AGROFORESTRY

SEED TECHNOLOGY AND NURSERY MANAGEMENT

A TRAINING MANUAL

ICRAF

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and

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October 1998

FOREWORD

The success of agroforestry as a land-use management system depends, among other things, on quality planting materials for optimum production. Recent developments in technology present various alternatives to producing such planting materials. Of these, the combination of biotechnology with indigenous or traditional propagation techniques have gained wide acceptance and, through practice, have proven essential in seed technology, and nursery establishment and management.

But behind the successful production and management of quality planting materials are the people involved in such activities. Those engaged in agroforestry project implementation should be equipped with the knowledge and skills in seed technology and nursery management, including the various technologies recently developed.

One possible approach towards this is through training. There is really no substitute for hands-on experience. This is the concept behind the short-term training course on Agroforestry Seed Technology and Nursery Management (STNM). Together with the other short training courses in agroforestry, STNM has catered to more than a thousand field personnel, academicians, researchers, farmers and other agroforestry practitioners in the Philippines and has benefited more than 500 NGOs, GOs, local government units, academic and research institutions, and people's organizations from all parts of the country since 1991, when the course started to be offered.

Another way is through training manuals. The manuals do not only supplement the skills enhanced through training but also immediately provide technicians and development agents the information they need. Manuals can indeed save users from spending valuable time, effort and resources in attending workshops and seminars.

Recognizing the manuals' potentials, the International Centre for Research in Agroforestry, Rockefeller Brothers Fund, Winrock International, and the Institute of Agroforestry (IAF) collaborated to produce this manual on STNM for Agroforest Farms. For this, the resource persons in IAF's two-week course on STNM were tapped to share their expertise and experiences on STNM principles and practices; indigenous seed technology; seed technology concerns in sustainable agriculture; and application of biotechnology in nursery management and genetic resource conservation.

Technologies and the learning process develop side by side – simultaneously and continuously. Moreover, additional knowledge would be gained through actual practice. Thus, users of this manual are encouraged to use the many tips it offers as launching pads to continue discovering new ways and means to ensure good quality planting materials.

We hope that the knowledge and experiences gained from this manual will not stop with you. Please share it with other interested partners so that we all can grow together in a world made better through the economic and environmental impacts of agroforestry.

Romulo A. del Castillo
Director
Institute of Agroforestry

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We would like to express our sincerest gratitude to the following persons and/or groups who have contributed one way or the other in developing this STNM manual:

- Mr. James Roshetko of Winrock International and the International Centre for Research in Agroforestry (ICRAF), for facilitating the allocation of some funds to produce this manual and reviewing the contents;

- Mr. Bruno Verbist of ICRAF for his key role in laying the groundwork for the conceptualization and production of the manual;

- Dr. Romulo A. del Castillo for his guidance and support in the manual's conceptualization, management, development and production;

- Winrock International and ICRAF for extending their support in the production of this STNM manual – helping us achieve at last our long-term goal of producing manuals for the immediate use of agroforestry practitioners;

- The two Subject Matter Specialists and readers who reviewed and refined the contents -- Dr. Armando M. Palijon for materials on nursery management; and Prof. Portia G. Lapitan for materials on seed technology;

- All the resource persons who shared their expertise, insights, and experiences during the implementation of the training course on STNM from 1991 to 1998;

- All the STNM participants who have also shared their experiences, insights and lessons in seed technology, and nursery establishment and management, in their respective sites;

- For. Charles P. Castro for taking time to edit and refine the manual's contents; and

- The IAF administrative and technical staff who did most of the spade work, as it were, and participated in all stages of the manual's production process.

INSTITUTE OF AGROFORESTRY

Formerly the UPLB Agroforestry Program, the Institute of Agroforestry (IAF) functions to undertake research and extension activities and coordinate the development of curricular programs in agroforestry in UPLB. Its mission is to develop and promote agroforestry as a land-use management system addressing the needs for soil, water and resource conservation; increased production; and greater economic gain.

The Institute recognizes the significant role being played by the people and other concerned agencies in forming progressive and productive communities where farming is harmonized with environmental conservation principles for the sustained production of food, and wood and provision of services through the use of sound agroforestry practices.

