and the results of their participatory technology development (PTD) activities. The best time to have a simultaneous field day and graduation ceremonies is when there is still standing crop nearing maturity except in an emergency situation (e.g., pending typhoon) and there is no choice but to harvest early[43].

The conduct of simultaneous field day and graduation ceremonies is the training participants' affair. This means that they plan for and implement the activity. For the AGF-FFS, farmer-participants may choose to invite co-farmers from the same or neighboring barangays (villages). For TOT and TOS facilitator-participants, they may choose to invite their local chief executives or direct supervisors with the end in view of orienting them on the program. Non-government organizations (NGOs) and other possible stakeholders (except pesticide industries) may also be invited to encourage them to support future AGF-FFS activities in their communities.

A simultaneous field day and graduation ceremonies may include such activities as field tours of the participants learning fields to showcase results of their participatory technology development (PTD) activities and a program wherein local officials and other stakeholders deliver speeches. In the Philippines, the participants and their communities also jointly prepare foods as part of the event. The atmosphere of a simultaneous field day and graduation ceremonies takes is a festival. Folk media presentations prepared by participants complete the celebration. The necessary preparations for a simultaneous field day and graduation ceremonies are the primary concern of this exercise.

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42 Adapted from Callo, Jr. D.P., A.G. Castillo, and C.A. Baniqued (eds). 2001. Field Guide of Discovery-based Exercises for Corn Production. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp44-45.

43 Callo, Jr. D.P., W.R. Cuaterno, and H.A. Tauli (eds). 1999. Handbook of Non-formal Education and Team Building Exercises for Integrated Pest Management. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp26.

How long will this exercise take?

- At least one hour a week for three weeks devoted to planning, brainstorming, and participatory discussions prior to the last week of preparation; and
- At least seven full days of preparation before the scheduled simultaneous field day and graduation ceremonies.

Learning objectives

- To discuss the reasons behind holding simultaneous field day and graduation ceremonies;
- To discuss the activities to be undertaken in simultaneous field day and graduation ceremonies; and
- To plan, conduct, and evaluate lessons learned from simultaneous field day and graduation ceremonies.

Materials

- Learning fields at least 2 weeks before harvest;
- Video tape presentation of a previous field day;
- Props, preserved and live specimens, graphs of PTD results, and field labels; and
- Other supplies and material needed for a simultaneous field day and graduation ceremonies.

Methodology

- Field visits, role playing, participatory discussions, and sharing of experiences

Steps

1. Present video tape presentation of a previous simultaneous field day and graduation ceremonies conducted in any AGF-FFS, TOT, or TOS group. Based on the presentation, conduct participatory discussions with the group on:

   ☑ What is a simultaneous field day and graduation ceremonies;
   ☑ What are the reasons behind holding a simultaneous field day and graduation ceremonies;
   ☑ What are the activities during a simultaneous field day and graduation ceremonies;
   ☑ What are the lessons learned (e.g., what went well and what needed improvements) in the presentation;

2. Write down all the answers, particularly for the third question, and use them as basis for planning the group's conduct of a simultaneous field day and graduation ceremonies;

3. Plan activities for and conduct a simultaneous field day and graduation ceremonies; and

4. Summarize and synthesize all learning experiences after conducting a simultaneous field day and graduation ceremonies.

Some suggested questions for processing discussion

- Who would we invite in a simultaneous field day and graduation ceremonies? Why?
- How do we solicit the involvement and commitments of local leaders and other stakeholders in the community through the conduct of a simultaneous field day and graduation ceremonies?
- How do we sell our local agroforestry programs to our concerned government officials and politician through the conduct of a simultaneous field day and graduation ceremonies?
- What activities are necessary to sustain local agroforestry programs that will need active participation and support from LGUs and NGOs, among others?

Section 3

NURSERY MANAGEMENT AND FOREST PLANTATION ESTABLISHMENT

Section 3

NURSERY MANAGEMENT AND FOREST PLANTATION ESTABLISHMENT[44]

The basic goal of having good quality seedlings is to achieve the best growth possible and have the highest amount of desired outputs. Outputs can be timber, food, fuel, fodder, or other uses such as site improvement. Seedling quality is gauged by two factors: (a) genetic make-up of the parent stock; and (b) physical growth, which is influenced by the seedling's immediate environment (e.g., nursery condition and establishment practices).

Regardless of the size of the tree planting efforts, several common techniques can be applied to ensure the best planting stock quality possible. These techniques are applicable across a wide range of climate and soil variations. The application of good practices must begin when the project, large or small, must continue through nursery management to out-planting in the field or forest plantation establishment. In all cases, everything that can be done should be done, within reasonable limits of time and capital constraints. Thus, this section compiles appropriate discovery-based exercises that take in hand nursery management and forest plantation establishment.

44 Jones, N. 2009. Forestry Technology No. 2: Essentials of Good Planting Stocks. Agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. www.agroforestry.net. pp1-3.

NURSERY OPERATION AND MANAGEMENT[45]

Depending on type and duration of the project, tree nurseries may be either temporary or permanent. Temporary sites are preferred for small, short-term projects, such as establishing erosion control in a limited area or planting windbreaks for a set of fields. In this case, nursery construction can be done on a small scale using such disposable materials as cut thorn bushes for protective fencing. However, the same level of attention is required for the plants' needs regardless of nursery size.

Permanent nurseries, on the other hand, supply seedlings for ongoing programs like area reforestation, commercial plantations, village shade trees, fuel-wood plantations, or agroforestry. In either case, the forester or nursery manager must consider where nursery will be located in relation to total planting area. Ideally, the nursery should be built in a central location with easy access to roads for transportation of seedlings, people, and supply. An ample, reliable, and consistent water source must be located nearby. And, if possible, the site should be near settled area to have a source of workers, materials, and for security.

Essential parts of a nursery layout include: (a) a water storage source and location with siltation facilities, if needed; (b) shade for young seedlings [and nursery workers]; (c) adequate space for nursery beds and pathways; (d) driveways and turnaround areas; (e) storage areas for tools and equipment; (e) soil mix stockpiles; and (f) fencing, gates, fire buffers, and clear areas. When planning any nursery, it is important to have a 'material-flow-chart' or plan indicating how materials enter the nursery, how they move within the nursery, and how they leave the nursery.

In this regard, this sub-section assembles discovery-based exercises on: (a) importance of nursery and its selection parameters; (b) seed collection, seed sowing, and seedling production; (c) seed morphology, and (d) tissue culture and other vegetative propagation methods.

45 Jones, N. 2009. Forestry Technology No. 2: Essentials of Good Planting Stocks. agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. www.agroforestry.net. pp4-6.

Exercise No. 3.01

NURSERY: ITS IMPORTANCE AND SELECTION PARAMETERS

When is this exercise most appropriate?

- In AGF-FFS, TOT, or TOS sessions, before the start of weekly AFESA activity; and
- When participants are interested to know about nursery; its importance and selection parameters.

BACKGROUND AND RATIONALE[46]

Nursery in general is a place where good seedlings are grown with care and maintenance. Nurseries provide necessary control on moisture, light, and predators pest and diseases as well as allow production of healthy and hardy seedlings. Factors to be considered in choosing a nursery site includes water supply, size, accessibility, location, topography and soil condition. Production of good quality seedlings may provide best result in forestry plantation development.

Different types of nurseries require different site selection factors. Bare-root nurseries need to be carefully located in suitable soils to provide optimum root development and growth. Loose, deep sandy clay loam soils are preferred. Also, a system of proper drainage is essential in preventing root growth stagnation due to stagnant water. Poor soils may be too hard for water to penetrate, too sandy to retain moisture, or are nutrient poor as well. In comparison, containerized nurseries are easier to locate because the potting medium can be brought in from a number of sources. It can be either mixed on or off-site with required ingredients.

How long will this exercise take?

- At least 30 minutes to one hour for field walks and hands-on (clearing, layouting) exercises; and
- At least 30 minutes to one hour for brainstorming and processing of lessons learned from the activity in processing area.

Learning objectives

- To make participants aware and understand the different factors necessary in selecting a good nursery site;
- To make participants aware on importance of nursery establishment in raising high quality seedlings; and
- To learn the different techniques in producing good quality seedlings through hands-on exercise.

46 Jones, N. 2009. Forestry Technology No. 2: Essentials of Good Planting Stocks. Agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. www.agroforestry.net. pp6-7.

Materials

- Nursery site located nearby the learning fields; and
- Record book, brushing or cleaning tools, spade, bolo, string and or plastic twine, bamboo or wooden pegs.

Methodology

- Field walks, hands-on, brainstorming, participatory discussions, and sharing of ideas and experiences

Steps

1. Divide big group into smaller groups and ask them to select a nursery site;

2. Select a good nursery site giving emphasis among others on following factors:

   ☑ water supply;
   ☑ size, accessibility (road network);
   ☑ topography and soil condition; and
   ☑ availability of labor supply

3. Conduct hands-on exercise on layouting and clearing of selected nursery site (e.g., size of nursery depends on choice by farmers in the field);

4. Go back on processing area, brainstorm in small groups and present outputs in big group;

5. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share their experiences in nursery establishment;

6. Develop improve techniques in nursery establishment based on experiences shared by farmers and facilitators; and

7. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

- Did you observe the criteria or factors in choosing a good nursery site? What are these criteria or factors?
- Did you follow different techniques in layouting the nursery? What are these techniques?
- What difficulties did you encounter in establishing the nursery? How did you solve these difficulties?
- Why is it important to put up nursery in or near the project site? What type of nursery is more appropriate for the project site?
- What are the types of nurseries? What type of nursery did you establish? Why?
- When is the best time for nursery establishment and seedling production?
- How do you differentiate permanent or central nursery from temporary or subsidiary nursery?
- What are the different kinds of nursery tools and equipments needed?
- What are the different nursery facilities to be installed? What is their importance?

Exercise No. 3.02

SEED COLLECTION, SEED SOWING, AND SEEDLING PRODUCTION OF AGROFORESTRY SPECIES

When is this exercise most appropriate?

- In AGF-FFS, TOT, or TOS sessions, as part of topic on 'Nursery Management', conducted before the start of weekly AFESA activity.

BACKGROUND AND RATIONALE

In forestry, as in agriculture, quality of offspring plants' improved populations will result if seeds used to produce them were collected from superior mother or plus trees stands, or orchards. Seed quality is measured in two ways. One, by physical quality of seeds and secondly, by desired physical traits of matured trees. On the other hand, the benefits of using quality seeds, chosen from selected mother trees, are twofold[47]:

- *Improved survival*. Seeds from healthy, well-formed trees provide greater assurance that resulting stock will have good form, survive and better resist stressed conditions due to marginal sites, frequent cutting, or harsh climates. These adverse conditions typically weaken all but the strongest trees, making them vulnerable to insects, fungi, parasitic plants, and diseases. Most important, because of long-term resource investment and land and labor commitment in forestry, high survival rates of good quality trees is a must. In agriculture, farmers can recoup their losses after a poor season, or two. Trees, however, occupy a site for years. Therefore, any reduction in growth or quality from planting inferior stock represents a lost opportunity, which can be measured in time and capital, for as long as a tree occupies a particular site; and

- *Higher product yields*. Economic return of investment in selection will be more than compensated for higher product yields over shorter rotations. Better yields result in more building materials, higher fruit production and quality, faster fuel-wood growth, and quicker and more prolific re-growth after lopping.

- After successful seed collection, one of the primary activities in agroforestry nurseries is seed sowing and seedling maintenance. A good understanding of basic and appropriate techniques in seed sowing and seedling management is very crucial in producing consistent quality stock. The nursery in charge must keep the primary objective in mind: to grow the best uniform seedlings, for the highest plantation outputs, at the least possible cost[48].

47 Jones, N. 2009. Forestry Technology No. 1: Seed Collection. Agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. www.agroforestry.net. pp1-9.
48 Jones, N. 2009. Forestry Technology No. 2: Essentials of Good Planting Stocks. Agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. www.agroforestry.net. pp1-4.

In AGF-FFS, farmers and facilitators can learn from each other experiences that will improve practices on seed collection, seed sowing, and seedling maintenance of agroforestry species through participatory, discovery-based and experiential approaches, hence this exercise.

When this exercise is most appropriate?

- In AGF-FFS, TOT, or TOS sessions, as part of topic on 'Nursery Management', conducted before the start of weekly AFESA activity.

How long will this exercise take?

- 30 minutes for field walks and seed collection;
- At least 30 minutes to one hour for brainstorming on seed sowing; and
- Another one hour for hands-on and processing of lessons learned from the activity in processing area.

Learning objectives

- To make participants understand the basic techniques in seed collection, seed sowing and seedling maintenance of agroforestry species; and
- To provide the farmers hands-on and techniques to practice seed collection, seed sowing and seedling management.

Materials

- Manila paper, pentel pens, masking tape, ball pens, and ruled papers;
- Materials (e.g., sowing box, seed box, seed bed, seed basket or container);
- Selected seeds of agroforestry species harvested from the learning field or adjacent site; and
- Equipments (e.g., pot for water boiling, seed boxes or containers, seedling pots, and digging tools).

Methodology

- Field walks, brainstorming, and hands-on exercises

Steps

1. Conduct participatory discussion to develop pointers on how to collect seeds from superior individuals, stands, or orchards. The following short list of collection tactics may be considered[49]:

    ☑ Collect in seed-lots from between 15 and 25 individuals that are spaced at least 100 meters distance from any other collection tree of the same species;
    ☑ Choose trees in vigorous health and avoid any that are diseased, suppressed, deformed, environmentally stressed, or in otherwise poor health;
    ☑ Collect from trees that are well formed and either dominant or co-dominant in the canopy;
    ☑ Avoid individuals that are isolated from others of the same species;
    ☑ Harvest only mature seeds from ripen fruits;
    ☑ To ensure genetic variation, collect fruits equally from all parts of the crown (e.g., top, side, and bottom) as these parts may have been pollinated at varying times from different sources;
    ☑ Collect throughout a species' normal habitat, noting variations in site; and
    ☑ Man-made stands, including live fencing, plantations, or windbreaks, should be carefully reviewed as to their establishment before being selected as a seed source.

2. Divide participants in small groups and ask them to conduct field walks, assess, and collect seeds from superior individuals, stands, or orchards in agroforestry learning and adjoining fields as follows:

    ☑ Each small group takes sample seeds in agroforestry learning and adjoining fields. Request each small group to do hands-on of proper seed collection procedures agreed upon;
    ☑ Let each small group to collect seeds in two field sites: one activity to be undertaken at learning field and another in a nearby adjoining field; and
    ☑ Collect only full seeds (e.g., seeds must not be empty or half empty).

3. Conduct another participatory discussion to develop pointers on how to prepare collected seeds for seed sowing and seedling production. For hard-coated seeds, the following techniques of breaking the seeds coat may be adapted:

    ☑ Get a pot and put water. Heat water up to boiling. Upon boiling remove pot from fire and dip selected seeds for at least ten seconds. The seeds are ready for sowing;
    ☑ In a container, put sufficient ordinary water and soak the seeds for 3 days (this technique is best for stocked seeds); and

49 Jones, N. 2009. Forestry Technology No. 1: Seed Collection. Agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. www.agroforestry.net. pp6.

- ☑ Conduct seed scarification or nicking. With a pointed instrument, scratch surface of seed coat to create an opening for seed germination.

4. Conduct another participatory discussion to develop pointers on how to properly sow seeds and produce healthy seedlings. The following procedures may be modified:

   - ☑ Sow seeds in containers (box or pots) to germinate seeds. Germination period is dependent on the kind of seeds;
   - ☑ When seeds have germinated and developed 2-3 cotyledons, they are ready for pricking-out into plastics bags filled with growing media;
   - ☑ The seedlings are allowed to harden-off for at least 2-3 weeks in partial shade with care and maintenance; and
   - ☑ Upon completing the hardening-off period, seedlings are ready for out-planting when seedlings are about one foot tall and with a pencil size diameter.

5. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

- ❑ What is your idea of a good seed? How do you measure seed quality?
- ❑ How do you store seeds?
- ❑ How do you propagate fine seeds? How about big seeds?
- ❑ What is the best mixture for potting media?
- ❑ When do you prick-out and transplant into the pots?
- ❑ How do you maintain seedlings?
- ❑ Why is hardening-off of seedlings important prior to out-planting?

Exercise No. 3.03

> **When is this exercise most appropriate?**
>
> - In AGF-FFS, TOT, or TOS sessions, before nursery establishment; and
> - When participants are interested to know about seed morphology; its importance understanding seed quality of agroforestry crops.

SEED MORPHOLOGY: ITS IMPORTANCE IN UNDERSTANDING SEED QUALITY OF AGROFORESTRY CROPS

BACKGROUND AND RATIONALE[50]

The seed is a basic requirement in all development programs (e.g., agricultural production, agroforestry, plantation and reforestation projects). The desire to meet pressing need for seeds has often led to sacrifice in quality, suitability, and overall sustainability in favor of assured supply. It must be remembered that form, type, and quality (e.g., viability, germinability, vigor, health, purity and authenticity, moisture content and genetic uniformity) of seeds contribute greatly to success of any development undertakings.

Some seeds, referred to as *apomicts* as opposed to true seeds, are produced without fertilization (e.g., many forage grasses). Others (e.g., mango and citrus species) have *polyembryonic* seeds producing several embryos one of which is sexual and others are clones. In this regards, certain seed morphological structures must be examined thoroughly to understand prevailing quality of seed lots.

In AGF-FFS, farmers and facilitators can learn from each other experiences that will improve understanding of seed quality by thorough examination of seed morphology of agroforestry species and through subsequent participatory, discovery-based, and experiential approaches, hence this exercise.

How long will this exercise take?

- At least 30 minutes to one hour for field walks, seed collection, and hands-on (identifying and drawing of morphological structures) exercises; and
- At least 30 minutes to one hour for brainstorming and processing of lessons learned from the activity in processing area.

50 IIRR. 1998. Seeds and Plant Propagation. Agroforestry Technology Information Kit (ATIK) No. 5, International Institute of Rural Reconstruction (IIRR), Department of Environment and Natural Resources (DENR), and Ford Foundation (FF). pp1-9.

Learning objectives

- To make participants aware and understand how to select high quality seeds based on seed morphology; and
- To learn through hands-on exercise (e.g., identify and draw) the different morphological parts, which could be used as guide in determining seed quality of agroforestry crops.

Materials

- Seeds from mother trees located nearby the learning fields; and
- Manila papers, coloring pens, record book, pencils, ball pens, and pentel pens.

Methodology

- Field walks, hands-on, brainstorming, participatory discussions, and sharing of ideas and experiences

Steps

1. Divide big group into smaller groups and ask them to do field walks, observe, and collect seeds from selected mother trees in learning and adjoining agroforestry fields;

2. Select a good quality seeds giving emphasis among others on following factors:

    ☑ Collect seeds from best parent trees;
    ☑ Collect seeds from several parent trees to assure genetic diversity;
    ☑ Keep proper distance (e.g., 100-meter) between selected parent trees; and
    ☑ Collection should cover broad geography, including environmental extremes.

3. Conduct hands-on exercise on identifying and drawing seed morphological parts (e.g., size, shape, color, among others that suggest high seed quality) to compare seed quality of agroforestry crops;

4. Go back on processing area, brainstorm in small groups and present outputs in big group;

5. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share their experiences in ensuring high quality seeds of their own agroforestry crops;

6. Develop improve techniques in ensuring high quality seeds of agroforestry crops based on experiences shared by farmers and facilitators;

7. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

- Did you observed the criteria or factors in choosing good quality seeds of agroforestry crops? What are these criteria or factors?
- Did you follow different techniques in selecting parent trees? What are these techniques?
- What difficulties did you encounter in identifying morphological structures of seeds?
- What seed morphological structures did you observe that suggested high seed quality?
- Why is it important to collect seeds from best and several parent trees?
- When is the importance of identifying and knowing seed morphology in agroforestry crops?

Exercise No. 3.04

TISSUE CULTURE AND OTHER VEGETATIVE PROPAGATION METHODS FOR AGROFORESTRY SPECIES

When is this exercise most appropriate?

- In AGF-FFS, TOT, or TOS sessions, as part of topic on 'Nursery Management', conducted before the start of weekly AFESA activity; and
- When farmers want to learn innovative practical techniques in vegetative propagation in the absence of seedlings.

BACKGROUND AND RATIONALE

The vegetative method of propagation involves the use of vegetative parts of the plants, like roots, stems, and leaves, to increase the number of plants of the same kind. It is also called asexual propagation, since no union of the male and female gametes is involved. In agroforestry, vegetative or asexual propagation is a means of planting stock production wherein vegetative parts of the plant like the stems or stamps are used as initial materials instead of seeds[51]. There are different vegetative propagation methods for agroforestry species, as follows:

- *Cuttage* or *Use of Cuttings* is a method of vegetative propagation involving regeneration of structural parts in detached vegetative parts under favorable conditions. For agroforestry species, it can be a portion of a stem or a leaf of donor plants placed under favorable conditions for induction of roots and shoots;

- *Graftage* or *Grafting* is a general term for propagation methods whereby two plant parts are joined in such a manner that they will unite, continue their growth, and develop as one plant;

- *Budding* is usually used instead of grafting if one wants to economize in the use of scion materials, since each bud is a potential new plant; a scion is reduced in size to contain only one bud in a small portion of the bark with or without wood. It is at times termed as *bud grafting* because the physiological processes involved are the same as in grafting; and

- *Marcotting* or *Air Layering* is a method of rooting selected shoot or branch by wrapping a portion of stem with a rooting medium with or without stem treatment. It involves growing of roots on a branch while it is still part of the tree.

On the other hand, tissue culture consists of implanting disease-free tissues in a sterile artificial medium, allowing them to divide and form a mass of undifferentiated tissues called *callus* or *proto-corm*. This is followed

51 Tandug, L.M., Uy, M.U., Umali, Jr., P., and Lantican, N.L. 1992. Development and Management of Forest Plantations: A Silvicultural Guide, Agroforestry Technology Information Kit (ATIK) Volume No. 5.

by dividing them to increase their number and allowing them to differentiate into plantlets. When they become too crowded, they are transplanted into fresh medium. Finally, they are transplanted outside the bottle when they are mature and hardy enough to survive the natural environment[52]:

- *Disease Testing*. It is necessary to test the source of plant for freedom from virus or other systemic pathogens by virus indexing. The method of surface sterilization being used for tissues cannot kill viruses, for they are found inside cells up to where vascular bundles extend.

- *Initial Implantation.* Prior to sowing, ex-plants are surfaced-sterilized in 5-10 percent solution of commercial bleach (chlorox) or 1-2 percent calcium hypochlorite for a few minutes, and rinsed several times with plenty of sterile water.

- *Multiplication*. As soon as callus attains sufficient size to be subdivided, it is cut into pieces and replanted into separate culture tubes, bottles, or flasks, agitated again if further multiplication is desired, and re-flasked into another culture bottle to produce more growth.

- *Pre-transplanting*. The plantlets will soon crowd the container as they develop. To give them more space for development, plantlets are transferred to several bottles containing nutrient medium without hormones in an operation called *re-flasking*. The number of plantlets in a bottle will depend on size of plantlets. They are then exposed for hardening-off.

- *Transplanting*. As soon as the plants have attained sufficient size, they are ready for transplanting. At this point, plants are very delicate and require more hardening-off to make them tolerant to moisture stress and light. They are transplanted in pots, several in a pot, hence the term *community pot* or *compot*.

In AGF-FFS, farmers and facilitators can learn from each others experiences that will improve practices on tissue culture and other vegetative propagation methods for agroforestry species through participatory, discovery-based, and experiential approaches, hence this exercise.

How long will this exercise take?

- At least 30 minutes to one hour for field walks, interaction with farmers, observation, and hands-on; and
- At least one hour for brainstorming and processing of lessons learned from the activity in processing area.

52 Bautista, O.K. (ed.). 1994. Introduction to Tropical Horticulture. 2nd Edition, SEAMEO Regional Center for Graduate Study and Research in Agriculture and University of the Philippines Los Baños, College, Laguna, Philippines. pp223-242.

Learning objectives

- To make participants understand the basic knowledge and skills on how to perform vegetative or asexual propagation for agroforestry species;
- To provide venue for farmers to practice the techniques they learned on vegetative propagation for agroforestry species; and
- To make participants of TOT and TOS understand basic knowledge and concepts of tissue culture method of propagation.

Materials

- Nursery site or areas adjacent to learning field where materials on vegetative vegetations are available and methods of vegetative propagation on agroforestry species will be performed;
- Manila paper, notebooks, crayons, ball pen, and pencil;
- Materials for grafting, budding and marcotting (e.g., root stock, scion plastic strip, plastic string, grafting knife, moss, cutter, and pruning shear); and
- Materials for tissue culture (e.g., bottles, tissue culture media, and sterilizer).

Methodology

- Field walks, brainstorming, and hands-on exercises

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe tissue culture and other methods of vegetative propagation of agroforestry species undertaken in a nursery site near learning and adjoining fields. Interview other farmers and list down all observations;

2. Go back to processing area, brainstorming in small groups and present output to big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in vegetative propagation through tissue culture and other methods;

3. Develop an improved procedure for tissue culture and other methods of vegetative propagation on agroforestry species;

4. Facilitate each farmer to do hands-on on vegetative propagation of agroforestry species and other methods by improving the procedure below:

   For Tissue Culture (allow participants to either do hands-on or observe and familiarize only with procedures undertaken in a tissue culture laboratory as indicated below)[53]

   - ☑ Implanting disease-free tissues in a sterile artificial medium;
   - ☑ Allowing implanted tissues to divide and form a mass of undifferentiated tissues called callus or proto-corm;
   - ☑ Dividing proto-corm to increase their number and allowing them to differentiate into plantlets;
   - ☑ Transplanting plantlets into fresh medium in bottles; and
   - ☑ Transplanting plantlets outside bottles when they are mature and hardy enough to survive natural environment.

   For Grafting Method (allow participants to do actual procedures in an agroforestry species nursery as shown below)[54]

   - ☑ Provide each small group with seedlings, scions, and other materials needed;
   - ☑ Make vertical incision on root stock;
   - ☑ Cut scion bud stick into a short wedge;
   - ☑ Insert bud stick into root stock;
   - ☑ Wrap union with thin plastic strip dipped with wax, or any material that could prevent drying up;
   - ☑ Cover with plastic bag or anything that could help reduced immediate drying up of the grafted material;
   - ☑ Remove plastic bag as new shoots emerges; and
   - ☑ Remove plastic strip before planting.

   For Other Vegetative Propagation Methods (allow participants to either do hands-on or observe and familiarize only with the procedures undertaken in a nearby plant nursery)

5. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

53 Bautista, O.K. (ed.). 1994. Introduction to Tropical Horticulture. 2nd Edition, SEAMEO Regional Center for Graduate Study and Research in Agriculture and University of the Philippines Los Baños, College, Laguna, Philippines. pp232-233.

54 Tandug, L.M., Uy, M.U., Umali, Jr., P., and Lantican, N.L. 1992. Development and Management of Forest Plantations: A Silvicultural Guide, ATIK Volume No. 5.

Some suggested questions for processing discussion

- What is asexual or vegetative propagation?
- What asexual or vegetative propagation methods do you know?
- How do you differentiate asexual from sexual method of plant propagation? What are their advantages and disadvantages?
- How do you differentiate tissue culture from grafting and other vegetative propagation methods? What are their advantages and disadvantages?
- What vegetative propagation method do you prefer to use? Why?
- Is tissue culture method of propagation applicable to AGF-FFS? Why?
- What are the different plant parts to be used in asexual propagation and tissue culture?

FOREST PLANTATION ESTABLISHMENT AND MANAGEMENT[55]

More than ever, reforestation and afforestation projects worldwide are expanding at a tremendous rate. Surveys indicate an increase in planted area from 18 million ha in 1980 to 44 million ha in 1990. Much planting takes place in areas that exhibit a broad range of site qualities. However, many sites have been degraded by inappropriate agriculture, exploitation, and particularly excessive grazing. Forests are rarely planted on top-quality sites as these are typically reserved for agriculture. As a result, forested sites range from serviceable to severely degraded. They may be characterized by poor drainage, thin soil, steep slopes, salinity, or previous heavy use.

In the same way, Philippine Forestry Statistics (1993) show that 15 million hectares or 50 percent of the country's total land area is classified as forest land. These areas, formerly occupied by luxuriant natural forest, has declined dramatically and continues to do so at an average of 200 ha/year. The actual forest cover left is only 5.8 million hectares with only 8.0 million hectares old growth forest and 3.23 million hectares residual production forest. Other areas were found covered with weeds, grasses, and bushes. In fact, Forest Development Statistics (2002) indicate that actual forest cover left is only 5.2 million hectares (Global Agricultural Network, USDA).

Under these conditions, there is aggravation of socio-economic situation in these areas. The percentage of non-productive land rises while bio-diversity is reduced with incalculable economic and environmental costs and losses. Communities that depend on these resources increase in population and there is growing demand for what forest can give out for human welfare. It is there that the role of management comes in. Thus, planting of agroforestry crops become a responsibility of the entire citizenry. In this case, people's organizations (POs), in coordination with various local government units (LGUs) and other stakeholders, should take active role in leading its constituents in this endeavor.

This sub-section compiles discovery-based exercises that address some basic measures to guide field foresters and farmers in analyzing and preparing sites for out-planting or forest establishment and operation.

55 Jones, N. 2009. Forestry Technology No. 3: Soil Analysis and Out-planting. agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. www.agroforestry.net. pp1-2.

Exercise No. 3.05

> **When is this exercise most appropriate?**
>
> - In AGF-FFS, TOT, or TOS sessions, before plantation establishment in learning field; and
> - When farmers want to learn innovative practical techniques in plantation establishment of agroforestry species.

PLANTATION ESTABLISHMENT: SURVEY AND MAPPING, PLANTING DESIGN, CHOICE OF SPECIES, SOIL SAMPLE COLLECTION AND ANALYSIS, AND SITE PREPARATION AND PLANTING

BACKGROUND AND RATIONALE[56]

Usually, there is little that can be done to alter or improve a given project site; but nonetheless, field foresters and villagers can be aware of potential problems (and opportunities). They must learn to differentiate sites that can be worked with from those that are marginal and others that must be avoided entirely. By recognizing a site's limitations, communities can better direct their limited resources toward optimal site preparation to ensure both desired production and long-term plant survival.

The forester and the community who works with must understand the site's capabilities and limitations both to ensure proper establishment and because of long-term investment in tree growth. They can gain this understanding through an analysis of the site's properties. The analysis is best completed prior to collection of nursery tree seeds in order to confirm selection of agroforestry species. Otherwise, decisions based on incomplete information or guesswork will greatly increase chances of error. A thorough analysis through survey and mapping examines four main site properties: (a) soil; (b) site biology; (c) climate; and (d) physical characteristics.

Soil is main indicator of a site's tree growth potential. The soil physical properties determine the flow and retention of ground moisture and either enhance or hinder proper root development. On the other hand, site biology, climate and physical characteristics help resolve concerns related to planting design, agroforestry species, and site preparation. In consulting with local users, foresters must plan to either sustain existing goods and services (e.g., fuel, fodder, food, medicine, among others) or provide for acceptable substitutes (e.g., tree fodder for grass, cash income for food, and so forth). Take note also that future earnings from plantation products are only attractive to those farmers and villagers whose immediate needs are met. Even industrial plantations may need to provide other products and services.

56 Jones, N. 2009. Forestry Technology No. 3: Soil Analysis and Out-planting. Agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. wwwagroforestry.net. pp3-12.

In AGF-FFS, farmers and facilitators can learn from each other many learning experiences that will improve decision-making on site preparation and plantation establishment for agroforestry species through participatory, discovery-based and experiential approaches, hence this exercise.

How long will this exercise take?

- Thirty minutes to one hour for field walks of farmer participants, site observation, farmer to farmer interaction; and
- At least 30 minutes to one hour for brainstorming and processing of lessons learned from the activity in processing area.

Learning objectives

- To make participants aware and understand the basic techniques and factors to be considered in establishing agroforestry plantations;
- To make participants aware and understand how to choose agroforestry crops most suitable in a project area; and
- To provide venue for farmers to learn appropriate steps necessary in plantation establishment of agroforestry species.

Materials

- A learning field or project site where agroforestry plantation will be established;
- Manila papers, notebooks, crayons, ball pen, and pencil; and
- Working tools (e.g., shovel, sharp bolos, stakes, measuring tapes, compass, craw bar, and seedlings).

Methodology

Field walks, brainstorming, and hands-on exercises

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe plantation establishment of agroforestry species in a learning field or an agroforestry project site. Interview other farmers and list down all observations;

2. Go back to processing area, brainstorm in small groups and present output to big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in plantation establishment of agroforestry species;

3. Develop an improved procedure and techniques for plantation establishment of agroforestry species by considering factors given below, among others:

   ☑ *Planting survey and mapping* as basis for planting plan is first step to be taken up. Field report should normally cover: (a) general description of topographical features; (b) brief history; (c) soil condition; and (d) description of existing vegetation of project site;
   ☑ *Selection of agroforestry species or crops*, giving preference to most promising local species, where feasible and practical, both for production of high and quality timber volumes;
   ☑ *Spacing*, which varies depending on agroforestry species, site quality, and objective of planting;
   ☑ *Staking*, which is done to determine exact locations of holes to be dug-out and serve as support for the plants;
   ☑ *Holing*, which is undertaken to dig holes large enough to accommodate roots of seedlings and manure or compost; and
   ☑ *Out-planting*, which is performed by gently removing plant from planting bag or tray and gently inserting in planting hole. Quality of planting will depend materially on quality of site preparation, which is very important to get out-planted seedlings growing fast so that they can suppress growth of grasses.

4. Facilitate the participants to do hands-on establishing agroforestry plantation;

5. Go back to session hall, brainstorm in small group and present learning experiences and outputs to big group for comments and suggestions; and

6. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

❑ What are the basic techniques to be considered in agroforestry plantation establishment?
❑ Is there a need to consult with villagers and farmers of local communities before establishing agroforestry plantation in the project site? Why?

- ❑ What are the benefits derived from early planning for agroforestry plantation establishment? What is the importance of establishing agroforestry plantation in the project site?
- ❑ What are the important steps to be followed in agroforestry plantation establishment?

Other References

Reyes, G.D. 2002. Handout prepared for Clonal Workshop conducted on 17 May 2002 at Arisabel Clubhouse, Timugan, Los Banos, Laguna, Philippines.

Weidelt, H.J. (ed). 1975. Manual of Reforestation and Erosion Control for the Philippines, German International Technical Cooperation Agency (GTZ), Eschborn, Germany.

Exercise No. 3.06

SPECIES COMPATIBILITY

When is this exercise most appropriate?

- In AGF-FFS sessions, before plantation establishment at the learning fields.

BACKGROUND AND RATIONALE

Species compatibility is one important factor in the establishment of plantation in agroforestry. High percentage of survival is expected when the species planted is compatible not only with the edaphic and environmental conditions of the site. Reforestation and plantation establishment efforts in the past have failed because the compatibility of the species planted was not considered. Species were planted simply because it is available at that time and sometimes it is being dictated by the needs of the time, or simply because it is found to be successfully growing somewhere else. Species trials conducted in the past showed that different species have different site requirements for optimum growth and development.

The Ecosystems Research and Development Bureau (ERDB) and Green Tropics International (GTI) have developed a classification functions for several forest tree species used in forest plantation and reforestation. With the development of the classification functions, species and site matching, forest tree species that may be compatible in a certain site can be easily determined.

How long will this exercise take?

- One hour for field work, observation, and hands on the field; and
- Thirty minutes brainstorming and exchange of the ideas.

Learning objectives

- To make the participants aware and understand the different factors to be considered in the successful development of forest plantations in agroforestry areas through proper species-site classification.

Materials

- Manila papers, notebooks, ball pen, and crayons

Steps

1. Divide the group into small groups of 5 participants per group;

2. Facilitators to give questions on species compatibility to the group participants to answer. The answers are written in manila paper; and

3. Each group presents the answers to the questions given in a big group. Comments and questions are given by the participants.

Some suggested questions for discussion

- ❑ Why is species compatibility important in plantation establishment?
- ❑ What are the environmental factors considered in plantation establishment?
- ❑ What are other factors considered in successful development of a plantation?
- ❑ Can you give examples of forest tree species that you consider successfully grown in your area?

Other References

Tandug, L.V. 2004. The Species-Site Compatibility Assessment Software for Improved Reforestation Planning. Lecture presented during the Regional Technology Transfer Series of Computer-based Species-Site Matching Procedure and Other Concerns for Improved Reforestation Planning in the Philippines.

Exercise No. 3.07

PLANTATION CARE AND MAINTENANCE: REPLANTING, WEEDING, FERTILIZATION, THINNING, AND PRUNING OPERATIONS

When is this exercise most appropriate?

- In AGF-FFS, TOT, or TOS sessions, after plantation establishment in learning field or actual project site; and
- When farmers want to learn innovative practical techniques in plantation maintenance of agroforestry species after plantation establishment.

BACKGROUND AND RATIONALE

With proper tending and protection, trees should dominate the site within at least the first five years after planting and even earlier in the tropics. At this point, the trees have essentially become established and are ready for the primary phases of silvicultural treatments. This includes replanting, weeding, fertilization, thinning, and pruning as described below[57]:

- *Replanting* is the replacement of missing or dead plants as a result of suppression by weeds, pest and diseases, animal grazing, or other physical and environmental factors in a newly established agroforestry crop stand. Replanting should be done as soon as detected in early crop establishment phase to create favorable conditions for both plant's survival and to stimulate a healthy, vigorous growth, soon after replanting.

- *Weeding* is the removal of unwanted vegetation or weeds to promote better growth and development of planted trees. Weeds interfere with the survival of young plants by competing with them for sunlight, water, space, and nutrients. In general, the intensity of weeding operation should be done at a level that effectively encourages establishment at a reasonable cost. Also, types of treatment should not be so severe that it degrades the site through soil or nutrient loss.

- *Fertilization* can be used to either enhance stand's growth or to amend soil to correct any detected nutrient deficiencies. Treatment should be done early in the establishment phase, soon after planting. This is the point at which young plants can most use a growth spurt. Also, crown closure in a developing stand could inhibit proper application if treatment is putt-off for several years.

- *Thinning* essentially reduces the number of trees on site to allow more growing space for those remaining. The goal is to reach the optimum spacing for mature trees to maximize the desired products or end

57 Jones, N. 2009. Forestry Technology No. 4: Forestry Plantation. Agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. www.agroforestry.net. pp14-16.

use. For most species, the sale value of wood increases significantly with tree size and a suitable thinning regime will guarantee larger number of biggest trees possible. Thinning also results in more uniform distribution of crop trees throughout the stand. If stand is not thinned, trees will become crowded, restricting their development and growth.

- *Pruning* is the removal of branches to a height as far as can be reached. It is generally done when stand is a decade old. Again, correct timing depends on species and growth rate. Moreover, the activity should take place during a dormant season or slow growth period. Pruning benefits stand by adding value to timber crops by creating clearer, knot-free wood. The operation also reduces fire hazard by eliminating a fuel source and improves access through the stand.

In AGF-FFS, farmers and facilitators can learn from each other many learning experiences that will improve decision-making on plantation maintenance for agroforestry species through participatory, discovery-based and experiential approaches, hence this exercise.

How long will this exercise take?

- Thirty minutes to one hour for field walks, interaction with farmers, observation, and hands-on; and
- At least 30 minutes for brainstorming and processing of lessons learned from the activity in processing area.

Learning objectives

- To make participants aware and understand the basic techniques in plantation maintenance of agroforestry species after plantation establishment; and
- To provide venue for farmers to learn different steps necessary in plantation maintenance of agroforestry species after plantation establishment.

Materials

A learning field or project site in a newly established plantation of agroforestry species;
Manila papers, notebooks, crayons, ball pens, and pencils; and
Other supplies (e.g., shovel, sharp bolos, stakes, measuring tapes, compass, craw bar, hole digger, fertilizer materials, and seedlings for replanting).

Methodology

- Field walks, brainstorming, and hands-on exercises

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe plantation maintenance in a newly established agroforestry species in a learning field or an agroforestry project site. Interview other farmers and list down all observations;

2. Go back to processing area, brainstorm in small groups and present output to big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in plantation maintenance of an established agroforestry project site;

3. Develop an improved procedure for plantation maintenance of a newly established of agroforestry project sites by taking into consideration appropriate success factors on the following operations:

   ☑ Replanting on missing or dead plants;
   ☑ Controlling unwanted vegetation;
   ☑ Fertilization and fertilizer management;
   ☑ Pre-commercial thinning of crop stand; and
   ☑ Initial pruning activities.

4. Facilitate each farmer to do hands-on on appropriate plantation maintenance in learning field of a newly established agroforestry project sites using the improved procedure;

5. Go back to session hall, brainstorm in small group and present learning experiences and outputs to big group for comments and suggestions; and

6. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

❑ What are the basic activities and techniques to be undertaken in a 2-3 year old established agroforestry plantation?

- ❑ What are the benefits derived from a well maintained agroforestry plantation?
- ❑ When to undertake appropriate plantation maintenance operations in a 2-3 year old established agroforestry plantation? Why?
- ❑ What are the conditions to be considered in conducting thinning and pruning activities?
- ❑ What are the things to be considered in conducting replanting activities in established agro forestry plantation?
- ❑ Is their a need to apply fertilizer in an established agro forestry plantation? When is the best period to apply fertilizer?

Exercise No. 3.08

PLANTATION PROTECTION: TOWER AND FIRE-LINE CONSTRUCTION, PATROLLING, FIRE CONTROL, AND PEST AND DISEASE MANAGEMENT

When is this exercise most appropriate?

- In AGF-FFS, TOT, or TOS sessions, after plantation establishment in learning field or actual project site; and
- When farmers want to learn innovative practical techniques in plantation protection of agroforestry species after plantation establishment.

BACKGROUND AND RATIONALE[58]

Much of the emphasis for a planting project is placed at the beginning with seed selection, nursery development, and out-planting. Unfortunately, the project manager and the community he works with reduce their efforts after the seedlings are in the ground. Given the high risks during this period of establishment, such reduced efforts could prove disastrous to tree crop stand.

Once planted in the field, seedlings no longer have the safe nursery environment. Instead, they are subject to several natural and human-caused hazards. Establishment thus becomes a period of protecting and tending the tree crop. In addition, establishment also determines how the tree develops for the remainder of the strand's life. Stands that have a vigorous, hazard-free start are more likely to develop into vigorous, healthy plantations. Those stands that have to compete with vegetation and other factors will have a slower start and may even fail.

Thus, protection is one of the important activities to be considered in agroforestry plantation to safeguard from destructive human activities such as forest fires, squatting, *kaingin* making, and from pests and diseases. This protection activity includes tower and fire-line constructions, patrolling, fire control, and pests and diseases management.

- *Tower and fire-line constructions*. In areas prune to frequent fires, plantation planners should consider tower and fire-line construction. This means that during hazardous period, a fire tower will be necessary, where a team of fire fighters will be there on some form of standby to take rapid action on any identified fire. Also, fire-lines can be made rapidly by the team, who working in a single line, use hand tools to scrape earth. The fire-line, which is cleared to bare mineral soil in approaching path of fire, contains fire's spread. For small ground fires, fire-line only needs to be about 50 cm wide. Wider lines (e.g., up to 10 m wide vegetation-free strips) should be dug for hotter fires or where wind is a consideration. When fire

58 Jones, N. 2009. Forestry Technology No. 4: Forestry Plantation. Agroforestry Net, Inc., PO Box 428, Holualoa, Hawaii 96725, U.S.A. wwwagroforestry.net. pp6-16.

is contained within fire-line, it can be extinguished. The area must be watched until fire is absolutely out. Many fires thought to be dead have started after being left too early.

- *Patrolling and fire control*. Assessing degree of fire hazard involves a simple check of four factors, namely: (a) air temperature; (b) relative humidity; (c) wind direction and velocity; and (d) fuel build-up. Many villages and communities periodically burn vegetation as a common practice. Fire prevention for plantations should be a main consideration in such areas. Methods to reduce chance of fire include: (a) reduction of ground level vegetative fuel source; (b) controlled burns; and (c) firebreaks. Reducing fuel source can be done through either cultivation of soil or cutting and chopping grass and weeds. Burnable materials can be removed between rows or around each plant. Firebreaks provide a direct barrier to ground fires and allow access to plantation for maintenance or in case fire does occur. Main firebreaks are kept entirely free of vegetation and should be laid at right angles to prevailing winds. Plantation managers must also consider fire threat from both within and outside of plantation. A full perimeter break will reduce risk of outside fires, while intermittent breaks will stem spread of fire from within stand. When feasible, controlled burning can be used to reduce vegetative fuel source. Controlled burns require appropriate weather conditions including light winds, some ground moisture, and mild temperatures and most of all careful planning and supervision. Otherwise, there is potential that fire will spread beyond designated area.

- *Pests and diseases management*. To counter potential hazards to attack of pests and diseases, preventive measures are the first line of defense. The best precaution is to plant species that are resistant to, or tolerant of, prevailing pests and diseases, and is suited to site's climate and soils. Afterward, proper tending operations that promote a healthy, vigorous growth of plants are a must. Plantation of mixed species also will help prevent widespread infestations or infections. Typically, pests and diseases are specific to their host species and are not likely to switch species. Proper sanitation, mechanical and biological controls are also environmentally safe and promote balanced agroforestry ecosystem.

In AGF-FFS, farmers and facilitators can learn from each other many learning experiences that will improve decision-making on protection of established agroforestry plantation through participatory, discovery-based and experiential approaches, hence this exercise.

How long will this exercise take?

- One to two hours for field walks, interaction with farmers, observation, and hands-on; and
- At least 30 minutes for brainstorming and processing of lessons learned from the activity in processing area.

Learning objectives

- To make participants aware and understand the basic strategies to be considered in the protection of agroforestry plantation;
- To provide venue for farmers to learn appropriate steps necessary in protection of agroforestry species after plantation establishment; and
- To provide the participants basic knowledge on fire prevention and suppression techniques.

Materials

- A learning field or project site in a established plantation of agroforestry species;
- Manila papers, notebooks, crayons, ball pen, and pencil;
- Other supplies (e.g., shovel, sharp bolos, stakes, measuring tapes, compass, craw bar); and
- Fire fighting materials and equipments (e.g., fire swatter, fire rake, and knapsack sprayer).

Methodology

- Field walks, brainstorming, and hands-on exercises

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe protection activities in an established agroforestry plantation in a learning field or an agroforestry project site. Interview other farmers and list down all observations;

2. Go back to processing area; brainstorm in small groups and present output to big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in protection of an established agroforestry plantation in a project site;

3. Develop an improved procedure for plantation protection of a established of agroforestry project sites by taking into consideration appropriate success factors on the following operations:

   ☑ Tower and fire-line constructions (e.g., in areas prone to frequent fires);
   ☑ Patrolling and fire control (e.g., reduction of ground level vegetative fuel source, controlled burning, installation of firebreaks and billboards); and

- ☑ Pests and diseases management (e.g., biological, botanical, mechanical, physical, and cultural methods).

4. Facilitate each farmer to do hands-on on appropriate plantation protection in learning field or project site of an established agroforestry species using the improved procedure;

5. Go back to session hall, brainstorm in small group and present learning experiences and outputs to big group for comments and suggestions; and

6. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

- ❑ What are the elements of fire? What is the importance of knowing the elements of fire?
- ❑ Why do forest fires occur? How do we prevent them? What are the effects of forest fire?
- ❑ What are the basic strategies and techniques to be considered in protection of agroforestry plantation?
- ❑ What factors should we consider in constructing a look-out tower?
- ❑ What factors should we consider in constructing fire-lines and fire breaks in an agroforestry plantation?
- ❑ What are the techniques of forest fire control in an established agroforestry plantation?
- ❑ What benefits are derived from undertaking appropriate operations to protect agroforestry plantation?
- ❑ When should we undertake each appropriate operation in plantation protection of an agroforestry plantation? Why?
- ❑ Is fire protection considered as a good management tool in agroforestry? Why?