Since its founding as a Program in 1991 until its elevation as an Institute in June 1998, IAF has pursued and will continue to pursue agroforestry education development coordination, research and technology development, and provision of rural development services by:

- Facilitating the development of agroforestry curricular programs at UPLB
- Working towards agroforestry education networking among schools in the Philippines and Asia-Pacific to strengthen and safeguard quality of agroforestry education
- Developing and implementing a comprehensive research program in agroforestry

- Developing, packaging, and disseminating agroforestry technologies for increased production and sustainable development

- Formulating and implementing a continuing program of agroforestry information management and dissemination

- Promoting the advancement of agroforestry science and technology through training, seminars, workshops, and other similar activities

- Proactively working to integrate agroforestry principles and practices in formulating policies and guidelines related to community-based management of agricultural and natural resource programs

- Establishing, strengthening, and broadening local and international linkages with institutions involved in agroforestry development

- Proactively developing and implementing agroforestry support programs in collaboration with key actors

INTERNATIONAL CENTRE FOR RESEARCH IN AGROFORESTRY

Established in 1977 as an autonomous, non-profit organization, ICRAF's is a member of the Consultative Group on International Agricultural Research (CGIAR). Its goal is to help alleviate tropical deforestation, land depletion and rural poverty through the development and promotion of improved agroforestry systems. ICRAF aims to improve human welfare, increase cash income especially among women, and improve nutritional security. It also works to enhance environmental resilience by replenishing soil fertility, conserve the soil, enhance biological diversity, sequester carbon, and reduce emissions of greenhouse gasses.

ICRAF is highly decentralized -- 51% of the staff are based at headquarters in Nairobi, Kenya and 49% are outposted in 13 countries. Of the 150 professional staff members, 105 are in Africa, 23 in Southeast Asia and 7 in Latin America.

ICRAF carries out research in 6 ecoregions in collaboration with National Agricultural Research Systems (NARS), one of which is the humid tropics of Southeast Asia. These 6 regions represent a range of environmental and socio-economic conditions that contribute to improved agroforestry systems and extrapolate research results to the geographical areas.

ICRAF's research division implements three programs:

- Natural Resource Strategies and Policy determines how farmers' management of natural resources in agroforestry systems interacts with markets, government policies and the physical environment, working towards a more favorable policy framework for agroforestry.

- Domestication of Agroforestry Trees develops ways to manage and improve the tree germplasm used in agroforestry systems.

- Ecosystem Rehabilitation focuses on the tree-soil-crop interactions in agroforestry systems and landscape functions in agroforestry.

On the other hand, the newly established development division is tasked to do:

- Systems Evaluation and Dissemination which compares existing and improved versions of agroforestry systems through farm-testing, eventually disseminated to farmers everywhere.

- Capacity and Institutional Strengthening strengthens local human resources and institutions involved in agroforestry training and education.

ICRAF is governed by an international Board of Trustees. Its research and development programs are made possible by generous funding from many private donors – Asian Development Bank, Australia, Austria, Belgium, Ben Gurion University, Boehringer Ingelheim KG, Brazil, Canada, Centre Technique de Cooperation Agricole et Rurale (CTA), Denmark, the European Union, Finland, the Ford Foundation, France, GAPKINDO (Rubber Processors Association of Indonesia), Germany, the Interamerican Development Bank, the International Development Research Center, the International Fund for Agricultural Development, Ireland, Japan, Mexico, the Netherlands, New Zealand, Norway, the Philippines, the Rockefeller Foundation, Spain, Sweden, Switzerland, the United Kingdom, the United Nations Development Programme, and the World Bank. Generous assistance also comes from many other governments, national institutions, centers, and agencies with which ICRAF collaborates around the world.

WINROCK INTERNATIONAL

Winrock International is an independent, non-profit, tax exempt organization for agricultural and natural resource and environmental research, education, development, and training. Winrock's mission is to work with people to build a better world by increasing agricultural productivity and rural employment while protecting the environment. Winrock implements and manages projects for clients and donor agencies. Headquartered in Arkansas, Winrock maintains offices in Washington D.C., Cote d'Ivoire, Kenya, Brazil, China, India and the Philippines. Additionally, some 25 field offices coordinate on-site contract and project implementation. Winrock has over 25 years of technical experience and project management capability. Currently Winrock manages over 60 projects in Asia, Africa, Latin America and the NIS.

Development is a people oriented business. Recognizing the ultimate importance of well-trained people, Winrock places high priority on human resource development. By doing so, Winrock seeks to improve people's capacity to understand and analyze, to develop workable solutions to problems, to develop new technology, and to effectively manage public and private institutions. Winrock's investment in people demonstrates our long-term approach to development. Winrock International is organized into five divisions:

- Forestry and Natural Resource Management
- Agricultural Productivity
- Renewable Energy
- Global Women's Leadership
- Rural Employment and Enterprise Development

In 1994, the non-profit Nitrogen Fixing Tree Association (NFTA) merged with Winrock. Subsequently becoming the Forest, Farm and Community Tree Network (FACT Net), it is an international

group of individuals and organizations who share the goal of expanding and improving the use of multiple purpose tree species (MPTS) for human and environmental benefits. Through applied research, training, outreach and communication activities, FACT Net provides resources needed to help smallholders use MPTS for sustainable agriculture and environmental protection.