Section 4

FOREST ECOLOGY AND AGROFORESTRY

Section 4

FOREST ECOLOGY AND AGROFORESTRY[59]

One of more revealing lessons learned during the past two decades of environmental awakening in the Philippines is that the maintenance of earth's delicate balance by mere prophylactics of pollution control and other ecological mitigation measures cannot ensure sustainable development. Most Filipinos still depend on natural resources systems for their subsistence and must therefore confront the inexorable reality of ecological principles. Indeed there are strong coincidences between population growth, resource depletion, environmental quality, and incidence of poverty. Since the Philippines is almost all forest in its natural state, and since the country's topography and ecology appear to be significantly controlled by ecological dynamics of forests, the state of forests could serve as a qualitative and quantitative indicators that could testify to ominous decline of environmental quality such as the: (a) ravaging of fishing grounds and coral reefs; (b) pollution of rivers, lakes, and bays; and (c) clearly visible air pollution in Metro Manila and other urban areas

Faced with problem of rapid forest denudation and ever increasing demand for forest products, a well planned, small scale multiple-use agroforestry project could successfully provide long-term economic benefits to a rural community while still protecting and enhancing resource base. The agroforestry project may involve only few farmsteads or the entire community without need for substantial capital outlay. Given the alternative uses of a particular resource, the basic objectives of multiple-use agroforestry is to determine best mix of present and future uses of a resource in order to obtain maximum benefits. Combining uses may be achieved through the following options or a combination of these: (a) concurrent use of resource products and uses which ensures production of different goods and services for the same area; (b) alternative or rotating uses of a natural resource for specific period of time; and (c) geographical allocation of uses over an area.

Agroforestry, as the term suggests, combines agricultural production with growing of trees, either simultaneously or sequentially, over same unit of land. This system is useful especially for previously forested lands or grasslands. It is sustainable and regenerative. Overall yield of land increases. The use of land resource is maximized while ecologically-sound farm management practices are employed. Ideally, trees usually dominate an agro-forest. They may be inter-planted among agricultural crops or line perimeter of field to act as windbreaks. The idea is to create a two- or three-storey system that approximates a multi-level natural forest.

59 Reyes, M.A., Trinidad, C.A., Baguilat, Jr., T., Velasquez, M.A. 1991. Towards Sustainable Development, Primer Series No. 14. Justice and Peace Among Humans Through Justice and Peace on Earth and Lingkod Tao-Kalikasan. pp40-47.

Being an integrated farming system, agroforestry brings multiple benefits to farmers. Trees provide shade to crops and domestic livestock as well as improve soil fertility. Leaves provide forage and mulching material. Wood serves as fuel and construction material. Thus, a subsistence farmer's energy food supplies are adequately provided for, and any surplus may even be marketed for extra income. Thus, this section includes discovery-based exercises that articulate: (a) agroforestry systems, production, and protection; and (b) forest ecology and agroforestry ecosystem.

Exercise No. 4.01[60]

FOREST ECOLOGY AND AGROFORESTRY ECOSYSTEM

When is this exercise most appropriate?

- In AGF-FFS, TOT, or TOS sessions, before the first agroforestry ecosystem analysis (AFESA) in learning field.

BACKGROUND AND RATIONALE

In an activity 'what is this?' learning to answer questions with questions were emphasized. The response would be about any question about a specimen. In agroforestry ecosystems, however, everything has a function, and function is more important than technical name.

There are levels of functions in all ecosystems. The first levels are producers of organic material; the plants, which include agroforestry crops (e.g., agricultural crops and forest trees) and weeds. The weeds have an additional function in agroforestry field. Weeds also compete with water, nutrients (e.g., N, P, K, and others), sunlight, and space. Weeds are defined in many ways but one good definition is that they are producers that are unwanted by mankind at that time and space when they grow with agroforestry crops.

The second levels are consumers that feed on plants and other organisms. The first sub-level includes plant eaters such as insects, rats, and other animals. These insects are usually referred to as 'pests'. But pests are defined by their population, not by their function. For example, if a population of hoppers reaches a high level of damage to agroforestry crops, these hoppers become 'pests'. If population is low, they are not pests. In fact, if there are no hoppers at all, spiders would have less food and their population would be low. In this case, hoppers at low population are important to keep spider population high. The second sub-level includes organisms that feed on organisms from second's first sub-level. These include spiders, insects (e.g., predators and parasitoids), fungi, bacteria, and viruses that attack pests, as well as owls, cats, and other predators of rats. These organisms are usually called 'natural enemies' of pests or friends of farmers because they attack things that could become pests. Preserving these organisms is important to prevent the second levels' population from increasing.

The third levels, in the context of agroforestry ecosystem, are decomposers. These include bacteria, fungi, and maggots that feed on dead plants, insects, spiders, rats, and other dead organisms that are in an agroforestry ecosystem. In this cycle, nutrients used by producers will go back to the system.

60 Adapted from Callo, Jr. D.P., M.O. Olanday, and C.A. Baniqued (eds). 2000. Field Guide of Discovery-based Exercises for Mango IPM. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp2-46 to 2-49.

In this activity, participants will practice to identify the composition found in agroforestry ecosystem. Thus, this exercise is a good introductory exercise for study of forest ecology and agroforestry ecosystem by both farmers and facilitators.

How long will this exercise take?

- One to two hours for field walks, brainstorming and processing of lessons learned from the activity in processing area.

Learning objectives

- To build participants' awareness and understanding of relationship that exists in many biotic and abiotic things that are found in agroforestry ecosystem;
- To make participants aware of existence and balance of components of agroforestry ecosystem;
- To let participants appreciate that if one thing in network of interaction s is changed, it can influence all other components of an agroforestry ecosystem;
- To make participants become more aware of things and interactions that makes up an agroforestry ecosystem; and
- To allow participants to start using their understanding and observations of ecology and agroforestry ecosystem as basis for decision-making about agroforestry crop management.

Materials

- A project site where different agroforestry systems are practiced; and
- Manila paper, notebooks, crayons, ball pen, and pencil.

Methodology

- Field walks, brainstorming, and hands-on exercises

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe agroforestry ecosystems in an agroforestry project site. Each small group should try to work to:

   ☑ Look around to observed all things that are visible to naked eye;

- ☑ List all biotic and abiotic things observed in agroforestry ecosystem; and
- ☑ Brainstorm in small group on what biotic and abiotic things observed to record (Facilitators move between groups to assist in brainstorming).

2. Go back to session hall and present output to big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Facilitators guide big group to expound on interactions or relationship among various components of an agroforestry ecosystem;

3. Develop a conceptual framework for participants to better understand inter-relationship and interaction of various components of agroforestry ecosystems; and

4. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

- ❑ How many components of an agroforestry ecosystem did you find?
- ❑ What would happen to the ecosystem if you remove one of the components (e.g., trees, water, sunlight, birds, and/or others)?
- ❑ Which of these components do we often try to change in an agroforestry ecosystem?
- ❑ What other components in agroforestry ecosystem, if removed or disturbed, would affect the ecosystem? Why?
- ❑ What is your understanding of a 'Forest Ecology and Agroforestry Ecosystem'?

Exercise No. 4.02

AGROFORESTRY, AGROFORESTRY SYSTEMS, PRODUCTION AND PROTECTION ASPECTS

When is this exercise most appropriate?

- In AGF-FFS, TOT, or TOS sessions, after plantation establishment in learning field or actual project site; and
- When farmers want to learn innovative practical techniques in agroforestry systems, production, and protection aspects.

BACKGROUND AND RATIONALE[61]

Agroforestry has been practiced since time immemorial but it was only during the last three decades that it was recognized as a field study. Based on ICRAFT, agroforestry can be classified on component mixed, dominant role of tree component, and interactions between or among components in time and space. There are traditional astute agroforestry practices being employed mostly by indigenous people in the uplands. The great majority of population, however, remains in need of improving their system of farming uplands to increase income and protect the environment.

In the Philippines, just like in many parts of the tropics, agroforestry is being viewed as most promising land use of cultivated lands. It can be described as the raising of woody perennials with agricultural crops and/or livestock in a sustainable manner. The components can be arranged in a wide variety to primarily provide site protection and the agricultural crops and livestock principally to provide economic benefits. Agroforestry can be applied in private and forest lands where the land is highly erodable, flood-prone, economically marginal, and environmentally sensitive. The land is typically agricultural and trees are planted to create desired benefits. The goal of agroforestry is to restore essential processes needed for ecosystem health and sustainability, rather than restore 'natural ecosystem'.

Agroforestry provides strong incentive for adoption of conservation practices and alternative land uses and supports a collaborative watershed analysis approach to management of landscape containing mixed ownerships, vegetation types, and land use. Agroforestry farms are indeed unique depending on existing biophysical and socio-economic conditions of the area. There will always be threats, problems, and challenges in agroforestry. But with combined efforts and outmost cooperation of farmers, extension workers, foresters, and researchers, the twin problem of poverty and environmental degradation will surely be attained through proper practice of agroforestry.

61 Esteban, I.D. 2009. Personal communication.

In AGF-FFSs, farmers and facilitators can learn from each other their best experiences and understanding of agroforestry systems, production, and protection aspects through participatory, discovery-based and experiential learning approaches, hence this exercise.

How long will this exercise take?

- One to two hours for field walks, interaction with farmers, observation, and hands-on; and
- At least 30 minutes for brainstorming and processing of lessons learned from the activity in processing area.

Learning objectives

- To make participants aware and understand production and protection aspects of agroforestry;
- To learn from each other actual agroforestry systems practiced by farmers;
- To identify agroforestry systems best suited in project site and for farmers' adaptation; and
- To make participants aware and understand different agroforestry systems practiced in the Philippines.

Materials

- A project site where different agroforestry systems are practiced; and
- Manila paper, notebooks, crayons, ball pen, and pencil.

Methodology

- Field walks, brainstorming, and hands-on exercises

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe agroforestry systems, production, and protection aspects in an established agroforestry plantation in a learning field or an agroforestry project site. Interview other farmers and list down all observations on:

   ☑ Contour farming (e.g., SALT);
   ☑ Agrisilviculture (e.g., combination of forestry and agricultural crops either simultaneously or in rotation);
   ☑ Silvipastoral system (e.g., controlled grazing of forest vegetation);

- ☑ Agrisilvipastoral system (e.g., combination of forestry vegetation, agricultural crops, and pasture animal);
- ☑ Multi-purpose tree production system (e.g., uses of forest products like honey, game meat, fruits as well as weeds);
- ☑ Terraces (e.g., bench terraces);
- ☑ Fallow system (e.g., forested land is cleared, burned and without plowing, planted to agricultural crops); and
- ☑ Multi-storey system (e.g., forest trees, fruit trees, and medicinal plants are planted in multi-layered canopy consideration).

2. Go back to processing area, brainstorm in small groups and present output to big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in agroforestry systems, production, and protection aspects;

3. Develop an improved framework of agroforestry systems, production, and protection aspects for the project site by taking into consideration appropriate success factors arising from shared best experiences; and

4. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

- ❑ What are the agroforestry systems and practices did you observed in different project sites?
- ❑ Which of these practices you observed is (are) most beneficial to your project site? Why?
- ❑ What agroforestry production and protection practices did you observed in different project sites?
- ❑ Which of these production and protection practices you observed is (are) most beneficial to your project site? Why?
- ❑ What are the benefits derived from undertaking appropriate operations in plantation protection of an established agroforestry crop?
- ❑ Which of these practices will need improvement to suit and benefit your project site? How?

Exercise No. 4.03[62]

LIFE CYCLE, FOOD CHAIN, AND FOOD WEB

When is this exercise most appropriate?

- In AGF-FFS, TOT, or TOS sessions, after at least two agroforestry ecosystem analyses (AFESA) sessions have been conducted in learning field.

BACKGROUND AND RATIONALE

Life cycle of plants, insects, and natural enemies are well known to us. The development from egg to adult insects on seeds to plants has been established in fields and in insect zoos. Food chain is the interaction between plants, herbivores, and natural enemies of herbivores. The energy from one level of ecosystem (plant) moves to another level (herbivores) along a chain of interaction.

As a facilitator working with farmers, you must begin to integrate these two motions together in a smooth acting dynamic ecosystem. Seeds germinate to be eaten by insects that lay eggs are parasitized. In this exercise, you will have to put the two systems together so that they are functional. These will help you 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 nymphs feed on stems or leaves by sucking. Finally adults mate and lay eggs on same plants or migrate to other fields. During each stage, different natural enemies attack a leafhopper. During an egg stage, parasitoids complete their life cycle (e.g., egg, larva, pupa, and adult) in a leafhopper egg and kill the pest. During nymph and adult stages, hunting spiders, ladybeetles, and other predators feed on leafhoppers. Parasitoids and other natural enemies act in the same way. The combination of interacting life cycles of plants, leafhoppers, and natural enemies is a good view of a dynamic system in an agroforestry field. It also shows that balance is needed in a system to make these life cycles possible. For example, a spider's life cycle depends on leafhoppers. If there are no leafhoppers, then there will be no spider to protect field.

In this system, insects such as leafhoppers at low population are very beneficial to farmers because they are spider's food and spiders are what protect beneficial insects from large population changes. Did you ever think that leafhoppers might be beneficial to farmers as well? It all depends on how many are there in the field. These can be explained now by looking on how the system interacts.

How long will this exercise take?

- At least one and a half hours for field walks, brainstorming and processing of lessons learned from the activity in processing area.

62 Adapted from Callo, Jr. D.P., M.A. Olanday, and C.A. Baniqued (eds). 2000. Field Guide of Discovery-based Exercises for Mango IPM. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp2-70 to 2-72.

Learning objectives

- To build participants' awareness and understanding of relationship that exists in many biotic and abiotic things that are found in agroforestry ecosystem;
- To make participants aware of existence and balance of components of agroforestry ecosystem;
- To let participants appreciate that if one thing in network of interaction s is changed, it can influence all other components of an agroforestry ecosystem;
- To make participants become more aware of things and interactions that makes up an agroforestry ecosystem; and
- To allow participants to start using their understanding and observations of agroforestry ecosystem as basis for decision-making about agroforestry crop management.

Materials

- A project site where different agroforestry systems are practiced; and
- Manila paper, notebooks, crayons, ball pen, and pencil.

Methodology

- Field walks, brainstorming, and hands-on exercises

Steps

1. Divide participants in small groups and ask them to conduct field walks, observe, and collect pests and their natural enemies in learning field and adjacent agroforestry project site. Each small group should try to work to:

   ☑ Draw a large circle and write down general stages of insects on guild around a circle;
   ☑ Make a list of insect stages in one column. Make also a list of natural enemies (by guild) which attack each stage;
   ☑ Show that there is a corresponding natural enemy attacking each stage of pest's life cycle;
   ☑ Draw in a circle life cycle of each natural enemy attacking a particular stage of pest;
   ☑ Draw third level circles of natural enemies attacking other natural enemies (e.g., spider eats another spider); and
   ☑ Show chain until last organism dies, decomposes, return to soil as nutrients, and is consumed by plants.

2. Go back to processing area. Present outputs to big group. Do short role plays depicting functions of pests and natural enemies in agroforestry ecosystem.

3. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Facilitators guide big group to expound on inter-relationship and interaction among pests and natural enemies to create food chain and food web in an agroforestry ecosystem.

4. Develop a conceptual framework to better understand life cycle, food chain, and food web in an agroforestry ecosystem setting.

5. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

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

Exercise No. 4.04

> **When is this exercise most appropriate?**
>
> ❧ In AGF-FFS, TOT, or TOS sessions, at least during first two weeks meeting of an agroforestry training sessions.

BIOGEOCHEMICAL CYCLES: HYDROLOGIC, CARBON-OXYGEN, NITROGEN, AND NUTRIENT CYCLES IN AGROFORESTRY

BACKGROUND AND RATIONALE

Water conservation is important, especially in areas where water is limited or not enough for crop production. The goals of water conservation strategies are to store more rain water, increase infiltration, decrease runoff, percolation and seepage, and minimize evaporation. Land management practices that aim to conserve water in upland farms are based on understanding of hydrologic or water cycle and its component processes, namely[63]:

- Upland farms receive water mainly from rainfall and is used by crops;
- Some of this water enters soil (infiltration). Some run over land surface and flow out to streams, rivers, and seas (runoff);
- Some water in soil move downward (percolation) and sideward (seepage) into ground water then also to streams, rivers, and seas;
- Water is returned to air directly from water surfaces, ground surfaces (evaporation) and through plants (transpiration); and
- Water vapor in air join together to form clouds and condense to form rains.

Carbon is a common constituent of all organic matter and is involved in essentially all life processes. Consequently, the transformations of this element, termed carbon cycle are in a reality a bio-cycle that makes possible the continuity of life on earth. In all soils, on the other hand, considerable intake and loss of nitrogen in the course of a year are accompanied by many complex transformations. Some of these changes may be controlled more or less by man, whereas others are beyond his command. This interlocking succession of largely bio-chemical reactions constitutes what is known as nitrogen cycle[64].

63 IIRR. 1998. Soil and Water Conservation and Agroforestry Systems. Agroforestry Technology Information Kit (ATIK) No. 1, International Institute of Rural Reconstruction (IIRR), Department of Environment and Natural Resources (DENR), and Ford Foundation (FF). pp85-87.

64 Brady, N.C. 1985. The nature and properties of soils. 9th Edition. Macmillan Publishing Company, Inc., 866 Third Avenue, New York, New York, USA. pp261-262 and 285-287.

Agroforestry aims to develop upland farms into self-sustaining yet productive ecosystems. The key to this goal is an efficient cycling of nutrients within the system. In this regard, the carbon-oxygen and nitrogen cycles are important in accelerating nutrient cycles in upland farms. The nutrients required for plant growth consist of: carbon (C), hydrogen (H), and oxygen (O), which are all derived from air and water; major nutrients, nitrogen (N), phosphorus (P), and potassium (K); and secondary nutrients, calcium (Ca), magnesium (Mg), and sulfur (S); and trace or micronutrients (around seven), which are all soil-derived. The soil nutrient cycle operating in an upland farm can be viewed as a system consisting of stores, flows, gains, and losses as described below[65]:

- *Nutrient stores* consist of roots and shoots of all crops and trees, plant residues, soil organisms, soil organic matter, clay minerals (through fixation, and soil solution);

- *Nutrient flows* include plant uptake and mineralization (from plant to residues, via organisms to soil humus);

- *Nutrient gains* come from symbiotic, non-symbiotic fixation (for N only), rock weathering, rain and dust, organic materials from outside, and from fertilizers; and

- *Nutrient losses* arise from burning (for N and S), de-nitrification and volatilization (for N), leaching, erosion, and harvests.

In AGF-FFS, understanding these cycles is important for farmers to more effectively manage their agroforestry farms. It can also be used as basis for determining what soil and water conservation measures are needed. Likewise, this should guide farmers in their more rational use of water and fertilizers.

How long will this exercise take?

- At least one hour for field walks and observations in agroforestry learning field;
- At least 30 minutes brainstorming in small groups; and
- At least another 30 minutes big group participatory discussions to critique small group outputs.

Learning objectives

- To build participants' awareness and understanding on role of some important biogeochemical cycles in an agroforestry ecosystem;

65 IIRR. 1998. Soil and Water Conservation and Agroforestry Systems. Agroforestry Technology Information Kit (ATIK) No. 1, International Institute of Rural Reconstruction (IIRR), Department of Environment and Natural Resources (DENR), and Ford Foundation (FF). pp6-7.

- To let participants learn actual agroforestry systems practiced by farmers and to find out if their practices either enhances or hinders benefits of biogeochemical cycles; and
- To allow participants to identify measures that will maximize and sustain benefits of these biogeochemical cycles in an agroforestry system.

Materials

- A project site where different agroforestry systems are practiced; and
- Manila paper, notebooks, crayons, ball pen, and pencil.

Methodology

- Field walks, observations, participatory discussion and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe agroforestry systems practiced by farmers in adjacent agroforestry project site. Each small group should make observations on following energy cycles (e.g., define what they will need to observe during field walks):

   ☑ Hydrologic cycles (e.g., water supply and management and indications of surface runoff or reduction measures);
   ☑ Carbon-oxygen cycles (e.g., carbon sources and oxygen-affected agroforestry systems);
   ☑ Nitrogen cycle (e.g., nitrogen reach plants and composting or decomposing materials); and
   ☑ Nutrient cycle (e.g., nutrient store, flows, gains, and losses).

2. Go back to processing area and present outputs to big group. Do short role plays depicting functions of pests and natural enemies in agroforestry ecosystem;

3. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Facilitators guide big group to expound on processes of energy cycles in an agroforestry ecosystem;

4. Develop a conceptual framework for participants to better understand biogeochemical cycles in an agroforestry ecosystem setting; and.

5. Synthesize and summarize outputs of small groups into one big group output. Draw-up conclusions and recommendations from the exercises.

Some suggested questions for processing discussion

- ❑ What kind of biogeochemical cycles did you observed in an agroforestry ecosystem?
- ❑ How do these biogeochemical cycles affect practices and managements of your agroforestry crops?
- ❑ What are the processes involved in hydrologic, carbon-oxygen, and nitrogen cycles?
- ❑ How will carbon-oxygen and nitrogen cycles accelerate nutrient cycle in agroforestry system?
- ❑ What measures should you consider in management of your agroforestry crops to maximize and sustain benefits from these biogeochemical cycles? Explain.

Section 5

INTEGRATED SOIL AND NUTRIENT MANAGEMENT FOR THE UPLANDS

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People are dependent on soils, and to a certain extent, good soils are dependent upon people and the use they make of them. Soils are natural bodies on which plants grow. Society enjoys and uses these plants because of their beauty and because of their ability to supply fiber and food for humans and for animals. Standards of living are often determined by quality of soils and kinds and quality of plants and animals grown on them. Farmers, along with homeowners, look upon soil as a habitat for plants. A farmer makes a living from soil and is thereby forced to pay attention to its characteristics. To a farmer, soil is more than useful - it is indispensable[66].

Effective conservation and management of soils require an understanding of these natural bodies and of processes going on with them. These processes, which are vital to production of plants, also influence many other uses of soils. With only a few exceptions, agroforestry crops depend upon soil for anchorage, water, and nutrients. Very little can be done to alter climatic factors, but much can be done with soil for benefit of a crop[67]. Consequently, soil management aims to allow a grower to produce optimum yield and sustained long-term returns.

One of the basic principles in Integrated Pest Management (IPM) is growing a healthy crop[68]. Among others, this principle is attained through Integrated Soil and Nutrient Management (ISNM), which include efficient nutrient, water, and weed management. In addition, ISNM also includes effective soil-borne pest and disease management as well as effective use of beneficial soil microorganisms for better agroforestry crop productivity. Sound soil and nutrient management must provide a suitable medium in which seeds can germinate and roots can grow. It must supply nutrients necessary for crop growth. Weeds must be kept in check and necessary build-up of pests and diseases prevented[69].

The soils harbor a varied population of living organisms. The whole range in size from larger rodents through worms and insects to tiniest bacteria commonly occurs in normal soils. The quantity of living organic matter, including plant roots, is sufficient to influence profoundly many physical and chemical trends of soil changes. Virtually all-natural soil reactions are directly or indirectly biochemical in nature.

66 Brady, N.C. 1985. The nature and properties of soils. 9th Edition. Macmillan Publishing Company, Inc., 866 Third Avenue, New York, New York, USA. pp 1-33.
67 Bautista, O.K. (ed). 1994. Introduction to tropical horticulture. 2nd Edition. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA) and University of the Philippines Los Baños (UPLB), College, Laguna, The Philippines. pp 279-316.
68 Philippine National IPM Program. 1993. Kasaganaan ng Sakahan at Kalikasan (KASAKALI9KASAN), The National IPM Program Document. National Agricultural and Fishery Council (NAFC), Department of Agriculture, Elliptical Road, Diliman, Quezon City, Philippines. pp1-12.
69 Davies, D.V., D.J. Eagle and J.B. Finney. 1972. Soil Management. Farming Press Limited, Fenton House, Wharfedale Road, Ipswich, Suffolk, Great Britain. pp 15-25.

In the context of IPM, therefore, ISNM will require provision of environment-friendly soil management options for improvement of some important interrelated soil properties (e.g., physical, biological and chemical), which will result to better agroforestry crop productivity and higher growers' income[70]. Thus, this section consists of sub-sections on: (a) soil and water conservation; (b) compost making and vermiculture; and (c) organic and inorganic fertilizers.

70 Settle, W. 1999. Living soil: A source book for IPM training. United Nations-Food and Agriculture Organization (UN-FAO) Programme for Community IPM in Asia, Jl. Jati Padang, Pasar Minggu, Jakarta, Indonesia. pp 5.

SOIL AND WATER CONSERVATION

Organic matter plays a very important role in soil and water conservation. It functions as a 'granulator' of mineral particles, being largely responsible for loose, easily managed condition of productive soils. Through its effect on physical condition of soils, organic matter also increases amount of water a soil can hold or water holding capacity and proportion of this water available for plant growth. Soils high in organic matter are darker and have greater water holding capacity than soils low in organic matter[71].

Two major concepts concerning soil water emphasize significance of this component of soil in relation to plant growth, namely: (1) water is held within soil spaces (pores) with varying degrees of attraction (tenacity) depending on amount of water present and size of pores; and (2) together with its dissolved nutrients (salts), soil water makes up soil solution, which is very important as a medium for supplying nutrients to growing plants.

A clearly important characteristic of a soil is its ability to hold water. One problem with a coarse sandy soil is that water (and nutrients) is rapidly lost from soil. One important quality of soil organic matter is that it helps in water retention. To demonstrate this to farmers is a simple exercise that should help promote use of compost and mulch in vegetable production in agroforestry project sites.

In agroforestry, tree roots help to anchor and stabilize soil. Leaf litter and humus that build up under tree stands allow water to percolate into lower soil layers. Ground cover vegetation under trees can also contribute to leaf litter and humus build-up and can help to prevent soil loss. Trees can also improve soil fertility by serving as 'nutrient pumps', that is, they efficiently absorb nutrients from soil[72]. The nutrients that are concentrated in leaves can then be returned to soil as green manure. Thus, this sub-section includes discovery-based exercises on: (a) soil mapping of agroforestry sites; (b) soil sampling and soil test kit analysis; and (c) contour planting as a soil and water conservation strategy for upland farming.

71 Brady, N.C. 1985. The nature and properties of soils. 9th Edition. Macmillan Publishing Co., 866 3rd Ave., New York, New York, U.S.A. pp14-16.

72 IIRR. 1998. Trees and Their Management. Agroforestry Technology Information Kit (ATIK) No. 2, International Institute of Rural Reconstruction (IIRR), Department of Environment and Natural Resources (DENR), and Ford Foundation (FF). pp89-94.

Exercise No. 5.01[73]

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, as component of topic on 'Soil Conservation and Management' or 'Agroforestry Site Soil Mapping'; and
- When farmers want to learn more improved soil-water management practices from other farmers by studying soil textural and structural classes of their individual farms.

SOIL MAPPING OF AGROFORESTRY SITES: DETERMINING SOIL TYPES AND THEIR UPLAND FARM LOCATIONS AS A MANAGEMENT GUIDE FOR IMPROVING AGROFORESTRY FARM PRODUCTIVITY

BACKGROUND AND RATIONALE

For practical purposes, soil types can be determined by examining soil textures and soil structures. Physically, a mineral soil is a porous mixture of inorganic particles, decaying organic matter, and air and water. The larger mineral fragments usually are embedded in and coated over with colloidal and other fine materials. Where the larger mineral colloids are dominant, the soil has clayey characteristics; and all gradations between these extremes are found in nature. Organic matter acts as binding agent between individual particles, thereby encouraging the formation of clumps or aggregates.

The size of particles in mineral soil is not subject to ready change. Thus, a sandy soil remains sandy and a clayey soil remains clay. The proportion of each size group in a given soil (soil texture) cannot be altered and thus is considered a basic property of a soil. Soil structure on the other hand relates to the grouping or arrangement of soil particles. It is strictly a field term that describes the gross, overall combination or arrangement of the primary soil separates into secondary groupings called aggregates or peds. A profile may be dominated by a single type of aggregate. More often, several types are encountered in the different horizon. The dominant shape of peds or aggregates in a horizon determines their structural types. Soil structure grades, on the other hand, relates to the degree of inter-aggregate adhesion and to aggregate stability. Four grades are recognized[74]:

a) *Structureless*. Particles not arranged into peds or aggregates. If separates are not bound together (not coherent), as in a coarse sand, the term 'single' grain is used. If they are tightly bound (coherent), as in very compact subsoil or in a paddled surface soil, 'massive' is used;

b) *Weak*. Poorly formed peds or aggregates barely observable in place;

73 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp61-63.

74 Brady, N.C. 1985. The nature and properties of soils. 9th Edition. Macmillan Publishing Co., 866 3rd Ave., New York, New York, U.S.A. pp36-60.

c) *Moderate*. Well-formed and moderately durable peds that are not very distinct in undisturbed soil; and

d) *Strong*. Durable peds or aggregates that are quite evident in undisturbed soil and become separated when the soil is disturbed.

The characteristics of any soil emerged from its parent material and from external conditions such as weather, slope, vegetation, and farming practices. Parent materials and external conditions are often location-specific and may differ within a short distance in an agroforestry project area of a same community[75]. In AGF-FFS, an agroforestry soil map can be developed to indicate not only soil types, based on soil textures and structures, but also location of grower's individual farms. This information will be very useful in determining appropriate soil management strategies for each soil type by actual field examination and sharing of experiences among farmers. This particular exercise was designed to address this concern.

How long will this exercise take?

- Thirty minutes to one hour for field walks and observations of different soil textural and structural classes of individual farmers in adjoining and learning fields; and
- Thirty minutes to one hour for identifying, surveying, soil mapping, and brainstorming session in processing area.

Learning objectives

- To make participants aware of and understand the different soil-water management requirements for different soil textural and structural classes to improve agroforestry crop productivity;
- To learn how to do an agroforestry site soil map showing different soil textural and structural classes of farmers' individual farms; and
- To learn from each other appropriate soil-water management practices for different soil textural and structural classes.

Materials

- Individual farmer's agroforestry site in adjoining and learning fields where different soil textural and structural classes can be observed visually;
- Manila papers, notebooks, ball pens, and marking pens; and
- Soil samples from agroforestry site in adjoining and learning fields.

75 FARM. 1998. Facilitator's Manual: Farmer Field School on Integrated Soil Management. Farmer-centered Agricultural Resource Management (FARM) Programme, Food and Agriculture Organization Regional Office for Asia-Pacific, Bangkok, Thailand. pp34-35.

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups in accordance with the closeness of their farms. Briefly explain the objective of exercise and ask them to conduct field walks and observe soil textural and structural classes of their individual farms as follows:

   ☑ describe physical characteristics (e.g., soil textural and structural classes) of soil in their individual farms; and
   ☑ take note in a piece of paper description of physical characteristics of soils in their individual farms.

2. Go back to processing area. Brainstorm in small groups to integrate all observations in individual farms;

3. Present output of small groups to the big group. Conduct participatory discussion to allow sharing of experiences among participants on the characteristics of each identified soil textural and structural classes. Relate effects on crop growth and soil-water management practices. Perform the following activities:

   ☑ Draw a simple map of area on a manila paper indicating roads, rivers, settlements, slopes (e.g., for mountain areas), etc.;
   ☑ Mark farm location of individual farmers on map;
   ☑ Identify soil textural and structural classes boundary on map; and
   ☑ Place each group's soil texture and soil structure descriptions close to their site on map.

4. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

Some suggested questions for processing discussion

❑ What do we mean by agroforestry site soil mapping? What is the importance of making a soil map based on soil type (e.g., soil texture and soil structure)?
❑ Were there differences observed in the soil characteristics of farmers' individual farm? Were there differences in soil textures and soil structures?

- ❑ How did soil texture and soil structure relate to water retention, nutrient availability, and soil microbial activity?
- ❑ How did soil type (soil textural and structural classes) and farm location influence selection of agroforestry crops planted and the soil-water management practices employed?
- ❑ Did farmers use different soil-water management practices because of different soil textural and structural classes as well as farm locations? Why?
- ❑ Do you think there will be differences in agroforestry crop performance (e.g., plant growth, development, and yield) among farms exhibiting different soil textural and structural classes? Why?
- ❑ Did you learn any important soil-water management practices from other farmers related to differences in soil textural and structural classes? What are they?

Exercise No. 5.02[76]

When is this exercise most appropriate?

- In AGF-FFS sessions, before land preparation; and
- When farmers want to learn from others some innovative ways of assessing soil fertility and do hands-on of proper soil sampling and using Soil Test Kit (STK) for soil analysis.

SOIL SAMPLING AND SOIL TEST KIT ANALYSIS: UNDERSTANDING AVAILABLE SOIL NUTRIENTS FOR AGROFORESTRY FARM PRODUCTIVITY

BACKGROUND AND RATIONALE[77]

One basic requirement for proper and efficient use of organic fertilizers is for farmers to be able to take as well as analyze soil samples from their newly prepared agroforestry fields. Proper soil sampling from different locations within and adjoining agroforestry areas requires simple skills that extension workers and farmers alike should possess. They must also know how to take care of their soil samples after collecting them for analysis at a later date. In AGF-FFS, facilitators and farmers together can do an analysis. But in cases where this kind of arrangement is not possible, then collected samples can be submitted to nearest provincial or regional soil laboratory for analysis.

There are four (4) ways to determine soil fertility: (a) a farmer can collect soil samples from his field and submit it to a government soil laboratory for analysis, a process that usually takes time; (b) another method is to analyze plant tissues for presence of nutrients, requiring highly qualified persons to do an analysis; (c) still another method is to study crop yields over seasons; and (d) a quick method for soil analysis is using a soil test kit [STK], although this may not be available in most areas. If available, however, an analysis using STK is simple that even farmers can undertake by themselves even without assistance from a trained extension worker.

Soil analysis by STK involves simple chemical analysis that measures amount of available soil nutrients in plants. Results are interpreted and used as basis in making a recommendation on right kind and amount of organic and inorganic fertilizers for a particular agroforestry crop when grown in soil being tested. STK is handy and easy to use. It does not require sophisticated laboratory instruments and specialized training for users. Soil testing can be done right in agroforestry fields and results are obtained within a few hours. It is, therefore, a useful tool for farmers and extension workers who, oftentimes, need immediate answer to question of what kind and amount of organic and inorganic fertilizers to use for an agroforestry crop to be grown in a particular soil.

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76 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp67-70.

77 Corado, M. 2008. Living Soil Exercises Developed for Farmer Field School. Reference material distributed during a Write-shop to Develop A Field Guide of Discovery-based Exercises for FFS of IPM on Organic Vegetable Farming conducted in the Philippines on 17-19 June 2008 at the Headquarters, Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. 105p.

In this exercise, participants will try to learn how to undertake proper soil sampling and to analyze soil using an STK. Proper soil sampling and analysis is important in deciding appropriate cultural management practices that will enhance agroforestry crop productivity. Apart from soil analysis, through years of experience, farmers had evolved their own way of assessing soil fertility. In AGF-FFS, these experiences must be shared among farmers and facilitators to gain new knowledge in improving soil fertility and productivity in their agroforestry farms. This exercise was designed to achieve this particular objective.

How long will this exercise take?

- Thirty minutes to one-hour for field walks, observations, and hands-on of proper soil sampling and using Soil Test Kit (STK) for soil analysis in the different locations within and adjoining agroforestry areas; and
- Thirty minutes to one-hour for brainstorming in the session area.

Learning objectives

- To make participants aware and understand how soil fertility assessment and soil analysis can be used in deciding appropriate cultural management practices to improve soil fertility and productivity of an agroforestry area; and
- To learn innovative ways of assessing soil fertility and do hands-on of proper soil sampling and using Soil Test Kit (STK) for soil analysis.

Materials

- Soil samples taken from the different locations within a learning field and adjoining agroforestry areas;
- Manila papers, notebooks, ball pens, and marking pens; and
- Other supplies (e.g., plastic bags, meter stick, spade, shovel, crowbars, magnifying lens, and bolo).

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and assess soil fertility and do hands-on of proper soil sampling and using Soil Test Kit (STK) for soil analysis in different locations within a learning field and adjoining the agroforestry areas. The following suggestions may be tried, thus:

For Assessing Soil Fertility (Optional):

- ☑ Group I to assess soil fertility on the lower portion of learning field
- ☑ Group II to assess soil fertility on the middle portion of learning field
- ☑ Group III to assess soil fertility on the upper portion of learning field
- ☑ Group IV to assess soil fertility in an adjoining agroforestry area

For Proper Soil Sampling:

- ☑ Conduct participatory discussions to develop pointers on how soil samples will be taken from each parcel/location;
- ☑ Let each small group collect two soil samples from their respective locations for further comparison;
- ☑ Mix thoroughly all the collected soil samples and get 1 kilo soil sample for soil analysis; and
- ☑ One sampling activity shall be undertaken in adjoining area.

Note: Soil sample taken from learning field should be kept by each small group for soil test kit (STK) analysis. Results will be used later as basis for conducting their Participatory Technology Development (PTD) studies.

For Soil Test Kit (STK) Analysis:

- ☑ Conduct participatory discussions to level-off on objectives and procedures of this exercise;
- ☑ Distribute soil test kit to and request each small group to copy steps for analysis on a Manila paper; and
- ☑ Guide and assist each small group to do hands-on of STK analysis by carefully following steps indicated on Manila paper or directly from STK instruction leaflet.

Note: Results of this exercise will be used in determining amount of organic and inorganic fertilizer requirements for conducting their Participatory Technology Development (PTD) studies.

2. Go back to processing area. Brainstorm in small groups to design a suitable matrix to record observations and do following activities:

- ☑ Summarize results of exercises;
- ☑ Analyze results and draw conclusions as regards: soil fertility assessment, proper soil sampling procedures, and STK analysis; and

☑ List down all pertinent observations on farmers' innovative soil and nutrient management practices.

3. Present output of small groups to big group. Conduct participatory discussions to allow sharing of experiences among participants. Relate soil fertility assessment and STK analysis results to abundance of soil organisms, soil organic matter content, and soil water holding capacity, soil nutrient availability, and agroforestry crop productivity; and

4. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

Some suggested questions for processing discussion

- ❑ Why is there a need for soil sampling? How often should a soil analysis be done?
- ❑ How many soil samples are needed in a hectare of agroforestry farm?
- ❑ What procedures are to be followed in taking soil samples from different locations/elevations of an agroforestry farm?
- ❑ What are the steps necessary before and after taking soil samples? Did you see variations in color and textures in different soil layers?
- ❑ What are the different procedures in analyzing soils? What are their advantages and disadvantages?
- ❑ Were the results of STK analyses conform expectations of farmers?
- ❑ Were there differences in results between different soil samples analyzed?
- ❑ What are the limitations of using soil test kits (STK) for soil analysis?

Exercise No. 5.03[78]

When is this exercise most appropriate?

- In AGF-FFS sessions, before land preparation and laying-out learning field in an agroforestry area; and
- When farmers want to learn from other farmers some innovative contour farming practices.

CONTOUR FARMING: A SOIL AND WATER CONSERVATION STRATEGY FOR UPLAND FARMING

BACKGROUND AND RATIONALE

When land is cultivated up and down a slope, furrows act as fabricated channels or rills. Each time it rains, water runs down furrows and enlarges them, becoming gullies, if not checked. The solution is to plow across slope following contour lines rather than up and down, a method called contour farming or *contour planting*. Contours are areas around a field having same elevation.

In contour planting, a row of plants is planted on a contour and the next rows of plants on the next contour. Each furrow in contour serves as a small dam to check flows of water; eventually water seeps into the ground. If one to four contours of cultivated crops are followed by either a row (also called strip) of a perennial crop, that will not shade vegetable crops, such practice is called *contour strip farming*. If hedges are used along contour lines, such hedges are more aptly called contour hedgerows and such cropping system is known as *alley cropping system* or *sloping agricultural land technology* (SALT)[79]. The strips slow and spread water movement, thus reducing likelihood of serious erosion in cultivated areas. The SALT is gaining wide acceptance among small vegetable farmers in sloping areas. The rows or strips are closer in steeper slopes and wider in moderate slopes.

In establishing an agroforestry field, planting of one permanent crop as hedgerow species would help greatly in conserving soil and water. However, tall crops should be planted at the lower portion while the shorter ones at the upper portion to avoid shading. Farmers in the Cordilleras are continuously adapting more innovative contour farming practices, which when shared with others in AGF-FFS will further improve existing best practices. This exercise was so designed to enhance such sharing of experiences.

78 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp97-100.

79 Bautista, O.K. (ed). 1994. Introduction to Tropical Horticulture. 2nd Edition, SEAMEO Regional Center for Graduate Study and Research in Agriculture and University of the Philippines Los Baños, College, Laguna, Philippines. pp301-304.

How long will this exercise take?

- Thirty minutes to one-hour for field walks, observations, interaction with farmers, and hands-on in learning field; and
- Thirty minutes for brainstorming in the session area.

Learning objectives

- To create awareness and understanding among participants on the role of contour farming as a soil and water conservation strategy in agroforestry fields; and
- To learn from others and do hands-on of proper contour farming practices.

Materials

- Learning field in a sloping agroforestry field;
- Manila papers, notebooks, ball pens, marking pens, and crayons; and
- Other materials (e.g., marking, leveling and staking materials, grab hoe, shovel or spading fork, tape measure, bolo or scythe).

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe different contour farming practices in agroforestry project areas. Take note of cultural management practices employed. Interview other farmers, if necessary. List down all observations related with the following:

   ☑ Kind of crops (e.g., vegetable and perennial crops) planted and crop stand;
   ☑ Row orientation of crops grown in relation to topography; and
   ☑ Cultural management practices employed, etc.

2. Go back to the session area. Brainstorm in small groups and present output to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in contour farming practices for vegetables grown in sloping agroforestry areas;

3. Develop improved procedures in contour farming for sloping agroforestry areas;

4. Facilitate each small group to do hands-on of contour farming in learning field during land preparation and laying-out by improving procedure below:

☑ Steps in making an A-frame

(a) Prepare three wooden or bamboo poles or slots (two of which are 2.1 m long; sturdy string and nail for tying; and rock or stone, the size of a fist);
(b) Tie the two longer poles (e.g., this will serve as legs of an A-frame);
(c) Spread legs and brace with a shorter pole to make an 'A' figure. Tie the crossbar at the middle of legs;
(d) Tie one end of string to the point where two legs of an A-Frame are joined;
(e) Tie the other end with a rock or stone; and
(f) Calibrate A-Frame (e.g., test A-Frame in a level ground; mark spots where legs A and B touch the ground; mark crossbar at the point where weighted string passes; and repeat the process)[80]

☑ Steps in locating contour lines using an A-frame

(a) Mark point 1 (e.g., where you want to start rows or trees) on a slope. Place leg A of A-frame on the point;
(b) By trial and error, find proper location of leg B (e.g., without moving leg A from point 1) when plumb bob string coincides with middle mark on horizontal bar, mark location of leg B as point 2. This is on same location as point 1 (Caution: When wind is strong, it may push plumb bob string from vertical line and A-frame may give wrong results). To avoid errors, shelter plumb bob from wind or avoid using A-frame on windy days;
(c) Transfer leg A to point 2 and use same process as in step 2 to locate point 3;
(d) Continue process until a series of points are established on a slope. All these points have same elevation, and a line connecting these points is a contour. A row of trees planted along this contour line is a contour hedge; and
(e) Established next contour line (e.g., either above or below the one first made) by following same procedure as above;

☑ Prepare the contour by removing all weeds, crop residues and all unwanted materials in the area;
☑ Plant seeds or cuttings for hedgerows (e.g., *kakawate* or *malungay* cuttings, lemon grass, and others);

80 Esteban, I.D. 2009. PowerPoint Presentation on Contour Farming in Upland Areas for Agro-forestry presented during the AGF-FFS Orientation for CBFM Implementers, Session 2 on April 15-17, 2009 held at Tarlac College of Agriculture (TCA), Camling, Tarlac, Philippines. 11 slides.

- ☑ Plant permanent crops (e.g., coffee, cacao, banana, citrus, and others);
- ☑ Plant short term and medium term income producing crops (e.g., pineapple, peanut, ginger, mongo, corn, beans, upland rice, taro, sweet potato, among others);
- ☑ Trim contour hedgerows once a year after planting to 40 cm height. Pile twigs and leaves at base of crops;
- ☑ Rotate food crops and cash crops by planting cereals after legumes (e.g., beans, peanuts, and others) to maintain soil fertility. Weeding and pest management should be done regularly; and
- ☑ Maintain the area. To enrich soil and effectively control soil erosion, always pile straws, branches, leaves, rocks or stones at the base of nitrogen-fixing trees (NFT). As years go by, strong permanent and natural green terraces will be formed, which will reliably anchor the precious fertile soil[81].

5. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ What is contour farming? What are the species or crops used as hedgerow?
- ❑ What are the steps in making an A-frame?
- ❑ What are the steps in establishing contour lines?
- ❑ What are the steps in contour farming?
- ❑ Is contour farming an effective soil and water conservation strategy for upland farming? Explain.

81 Esteban, I. D. 2009. PowerPoint Presentation on Contour Farming in Upland Areas for Agroforestry presented during the AGF-FFS Orientation for CBFM Implementers, Session 2 on April 15-17, 2009 held at Tarlac College of Agriculture (TCA), Camling, Tarlac, Philippines. 11 slides.

COMPOST MAKING AND VERMICULTURE

The composting process involves decomposition of organic materials to form small bits of organic matter called *compost*. Compost and other organic fertilizers, are product of biological decomposition or processing of organic materials from animal and/or plants, which can supply one or more essential nutrient elements for plant growth and development. In organic farming, they are considered as the only natural, complete, and chief source of plant nutrients. Compost contains high organic matter, which is not present in any synthetic chemical fertilizer. Organic matter is main source of carbon and energy for soil microorganisms, responsible for transforming 'life in soil'[82].

Activities of soil organism range from largely physical disintegration of plant residues by insects and earthworms to eventual complete decomposition of these residues by smaller organisms such as bacteria and fungi[83]. Accompanying these decaying processes is the release of several nutrient elements, including nitrogen, phosphorus and sulfur, from these decomposed organic matters. One effective way of decomposing organic materials is through vermi-composting. It involves use of earthworms for composting organic materials. Earthworms ingest all kinds of organic material equal to their body weight per day. In the Philippines, popularly used earthworms for composting are *Lumbricus rubellos* and *Perionyx* excavator.

To highlight importance of composting and vermi-composting in agroforestry system, this sub-section takes account of and compiles discovery-based exercises on: (a) composting as a soil and weed management strategy; (b) role of earthworms in improving soil fertility and productivity; and (c) vermicompost as an organic fertilizer for agroforestry crops.

82 De la Cruz, N.E. 2008. Organic Fertilizer and Other Farm Inputs Production, Module 4. Reference material distributed during a Workshop on Designing Farmer Field School Curriculum on Integrated Pest Management For Organic Vegetable Production held on 28-30 April 2008 at the Headquarters, Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. 1p.

83 Brady, N.C. 1985. The nature and properties of soils. 9th Edition. Macmillan Publishing Company, 866 3rd Avenue, New York, New York, USA. pp1-33.

Exercise No. 5.04[84]

COMPOSTING[85]: A SOIL AND WEED MANAGEMENT STRATEGY IN UPLAND FARMING

When is this exercise most appropriate?

- In AGF-FFS sessions, during land preparation for agroforestry area where there are some materials for composting;
- Before or immediately after weeding operations of agroforestry farm, where sloping agricultural land technology (SALT) will be established; and
- When farmers want to learn from other farmers some innovative composting process for weeds, decayed leaves, branches of trees, and other crop residues found in the area.

BACKGROUND AND RATIONALE

Many farmers believe that weeds are more of a problem in agroforestry areas especially when forest trees are newly planted. This is so because weeds do not only compete with crops for nutrient uptake but also harbor some pests. This is also one reason why farmers, during land clearing and preparation, will either throw or burn weeds. Unknown to most of them is the many benefits that can be derived when weeds are used or managed properly. Using and managing weeds properly will ease burden on lack of fertilizers, improving soil structure, and encouraging soil microbial activity, which will eventually lead to improved soil fertility and productivity.

One way of doing this is by weed composting. The whole process is done by decomposers that use organic matter as source of energy for their growth and reproduction. A majority of decomposers are micro-organisms. Macro-organisms such as earthworm, termite, and other insects also contribute in breaking down organic materials. Therefore, two requirements for process to occur are: (1) composting materials, and (2) decomposers. Microorganisms prefer materials that are high in nitrogen (N), such as weeds and crop residues. Materials high in N are also easier to break down. The more decomposers present, the faster is the decomposition process.

The soil-borne fungus *Trichoderma harzianum* is now locally available. If applied to compost materials, it can shorten composting process from four months to only 3-5 weeks. This microorganism is now mass-cultured and mass distributed to farmers. Such innovative strategies can be shared and enriched by farmers and facilitators in AGF-FFS sessions to improve current practices through participatory, discovery-based, and experiential learning approaches, hence this exercise.

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84 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp76-79.

85 Bautista, O.K. (ed.). 1994. Introduction to Tropical Horticulture. 2nd Edition, SEAMEO Regional Center for Graduate Study and Research in Agriculture and University of the Philippines Los Baños, College, Laguna, Philippines. pp284-294.

How long will this exercise take?

- Thirty minutes to one-hour for field walks, observations, interaction with farmers and hands-on in learning field of agroforestry area; and
- Thirty minutes for brainstorming session in processing area.

Learning objectives

- To create awareness and understanding among participants about the importance of composting as a soil and weed management strategy in upland farming; and
- To learn from others and do hands-on of proper composting of weeds, decayed leaves, branches of trees, and other crop residues found in the area.

Materials

- Established agroforestry farm that are newly weeded or ready for weeding operations in learning and adjoining fields;
- Manila papers, notebooks, ball pens, marking pens, and crayons; and
- Other materials (e.g., weeds, animal manure, *Trichoderma harzianum* fungus, black polyethylene sheets, bamboo poles, banana trunks, shovel or spading fork, top soil, tape measure, bolo or scythe, and sprinkler)

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe weeding and post-weeding practices especially on agricultural crops component of an agroforestry learning field. Take note of cultural practices employed. Interview other farmers, if necessary. List down all observations on:

   ☑ Kind of agricultural and forestry crops planted;
   ☑ Prevalent weeds, pests, and diseases; and
   ☑ Weeding and post-weeding practices, etc.

2. Go back to processing area; brainstorm in small groups and present output to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in composting of weeds and other crop residues;

3. Develop an improved procedure of composting as a soil and weed management strategy in upland farming;

4. Facilitate each farmer to do hands-on of composting of weeds and other crop residues in learning field every after weeding operation by improving the procedure below:

   - ☑ After weeding operation, collect at least 100 kg composting materials (e.g., weeds, decayed leaves and branches of trees, and other crop residues);
   - ☑ Soak collected composting materials in water overnight;
   - ☑ Dig a pit with an area of 2 m x 2 m and a depth of one foot to pile composting materials;
   - ☑ Place banana trunks or any other available materials as walling to hold composting materials;
   - ☑ Pile composting materials into pit to a height of about one foot;
   - ☑ Spread uniformly a thin coating of *Trichoderma harzianum* fungus (optional) over composting materials;
   - ☑ Spread also uniformly one-foot thick animal manure over composting materials;
   - ☑ Cover pile with one-inch topsoil;
   - ☑ Repeat procedure until at least five layers are formed;
   - ☑ Cover compost pile with black polyethylene sheet;
   - ☑ Insert a bamboo pole (e.g., joints have been bored at side of pole) into pile to serve as ventilation vent; or after two weeks, mix thoroughly compost pile then cover again with black polyethylene sheet;
   - ☑ Compost process is complete in one (with *Trichoderma*) to four (without *Trichoderma)* months (e.g., 100 kg composted weeds and other crop residues is equivalent to one sack pure organic fertilizer); and
   - ☑ Take note of all relevant observations and experiences during this activity.

5. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe different weeding and post-weeding practices applied within and in adjoining agroforestry area?

- ❑ Did you observe farmers preparing composts in their fields? Did they use weeds and other crop residues as composting materials?
- ❑ Did you observe farmers using other composting materials? What are these composting materials?
- ❑ Is composting effective as a soil and weed management strategy in upland farming? When is the best time to do composting as a soil and weed management strategy in upland areas?
- ❑ Did you observe any innovative composting procedures used by farmers as a soil and weed management strategy? What benefits did farmers derive in composting weeds and other crop residues?
- ❑ What other cultural management options can you use to complement composting as a soil and weed management strategy in upland areas?

Exercise No. 5.05[86]

EARTHWORMS: THEIR ROLE IN IMPROVING SOIL FERTILITY AND PRODUCTIVITY IN UPLAND FARMING

When is this exercise most appropriate?

- In AGF-FFS sessions, as follow-up or integral part of topic on 'Integrated Soil and Nutrient Management'; and
- When farmers want to learn from facilitators and other farmers some earthworm's important role in improving soil fertility and productivity for upland farming.

BACKGROUND AND RATIONALE[87]

One essential component of a living soil is earthworm. Earthworms are important in many ways, especially in upper 15-25 cm of soil surface. The amount of soil these creatures pass through their bodies annually may amount to as much as 10 t/ha of dry earth, a startling figure. During this process, not only organic matter that serves earthworms as food, but also mineral constituents is subjected to digestive enzymes and to a grinding action within the animal. Earthworm casts on a cultivated field may weigh as much as 18,000 kg/ha. Compared to soil itself, casts are definitely higher in bacteria and organic matter, total and nitrate nitrogen, exchangeable calcium and magnesium, available phosphorus and potassium, pH and percentage base saturation, and cation exchange capacity. The rank growth of grass around earthworm casts suggests an increase availability of plant nutrients therein. Earthworms are noted for their favorable effect on soil productivity[88].

The ordinary earthworms are, probably, most important soil macro-organism and most helpful living things in soil system. They digest organic matter and help create humus. They fertilize soil with their droppings. The tunnels or burrows created as earthworms move soil particles help to loosen and condition soil. When earthworms tunnel deeply into soil, they bring subsoil closer to soil surface, and mix it with topsoil which has organic matter. As earthworms mix soil and create burrows, they create channels in soil, providing passages for air or water to get next to roots deep in ground. Earthworms are farmers' friends. The more earthworms there are in soil, the more fertile soil is likely to be.

In this exercise, participants will try to study earthworm's important role in improving quality of soil. In this regard, practical and worthwhile experiences can be shared and enriched by farmers and facilitators in AGF-

86 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp85-88.

87 Corado, M. 2008. Living Soil Exercises Developed for Farmer Field School. Reference material distributed during a Write-shop to Develop A Field Guide of Discovery-based Exercises for FFS of IPM on Organic Vegetable Farming conducted in the Philippines on 17-19 June 2008 at the Headquarters, Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. 105p.

88 Brady, N.C. 1985. The nature and properties of soils. 9th Edition. Macmillan Publishing Co., 866 3rd Ave., New York, New York, U.S.A. pp229-232.

FFS to improve current soil and organic fertilizer management practices through participatory, discovery-based, and experiential learning approaches, hence this exercise.

How long will this exercise take?

- Thirty minutes to one-hour for field walks, observations, interaction with farmers on possible earthworm habitats in upland area (e.g., dry and shaded, moist and shaded, moist grassy area, or uncultivated moist area);
- Thirty minutes to one-hour hands-on in learning field for setting up of study;
- Thirty minutes to one-hour for brainstorming session in processing area; and
- This exercise will require 2-3 weeks for making observations.

Learning objectives

- To create awareness and understanding among participants on some important role of earthworms in improving soil fertility and productivity for upland farming; and
- To learn from others and do hands-on on setting up studies to learn some important role of earthworms in improving soil fertility and productivity for upland farming.

Materials

- Manila papers, notebooks, ball pens, marking pens, crayons;
- Shovel or spading fork, dark cloth, string or rubber band, bean seeds;
- Soils from where earthworms are found in learning and adjoining fields;
- Clay, sand, loam, plant debris (e.g. leaves, cut up stems), water; and
- Earthworms (2-3 pieces), soil from where earthworms are found.

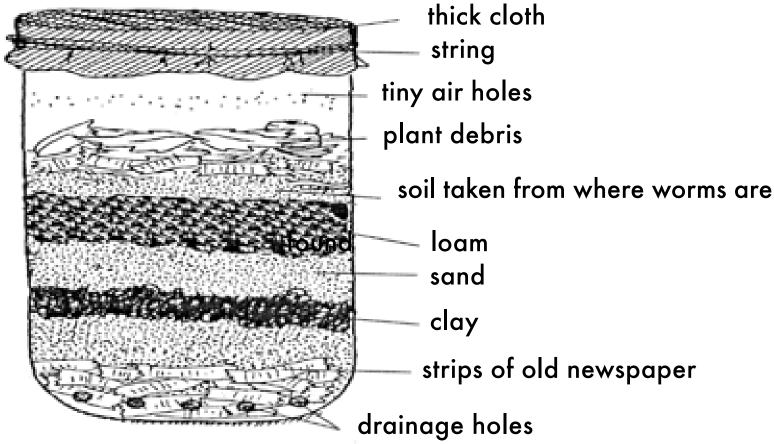
Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe presence of earthworms within and adjoining the agroforestry area. Interview other farmers and list down all observations. Guide small groups to do following:

- ☑ Dig earthworms found within and adjoining the agroforestry area;
- ☑ Make some very small holes in sides of bottles near top for ventilation and slight larger ones at bottom for drainage;
- ☑ Fill each container with layers of clay, sand, loam, and plant debris in that order. The top layer should be soil from where earthworms were found. See picture below:



One of two containers

- ☑ Add enough water to moisten plant debris;
- ☑ Put earthworms into one of containers. Label this container ‘with earthworms’;
- ☑ Cover container with a cloth and secure with a string or rubber band;
- ☑ Cover sides of containers with dark cloth. Make sure contents of both containers are always kept slightly moist;
- ☑ Observe what changes will take place in containers over two weeks;
- ☑ After two weeks, plant two seeds in each container of soil. Keep soil moist until seeds sprout, and then water seedlings as necessary; and
- ☑ Observe differences in growth of seedlings in two containers.

2. Go back to processing area. Brainstorm in small groups and present output to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share their observations and experiences in studying some important role of earthworms in improving soil fertility and productivity for upland farming.

3. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe changes in soil layers of containers?
- ❑ What evidences did you see to indicate earthworms at work?
- ❑ From your observations, how do you think earthworms help improve quality of soil?
- ❑ Is there a relationship between soil profile and rooting ability of plants?
- ❑ Based on your observations, do you think adding earthworms to garden would help plants grow? Why or why not?
- ❑ How did you feel while preparing and observing the exercise? Was it difficult to prepare and observe?
- ❑ What cultural management options can you use to complement role of earthworms in improving soil fertility and productivity in upland farming?

Exercise No. 5.06[89]

When is this exercise most appropriate?

- In AGF-FFS, as follow-up or integral part of topic on 'Integrated Soil and Nutrient Management'; and
- When farmers want to learn from facilitators and other farmers some innovative ways of producing organic fertilizers through vermicomposting for upland farming.

VERMICOMPOST AS AN ORGANIC SOLID FERTILIZER FOR AGROFORESTRY CROPS PRODUCTION

BACKGROUND AND RATIONALE

In vermicompost production, substrates or organic materials used for composting should be indigenous and readily available on-farm. However, to attain a good harvest of vermicompost, there are plants and animal manures that are rich in carbon-nitrogen ratio essentially needed for rapid decomposition. Local nitrogenous sources include manure, *kakawate*, *acacia*, and *ipil-ipil* leaves, mungbean, peanuts, soybeans, and *camote* vines, and *azolla*. On the other hand, common sources of carbon are dried leaves, grasses, vegetables, cornstalks, rice straw, paper, sawdust, and cardboard. A varied mixture of substances produced good quality compost, rich in macro- and micro-nutrients. Substrate (feed) combination of coco dust/sawdust (75%) and *ipil-ipil/kakawate* leaves (25%) is best for earthworm production. The production ranged from 1,540-4,514 earthworms depending on number and age of earthworms stocked and amount of feed[90]. Earthworm case is harvested in 4-6 weeks. About 60% of bedding material is converted into vermicompost[91]. Vermi-cast or worm casting is the material that passes through digestive track of earthworm (worm manure).

The benefits, which can be derived from vermicomposting include: (a) improving soil texture, porosity, and water holding capacity, (b) enhancing soil microbial activity and nutrient supply for better plant growth, (c) providing plant growth regulators, and (d) suppressing soil-borne pests and diseases.[92] One important innovation in use of vermicompost is formulation of vermi-tea as a foliar fertilizer. It is prepared by brewing a kilogram of vermicompost in 30 liters of water with ½ kg of crude sugar for 24 hours. Continuous aeration and agitation is required to maintain aerobic condition and extraction of micro-organisms.

89 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp89-93.

90 Guerero, R. 2006. Vermicomposting. As cited in: Philippine Organic Agriculture Information Network. http//www.pcarrd.dost.gov.ph/phil-organic/technologies.

91 PCARRD. 2006. The Philippine Recommends for Organic Fertilizer Production and Utilization, Series No. 92, Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. pp58-59.

92 Villegas, L.G. 2000. Vermi-culture and Vermicompost Technology. National Crop Research and Development Center, Bureau of Plant Industry, Los Baños, Laguna. As cited in: Philippine Organic Agriculture Information Network. http//www.pcarrd.dost.gov.ph/phil-organic/technologies.

These practical and worthwhile innovations can be shared and enriched by farmers and facilitators in AGF-FFS to improve current soil and organic fertilizer management practices through participatory, discovery-based, and experiential learning approaches, hence this exercise.

How long will this exercise take?

- Thirty minutes to one-hour for field walks, observations, interaction with farmers on possible earthworm habitats in agroforestry area (e.g., dry and shaded, moist and shaded, moist grassy area, or uncultivated moist area);
- Thirty minutes to one-hour hands-on in learning field for construction of vermicompost pit, collection of waste materials, segregation, shredding or chopping, and thermophilic composting; and
- Thirty minutes to one-hour for brainstorming session in processing area.
- This exercise will require one month and two weeks from the preparation of vermicompost pit and collection of waste material to harvesting of compost.

Learning objectives

- To create awareness and understanding among participants on some practical and innovative ways of producing organic fertilizers through vermicomposting for agroforestry crops production; and
- To learn from others and do hands-on on production and use of vermicompost as organic fertilizer for agroforestry crops production.

Materials

- Manila papers, notebooks, ball pens, marking pens, crayons;
- Other supplies (e.g., shovel or spading fork, bamboo poles, plastic sheets, wood, feedstuff sacks, and other receptacle materials);
- Agroforestry fields ready to be applied with vermicompost in learning and adjoining fields;
- 1.0 kg earthworm (e.g., 200 gm/group); and
- Organic materials (e.g., manures, grasses, kakawate leaves, and others).

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe presence of vermi-casts in agroforestry learning and adjoining fields. Interview other farmers and list down all observations related to:

   ☑ Dry, shaded, and cultivated agroforestry areas;
   ☑ Moist, shaded, and cultivated agroforestry areas;
   ☑ Moist, grassy, and cultivated agroforestry area;
   ☑ Moist and uncultivated field; and
   ☑ Dry and uncultivated field.

2. Go back to processing area; brainstorm in small groups and present output to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in producing and using vermicompost as organic fertilizer in agroforestry crops production;

3. Develop an improved procedure of producing and using vermicompost as organic fertilizer in agroforestry crops production;

4. Facilitate each farmer to do hands-on of producing and using vermicompost as organic fertilizer by improving the procedure below[93]:

   A. Producing Vermicompost:

   ☑ Dig a series of pits, about 3m x 4m x 1m deep, with sloping sides. To provide drainage for earthworms, lay bamboo poles at bottom of pit and cover with a layer of wood strips;
   ☑ Line pit with a lining material (e.g., feedstuff sacks to keep earthworms from going into surrounding soil);
   ☑ Fill pit with available organic materials (e.g., crop residues, animal manures, and others). Cover lightly with soil and keep moist for about a week;
   ☑ Water a spot in pile then transfer earthworms from breeding boxes to said spot. They will quickly burrow into damp soil;
   ☑ Leave pit for about two months but keep pile always moist; and
   ☑ Remove about 2/3 of vermicompost and earthworms from pit but leave enough worms for continuation of composting. Refill pit with fresh organic materials.

93 PCARRD. 2006. The Philippine Recommends for Organic Fertilizer Production and Utilization, Series No. 92, Philippine Council for Agriculture, Forestry, and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. pp58-59.

B. Using Vermicompost as Organic Fertilizer:

- ☑ Divide big group into 5 small groups and assign each group to field test vermicompost as organic fertilizer in agroforestry crops production;
- ☑ Each small group will have sample plots at border of learning field to test efficacy vermicompost as their side study;
- ☑ Sample plot will be divided equally into two sub-plots; first sub-plot will be treated with vermicompost material, while another sub-plot will be treated with a popular compost material;
- ☑ Each group apply vermicompost and a popular compost material as basal (e.g., before or during transplanting);
- ☑ Each group will collect weekly data on; (a) plant height, (b) vigor, and (c) color of leaves;
- ☑ Presentation of observations and data gathered will be done on a monthly basis; and
- ☑ Small and big group participatory discussions and interactions will follow thereafter.

5. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe different crops planted and crop stand using vermicompost as organic fertilizer for agro-forestry crops in learning and adjoining fields?
- ❑ Did you observe farmers producing and using vermicompost as organic fertilizer in their agroforestry fields?
- ❑ Did you observe farmers using other organic fertilizer materials? What are these organic fertilizer materials?
- ❑ Is use of vermicompost as organic fertilizer effective as a soil and nutrient management strategy in agro-forestry crops production? When is best time to use vermicompost as organic fertilizer in agroforestry crops production?
- ❑ Did you observe any innovative procedures in vermicompost production and application used by farmers as soil and nutrient management strategy in agroforestry crops production? What benefits did farmers derive in using vermicompost as organic fertilizer in agroforestry crops production?
- ❑ How did you feel while preparing and using vermicompost? Was it difficult to produce and use vermicom-post as organic fertilizer in agroforestry crops production?
- ❑ What other cultural management options can you use to complement using vermicompost as a soil and nutrient management strategy in agroforestry crops production?

ORGANIC AND INORGANIC FERTILIZERS

Although use of animal excrements (organic fertilizers) on cultivated soil was common as far back as agroforestry records can be traced, mineral salts (inorganic fertilizers) have been systematically and extensively employed for encouragement of crop growth hardly more than 100 years. They are now an economic necessity on many soils. Any inorganic salt (e.g., ammonium sulfate, urea, ammonium phosphate, or potassium chloride) or an organic substance (e.g., sewage sludge, bio-fertilizer, or vermi-compost) purchased and applied to soil to promote crop development by supplying plant nutrients is considered to be a commercial fertilizer.

There are at least fourteen essential nutrient elements that plants obtain from soil. Two of these, calcium and magnesium, are applied as lime in regions where they are deficient. Although not usually rated as fertilizer, lime does exert a profound nutritive effect. Sulfur is present in several commercial fertilizers and its influence is considered important, especially in certain localities. This leaves three elements other than micronutrients, nitrogen, phosphorous, and potassium. And since they are so commonly applied in commercial fertilizers, they are often referred to as fertilizer elements[94].

In order for participants to appreciate role of organic and inorganic fertilizers in agroforestry crops productivity, this sub-section assembles a few discovery-based exercises on: (a) functions, sources, kinds, advantages, and disadvantages of using organic and inorganic fertilizers; and (b) fertilizer management.

94 Brady, N.C. 1985. The nature and properties of soils. 9th Edition. Macmillan Publishing Co., 866 3rd Ave., New York, New York, U.S.A. pp589-651.

Exercise No. 5.07

ORGANIC AND INORGANIC FERTILIZERS: THEIR FUNCTIONS, SOURCES, KINDS, ADVANTAGES, AND DISADVANTAGES

When is this exercise most appropriate?

- In AGF-FFS sessions, after agroforestry farm establishment and before fertilization; and
- When farmers want to learn and understand more about functions, sources, kinds, advantages and disadvantages of organic and inorganic fertilizers.

BACKGROUND AND RATIONALE

There are two (2) types of fertilizer, organic and inorganic. Organic fertilizers, sometimes called as compost materials, come from weeds, decayed tree leaves and branches, paper, and other bio-degradable materials. Inorganic fertilizers or chemical fertilizers are commercially known and are commonly used by farmers.

Organic fertilizers have lower N-P-K values than chemical nutrients and released into the soil much slower. Plants can still easily burn organic fertilizer, if over fertilized with this material. Inorganic fertilizers, on the other hand, have complete elements such as nitrogen (N), phosphorus (P) and potassium (K). Nitrogen is essential for vegetative growth of plants above ground. Phosphorus is essential for diameter growth, strong roots, fruit and flower development, and lignifications of tissues. Potassium increases osmotic pressure in plant cells, favors uptake of water, and opposes wilting. In other words, it helps plants resist drought. However, heavy use of inorganic fertilizers damage natural fertility and vitality of soil resulting to lower production yields of farmers.

One cultural management practice undertaken after agroforestry farm establishment is proper fertilizer application. Numerous experiments carried out in temperate and tropical countries have shown that a considerable increase of height growth and volume production can be obtained through fertilizer application. A significant effect can already be achieved by relatively small qualities if applied in a proper way[95].

In AGF-FFS, it is very important for farmers to learn and understand functions, sources, kinds, advantages and disadvantages of organic and inorganic fertilizers by sharing of experiences among them and their facilitators. This exercise was specifically designed to address this particular concern.

95 Weidelt, H.J. (ed). 1975. Manual of Reforestation and Erosion Control for the Philippines, German International Technical Cooperation Agency (GTZ), Eschborn, Germany. 136p.

How long will this exercise take?

- Thirty minutes to one hour field walks, observations, and mini-workshop in small groups; and
- At least one hour participatory discussion and brainstorming in big group.

Learning objective

- To make participants aware of and understand functions, sources, kinds, advantages, and disadvantages of organic and inorganic fertilizers in agroforestry crops productivity; and
- To learn through field walks and observations the effects of using organic and inorganic fertilizers on agroforestry crops.

Materials

- Agroforestry crops applied with organic and inorganic fertilizers;
- Notebooks, ball pens, Manila papers and marking pens; and
- Field supplies (e.g., organic and inorganic fertilizers).

Methodology

- Field walks, observation, mini-workshop, participatory discussions, and brainstorming

Steps

A. <u>Field Walk and Observations</u>

1. Divide participants in small groups and ask them to conduct field walks and observe presence of agroforestry crops applied with organic and inorganic fertilizers in adjoining fields. Interview other farmers and list down all observations related to:

   ☑ Kind of fertilizer used (e.g., organic, inorganic, or combination of both);
   ☑ Crop stand (e.g., plant vigor, plant height, stem diameter, others); and
   ☑ Others (e.g., color of leaves, pest and diseases, physiological disorders).

B. <u>Mini-workshop</u>

2. Go back to processing area. Conduct mini-workshop in small groups to consolidate field observations. Based on their field observations, motivate farmers to share their learning experiences on the following:

   ☑ Kind of fertilizer used (e.g., organic, inorganic, or combination of both);
   ☑ Functions (e.g., vegetative growth, root or fruit development) and sources (e.g., home made compost from decaying farm and animal waste, commercial fertilizer preparations); and
   ☑ Advantages (e.g., contains macro- and micro-elements, improve soil structure) and disadvantages (e.g., contains only macro-elements, causes soil acidity).

C. Participatory Discussions

3. Present output to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to further share their best experiences in using organic and inorganic fertilizers for agroforestry crops; and

4. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

Some suggested questions for processing discussion

❑ What is an organic fertilizer? What is an inorganic fertilizer?
❑ What are the functions, kind, and sources of organic and inorganic fertilizers?
❑ What are the advantages and disadvantages of using organic and inorganic fertilizers?
❑ What kind of fertilizer do you prefer to use? Why?
❑ Do you prepare your own compost fertilizer? What are the materials you use in preparing compost fertilizer?

Other References

Esteban, I.D. 2007. What's the difference between organic and inorganic fertilizer and what do these 3 numbers stand? Reading materials prepared for agroforestry practitioners.

Exercise No. 5.08[96]

When is this exercise most appropriate?

- In AGF-FFS sessions, before plot and furrow preparations or before planting vegetable crops; during or after weeding activities for forest trees; and
- When farmers want to learn from other farmers their best fertilizer application practices for agroforestry crops.

FERTILIZER MANAGEMENT: METHODS OF APPLYING FERTILIZER AS A FACTOR IN IMPROVING UPLAND FARM PRODUCTIVITY

BACKGROUND AND RATIONALE

Fertilizer application is important and must not be overlooked. Fertilizer should be applied as close as possible to but not touching roots and seeds so as not to adversely affect physically root growth or germination. It should be applied when nutrients are most needed, usually at early vegetative stage and at flowering or fruiting time. For upland areas, application of fertilizer is done when there is still moisture in the soil.

The usual practice in applying chemical fertilizer at planting time for direct-seeded upland vegetables crops is to place half or one-third of fertilizer at bottom of furrows, cover slightly with soil, and then plant seed. During growing stage of crop, fertilizer can be applied on surface of soil between rows with shallow cultivation. The rest of the fertilizer can be applied during vegetative growth, before flowering, or during fruit development. The area must be free from weeds to limit crop-weed competition for nutrients[97].

For transplanted crops, a starter solution will enable plant to be established quickly. However, many upland farmers in the Cordilleras do not follow appropriate methods of application. Hence, use of very high organic and inorganic fertilizer rates is common. This practice has resulted in inefficient fertilizer usage and high production cost. On the other hand, a number of enterprising farmers have evolved, through time, sound fertilizer application practices that must be shared with others in AGF-FFS, to further improve their existing best fertilizer application practices. This exercise was specifically designed for this purpose.

96 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp87-89.

97 Bautista, O.K. (ed.). 1994. Introduction to Tropical Horticulture. 2nd Edition, SEAMEO Regional Center for Graduate Study and Research in Agriculture and University of the Philippines Los Baños, College, Laguna, Philippines. pp290-293.

How long will this exercise take?

- Thirty minutes to one-hour for field walks and observations of best fertilizer application practices for upland crops in adjoining fields of learning fields; and
- Thirty minutes to one-hour brainstorming session in processing area.

Learning objectives

- To make participants aware of and understand how proper fertilizer application methods can improve productivity and profitability in agroforestry crops production; and
- To learn best practices on fertilizer application from other farmers.

Materials

- Manila papers, notebooks, ball pens, marking pens, crayons;
- Other supplies (e.g., shovel or spading fork, bamboo poles, plastic sheets, wood, and feedstuff sacks); and
- Established agroforestry area ready to be applied with organic and inorganic fertilizers.

Methodology

- Field walks, observation, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe present fertilizer application practices in adjoining agroforestry area. List down all observations related to fertilizer application practices, kind of fertilizer material used, crops planted, crop stand, among others;

2. Go back to processing area. Brainstorm in small groups and present outputs to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. List down important observations shared by farmers, as follows:

   ☑ Frequency and timing of fertilizer application for different agroforestry crops;
   ☑ Placement and method of fertilizer application for different agroforestry crops; and
   ☑ Kind and amount of fertilizers applied for different agroforestry crops.

3. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- Did you observe different fertilizer application practices for agroforestry and other upland crops planted?
- When and why farmers apply basal fertilizer? When and why did farmers apply side or top dress fertilizer? When and why did farmers apply foliar fertilizer?
- What growth stages of agroforestry and other upland crops are critical to fertilizer application?
- Did you observe differences in crop stand with different fertilizer application practices for agroforestry and other upland crops?
- What pests and diseases were prevalent on agroforestry and other upland crops observed on farmers' field in relation to fertilizer application practices?
- Did you learn from other farmers their best experiences regarding methods of fertilizer application for different agroforestry and other upland crops? How did they do it?
- What other cultural management practices can complement proper fertilizer application to improve productivity and profitability in agroforestry and other upland crops production?

Section 6

INTEGRATED PEST MANAGEMENT FOR AGROFORESTRY CROPS

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This section consists of four sub-sections, namely: (a) integrated insect pest management; (b) integrated rodent management; (c) integrated plant disease management; and (d) simultaneous insect pest and disease management. Many discovery-based exercises accumulated in this section were adapted from *Field Guide of Discovery Exercises for Vegetable IPM (Volume II)*[98] and a new *Field Guide of Discovery-based Exercises for Organic Vegetable Production*[99].

The sub-sections on integrated insect and rodent pest management include discovery-based exercises, which employ intelligent manipulation of pest population using a combination of possible techniques e.g., mechanical or physical, cultural, and biological) in consideration of natural regulatory factors to reduce economic damage and avoid unwanted side effects. Similarly, an integrated disease management sub-section compiles mainly discovery-based exercises, which integrate various mechanical or physical (e.g., heat treatment, flooding, rouging of diseased plants or pruning of infected plant parts), cultural (e.g., crop rotation, trellising) as well as biological (e.g., use of microbial antagonists, use of resistant varieties, bio-fumigation) control methods.

An added feature of this section is a sub-section on insect pests and diseases management to highlight several discovery-based exercises, which simultaneously address management of both insect pest and disease problems in vegetables and other agroforestry crops.

98 Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. 366p.

99 Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp189-369.

INTEGRATED INSECT PEST MANAGEMENT[100]

Insect pests have high reproductive capacities to offset naturally high mortality that they face in nature. Similarly, there are rich communities of beneficial insects, spiders, and diseases that attack insect pests. Without these beneficial species, insect pests would multiply so quickly that they would completely consume crops. However, the normal balance between insect pests and their natural enemies is often disrupted by indiscriminate use of chemical insecticides[101]. Such a scenario would require employment of environment-friendly insect pest management strategies to conserve these beneficial organisms in nature.

Thus, this sub-section consists of discovery-based exercises, which relies chiefly on: mechanical or physical (e.g., handpicking, mechanical cultivation); cultural (e.g., crop rotation, careful farm design to achieve desired biodiversity and integration); and biological control (e.g., use of parasitoids, predators, insect pathogens as bio-control agents) options.

100 Javier, P.A. 2008. Management of Insect Pests in Organic Vegetable Production. Power Point Presentation during the Workshop On Designing Farmer Field School Curriculum on Integrated Pest Management for Organic Vegetable Production held at the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Department of Science and Technology, Los Baños, Laguna, Philippines on 28-30 April 2008. Slides 1-31.

101 Shepard, B.M., A.T. Barron, and J.A. Litsinger. 2000. Friends of the Rice Farmers: Helpful insects, Spiders, and Pathogens. International Rice Research Institute, Los Baños, Laguna, Philippines. pp4-5.

Exercise No. 6.01[102]

IDENTIFICATION OF INSECT PESTS AND THEIR NATURAL ENEMIES

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, after conducting at least 3 or 4 weekly AFESA in agroforestry learning field; and
- When farmers want to identify and learn functions of different insects and other small animals in an agroforestry ecosystem.

BACKGROUND AND RATIONALE

In a previously concluded intensive one-month *Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetables*[103], the participants agreed that design of discovery-based exercises on insects and other pests and natural enemies must be started with field walks, observations, and collection of live specimens (including plants exhibiting damages) in vegetable fields. Sorting and identification of collected insects, other pests and their natural enemies by participants will be then conducted in small groups. Eventually, validation of output in big group with assistance of technical experts would follow and the participants, together with technical experts, will summarize the activity by classifying collected specimens as follows[104]:

- ***Destructive insects***. A group of insects that feeds on vegetable crops specifically on leaves, stems, flowers, and fruits. The feeding of these insects causes damage to crop, which affects yield or quality of produce. Destructive insects are grouped based on the kind of feeding they inflict on vegetable crops:

  Sucking insects. These insects are normally represented by plant bugs, which have piercing-sucking mouthparts. As sap feeders, majority of these insects have toxic saliva, which when injected into plant produces curling, necrosis and drying of tissues, resulting sometimes in death of shoots and branches. Some bugs transmit virus diseases in cucurbits and solanaceous vegetables. Some examples are true bugs, aphids, thrips, and mites.

  Chewing insects. These are insects whose destructive stages have mandibulate or chewing mouthparts. They feed mostly on leaves, flowers, and fruits. During severe infestation, insects may defoliate

102 Adapted from Callo, Jr., D.P., M.O. Olanday, and C.A. Baniqued (eds). 2000. Field Guide of Discovery-based Exercises for Mango IPM. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp4-3 to 4-10.

103 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp22-28.

104 Medina, J.R. 1998. As cited in: Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp169-172.

whole plants. Other damages are folding of leaves, pinholes, and huge holes and feeding on under-surface of leaves. On flowers and fruits, scraped surface is a sign of damage done by insects. Some common examples are diamondback moth (DBM), cutworm, leaf-folder, and flea beetle.

<u>Borer insects</u>. The immature stages of these insects bore or tunnel fruit or stem of plant. In severe infestation, many fruits drop prematurely. Stems heavily affected dry up leading to death of crop. A few examples are shoot borer, pod borer, melon fruit fly, and fruit worm.

<u>Miner insects</u>. Immature stages of insects puncture and mine on leaves down to petiole and stem. On leaves, damage is characterized by transparent mine extending over surface. Heavily infested leaves may dry up but remain attached to plant. Seriously infested plants are stunted and produce injuries on flowers and fruits. Some examples are sweet pea miner and bean fly.

<u>Root feeders</u>. Immature stages and some adults of insects feed on living roots or base of plants, causing stunted growth or death of plants. Yellowing of leaves or plants in patches is the first indication of damage by these insects. Some result in complete cutting of aerial portions from roots. A few examples are crickets, mole cricket, and grubs.

- ***Beneficial Insects***. Refer to insect groups that give benefit to farmers in terms of insect pest reduction and improvement of yield or quality of product.

<u>Biological control agents</u>. This refers to any living organism used in reducing pest population in vegetable farms. The employment of sound agricultural practices will help conserve and encourage reproduction of naturally occurring enemies of vegetable pests. The kind of living organism identified can be one of following:

☑ *Predators.* A group of organisms that is free-living throughout their entire life cycle. Each predator consumes a number of pests, called preys, in its lifetime. In vegetable areas, spiders, predatory bugs, ants, wasps and some ladybird beetles are organisms identified eating both larval and adult stages of insect pests.

☑ *Parasitoids.* These are insects, mostly wasps and flies that lay eggs on or near insect pests of vegetables. Upon hatching, parasitoid larvae feed on hosts, either internally or externally and kill hosts during their development. Adult parasitoids feed mostly on flowers. Some examples are *Diadegma sp., Cotesia sp., Diadromus sp.,* and *Trichogramma sp.*

☑ *Pathogens.* These are parasitic microorganisms used to control insect pests of vegetables. Some insect pathogens infecting various insect pests are viruses, bacteria, and fungi. Both viruses and bacteria infect their host when eaten. Fungal pathogens can infect their hosts by penetrating directly through surfaces of host's body. A few examples are *nucleo-polyhedrosis virus* (NPV)*, Nomurea sp., Beauverea sp.,* and *Cordecyps sp.*

☑ *Pollinators.* These insects pollinate flowers of some vegetable crops like cucumber, chayote, snap bean, green pea, bell pepper, and tomato. Wild bees and honeybees are most predominant pollinators of vegetables.

How long will this exercise take?

- Thirty minutes field walks, observations, and collection of different insects and other small animals in agroforestry field; and
- Thirty minutes to one hour identification and sorting of specimens according to ecological functions, and brainstorming session in processing area.

Learning objectives

- To develop participants' skills in observing and recognizing shapes, colors, and functions of insects and other small animals found in agroforestry ecosystem; and
- To encourage participants to differentiate 'unknown' insects and other small animals based on their ecological functions instead of their technical descriptions.

Materials

- Agroforestry crops grown in learning and adjoining fields;
- Collecting equipment (e.g., plastic bags, jars, sweep net, aspirator, fine hair paintbrush); and
- Other materials (e.g., alcohol to kill insects, white plates or trays to spread insects for sorting, hand lenses, Manila paper and pentel pens, enough candies for all participants [as prizes]).

Methodology

- Field walks, observation, collection, sorting, identification, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks, observe, and collect insects and other small animals in agroforestry learning and adjoining fields. Take note of feeding characteristics of these animals. Interview other farmers, if necessary. List down all observations related to occurrence, crops or weeds inhabited or infested, degree and characteristic of damage to crops or pests, among others.

2. Facilitate each small group to sort and identify collected specimens based on their similarities in color, shape, and ecological functions as observed in agroforestry learning field. Have a 'competition' with prizes for small groups that can collect:

   ☑ Largest number of different insects and other small animals;
   ☑ Biggest insect or other animal; and
   ☑ Smallest insect or other animal.

3. Go back to processing area; brainstorm in small groups and present outputs to big group. Allow small groups to kill insects by putting in a bag with a little alcohol and quickly sort them on white trays or plates into groups of different types of insects. While small groups are sorting specimens, facilitators draw up a matrix table on a Manila paper for competition results. Fill in competition results and give candies to winning groups and all other groups for working so hard, to wit:

GROUP	HOW MANY KIND	LARGEST	SMALLEST	TOTAL
1				
2				
3				
4				
5				
TOTAL				

4. Conduct participatory discussions and motivate farmers to share their ideas and knowledge on similarities, differences, and functions of collected specimens in agroforestry ecosystem. Facilitate each small group to make a list of all different ways of grouping specimens that are useful when observing agroforestry ecosystem and making management decisions, like:

- ☑ What does it eat (e.g., plant-feeders, insect-feeders, nectar-feeders, decomposers)?
- ☑ Where is it found (e.g., on leaves, stem, fruit, soil, or weeds)?
- ☑ What stage is it (e.g., egg, larva, nymph, pupa, or adult)?
- ☑ How does it feed (e.g., chewing, sucking, piercing, or rasping)?
- ☑ How does it move (e.g., flying, jumping, or crawling)?
- ☑ How many are there (e.g., in groups or single)?
- ☑ What type of insect or animal (e.g., spider, fly, beetle, butterfly, bug, wasp, frog, slug, etc.)?

5. Each small group take each animal that they have collected, goes down the list and makes a check against each group that it belongs to. Each group makes a table/matrix with all the different ways of grouping listed like this:

WAYS OF GROUPING	TALLY/CHECK	TOTAL NUMBER
What it eats?		
Plant-feeder	~~IIII~~ ~~IIII~~ ~~IIII~~ III	**13**
Insect-feeder	~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ ~~IIII~~ III	**28**
Decomposer	~~IIII~~ I	**6**
Unknown	~~IIII~~ I	**6**
What stage is it?		
Egg	IIII	**4**
Larva	~~IIII~~ ~~IIII~~ III	**13**
Pupa		**0**
Adult		**0**
Nymphs		**0**

6. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ How many insects did you have difficulty in grouping? How many were 'unknowns'?
- ❑ What characteristics did you use in grouping insects and other mall animals that you know?
- ❑ If you did not know the animal, how did you find out its characteristics?
- ❑ What plant parts did the plant-feeders feed on?
- ❑ What insects did the insect-feeders feed on?

Exercise No. 6.02[105]

USING REPELLENT AND TRAP CROPS AS A PEST MANAGEMENT STRATEGY IN AGROFORESTRY CROPS PRODUCTION

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, during discussions on cultural management practices as a component of Integrated Pest Management in agroforestry crops production; and
- When farmers want to learn best practices from other farmers on the use of repellent and trap crops as a management strategy for agroforestry crop pests.

BACKGROUND AND RATIONALE

The use of repellent and trap crops, when properly implemented as a cultural management strategy can effectively reduce pest populations without resorting to pesticide application. A popular repellent crop in highlands is marigold, which is used against diamondback moth (DBM). Trap crops, on the other hand, may include susceptible crops (e.g., marigold) or alternate hosts (e.g., *Galinzoga parviflora* and *Bidens pilosa*) of destructive pests (e.g., root knot nematodes) that are strategically planted in field to evade attacks by altering their food preference and migration from main agroforestry crop to trap crop[106].

Other upland crops, such as Chinese cabbage (locally known as *wong-kok*), seem to be preferred by flea beetles and this could be used as a trap crop of this pest. For cutworm caterpillars, a simple and effective trap crop is use of large senescing cabbage leaves, which are placed on ground around plants in late afternoon. The caterpillars seek refuge under these leaves where they can be easily collected when the sun rises the following day. This trap crop is also effective for snails and slugs.

Many farmers in the Cordilleras had their own innovations in using repellent and trap crops. These experiences can be effectively shared and learned among farmers in AGF-FFSs through field walks, observations, and brainstorming. These learning experiences can be enhanced further by role-playing, hence this exercise.

105 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp189-191.

106 Medina, J.R. 1998. As cited in: Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. 366p.

How long will this exercise take?

- Thirty minutes for field walks, observations, and collection of suspected repellent, trap, and main crops in agroforestry learning and adjoining fields; and
- Thirty minutes to one hour role-playing and brainstorming session in processing area.

Learning objectives

- To make participants aware of and understand the role of repellent and trap crops for pest management in their own agroforestry fields; and
- To enhance farmers' learning experiences by role-playing of how repellent and trap crops work as a management strategy for agroforestry crop pests.

Materials

- Agroforestry fields where pest infestations or non-infestation can be observed on possible trap or repellent crops; and
- Other office supplies (e.g., Manila papers, notebooks, ball pens, and marking pens).

Methodology

- Field walks, role-playing, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe as many possible repellent and trap crops in adjoining agroforestry farms of learning field. Interview other farmers, if necessary. List down all observations related to degree of pest infestations, kinds of repellent, trap or main crops planted, crop stand, etc.

2. Go back to processing area and prepare for a role-play. A facilitator explains mechanics of play to the big group and assigns two groups to different repellent or trap crops, one group to a main crop and two groups to different pests as shown below:

   ☑ Group 1 to repellent-trap crops A (Marigold);
   ☑ Group 2 to trap crops B (*Galinzoga parviflora);*

- ☑ Group 3 to main crops C (Carrot);
- ☑ Group 4 to pests A (half the group as root knot nematodes; half as diamondback moths);
- ☑ Group 5 to pests B (cutworms)

3. Each small group selects volunteers, discusses, and prepares for their roles. The role-play is then conducted by the big group to depict the following scenes:

   - ☑ The pests shall migrate and pass by different repellent or trap crops;
   - ☑ Half of pests A (root knot nematodes) shall be attracted to repellent-trap crops A while another half (diamondback moths) shall shy away and die;
   - ☑ On the other hand, pests B shall be attracted to trap crops B;
   - ☑ One or two of pests A and B shall not notice trap crops A and B and shall land instead on main crops C;
   - ☑ These few pests shall survive on main crops C but shall be weak and sluggish;
   - ☑ Most pests shall be strong, active, and cling to trap crops A and B; and
   - ☑ Main crops C shall exhibit minimal damage while trap crops A and B shall be totally destroyed.

4. Brainstorm in a big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Relate lessons learned in field walks to those learned in role-play.

5. Synthesize and summarize output in brainstorming session into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe any weeds or crops in agroforestry field, which can be used as repellent or trap crops?
- ❑ Did you observe varying degrees of pest damage among crops?
- ❑ What pests did these repellent or trap crop repelled or trapped?
- ❑ What is the economic importance of repellent and trap crops?
- ❑ Can we effectively manage pests by using repellent or trap crops? How?
- ❑ How do we layout repellent or trap crops in agroforestry field?
- ❑ Did you learn from other farmers some innovations in using repellent or trap crops as a management strategy for agroforestry crop pests?
- ❑ In this role-play, what were portrayed as characteristics of a good repellent or trap crop?
- ❑ What other cultural practices can complement the use of repellent or trap crops to manage agroforestry crop pests?

Exercise No. 6.03[107]

SANITATION PRACTICES FOR MANAGEMENT OF POD BORERS, LEAFMINERS, AND LEAF-FOLDERS IN UPLAND VEGETABLES CROPS

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, when there are infestations of pod borers, leafminers, and leaf folders to some vegetables grown with agroforestry crops in learning field; and
- When farmers want to learn innovative sanitation practices from others to control pod borers, leafminers, and leaf folders to some vegetables grown with agroforestry crops.

BACKGROUND AND RATIONALE

One of the most practical approaches to pest management is good cultural control, specifically sanitation. Sanitation is aimed at reducing exposure of crops to pest infestation. Sanitation excludes use of biological control. For pests of some vegetables grown with agroforestry crops, such as pod borers, leaf miners, and leaf folders, a primary objective of sanitation is prevention of pest build-up and not total destruction of existing or damaging pest populations[108]. Proper disposal of crop residues, which may serve as breeding places for pests, is a good way of preventing build-up of these pests. Elimination of crop residues after harvest destroys pests and prevents carry-over to next crop.

There are several sanitation practices commonly employed to control pod borers, leafminers, and leaf folders in some vegetables grown with agroforestry crops. These are: (1) roguing of host weeds and plants at earlier stages of growth; (2) removal of infested leaves and fruits at later growth stages; (3) proper disposal of rogued plants, removed leaves or fruits, and other crop residues by burying, burning, etc.; and (4) plowing under of infested crop residues immediately after harvest[109].

Many farmers in the Cordilleras had adapted better sanitation practices to control pod borers, leafminers, and leaf folders in some vegetables grown with agroforestry crops, through time, which when shared with others in AGF-FFSs will result in much improved sanitation practices. The foregoing exercise was designed primarily to address this concern.

107 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp205-207.

108 Cardona, Jr. E.V. 1998. As cited in: Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. 366p.

109 Bautista, O.K. (ed). 1994. Introduction to Tropical Horticulture. 2nd Edition, SEAMEO Regional Center for Graduate Study and Research in Agriculture and University of the Philippines Los Baños, College, Laguna, Philippines. pp369-371.

How long will this exercise take?

- Thirty minutes to one-hour for field walks, observations, interaction with farmers, and hands-on in agroforestry learning field; and
- Thirty minutes for brainstorming session in processing area.

Learning objectives

- To create awareness and understanding among participants on role of sanitation to control pod borers, leafminers, and leaf folders to some vegetables grown with agroforestry crops; and
- To learn from others and do hands-on of proper sanitation to control pod borers, leafminers and leaf folders to some vegetables grown with agroforestry crops.

Materials

- Some vegetables grown with agroforestry crops showing infestations of pod borers, leafminers, and leaf folders in learning and adjoining fields;
- Manila papers, notebooks, ball pens, marking pens, and crayons; and
- Farm implements (e.g., pruning shear, knife, or scythe).

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe sanitation practices to control pod borers, leaf miners, and leaf folders on some vegetables grown with agroforestry crops in learning and adjoining fields. Take note of cultural practices employed. Interview other farmers, if necessary. List down all observations related to:

   ☑ Kind of crops planted and crop stand;
   ☑ Prevalent weeds, pests, and diseases; and
   ☑ Quality of products, etc.

2. Go back to processing area; brainstorm in small groups and present outputs to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate

farmers to share their best experiences in sanitation practices to control pod borers, leaf miners, and leaf folders on some vegetables grown with agroforestry crops.

3. Develop an improved procedure of sanitation as a management strategy against pod borers, leaf miners, and leaf folders on some vegetables grown with agroforestry crops.