Over the past 18 years, FACT Net has conducted training in Asia, the Pacific, Africa and Latin America for over 3,000 farmers, extension agents, and government officials. FACT Net has conducted more than 30 training courses on the production, management, and use of nitrogen fixing trees in a wide range of agriculture and forestry systems. Courses have been held in China, Guatemala, Indonesia, Micronesia, the Philippines, Tanzania, Thailand, Uganda, and the United States. Most participants are extension agents and project personnel. Courses are typically for 1 week and include hands-on field activities. The lectures and discussions focus on the environmental and social benefits of MPTS and nitrogen-fixing trees, tree products, the process of biological nitrogen fixation, the selection of appropriate species for particular sites, the design of management systems, and project planning. Activities and demonstrations provide participants with basic nursery management, seed-handling, planting, and maintenance skills through practice and observation.

In 1991, the USDA Forest Service selected FACT Net to spearhead the establishment of AIS to provide a mechanism for agroforestry information exchange and to foster the adoption of promising agroforestry technologies. AIS is already distributing information from projects to a network of over 200 individuals and institutions throughout Southeast Asia. Since 1982, FACT Net has conducted and supported 20 international workshops with over 1,500 participants. The objectives of these gatherings are to improve communications of research results between scientists and to transfer this valuable information into materials appropriate for extension agents.

ROCKEFELLER BROTHERS FUND

The Rockefeller Brothers Fund (RBF) is a United States private grant-making foundation incorporated under the laws of New York State and headquartered in New York City. RBF was founded in 1940 as a vehicle through which the five sons and daughter of John D. Rockefeller, Jr. could share a source of advice and research on charitable activities and combine some of their philanthropies to better effect. The Fund's major objective is to improve the well-being of all people through support of efforts in the United States and abroad that contribute ideas, develop leaders, and encourage institutions in the transition to global interdependence. Its grantmaking aims to counter world trends of resource depletion, conflict, protectionism, and isolation which now threaten to move humankind everywhere further away from cooperation, equitable trade and economic development, stability and conservation.

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ACRONYMS

A&D	-	Alienable and Disposable
AF	-	agroforestry
ANR	-	Assisted Natural Regeneration
ANZAP	-	ASEAN-New Zealand Afforestation Project
BFD	-	Bureau of Forest Development
BNF	-	Biological Nitrogen Fixation
BPI	-	Bureau of Plant Industry
CADC	-	Certificate of Ancestral Domain Claim
CBFMA	-	Community-Based Forest Management Agreement
CBFMP	-	Community-Based Forest Management Program
CFA	-	Compost Fungus Activator
CFP	-	Community Forestry Program
CFNR	-	College of Forestry and Natural Resources
CFSA	-	Community Forestry Stewardship Agreement
CSC	-	Certificate of Stewardship Contract
CRTD	-	Center for Research and Technology Development
CTF	-	Communal Tree Farming
DA	-	Department of Agriculture
DENR	-	Department of Environment and Natural Resources
ERDB	-	Ecosystems Research and Development Bureau
FAR	-	Family Approach to Reforestation
FLMA	-	Forest Land Management Agreement
FLMP	-	Forest Land Management Program
FOM	-	Forest Occupancy Management
GATT	-	General Agreement on Tariffs and Trade
GO	-	government organization
IAF	-	Institute of Agroforestry
ICRAF	-	International Centre for Research in Agroforestry
ICC	-	Indigenous Cultural Community
IPB	-	Institute of Plant Breeding
IPR	-	Intellectual Property Rights
LBES	-	Los Baños Experimental Station
LGU	-	Local Government Unit
MC	-	moisture content

NALCO	-	Nasipit Logging Company
NFP	-	National Forestation Program
NGO	-	Non-Government Organization
NPGRL	-	National Plant Genetic Resources Laboratory
NSIC	-	National Seed Industry Council
PBSP	-	Philippine Business for Social Progress
PCARRD	-	Philippine Council for Agriculture, Forestry and Natural Resources Research and Development
PFDPIN	-	Philippine Forestry Development Project In Ilocos Norte
PGR	-	Plant Genetic Resources
PICOP	-	Paper Industries Corporation of the Philippines
RH	-	Relative Humidity
RRDP	-	Rainfed Resources Development Project
SALT -1	-	Sloping Agricultural Land Technology
SALT - 2	-	Simple Agro-Livestock Technology
SALT - 3	-	Sustainable Agroforest Land Technology
STNM	-	Seed Technology and Nursery Management
TLA	-	Timber License Agreement
TNC	-	transnational companies
TSI	-	Timber Stand Improvement
UDP	-	Upland Development Program
UPLB	-	University of the Philippines Los Baños