4. Facilitate each farmer to do hands-on of sanitation practices to control pod borers, leaf miners, and leaf folders on some vegetables grown with agroforestry crops observed in learning field at all growth stages by improving procedure below:

   - ☑ Determine if there are infestations of pod borers, leaf miners, and leaf folders on some vegetables grown with agroforestry crops;
   - ☑ Rogue host weeds or plants at earlier stages of growth;
   - ☑ Remove infested leaves and fruits at later growth stages;
   - ☑ Dispose properly rouged plants, removed leaves or fruits and other crop residues by burying, burning, etc.;
   - ☑ Plow under infested crop residues immediately after harvest in agroforestry fields; and
   - ☑ Take note of all relevant observations and experiences during this activity.

5. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe infestations of pod borers, leafminers, and leaf folders on some vegetables grown with agroforestry crops in learning and adjoining fields?
- ❑ Did you observe any farmer practicing sanitation to control pod borers, leafminers, and leaf folders on some vegetables grown with agroforestry crops in farmers' field?
- ❑ What other pests can be effectively controlled by sanitation practices? Is sanitation applicable as a control strategy for all pests of vegetables and other agroforestry crops? When is best time to do sanitation as a control strategy for pod borers, leafminers, and leaf folders on some vegetables grown with agroforestry crops?
- ❑ Did you observe any innovative sanitation practices by farmers as a control strategy for pod borers, leafminers, and leaf folders on some vegetables grown with agroforestry crops?
- ❑ What other cultural management options can you use to complement sanitation as a control strategy for pod borers, leaf miners, and leaf folders of vegetables and other agroforestry crops?

Exercise No. 6.04[110]

> **When is this exercise most appropriate?**
>
> - In AGF-FFS, TOT, and TOS sessions, as follow-up or integral part of topic on 'Biological Control of Insect Pests'; and
> - When farmers want to learn some innovative ways of using green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi as biological control agents against lepidopterous pests of agroforestry crops.

FIELD-COLLECTION AND USE OF GREEN AND WHITE MUSCARDINE FUNGI FOR LEPIDOPTEROUS PESTS MANAGEMENT IN AGROFORESTRY CROPS PRODUCTION

BACKGROUND AND RATIONALE

There are naturally occurring predators, parasitoids, and insect pathogens attacking eggs, larvae, nymphs, and adults of lepidopterous insect pests of agroforestry crops. Among insect pathogens, most common are green (*Metarhizium anisopliae* [Metchnikoff] Sorokin) or GMF and white (*Beauveria bassiana* [Balsamo] Vuillemin) or WMF muscardine fungi. Among others, they are known to attack larvae of many lepidopterous pests of agroforestry crops. These insect pathogens are described below[111]:

- Green muscardine fungus or GMF is a naturally occurring insect pathogen that attacks more than 200 insects. The fungus has cylindrical conidiogenous cells. Inside these cells are powdery masses of dark green to yellow-green columns of conidia that arise from white mycelium. The conidia are > 9 µm long and are cylindrical with a slight central narrowing. They form very long and laterally adherent chains. The spores are shaded green. GMF spores land on host's body and high humidity favors its growth. During its development, fungus consumes its host's contents. When host dies, fungus emerges as a white growth and then turns dark green with age. The spores are spread by wind or water to new hosts.

- White muscardine fungus or WMF is a naturally occurring insect pathogen commonly used for insect pest control worldwide. The fungus forms white powdery conidial masses that are globosely to broadly ellipsoid. They measure 2.5-3.5 µm. They are produced on sympodial conidiogenous cells present on hyphae arising from mycelium mat. These cells are globosely to flask-shaped, 2-3 x 2-4 µm with dented zigzag-shaped rachis that reaches up to 20 µm. During development, fungus uses soft tissues and body fluids of host. The growth of WMF requires conditions of prolonged high moisture for airborne and

110 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp251-255.

111 IRRI. 2008. Insect Pathogens. As cited in: http://www.knowledgebank.irri.org/beneficials.

waterborne spores to germinate. When ready to produce chalky-white spores, fungus grows out of host's body.

The GMF and WMF can be easily mass-produced on rice or corn seeds, brewery wastes, and grass cuttings and cultured in plastic bags, glass containers, or similar vessels. They can be produced in powder form (pure spores), solution, or granular form when mixed with sand. Infected larvae produce spores that infect second pest generation. These fungi can be easily conserved in agroforestry fields by not using chemical pesticides, particularly fungicides, which will normally kill them. These fungi can also be introduced to augment existing natural enemies in areas where they are not present[112].

These practical and worthwhile innovations can be shared and enriched by farmers and facilitators in AGF-FFSs to improve pest management practices through participatory, discovery-based, and experiential learning approaches, hence this exercise. While use of GMF and WMF as biological control agents against numerous lepidopterous pests is an essential topic in any regular season-long AGF-FFS session, farm-level mass-production of these fungi is more applicable and sustainable when introduced as a follow-up activity of regular AGF-FFS farmer-graduates.

How long will this exercise take?

- One hour for field walks, observations (e.g., presence of egg masses, larvae, adults, damage symptoms, and other signs of presence), and interaction with farmers on occurrence and severity of lepidopterous pests infestations in agroforestry learning and adjoining field;
- Thirty minutes hands-on on collection of green (GMF) and white (WMF) muscardine fungi as initial stocks for field-rearing;
- One hands-on on actual field-rearing of green (GMF) and white (WMF) muscardine fungi;
- Thirty minutes to one-hour weekly brainstorming session in processing area; and
- This exercise will require at least two consecutive weeks from collection of green (GMF) and white (WMF) muscardine fungi initial stocks and final observation of fungi infection on lepidopterous pest larvae.

Learning objectives

- To create awareness and understanding among participants on innovative field-production and use of green (GMF) and white (WMF) muscardine fungi as biological control agents against lepidopterous pests; and

112 PGCPP. 1987. Pocket Reference Manual on Integrated Pest Management for Corn. Philippine-German Crop Protection Programme (PGCPP), Bureau of Plant Industry, Department of Agriculture, Malate, Manila, Philippines. pp89.

- To learn and do hands-on on field-collection, production, and use of green (GMF) and white (WMF) muscardine fungi as biological control agents against lepidopterous pests.

Materials

- Vegetables and other agroforestry crops in learning and adjoining fields showing relatively moderate to serious infestations of lepidopterous pests and GMF- and/or WMF-infected lepidopterous pest larvae;
- Notebooks, ball pens, marking pens, crayons, Manila papers; and
- Other materials (e.g., hand sprayer, water, bottles with cap, wide-mouth transparent jars, and Petri dishes).

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks, observe, and interact with farmers on occurrence of eggs, larvae, and pupae as well as severity of lepidopterous pest infestations on vegetables and other agroforestry crops in learning and adjoining fields. Interview other farmers and list down all observations related to:

   ☑ presence of eggs, larvae, and pupae as well as of GMF- and/or WMF-infected lepidopterous pest larvae;
   ☑ damage symptoms, and other signs of lepidopterous pest infestations;
   ☑ severity of lepidopterous pest infestations;
   ☑ control methods employed against lepidopterous pests; and
   ☑ occurrence of other pests and diseases on agroforestry crops.

2. Go back to processing area; brainstorm in small groups and present outputs to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in using non-chemical methods or approaches to manage lepidopterous pests.

3. Develop or improve current procedure of field-production and use of green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi as biological control agents against lepidopterous pests.

4. Facilitate each farmer to do hands-on on field-production and use of green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi as biological control agents against lepidopterous pests [113]:

   ☑ Collect GMF- and/or WMF-infected and healthy lepidopterous pest larvae in learning and adjoining fields of vegetables and other agroforestry crops;
   ☑ Place GMF- and/or WMF-infected and healthy lepidopterous pest larvae in a bottle with cap; Add enough water and shake vigorously until water has whitish tint;
   ☑ Pour suspension into a hand sprayer using a sieve to separate solids;
   ☑ Set up Petri dishes with healthy lepidopterous pest larvae; Spray suspension on healthy lepidopterous pest larvae in Petri dishes to multiply green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi;
   ☑ Incubate for 1-2 days under room temperature; Observe for fungal growth; If exposed lepidopterous pest larvae are totally colonized by fungus, repeat 3rd and 4th steps of procedure;
   ☑ If enough green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi are produced, try spraying suspension on lepidopterous pest infested vegetables and other agroforestry crops in learning or adjoining fields; and
   ☑ Observe daily for at least one week; Present observation and conduct participatory discussions.

5. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe different vegetables and other agroforestry crops infested with lepidopterous pests in learning and adjoining fields?
- ❑ What control methods were employed by farmers against lepidopterous pests infesting vegetables and other agroforestry crops?
- ❑ What signs and symptoms were exhibited by lepidopterous pest larvae infected with green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi? Characterize.
- ❑ How long did it take GMF and/or WMF to kill host lepidopterous pest larvae? Which instars was more affected by GMF and/or WMF?
- ❑ What was effect of GMF and/or WMF on non-lepidopterous pests?
- ❑ Did you observe farmers producing and using biological control agents to manage lepidopterous pests in their agroforestry fields?

113 Callo, Jr. D.P., A.G. Castillo, and C.A. Baniqued (eds). 2001. Field Guide of Discovery-based Exercises for Corn Production. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp298-300.

- ☐ Did you observe farmers using GMF and/or WMF as biological control agents against lepidopterous pests in their agroforestry fields?
- ☐ Is use of green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi as biological control agents effective against lepidopterous pests of vegetables and other agroforestry crops?
- ☐ How, how much, and when is best time to apply green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi as biological control agents against lepidopterous pests of vegetables and other agroforestry crops?
- ☐ Did you observe any innovative procedures in mass-production and application by farmers of green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi as biological control agents against lepidopterous pests? What benefits did farmers derive in using biological control as pest management strategy in vegetables and other agroforestry crops production?
- ☐ How did you feel while mass-producing and using green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi? Was it difficult to mass-produce and use green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi as biological control agents against lepidopterous pests of vegetables and other agroforestry crops?
- ☐ What other cultural management options can you use to complement using green (*Metarhizium anisopliae*) or GMF and white (*Beauveria bassiana*) or WMF muscardine fungi as biological control agents against lepidopterous pests of vegetables and other agroforestry crops?

Exercise No. 6.05[114]

FARM-LEVEL PRODUCTION AND USE OF EARWIG AS PREDATOR OF INSECT PESTS OF AGROFORESTRY CROPS

When is this exercise most appropriate?

- In FFS, TOT, and TOS sessions, as follow-up or integral part of topic on 'Biological Control of Insect Pests'; and
- When farmers want to learn some innovative ways of farm-level mass-production and use of *Euborellia* as a general predator of numerous insect pests of agroforestry crops.

BACKGROUND AND RATIONALE

Predators are organisms that feed on pests. Generally, they are bigger than their prey (pest), which they actively seek and capture. Some examples of predators are earwigs, flower bugs (*Orius*), and ladybird (coccinellid) beetles.

Earwigs, belonging to Order Dermaptera, are general predators of eggs, larvae, and pupae of Lepidopterans, Coleopterans, and Dipterans as well as leafhoppers, planthoppers, aphids, and many soft-bodied insects. They are nocturnal (more active at night) and prefer slightly moist conditions as their habitat. They are easily recognized by their elongated, flattened body and mobile abdomen, which extend into a pair of forceps. The earwig species, *Euborellia annulata* (Fabricius), is shiny-black in color and generally wingless, has a 7-segmented antennae with its 3rd and 4th from apex pale, and prefers to stay in soil during daytime but crawls on plants at nighttime.

As a biological control agent against insect pests, biology of *Euborellia* is already well-studied. It develops from an egg to an adult in about 35 days, lays 6 egg batches with 40 eggs per batch or a total of 240 eggs. Its egg hatches in 6-8 days and undergoes five nymphal instars. The survival rate from eggs to adults is about 90 percent and an adult lives for approximately 74 days. The predator can establish well with a 1:6 male-female ratio under laboratory conditions. During field dispersal, *Euborellia* can travel within a radius of about 6 meters from release point.

These practical and worthwhile innovations can be shared and enriched by farmers and facilitators in AGF-FFSs to improve pest management practices through participatory, discovery-based, and experiential learning approaches, hence this exercise. While use of *Euborellia* as a general predator of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insects is an essential topic in any regular season-long AGF-FFS session, farm-level *Euborellia* mass-production is more applicable and sustainable when introduced as a follow-up activity of AGF-FFS farmer-graduates.

114 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp245-250.

How long will this exercise take?

- Thirty minutes to one-hour for field walks, observations (e.g., presence of egg masses, larvae, adults, damage symptoms, and other signs of presence), and interaction with farmers on occurrence and severity of numerous insect pests including leafhoppers, planthoppers, aphids, and many soft-bodied insects infestations on agroforestry crops in learning and adjoining fields;
- One to two hours hands-on (e.g., 1st 2 weeks before planting) on collection of *Euborellia annulata*, as initial stocks, and preparation of mass-rearing equipment;
- One to two hours weekly hands-on on actual mass-production of *Euborellia annulata* (e.g., 1st 4 weeks after planting);
- Thirty minutes to one-hour weekly brainstorming session in processing area; and
- This exercise will require one month and two weeks from collection of *Euborellia annulata* initial stocks and preparation of mass-rearing equipment.

Learning objectives

- To create awareness and understanding among participants on innovative farm-level mass-production and use of *Euborellia annulata* as a general predator of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests of agroforestry crops; and
- To learn and do hands-on on farm-level mass-production and use of *Euborellia annulata* as a general predator of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests of agroforestry crops.

Materials

- Corn cobs
- Dog food or fish feed
- Initial stock of *Euborellia annulata*
- Scissors
- Strainer
- Small paint brush
- Rubber band
- Cutter
- Manila paper
- Masking tapes
- Marking pen and pen
- Plastic tray
- Plastic tray holder

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks, observe, and interact with farmers on occurrence and severity of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests on agroforestry crops in learning and adjoining field. Interview other farmers and list down all observations related to:

   ☑ presence of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests;
   ☑ damage symptoms, and other signs, presence of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests;
   ☑ severity of infestations of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests;
   ☑ control methods employed against numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests; and
   ☑ occurrence of other pests and diseases on agroforestry crops.

2. Go back to processing area; brainstorm in small groups and present output to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in using non-chemical methods or approaches to manage numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests of agroforestry crops.

3. Develop or improve current procedure of farm-level mass-production and use of *Euborellia annulata* as a general predator of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests of agroforestry crops.

4. Facilitate each farmer to do hands-on on farm-level mass-production and use of *Euborellia annulata* as a general predator of eggs, larvae, and pupae of numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests of agroforestry crops [115]:

   A. Collection and Rearing of Founder Population:

   ☑ Collect initial earwig population;

115 Javier, P.A. 2005. Farm-level utilization of predators: Earwigs and Orius. Power point presentation during a Workshop on Integrated Production and Pest Management in Processing Tomato: Issues and Prospects held on July 2005 at Laoag City, Ilocos Norte, Philippines. 17 slides.

a) dissect corn stalks heavily infested with ACB
b) pile of decomposing corn cobs
c) request from NCPC

- ☑ Place 3-4 cm soil-sand mixture (3:1 by volume) inside an acrylic pan (14.5 cm diameter and 8.5 cm high);
- ☑ Moisten mixture to about 27–30% moisture content;
- ☑ Release adults (12 females and 4 males);
- ☑ Feed with corn cob and dog food or fish feed mixture (about 15 g each);
- ☑ Feed insect weekly with about 7.5 g food mixture; and
- ☑ Adults will lay about 3-4 egg batches and these offspring will be utilized in mass-rearing.

B. Mass-rearing of Earwig (*Euborellia annulata*):

- ☑ Construct galvanized boxes (73 X 37.5 X 28 cm);
- ☑ Place 7.5 cm-high soil : sand mixture (3:1) inside rearing box;
- ☑ Maintain soil moisture content to 27 to 30%;
- ☑ Introduce adult earwigs (150 females and 50 males);
- ☑ Feed earwigs initially with 400 g mixture of diet, and 200 gm diet every 10 days thereafter (A total of 1 kg diet can be used per box per month);
- ☑ About 5,000 earwigs of different ages can be produced per rearing box within two months; and
- ☑ Cost of rearing earwigs is P0.06 per individual.

C. Using Earwig (*Euborellia annulata*) as Biological Control Agent:

- ☑ At 20 and 27 days after planting (DAP) or days after transplanting (DAT), release 20,000 earwigs per hectare per release;
- ☑ Use straw as organic mulch to provide cozy shelter for earwigs at daytime; and
- ☑ If target pests are predominantly lepidopterans and exceedingly high, supplement with release of *Trichogramma* to be more effective.

5. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendation from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe different agroforestry crops infested with numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests in learning and adjoining fields?
- ❑ What control methods were employed by farmers against numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests infesting their other agroforestry crops?
- ❑ Did you observe farmers producing and using biological control agents to manage numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests in their agroforestry fields?
- ❑ Did you observe farmers using earwig (*Euborellia annulata*) as biological control agent to manage numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests in their agroforestry fields?
- ❑ Is use of earwig (*Euborellia annulata*) as biological control agent effective in managing numerous insect pests as well as leafhoppers, planthoppers, aphids, and many soft-bodied insect pests in agroforestry crops production?
- ❑ How, how much, and when is best time to apply earwig (*Euborellia annulata*) as biological control agent in agroforestry crops production?
- ❑ Did you observe any innovative procedures in village-based biological control agent mass-production and application used by farmers in agroforestry crops production? What benefits did farmers derive in using biological control agents as pest management strategy in agroforestry crops production?
- ❑ How did you feel while mass-producing and using earwig (*Euborellia annulata*)? Was it difficult to mass-produce and use earwig (*Euborellia annulata*) as biological control agent in other agroforestry crops production?
- ❑ What other cultural management options can you use to complement using earwig (*Euborellia annulata*) as biological control agent in agroforestry crops production?

INTEGRATED RODENT MANAGEMENT

Rodents, on the other hand, are one of most consistent and serious pests of agricultural crops. The main problem in rodent management is that it must be undertaken through community-based actions, but organizing communities is not an easy task. Thus, this sub-section, will guide us to study rodent biology, baiting and rodent burrow digging, but mostly, we will learn activities that are helpful in organizing communities for more effective rodent management[116].

Rodents (e.g., *Rattus argentiventer* and *Rattus rattus mindanensis*) are nocturnal animals, which can cause devastation to many agroforestry crops. Evident sign of their presence are gnawing, nibbling, cut stems, and presence of runways and burrows in crop fields. Rodents readily multiply in areas where there is abundant food. Re-productivity of rodents is not constant but varies significantly, indicating that factors other than food and climate influence rodent reproduction[117].

There are a few differences between rodents and insect pests that make implementation of management different. First, is rodents' ability 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 next season. The other difference is method of management. Rodent management must be organized over a wide area to be very effective. Rodent drives, baiting, digging, and any other management method or approach is most effective if done as community-based actions.

One last note is a misconception that in many communities, success of a rodent management campaign program is determined by how many rodents have been killed. A large file of rodents is not considered a big success. In fact, an opposite is true. A large file of rodents really means that there is a lot more rodents, which are out in fields ready to feed on agroforestry crops. The number of dead rodents is not very important. The number of rodents that are alive and eating crop is more important. Thus, this sub-section includes discovery-based exercises on: (a) rodent population dynamics; and (b) community-based rodent management strategies.

116 Sumangil, J.P. 1990. Control of ricefield rats in the Philippines. In Quick, G.R. (ed). 1990. Rodents and Rice. Report and Proceedings of an Expert Panel Meeting on Rice Rodent Control held on 10-14 September 1990 at international Rice Research Institute, Los Baños, Laguna, Philippines. pp35-48.

117 Sumangil, J.P. 1990. Control of ricefield rats in the Philippines. In Quick, G.R. (ed). 1990. Rodents and Rice. Report and Proceedings of an Expert Panel Meeting on Rice Rodent Control held on 10-14 September 1990 at international Rice Research Institute, Los Baños, Laguna, Philippines. pp35-48.

Exercise No. 6.06[118]

RODENT POPULATION DYNAMICS: A GROUP DYNAMICS EXERCISE AS WELL

When is this exercise most appropriate?

- In AGF-FFS, TOT and TOS sessions, immediately after crop establishment in agroforestry learning field; and
- When farmers want to learn and understand rodent population dynamics in their agroforestry fields.

BACKGROUND AND RATIONALE

A female rat specimen can be dissected to determine incidence of pregnancy. This process can be used to predict probable rodent population outbreaks even before establishment of agroforestry crops. Scientist had provided procedures for estimating annual productivity at pregnancy and lactation of rodents (e.g., *Rattus argentiventer* and *Rattus rattus mindanensis*) by employing these equations[119]:

- Incidence of pregnancy multiplied against mean litter size at gestation period (18 days) gives a good estimate of a rodent's potential productivity; and
- Incidence of lactation multiplied against average litter size at late weaning period (21 days) gives an estimate of annual productivity of rodents.

However, rodents are known to regulate their own number in presence of extreme numerical abundance or increased competition for food and space resulting in population stress. Evidences involving active self-regulation include delayed rate of maturity, obesity in mature females, absence of sexually precocious young, reduce litter sizes, and severe drop in pregnancy and lactation. Self-regulation as a function of survival may provide a reverse mechanism for depleted population, including those resulting from reduction control programs, to recover their number to a level of their carrying capacity[120].

Nevertheless, rodent populations increase very rapidly because they, very often, have many offspring. In AGF-FFS, a simulation exercise can be undertaken to visualize simple population growth for one year. This activity was designed to understand rodent population dynamics.

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118 Adapted from Callo, Jr. D.P., A.G. Castillo, and C.A. Baniqued (eds). 2001. Field Guide of Discovery-based Exercises for Corn Production. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp360-362.

119 Davis, D.E. 1953. Characteristics of rat populations. Quar. Rev. Biol. 28(4): pp373-401.

120 Sumangil, J.P. 1990. Control of ricefield rats in the Philippines. In Quick, G.R. (ed). 1990. Rodents and Rice. Report and Proceedings of an Expert Panel Meeting on Rice Rodent Control held on 10-14 September 1990 at international Rice Research Institute, Los Baños, Laguna, Philippines. pp35-48.

How long will this exercise take?

- Thirty minutes to one-hour field walks, observations, and interaction with farmers; and
- Thirty minutes to one-hour hands-on and brainstorming session.

Learning objectives

- To create awareness and understanding among participants on how rodent population increases in their agroforestry fields; and
- To learn from other farmers how population dynamics information were used to design management strategies against rodents in their fields as it relates to principles that:

  ☑ It does not matter how many rodents were killed, it only matters how many rodents remain alive in agroforestry fields; and
  ☑ Continuous rodent management is important to keep rodent population always at low level.

Materials

- Vegetables and other agroforestry crops grown in learning and adjoining fields showing early infestation signs of rodents;
- Office supplies (e.g., Manila papers, notebooks, ball pens, marking pens, and crayons); and
- Other supplies (e.g., at least 2,050 mungbean seeds [or any similar materials]) per group.

Methodology

- Field walks, simulation, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe as many agroforestry crops with early infestation signs of rats in learning and adjoining fields. Take note of the signs of gnawing, nibbling, cut seedlings, and damaged plant parts (e.g., flowers, pods, fruits, roots, tubers, etc.) and presence of runways and burrows in field. Interview other farmers, if necessary. List down all observations related to the following:

   ☑ Crops grown and crop stand;

- ☑ Signs of rat damages on plants and plant parts;
- ☑ Presence of runways, burrows, footprints, and feces; and
- ☑ Management strategies employed by farmers, if any.

2. Go back to processing area; brainstorm in small groups and present outputs to the big group.

3. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share how they can use population dynamics information to design management strategies against rodents in their agroforestry fields.

4. Facilitate farmers to do simulation exercises on estimating rodent population growth over a period of one year in their own agroforestry fields by improving procedures given below:

   - ☑ On a Manila paper, draw 12 lines to divide into 13 sections;
   - ☑ On first section, place two seeds; one seed to represent a female rodent and another to represent a male rodent;
   - ☑ Move to 1st month. Add six seeds for six offspring from an original pair of rodents, three rodents are females and three rodents are males;
   - ☑ Move to 4th month. Add six seeds for six offspring from an original female, then add 18 seeds for three females in the 1st month (e.g., three females x six offspring each); half of seeds represent female rodents;
   - ☑ Move to 7th month. Ad six seeds for six offspring from an original female, then add 18 seeds in 1st month (e.g., three females x six offspring each). Add 72 (e.g., 12 females with 6 offspring each) for offspring from females in 4th month, half of seeds represent female rodents;
   - ☑ Continue this process for the 10th and 13th months; and
   - ☑ Write on a Manila paper total numbers of rodents for each month, and a cumulative total from month to month.

5. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ How many rodents are produced in one year (e.g., one section is three months)?
- ❑ If half of rodents are killed on 7th month, how many rodents will be produced by end of 12th month?
- ❑ If there are 10m female rodents in 1st month, how many rodents will be produced on 13th month? If you

organize a rodent management campaign and kill these many rodents, will you be very excited and call your campaign a success? How many rodents are remaining in a vegetable field? Do you think a rodent management campaign was still a success? How many rodents will be in agroforestry field considering reproduction? (Note that reproduction is even greater after many rodents are killed because of les competition for food and space.)

- ❑ What is meaning of a saying ‘it does not matter how many rodents were killed, it only matters how many are left in an agroforestry field to reproduce’?
- ❑ Many farmers say that if you kill rodents, they will bring their rat friends and completely destroy an agroforestry field. Can you explain why agroforestry fields are destroyed after one rodent management campaign (e.g., remember that reproduction is faster when population is low)?
- ❑ Why is it important to begin killing rodents at an early stage of an agroforestry crop? Why is it important to keep killing rodents all season-long? What would be rodent population after 6 months if only one female from each group of six offspring survived? (Totals by cycle will look something like this: 1st month = 6; 4th month = 24; 7th month = 96; 10th month = 384; 13th month = 1,536 or cumulative total is 2,046.)

Exercise No. 6.07[121]

COMMUNITY-BASED RODENT MANAGEMENT STRATEGIES FOR PROFITABLE AGROFORESTRY CROPS PRODUCTION

When is this exercise most appropriate?

- In AGF-FFS, TOT and TOS sessions, as follow-up of 'Rodent Population Dynamics: A Group Dynamics Exercise As Well' topic; and
- When farmers want to learn innovative community-based integrated rodent management (IRM) options for their agroforestry crops.

BACKGROUND AND RATIONALE

Rodents concentrate in adjoining grass and other covers following cultivation. Rapid movements into crop field are enhanced with more plant and weed cover, more so in presence of greening corn or leafy and fruit vegetables grown with agroforestry crops. Enhanced reproduction also occurs under these conditions[122].

As previously discussed, effective rodent management requires a community-based effort. Past experiences indicate that a number of cultural management practices can be incorporated in a community-based management approach[123] to effectively regulate rodent population in agroforestry fields, such as:

Physical methods:

- *Blanket system* is probably the most popular removal process. It involves driving rodents into a central grass trap where they are eventually killed. It offers a direct estimate of animal population given a required sample size. Removal process is comparatively fast and effective particularly when used selectively in preferred harborages or against probable bait-shy population. Community-based actions, which employ men, work animals, and tractor-drawn cultivators are necessary.

- *Burrow excavation* or *digging* is preferred over use of fumigants, flames, or water to dislodge occupants. However, this method may result to a high rate of escape and more often is not cost-effective due to difference in percent occupancy.

121 Adapted from Callo, Jr. D.P., A.G. Castillo, and C.A. Baniqued (eds). 2001. Field Guide of Discovery-based Exercises for Corn Production. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp360-362.

122 PGCPP. 1987. Pocket Reference Manual on Integrated Pest Management in Corn. Philippine-German Crop Protection Programme (PGCPP), Bureau of Plant Industry (BPI), manila, Philippines. pp60-63.

123 Sumangil, J.P. 1990. Control of ricefield rats in the Philippines. In Quick, G.R. (ed). 1990. Rodents and Rice. Report and Proceedings of an Expert Panel Meeting on Rice Rodent Control held on 10-14 September 1990 at international Rice Research Institute, Los Baños, Laguna, Philippines. pp35-48.

- *Others*, such as use of traps, deep trenches, barriers, and other auxiliary methods may also be used as a matter of choice.

Biological Methods:

- *Predation*. Gras owls, black-winged kites, and leopard cats are considered as primary rodent predators. Most other wild cats, including feral forms, are secondary rat feeders along with monitor, lizards, and snakes.

- *Habitat manipulation*. A practical approach to pest management would be to modify habitat to make it unsuitable for occupancy.

Integrated Rodent Management:

- A community-based integrated rodent management (IRM) approach is the most effective and efficient way to deal with rodent problems. This approach may include a combination of following:

- A rat damage assessment procedure for pest monitoring, whose index can be transformed to crop loss estimate;

- A large body of reduction control procedures and management strategies involving physical and biological means;

- A body of organized farmers and extension workers from local government units (LGUs) and non-government organizations (NGOs); and

- A body of legislations, instructions, and related administrative set-ups responsible for organization and implementation of rodent management at various levels of undertakings (e.g., national down to village levels).

However, for everyone to be effective, they must also learn to identify presence of rodents and their runways, understand rodent burrow structures, and suggest practical management strategies. Sharing of experiences among participants is very important in understanding rodent occurrences in different agroforestry areas. In this exercise, these shared experiences will be critically analyzed and used in coming up with community-based rodent management options or strategies.

How long will this exercise take?

- Thirty minutes to one-hour field walks, observations, interaction with farmers, and hands-on to identify presence of rats and prepare, construct, and install rat traps and baiting stations;
- Thirty minutes to one-hour and brainstorming session to design rodent management strategies;
- Ten to fifteen minutes follow-up activities every week to refine rodent management strategies designed earlier; and
- Another hour to assess effectiveness of developed rodent management strategies towards end of season and developing a community-based integrated rodent management approach based on a season-long experience.

Learning objectives

- To create awareness and understanding among participants on value of a community-based rodent management undertaking for profitable growing of agroforestry crops;
- To learn how to identify presence of rats and to prepare, construct, and install rat traps and baiting stations; and
- To learn how to design, refine, and assess innovative community-based management approaches for growing agroforestry crops.

Materials

- Agroforestry crops (e.g., agricultural crops as well as fruit and forest trees) in learning and adjoining field showing early infestation signs of rodents;
- Manila papers, notebooks, ball pens, marking pens, and crayons; and
- Other materials (e.g., bamboo, bolo, handsaw, plastic pail, spade, sacks, bait materials).

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe as many agroforestry crops with early infestation signs of rats in learning and adjoining fields. Take note of signs of gnawing, nibbling, cut seedlings, and damaged plant parts (e.g., flowers, pods, fruits, roots, tubers, etc.) and

presence of runways and burrows in field. Interview other farmers, if necessary. List down all observations related to the following:

- ☑ Crops grown and crop stand;
- ☑ Signs of rat damages on plants and plant parts;
- ☑ Presence of runways, burrows, footprints, and feces; and
- ☑ Management strategies employed by farmers, if any.

2. Go back to processing area; brainstorm in small groups and present output to big group.

3. Conduct participatory discussions to allow sharing of experiences among participants and facilitators. Motivate farmers to share experiences on how to identify presence of rats and prepare, construct, and install rat traps and baiting stations as well as employ rodent management strategies in their agroforestry fields.

4. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

5. Facilitate farmers to do hands-on exercises to identify presence of rats and prepare, construct, and install rat traps and baiting stations as well as employ rodent management strategies in their agroforestry learning and adjoining fields by improving procedures given below:

   - ☑ Each small group should prepare rodent baits, construct two rodent baiting stations and install them in strategic areas in learning and adjoining fields;
   - ☑ Each small group should do hands-on around learning and adjoining fields on:

     a) identifying presence of rats by their runways, live burrows, and others;
     b) digging live rodent burrows to understand their structures; and
     c) catching live rodents from burrows.

   - ☑ Return to session hall and process activity. Provide guide questions based on field observations and interactions with farmers, which each small group should answer and report to big group for critiquing;
   - ☑ Conduct a participatory discussion in a big group to design appropriate rodent management options;
   - ☑ Elicit community participation and implement designed rodent management options in learning and adjoining fields;

- ☑ Regularly assess, modify, or refine designed management options for current cropping season; and
- ☑ Redesign a more innovative community-based rodent management strategy based on a season-long experience for implementation by farmers in their community in succeeding cropping seasons.

Some suggested questions for processing discussion

- ❑ As reported by foresters, Bayawan City of Negros Oriental has a rodent damage index which ranges from 5 to 17 percent last cropping season. Draw up your management plan to protect next cropping from ravages of rodents. What can be done instead of using acute poison?
- ❑ Presently, another city, Tagum City of Davao Norte, has a rodent outbreak. A neighboring municipality, Compostela, has a damage index which ranges from 0.1 to 1.2 percent. What are your indicators that there is an impending outbreak in latter city? What are your suggestions to protect agroforestry crops in said city?
- ❑ Other provinces, Bukidnon and Misamis Oriental, have an endemic rodent problem. What are your suggestions to contain such a problem or lessen rodent population build-up?
- ❑ There is a confusion identification of rodents in Bayawan City. Some said they are *Rattus rattus mindanensis* and *Rattus exulans*. Others said that *R. norvegicus* and *Rattus argentiventer* ravaged their agroforestry crops. Due to this confusion, a Regional Executive Director ordered a group to identify these species. How will they identify those rodent species by their physical appearance?
- ❑ Based on field observations, draw up and explain your rodent management strategy for your respective AGF-FFS, TOT, and TOS learning fields. Include appropriate cultural management practices shared by farmers in your locality.
- ❑ What stages of agroforestry crops are most susceptible to rodent damage? Why is this so?

INTEGRATED PLANT DISEASE MANAGEMENT

A plant disease is defined as any physiological disturbance brought about by a pathogen or environmental factor that prevents normal development of a plant resulting to changes in its appearance and reduction of its economic value. Plant diseases are caused either by infectious or biotic factors, or non-infectious or abiotic factors. Plant diseases that are caused by infectious or biotic factors usually occur when: (a) *pathogen* is highly virulent, in high inoculums density, or not in equilibrium with antagonists; (b) *environment* is relatively more favorable to pathogen than to host plant and/or antagonists; and (c) *host plant* is genetically homogenous, highly susceptible, and continuously or extensively grown.

Plant disease management in agroforestry crops production consists mainly of integrating various mechanical or physical (e.g., heat treatment, flooding, rouging of diseased plants or pruning of infected plant parts), cultural (e.g., crop rotation, trellising) as well as biological (e.g., use of microbial antagonists, use of resistant varieties, bio-fumigation) control methods[124]. Thus, this sub-section includes exercises dealing on these control methods. In addition to exercises crafted by IPM facilitators and specialists during a *Write-shop to Develop A Field Guide of Discovery-based Exercises for FFS of IPM on Organic Vegetable Farming* conducted in 17-19 June 2008 and a recent *Write-shop on Field Guide of Discovery-based Exercises on FFS for Agroforestry* held on 13-15 January 2009, this section adapted a number of applicable exercises from *Field Guide of Discovery Exercises for Vegetable IPM (Volume II)*[125].

In a previous refresher course[126] mentioned earlier, field walks, observations and collection of diseases and physiological disorders of upland vegetables, such as crucifers (e.g., cabbage and cauliflower), parsley (e.g., carrot and celery), legumes (e.g., snap bean and garden pea), cucurbits (e.g., cucumber, chayote, and zucchini), and solanaceous vegetables (e.g., potato, tomato and bell pepper), were similarly agreed upon by participants as initial step in field diagnosis of upland vegetable diseases. This will be followed by sorting and identification of collected specimens by participants in small groups and validation with technical experts in a big group session. Again, participants together with technical experts should summarize outputs of said session by coming up with a list of most distinguishing characteristics for field identification of upland vegetable diseases[127] and physiological disorders[128] as follows:

124 Bayot, R.G. 2008. Diseases Management in Organic Vegetable Production. Power Point Presentation during the Workshop On Designing Farmer Field School Curriculum on Integrated Pest Management for Organic vegetable Production held at the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Department of Science and Technology, Los Baños, Laguna, Philippines on 28-30 April 2008. Slides 1-31.

125 Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. 366p.

126 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp15-22.

127 Milagrosa, S.P. 1998. As cited in: Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. 366p.

128 Balaki, E.T. 1998. As cited in: Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. 366p.

- *Virus Diseases.* The general symptoms are: (a) leaf discoloration, (b) stunting, (c) leaf rolling or twisting, and (d) vein clearing;

- *Bacterial Diseases***.** The most common symptoms are: (a) maceration or disintegration of tissues, (b) 'water-soaked' appearance, and (c) 'foul' odor;

- *Fungal Diseases.* The general symptoms are presence of: (a) 'cottony-like' and (b) 'dry' appearances (e.g., leaf spots) of infected plant parts;

- *Nematodes (or the 'unseen enemy').* The general symptoms are: (a) yellowing, (b) stunting, (c) root necrosis (e.g., lesions on the roots), and (d) swelling of the roots or gall formation in the root system (in contrast to nodules which are formed outside root system); and

- *Physiological Disorders.* The usual symptoms are malformations caused by: (a) non-infectious organisms, (b) nutrient deficiencies or toxicities, and (c) chemical injuries or toxic residues.

Exercise No. 6.08[129]

> **When is this exercise most appropriate?**
>
> - During AGF-FFS, TOT, and TOS sessions as starting activity of an 'Integrated Disease Management' topic; and
> - When farmers want to learn how diseases of agroforestry crops develop.

DISEASE TRIANGLE RELATIONSHIP: UNDERSTANDING SPREAD OF PLANT DISEASES IN AGROFORESTRY CROPS

BACKGROUND AND RATIONALE

Disease is a function of host, pathogen, and environment; all are components of a disease triangle. Disease triangle is based on an equivalence theorem, which states that effect of environment, pathogen, and host can each be translated into terms of epidemic rate parameter. A result is that changes in anyone of disease triangle components (e.g., from a more to less susceptible host, from a favorable to an unfavorable environment, or from a more aggressive to a less aggressive pathogen) all have an equivalent effect on an epidemic. Therefore, it is not surprising that disease management is centered on this equivalence theorem and that much disease predictive systems are based on one or more components of a disease triangle[130].

For participants to effectively manage common diseases of upland vegetables and other agroforestry crops, they must develop a conceptual definition of a disease. The concept of a disease and factors associated with their occurrence are important tools in developing management strategies for diseases. As a way of synthesizing results of a disease triangle exercise, role-playing may be conducted. This method will allow facilitators to gauge how deep participants' understanding is of initial participatory discussion on plant diseases topics. Similarly, this activity will provide participants an opportunity to clear some gray areas or misconceptions about previously mentioned equivalence theorem.

In AGF-FFS, this activity is aimed at developing farmers' basic knowledge on diseases and their occurrences as affected by components of a disease triangle. This exercise was developed to serve this purpose.

How long will the exercise take?

- Thirty minutes to one-hour field walk observation and simulation exercise; and
- Thirty minutes to one hour brainstorming session.

129 Adapted from Callo, Jr. D.P., A.G. Castillo, and C.A. Baniqued (eds). 2001. Field Guide of Discovery-based Exercises for Corn Production. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Laguna, Philippines. pp360-362. pp380-383.

130 Johnson, K.B. 1987. The role of predictive system in disease management. In: Teng, P.S. (ed). 1987. Crop Loss Assessment and Pest Management. The American Phytopathological Society, Minnesota, U.S.A. pp176-190.

Learning objectives

- To develop a conceptual definition of a plant disease by individually sharing ideas and experiences among participants and facilitators;
- To make participants aware and appreciate interrelations of environment, pathogen, and host in development of forestry crops diseases; and
- To improve farmers' decision-making skills through better understanding of disease triangle equivalence theorem.

Materials

- Agroforestry fields with standing agroforestry crops (e.g., agricultural crops as well as fruit and forestry trees) that are infected with diseases;
- Manila paper, masking tape, stapler, crayon, marking pens, record book, pen, and chalks; and
- Other materials (e.g., plastic bags and plant disease samples).

Methodology

- Field walks, role-playing, and brainstorming

Steps

<u>For Field Walks and Brainstorming Exercises</u>:

1. Start exercise by conducting field walks and observations in agroforestry fields with standing agroforestry crops (e.g., agricultural crops as well as fruit and forestry trees) that are infected with diseases. Ask participants to undertake the following:

   ☑ Each small group collects diseased agroforestry crops in learning and adjoining fields;
   ☑ Note down crop stand and factors in surroundings that may have favored occurrence of diseases in agroforestry learning and adjoining fields;
   ☑ List down all observations related to spread of diseases among plants within a field and between agroforestry fields; and
   ☑ Return to session hall or shade and process observations in small groups.

2. Formulate and distribute discussion guide questions for each small group to answer based on their field observations;

3. Each small group presents and discusses answers to guide questions in big group;

4. Facilitators integrate and summarize outputs;

5. Ask participants to go to a barren field and request for one volunteer to broadcast any available powder material evenly on soil surface of a barren field. Ask other participants to observe how powder material is distributed in a barren field. Let all participants walk over an area and observe what happened to applied powder material as they walk around;

6. Parallel simulation exercise with disease transport mechanisms in an agroforestry field observed with standing agroforestry crops that are infected with diseases, such as:

   ☑ Bacteria get around by water;
   ☑ Fungi get around by wind;
   ☑ Viruses get around by insects; and
   ☑ Nematodes get around by dirt.

7. Process activity by brainstorming and participatory sharing of experiences among participants and facilitators; and

8. Summarize and synthesize all learning experiences shared. Draw up conclusions and recommendations from this exercise.

<u>For Role-playing</u>:

9. Get eight volunteers to do a role-play:

   ☑ Prepare labels for every role of volunteers;
   ☑ Do role-play showing possible effects and reactions of different actors in disease development; and
   ☑ Process observations in small groups and present to big group.

10. Process activity by brainstorming and participatory sharing of experiences among participants and facilitators; and

11. Summarize and synthesize all learning experiences shared. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- What is a plant disease? Give examples of specific diseases of agroforestry crops (e.g., agricultural crops as well as fruit and forestry trees).
- Are signs and symptoms of plant diseases the same? Defend your answer by giving examples.
- Can a disease occur if there are susceptible host, aggressive pathogens, and unfavorable environment?
- Is man a factor in severity or development of a disease? Support your answer.
- Can you consider physiological disorder a disease? Explain.
- What factors enhance development of a plant disease? Why?
- Can a disease occur in absence of any one of these factors? Explain.
- How do climatic factors affect disease development?

Exercise No. 6.09[131]

SIMULATION EXERCISE: UNDERSTANDING DISEASE TRANSPORT IN AGROFORESTRY CROPS

When is this exercise most appropriate?

- During AGF-FFS, TOT, and TOS sessions as component of 'Integrated Disease Management' topic; and
- When farmers want to learn how agroforestry crops diseases are transported from one place to another.

BACKGROUND AND RATIONALE

Plant pathogens are very minute disease-causing microorganisms that reduce the aesthetic value, quality, and yield of infected agroforestry crops. Unlike insect pests, which normally move using their appendages (e.g., wings, legs, etc.), microorganisms are transported mainly through mechanical means from one place to another. Thus, disease transport can be accomplished by any of the following means: (a) carried from source by wind or water, (b) transported from source by clinging to anything it came in contact with, or (c) transferred by man and animals directly from source to another point either intentionally or accidentally.

Clearly, diseases do not just occur. They consist of a sequence of various stages during the course of their development, a succession of events or modifications, and one usually leading to another. These living and non-living things play an important role in the dissemination of diseases. However, these agents have their own way of transporting a disease[132].

In AGF-FFSs, farmers can better understand mechanisms of disease transport through field walks, observations, simulation exercise and participatory sharing of experiences among them and facilitators. This exercise was developed to serve this purpose.

How long will the exercise take?

- Thirty minutes to one-hour field walk observation and simulation exercise; and
- Thirty minutes to one hour brainstorming session.

131 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp218-220.

132 IIBC. 1996. Integrated Pest Management for Highland Vegetables, Volume 4: Training Guide for Participatory Action Towards Discovery Learning. International Institute for Biological Control, BPI Compound, Baguio City, Philippines. pp113.

Learning objectives

- To make participants aware of and appreciate the different disease transport mechanisms in agroforestry fields; and
- To improve farmers' decision-making skills through better understanding of these different disease transport mechanisms.

Materials

- Agroforestry fields with standing crops that are infected with diseases;
- Flour, rice bran, lime or any non-toxic white powder substance that is cheap and locally available; and
- Barren field (e.g., probably dry and not so weedy).

Methodology

- Field walks, simulation exercise, and brainstorming

Steps

1. Start exercise by conducting field walks and observations in agroforestry fields with standing crops that are infected with diseases. List down all observations related to spread of diseases among plants within a field and between vegetable fields.

2. Ask participants to go to a barren field and request for one volunteer to broadcast any available powder material evenly on soil surface of a barren field. Ask other participants to observe how powder material is distributed in a barren field. Let all participants walk over an area and observe what happened to applied powder material as they walk around.

3. Parallel simulation exercise with disease transport mechanisms in agroforestry field observed with standing crops that are infected with diseases, such as:

   ☑ Bacteria get around by water;
   ☑ Fungi get around by wind;
   ☑ Viruses get around by insects; and
   ☑ Nematodes get around by dirt.

4. Process activity by brainstorming and participatory sharing of experiences among participants and facilitators.

5. Summarize and synthesize all learning experiences shared. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ What part of your body was contaminated with white powder material when you walked over a field? How did white powder material contaminate your body?
- ❑ Did the white powder material applied in a field move to other areas? How?
- ❑ Did the white powder material that contaminated your body move to other bodies or areas as you walked in a field? How?
- ❑ Were there still white powder materials left in your body after leaving a field? Where did the white powder material go? How?
- ❑ Do you think agroforestry crop diseases can be transported in the same way? What made you think so?
- ❑ Can farm tools transport agroforestry crop diseases to other areas? Do you know of other means by which agroforestry crops diseases can be transported to other places?
- ❑ Can we manage agroforestry crop diseases by knowing how they are transported to other places? How?
- ❑ What practical cultural management practices can you suggest that will avoid transport of agroforestry crop diseases from one place to another?

Exercise No. 6.10[133]

SAP TRANSMISSION TECHNIQUE: UNDERSTANDING HOW VIRUS DISEASES ARE TRANSMITTED IN VEGETABLES GROWN IN AGROFORESTRY FIELDS

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, when first signs or symptoms of virus disease infection are observed in agroforestry learning and adjoining fields; and
- When farmers want to learn practical techniques to accurately identify and understand virus disease transmission in their vegetable crops grown in agroforestry fields.

BACKGROUND AND RATIONALE

Virus diseases are most difficult to manage in vegetable production. Either one or a combination of the following usually transmits them: (a) direct mechanical contact, (b) aid of insect victors, or (c) other carriers. Strong winds and rains, as well as action of man who tends his agroforestry crops regularly and other animals harboring around these crops may cause direct mechanical transmission of virus diseases. Symptoms of some virus diseases may also appear similar to those suffering from physiological and nutritional disorders.

In AGF-FFS, farmers will need practical techniques that will ensure accurate disease identification and understanding of virus disease transmission in their own fields. Thus, this simple exercise was designed to enable participants to address this particular concern.

How long will this exercise take?

- Thirty minutes to one hour for field walks, observations, and collection of suspected virus-infected vegetables in agroforestry learning and adjoining field;
- Thirty minutes to one hour brainstorming session and setting-up of exercise in processing area; and
- Fifteen to 30 minutes consecutive weekly observations and processing after setting-up this exercise.

Learning objectives

- To make participants aware and understand how accurate virus disease identification and transmission lead to better management in their own farms; and
- To learn through hands-on and direct observations how virus diseases are transmitted in vegetables by mechanical means.

133 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp 226-228.

Materials

- Vegetables grown in agroforestry fields where signs and symptoms of virus infections can be observed;
- Mortar and pestle (can be improvised), suspected virus infected and healthy test-plants, hand-sprayer and sandpaper); and
- Other office supplies (e.g., Manila papers, notebooks, ball pens, and marking pens).

Methodology

- Field walks, hands-on and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe and collect healthy and suspected virus infected plants or plant parts in agroforestry learning and adjoining fields. Interview other farmers, if necessary. List down all observations related to signs and symptoms (e.g., rosetting, curling, mosaic appearance, etc.), pest and disease occurrence, kind of crops planted, crop stand, etc.

2. Go back to processing area and set-up this exercise by performing the following activities:

   ☑ Pound suspected virus-infected plants and extract juice or sap;
   ☑ Create artificial mechanical damage by rubbing sandpaper on leaves of healthy test-plants (e.g., same crop species, or any seedlings of other crop species);
   ☑ Spray or rub extracted sap or juice on damaged and undamaged leaves of healthy test-plants; and
   ☑ Observe and take note of physical changes on test-plants after 14-21 days.

3. Brainstorm in small groups and present output to the big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators.

4. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

❑ What vegetables grown with other agroforestry crops did you observe showing symptoms of virus infections?

- ❑ Were there differences in symptoms exhibited by different agroforestry crops you observed?
- ❑ Did you observe same symptoms in test-plants after one week, two weeks, and three weeks? Were you convinced that virus diseases could be transmitted through mechanical means?
- ❑ What are the other means by which virus diseases can be transmitted in vegetables and other agroforestry crops?
- ❑ What is the importance of knowing how virus diseases are transmitted in vegetables and other agroforestry crops?
- ❑ What practical management strategies can you design after knowing virus diseases transmission mechanism?

Exercise No. 6.11[134]

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, when there are early symptoms of leaf diseases on agroforestry crops in learning and adjoining fields; and
- When farmers want to learn innovative practices of leaf removal and disposal from others as a management strategy against leaf diseases of agroforestry crops.

LEAF REMOVAL AND PROPER DISPOSAL AS A DISEASE MANAGEMENT STRATEGY AGAINST LEAF DISEASES OF AGROFORESTRY CROPS

BACKGROUND AND RATIONALE

In certain instances, removal of entire plants in field to control diseases is unnecessary. Simply removing and disposing properly diseased foliage of vegetable crops can achieve satisfactory control[135]. For instance, lower leaves of snap bean and garden pea are removed and burned to control powdery mildew and bean rust. Potato foliage affected with late blight is dehaulmed and destroyed by burning to prevent inoculums from reaching tubers. Farmers, as an effective management approach against purple blotch disease, report removal and proper disposal of outermost fungus-infected leaves of green onion and leek.

In many FFSs conducted in Benguet and Mountain Province, leaf removal is normally shared as a common practice of upland farmers in managing moderate leaf disease infections in their vegetable farms. It is their experience that removal of infected leaves at earlier stage of disease development can effectively prevent spread of these diseases to other plants or plant parts. This exercise was designed so those farmers can share their best experiences in employing leaf removal and their proper disposal as a management strategy against leaf diseases of agroforestry crops.

How long will this exercise take?

- Thirty minutes to one-hour field walks, observations, and interaction with farmers and hands-on in agroforestry learning field; and
- Thirty minutes brainstorming session in processing area.

134 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp247-249.

135 Quebral, F.C. 1988. What one should know about plant diseases. University of the Philippines Los Baños, College, Laguna, Philippines. pp18-20.

Learning objectives

- To make participants aware of and understand the role of early leaf removal and disposal as a management strategy against leaf diseases of agroforestry crops; and
- To learn and do hands-on of proper leaf removal and disposal as a management strategy against leaf diseases of agroforestry crops.

Materials

- Office supplies (e.g., notebooks, ball pens, marking pens, crayons, Manila papers);
- Agroforestry crops showing early symptoms of leaf diseases in learning and adjoining fields; and
- Other supplies (e.g., pruning shear, knife, or scythe).

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe agroforestry crops showing early symptoms of leaf diseases in learning and adjoining fields. Take note of cultural practices employed. Interview other farmers, if necessary. List down all observations related to disease occurrence, degree of infection, and characteristic symptoms, etc.

2. Go back to processing area, brainstorm in small groups and present output to the big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in managing leaf diseases of agroforestry crops. Develop an improved procedure of leaf removal and proper disposal as a management strategy for leaf diseases of:

   ☑ Powdery mildew and bean rust of legumes;
   ☑ Early and late blight of potato; and
   ☑ Purple blotch of green onion and leek.

3. Facilitate each farmer to do hands-on of leaf removal when early infection of leaf diseases is observed in learning field by improving the procedure below:

- ☑ Determine if there are early symptoms of leaf diseases in learning field;
- ☑ If there are early symptoms, remove all disease-infected leaves;
- ☑ Dispose off all foliage removed and other plant debris properly; and
- ☑ Take note of all relevant observations and experiences during the activity.

4. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe agroforestry crops showing early symptoms of leaf diseases in learning and adjoining fields?
- ❑ Did you observe any farmer practicing leaf removal to control early infection of leaf diseases in the field?
- ❑ What leaf diseases can be effectively controlled by leaf removal? Is leaf removal applicable to all agroforestry crops with leaf diseases? When is the best time to do leaf removal to control leaf diseases?
- ❑ Did you observe any innovative practices by farmers in leaf removal to control leaf diseases of agroforestry crops?
- ❑ Did you observe lesser degree of disease infection when leaf removal was practiced to control leaf diseases?
- ❑ What other cultural management options can you use to complement leaf removal as a control strategy against leaf diseases of agroforestry crops?

Exercise No. 6.12[136]

UPROOTING AND PROPER DISPOSAL AS A MANAGEMENT STRATEGY AGAINST TYMO VIRUS DISEASE OF CHAYOTE GROWN IN AGROFORESTRY FIELDS

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, when early symptoms of *tymo* virus disease are observed on chayote planted in learning and adjoining fields; and
- When upland farmers want to learn from other farmers proper uprooting and disposal of chayote plants infected with *tymo* virus disease.

BACKGROUND AND RATIONALE

The most common symptoms and effects exhibited by chayote plant with *tymo* virus disease are overgrowths, stunting, yellowing, curling, and mottling. Collectively, these symptoms are locally known as *ag-parparya* or *parparya*. The *tymo* virus disease is very infectious and can be transmitted easily from diseased to healthy plants by mere contact or by animals, men, and machines. It is also suspected that *tymo* virus can be spread by some insects.

Uprooting or removal of entire disease plant is one common control measure. Diseased plants are systematically removed from a plant population in order to reduce the amount of inoculum to which chayote crop will be exposed. Uprooting is a very sound practice in disease management, particularly when *tymo* virus disease is just starting to build up. In severe cases, complete destruction or uprooting of entire chayote population is an effective way of eradicating *tymo* virus disease[137]. In highlands, some chayote farmers practice uprooting *tymo* virus-infected plants in their fields. Unfortunately, they lack knowledge on the proper disposal of uprooted infected plants. Many upland farmers, however, know that uprooting and proper disposal of virus-infected plants is the most practical and effective management strategy against *tymo* virus disease.

Through time, upland farmers who are more enterprising in the Cordilleras had developed more effective strategies that can complement uprooting and proper disposal for better *tymo* virus disease management. Through participatory, discovery-based, and experiential learning approaches in AGF-FFS, these strategies can be further improved. The foregoing exercise was designed to achieve this purpose.

136 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp250-252.

137 Quebral, F.C. 1988. What one should know about plant diseases. University of the Philippines Los Baños, College, Laguna, Philippines. pp18-20.

How long will this exercise take?

- Thirty minutes to one hour for field walks and observations of proper uprooting and disposal of chayote plants infected with *tymo* virus disease in agroforestry learning and adjoining fields; and
- Thirty minutes to one hour for brainstorming session in processing area.

Learning objectives

- To make participants aware of and understand the role of proper uprooting and disposal in management of *tymo* virus disease of chayote; and
- To learn from other farmers proper uprooting and disposal in management of *tymo* virus disease of chayote.

Materials

- Agroforestry fields showing early symptoms of *tymo* virus disease on chayote planted in learning and adjoining fields;
- Office supplies (e.g., Manila papers, notebooks, ball pens, and marking pens); and
- Other supplies (e.g., plastic bags, cutting, and digging tools, basket, match or lighter, etc.).

Methodology

- Field walks and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe *tymo* virus-infected chayote plants in agroforestry learning and adjoining fields. Interview other farmers, if necessary. List down all observations related to:

   ☑ Varieties or cultivars of chayote planted;
   ☑ Degree of *tymo* virus disease infection of varieties or cultivars; and
   ☑ Cultural management practices employed (e.g., uprooting, pruning, leaf removal, disposal of crop residues, etc.)

2. Go back to processing area. Brainstorm in small groups and present outputs to the big group.

3. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. Motivate farmers to share their best experiences in proper uprooting and disposal to manage the *tymo* virus disease of chayote.

4. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

5. Facilitate farmers to do hands-on of proper uprooting and disposal to manage *tymo* virus disease of chayote when early symptoms are observed in ago-forestry learning field by improving procedures given below:

   - ☑ Look for *tymo* virus-infected vines and trace downward to base of plant;
   - ☑ Dig and uproot plants with *tymo* virus-infected vines;
   - ☑ Place uprooted plants in a plastic bag or any suitable container;
   - ☑ Dispose and burn *tymo* virus-infected plants in a pit;
   - ☑ Repeat process as often as necessary or as disease symptoms are observed in learning field; and
   - ☑ Take note of all relevant observations and experiences during this activity.

Some suggested questions for processing discussion

- ❑ Did you observe *tymo* virus-infected chayote plants in agroforestry fields? What symptoms did you observe on chayote plants infected with *tymo* virus disease?
- ❑ What chayote varieties or cultivars were more resistant to *tymo* virus disease? What chayote varieties or cultivars were more susceptible to *tymo* virus disease?
- ❑ What sanitation practices did upland farmers commonly employ against *tymo* virus disease of chayote?
- ❑ Did farmers employ uprooting of *tymo* virus–infected chayote plants? Did farmers properly dispose uprooted *tymo* virus–infected chayote plants? How?
- ❑ Did you see different degree of infections in chayote fields where uprooting and no uprooting of *tymo* virus-infected plants were done? Did you observe any innovative sanitation practices employed by farmers? What were these practices?
- ❑ What other cultural management practices can complement proper uprooting and disposal of *tymo* virus-infected chayote fields?

Exercise No. 6.13[138]

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, as component of topic on 'Integrated Disease Management'; and
- When farmers want to learn from others some innovative practices in using beneficial soil microorganisms for management of vegetable diseases in their own agroforestry fields.

USE OF BENEFICIAL MICROORGANISMS IN MANAGING SOIL-BORNE DISEASES OF AGROFORESTRY CROPS

BACKGROUND AND RATIONALE

Man has become aware of the advantages of working with nature rather than against it. Since then, use of natural enemies and antagonist of crop pathogens, generally called biological control (bio-con) agents, for plant diseases and pest management had gained popularity worldwide. The widely quoted and accepted definition of biological control of plant diseases is 'reduction in amount of inoculums or disease-producing activity of a pathogen accomplished by or through one or more organisms'[139].

In soil, many microorganisms live in close proximity and they interact in a unique way. The use of beneficial soil microorganisms for biological control of soil-borne plant pathogens is possible only if such interactions between species as competition, antibiosis (amensalism), and parasitism or predation occur. *Competition* is a condition where there is suppression of one organism as two species struggle for limiting quantities of nutrients, oxygen, or other common requirements. *Antibiosis* or *Amensalism*, on the other hand, occurs when one species is suppressed while a second is not affected, typically a result of toxin production, while *parasitism* or *predation* refers to direct attack of one organism on another[140].

In agroforestry crops production, use of a soil fungus, *Paecilomyces lilacinus* (commercially known as BIO-ACT) as parasite of *Meloidogyne incognita* (root knot nematode) or as competitor of another soil fungus, *Plasmodiophora brassica* (clubroot), is a typical example of a beneficial microorganism used to control a harmful microorganism[141]. Such practices as soil incorporation of guano and organic matters to increase soil pH will drastically reduce population of harmful soil microorganisms in favor of beneficial ones[142]. In AGF-FFSs,

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138 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp253-255.

139 Sinohin, A.M. and V.C. Cuevas. 2005. Biological control of damping-off pathogens of tomato. Paper presented during a Workshop on Integrated Production and Pest Management in Processing Tomato: Issues and Prospects held on July 2005 at Laoag City, Ilocos Norte, Philippines. 8p.

140 Alexander, M. 1977. Introduction to soil microbiology. 2nd Edition. John Wiley and Sons, Inc., New York, USA. pp405-437.

141 Davide, R.G. 1990. Biological control of plant pathogens: progress and constraints in the Philippines. Phil. Phytopath. 26:pp1-7.

142 Callo, Jr. D.P. 1993. Recent Development on the Utilization of Soil Microorganisms for Biological Control of Plant Pathogens. Term paper submitted in partial fulfillment of the requirements for Advance Soil Microbiology, Institute of Graduate School, Gregorio Araneta University Foundation, Malabon City, Philippines. pp11-12.

some innovative farmers can share their experiences in using useful soil microorganisms to improve current practices in managing soil-borne diseases of agroforestry crops. This exercise is meant to address this particular concern.

How long will this exercise take?

- Thirty minutes to one hour field walks, farmer interviews, and observations of crops where beneficial soil microorganisms were used for plant diseases management of agroforestry crops; and
- Thirty minutes to one hour role-playing and brainstorming session in processing area.

Learning objectives

- To make participants aware of and understand the importance of beneficial soil microorganisms for plant diseases management of agroforestry crops; and
- To learn from other farmers some innovative practices in using beneficial soil microorganisms for plant diseases management of agroforestry crops.

Materials

- Agroforestry crops grown in adjoining fields of learning field where beneficial soil microorganisms are used to manage plant diseases; and
- Office supplies (e.g., Manila papers, notebooks, ball pens, and marking pens).

Methodology

- Field walks, role-playing, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe agroforestry crops where beneficial soil microorganisms were used to manage plant diseases. Interview other farmers, if necessary. List down all observations related to pest and disease occurrence, kind of crops planted, crop stand, etc.

2. Go back to processing area, brainstorm in small groups and present output to the big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. As a wrap-up session, the following activities may be undertaken as an option:

- ☑ Post in processing area an illustration showing some beneficial and harmful soil microorganisms;
- ☑ Ask each small group to examine and familiarize themselves with appearance of microorganisms in illustration;
- ☑ Let each small group discuss among themselves and relate what they learn from field walks to what was depicted in illustration;
- ☑ Request each small group to role-play their impression of a beneficial and harmful soil microorganisms; and
- ☑ Process activity in big group.

3. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ What beneficial soil microorganisms did farmers use to manage plant diseases of agroforestry crops? Did you observe differences in crop stand, pest and disease occurrence, etc.?
- ❑ What is the most common beneficial soil microorganism used in an area? Why is this beneficial soil microorganism preferred over others?
- ❑ What benefits were derived from using beneficial soil microorganisms to manage plant diseases of agroforestry crops?
- ❑ What plant diseases can be managed by using beneficial soil microorganisms? When is the most appropriate time to use beneficial soil microorganisms to manage plant diseases of agroforestry crops?
- ❑ What innovations did you learn from other farmers in using beneficial soil microorganism to manage plant diseases of agroforestry crops?
- ❑ How did you feel doing a role-play? Did it help you understand the topic better? How?
- ❑ How do we conserve and enhance multiplication of beneficial soil microorganisms in our own farms?
- ❑ What other cultural management practices can complement use of beneficial soil microorganisms to manage plant diseases of agroforestry crops?

Exercise No. 6.14[143]

> **When is this exercise most appropriate?**
>
> - In AGF-FFS, TOT, and TOS sessions, at early vegetative stage and as component of topic on 'Integrated Disease Management'; and
> - When farmers want to learn how to prepare and use egg yolk + cooking oil (EYCO) for management of powdery and downy mildews in vegetables grown with other agroforestry crops.

PREPARATION AND USE OF EGG YOLK + COOKING OIL (EYCO) FOR MANAGEMENT OF POWDERY AND DOWNY MILDEWS OF VEGETABLES GROWN IN AGROFORESTRY FIELDS

Background and rationale

Powdery and downy mildews are serious fungal diseases infecting vegetative portions of many vegetables. White powdery and cottony growths are usually observed on infected plant parts. These diseases, more prevalent during high moisture conditions, are characterized as follow[144]:

- Powdery mildew, caused by *Erysiphe polygoni* D.C., appears as small, discrete, white moldy spots on upper surface of leaflets, which rapidly enlarge to an indefinite size until they coalesce. A light powdery white dirty-gray fungus growth later covers part of entire upper leaf surface, petioles, and young stems. Infected leaves gradually turn yellow, then brown, and die. This disease infects mostly solanaceous and cucurbit vegetables.

- Downy mildew, caused by *Pseudoperonospora cubensis* Rostow, appears as yellow spots on surface of leaves with a purplish downy-growth on lower surface. These yellow spots may soon turn reddish-brown and eventually kill leaves. If infected plants do not die, fruits may not mature and flavor is poor. This disease infects mainly legume and parsley vegetables.

Recently, control of mildews were found effective by spraying crops with various biological pesticides, which includes use of egg yolk + cooking oil (EYCO). This simple technology is widely adopted by Korean farmers for controlling various insect pests and improving plant health. The EYCO is simply made at home by manual or motor mixing of cooking oil and egg yolk. Cooking oil showed direct and indirect effects in control of plant pathogens and insect pests, while egg yolk served as natural emulsifier and biological fertilizer. In lettuce, seedling stands increased by over 70% and showed 89.6-96.3% control value when EYCO was applied against powdery mildew. This result is comparable to effect of applying a fungicide, Azoxystrobin.

143 Adapted from Callo, Jr., D.P., J.R. Medina, L.B. Teofilo, H.A. Tauli, and W.R. Cuaterno. 2002. Manual of Participatory Technology Development Activities for IPM in Vegetables. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp329-332.

144 Callo, Jr., D.P., J.R. Medina, L.B. Teofilo, H.A. Tauli, and W.R. Cuaterno. 2002. Manual of Participatory Technology Development Activities for IPM in Vegetables. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp380-386.

In AGF-FFS, such innovative experiences can be shared with farmers to improve their current practices in managing powdery and downy mildews in vegetables grown with other agroforestry crops. This exercise is meant to address this particular concern.

How long will this exercise take?

- Thirty minutes to one hour field walks, farmer interviews, and observations early vegetative stages of vegetables in agroforestry learning and adjoining fields infected with powdery and downy mildews;
- Thirty minutes to one hour hands-on on preparation and use of egg yolk + cooking oil (EYCO) for management of powdery and downy mildews in vegetables grown with other agroforestry crops; and
- Thirty minutes to one hour brainstorming session in processing area.

Learning objectives

- To make participants aware of and understand how to use egg yolk + cooking oil (EYCO) for management of powdery and downy mildews in vegetables grown with other agroforestry crops; and
- To learn some innovative practices in using egg yolk + cooking oil (EYCO) for management of powdery and downy mildews in vegetables grown with other agroforestry crops.

Materials

- Agroforestry learning and adjoining fields grown to vegetables infected with powdery or downy mildew at early vegetative stage;
- Farm implements (e.g., knapsack sprayer, mixer, cooking oil, poultry eggs, and others); and
- Office supplies (e.g., Manila papers, notebooks, ball pens, and marking pens).

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe agroforestry learning and adjoining fields grown with vegetables infected with powdery or downy mildew at early vegetative stage. Interview other farmers, if necessary. List down all observations related to pest and disease occurrence, kind of crops planted, crop stand, etc.

2. Go back to processing area, brainstorm in small groups and present output to the big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators. As a wrap-up session, agree in big group how to improve some procedures provided below:

   - ☑ Break eggs and separate yolks from white;
   - ☑ Macerate egg yolk with small amount of water for 3-4 minutes;
   - ☑ Put one (1) yolk to 60 mL cooking oil in container and mix thoroughly;
   - ☑ Allow emulsion to stand for 5 minutes before mixing it with water for spraying;
   - ☑ Mix 48 mL of EYCO emulsion to 16 L of water and spray to plants in early morning or late afternoon (e.g., not in heavy sunlight);
   - ☑ Prepare 0.3% solution for protective spray application or 0.5% solution for curative spray application; and
   - ☑ Monitor sprayed plants weekly (use marker in affected area for reference).

3. Go back to learning field and do hands-on on the preparation and use of egg yolk + cooking oil (EYCO) for management of powdery or downy mildews in vegetables grown with other agroforestry crops in small group.

4. Return to processing area, process output in small group, and share experiences and lessons learned to big group.

5. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ What vegetables grown with other agroforestry crops were infected with powdery or downy mildews? Did you observe differences in crop stand, disease severity, and others among different vegetables grown in agroforestry fields?
- ❑ What are the most common vegetables infected with powdery or downy mildews in nearby agroforestry areas?
- ❑ What benefits can be derived from using egg yolk + cooking oil (EYCO) for management of powdery or downy mildews in vegetables?
- ❑ When is the most appropriate time to use egg yolk + cooking oil (EYCO) for management of powdery or downy mildews in vegetables?
- ❑ What innovations did you learn from other farmers in using egg yolk + cooking oil (EYCO) for management of powdery or downy mildews in vegetables?

- ❑ How did you feel doing a hands-on? Was it practical? Can you improve procedure to make it easier for farmers to follow? How?
- ❑ What other cultural management practices can complement use of egg yolk + cooking oil (EYCO) for management of powdery or downy mildews in vegetables grown in agroforestry fields?

SIMULTANEOUS INSECT PEST AND DISEASE MANAGEMENT

A sub-section on simultaneous insect pest and disease management is incorporated in this field guide to highlight several discovery-based exercises, which simultaneously address management of both insect pest and plant disease problems in agroforestry crops production. All discovery-based exercises compiled under this sub-section are either new or additional exercises identified in a previous curriculum development workshops conducted in 1998[145] and 2008[146], respectively, which were validated by participants in a previous intensive one-month *Refresher Course for Trainers of Farmer Field Schools in IPM for Crucifers and Other Vegetables in the Cordilleras*[147] and in a recent three-day *Write-shop to Develop A Field Guide of Discovery-based Exercises for FFS of IPM on Organic Vegetable Farming*[148] held in 1998 and 2008, respectively. Many of these discovery-based exercises were adapted from *Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II*[149]. These exercises emphasize some fundamental principles of insect pest and disease management[150], such as:

- *Exclusion.* Exclusionary measures prevent a pest or pathogen from entering and becoming established in a non-infested or non-infected area. Measures include plant quarantine regulations, crop diversification, and use of certified pest- or disease-free seed materials.

- *Eradication.* This involves eliminating a pest or pathogen once it has become established on plant or in a cropping area. Non-chemical eradication measures include removing and destroying pest-infested or disease-infected materials and plant trash, leaf removal, pruning and crop rotation with non-susceptible crops.

- *Protection.* This is achieved through interposing a protective barrier between pest or pathogen and susceptible plant. One environment-friendly barrier is spraying soap solution in vegetables to avoid infestation of scale insects or infection of sooty mold.

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145 Binamira, J.S. 1998. A Consultant's Report: Curriculum Development for Trainers and Farmer Field Schools on IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp6-23.

146 Callo, Jr., D.P. 2008. Highlights of Outputs. Workshop on Designing Farmer Field School Curriculum on Integrated Pest Management For Organic Vegetable Production held on 28-30 April 2008 at the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development Council (PCARRD), Los Baños, Laguna, Philippines.

147 Binamira, J.S. 1998. A Consultant's Report: Refresher Course for Trainers of IPM in Crucifers and Other Highland Vegetable Crops. Cordillera Highland Agricultural Resources Management Project, Department of Agriculture, CAR Regional Field Unit, Baguio City, Philippines. pp15-22.

148 Callo, Jr., D.P. 2008. Highlights of Outputs. Write-shop to Develop A Field Guide of Discovery-based Exercises for FFS of IPM on Organic Vegetable Farming conducted in the Philippines on 17-19 June 2008 at the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development Council (PCARRD), Los Baños, Laguna, Philippines.

149 Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp 259-286.

150 Quebral, F.C. 1988. What one should know about plant diseases. University of the Philippines Los Baños, College, Laguna, Philippines. pp11-20.

- *Resistance.* This refers to development and use of cultivars that can thwart or impede activity of a pest or pathogen. Generally, resistance can be categorized as vertical or specific resistance, and horizontal or non-specific resistance. Vertical resistance is usually conferred by one or a few genes and is effective only against some biotypes or strains of pests or pathogens. Many genes control horizontal resistance and resistance is evenly spread against all biotypes or strains of pests or pathogens.

- *Therapy.* This refers to treatment of plants infested by a pest or infected by a pathogen. An example of non-chemical therapy is application of heat (hot or moist) to affected area or plant parts or materials. This inactivates or inhibits a pest in an infested area or a pathogen in an infected area or plant tissues.

- *Avoidance.* This tactic alters environment by making it less favorable to growth and development of a pest or pathogen. Examples include field sanitation measures such as leaf removal, and cultural practices, such as changing planting density, date of planting, date of harvesting, fertilization, liming, and irrigation.

Exercise No. 6.15[151]

HILLING-UP AS AN INSECT PEST AND PLANT DISEASE MANAGEMENT STRATEGY FOR AGROFORESTRY CROPS

BACKGROUND AND RATIONALE

Most upland farmers, particularly in the Cordilleras, practice hilling-up. Hilling-up is a cultural management practice where soil is cultivated and raised at base of plant primarily to enhance better root development, improve anchorage, and suppress growth of weeds. For most agroforestry crops, this operation is usually conducted a month after transplanting or immediately after second application of fertilizers, thereby ensuring its proper soil incorporation and its more efficient use by plants. For tuber crops, hilling-up is done to suppress growth of aerial tubers and prevent infestation of potato tuber moth and other pests[152].

Hilling-up also disturbs development of other soil-borne pests and exposes to sunlight many soil-borne plant pathogens that thrive near base of plants. Hence, this practice contributes largely to better pest and disease management. Hilling-up is useful only as a pest and disease management strategy if done at proper time. In AGF-FFSs, best practices in hilling-up can be shared among farmers by conducting field walks, hands-on, simulation exercises, and participatory discussion. This exercise was designed to address this particular concern.

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions as part of 'Other Cultural Management Practices in Agroforestry Crops Production' topic;
- When upland farmers want to learn improved practices from other farmers in hilling-up; and/or
- When hilling-up operation is to be conducted in agroforestry learning field.

For field walk and brainstorming exercise:

How long will this exercise take?

- Thirty minutes to one hour field walks, observations, and interaction with agroforestry farmers; and
- Thirty minutes to one hour brainstorming session in processing area.

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151 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp 264-268.

152 Balaki, E.T. 1998. As cited in: Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. 366p.

Learning objectives

- To make participants aware of and appreciate the role of hilling-up in management of agroforestry crop pests and diseases;
- To learn from other farmers the proper ways and the best time to do hilling-up of agroforestry crops; and
- To learn from other farmers other benefits derived from practicing hilling-up in agroforestry crops production.

Materials

- Office supplies (e.g., notebooks, ball pens, marking pens, crayons, Manila papers); and
- Hilled-up and not hilled-up vegetable plots or beds (e.g., crops should be more or less at same growth stages) in agroforestry learning field.

Methodology

- Field walks and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe as many hilled-up and not hilled-up plots or beds in an agroforestry field. Take note of different practices in hilling-up. Interview other upland farmers, if necessary. List down all observations related to pest and disease occurrence, crop stand, weed growth, soil moisture conditions, etc.

2. Go back to processing area, brainstorm in small groups and present output to big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators.

3. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

For hands-on and brainstorming exercise:

How long will this exercise take?

- One hour and 30 minutes for field walks and observations in agroforestry learning and adjoining fields; and
- Thirty minutes to one-hour hands-on and brainstorming session.

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, when agroforestry crops are about a month after planting or transplanting in learning field; and/or
- When farmers want to learn and understand how hilling-up can be used as a pest and disease management strategy in agroforestry crops production.

Learning objectives

- To make participants aware of and understand the role of hilling-up for pest and disease management in agroforestry crops production; and
- To learn and share with co-farmers appropriate skills in hilling-up operations for pest and disease management in agroforestry crops production.

Materials

- Office supplies (e.g., notebooks, pencils, ball pens, and marking pens);
- Field supplies and tools (e.g., fertilizer materials and grab hoe); and
- Adjoining and learning fields planted to one-month old agroforestry crops and ready for hilling-up operations.

Methodology

- Field walks, hands-on, and brainstorming

Steps

1. Divide big group into five small groups. Before hilling-up operation, each group should observe and record the crop stand, plant vigor, weeds present, pest and disease occurrence, etc., in agroforestry learning and adjoining fields. Each small group will then do hilling-up (e.g., hands-on) in half of the plots assigned to them in agroforestry learning field. The other half will not be hilled-up for comparison.

2. Every week thereafter, each group will record the same observations they made before hilling-up operations.

After every observation, participants should brainstorm in small groups to summarize their observations but present the same to the big group every other week. The summary of weekly observations should be printed in Manila paper.

3. After final observation, conduct participatory discussion in a big group to allow sharing of experiences among participants and facilitators. Synthesize and summarize outputs of small groups into one big group output.

4. Draw up conclusions and recommendations from this exercise.

For the simulation and brainstorming exercise:

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, when tuber crops are about a month after planting or transplanting; and/or
- When vegetable farmers want to learn and understand how hilling-up can be used as a management strategy for insect pests of tuber crops.

How long will this exercise take?

- Thirty minutes to one hour for field walks and observations in tuber crops grown in agroforestry fields; and
- Thirty minutes to one-hour simulation exercise and brainstorming session in processing area.

Learning objectives

- To make participants aware of and understand the role of hilling-up operations in the management of tuber crop pests; and
- To learn and share with co-farmers appropriate skills in hilling-up operation for tuber crops.

Materials

- Office supplies (e.g., notebooks, pencils, ball pens, and marking pens);
- Field supplies (e.g., plastic trays and two spoon of sugar); and
- Other materials (e.g., garden soil and at least 8 potato stem cuttings).

Methodology

Field walks, simulation, and brainstorming

Steps

1. Divide big group into five small groups. Go to the field and observe tuber crops that were hilled-up and not hilled-up. Record all observations on crop stand, plant vigor, weed growth, soil moisture condition, pest and disease occurrence, etc. Gather some garden soil and potato stem cuttings.

2. Proceed to processing area and do simulation exercise. Each small group fills-up two plastic trays with the same amount of soil. Cultivate soil and form two mini-plots per tray. Plant four stem-cuttings per tray. To simulate organic fertilizer application, apply one spoon of compost to soil in both trays. Simulate hilling-up operation in one of the trays by using spoon as grab hoe. No hilling-up operation is done on the other tray. Put water to simulate irrigation in trays.

3. After the exercise, conduct participatory discussion in a big group to allow sharing of experiences among participants and facilitators. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Suggested questions for processing discussion

- ❑ What is hilling-up? When is the best time to do hilling-up?
- ❑ In simulation exercise, what happened when you applied water in hilled-up and not hilled-up plots? Why? Can this happen in real field conditions?
- ❑ In a field, did you observe any differences in pest and disease occurrence between hilled-up and not hilled-up plots or beds? What pests and diseases were more prevalent? Were there differences in crop stand, weed growth, and other conditions between hilled-up and not hilled-up plots or beds?
- ❑ Did you observe variation in hilling-up practices? Were there differences in pest and disease occurrence among variations? Were there differences in crop stand, weed growth, and other conditions among variations?
- ❑ Were there variations in other cultural management practices employed when using different hilling-up operations? Which of the hilling-up variation was most cost-efficient? Which of hilling-up variation was the most practical to use? Was hilling-up effective in reducing pest and disease occurrence?
- ❑ What other management strategies can you employ to complement hilling-up in reducing pest and disease occurrence? What other benefits can you derive in practicing hilling-up in agroforestry crops production?

Exercise No. 6.16[153]

> **When is this exercise most appropriate?**
>
> - In AGF-FFS, TOT, and TOS sessions, when first signs or symptoms of pest infestation or disease infection are observed in agroforestry learning field; and/or
> - When farmers want to learn best sanitation practices from other farmers to minimize pest and disease occurrence in their agroforestry crops.

SANITATION AS AN INSECT PEST AND PLANT DISEASE MANAGEMENT STRATEGY FOR AGROFORESTRY CROPS

BACKGROUND AND RATIONALE

Sanitation is the most common and practical cultural management approach against most insect pests and diseases in agroforestry crops production. Sanitation starts with the use of clean seeds, seedlings, and other planting materials to prevent insect infestations and disease infections. On the other hand, pruning, roguing, and proper disposal of affected plants or plant parts are employed to reduce insect pest and disease incidence in agroforestry field[154].

Sanitation practices vary with locations and among farmers depending upon their understanding of pest or disease problem, crops grown, and cropping season. In AGF-FFS, these innovations and best sanitation practices can be shared and learned among upland farmers through field walks, observations and brainstorming. This exercise is designed to enhance learning experiences of upland farmers on proper sanitation practices.

How long will this exercise take?

- Thirty minutes to one hour for field walks and observations of different sanitation practices in adjoining farms of agroforestry learning field; and
- Thirty minutes to one hour brainstorming session in processing area.

153 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp 75-276.

154 Bautista, O.K. (ed). 1994. Introduction to Tropical Horticulture. 2nd Edition. SEAMEO Regional Center for Graduate Study and Research in Agriculture and University of the Philippines Los Baños, College, Laguna, Philippines. pp369-371.

Learning objectives

- To make participants aware of and understand the importance of proper sanitation practices in management of pests and diseases in agroforestry crops production; and
- To learn the best sanitation practices from other farmers in minimizing pest and disease occurrence in agroforestry crops production.

Materials

- Crops grown in agroforestry fields where different sanitation and other cultural management practices can be observed; and
- Office supplies (e.g., Manila papers, notebooks, ball pens, and marking pens).

Methodology

- Field walks and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe different sanitation and other cultural management practices in as many adjoining agroforestry fields of learning field. Interview other farmers, if necessary. List down all observations related to sanitation practices (e.g., roguing, pruning, leaf removal, disposal of crop residues, etc.), pest and disease occurrence, kind of crops planted, crop stand, etc.

2. Go back to processing area, brainstorm in small groups and present output to the big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators.

3. Synthesize and summarize outputs of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe different sanitation practices in agroforestry field? What were the most common sanitation practices employed by farmers?
- ❑ Did farmers properly dispose their crop residues? How?

- ❑ Did farmers dispose their crop residues for pest and diseases management?
- ❑ Did you see differences in pest and disease incidence with different sanitation practices? Did you observe any innovative sanitation practices employed by farmers? What were these practices?
- ❑ Why do we have to be very cautious in applying different sanitation methods?
- ❑ What sanitation practices were more appropriate for each pest and disease problem of different agroforestry crops?
- ❑ What other cultural management practices can complement proper sanitation to reduce pest and disease problems of different agroforestry crops?

Exercise No. 6.17[155]

CROP ROTATION AS AN INSECT PEST AND PLANT DISEASE MANAGEMENT STRATEGY IN AGROFORESTRY CROPS PRODUCTION

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, during discussion on cultural management practices as a component of Integrated Pest Management in agroforestry crops production; and/or
- When farmers want to learn from other farmers their best crop rotation schemes as a pest management strategy in agroforestry crops production.

BACKGROUND AND RATIONALE

Growing two or more crops one after another is called *succession cropping*. A regular succession of such crops being followed for two or more years is more specifically termed *crop rotation*. As a cultural management strategy, crop rotation is used with an idea that a crop susceptible to a pest or disease is followed by a resistant crop or is combined in simultaneous cropping with other crops. There is no buildup of organisms to a high level since growth cycle of organism is broken[156].

In agroforestry crops production, particularly in the Cordilleras, crop rotation is the most practical management approach to diamondback moth (DBM) of crucifers and to many soil-borne diseases of vegetables. Through time, some innovative farmers had designed crop rotation schemes that best suit their location specific requirements. These learning experiences must be constantly shared among farmers in AGF-FFSs to improve their current crop rotation practices which will eventually lead to better pest and disease management strategies in growing agroforestry crops. This exercise was designed to address this particular concern.

How long will this exercise take?

- Thirty minutes for field walks and observations of different crop rotation schemes in agroforestry learning and adjoining fields; and
- Thirty minutes to one hour role-playing and brainstorming session in processing area.

155 Adapted from Callo, Jr., D.P., L.B. Teofilo, and H.A. Tauli (eds). 2002. Field Guide of Discovery-based Exercises for Vegetable IPM, Volume II. SEAMEO Regional Center for Graduate Study and Research in Agriculture (SEARCA), Los Baños, Laguna, Philippines. pp 283-285.

156 Bautista, O.K. (ed). 1994. Introduction to Tropical Horticulture. 2nd Edition. SEAMEO Regional Center for Graduate Study and Research in Agriculture and University of the Philippines Los Baños, College, Laguna, Philippines. pp280-284.

Learning objectives

- To make participants aware and understand how crop rotation can be used as a pest and disease management strategy in agroforestry crops production; and
- To enhance farmers' learning experiences by role-playing how crop rotation works as a pest and disease management strategy in agroforestry crops production.

Materials

- Agroforestry fields where different crop rotation schemes can be observed; and
- Manila papers or blackboard and chalks, notebooks, staplers, crayons, ball pens, and marking pens.

Methodology

- Field walks, role-playing, and brainstorming

Steps

1. Divide participants in small groups and ask them to conduct field walks and observe as many crop rotation schemes in agroforestry adjoining and learning fields. List down all observations related to crop rotation schemes, degree of pest and disease infestation, kind of crops planted, crop stand, etc.;

2. Go back to processing area and do a role-play. A facilitator explains the mechanics of the play to the big group and assigns a crop rotation scheme per small group, as shown below:

   ☑ Group 1 to mono-cropping scheme (e.g., cabbage is planted year-round)
   ☑ Group 2 to crop rotation scheme 1 (e.g., different crucifers are rotated year-round)
   ☑ Group 3 to crop rotation scheme 2 (e.g., crucifers and potato are rotated year round)
   ☑ Group 4 to crop rotation scheme 3 (e.g., potato and other solanaceous vegetables are rotated year-round)
   ☑ Group 5 to crop rotation scheme 4 (e.g., crucifers, legumes, parsley and solanaceous crops are planted in succession for two years)

3. Each group should show possible effects and reactions of crops on different factors contributing to the development and occurrence of pest and diseases. Thus, a play should portray, among others: pest and disease transferred to other crops, pest and disease reduced or controlled, crop rotation scheme less or seriously affected by pests and diseases, etc.

4. Brainstorm in small groups and present output to big group. Conduct participatory discussion to allow sharing of experiences among participants and facilitators.

5. Synthesize and summarize output of small groups into one big group output. Draw up conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ What is crop rotation? How do you differentiate crop succession from crop rotation?
- ❑ Did you observe different crop rotation scheme in different agroforestry fields? What crop rotation schemes did farmers commonly practice?
- ❑ In role-play, which was the best crop rotation scheme? Why? What were the important characteristics of a good crop rotation scheme?
- ❑ Do you think crop rotation will solve pest and disease problems in your area?
- ❑ What benefits can you derive from practicing crop rotation?
- ❑ What other cultural practices can complement crop rotation to effectively manage pest and disease problems in agroforestry crops production?

Section 7

POST PRODUCTION AND LIVELIHOOD TECHNOLOGIES FOR AGROFORESTRY SYSTEMS

Section 7

POST PRODUCTION AND LIVELIHOOD TECHNOLOGIES FOR AGROFORESTRY SYSTEMS

Agroforestry is a land-use management system that combines production of trees with agricultural crops, animals and/or other resources in the same area. It aims to increase or sustain productivity while maintaining ecological stability. It also hopes to increase income for improved quality of life. Experts identify several types of agroforestry; among them agrosilvicultural (e.g., trees with agricultural crops) and silvopastoral (e.g., trees with pastures and livestock). In recent years, fruit crops and other perennial horticultural crops are integrated in agroforestry projects. In southern part of the Philippines, fruit trees were introduced into a new SALT system called Small Agro-fruit Livelihood Technology (SALT 4).

The system's general objectives are to produce food, increase income, and practice soil conservation in a limited sloping land (e.g., one-half hectare). Likewise, this system provides many livelihood opportunities in upland farming communities. However, marketing of agricultural crops has been cited by most farmers as one of their biggest problems as most uplands have no farm-to-market roads. Because of this, the growing of high value crops like fruits was introduced. Fruits, after all, can be easily marketed, not mentioning that they can stand rigors of spoiling unlike easily perishable vegetables and other perennial crops. In cases where fruits easily rot, farmers may resort to planting those fruits that can easily be marketed right in their farm or neighboring areas[157].

Thus, this section compiles several exercises that relate to post production and livelihood technologies for agroforestry systems. It includes a sub-section on: (a) integration of agricultural crops, fruit trees, and forest species; and (b) livelihood opportunities, marketing strategies, and re-entry planning.

157 AFIN. 2003. Small Agro-fruit Livelihood Technology (SALT 4): A guide on how to integrate fruit trees into the SALT system. Agroforestry Information Network (AFIN), Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. http://maidon.pcarrd.dost.gov.ph/cin/afin/small-agrofruit-livelihood-technology-salt-4.htm.

INTEGRATION OF AGRICULTURAL CROPS, FRUIT TREES, AND FOREST SPECIES

Nature provides us with what we need and we must be responsible in taking care of it. But with growing population, upland resources are being threatened. People migrating to uplands brought with them diverse lowland farming practices that are most often not applicable in uplands. These circumstances greatly contribute to destruction of our upland resources; a situation which would also mean diminishing production, vanishing biodiversity, continuous soil erosion, flashfloods, and other problems.

As one of the alternative farming systems, agroforestry improves these lowland-farming practices making it more appropriate in uplands. Agroforestry integrates two major disciplines of utilizing and managing land: agriculture and forestry. Through agroforestry, you can utilize your farm into various combinations of food crops, trees, animals and other resources. Integrated production systems as well as soil and water conservation measures are adopted to efficiently increase food production while maintaining soil fertility and improving its physicochemical and biological properties[158].

It is in this perspective that this sub-section brings in discovery-based exercises which will attempt to integrate: (a) multipurpose trees, non-timber forest species, and fruit trees; and (b) agricultural and horticultural crops in agroforestry system.

158 Ramos, G. 2000. Securing the Future: by Promoting the Adoption of Sustainable Agroforestry Technologies: A Primer. In Dalmacio. R. and N. Lawas (eds), Institute of Agroforestry, University of the Philippines Los Banos, College, Laguna. As cited in AFIN. 2003. Small Agro-fruit Livelihood Technology (SALT 4): A guide on how to integrate fruit trees into the SALT system. Agroforestry Information Network (AFIN), Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. http://maidon.pcarrd.dost.gov.ph/cin/afin/small-agrofruit-livelihood-technology-salt-4.htm.

Exercise No. 7.01

INTEGRATING MULTI-PURPOSE TREES, NON-TIMBER FOREST SPECIES, AND FRUIT TREES IN AGROFORESTRY SYSTEM

When is this exercise most appropriate?

- In AGF-FFS sessions, before seedling production or propagation and before planting multi-purpose trees, non-timber forest tree species, and fruit trees in agroforestry learning field; and
- When upland farmers want to learn more on adaptability and purposes or uses of multi-purpose trees, non-timber forest tree species, and fruit trees for agroforestry system.

BACKGROUND AND RATIONALE

In selection of forest tree species to be raised in a nursery, and to be planted in community-based forest management (CBFM) areas, it is very important to consider their purposes or uses (e.g., trees for hedgerow, nurse tree, fuel-wood, timber, windbreak, etc.) so that upland farmers can properly pick species of their choice. Likewise, there is a need for them to identify some non-timber forest tree species (e.g., anahaw, bamboo, rattan, etc.) and fruit trees (e.g., coconut, jackfruit, mango, etc.) to be integrated in development of their agroforestry farms.

Bamboo and rattan are examples of non-timber forest tree species that thrive well in many agroforestry areas of the Philippines. Bamboo is tallest perennial grass belonging to *Graminae* family. It is a versatile material for a variety of economic uses: handicraft and furniture; farm implements; fish pen, fish cages, and other fishing gears; banana props; musical instrument; pulp and paper; and house construction. Aside from these, young shoots of some species are edible. On the other hand, rattan belongs to *Palmae f*amily. Aside from manufacture of furniture, rattan is used for making fish traps, sleeping mats, baskets, twines, toothbrushes, and even skirts of some tribal groups of women[159].

Some locally-adapted hedgerow species should be planted, such as nitrogen fixing trees and shrubs like *Flemingia macrophylla* and *Desmodium rensonii*. Hedgerows should occupy at least 20% of farm area. Other species which can be used for hedgerows include *Gliricidia sepium* (locally known as 'madre de cacao' or 'kakawate'), *Leucaena leucocephala* (also known as 'ipil-ipil'), and other locally grown species. There is also a need to plant several and different fruit species to add diversity; 3-5 species is best. Alternate these species to help prevent disease and insect problems. Doing this will lessen monetary loss if there is a poor fruiting year from one species[160].

159 IIRR. 1998. Trees and Their Management. Agroforestry Technology Information Kit (ATIK) No. 2, International Institute of Rural Reconstruction (IIRR), Department of Environment and Natural Resources (DENR), and Ford Foundation (FF). pp38-55.

160 AFIN. 2003. Small Agro-fruit Livelihood Technology (SALT 4): A guide on how to integrate fruit trees into the SALT system. Agroforestry Information Network (AFIN), Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. http://maidon.pcarrd.dost.gov.ph/cin/afin/small-agrofruit-livelihood-technology-salt-4.htm.

In many parts of the country, upland farmers themselves through their experiences select fruit and forest tree species most suitable to their local growing conditions. In this way, agroforestry areas will become more productive, economically feasible, and sustainable. Innovative farmers' experiences must be regularly shared among themselves during AGF-FFSs to update their knowledge on local adaptability and purpose or use of these tree species.

How long will this exercise take?

- One to two hours for field walks and observations of multi-purpose trees, non-timber forest tree species, and fruit trees planted and grown in upland areas; and
- Thirty minutes to one hour for brainstorming session in processing area.

Learning objectives

- To make upland farmers aware of and understand multi-purpose trees, non-timber forest tree species, and fruit trees according to purposes or uses in improving agroforestry productivity; and
- To learn adaptability of multi-purpose trees, non-timber forest tree species, and fruit trees from other upland farmers.

Methodology

- Field walks, observations, and brainstorming

Materials

- Upland areas planted with multi-purpose trees, non-timber forest tree species, and fruit trees showing their adaptability to local condition; and
- Manila papers, notebooks, ball pens, and marking pens.

Steps

1. Divide participants into smaller groups and ask them to conduct field walks and observations of multi-purpose trees, non-timber forest tree species, and fruit trees planted in upland areas adjoining their learning field. Interview other upland farmers and list down their experiences and recommendations (e.g., while they choose particular species, etc).

2. Go back to session or processing area. Brainstorm in small groups and present outputs to big group. Conduct participatory discussions to allow sharing of experiences among participants and facilitators on how to integrate multi-purpose trees, non-timber forest tree species, and fruit trees in agroforestry system; and

3. Synthesize and summarize outputs of smaller group into one big group output. Draw conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ Did you observe differences in adaptability of certain multi-purpose trees, non-timber forest tree species, and fruit trees planted in upland areas?
- ❑ Were you able to determine purposes or uses of certain multi-purpose trees, non-timber forest tree species, and fruit trees planted in upland areas?
- ❑ Did you learn from other upland farmers their experiences in productivity and profitability of multi-purpose trees, non-timber forest tree species, and fruit trees planted in upland areas?
- ❑ Do you know how to propagate your identified non-timber forest tree species?

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Exercise No. 7.02

INTEGRATING AGRONOMIC AND HORTICULTRAL CROPS IN AGROFORESTRY SYSTEM

When is this exercise most appropriate?

- In AGF-FFS sessions, preferably before nursery operation, or if not, during planting or transplanting of agroforestry crops in learning field; and
- When upland farmers want to learn more from other farmers their experiences on integrating agronomic and horticultural crops with forest tree species in agroforestry system.

BACKGROUND AND RATIONALE

In contrast to pure agriculture, agroforestry involves a complex of diversified farming systems as it seeks to combine growing of agricultural, horticultural, and forestry crops in one area. In any cropping scheme, a balance is always struck between productive and protective functions of resulting ecosystem. A desirable agroforestry cropping scheme, therefore, is one that gives good yield while conserving both soil and water.

The crops mixed in a scheme have to be compatible with each other. A working knowledge of optimum environmental requirements of crop mix is therefore necessary. These include soil nutrient, light, moisture, temperature, and relative humidity. Spatial arrangement of plant canopies and root systems must be considered to minimize competition for nutrients, light and space. This necessitates familiarity with rooting behavior, height, branching habit and crown form of plants mixed. To maximize use of space, inter-planting shade resistant crops is undertaken. Crop mixtures which biologically repel pests and diseases are best. For example, combined crops must not be alternate hosts of pests or disease causing organisms mutually destructive to crops planted[161].

The development of upland areas is one of major concerns of the government due to continued pressure exerted on these fragile ecosystems. So now comes agroforestry farming system to address this problem, wherein agronomic (e.g., cash crops) and horticultural (e.g., ornamental, plantation of fruit bearing trees) crops are integrated with forest tree and non-timber forest species (e.g., bamboo, rattan, anahaw, etc.) in a particular area to improve its productivity and environmental condition.

With the proper integration or combination of agronomic and horticultural crops with forest tree species, upland farmers would be given more opportunity to manage and develop their areas under the concept of

161 PCARRD. 1986. The Philippines Recommends for Agroforestry. Committee for Agroforestry, Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. 90p. As cited in AFIN. 2003. Small Agro-fruit Livelihood Technology (SALT 4): A guide on how to integrate fruit trees into the SALT system. Agroforestry Information Network (AFIN), Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. http://maidon.pcarrd.dost.gov.ph/cin/afin/small-agrofruit-livelihood-technology-salt-4.htm.

sustainable forest management. In this exercise, upland farmers who will undergo AGF-FFS will be able to familiarize themselves with the major agronomic and horticultural crops, their adaptation, growth characteristic, and proper places as crop components of agroforestry system.

How long will this exercise take?

- One to two hours for field walks and observations of agroforestry area where agronomic and horticultural crops were integrated with forest tree species; and
- One hour for brainstorming session in processing area.

Learning objectives

- To familiarize AGF-FFS participants on available and suitable agronomic and horticultural crops integrated with forest tree species in local agroforestry system; and
- To enable participants to know proper places of these crops as agroforestry components to improve upland farm productivity and sustainability.

Methodology

- Field walks, observations, and brainstorming

Materials

- Upland areas planted with agronomic and horticultural crops, preferably those exhibiting good adaptation and growth characteristic; and
- Manila papers, notebooks, ball pens, and marking or pentel pens.

Steps

1. Divide participants into smaller groups and let them conduct field walks and observations of agronomic and horticultural crops integrated with forest tree species, preferably near or adjacent to learning field. Facilitators should encourage participants to interview or interact with other upland farmers and get as much relevant basic information from them regarding these crops;

2. Return to session hall or processing area. Brainstorm in small groups and present outputs to big group. Conduct participatory discussions to allow sharing of observations and experiences among participants

and facilitators on adaptation, growth characteristic, and proper places of major agronomic and horticultural crops in an agroforestry system; and

3. Synthesize and summarize outputs of smaller group into one big group output. Draw conclusions and recommendations from this exercise.

Some suggested questions for processing discussion

- ❑ Were you able to identify available and suitable agronomic and horticultural crops grown in the locality? Are you familiar with these crops? Please list them down.
- ❑ Did you obtain basic or relevant information from other upland farmers and learned from them on adaptation and growth characteristics of these crops in local agroforestry system?
- ❑ Did you learn from other upland farmers proper places of these crops in local agroforestry system?

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LIVELIHOOD OPPORTUNITIES, MARKETING STRATEGIES, AND RE-ENTRY PLANNING

It is very difficult to quantify benefits derived from agroforestry. First, because it is a combination of agriculture and forestry, a whole gamut of products are produced on a small scale including cash crops, timber, firewood, livestock, and poultry, among others. Secondly, a more important benefit from agroforestry, which is environmental conservation, cannot be easily measured[162]. In this respect however, agroforestry offers a lot of livelihood opportunities. Hence, as a component of this sub-section, an exercise on crops-livestock integration will be taken on.

This sub-section also explores farmers' market environment and analyzes linkages between market and crop diversity. It aims to strengthen farmers' knowledge of their product market and develop a realistic strategy and action plan to diversify marketable agroforestry farm products. Farmers first focus on internal aspects, investigating their main problems in production and marketing of crops and capacities to change their current production and marketing strategies.

Later, farmers, and other stakeholders analyze external aspects, exploring existing and alternative strategies. They also examine crop's success factors for current and future markets, including an analysis of products, potential for novel diversity within crops, features of costumers, market chain, competitors, and a macro-analysis. Subsequently, this combined information of internal and external market analysis will lead to determining strengths, weaknesses, opportunities, and risks for developing an action or re-entry plan[163].

162 AFIN. 2003. Agroforestry Industry Status. Agroforestry Information Network (AFIN), Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. http://maidon.pcarrd.dost.gov.ph/cin/afin/small-agrofruit-livelihood-technology-salt-4.htm.

163 Smolders, H. (ed). 2006. Enhancing Farmers' Role in Crop Development: Framework Information for Participatory Plant Breeding in Farmer Field Schools. Participatory Enhancement of Diversity of Genetic Resources in Asia (PEDIGREA) Publication. Center for Genetic Resources, the Netherlands. pp11-12.

Exercise No. 7.03

When is this exercise most appropriate?

❧ In AGF-FFS sessions, as integral part of topic 'Identification of Livestock and Other Livelihood Components'.

IDENTIFICATION OF LIVESTOCK AND OTHER LIVELIHOOD COMPONENTS OF AGROFORESTRY SYSTEM

BACKGROUND AND RATIONALE

Agroforestry system in the Philippines can be classified according to their dominant component, which includes agricultural crops, forest trees, and animals. These systems are classified as agricisilvicultural, silvipastoral, and agripastoral or agrisilvipastoral system. These are described below[164]:

- *Agrisilvicultural system* is combination of agricultural crops with woody perennials. This system includes: alley cropping, multi-storey, boundary planting, windbreaks, improved fallow, and *taungya*;

- *Silvipastoral system* is combination of woody perennials with livestock production. This system includes livestock-under-tree, protein bank (fodder bank), live fence, and hedgerow planting of improved pasture grasses and/or other fodder trees or shrubs; and

- *Agrisilvipastoral system* is combination of agricultural crops, woody perennials, and livestock. This system includes silvipastoral, multi-storey with animals, and alley-cropping with pasture grasses and agricultural crops.

The present problem of livestock industry in our country commands a change of existing animal productivity system especially for agroforestry farmer clienteles. A potential animal for livestock component in agroforestry system is goat (*Capra hircus*), which is one of our oldest domesticated ruminants endowed with an almost unique adaptability to varying local conditions.

In AGF-FFS, goat production can be tried as a livestock component of local agroforestry system. This animal requires low initial investment while its high fertility and reproductive rates makes possible for a cheap source of meat and milk at a shorter period of time. The potential to produce meat and milk is highly regarded to narrow down problem of malnutrition in countryside.

164 PCARRD. 2003. Agroforestry and multipurpose trees and shrubs R&D team. R&D Status and Directions (2000 and beyond): Agroforestry and multipurpose trees and shrubs. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. 45p. As cited in AFIN. 2003. Agroforestry Industry Status. Agroforestry Information Network (AFIN), Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Baños, Laguna, Philippines. http://maidon.pcarrd.dost.gov.ph/cin/afin/small-agrofruit-livelihood-technology-salt-4.htm.

How long will this exercise take?

- Two hours for field visits to some households, neighbors, and goat farms involved in goat production and other livelihood components (e.g., mushroom production, vegetable production, and aquaculture, among others)
- Thirty minutes for mini-workshop in small groups; and
- At least one hour for participatory discussion in big group.

Learning objectives

- To share experiences among participants, facilitators, and other farmers predominant problems, issues, and concerns affecting livestock production and other livelihood components, and how these are addressed; and
- To identify potential livestock and other livelihood components and strategies to ensure success in adapting them in their local agroforestry systems.

Methodology

- Field visit, mini-workshop, and brainstorming

Materials

- Adjoining farms of learning field where goat production and other livelihood components are integrated into local agroforestry system; and
- Notebooks, ball pens, and manila paper and marking pen per group.

Steps

<u>Field visit</u>:

1. Prior to field visit, facilitators conduct initial interviews of some livestock raisers, vegetable growers, and mushroom producers;

2. Present initial results of observations or data gathered to participants. Brainstorm in a big group to agree on what data to collect and observe or questions to ask for interviews to farmers as regards:

- ☑ Livelihood components (e.g., mushroom and vegetable production, aquaculture, etc.) adapted in the area; and
- ☑ Livestock (e.g., goat, cattle, or carabao production, etc.) adapted in the area.

3. Participants conduct field visits in small groups to some livestock raisers, vegetable growers, and mushroom producers to understand importance of identifying appropriate livestock and other livelihood components of local agroforestry system;

4. Go back to session hall, consolidate outputs of field visits in small groups, and report it to big group;

Mini-workshop:

5. Divide big group into five smaller groups and give them their respective assignments or tasks. Provide sheets of manila paper and pens to draw and write results of discussions. Ask farmers to further elaborate on questions about identifying potential livestock and other livelihood components. Facilitators should not read out questions, but introduce them in a natural way during brainstorming in small groups:

   - ☑ Livelihood components (e.g., mushroom and vegetable production, aquaculture, etc.) adapted in the area; and
   - ☑ Livestock (e.g., goat, cattle, or carabao production, etc.) adapted in the area

Participatory Discussions:

6. Ask each small group to present and discuss results with big group; and

7. Facilitators guide a participatory discussion to synthesize and summarize results of this exercise.

Some suggested questions for processing discussion

- ❑ Did you identify potential livestock and other livelihood components adapted in the area? Do you think they will be practical to adapt in your area? Why?
- ❑ What are commonest problems, issues, and concerns affecting livestock productions and livelihood components in the area? Were there solutions to these problems, issues, and concerns?
- ❑ Did you learn strategies which will ensure success in adapting them in your local agroforestry systems?

Exercise No. 7.04[165]

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, after discussions of the topic 'Post-harvest Handling and Primary Processing of Agroforestry Products'.

UNDERSTANDING MARKETING CHAIN FOR PROFITABLE GROWING OF AGROFORESTRY CROPS[166]

BACKGROUND AND RATIONALE

Buying and selling operations are at the heart of marketing process. Markets and marketing middlemen develop to smooth buying and selling operations. How well these operations are carried out affects consumer welfare. This is so because goods take on value only when they are in the right place at the right time so that customers can take possession of them[167]. For agroforestry crops, marketing chain varies with different types of agroforestry products (e.g., agricultural and horticultural, fruit and forestry, and/or livestock products) and different types of consumers. This chain passes through different types of intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) between farmers and consumers.

In AGF-FFS, innovative experiences in maintaining appropriate marketing chain for varied agroforestry products must be shared among farmers to further improve their productivity and profitability. The foregoing exercise was specifically designed to achieve this purpose.

How long will this exercise take?

- Two hours for field visit to some community-based market intermediaries, where market chain for agroforestry products selling operations is appropriately demonstrated (optional for AGF-FFS);
- Thirty minutes for mini-workshop in small groups; and
- At least one hour for participatory discussion in a big group.

165 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp436-439.

166 Smolders, H. and Caballeda, E. 2006. Field Guide for Participatory Plant Breeding in Farmer Field Schools: With Emphasis on Rice and Vegetables. Participatory Enhancement of Diversity of Genetic Resources in Asia (PEDIGREA) Publication. Center for Genetic Resources, the Netherlands. pp120-121.

167 McCarthy, E.J. and Perreault, Jr., W.D. 1987. Learning Aid for Use With Basic Marketing: A Managerial Approach. 9th Edition. Richard D. Irwin, Inc., Homewood, Illinois 60430, USA. pp1-9 to 1-14.

Learning objectives

- To discuss participants' problems, issues, and concerns affecting market chain in agroforestry products selling operations and how these are addressed; and
- To develop strategies for improving farmer-intermediaries relationship in agroforestry products selling operations to increase farmers' incomes.

Methodology

- Field visit, mini-workshop, and brainstorming

Materials

- Some agroforestry intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.), where there is an on-going selling operations; and
- Notebooks, ball pens, and manila paper and marking pen per group.

Steps

Field visit:

1. Prior to field visit, facilitators conduct initial interviews to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) involved in agroforestry products selling operations;

2. Present initial results of observations or data gathered to participants. Brainstorm in a big group to agree on what data to collect and observe or questions to ask for interviews to farmers. Some examples of questions to be asked are:

   ☑ What different types of agroforestry products (e.g., agricultural and horticultural, fruit and forestry, and others) are sold to what different types of consumers?
   ☑ To whom do farmers sell their agroforestry products?
   ☑ What types of intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) exist between farmers and consumers of agroforestry products?

3. Participants conduct field visit in small groups to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) involved in agroforestry products selling operations and implement procedure agreed upon by the big group;

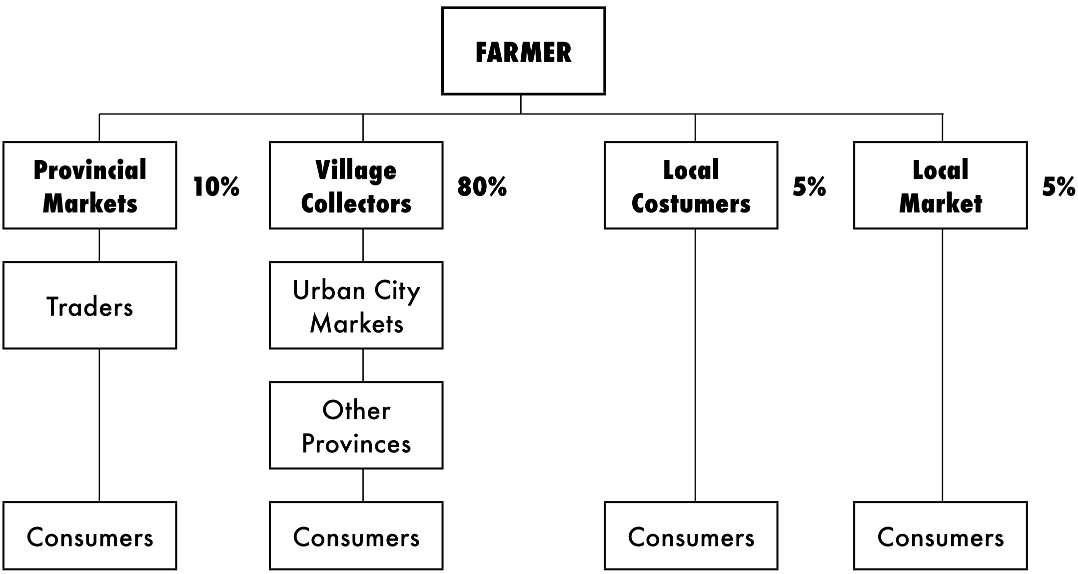
4. Go back to the session hall, consolidate outputs of field visit in small groups, and report it to the big group;

<u>Mini-workshop</u>:

5. Divide big group into five small groups and give them their respective assignments or tasks. Provide sheets of manila paper and pens to draw and write results of discussions. Facilitators should not read out questions, but introduce them in a natural way during brainstorming in small groups:

   - ☑ Each small group draws a marketing chain (see figure below as an example) of agroforestry products;
   - ☑ Each small group specifies different types of products (e.g., agricultural and horticultural, fruit and forestry, and others) and different types of consumers of agroforestry products;
   - ☑ Each small group lists all types of intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) exist between farmers and consumers of agroforestry products; and
   - ☑ Each small group writes down proportion of produce going into each sub-chain.

Example of a market chain for agroforestry products in the Philippines



Participatory Discussions:

6. Ask each small group to present and discuss results with big group; and

7. Facilitators guide a participatory discussion to synthesize and summarize results of this exercise.

Some suggested questions for processing discussion

- What happens with your different harvested agroforestry products at different seasons?
- Was your harvests sorted and graded (e.g., quality, size, etc.)?
- What maximum amount would have been possible for you to sell your harvested agroforestry products?
- How reproducibly can you provide such volume of agroforestry products?
- What are the advantages and disadvantages of your different selling destinations for harvested agroforestry products?
- Are there any other possible selling destinations for harvested agroforestry products that you know but do not use?
- What are some of farmers' common problems, issues, and concerns affecting market chain in agroforestry products selling operations and how will they be addressed?

Exercise No. 7.05[168]

> **When is this exercise most appropriate?**
>
> ❧ In AGF-FFS, TOT, and TOS sessions, after discussions of the topic 'Post-harvest Handling and Primary Processing of Agroforestry Products'.

PRICING AND PRICING ARRANGEMENTS FOR PROFITABLE GROWING OF AGROFORESTRY CROPS[169]

BACKGROUND AND RATIONALE

Demand must be considered when setting prices. Usually, a market will buy more at lower prices so that total sales may increase if prices are lowered. In this regard, retailers and wholesalers, for example, use traditional markups that they feel will yield a reasonable rate of profit. In this regard, farmers should understand how various types of prices differ, how they relate to each other, and how they affect profits as sales volume varies[170].

In AGF-FFS, innovative experiences in pricing and pricing arrangements for marketing of agroforestry products must be shared among farmers to further improve their existing pricing schemes. The foregoing exercise was specifically designed to achieve this purpose.

How long will this exercise take?

- Two hours for field visit to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) involved in agroforestry products selling operations where market pricing and pricing arrangements is appropriately demonstrated (optional for FFS);
- Thirty minutes for mini-workshop in small groups; and
- At least one hour for participatory discussion in a big group.

Learning objectives

- To discuss participants' problems, issues, and concerns affecting market pricing and pricing arrangements in agroforestry products selling operations and how these are addressed; and
- To develop strategies for improving pricing and pricing arrangements in agroforestry products selling operations to increase farmers' incomes.

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168 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp440-442.

169 Smolders, H. and Caballeda, E. 2006. Field Guide for Participatory Plant Breeding in Farmer Field Schools: With Emphasis on Rice and Vegetables. Participatory Enhancement of Diversity of Genetic Resources in Asia (PEDIGREA) Publication. Center for Genetic Resources, the Netherlands. pp121.

170 McCarthy, E.J. and Perreault, Jr., W.D. 1987. Learning Aid for Use With Basic Marketing: A Managerial Approach. 9th Edition. Richard D. Irwin, Inc., Homewood, Illinois 60430, USA. pp19-13 to 19-18 and 19-23 to 19-30.

Methodology

- Field visit, mini-workshop, and brainstorming

Materials

- Some agroforestry product intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.), where pricing and pricing arrangements are aptly established in their on-going selling operations; and
- Notebooks, ball pens, and manila paper and marking pen per group.

Steps

Field visit:

1. Prior to field visit, facilitators conduct initial interviews to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) to understand pricing and pricing arrangements for agroforestry products;

2. Present initial results of observations or data gathered to participants. Brainstorm in a big group to agree on what data to collect and observe or questions to ask for interviews to farmers as regards:

   ☑ Price agreements (e.g., before, during, and after harvest) for agroforestry products sold;
   ☑ Prices received by farmers for their agroforestry products at different seasons; and
   ☑ Time (e.g., days before or after harvest) of payments to farmers for their agroforestry products.

3. Participants conduct field visit in small groups to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) to understand pricing and pricing arrangements for agroforestry products;

4. Go back to the session hall, consolidate outputs of field visit in small groups, and report it to the big group;

Mini-workshop:

5. Divide big group into five small groups and give them their respective assignments or tasks. Provide sheets of manila paper and pens to draw and write results of discussions. Ask farmers to further elaborate on

questions about pricing and pricing arrangements. Facilitators should not read out questions, but introduce them in a natural way during brainstorming in small groups:

- ☑ Price agreements (e.g., before, during, and after harvest) for agroforestry products sold;
- ☑ Prices received by farmers for their agroforestry products at different seasons; and
- ☑ Time (e.g., days before or after harvest) of payments to farmers for their agroforestry products.

Participatory Discussions:

6. Ask each small group to present and discuss results; and

7. Facilitators guide a participatory discussion to synthesize and summarize results of this exercise.

Some suggested questions for processing discussion

- ❑ With respect to sold agroforestry products, what kind of arrangement do you have with persons buying?
- ❑ When was such agreement made (e.g., before, during, and after harvest)?
- ❑ When was such prices determined and how?
- ❑ Which prices were received for different agroforestry products at different seasons?
- ❑ When (e.g., days before or after harvest) was money paid for different agroforestry products?
- ❑ What would have been your minimum price for different agroforestry products at different seasons?
- ❑ What are some of farmers' common problems, issues, and concerns affecting pricing and pricing arrangements in agroforestry products selling operations and how will they be addressed?

Exercise No. 7.06[171]

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, after discussions of the topic 'Post-harvest Handling and Primary Processing of Agroforestry Products'.

UNDERSTANDING MARKET COMPETITION FOR PROFITABLE GROWING OF AGROFORESTRY CROPS[172]

BACKGROUND AND RATIONALE

A practical first step in searching for breakthrough opportunities is to define present (or potential) markets. Markets consist of potential customers with similar needs and sellers offering various ways of satisfying those needs. The development of successful marketing strategies depends largely on planner's ability to segment markets. Unfortunately, this is not a simple process. It usually requires considerable management judgment and skill. Marketers who have their necessary judgment and skill have a real advantage over their competitors in finding profitable opportunities[173].

In AGF-FFS, innovative market competition schemes for marketing agroforestry products must be shared among farmers to further improve their existing strategies. The foregoing exercise was specifically designed to achieve this purpose.

How long will this exercise take?

- Two hours for field visit to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) involved in agroforestry products selling operations where several market competition schemes are suitably recognized (optional for FFS);
- Thirty minutes for mini-workshop in small groups; and
- At least one hour for participatory discussion in a big group.

Learning objectives

- To discuss participants' problems, issues, and concerns affecting market competition in agroforestry products selling operations and how these are addressed; and
- To develop strategies for improving market competition strategies in agroforestry products selling operations to increase farmers' incomes.

171 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp443-445.

172 Smolders, H. and Caballeda, E. 2006. Field Guide for Participatory Plant Breeding in Farmer Field Schools: With Emphasis on Rice and Vegetables. Participatory Enhancement of Diversity of Genetic Resources in Asia (PEDIGREA) Publication. Center for Genetic Resources, the Netherlands. pp121.

173 McCarthy, E.J. and Perreault, Jr., W.D. 1987. Learning Aid for Use With Basic Marketing: A Managerial Approach. 9th Edition. Richard D. Irwin, Inc., Homewood, Illinois 60430, USA. pp3-1 to 3-18 and 4-11 to 4-14.

Methodology

- Field visit, mini-workshop, and brainstorming

Materials

- Some agroforestry products intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.), where market competition schemes are suitable instituted in their on-going selling operations; and
- Notebooks, ball pens, and manila paper and marking pen per group.

Steps

Field visit:

1. Prior to field visit, facilitators conduct initial interviews to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) to understand market competitions for agroforestry products;

2. Present initial results of observations or data gathered to participants. Brainstorm in a big group to agree on what data to collect and observe or questions to ask for interviews to farmers as regards:

   ☑ Market strategies for selling agroforestry products;
   ☑ Major competitors for selling agroforestry products at different seasons; and
   ☑ Market competition strategies to out-compete major competitors for selling agroforestry products.

3. Participants conduct field visit in small groups to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) to understand market competition schemes for agroforestry products;

4. Go back to the session hall, consolidate outputs of field visit in small groups, and report it to the big group;

Mini-workshop:

5. Divide big group into five small groups and give them their respective assignments or tasks. Provide sheets of manila paper and pens to draw and write results of discussions. Ask farmers to further elaborate on

matters of market competition. Facilitators should not read out questions, but introduce them in a natural way during brainstorming in small groups:

☑ Market strategies for selling agroforestry products;
☑ Major competitors for selling agroforestry products at different seasons; and
☑ Market competition strategies to out-compete major competitors for selling agroforestry products.

Participatory Discussions:

6. Ask each small group to present and discuss results; and

7. Facilitators guide a participatory discussion to synthesize and summarize results of this exercise.

Some suggested questions for processing discussion

❑ What strategies did you have to get a better price for your agroforestry products?
❑ Who are your biggest competitors in marketing agroforestry products at different seasons?
❑ What can you do to out-compete your competitors in marketing agroforestry products?
❑ What do you do with your agroforestry harvests when price is too low?
❑ What are some of farmers' common agroforestry marketing problems, issues, or concerns and how will they be addressed?

Exercise No. 7.07[174]

MARKETING PROBLEM TREE ANALYSIS FOR AGROFORESTRY CROPS[175]

When is this exercise most appropriate?

- In AGF-FFS, TOT, and TOS sessions, after discussions of the topic 'Post-harvest Handling and Primary Processing of Agroforestry Products'.

BACKGROUND AND RATIONALE

The marketing process does not take place automatically. It requires that certain marketing functions or activities be performed by various marketing groups and by consumers themselves. The following functions are essential to marketing of all goods: buying, selling, transporting, storing, grading, financing, risk-taking, and market information[176]. In marketing agroforestry products, several problems may be encountered, along the way, while performing these essential marketing functions.

In AGF-FFS, innovative experiences in addressing problems in marketing agroforestry products must be shared among farmers and analyzed to craft a more sustainable business venture. The foregoing exercise was specifically designed to achieve this purpose.

How long will this exercise take?

- Two hours for field visit to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) involved in agroforestry products selling operations where marketing problems can be critically articulated (optional for AGF-FFS);
- Thirty minutes for mini-workshop in small groups; and
- At least one hour for participatory discussion big group.

174 Adapted from Callo, Jr., D.P. C.A. Baniqued, A.G. Maagad, N.C. Villa, O.T. Tobia, and K.A. Seballos (eds). 2009. Field Guide of Discovery-based Exercises for Organic Vegetable Production. ASEAN IPM Knowledge Network, National Agribusiness Corporation, 14th Floor, PSE Building, Exchange Road, Ortigas Center, Pasig City, Philippines (In Press). pp446-448.

175 Smolders, H. and Caballeda, E. 2006. Field Guide for Participatory Plant Breeding in Farmer Field Schools: With Emphasis on Rice and Vegetables. Participatory Enhancement of Diversity of Genetic Resources in Asia (PEDIGREA) Publication. Center for Genetic Resources, the Netherlands. pp122.

176 McCarthy, E.J. and Perreault, Jr., W.D. 1987. Learning Aid for Use With Basic Marketing: A Managerial Approach. 9th Edition. Richard D. Irwin, Inc., Homewood, Illinois 60430, USA. pp1-15 to 1-20.

Learning objectives

- To identify with participants the problems, issues, and concerns in marketing of agroforestry products in local communities and determine how same can be addressed; and
- To develop marketing problem tree which can be analyzed and used to develop strategies for improving marketing operations of agroforestry products in local communities to increase farmers' incomes.

Methodology

- Field visit, mini-workshop, and brainstorming

Materials

- Some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.), involved in agroforestry products selling operations where marketing problems can be critically articulated; and
- Notebooks, ball pens, and manila paper and marking pen per group.

Steps

Field visit:

1. Prior to field visit, facilitators conduct initial interviews to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) to understand market competitions for agroforestry products;

2. Present initial results of observations or data gathered to participants. Brainstorm in a big group to agree on what data to collect and observe or questions to ask for interviews to farmers as regards:

   ☑ Main problems and reasons for problems in marketing agroforestry products;
   ☑ Secondary problems and reasons or problems in marketing agroforestry products; and
   ☑ Tertiary problems and reasons or problems in marketing agroforestry products.

3. Participants conduct field visit in small groups to some market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) to understand marketing problem tree for agroforestry products;

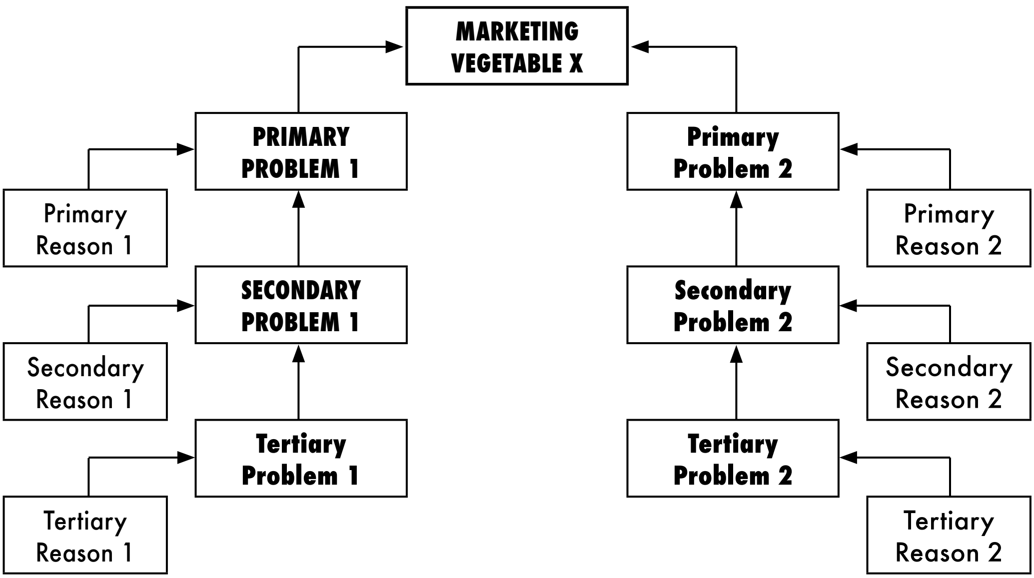
4. Go back to the session hall, consolidate outputs of field visit in small groups, and report it to the big group;

Mini-workshop:

5. Divide big group into five small groups and give them their respective assignments or tasks. Provide sheets of manila paper and pens to draw and write results of discussions. Ask farmers to further elaborate and develop marketing problem tree in agroforestry production as shown below. Facilitators should not read out questions, but introduce the following in a natural way:

   ☑ Main problems and reasons for problems in marketing agroforestry products;
   ☑ Secondary problems and reasons or problems in marketing agroforestry products; and
   ☑ Tertiary problems and reasons or problems in marketing agroforestry products.

Example of a market problem tree



Participatory Discussions:

6. Ask each small group to present and discuss results; and

7. Facilitators guide a participatory discussion to synthesize and summarize results of this exercise.

Some suggested questions for processing discussion

- What were the main problems you experienced in marketing agroforestry products?
- What are your suggested solutions to these main problems?
- What were the secondary problems you experienced in marketing agroforestry products?
- What are your suggested solutions to these secondary problems?
- What were the tertiary problems you experienced in marketing agroforestry products?
- What are your suggested solutions to these tertiary problems?
- Can you develop marketing problem tree of your community, which can be analyzed and used to develop strategies for improving marketing operations of agroforestry products?

Exercise No. 7.08

PREPARING INDICATIVE PLAN (RE-ENTRY PLAN) TO SUSTAIN AGROFORESTRY FARMER FIELD SCHOOL FOLLOW-UP ACTIVITIES

When is this exercise most appropriate?

- Before an initial season-long AGF-FFS ends, or just before start of succeeding planting season.

BACKGROUND AND RATIONALE

Farmers highly appreciate new opportunities provided to them through agroforestry farmer field school (AGF-FFS), in particular their studies on adaptability of cash crops as agroforestry system components and their pest management options. At first, they thought these activities belong only to scientists and professionals at research stations. Though AGF-FFS, these aspects suddenly becomes theirs, providing farmers the capacity to adapt or develop appropriate technologies by themselves. Most farmers, therefore, are keen to continue with field studies, as this gives them sense of autonomy and recognition.

Most follow-up field studies and re-entry plans are organized in a cropping season immediately following completion of an AGF-FFS main course. In this way, farmers who are curious about results of their studies, can straight away see and analyze results for themselves. In addition to follow-up studies, farmer groups may decide to focus on enhancement studies. These studies, which can be short or long, and usually have a broader scope, are conducted to support future AGF-FFS programs[177].

Thus, farmer-participants should sit together to plan what they will do upon completion of a season-long AGF-FFS program. This means that before an initial season-long training ends, they must already start re-entry planning for follow-up activities in their communities to sustain initial gains. In so doing, community-based organizations (e.g., AGF-FFS clubs) are likewise strengthen.

How long will this exercise take?

- One to two hours meeting with participants before an initial season-long AGF-FFS ends, or just before start of succeeding planting season with facilitators and other interested stakeholders; and
- One to two hours mini-workshop and participatory to finalize re-entry plans.

177 Smolders, H. and Caballeda, E. 2006. Field Guide for Participatory Plant Breeding in Farmer Field Schools: With Emphasis on Rice and Vegetables. Participatory Enhancement of Diversity of Genetic Resources in Asia (PEDIGREA) Publication. Center for Genetic Resources, the Netherlands. pp99-122.

Learning objectives

- To discuss with participants current problems, issues, and concerns arising from initial season-long AGF-FFS activities; and
- To organize prospective graduates and develop re-entry plans and implementation strategies on how to sustain lessons learned gained from initial AGF-FFS learning experiences.

Methodology

- Meetings, mini-workshops and brainstorming

Materials

- Notebooks, ball pens, and manila paper and marking pen per group

Steps

<u>Field visit</u>:

1. Conduct assessment and evaluation of initial season-long AGF-FFS activities with facilitators and participants prior to planning of activities;

2. Summarize and analyze results of assessment and evaluation. Brainstorm in a big group on how to sustain learning experiences gained from initial season-long AGF-FFS activities. Some guide questions may be used to ask participants as regards;

   ☑ What good things did you learn from initial season-long AGF-FFS activities?
   ☑ What re-entry plans do you propose as succeeding season's AGF-FFS follow-up activities?
   ☑ What important lessons did you learn from initial season-long AGF-FFS activities? How will you use those learning experiences in your own fields?
   ☑ How will be your strategies to sustain your learning experiences gained during initial season-long AGF-FFS activities?
   ☑ What livelihoods projects do you want to establish after initial season-long AGF-FFS activities to improve your way of living?

3. Allow participants to conduct brainstorming in small groups to agree on what they plan to do for succeeding season as a result of lessons learned from initial season-long AGF-FFS activities;

4. Go back to session hall, consolidate outputs of re-entry plans proposed by each small groups and report to big group;

Mini-workshop:

5. Divide big group into five small groups and give them their respective tasks and assignment. Provide sheets of paper and pens to write results of discussion. Ask farmers to further elaborate on questions about their learning experiences during the initial season-long AGF-FFS activities. Facilitator should not read out questions but introduce them in a natural way during brainstorming in small group:

   - ☑ Good things learned during initial season-long AGF-FFS activities;
   - ☑ Proposed re-entry plans as a results of lessons learned from initial season-long AGF-FFS activities; and
   - ☑ Proposed strategies on how to sustain lessons learned gains from initial season-long AGF-FFS activities.

Participatory Discussions:

6. Ask each small group to present and discuss results; and

7. Facilitators guide a participatory discussion to synthesize and summarize results of this exercise, then finalize a re-entry plan for succeeding season.

Some suggested questions for processing discussion

- ❑ Note: Since this exercise is a guided participatory discussion, there is no need to conduct further processing discussions.

GLOSSARY

Activity is a generic term for participatory training experiences such as exercises, games, role-plays, small group experiences, and instrumentation.

Adaptation refers to: (a) a characteristic of survival value for plants or animals; survival in a specific environment; or (b) process by which individuals (or parts of individuals), populations or species change in form or function in such a way as to survive better under given environmental conditions (also the results of this process).

Afforestation refers to: (a) conversion of bare land into forest land by planting of forest trees; and (b) planting of a forest crop on land that has not previously, or not recently, carried a forest crop.

A-frame is an inexpensive soil surveying equipment use to locate contour lines of a land or farm. It is a simple and practical instrument that can easily be made by farmers using locally available materials.

Agricultural limes are lime materials containing oxides, hydroxides, or carbonates of calcium (Ca) and magnesium (Mg) that are applied to soil to reduce soil acidity.

Agrisilvicultural system is combination of agricultural crops with woody perennials. This system includes: alley cropping, multi-storey, boundary planting, windbreaks, improved fallow, and taungya.

Agrisilvipastoral system is combination of agricultural crops, woody perennials, and livestock. This system includes silvipastoral, multi-storey + animals, and alley-cropping with pasture grasses and agricultural crops.

Agro-ecosystem refers to a collection of physical, environmental, economic, and social factors that affect a cropping enterprise.

Agroforestry is a land-use management system that combines production of trees with agricultural crops, animals and/or other resources in the same area. It aims to increase or sustain productivity while maintaining ecological stability. It also hopes to increase income for improved quality of life.

Agroforestry ecosystem analysis (AFESA) refers to weekly study of crop agroforestry ecosystem components, such as plant morphology, agronomy, herbivores, natural enemies of the herbivores, diseases, rats, weather, water, weeds, etc., in a ‘learning field’, which will lead into a process useful for decision-making.

Agroforestry system is a land-use system in which woody perennials (e.g., trees, shrubs, palms, bamboos) are deliberately used on same land management unit as agricultural crops (e.g., woody or not), animals or both, either in some form of spatial arrangement or temperal sequence. In agroforestry systems there are both ecological and economic interactions between different components. ‘Agroforestry’ is a generic term for different types of systems, such as, agrosylvicultural system, or sylvopastoral system

Allelopathy refers to: (a) an interaction between different plants or between plants and microorganisms in which substances (e.g., allelo-chemicals) produced by one organism affect the growth of another (usually adversely); (b) suppression of germination or growth or the limiting of the occurrence of plants, as a result of the release of chemical inhibitors by some plants; or (c) influence of plants (other than micro organisms) upon each other arising from the products of their metabolism.

Alley cropping is an agroforestry intercropping system in which species of shrubs or trees are planted at spacing relatively close within row and wide between row, to leave room for herbaceous cropping between, that is, in the ‘alleys’ (synonym: hedgerow intercropping).

Antibiosis (amensalism) occurs when one species is suppressed while a second is not affected, typically a result of toxin production.

Ammonium phosphate (ammophos) is a chemical fertilizer material, which is a rich source of nitrogen and phosphorus elements or nutrients.

Ammonium sulfate (ammosul) is a chemical fertilizer material, which is a rich source of nitrogen and sulfur elements or nutrients.

Aphids are soft-bodied tiny insects whose color normally varies from yellowish-green to dark olive-green or almost dull black, which cause injury by sucking up cell sap of plants.

Apomicts, as opposed to true seeds, are seeds produced without fertilization (e.g., many forage grasses).

Avoidance is a fundamental principle in pest and disease management, which alters environment by making it less favorable to growth and development of a pest or a pathogen.

Bacteria are considered the simplest of plants. They are tiny, consist of only one cell, and multiply by cell division as frequently as every 10-15 minutes. They lack green pigments and cannot produce their own food. Most of them gain entry through wounds or natural openings found on surface of plants. Once inside, bacteria multiply rapidly, break down plant tissues, and usually move throughout plant.

Bacterial diseases refer to diseases that are caused by bacteria. The most common symptoms of bacterial diseases on plants are maceration or disintegration of tissues, 'water-soaked' appearance, and 'foul' odor.

Bacterial oozing technique (BOT) is a practical tool used by farmers for identifying bacterial wilt disease of solanaceous vegetables. This consists of putting a cutting of suspected diseased plant part in a glass filled with tap water to allow a cloudy bacterial fluid to ooze from that plant part to water.

Bacterial wilt, caused by Ralstonia solanacearum, is a bacterial disease of solanaceous crops causing rapid wilting, stunting, and death in tomato, and wilting of younger leaves or slight yellowing of leaves in potato. It survives in soil for a long time, infects many plants including weeds, and spreads through infected seedlings, contaminated irrigation water, farm implements, and animals.

'**Ballot box' evaluation (BBE)** is a simple, easy-to-use pre- or post-training evaluation tool for farmers and extension workers of their knowledge and skills in integrated pest management IPM). A participant selects an appropriate 'ballot box' where he or she drops his or her code number representing a correct answer.

Bamboo is a vegetation type consisting of woody graminaceous species from sub-family Bambusoideae. Found as dense thickets or foresting high-altitude tropics that have only a sparse ground cover of herbs, grasses, mosses and ferns. Sometimes also in the lowlands.

'Barangay' soil map is a map developed to indicate not only soil types but also location of farmer's individual farms. The information contained in a barangay (village) soil map is very useful in determining appropriate soil management strategies for each soil type as determined by actual field examination and sharing of experiences among farmers.

Baseline data are agronomic, demographic, socioeconomic, and other related data gathered from farmer field school (FFS) participants, which are used for comparison with current data when stakeholders review and assess impact of local integrated pest management (IPM) programs on farmer-participants and their communities.

Bean fly is a pest of leguminous vegetables belonging to the fly family, whose yellowish to reddish maggots hatch from eggs to feed as miners, working down the petiole into stem of plants.

Beating up refers to restocking failed areas in a crop or stand by further sowings or plantings. Many other terms are also used for this, such as, ‘blanking’, ‘filling’, ‘gapping’, ‘infilling’, ‘recruiting’, ‘reinforcement planting’.

Beneficial insects refer to insect groups that give benefit to farmers in terms of insect pest reduction and improvement of yield and quality of products. A beneficial insect can either be a parasitoid or a predator that controls population of pests or pollinators.

Beneficial microorganism refers to a soil-borne organism that gives benefit to farmers in terms of suppressing harmful soil-borne plant pathogens which consequently improve yield and quality of products. Beneficial microorganisms interact with harmful microorganisms through competition, amensalism, or parasitism.

Bench terracing is an effective erosion control measure practiced in the Cordilleras, which consists of creating a series of level strips running across a slope.

Big group discussion is a term used to describe the use of big groups (e.g., plenary sessions) in identifying and solving problem by participatory discussion.

Biogeochemical cycles refers to hydrologic (water), carbon-oxygen, nitrogen, and soil nutrient cycles in agroforestry systems.

Biological control is use of living organisms such as parasitoids, predators, and disease organisms to control pest populations.

Biological control agents refer to any living organism used in reducing pest population in organic vegetable farms.

Black cutworm is a lepidopterous pest of vegetables whose blackish larva remains buried below surface of ground level and attacks root and base of crop during first two weeks of crop growth.

Borer insects refer to a group of destructive insects whose immature stages bore or make tunnels on fruit or stem of plant.

Brainstorming is a basic and highly popular tool for group problem solving. It can be used to identify problems, to suggest causes for problems and to propose solutions for problems. The technique emphasizes deferred judgment and quantity to get quality.

Budding is a type of vegetative propagation. It is usually used instead of grafting if one wants to economize in the use of scion materials, since each bud is a potential new plant; a scion is reduced in size to contain only one bud in a small portion of the bark with or without wood. It is at times termed as bud grafting because the physiological processes involved are the same as in grafting.

Burn refers to setting fire (‘firing’) forest, woodland or rangeland (1) in forestry, to dispose of the slash left after forest clearing or, (2) in rangeland, to burn off old, inedible plant materials and to encourage a flush of new grass for animals to graze. It is important in which part of the dry season the burning is done, as it influences the amount to be burned and its condition, as does, for the latter, the time of day and the weather.

Bush refers to: (a) a general term for low tree–high grass vegetation occurring in semi-arid or seasonally arid regions. Can be further described by the dominant species present, such as, ‘acacia bush’, ‘combretum bush’; or (b) a low, well-branched shrub.

Bush fallow refers to natural vegetation that arises when land is left uncultivated for some time. Composed of small trees, shrubs, grasses (and sedges) and herbaceous plants. Bush fallow may be grazed or browsed and firewood collected from it before it is returned to cultivation.

Cabbage butterfly is a butterfly whose caterpillar feeds and produces big holes on the foliage of cabbage and other cruciferous crops.

Cabbage moth is a brownish gray pyralid moth whose larva attacks the growing point, which often results to non-formation of head or perforations on leaves of cabbage and other cruciferous crops during heavy infestation.

Cage trap is a type of trapping material made of appropriate wire mess, which is used in collecting and controlling field and house rats.

Calcium phosphate (CP) is an organic foliar spray derived from bones of grass-eating animals. It serves as flower inducer and strengthens flowers of crops

Calendar insecticide application means any scheduled insecticide treatment undertaken with no consideration for pest density or anticipated crop loss.

Callus in a cell culture, refers to a mass of thin-walled undifferentiated cells, developed as a result of wounding or culture on nutrient media.

Canopy means assemblage or volume of leaves of all ages supported by branched stems that form the photosynthetic layers of a tree or crop.

Carbon cycle refers to transformation of carbon, a common constituent of all organic matter, through process termed bio-cycle, which makes possible the continuity of life on earth.

Case study is a technique designed to give group training in solving problems and making decisions. The facilitator's role is typically catalytic rather than didactic.

Cash cropping is growing crops for sale either to a market or to agents, or at the 'farm gate'.

Catch crop refers to: (a) an alternate crop planted after the regular crop has failed or when other circumstances make its success doubtful; usually a short-season crop ;or (b) a crop produced incidental to the main crop of the farm and usually occupying the land for a short period; also a crop grown to replace a main crop that has failed.

Catchment area refers to land surface on which rain falls. Sometimes called a 'water catchment'. When referring to particular streams or rivers, it is the land surface from which water (rain) flows into them, sometimes through tributaries (feeder streams).

Certified seed is a high quality seed intended for commercial planting that passes through a seed certification standard of National Seed Industry Council in terms of genetic purity and identity. A certified seed is classified by a certifying agency depending upon its quality either as a breeder, a foundation, a registered, a certified, or a good seed.

Chemical control means any strategy or method that employs the application of any pesticide to control pests.

Chewing insects refer to a group of destructive insects whose destructive stages have mandibulate or chewing mouthparts.

Club root is fungal disease of crucifers causing swelling of the roots with characteristic club-like shapes and a reduction of fine lateral roots. The later reduces ability to absorb water resulting to stunted growth and death of plants under dry climatic conditions.

Common cutworm is a lepidopterous pest of vegetables whose greenish to blackish-brown larva is voracious feeder and feed actively at night. Damage consists of feeding on young and mature leaves of host making large holes on leaf blade.

Community-based forestry is a forestry developed in areas marginal to agriculture, with many members of a community being landless or small-scale farmers, often characterized by ecological and cultural diversity and employment of traditional technologies. Communal land development is basic to this type of forestry.

Competition is a condition where there is a suppression of one organism as two species struggle for limiting quantities of nutrients, oxygen, or other common requirements.

Compost tea is a concentrated microbial solution ('brew') produced by extracting beneficial microbes from compost. Aside from providing direct nutrition, it also makes available microbial functions, such as competing with disease-causing microbes, degrading toxic pesticides and other chemicals, producing plant growth hormones, mineralizing plant available nutrients, fixing nitrogen and beneficial microbes, leaving no room for pathogens to infect plant surfaces. It is applied much like a fungicide, to control target plant pathogens.

Composting refers to a process involving breakdown of organic materials through action of decomposers (e.g., microorganisms and macro-organisms) to form small bits of organic matter called compost.

Conifers are trees that usually but not always have needle leaves or scale leaves and that bear separate male and female cones. They are usually, but not always, evergreen. Some, for example, larch, are deciduous. Conifers belong to the class Gymnospermae.

Conservation is protection, use and improvement of natural resources according to principles that will assure their highest economic and social benefits.

Consumers' guarantee refers to an organic guarantee system which involves groups or organized consumers (e.g., Altertrade in Negros Occidental) who certify and buy organic products (e.g., banana) of known producers. The major activities in a consumers' guarantee program are: standard setting, inspection, and certification.

Containerized nursery is a type of nursery where seedlings are grown in potting medium brought in from a number of sources. It can be either mixed on or off-site with required ingredients.

Content refers to subject matters or topics taken up in an activity or activities to attain objectives.

Contour is a linear demarcation of land surface that indicates places of equal elevation; lines on a map that connect these points.

Contour planting or farming refers to a method of farming where cultivation is accomplished by plowing across slope following contour lines rather than up and down.

Cost and return analysis is an analysis of production cost relative to net return in an enterprise. Usually, the lower the cost of production, the higher is the net return for a particular enterprise.

Cost of production refers to amount of labor, power, and material input costs in each operation for every enterprise.

Cover crop refers to: (a) a crop grown to reduce soil erosion, conserve nutrients and provide organic matter. Cover crops are grown between the rows of a main crop or during the season when a cash crop is not being grown; or (b) in experimentation, a crop grown before an experiment to reduce soil variability.

Critiquing is an activity to assess progress and effectiveness of learning in terms of learning processes, relationships, physical environment, and problems and issues relevant to learning as expressed by participants.

Crop residue-inhabiting pests refer to all pests whose main harborage or habitat, in the absence of a suitable host, is crop residue, such as weeds or any plant debris often left in the field after harvest.

Crop diversification refers to the planting at the same time in on-farm or field of as many crops to maximize land uses and minimize pest and disease occurrence depending on such factors as crop preference, technical knowledge, adaptability, market demands, and profitability.

Cross-pollinating vegetables are vegetables wherein pods or fruit setting result from union of female (ovule) and male (pollen) reproductive cells of two different plants, varieties, or cultivars.

Crop rotation refers to the growing of two or more crops after another in a regular succession for two or more years with an idea that a crop susceptible to a pest or disease is followed by a resistant crop or combined in simultaneous cropping with other crops.

Crop sequencing refers to proper arrangement of crops planted in succession to maximize production. A good cropping sequence is one that will conserve or improve nutritional status of the soil, add organic matter, improve soil structure, protect land from erosion and, ultimately, give high yield.

Cucurbits are vegetable crops belonging to the cucurbit family. Some examples are squash, cucumber, chayote, zucchini, watermelon, bitter gourd, and loofah.

Cultural control is the modification of the environment by making the area less attractive to pests (e.g., tillage, planting date, crop rotation, etc.).

Curd- or head-forming vegetables are vegetable crops grown primarily for their flowers or terminal buds technically known as curds or heads, respectively. Some of these vegetables are Chinese cabbage, cabbage, head lettuce, broccoli, and cauliflower.

Cutworm is a polyphagous moth whose caterpillar is basically a leaf-eater, which can severely defoliate a crop when population is heavy.

Cuttage or Use of Cuttings is a method of vegetative propagation involving regeneration of structural parts in detached vegetative parts under favorable conditions. For agroforestry species, it can be a portion of a stem or a leaf of donor plants placed under favorable conditions for induction of roots and shoots.

Damping off is a fungal disease (caused by Sclerotium rolfsii, Rhizoctonia solani, or Pythium sp.) of cruciferous, solanaceous, leguminous, and cucurbit crops at seedling stage, which can be distinguished by the presence of water-soaked lesions on the hypocotyls or reddish-brown lesions at the base of seedlings at or just below the ground level.

Debate is a participant-involving technique, structured formally or informally, to generate varying viewpoints on an issue or problem.

Destructive insects refer to a group of insects that feed on vegetable crops specifically on leaves, stems, flowers, and fruits causing damage to these crops thereby affecting yield or quality of produce.

Diamondback moth (DBM) is a small gray moth with a diamond pattern at the back when its wings are closed, whose larva feeds on the leaves of cabbage and other cruciferous crops.

Didactic teaching is a traditional approach to teaching or instructing, entailing the dissemination of facts, knowledge, information, manual skills, etc. Today it is contrasted with experiential or discovery-based learning.

Disease triangle refers to an equivalence theorem, which states that effect of environment, pathogen, and host can each be translated into terms of epidemic rate parameter. A result is that changes in anyone of disease triangle components (e.g., from a more to less susceptible host, from a favorable to an unfavorable environment, or from a more aggressive to a less aggressive pathogen) all have an equivalent effect on an epidemic.

Discovery-based learning is a learning process accomplished by doing and experiencing as opposed to listening, observing, reading, viewing, etc. It is synonymous with experiential learning.

Dormancy refers to the inability of a seed, a bulb or a tuber to germinate after harvest even when provided with the necessary conditions for germination.

Downy mildew is a fungal disease of solanaceous and cucurbit crops, which appear as yellow spots on the surface of the leaves with a purplish downy growth on the lower surface. These yellow spots may soon turn reddish-brown and eventually kill the leaves.

Earthworms are very important soil macro-organism and most helpful living things in soil system. Earthworms are farmers' friends. They digest organic matter and help create humus. They fertilize soil with their droppings. The more earthworms there are in soil, the more fertile soil is likely to be.

Earwigs *(Euborellia annulata)* are general predators of eggs, larvae, and pupae of Lepidopterans, Coleopterans, and Dipterans as well as leafhoppers, planthoppers, aphids, and many soft-bodied insects. They belonging to Order Dermaptera, are nocturnal (more active at night), and prefer slightly moist conditions as their habitat.

East-west row growing refers to vegetable growing in east-west row orientation or in relation to the rising and setting of the sun.

Ecology is the study of all organisms and their interactions with each other and with the physical environment.

Ecosystem is a biological community considered in relation to its physical environment.

Environment is totality of external conditions affecting a living organism or a community (biocoenosis) of organisms in their habitat (biotope).

Environmental factors are factors over which farmers often have little direct control, including the physical, biological, and socioeconomic aspects of their setting.

Eradication is a fundamental principle in pest and disease management, which involves the elimination of a pest or pathogen once it has become established on plant or in a cropping area.

Erodibility refers strictly, to propensity of a soil to be eroded; that is, soils are more erodible or less erodible.

Establishment is successful growth of young plants, brought about by providing them with the right site and favorable conditions.

Evaluation is the process of assessing the effectiveness of various learning activities, the participants, the facilitators and the conduct of the whole program.

Evaporative cooling method (ECM) is a simple method used to prolong the storage life of vegetable produce, under ordinary conditions for a few days, where cooling occurs when water is evaporated from a moist surface using heat or respiration coming from the produce in the process of evaporating.

Exclusion is a fundamental principle in pest and disease management, which includes exclusionary measures to prevent a pest or pathogen from entering and becoming established in a non-infested or non-infected area.

Exercise is a structured learning experience marked by a learning goal, high participation, and structure. Its overall purpose is to generate data from participant analysis.

EYCO is a form of homemade biological pesticides, which includes use of egg yolk + cooking oil. The EYCO is simply made at home by manual or motor mixing of cooking oil and egg yolk. Cooking oil showed direct and indirect effects in control of plant pathogens and insect pests, while egg yolk served as natural emulsifier and biological fertilizer.

Facilitator is a trainer or specialist who, as a change agent, structures learning situations and experiences with the end result of enhancing the learner's capabilities to be sensitive to his or her own processes and behavior. He or she is one who functions in a way to allow participants to assume responsibility for his or her own learning. The term is in contrast to the more didactic instructor, teacher, lecturer, presenter, etc.

Farmers' crop protection (FCP) practice refers to usual crop protection practice of farmers prior to the introduction of integrated pest management (IPM) practice in any vegetable production area. Normally, an FCP consists of a calendar-scheduled pesticide application for the control of pests and diseases.

Farmer field school (FFS), by design, is a 'school without walls', where about twenty five farmers meet once a week for the duration of the cropping season from planting to harvest. In each weekly session of an FFS, the farmers, working in-groups, conduct agro-ecosystem analysis (AESA), team building activities and special topics. Special topics are designed based on immediate problems encountered by farmers in their farming activities. Trained FFS facilitators allow farmers to be experts, facilitating them to bring forth and examine their own experiences.

Fast-growing tree is a tree species that matures quickly and is usually not long lived. Can often be highly productive on fertile sites: 15–20 t ha–1 of wood products per annum or more. Some, for example, leguminous species in the Mimosaceae and Papilionaceae families and actinorrhizal plants such as the genus Alnus, may also be nitogen fixing. Among the many genera included are Calliandra, Gliricidia, Leucaena and Sesbania.

Feed-backing is a way of receiving information from or giving to one or more participants or facilitators concerning one's behavior, attitudes and relationships in a learning situation.

'Feel' method is a common field method of classifying soil texture for vegetable production by its feel or by rubbing soil between thumb and fingers.

Fertilizer management means any strategy or method that will lead to effective and efficient use of fertilizers in crop production.

Field day is an occasion when farmers and facilitators show other people or the community what they have learned and the results of their participatory technology development (PTD) activities.

Field trip or field visit is a planned visit or tour to a given area, site, laboratory, field, plantation, project, etc. to study its operation in depth, learn lessons and to report back thereon. The field trip is typically a team project or activity, although not universally so.

Field walk is a planned observation accomplished by walking in a field nearby a training site to have a first hand experience of an issue or problem related to the training. Observations in a field walk are synthesized through small and big group discussions.

Final crop, in forestry, refers to trees that remain after successive thinning and are finally felled at maturity.

Fire is used in forestry and range management to carry out a burn in a controlled manner and to dispose of unwanted vegetation. A head-fire is where the fire is lit at the bottom of a slope and allowed to burn quickly to the top. A backfire is lit at the top and burns slowly downhill. Flank-fires are lit at the sides; jackpot fires are where only piled slash is burned. A wildfire is a burn occurring spontaneously (that is, an uncontrolled fire).

Firebreak refers to; (a) in forestry, an existing barrier, or one constructed before a fire occurs, from which flammable materials have been removed, designed to stop or check creeping or running fires. Also serves as a line from which to work and to facilitate the movement of men and equipment in fire suppression ; or (b) a form of fire protection, usually against uncontrolled fires, where either (i) a zone of trees and any other woody vegetation is removed so that only a limited amount of flammable material is present or (ii) tree species that are relatively less flammable are planted (for example, broadleaved) so as to separate more flammable species (for example, resinous conifers).

Flea beetle is an insect pest belonging to the beetle family, whose adult eats out ‘pin holes’ on the leaves of the host plants. If attack is excessive, the leaves fall and the plants may be completely defoliated.

Folk media presentation is a learning tool used to convey a developmental message using the most appropriate local medium that is familiar to a group of people. Local songs, dances, poems, proverbs, stories, tales, legends, and drama are some of the common forms of folk media.

Forest is a continuous stand of trees > 10 m high, with interlocking crowns. There are many kinds of forests and ways to classify them, for example, by eco-zone, vegetation type, climate, dominant species, or conformation.

Forest product refers to material that is obtained for use from a forest; includes major products such as poles and round-wood (for timber), as well as minor products such as medicinals, gums, resins, oils, fungi, honey.

Fruit worm is a lepidopterous pest whose larva tunnels into the fruit and feed voraciously on the tissues causing fruit to rot and subsequently fall off.

Functional questionnaire refers to questionnaires in a ‘Ballot Box’ test that focuses on functions of organisms or specimens rather than on their technical definitions. A functional questionnaire for ‘Ballot Box’ evaluation deals mainly on knowledge and skills in identification of pest damages, disease symptoms, arthropod pests and their natural enemies, organic fertilizers, as well as soil, irrigation, and environmental stresses in organic vegetable fields

Fungal diseases refer to diseases caused by fungi. The general symptoms of fungal diseases on plants are the presence of ‘cottony-like’ and ‘dry’ appearances (e.g., leaf spots) of infected plant parts.

Fungi are tiny, simple plants commonly called molds. Since they do not have green color, they lack the ability to make their own food. They depend upon living host plants for food. Thus, they are parasites, and in the course of their feeding, most produce diseases on their host plants.

Fusarium wilt is a fungal disease of solanaceous, leguminous, and cucurbit crops, which can be distinguished by the presence of a reddish discoloration on the roots, which gradually darkens and finally turns brown. The diseased plants are stunted and during dry weather, the leaves turn yellow and drop.

Game is an experiential learning activity marked by a learning goal, competition, rules, scores or outcomes and oftentimes with winners and losers. Games may be content-laden or be a 'pure' game devoid of content.

Germination refers to growth of embryo in the seed until emergence of embryonic radicle through the seedcoat. In seed testing, the capacity of the embryo to emerge from seedcoat with essential structures indicates a potential to produce normal plants. In dry seeds, germination follows imbibition (e.g., absorbing water and swelling).

Golden cyst nematode is a destructive nematode pest that can inflict serious damage to vegetable crops at high population density. Symptoms on above ground plant parts resemble that of drought injury or nutrient deficiency.

Grading refers to the sorting of vegetable produce according to a set of criteria recognized by the vegetable industry.

Graftage or Grafting is a general term of vegetative propagation method whereby two plant parts are joined in such a manner that they will unite, continue their growth, and develop as one plant.

Grassland refers to land covered with grasses and other herbaceous species. Woody plants may be present, but if so, they do not cover more than 10% of the ground. There are many different types of grassland designated by eco-zone, topography, climate, soil conditions, and so on. Derived grassland is maintained in that condition by regular burning; edaphic grassland arises on particular soil types, for example, those found in or around permanent or seasonal swamps.

Green leaf manuring (GLM) refers to the soil incorporation of plants grown outside an area where it is not intended before their flowering stage as a source of organic matter. Weeds gathered on side of terraces such as wild sunflowers, when incorporated in vegetable fields are classified as green leaf manures.

Green manuring (GM) refers to the soil incorporation of plants grown at a site where it is needed before their flowering stage as a source of organic matter. All fast-growing weeds when incorporated before flowering at land preparation and hilling-up operations are classified as green manures.

Green muscardine fungus (*Metarhizium anisopliae* [Metchnikoff] Sorokin) or GMF is a naturally occurring insect pathogen that attacks more than 200 insects. GMF spores land on host's body and high humidity favors its growth. During its development, fungus consumes its host's contents. When host dies, fungus emerges as a white growth and then turns dark green with age. The spores are spread by wind or water to new hosts.

Gross return refers to the product of price and volume relative to the type of produce in every enterprise.

Group dynamics is a process of interaction of a group at work. It includes such processes as communication, goal setting, decision-making, support giving, and leadership.

Gully is a channel cut by concentrated runoff but through which water commonly flows only during or immediately after heavy rains, or during the melting of snow. Conservationists distinguish a rill from a gully by its depth. A gully is sufficiently deep not to be obliterated by normal tillage operations.

Hardening-off refers to; (a) process by which young seedlings are prepared for transplanting by gradually reducing water, shade or both, and thus causing changes in the leading shoot that renders it more resistant to drought and cold; or (b) treatment of tender plants to enable them to survive a more adverse environment; achieved by, for example, withholding nutrients, lowering temperatures, allowing temporary wilting, and other methods to slow growth rate.

Hard seed is a seed with thick and tough test, which delays water penetration and germination.

Hardwoods are timbers from broadleaved, angiosperm trees often, but not always, harder than the timber from conifers (softwoods). They are often, but not always, deciduous (Eucalyptus, for example, are hardwoods).

Hedges are bushes or shrubs or trees planted in a row and trimmed. Used to separate one piece of land from another.

Hedgerow is a barrier of bushes, shrubs or small trees growing close together in a line. A hedge is similar but pruned.

Herbivore is any animal, including insects, that feeds on plant material.

High forest system is a silvicultural system that produces forest trees from seedlings rather than from coppice.

Hilling-up is a cultural management practice whereby soil is cultivated and raised at the base of plants primarily to enhance better root development, improve anchorage, and suppress growth of weeds. Hilling-up also disturbs development of other soil-borne pests and exposes to sunlight many soil-borne plant pathogens that thrive near the base of plants.

Humus refers to: (a) organic matter, including lignin that has reached a more or less stable, advanced stage of decomposition. It is usually characterized by its dark color, considerable content of nitrogen, a carbon-to-nitrogen ratio approaching 10:1, and by various physical and chemical properties, such as high base-exchange capacity, water absorption and swelling; (b) plant and animal residues in the soil that have undergone some appreciable degree of decomposition; and (c) lower part of the litter layer, consisting principally of amorphous organic matter and located immediately above the A horizon. A complex colloidal mixture

Hydroization is a pre-sowing hardening technique to induce drought resistance, which consists of soaking seeds for 1-48 hours depending on seeds, and then air drying to their original moisture content before sowing.

Imbibition is a process of seeds absorbing water from their surroundings or the stage at which they do it, for example, after a dry seed has been planted in moist soil.

Inorganic mineral transformation refers to a long series of bio-chemical transfer beginning with proteins and related compounds in soil that culminates in appearance of simple soluble products (e.g., ammonium compounds, nitrates, and sulfates) readily available to plants.

Insect pathogens refer to a group of biological control agents, mostly parasitic micro-organisms, used to control insect pests of vegetables. Some insect pathogens infecting various insect pests are viruses, bacteria, and fungi.

Insecticide is a pesticide or chemical used to control insect pests.

Insecticide non-user refers to a farmer or individual that does not use any insecticide to control insect pests.

Insecticide user refers to a farmer or individual that uses insecticides to control insect pests.

Integrated crop management (ICM) refers to all management strategies that are ecologically, economically, and socially acceptable. Therefore, integrated pest management (IPM) and integrated soil management (ISM) are integral part of ICM.

Integrated pest management (IPM) is a pest management strategy that builds on biological control as its foundation. In practice, it develops farmer's ability of making critical and informed decisions that renders production systems more productive, profitable and sustainable. Thus, it makes farmers experts in their own fields.

Integrated rodent management (IRM) refers to a community-based rodent management approach, which may include: (a) rat damage assessment procedure for pest monitoring; (b) physical and biological reduction control procedures and management strategies; (c) organized farmers and extension workers; and (d) legislations, instructions, and related administrative set-ups implementation of rodent management at various levels of undertakings.

Integrated soil nutrient management (ISNM) includes efficient soil nutrient, water and weed management, effective soil-borne pest and disease management as well as effective use of soil microorganisms for better crop productivity. Consequently, ISM aims to allow a grower to produce optimum yield and sustained long-term returns.

Integration is that stage of learning where the learner is able to piece together the learning in an activity and sees the value in its application to his or her real life situation.

Interaction refers to the dynamics among participants, including communication patterns, relationships, role assumptions, etc.

Intercropping refers to: (a) cultivation of two or more crops simultaneously on the same field, with or without a row arrangement (row intercropping or 'mixed intercropping'); or (b) growing of two or more crops on the same field with the planting of the second crop after the first one has already completed development. Also called relay cropping. See also mixed cropping, multiple cropping

KASAKALIKASAN is the acronym for Kasaganaan ng Sakahan at Kalikasan. It means Nature is Agriculture's Bounty. It is the Philippine Government's program that seeks to popularize Integrated Pest Management (IPM).

Labor and power cost refer to the amount of labor and power spent in each operation for every enterprise which is expressed in man-days, man-animal days, or man-machine days.

Leaf-folder is a lepidopterous pest whose larvae feed on leaf tissue and, as it becomes older, folds the leaf to form a tube.

Leafhopper is a pest belonging to the cicada family whose nymphs and adults attack solanaceous vegetables. As it feeds, it injects a toxic substance, which produces a condition known as 'hopper-burn'.

Leaf-miner is a small grayish fly whose larvae mine in-between the leaf epidermis which when several of them work in the same leaf, develop blotch and turn the entire leaf white and wither, resulting in the stunting of subsequent growth and ultimately in poor yield.

Leaf spot is a fungal disease of cucurbit and leguminous vegetables characterized by the presence of spots, circular to irregularly shaped, with tan or gray centers, and surrounded with reddish-brown to dark-brown margins.

Leafy vegetables are vegetables grown mainly for their leaves. Some examples of leafy vegetables are pechay, mustard, lettuce, celery, 'kangkong' (swamp cabbage), and 'kulitis' (amaranth).

Learner-centered training refers to a training situation wherein participants are given the opportunity to assume responsibility for their own learning.

Learning field is that portion of a farmer's field school measuring at least 1,000 square meters, containing a farmer-run comparative study of integrated pest management (IPM) and farmer's crop protection (FCP) practices. It is in this field that farmers practice agro-ecosystem analysis (AESA) which includes plant health, water management, weather, nutrient management, weed density, disease surveillance, and observation and collection of insect pests, beneficial predators, and parasites. Farmers interpret data from the learning field through direct experience using AESA to make field management decisions and develop a vision of balanced ecological processes.

Lecture method is a didactic instructional method, involving one-way communication from the active presenter to a more or less passive audience or trainee group.

Leguminous vegetables are vegetables belonging to the legume or pulse family. Some examples of leguminous vegetables are bush long bean, cowpea, snap beans, sweet peas, garden peas, chicken peas, and winged beans.

Liming refers to the addition of lime to reduce soil acidity or until the soil pH is within that required for optimum plant growth. Available iron, aluminum, and hydrogen must be replaced by Ca and Mg bases through liming to decrease soil acidity. Adding oxides, hydroxides, or carbonates of calcium and magnesium commonly does this.

Marcotting or Air Layering is a method of rooting selected shoot or branch by wrapping a portion of stem with a rooting medium with or without stem treatment; it involves growing of roots on a branch while it is still part of the tree

Market chain refers to market intermediaries (e.g., households, neighbors, village collectors, traders, wholesalers, etc.) where different types of organic products (e.g., mature, immature fruits, flowers, leaves, etc.) pass through between farmers or producers and their different types of consumers.

Market competition refers to dynamics among potential customers with similar needs and sellers offering various ways of satisfying those needs. The development of successful market competition strategies depends to a large extent on planner's ability to segment markets.

Market information refers to all available data from primary (e.g., obtained from new research surveys whenever new problem arises) and secondary (e.g., often available for free, or for a fee that is usually far less than cost of obtaining primary data) sources that can be used by marketing manager to help them make effective marketing decisions.

Material input cost is the total cost of all materials used in each enterprise such as seeds, fertilizers, and herbicides, among others.

Maturity index refers to signs expressed by a crop to show that it is ready for harvest.

Methodology refers to the various ways and means by which the dissemination of concepts, ideas, knowledge, and skills can be affected. This may include the definition of instructional media and the materials to be used as aids in facilitating the learning process.

Microbial-based fertilizers are organic fertilizers consisting prepared from live cells of micro-organism strains. Some of these microbes could fix air nitrogen, render phosphate soluble, or degrade cellulose.

Miner insects refer to a group of destructive insects whose immature stages puncture or mine on leaves down to petiole and stem of plant.

Mulching is the practice of covering bare soil around the stem of a growing plant with a layer of organic materials, plastic, and other appropriate materials primarily to conserve soil moisture, suppress growth of weeds, minimize splash soil erosion, and soft rot or other soil-borne disease infections.

Multipurpose tree is a woody perennial that is purposefully grown to provide more than one significant contribution to the production or service functions (for example, shelter, shade, land sustainability) of the land-use system that it occupies. Also called 'agroforestry tree'.

Multistorey cropping is planting of multi-species crop combinations involving both annuals and perennials with an existing stand of perennials. An association of tall perennials with shorter statured crop species.

Natural enemy refers to a beneficial insect, a predator, a parasitoid or an insect pathogen utilized for the control of insect pests.

Natural pest control is the conservation of beneficial insects, predators, and parasitoids by preventing their destruction or preserving their habitat. Choice of plant varieties, maintenance of alternative hosts, and proper soil management are among the tactics employed to keep beneficial species active and populous enough to control pests.

Need-based or threshold-based insecticide application means any insecticide treatment undertaken only when actual pest population exceeds a predetermined threshold level.

Nematodes are active, slender, threadlike roundworms about 1/70th of an inch long. Their mouthpart is equipped with a tiny spear or stylet, which they use to puncture plant cells to obtain plant juices. A number of plant parasitic nematodes feed from the outside of the roots, stems, buds, and leaves. Others feed by tunneling through the roots.

Net return or net income refers to the difference between gross return less and total cost of labor and materials in every enterprise.

Nitrogen cycle refers to the interlocking succession of largely bio-chemical reactions. In all soils, considerable intake and loss of nitrogen in the course of a year are accompanied by many complex transformations. Some of these changes may be controlled more or less by man, whereas others are beyond his command.

Nitrogen fertilizer refers to any fertilizer material containing nitrogen element or compound.

Nitrogen fixation refers to fixation of elemental nitrogen into compounds usable by plants through microbial processes in soils. Blue green algae and certain actinomycetes are significant nitrogen fixing organisms. But worldwide, bacteria are probably most important group in capture of gaseous nitrogen.

Nitrogen-fixing bacterium (NFB) refers to a microbial-based fertilizer consisting of powdered inoculants belonging to genus *Azospirillum*, a bacterium isolated from roots of 'talahib' [*Saccharum spontaneum*] grass.

Nutrient management means any strategy or method that will lead to effective and efficient use of nutrients in crop production.

Non-formal education (NFE) is a participatory learning approach that encourages the learners to see themselves as source of knowledge about the real world and to work with the knowledge they have from their own experience in the learning process.

Nursery refers to a place where good seedlings are grown with care and maintenance. Nurseries provide necessary control on moisture, light, and predators as well as allow production of healthy and hardy seedlings.

Nursery stock refers to shrub or tree species grown in a plant nursery for planting out elsewhere

Objective refers to the desired organizational and behavioral attributes or characteristics to be attained after conducting an activity.

Organic, in this text, refers to particular farming and processing systems described in organic certification standards and not in the classical chemical sense. The term ‘organic’ is nearly synonymous in other languages to ‘biological’ or ‘ecological’.

Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including bio-diversity, biological cycle, and soil biological activity. It emphasizes use of management practices in reference to use of off-farm inputs. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using synthetic materials, to fulfill any specific function within a system

Organic fertilizer refers to a product of biological decomposition or processing of organic materials from animal and/or plants that can supply one or more essential nutrient elements for plant growth and development. In organic farming, it is considered as the only natural, complete, and chief source of plant nutrients.

Organic foliar spray refers to animal and plant juice extracts used as rich sources of plant nutrients, which is used to supplement soil application of organic solid fertilizers. In organic vegetable farming, these can be derived from different sources such as fruits, young buds and foliage, materials derived from snails and marine fishes, and bones from grass-eating animals.

Organic matter decomposition refers to a process by which plant residues are broken down, thereby preventing an unwanted accumulation and allowing release of nutrients held in organic combinations within these residues for use by plants. Perhaps one most significant contribution of soil fauna and flora to organic vegetable productivity is that of organic matter decomposition.

Organic solid fertilizer refers to a non-liquid organic fertilizer such as compost, vermi-cast, and others. It contains high organic matter, which is not present in any synthetic chemical fertilizer. However, it contains low plant nutrients and its solubility is low, hence it should be applied in large quantities to supply right amounts of plant nutrients at different growth stages of crops.

Organic third party certification is a certification process undertaken by an independent body or a third party, when a producer is unknown. The production system, the process or method instead of a product, is certified as organic. Thus the ‘organic’ quality is not verifiable by product testing although in some cases product testing can be used to detect non-compliance.

Organic vegetable production is a production system that promotes environmentally, socially, and economically sound production of vegetable crops. It takes local soil fertility as a key to successful production. Organic vegetable production dramatically reduces external inputs by refraining from use of chemo-synthetic fertilizers, pesticides, and pharmaceuticals. Instead, it allows powerful laws of nature to increase both crop yields and disease resistance

Ornamental refers to any tree or plant that is planted for its beauty. This does not mean that it has no other uses. For example, *Chlorophora excelsa* is often planted as an avenue tree along roadsides (in Uganda); its stately appearance in no way diminishes its usefulness for timber. Ornamentals with other uses in agroforestry are the Cassias and *Senna* spp.

Overhead irrigation is a method of irrigation where water is applied either in form of a fine mist (spraying) or spray simulating rain (sprinkling). Water may be manually applied by use of watering cans or mechanically applied under pressure and at pre-determined intervals.

Palm is a member of Aracaceae (previously Palmae) family, containing over 200 genera and more than 2700 species, many of them economically important for food, fiber, canes, waxes, wood, thatch, and so forth. Typical agroforestry tree.

Panel discussion is a term used to describe the use of panel of interrogators and discussants in identifying, discussing and solving problem. This activity is an effective tool in helping participants to develop their capability to communicate ideas and knowledge with other participants.

Parasitism or predation refers to direct attack of one organism on another.

Parasitoid is a beneficial insect that lives for a while in or upon the body of a single host pest species or a few closely related species but gradually destroys or kills it.

Participant refers to a person who is the focus of learning activity and who is expected to participate actively in the learning process.

Participatory technology development (PTD) is the process of collective and collaborative inquiry with the purpose of initiating community actions on solving local problems.

Perennial is a plant that does not die after flowering but lives from year to year.

Pest management means an ecologically-based strategy of maintaining pest population below the economic injury level by the use of any or all control techniques that are economically and socially acceptable.

Pesticide is a compound or chemical, such as acaricide, insecticide, herbicide, fungicide, nematicide, rodenticide, and the like, that is used to control pests and diseases.

Pesticide non-user refers to a farmer or individual that does not use any pesticide to control pests and diseases.

Pesticide user refers to a farmer or individual that uses pesticides to control pests and diseases.

pH is an expression of soil reaction (e.g., acid, neutral, or alkaline), which is the negative logarithm of the hydrogen ion concentration. Acidity denotes an excess of H^+ ions over OH^- ions and alkalinity denotes the opposite. At neutral reaction, the H^+ and OH^- ion concentrations are equal.

Phosphorus fertilizer refers to any fertilizer material containing phosphorus elements or nutrients.

Physiological disorders refer to all plant abnormalities or disorders that are caused by one of combination of non-infectious organisms, nutrient deficiencies or toxicities, and chemical injuries or toxic residues.

Physiological maturity is when seed have accumulated all food reserves, is at its state of maximum dry weight, and highest vigor and quality level.

Plant disease refers to any physiological disturbance brought about by a pathogen or environmental factor that prevents normal development of a plant resulting to changes in its appearance and reduction of its economic value. Plant diseases are caused either by infectious or biotic factors, or non-infectious or abiotic factors.

Plant disease management consists mainly of integrating various mechanical or physical (e.g., heat treatment, flooding, rouging of diseased plants or pruning of infected plant parts), cultural (e.g., crop rotation, trellising) as well as biological (e.g., use of microbial antagonists, use of resistant varieties, bio-fumigation) control methods.

Pod borer is lepidopterous pest attacking leguminous vegetables whose larvae are voracious feeders on inflorescence with developing pods resulting to underdeveloped pods.

Pollinators are beneficial insects that pollinate flowers of some vegetable crops like cucumber, chayote, snap beans, green peas, bell pepper and tomato. Wild bees and honeybees are the most predominant pollinators of vegetables.

Polyembryonic seeds (e.g., mango and citrus species) are seeds producing several embryos one of which is sexual and others are clones.

Potassium fertilizer refers to any fertilizer material containing potassium element or nutrient.

Powdery mildew is a fungal disease of parsley and leguminous vegetables characterized by small, discrete, white moldy spots on the upper surface of the leaflets, which rapidly enlarge to an indefinite size until they coalesce.

Predators refer to a group of biological control agents that are free-living throughout their entire life cycle. A predator can be a beneficial insect or arthropod (e.g., spider) that feed on many different species of prey (e.g., insect pests or arthropods) by quickly eating them or sucking their body fluids.

Pricing arrangement refers to how various types of prices differ, how they relate to each other, and how they affect profits as sales volume of organically-grown vegetable products varies.

Pricking-off refers to initial transplanting of some vegetable seedlings (e.g., celery and lettuce) to give them greater space in which to grow before finally transplanting in the main field.

Problem solving is the process of effective decision-making. The skills, which relate to the classic model of decision-making, are how to: (a) define the problem, (b) generate data about the problem, and (c) generates ideas or alternate courses of action for problem resolution, (d) choose among the alternative solution, and (e) implement the solution or decision.

Process refers to the dynamics of interplay of behaviors within the learning situations leading to the attainment of the training objectives.

Processing is a way of surfacing experiences and insights of participants and interpreting these into the learning context.

Producer's guarantee refers to an organic guarantee system where the producer (e.g., farmer, processor, or operator) gives assurance to consumers. This is applicable where producer's integrity is widely known to consumers who usually live within same locality as producers. It is also sufficient when there is mutual understanding between producers and consumers such as in various versions of producer-consumer partnerships.

Productivity refers to the increase in yield resulting from improved decision-making skills among farmers associated with integrated pest management (IPM) practices such as selection of appropriate varieties, use of biological control agents (e.g., Diadegma or Cotesia), correct timing of fertilizer application, and sound water management.

Profitability refers to the increase in farmers' net income associated with increased yields and decreased production costs as a result of the IPM program.

Protection is a fundamental principle in pest and disease management, which is achieved through interposing a protective barrier between pest or pathogen and susceptible plant.

Pruning is a practical cultural management strategy, which includes the removal of all diseased and weak plant parts (e.g., leaves, stems, flowers, or fruits).

'Pulling the guts' technique is a practical tool used by farmers to determine the degree of larval parasitism by Diadegma semiclausum wasp or diamondback moth (DBM) of crucifers.

Range refers to: (a) land that produces primarily native forage suitable for grazing by livestock; also forest land producing forage. Usually relatively extensive areas of land suitable for grazing but not for cultivation, especially in arid, semi-arid or forested regions. A unit of grazing land used by an integral herd of livestock. The geographical area of occurrence of plants and animals; (b) geographical and altitudinal limits within which a taxon occurs; or (c) in statistics, the limits of magnitude (of a set of data).

Rangeland is a land suitable for grazing by domestic livestock. The vegetation consists mostly of native grasses, grass-like plants, forbs, shrubs.

Rapid rural appraisal is a methodology in which a multidisciplinary team of researchers uses social science tools for the quick collection of primary data during one or several visits. The research team transforms the primary data into secondary data for assessment and analysis.

Rattan is a climbing palm (mainly Calamus spp and others in the lepidocaryoid line). Used for making baskets and furniture.

Recalcitrant seed refers to seed of some species have relatively short viability and cannot be stored in a dry condition or at low (subzero) temperatures. Some such seeds even suffer chilling damage. Examples are seeds of cocoa and rubber.

Record keeping is an essential activity in farming that furnishes valuable information about past performance in specific areas of farming operations, which can be used together with other data in determining future operations. Record keeping is important because: (1) it increases farmer's efficiency by providing him a basis in deciding where to put his resources; (2) it can be used for planning and budgeting; (3) profitability of various operations can be evaluated; (4) it shows where a farmer's money comes from and where it goes; (5) a farmer's capacity to pay is best shown by his farm records; and (6) settling questions becomes easy if all transactions are well recorded.

Repellent crops are crops with pest repelling properties, which are grown in-between or around the area planted to vegetable crops to repel some specific destructive pests of a particular vegetable crop.

Resistance is a fundamental principle in pest and disease management referring to the development and use of cultivars that can thwart or impede activity or a pest or a pathogen.

Resistant variety means any crop variety that can resist the adverse effect or damage caused by insect pests, diseases, and adverse environment.

Return on investment refers to the ratio between net return or income and the total cost of production in every enterprise.

Roguing refers to the removal of off-types in crops intended for seed production. It also means the removal of diseased plants with the accompanying pathogens for disease management. Roguing must be done continuously if it is to be successful.

Role-playing is a learning technique in which participants act out and thus experience real-life roles and situations. It is both a form of simulation and experiential learning.

Root feeders refer to a group of destructive insects whose immature stages and some adults of insect feed on living roots or base of plants, causing stunted growth or death of plants.

Root knot nematode (RKN) is kind of nematode which causes swellings or knots on the roots of affected plants known as galls. Plants affected by this nematode become stunted and wilt readily in hot, dry weather.

Root, tuber and bulb vegetables are vegetable crops primarily grown for their swollen underground stems or roots. Examples are sweet potato, onion, garlic, carrot, radish, potato, and ginger.

Sanitation is a practical cultural management practice aimed at reducing either the source of inoculums or the exposure of the plants to infection. Sanitation excludes use of chemicals or biological control agents (BCA).

Sap transmission technique (STT) is a practical tool used facilitators to show to farmers how virus diseases are transmitted in vegetable fields.

Scaring materials are repellent materials (e.g., scarecrow, used video, or music tapes), which are installed in vegetable fields to scare and repel rats, thus avoiding infestation.

Scarification of seeds refers to abrasion of the seed coat (or fruit coat) by mechanical, chemical or physical (for example, dry heat) means. Usually needed to improve the germination of hard-seeded species.

Secondary pest is a pest that does not normally cause economic damage, except when insecticide application destroys its natural enemies.

Seed production refers to the multiplication of seeds selected for planting in the succeeding seasons in isolation. In farmers' fields, these seeds are produced naturally in self- or cross-pollinating varieties.

Seedling refers to a young plant arising from a germinated seed. Trees progress to the sapling stage. A plant grown as a seedling may retain its taproot, unlike one propagated from a cutting, and hence have a differently structured root system.

Seed-lot refers to: (a) a convenience term denoting a group of seeds, or their offspring, which will be considered as a unit in an experiment; or (b) an indefinite quantity of seed having uniform quality produced at a specific location and collected from a single crop.

Seed orchard is a tree plantation established primarily for the production of seed of proven genetic quality.

Seed selection is a process by which farmers select seeds from their standing vegetable crops as mother plants for planting or seed multiplication in the succeeding seasons. From the source mother plants, only the best fruits or pods are selected. From these fruits or pods, only the best seeds are selected. For any variety, big seeds are selected because they have more food reserves than small seeds, all other factors being equal, hence better seed materials.

Self-pollinated vegetables are vegetables wherein pods or fruit setting results from union of female (ovule) and male (pollen) reproductive cells of the same plant, variety, or cultivar.

Shade-bearing trees are tree species that will regenerate in shade so is often large seeded. Also known as 'climax species'.

Shelterbelt is an extended windbreak of living trees and shrubs established and maintained for the protection of farmlands over an area larger than a single farm.

Shifting cultivation is a traditional cultivation method found mainly in the tropics, especially in humid and sub-humid regions. There are different kinds; for example, where a settlement is permanent, but certain fields are fallowed and cropped alternately ('rotational agriculture'). In others, whole settlements move and clear new land once the old is no longer productive. Also called 'swidden' (Old English for a 'burnt clearing'), used more to designate the social group, or 'slash-and-burn', so-called because of the operations undergone.

Shoot and fruit borers are lepidopterous pests attacking solanaceous vegetables at all development stages. At early vegetative stage, the larvae feed on the stem, shoots, and leaves. Later, at fruit setting, the larvae bore into the fruits rendering them unusable for marketing and storage.

Silviculture is a branch of forestry that is concerned with the methods of raising and growing trees.

Slash-and-burn system refers to: (a) a kind of shifting cultivation in high rainfall areas where the cropping period is followed by a fallow period during which grass, herb, bush or tree growth occurs; or (b) a pattern of agriculture in which existing vegetation is cut, stacked and burned to provide space and nutrients for cropping; also called 'swidden' cultivation and shifting cultivation.

Silvipastoral system is combination of woody perennials with livestock production. This system includes livestock-under-tree, protein bank (fodder bank), live fence, and hedgerow planting of improved pasture grasses and/or other fodder trees or shrubs

Simulation or simulation game is a learning activity designed to reflect reality. It may range from a role-play and an in-basket exercise to a mock military invasion. It can be a learning activity akin to real life marked by such game attributes as competition, scores, outcomes, winners and losers.

Slashing, in forestry, refers to cutting back the less tough, competing vegetation, for example, ground cover like bracken. A form of clearing.

Slope is degree of deviation of a surface from horizontal, measured in a numeric ratio, percentage or degrees.

Sloping agricultural land technology or sloping agroforestry technology (SALT) or alley cropping system (ACS) refers to a method of farming or cropping system whereby hedges are used along contour lines. In this system, the strips slow down and spread water movement, thus reducing the likelihood of serious erosion in cultivated areas.

Small group discussion is a term used to describe the use of small groups (e.g., break-up sessions) in identifying and solving problem by participatory discussion.

Soil biodiversity refers to the relative abundance and varied population of living organisms, both animals and plants, in soils, which interact to influence profoundly the physical and chemical trends in soil changes.

Soil-borne organisms refer to all harmful and beneficial organisms living in the soil. Some soil-borne organisms are involved in the degradation of higher plant tissues. Even while, growing, plants are subject to attack by some soil-borne organisms.

Soil fertility refers to inherent capacity of a soil to supply nutrients to plants in adequate amounts and in suitable proportions.

Soil horizons are the individual layers in a soil profile. The upper layers of a soil profile generally contain considerable amounts of organic matter and are usually darkened appreciably because of such an accumulation.

Soil-inhabiting pests refer to all pests whose main harborage or habitat, in the absence of a suitable host, is the soil.

Soil nutrient cycle is a system (operating in an upland farm) consisting of stores (through fixation, and soil solution), flows (from plant to residues, via organisms to soil humus), gains (from symbiotic, non-symbiotic fixation [for N only], rock weathering, rain and dust, organic materials from outside, and from fertilizers), and losses (burning, de-nitrification and volatilization [for N], leaching, erosion, and harvests).

Soil productivity refers to the ability of a soil to yield crops and is a broader term since soil fertility is only one of the factors that determine the magnitude of crop yields.

Soil profile refers to the vertical section of a soil showing the presence of more or less distinct horizontal layers. Every well-developed, undisturbed soil has its own distinctive profile characteristics, which are used, in soil classification and survey and are of great importance. In judging a soil, one must consider its whole profile.

Soil solarization is a cultural management practice whereby soil under is exposed to sunlight for some time after cultivation to kill soil-borne pests and disease-causing pathogens in prepared seedbeds, beds, or plots intended for growing of vegetables.

Soil structure refers to the arrangement of soil particles into groups or aggregates. The soil texture and soil structure help determine not only the nutrient-supplying ability of soil solids but also the supply of water and air so important to plant life.

Soil test kit (STK) is a simple, handy tool for a quick soil chemical analysis that measures amount of available soil nutrients. Soil testing can be done right in vegetable fields and results are obtained within a few hours. It is a useful tool for farmers and extension workers who need immediate answer to question of what kind and amount of organic fertilizers to use for a crop in a particular soil.

Soil texture is concerned with the size of mineral particles. Specifically, it refers to the relative proportions of particles at various sizes in a given soil.

Softwood is a term used in the timber trade to describe the wood of most conifers (gymnosperms), as distinct from the hardwood, broadleaved species (angiosperms).

Solanaceous vegetables are vegetable crops belonging to the solanaceous or nightshade family, whose economically useful parts are the fruits, such as tomato, eggplant and pepper. Potato belongs to this family, although it can also be classified under root, tuber and bulb vegetables because it is grown for its tuber and is cultivated in a similar manner as the root and bulb vegetables.

Specialist refers to a facilitator of a Training of Trainers (TOT), who is a graduate of an intensive four-month, six days a week season-long Training of Specialists (TOS) in non-formal education techniques for integrated pest management (IPM) in rice, corn, vegetables, among others.

Stand: (a) of crops, refers to number of plants per unit of area that survive and grow; sometimes referred to as the ‘plant population; or (b) in forestry, it means a community of trees possessing sufficient uniformity of composition, constitution, age, spatial arrangement or condition to be distinguishable from adjacent communities, so forming a silvicultural or management entity.

Standards are norms, set of guidelines, requirements and principles that are used as in organic agriculture and processing. Standards are actually norms or guidelines by which a product or process can be labeled as 'organic'.

Stratification is pre-sowing activity whereby seeds are placed between layers of moist sand, soil, or sawdust at high and low temperatures so that action of water and high and low temperatures will soften the seed coat.

Sucking insects refer to a group of destructive insects, which have piercing-sucking mouthparts.

Surface irrigation or flooding is a method of irrigation where water flows on soil surface, then later seeps downward, or moves vertically (surface flooding), moves along a canal or horizontally (furrow flooding) in soil until it reaches the roots of plants.

Sustainable agriculture means any principle, method, and practice that aims to make agriculture economically viable, ecologically sound, socially just and humane (equitable), culturally appropriate, and grounded on holistic science.

Sustainable development refers to management and conservation of the natural base, and the orientation of technological and institutional change, in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. It conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically feasible and socially acceptable.

Sustainable land use is system of land use that achieves production sufficient to meet the needs of present and future populations while conserving or enhancing the land resources on which that production depends.

Synchronous planting involves planting of crops at the same time in a large scale to take advantage of hostile environmental conditions for pests at the stage new plants are most susceptible to pest attack. Synchronization is ideal in cases where product prices are non-fluctuating and irrigation water is available year round.

Synthetic refers to any substances manufactured by chemical or industrial processes, which include products not found in nature or simulation of products from natural sources (but not extracted from natural raw materials).

Taungya system is a method of raising forest trees in combination with (seasonal) agricultural crops. Used in the early stages of establishing a forest plantation. It not only provides some food but can lessen the establishment costs.

Taxon is a taxonomic unit of any size. A category in the taxonomic hierarchy.

Team building is an organized effort to improve team effectiveness. It is a process consisting of a series of synergy-building exercises designed to promote group cohesiveness and effectiveness in performing and achieving their common goals and tasks. It may relate to defining and clarifying policies or goals; to reviewing and refining procedures; to seeking out ways to be more innovative and creative; to improving management practices in such areas as communication, decision-making, delegation, planning, coaching, career development and initiatives; to improving relationships between team members; to improve external relations (e.g., with local government units); to improve relations with other work teams; and to improving services.

Terrace is a broad surface running along the contour. It can be a natural phenomenon or specially constructed to intercept runoff, thereby preventing erosion or conserving moisture. Terraces are sometimes built to provide adequate rooting depths for plants. See also broad-based terrace, ridge terrace

Therapy is a fundamental principle in pest and disease management referring to treatment of plants infested by a pest or infected by a pathogen.

Thinning refers to a cultural management practice, which involves the removal of undesirable plants to ease out overcrowding of seedlings, allow better penetration of sunlight, permit proper aeration or more rapid drying of dew or rain on foliage after a down pour, and minimize nutrient competition.

Third party certification is an organic guarantee system adopted when the producer is unknown, thus, an independent body or a third party does the certification. The production system, the process or method instead of a product, is certified as organic. Thus, the 'organic' quality is not verifiable by product testing although in some cases product testing can be used to detect non-compliance. The major activities in a certification program are: standard setting, inspection, and certification

Thrips are minute insect pests whose nymphs and adults suck the plant sap causing the leaves to turn yellow, then silvery-white, and later assumed a withered or blasted appearance.

Timber is a wood product of a tree obtained by sawing and milling. Timber is a major product of forests. It differs from poles or round-wood only in that it is cut.

Tissue culture consists of implanting disease-free tissues in a sterile artificial medium, allowing them to divide and form a mass of undifferentiated tissues called callus or proto-corm. This is followed by dividing them to increase their number and allowing them to differentiate into plantlets.

Training of specialist (TOS) is an intensive four-month, six-day a week season-long training course in non-formal education (NFE) techniques and integrated pest management (IPM) for extension and crop protection specialists.

Trap crops are alternate or susceptible crops planted within a particular vegetable area to attract some specific destructive pests of a particular vegetable crop thereby reducing their adverse effects to that particular vegetable crop.

Training team refers to a group of facilitators who work together to see to it that the learning process supports the objectives of the learning activities.

Training of trainers (TOT) is an intensive four-month, three days a week season-long training course in non-formal education (NFE) techniques and integrated pest management (IPM) for extension workers.

Trainer refers to a facilitator of a farmer field school (FFS), who is a graduate of an intensive four-month, three days a week season-long Training of Trainers (TOT) in non-formal education techniques for integrated pest management (IPM).

Trapping is a cultural management practice, which attracts insect pests to trap materials for the purpose of controlling them. The trap materials may contain non-pesticide baits such as sex attractant or an attractive food source for insect pest.

Tree refers to: (a) a woody plant that produces one main trunk or bole and a more or less distinct and elevated head; or (b) a woody plant having one well-defined stem and a more or less definitely formed crown and roots, usually attaining a height of at least 2½ meters.

Trellising is a cultural management practice in vegetable, which involves training vegetable crops to grow on trellis to improve quality of products and avoid rotting of fruits associated with soil-borne pathogen.

***Trichoderma* sp. (e.g., *pseudokoningii, parceramosum* and *harzianum* species)** is a common soil fungus and a natural component of soil micro-flora. It is a fast-growing fungus that secretes many hydrolytic enzymes. Aside from its antagonistic nature towards several plant pathogens, it is also a compost-decomposer and growth-enhancer of many organically-grown vegetables.

***Trichogramma* sp.** are very small parasitic wasps (0.1 to 0.5 mm long) which attack eggs of lepidopterous insect pests. *T. evanescens* Westwood was proven to be effective against corn borer, *Ostrinia furnacalis* while *T. chilonis* Ishii was tested against tomato fruit worm, *Helicoverpa armigera* Hubner. These species are also effective against eggs of corn earworm and semi-looper, tomato fruit worm, cotton bollworm, sugarcane borers, eggplant shoot and fruit borer, cacao pod borer, soybean leaf folder and other lepidopterous insect pests.

Tuber moth is an insect pest attacking potato tubers whose larvae form blotch mines on the leaves which later becomes dry and brittle and tunnel on the tubers.

Urea is a chemical fertilizer material, which is a rich source of nitrogen element or nutrient.

Tymo virus disease is a disease affecting cucurbits, particularly chayote, caused by virus infection, which is characterized by overgrowth, stunting, yellowing, curling, and mottling.

Varietal adaptability refers to the ability of a specific crop to grow productively under specific local conditions such as resistance to local pests, diseases, and environmental stresses.

Vegetable specialist training (VST) is an intensive four-month, six-day a week season-long training of specialists (TOS) in non-formal education (NFE) techniques and integrated pest management (IPM) for extension and crop protection specialists in vegetable production.

Vermi-cast or worm casting is the material that passes through digestive track of earthworm (worm manure). The amount of soil that passes through earthworm bodies annually may amount to as much as 10 t/ha of dry earth, a startling figure.

Vermicomposting involves use of earthworms for composting organic materials. Earthworms ingest all kinds of organic material equal to their body weight per day. Earthworms popularly used for composting are *Lumbricus rubellos* and *Perionyx excavator.* Compared to soil, vermi-compost or vermi-cast is definitely higher in bacteria and organic matter, total and nitrate nitrogen, exchangeable calcium and magnesium, available phosphorus and potassium, pH and percentage base saturation, and cation exchange capacity

Vernalization is a process by which seeds are subjected to cold temperature treatment before germination to trigger process of flowering at the later stage of crop development.

Viable seed are seeds that will germinate and develop into a plant, given favorable conditions, provided any dormancy that may be present is removed.

Village gene-bank refers to a low-tech seed storage facility that supports farmers' local breeding programs. Farmers need to access genebanks more frequently and, therefore, they need to be established close to farmers who will use breeding materials. In addition to local and exotic varieties, village genebanks may store seeds of multiple breeding lines. In practice, a village genebank can have 100 or more different entries.

Viruses are infectious particles that attack many forms of life, including bacteria and plants. They are so tiny that they can only be seen with an electron microscope.

Virus diseases refer to diseases that are caused by viruses. The general symptoms of virus diseases on plants are leaf discoloration, stunting, leaf-rolling or twisting, and vein clearing.

Water (hydrologic) cycle refers to a continuous cycle by which water is received by farms from rainfall (infiltration), lost by several pathways (e.g., runoff, percolation, and seepage, returned to air (e.g., evaporation and transpiration), as water vapor, join together to form clouds, condense to form rain, and water cycle continues.

Water holding capacity (WHC) refers to the amount of water a soil can hold which is proportionately related to the physical condition and organic matter content of the soil. Soils high in organic matter are darker in color and have greater water holding capacities than do soils low in organic matter.

Water management means any strategy or method that will lead to effective and efficient use of water in crop production.

Watershed may refer to following: (a) a physiographic unit in the landscape defined by the drainage dividers around the area drained by a particular body of water. If a lake, there is often one watershed with subunits for contributing streams. If a river, it may be defined for any point or all; (b) whole surface drainage area that contributes water to a lake. The total area above a given point on a stream that contributes water to the flow at that point (synonym: 'drainage basin', 'catchment basin', 'river basin'); or (c) total area, regardless of size, above a given point on a waterway that contributes runoff water to the flow at that point. A major drain-area subdivision of a drainage basin on the basis of this concept.

Weed management means any strategy or method that will lead to effective and efficient suppression of weed population.

Whitefly is a small white insect pest belonging to the fly family, which congregate on the undersides of the leaves where they suck juices and secrete honeydew. Severe infestation can cause plants to wilt.

White muscardine fungus (*Beauveria bassiana* [Balsamo] Vuillemin) or WMF is a naturally occurring insect pathogen that is commonly collected in agricultural crops for pest control worldwide. During development, fungus uses soft tissues and body fluids of host. The growth of WMF requires conditions of prolonged high moisture for airborne and waterborne spores to germinate. When ready to produce chalky-white spores, fungus grows out of host's body.

Windbreak is a group of trees or shrubs in any arrangement that will afford protection from high winds to animals or crops or both. When the arrangement is in a long line the group is called a shelterbelt. If an associated reason is also to harvest timber at some future date it is sometimes called a 'timber-belt'.

Wood refers to: (a) lignified secondarily thickened plant tissue. The structural parts of woody perennials; or (b) a small grove of trees of mixed species complete with undergrowth. The size is variable but it does not cover a large area.

Workshop refers to a 'hands on', highly participatory learning effort wherein participants learn by doing. Typically, the group is small enough to ensure adequate rapport and intimacy.

Yield refers to plant part harvested and the quantity of it. In agriculture, necessarily related to a specified crop or crops or to a group of animals or to an area, and to a period of time. For multipurpose trees, the amount of each specified part harvested.

Yield class is defined as: (a) potential or actual yield of a forest, calculated as the total volume of wood produced divided by the age when maximum mean annual increment is achieved. Usually expressed as cubic meters per hectare per year; or (b) a way of expressing the productivity of a particular tree crop on a particular site. It is signified by a number that represents the annual production of timber averaged over its economic lifetime or, more correctly, to the age at which the 'mean annual increment' culminates. Thus a crop of 'yield class 10' produces 10 cubic meters of timber per year on average. See also current annual increment, mean annual increment, site class.

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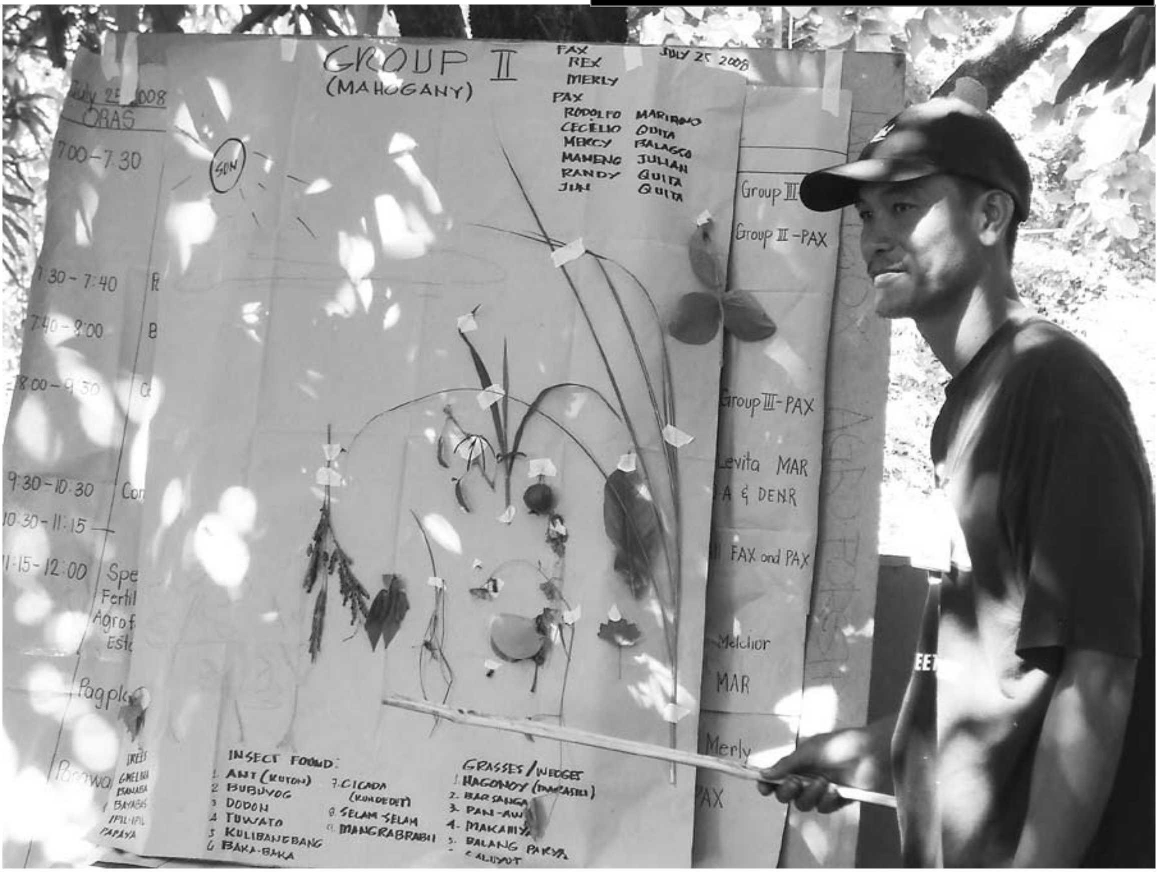
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ANNEXES

Annex A

List of Participants in Curriculum Development Workshop on FFS for Agroforestry held on 17-19 June 2008 at Camiling, Tarlac, Philippines

Department of Environment and Natural Resources (DENR)

1. For. Isabelita Austria, Chief, *Planning Division, Forest Management Bureau*
2. Dr. Sofio B. Quintana, *CESO IV, Regional Technical Director for Forestry, DENR-R3*
3. For. Nida R. Manabat, *Senior Forest Management Specialist, Regional Community Based Forest Management Office, DENR-R3*
4. For. Donaver Guevarra, *Information Officer II, Regional Public Affairs Office, DENR-R3*
5. Atty. Alcide B. Amador, *Provincial Environment and Natural Resources Officer, PENRO-Tarlac*
6. For. Brenda M. Clemente, *Provincial CBFM Coordinator, PENRO-Tarlac*
7. Dr. Carlos S. Arida, *Community Environment and Natural Resources Officer, CENRO-Tarlac*
8. For. Laurino D. Macadangdang, *Community Environment and Natural Resources Officer, CENRO-Camiling*
9. For. Mariano P.Lagartera,Jr., *Forester III, CENRO-Camiling*
10. For. Reynaldo M. Dela Cruz, *Chief, Plans and Programs Unit, CENRO-Camiling*
11. For. Heshidy S. Dela Cruz, *CENRO CBFM Coordinator, CENRO-Camiling*

Department of Agriculture (DA)

12. Dr. Jesus S. Binamira, *National Program Officer, National IPM Program (KASAKALIKASAN) and Director, ASEAN IPM Knowledge Network Center*
13. Mr. Damaso P. Callo, *Training and Curriculum Development Specialist, National IPM Program (KASAKALIKASAN) and ASEAN IPM Knowledge Network Center*
14. Mr. Cesar A. Baniqued, *Chief, Disease Management Section, Bureau of Plant Industry (BPI), Manila*
15. Ms. Rosario C. Lizarondo, *Director and Regional IPM Program Coordinator, , Regional Crop Protection Center (RCPC)-R3*
16. Mr. Reynaldo S. Vigilia, *Agriculturist II and Assistant Regional IPM Program Coordinator, Regional Crop Protection Center (RCPC)-R3*
17. Ms. Concepcion R. Mirano, *Senior Agriculturist, Regional Crop Protection Center (RCPC)-R3*
18. Mr. Efren E. Bessara, *Agricultural Technologist and Provincial IPM Coordinator, Zambales Provincial Agricultural Office*
19. Ms. Luisa V. Rodis, *Agricultural Technologist and Provincial IPM Coordinator, Bataan Provincial Agricultural Office*
20. Ms. Tessie P. Alcantara, *Agricultural Technologist and Provincial IPM Coordinator, Tarlac Provincial Agricultural Office*

Local Government Unit (LGU), Mayantoc, Tarlac

21. Mr. Melchor C. Pobre, *Agricultural Technologist, Municipal Agriculture Office*
22. Ms. Levita R. Damian, *Agricultural Technologist, Municipal Agriculture Office*
23. Ms. Merly F. Apostol, *Agricultural Technologist, Municipal Agriculture Office*
24. Mr. Delfin S. Asuncion, *Acting Municipal Environment Natural Resources Officer*

Cacupangan Tree Farmers Association Incorporated (CTFAI), Barangay Maniniog, Mayantoc, Tarlac

25. Mr. Rodolfo S. Mariano, *Peoples' Organization (PO) Chairman*
26. Ms. Virginia J Quita, *Peoples' Organization (PO) Member*

Japan International Cooperation Agency (JICA)

27. Ms. Chiharu Hiyama, *Expert on Community Development, Project for Enhancement of Community-Based Forest Management Program*
28. Mr. Akira Koto, *Expert on Farmers Organizations and Extension, Project for Enhancement of Community-Based Forest Management Program*
29. Mr. Reneboy E. Tavares, *Technical Assistant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*

Annex B

List of Participants in Assessment and Curriculum Modification Workshop on FFS for Agroforestry held on 16-17 December 2008 at Camiling, Tarlac, Philippines

Department of Environment and Natural Resources (DENR)

1. For. Alfredo Collado, *Chief, Regional Community-Based Forest Management Office, DENR-R3*
2. For. Laurino D. Macadangdang, *Community Environment and Natural Resources Officer, CENRO-Camiling*
3. For. Brenda M. Clemente, *Provincial CBFM Coordinator, PENRO-Tarlac*
4. For. Mariano P.Lagartera,Jr., *Forester III, CENRO-Camiling*
5. For. Reynaldo M. Dela Cruz, *Chief, Plans and Programs Unit, CENRO-Camiling*
6. For. Heshidy S. Dela Cruz, *CENRO CBFM Coordinator, CENRO-Camiling*
7. Mr. Rex C. Ramos, *Chief, Survey and Mapping Unit, CENRO-Camiling*

Department of Agriculture (DA)

8. Mr. Damaso P. Callo, *Training and Curriculum Development Specialist, National IPM Program (KASAKALIKASAN) and ASEAN IPM Knowledge Network Center*
9. Mr. Cesar A. Baniqued, *Chief, Disease Management Section, Bureau of Plant Industry (BPI), Manila*
10. Mr. Reynaldo S. Vigilia, *Agriculturist II and Assistant Regional IPM Program Coordinator, Regional Crop Protection Center (RCPC)-R3*
11. Mr. Noelito C. Villa, *Agriculturist II and Assistant Regional IPM Program Officer, DA RFU-CAR*
12. Ms. Tessie P. Alcantara, *Agricultural Technologist and Provincial IPM Coordinator, Tarlac Provincial Agricultural Office*
13. Mr. Reynold Udarbe. *Agricultural Technologist and Regional IPM Coordinator, DA RFU-Caraga*
14. Mr. Egmedio E. Samillano, *Senior Agriculturist, Davao Norte Provincial Agricultural Office*

Local Government Unit (LGU), Mayantoc, Tarlac

15. Mr. Melchor C. Pobre, *Agricultural Technologist, Municipal Agriculture Office*
16. Ms. Levita R. Damian, *Agricultural Technologist, Municipal Agriculture Office*
17. Ms. Merly F. Apostol, *Agricultural Technologist, Municipal Agriculture Office*
18. Mr. Juan D. Felizardo, Agricultural Technologist, Municipal Agriculture Office

Tarlac College of Agriculture (TCA)

19. Dr. Gerardo M. Buraga, *Professor*

Cacupangan Tree Farmers Association Incorporated (CTFAI), Barangay Maniniog, Mayantoc, Tarlac

20. Mr. Rodolfo S. Mariano, *Peoples' Organization (PO) Chairman*
21. Mr. Edgardo Yadao, *Peoples' Organization (PO) Board of Director*
22. Ms. Anita Carrera, *Peoples' Organization (PO) Sub-Treasurer*
23. Ms. Virginia J Quita, *Peoples' Organization (PO) Member*

Japan International Cooperation Agency (JICA)

24. Mr. Kensei Oda, Chief Advisor, *Project for Enhancement of Community-Based Forest Management Program*
25. Ms. Chiharu Hiyama, *Expert on Community Development, Project for Enhancement of Community-Based Forest Management Program*
26. Mr. Hideo Ishida, *Expert on Training, Project for Enhancement of Community-Based Forest Management Program*
27. Mr. Ryutaro Kobayashi, *Expert on Information, Project for Enhancement of Community-Based Forest Management Program*
28. Dr. Isidro D. Esteban, *Consultant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*
29. Ms. Janet B. Martires, *Consultant on Facilitation, Project for Enhancement of Community-Based Forest Management Program*
30. Ms. Joan Marie R. Alberto, *Technical Assistant, Project for Enhancement of Community-Based Forest Management Program*
31. Mr. Reneboy E. Tavares, *Technical Assistant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*

Annex C

List of Participants in Write-shop on Field Guide of Discovery-based Exercises on FFS for Agroforestry held on 13-15 January 2009 at San Fernando, Pampanga, Philippines

Department of Environment and Natural Resources (DENR), Region 3

1. For. Marina S. Corpuz, *Forester, Regional Community-Based Forest Management Office, DENR-R3*
2. For. Brenda M. Clemente, *Provincial CBFM Coordinator, PENRO-Tarlac*
3. For. Mariano P.Lagartera,Jr., *Forester III, CENRO-Camiling*
4. For. Reynaldo M. Dela Cruz, *Chief, Plans and Programs Unit, CENRO-Camiling*
5. For. Heshidy S. Dela Cruz, *CENRO CBFM Coordinator, CENRO-Camiling*

Department of Agriculture (DA)

6. Mr. Damaso P. Callo, *Training and Curriculum Development Specialist, National IPM Program (KASAKALIKASAN) and ASEAN IPM Knowledge Network Center*
7. Mr. Cesar A. Baniqued, *Chief, Disease Management Section, Bureau of Plant Industry (BPI), Manila*
8. Mr. Reynaldo S. Vigilia, *Agriculturist II and Assistant Regional IPM Program Coordinator, Regional Crop Protection Center (RCPC)-R3*
9. Mr. Noelito C. Villa, *Agriculturist II and Assistant Regional IPM Program Officer, DA RFU-CAR*
10. Ms. Tessie P. Alcantara, *Agricultural Technologist and Provincial IPM Coordinator, Tarlac Provincial Agricultural Office*

Local Government Unit (LGU), Mayantoc, Tarlac

11. Ms. Levita R. Damian, *Agricultural Technologist, Municipal Agriculture Office*

Japan International Cooperation Agency (JICA)

12. Dr. Isidro D. Esteban, *Consultant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*
13. Ms. Chiharu Hiyama, *Expert on Community Development, Project for Enhancement of Community-Based Forest Management Program*
14. Mr. Reneboy E. Tavares, *Technical Assistant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*
15. Ms. Ailyn D. Bondoc, *Technical Assistant, Project for Enhancement of Community-Based Forest Management Program*
16. Ms. Lizbeth L. David, *Technical Assistant, Project for Enhancement of Community Based Forest Management Program*
17. Ms. Joan Marie R. Alberto, *Technical Assistant, Project for Enhancement of Community Based Forest Management Program*

Annex D

List of Participants, Facilitators and Resource Persons in One-month Intensive Refresher Course for Trainers of Integrated Pest Management in Crucifers and Other Highland Vegetable Crops held on 27 September to 17 October 1998 at Bineng, La Trinidad, Benguet, Philippines.

Local Government Unit (LGU), Benguet Province

1. Ms. Rosita V. Alubia, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Tuba*
2. Mr. Ramon M. Anacioco, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Sablan*
3. Ms. Susan K. Aniban, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Tublay*
4. Ms. Josephine C. Apili, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Kapangan*
5. Mr. Marcos B. Baucas, *Agricultural Technologist and FFS Facilitator, Office of Provincial Agriculturist, Benguet*
6. Ms. Louisa L. Carbonel, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Bakun*
7. Mr. Perfecto B. Cayat, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Kibungan*
8. Mr. Dexter B. Dimas, *Provincial IPM Coordinator, Office of Provincial Agriculturist, Benguet*
9. Mr. James G. Lopez, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Buguias*
10. Ms. Victoria C. Marcelino, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Atok*
11. Ms. Jocelyn T. Martin, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Tublay*
12. Mr. Nicholas L. Pawid, *Agriculturist II and FFS Facilitator, Office of Provincial Agriculturist, Benguet*
13. Ms. Edna I. Raymundo, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Kibungan*
14. Mr. Esteban R. Reboldela, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Sablan*
15. Ms. Annabelle I. Saingan, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Tuba*
16. Ms. Cherry L. Sano, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Atok*
17. Ms. Annie B. Sebiano, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Kibungan*
18. Mr. Denson G. Tomin, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Kapangan*
19. Mr. Basanio T. Wasing, *Agriculturist II and FFS Facilitator, Office of Municipal Agriculturist, Bakun*

Local Government Unit (LGU), Mountain Province

20. Ms. Juliet P. Banoca, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Besao*
21. Mr. Renato M. Falag-ey, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Bontoc*
22. Ms. Marifee A. Lucaney, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Sabangan*
23. Ms. Fructosa D. Mamanteo, *Agricultural Technologist and FFS Facilitator, Office of Municipal Agriculturist, Sabangan*

Facilitators and Technical Resource Persons, National and Regional Government Agencies

24. Dr. Edwin T. Balaki, *Professor, College of Agriculture (CA) and Director of Extension, Benguet State University (BSU)*
25. Mr. Inocencio B. Bernard, *Technical Staff and IPM Specialist, Department of Agriculture, Cordillera Highland Agricultural Resources Management (DA-CHARM) Project*
26. Dr. Jesus S. Binamira, *IPM Consultant, Department of Agriculture, Cordillera Highland Agricultural Resources Management (DA-CHARM) Project*
27. Mr. Damaso P. Callo, Jr., *Training and Curriculum Development Specialist, ASEAN IPM Knowledge Network Center, SEAMEO-SEARCA (ASEAN IPM-SEARCA)*

28. Mr. Roland A. Carpio, *Technical Staff and IPM Specialist, Department of Agriculture, Cordillera Highland Agricultural Resources Management (DA-CHARM) Project*
29. Prof. Silvestre S. Kudan, *Professor, College of Agriculture, Benguet State University (CA-BSU)*
30. Mr. Charlie C. Sagudan, *Agriculturist II and IPM Specialist, National Training Center, Agricultural Training Institute, Cordillera Administrative Region (NTC-ATI-CAR)*
31. Mr. Freddie T. Langpaoen, *Technical Staff and IPM Specialist, Department of Agriculture, Cordillera Highland Agricultural Resources Management (DA-CHARM) Project*
32. Dr. Jose R. Medina, *Associate Professor, University of the Philippines Los Baños, College of Agriculture, (UPLBCA)*
33. Dr. Sergia P. Milagrosa, *Professor, College of Agriculture, Benguet State University (CA-BSU)*
34. Ms. Luz M. Palengleng, *Training Specialist II and IPM Specialist, Agricultural Training Institute, National Training Center (ATI-NTC), Cordillera Administrative Region (CAR)*
35. Ms. Araceli B. Pedro, *Technical Staff and IPM Specialist, Department of Agriculture, Cordillera Administrative Regional Field Unit (DA-CARFU)*
36. Ms. Harriet A. Tauli, *Technical Staff and Non-forma Education Expert, National Program Office, KASAKALIKASAN (IPM-NPO)*
37. Mr. Landis B. Teofilo, *Agriculturist II and IPM Specialist, Department of Agriculture, Cordillera Administrative Regional Field Unit (DA-CARFU)*

Annex E

List of Farmer-Graduates, Facilitators, Technical Resource Persons and Support Staff Who Validated the Discovery-based Exercises on FFS for Agroforestry conducted on 27 June to 28 November 2008 at Barangay Maniniog, Mayantoc, Tarlac, Philippines

Farmer-Graduates, Cacupangan Tree Farmers Association Incorporated (CTFAI), Cacupangan, Mayantoc, Tarlac

1. Mr. George Quita
2. Mr. Romeo Ramirez
3. Ms. Virginia J Quita
4. Mr. Leonardo Quita
5. Ms. Mameng Julian
6. Mr. Randy Quita
7. Mr. Rodolfo S. Mariano
8. Mr. Cecelio Quita
9. Ms. Mercilita Balagso
10. Ms. Anita Carrera
11. Ms. Revillia Labrador
12. Ms. Zenaida Quita
13. Mr. Soledad Julian
14. Mr. Febrelito Quita
15. Ms. Mercy Julian
16. Mr. Arthur J. Sebastian
17. Mr. Edgardo Yadao
18. Mr. Mariano Briones
19. Ms. Nancy Carrera

Facilitators, Local Government Unit (LGU), Municipal Agriculture Office, Mayantoc, Tarlac

20. Mr. Melchor C. Pobre, *Agricultural Technologist*
21. Ms. Levita R. Damian, *Agricultural Technologist*
22. Ms. Merly F. Apostol, *Agricultural Technologist*
23. Mr. Juan D. Felizardo, *Agricultural Technologist*

Student Facilitators, Department of Environment and Natural Resources, (DENR)-Region 3

24. For. Mariano P.Lagartera,Jr., *Forester III, CENRO-Camiling*
25. For. Reynaldo M. Dela Cruz, *Chief, Plans and Programs Unit, CENRO-Camiling*
26. For. Heshidy S. Dela Cruz, *CENRO CBFM Coordinator, CENRO-Camiling*
27. Mr. Rex C. Ramos, Chief, *Survey and Mapping Unit, CENRO-Camiling*

Technical Resource Persons and Support Staff, Local Government Unit (LGU), Department of Agriculture (DA), and Japan International Cooperation Agency (JICA)

28. Mr. Reynaldo S. Vigilia, *Agriculturist II and Assistant Regional IPM Program Coordinator, Regional Crop Protection Center (RCPC)-R3*
29. Ms. Tessie P. Alcantara, *Agricultural Technologist and Provincial IPM Coordinator, Tarlac Provincial Agricultural Office*
30. Mr. Akira Koto, *Expert on Farmers Organizations and Extension, Project for Enhancement of Community-Based Forest Management Program*
31. Ms. Chiharu Hiyama, *Expert on Community Development, Project for Enhancement of Community-Based Forest Management Program*
32. Dr. Isidro D. Esteban, *Consultant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*
33. Mr. Reneboy E. Tavares, *Technical Assistant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*

Annex F

List of Farmer-Graduates, Facilitators, Technical Resource Persons, and Support Staff Who Validated the Discovery-based Exercises on FFS for Agroforestry conducted on 3 February to 28 April 2009 at Barangay Papaac, Camiling, Tarlac, Philippines

Farmer-Graduates, Papaac Upland Farmers Association Incorporated (PUFAI), Barangay Papaac, Camiling, Tarlac

1. Mr. Roger S. Jugatan
2. Mr. Alberto E. Reyes
3. Mr. Robert Sanchez
4. Ms. Noly Depayso
5. Ms. Carmelita L. Dadulla
6. Ms. Rosita Bautista
7. Mr. Marlon Esteban
8. Ms. Dominga Ibarra
9. Mr. Elpedio Timmalog
10. Mr. Hermenigildo B. Matias
11. Mr. Victor T. Gomez
12. Mr. Cemon L. Diaz
13. Mr. Arsenio Castañeda
14. Mr. Arsenio B. Manzano
15. Mr. Maximino C. Bacarro
16. Ms. Melinda B. Manzano
17. Ms. Lourdes Basilio
18. Mr. Christian Azuzenas
19. Ms. Dionisia Gattoc
20. Mr. Loreto Andres
21. Mr. John Jugatan
22. Mr. Robert Sanchez
23. Mr. Ferdinand Gattoc
24. Mr. Rudy F. Cosme
25. Mr. Resto M. Bautista
26. Ms. Felita Manzano
27. Mr. Norio Matias
28. Mr. William Gattoc
29. Ms. Rosemarie Gattoc
30. Mr. Remegio Dadulla
31. Mr. Bartolome De Jesus
32. Ms. Felicidad De Jesus
33. Mr. Cristoper Cariño
34. Mr. Napoleon Timmalog
35. Mr. Kris Dela Cruz
36. Mr. Toto Cosme
37. Ms. Rita Balintay
38. Mr. Balderico Andres
39. Ms. Epefania Sumera

Facilitators, Local Government Unit (LGU), Tarlac

40. Mr. Melchor C. Pobre, *Agricultural Technologist, Municipal Agriculture Office, Mayantoc*
41. Mr. Jesus B. Reyes, *IPM Coordinator, Municipal Agriculture Office, Camiling*
42. Mr. Chrisanto Bugarin, *Agricultural Technologist, Municipal Agriculture Office, Camiling*
43. Ms. Sabina Garbin, *Agricultural Technologist, Municipal Agriculture Office, Camiling*

Student Facilitators, Department of Environment and Natural Resources (DENR)-Region 3

44. Ms. Marina S. Corpuz, *Forester I, Regional Community-Based Forest Management Office, RENRO 3*
45. Ms. Brenda Clemente, *Provincial CBFM Coordinator, PENRO-Tarlac*
46. Mr. Mariano Lagartera Jr., *Forester III, CENRO-Camiling*
47. Mr. Heshidy Dela Cruz, *CBFM Coordinator, CENRO-Camiling*
48. Mr. Reynaldo Dela Cruz, *Chief, Plans and Programs Unit, CENRO-Camiling*

Technical Resource Persons and Support Staff, Department of Agriculture (DA), Local Government Unit (LGU), and Japan International Cooperation Agency (JICA)

49. Mr. Reynaldo S. Vigilia, *Agriculturist II and Assistant Regional IPM Program Coordinator, Regional Crop Protection Center (RCPC)-R3*
50. Ms. Tessie P. Alcantara, *Agricultural Technologist and Provincial IPM Coordinator, Tarlac Provincial Agricultural Office*
51. Dr. Isidro Esteban, *JICA Consultant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*
52. Ms. Chiharu Hiyama, *JICA Expert on Community Development, Project for Enhancement of Community-Based Forest Management Program*
53. Mr. Reneboy Tavares, *JICA Technical Assistant on Agroforestry, Project for Enhancement of Community Based-Forest Management Program*

Annex G

List of Participants in the Assessment and Field Guide Modification Workshop on FFS for Agroforestry held on 21-23 April 2009 at Camiling, Tarlac, Philippines

Department of Environment and Natural Resources (DENR)

1. For. Marina S. Corpuz, *Forester, Regional Community-Based Forest Management Office, DENR-R3*
2. For. Laurino D. Macadangdang, *Community Environment and Natural Resources Officer, CENRO-Camiling*
3. For. Brenda M. Clemente, *Provincial CBFM Coordinator, PENRO-Tarlac*
4. For. Mariano P. Lagartera, Jr., *Forester III, CENRO-Camiling*
5. For. Reynaldo M. Dela Cruz, Chief, *Plans and Programs Unit, CENRO-Camiling*
6. For. Heshidy S. Dela Cruz, *CENRO CBFM Coordinator, CENRO-Camiling*

Department of Agriculture (DA)

7. Mr. Damaso P. Callo, *Training and Curriculum Development Specialist, National IPM Program (KASAKALIKASAN) and ASEAN IPM Knowledge Network Center*
8. Mr. Cesar A. Baniqued, *Chief, Disease Management Section, Bureau of Plant Industry (BPI), Manila*
9. Mr. Reynaldo S. Vigilia, *Agriculturist II and Assistant Regional IPM Program Coordinator, Regional Crop Protection Center (RCPC)-R3*
10. Ms. Tessie P. Alcantara, *Agricultural Technologist and Provincial IPM Coordinator, Tarlac Provincial Agricultural Office*

Local Government Unit (LGU), Tarlac

11. Mr. Melchor C. Pobre, *Agricultural Technologist, Municipal Agriculture Office, Mayantoc*
12. Ms. Levita R. Damian, *Agricultural Technologist, Municipal Agriculture Office, Mayantoc*
13. Mr. Jesus A. Reyes, *Agricultural Technologist and Municipal IPM Coordinator, Municipal Agriculture Office, Camiling*
14. Mr. Chrisanto I. Bugarin, *Agricultural Technologist, Municipal Agriculture Office, Camiling*
15. Ms. Sabina J. Garbin, *Agricultural Technologist, Municipal Agriculture Office, Camiling*

Papaac Upland Farmers Association Incorporated (PUFAI), Barangay Papaac, Camiling, Tarlac

16. Mr. Hermenigildo B. Matias, *Peoples' Organization (PO) Chairman*
17. Mr. Remegio M. Dadulla, *Barangay Captain and Peoples' Organization (PO) Adviser*
18. Mr. Roger S. Jugatan, *Sikap ng mga Katutubong Aeta ng Tarlac (SIKAT) Chairman*
19. Ms. Lourdes B. Basilio, *Barangay Councilor and Peoples' Organization (PO) Member*
20. Ms. Felicidad L. De Jesus, *Barangay Councilor and Peoples' Organization (PO) Member*

Japan International Cooperation Agency (JICA)

21. Ms. Chiharu Hiyama, *Expert on Community Development, Project for Enhancement of Community-Based Forest Management Program*
22. Dr. Isidro D. Esteban, *Consultant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*
23. Mr. Reneboy E. Tavares, *Technical Assistant on Agroforestry, Project for Enhancement of Community-Based Forest Management Program*

Annex H

Activity Guide on FFS for Agroforestry (Vegetable-based) used at Barangay Maniniyog, Mayantoc, Tarlac on 27 June to 28 November 2008

TIME	PRE-FFS ACTIVITIES	
7:00-12:00	Courtesy call Identification and formation of core group Identification and selection of learning field	
TIME	**WEEK 1**	**WEEK 2**
7:00-7:30	Arrival of participants, registration Opening Program	Opening prayer Recapitulation
7:30-10:00	FFS group organization (leveling of expectations, setting of norms and formation of sub group) Group dynamics	Pre Evaluation (Ballot Box) Discussion on Participatory Action Research (PAR) activities in the FFS Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Soil fertility, cropping systems Basic concept of agroforestry ecosystem	Participatory discussions and exercises on: Basics of agroforestry farm establishment
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 3**	**WEEK 4**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Seedbed preparation and sowing Finalize plans for PAR activities Group dynamics	Concept of ecosystem Introduction to agroforestry ecosystem analysis (AFESA) Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Nursery management Nursery cycle	Participatory discussions and exercises on: Fertilizer computation Selection of good mother tree
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	WEEK 5	WEEK 6
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA (on seedlings) Processing of field activities Compost making Group dynamics	▪ AFESA (on seedlings) ▪ Processing of field activities ▪ Land preparation for transplanting ▪ Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Functions, sources, kinds advantages and disadvantages of fertilizer Basics of agroforestry plantation maintenance	▪ Participatory discussions and exercises on: - Land preparation - Forest protection
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 7**	**WEEK 8**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA (on seedlings) Processing of field activities Transplanting of seedlings Group dynamics	▪ AFESA ▪ Processing of field activities ▪ Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Beneficial and spiders Plantation sanitation, fertilization and replanting	▪ Participatory discussions and exercises on: - Disease triangle, integrated soil and water management - Importance and establishment of fire line
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	WEEK 9	WEEK 10
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Group dynamics	AFESA Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Myths of forest and vegetable pests Asexual propagation	Participatory discussions and exercises on: Various cultural management Silvicultural management
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 11**	**WEEK 12**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Insect collection Group dynamics	▪ AFESA ▪ Processing of field activities ▪ Antagonism and parasitism ▪ Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Predation and parasitism, disease of vegetables (tomato and eggplant) Concept of forest ecology	▪ Participatory discussions and exercises on: - Major pest of vegetables (tomato and eggplant) - Seed collection and identification of mother tree
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	WEEK 13	WEEK 14
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Group dynamics	▪ AFESA ▪ Processing of field activities ▪ Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Hazards of pesticides (Effects on natural enemies) Major pest of forest trees	▪ Participatory discussions and exercises on: - Hazards of pesticides (Effects on human and environment) - Harvesting
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 15**	**WEEK 16**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Group dynamics	AFESA Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Plant propagation techniques Marketing of forest products	Participatory discussions and exercises on: Food web and food chain Forest fire management
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	WEEK 17	WEEK 18
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Group dynamics	Harvesting of vegetables Folk media discussion and preparation Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on diseases of tomato	Discussion on the details of exchange visit
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer

TIME	WEEK 19	WEEK 20
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	**EXCHANGE VISIT**
7:30-10:00	Post Evaluation (Ballot Box) Group dynamics	
10:00-10:15	**BREAK**	
10:15-11:45	Discussions on the result of the post evaluation Preparation for exchange visit	
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	

TIME	WEEK 21	WEEK 22
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	**FIELD DAY/GRADUATION DAY**
7:30-10:00	FFS wrap-up sessions Preparation for graduation and field day Group dynamics	
10:00-10:15	**BREAK**	
10:15-11:45	Discussion on remaining topics on agroforestry	
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	

Annex I

Modified Activity Guide on FFS for Agroforestry (Vegetable-based)
developed by participants in Assessment and Curriculum Modification Workshop on FFS for Agroforestry held on 16-17 December 2008 at Camiling, Tarlac, Philippines

TIME	PRE-FFS ACTIVITIES
7:00-12:00	Courtesy call Identification and formation of core group Identification and selection of learning field and Action Research
	Nursery Operations (seed bed/seed box preparation, germination media, soil sterilization, seed pretreatment, seed sowing/germination)

TIME	WEEK 1	WEEK 2
7:00-7:30	Arrival of participants, registration Opening Program	Opening prayer Recapitulation
7:30-10:00	FFS group organization (leveling of expectations, setting of norms and formation of sub group) Group dynamics	Pre Evaluation (Ballot Box) Preparation of the plan Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Current upland issues and updates of policies Forest conservation and watershed protection	Participatory discussions and exercises on: Introduction to agroforestry Agroforestry system and concept
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer

TIME	WEEK 3	WEEK 4
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Participatory discussion on agroforestry systems and establishment of Participatory Action Research (PAR) activities in the FFS Group dynamics	Introduction to agroforestry ecosystem analysis (AFESA) Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Agroforestry classification and examples Sloping Agricultural Land Technology (SALT) and STOP	Participatory discussions and exercises on the roles of agroforestry protection and production aspect
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	WEEK 5	WEEK 6
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Group dynamics	AFESA Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Multipurpose trees Fruit trees	Participatory discussions and exercises on species compatibility
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 7**	**WEEK 8**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Group dynamics	AFESA Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Forest ecology Components of ecosystem	Participatory discussions and exercises on soil and water conservation
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	WEEK 9	WEEK 10
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Tree Seed Management Group dynamics	AFESA Processing of field activities Nursery Operations Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on forest tree and cash crop seed management (importance of tree seed management, collection of quality seeds, seed processing, extraction, cleaning, drying and storage)	Participatory discussions and exercises on cash crop seed management
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 11**	**WEEK 12**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Group dynamics	AFESA Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on nursery operations, pricking and potting, potting media, hardening-off	Participatory discussions and exercises on vegetative propagation and tissue culture
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	WEEK 13	WEEK 14
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Group dynamics	AFESA Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on compost making, vermiculture, organic and inorganic fertilizers	Participatory discussions and exercises on forest plantation establishment and management, care and maintenance
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 15**	**WEEK 16**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	AFESA Processing of field activities Folk media discussion and presentation Group dynamics	AFESA Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on non-timber species i.e. bamboo, palm, rattan, buri, anahaw, bunga, salagonito	Participatory discussions and exercises on agronomic crops, horticultural crops, root crops and grain crops
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	**WEEK 17**	**WEEK 18**
7:00-7:30	**EXCHANGE VISIT**	Prayer Recapitulation Briefing for the day's activities
7:30-10:00		AFESA Processing of field activities Group dynamics
10:00-10:15		**BREAK**
10:15-11:45		Evaluation of exchange visit
11:45-12:00		Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 19**	**WEEK 20**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Post Evaluation (Ballot box) Group dynamics	Discussion on the remaining topics on agroforestry
10:00-10:15	**BREAK**	
10:15-11:45	Discussion on the result of the post-evaluation	Discussion on the remaining topics on agroforestry
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**WEEK 21**	**WEEK 22**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	**FIELD DAY/GRADUATION DAY**
7:30-10:00	FFS wrap-up session	
10:00-10:15	**BREAK**	
10:15-11:45	Preparation of field day and graduation	
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	

Annex J

Activity Guide on FFS for Agroforestry (Vegetable-based) used at Barangay Papaac, Camiling, Tarlac on 3 February to 28 April 2009

TIME	PRE-FFS ACTIVITIES
7:00-12:00	Courtesy call Identification and formation of core group Identification and selection of learning field and Action Research
	Nursery Operations (seed bed/seed box preparation, germination media, soil sterilization, seed pretreatment, seed sowing/germination)

TIME	SESSION 1	SESSION 2
7:00-7:30	Arrival of participants, registration Opening Program	Opening prayer Recapitulation
7:30-10:00	FFS Group Organization (leveling of expectations, setting the learning norms and formation of sub-group) Discussion on Participatory Action Research (PAR) activities in the FFS Group dynamics	Land Preparation Introduction to agroforestry ecosystem analysis (AFESA) Group dynamics
10:00-10:15	BREAK	
10:15-11:45	Participatory discussions and exercises on: Nursery operation and management (agriculture and forestry) Concept of agroforestry, problems, issues and concerns	Participatory discussions and exercises on record keeping
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer

TIME	SESSION 3	SESSION 4
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Pre Evaluation (Ballot Box) Insect collection Group dynamics	Land preparation Group dynamics
10:00-10:15	BREAK	
10:15-11:45	Participatory discussions and exercises on: Natural enemies and insect pest Establishment of contour using A-frame	Participatory discussions and exercises on: Seed morphology Agroforestry systems, production and protection aspects
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	SESSION 5	SESSION 6
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Application of organic fertilizer Hands-on on compost making Group dynamics	Transplanting of vegetable seedlings Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on forest protection management and forest fire control	Participatory discussions and exercises on: Fertilizer management Multi-purpose tree species, timber and non timber forest products
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**SESSION 7**	**SESSION 8**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Planting of forest/fruits tree seedlings Introduction to AFESA form Group dynamics	1^{st} AFESA on vegetables Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Fertilizer component, computation, soil sampling and analysis Forest protection and maintenance	Participatory discussions and exercises on: Disease triangle Seed collection, seed production and direct seeding
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	SESSION 9	SESSION 10
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Hands-on potting Group dynamics	2nd AFESA on vegetables Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Seedling morphology Livestock and livelihood opportunities	Participatory discussions and exercises on: Weed management Hands-on potting media preparation, potting and seed sowing
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**SESSION 11**	**SESSION 12**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Insect collection Group dynamics	3rd AFESA on vegetables Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Spider counting Agroforestry plantation establishment	Participatory discussions and exercises on: Identification of insect pest and natural enemies Agroforestry ecosystem
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	**SESSION 13**	**SESSION 14**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Insect collection Group dynamics	4th AFESA on vegetables Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Food chain, food web and life cycle Hydrologic cycle	Participatory discussions and exercises on: Defoliators Vegetative propagation and tissue culture
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**SESSION 15**	**SESSION 16**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	Tending, care and maintenance of agriculture, and forest/fruit tree crops Group dynamics	5th AFESA on vegetables Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on: Rodent management Species compatibility	Participatory discussions and exercises on: Bacterial diseases Agronomic and horticultural crops
11:45-12:00	Evaluation of the days' activity Planning for next weeks activities Closing prayer	Evaluation of the days' activity Planning for next weeks activities Closing prayer

TIME	SESSION 17	SESSION 18
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	Prayer Recapitulation Briefing for the day's activities
7:30-10:00	1st AFESA on forest/fruits trees Processing of field activities Group dynamics	6th AFESA on vegetables Processing of field activities Group dynamics
10:00-10:15	**BREAK**	
10:15-11:45	Participatory discussions and exercises on fungal diseases on vegetables and forest/fruit trees	Participatory discussions and exercises on virus diseases on vegetables and forest/fruit trees
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**SESSION 19**	**SESSION 20**
7:00-7:30	**EXCHANGE VISIT**	Prayer Recapitulation Briefing for the day's activities
7:30-10:00		Post Evaluation (Ballot box) 2nd AFESA on forest/fruits trees Processing of field activities Group dynamics
10:00-10:15		**BREAK**
10:15-11:45		Participatory discussions and exercises on soil and water conservation measures
11:45-12:00		Evaluation of the days' activity Planning for next weeks' activity Closing prayer
TIME	**SESSION 21**	**SESSION 22**
7:00-7:30	Prayer Recapitulation Briefing for the day's activities	**FIELD DAY/GRADUATION DAY**
7:30-10:00	FFS wrap-up session Preparation of field day and graduation	
10:00-10:15	**BREAK**	
10:15-11:45	Folk media discussion and presentation	
11:45-12:00	Evaluation of the days' activity Planning for next weeks' activity Closing prayer	

About the Publishers

The **Project for Enhancement of Community-Based Forest Management Program (ECBFMP)** is a 5-years technical cooperation project undertaking by the Department of Environment and Natural Resources (DENR) and the Japan International Cooperation Agency (JICA) from 2004 to 2009, focusing on technology development and transfer as well as capacity building for both participating communities and partner institutions such as DENR, LGUs and other parties. The project aims at promoting conservation, rehabilitation and sustainable utilization of forest and land resources within CBFM areas.

The **Department of Environment and Natural Resources (DENR) - Region III** is directed towards spearheading the conservation, management, development and proper use of the environment and natural resources in Region III. It administers 20 congressional districts, 13 cities and 118 municipalities with seven Provincial ENR Offices and sixteen Community ENR Offices. Its mission is to conserve, protect and manage the natural resources collaborating with people's organization, NGOs, private sectors and LGUs for a better environment in the future.

KASAKALIKASAN is the acronym for *Kasaganaan ng Sakahan at Kalikasan*. It means Nature is Agriculture's Bounty. The National IPM Program (KASAKALIKASAN) seeks to popularize Integrated Pest Management (IPM). The Philippine Department of Agriculture (DA) implements KASAKALIKASAN in collaboration with local government units (LGUs), and non-government organizations (NGOs) in participating provinces and municipalities. The Program assists farmers in developing their ability to make critical and informed decisions that render their crop production systems more productive, profitable, and sustainable. KASAKALIKASAN is Philippine government's commitment to Agenda 21 of the United Nations Conference on Environment and Development in promoting sustainable agriculture and rural development.

The ASEAN IPM Knowledge Network (ASEAN IPM) is an initiative to accumulate vast collection of knowledge capital on integrated pest management (IPM) that can be reused and shared by national IPM programs in ASEAN region. ASEAN IPM is an electronic Internet-like, wide-area network composed of each ASEAN member country with its regional center located in the Philippines. Its mission is to help governments improve effectiveness of their program implementation by making knowledge sharing easy among their national IPM programs.