CONTENTS

SPECIFIC SEED TECHNOLOGIES AND NURSERY MANAGEMENT PRACTICES

SPECIAL CONCERNS

1

PRE-PLANNING ACTIVITIES

This section consists of description of tasks to be completed prior to the start of the training. Among the tasks are:

- preparation of training design and calendar
- definition of staff roles
- identification of resource persons

DESIGN CURRICULUM AND CALENDAR

To appropriately design this type of training, the following information should be considered:

1. Programs in agroforestry -- goals, objectives, operations, etc. by UPLB, NGOs and GOs. The information is used as a guide in clarifying training needs.

2. Trainee's information -- pre-evaluation questionnaire submitted by incoming trainees provide information on their biodata, work history, education, agroforestry-related knowledge and skills, motivation and attitude (please see attached). The information gives the training staff a clear idea of who the audience will be, skill levels and how to fine-tune the design. Workload management is efficient if total number of trainees is known and trainor to trainee ratio is defined.

3. Past Training Courses -- information contained from reports, documentation, commentaries, consultations of designs from conduct of past training courses of experienced trainors and NGOs are also useful.

4. Qualifications of Trainees -- knowledge, background, skills and capability will help demonstrate and relate with other trainees, resource persons and training staff.

5. Training Sites -- biophysical and socio-economic environment, layout, resources, support, etc.

6. Current Status -- issues, policies, and events discussed are reinforced in the curriculum.

7. Length of Training -- proper ratio between time and content should be maintained to have quality learning experience in the class and field.

THE TRAINING DESIGN

Guided by the above factors, the following are the suggested minimum contents of the training design (please see attached sample).

1. Title
2. Rationale or Purpose of the Training
3. Objectives (must be attainable)
4. Course Content (must answer the objectives)
5. Methodology
6. Duration or Time Allocation
7. Schedule or Calendar (please see attached)

DEFINITION OF STAFF ROLES

Smooth implementation of the training is assured with proper tasking of staff members. This is done before designing the training and preparing the calendar. Tasks include the following:

1. Training design preparation
2. Session evaluation (please see attached samples)
3. Coordination of field trips and site visits
4. Implementation of house rules
5. Identification and invitation of resource persons
6. Preparation of supplies
7. Preparation of visual aides/materials

8. Budget and logistics preparation
9. Cliniquing implementation
10. Wrap-up activities
11. Post-training activities

RESOURCE PERSONS

To achieve the highest efficiency and effectiveness of the training, resource persons are selected based on proficiency and competence in their respective fields of expertise. University staff members are usually proficient but not necessarily ideal.

Pointers:
1. Identify contact.
2. Determine duration.
3. Identify learning tools.

ATTACHMENT A

TRAINING DESIGN

RATIONALE:

The use of agroforestry as a land-use management system requires the utilization of quality planting materials to insure optimum production. Good quality planting materials can be produced when the people involved in its production also have adequate skills and knowledge in their propagation.

Recent developments such as the use of biotechnology, coupled with the use of indigenous or traditional propagation techniques, have also gained importance in seed technology and nursery management. These are essential to produce quality planting materials and attain optimum yields.

This training course therefore aims to equip the participants with the necessary knowledge and skills on said recent innovations and techniques in seed technology, including nursery establishment and management.

OBJECTIVES:

At the end of the training course, the participants should be able to:

1. Identify, select and collect the seeds of given species/varieties;
2. Process and store the collected seed materials;
3. Identify the requirements for establishing a nursery;
4. Demonstrate the proper pre-germination and germination practices/techniques;
5. Perform the recommended practices of growing seedlings; and
6. Carry out the appropriate asexual propagation techniques for the specific species;
7. Identify the different indigenous seed technology practices and concerns;
8. Discuss the principles of genetic resource conservation; and
9. Discuss the various applications of biotechnology on nursery management.

COURSE CONTENT:

This training course covers the following topics:

Part I. Overviews

Session 1.	Expectation Setting and Course Overview
Session 2.	Current Issues in Upland Development
Session 3.	Agroforestry Concepts and Principles

Part II. Importance and Scope of Seed Technology and Nursery Management

Session 4.	Importance and Scope of Seed Technology
Session 5.	Importance and Scope of Nursery Management

Part III. General Principles of Seed Technology and Nursery Management

Session 6.	Seed Collection
Session 7.	Seed Processing and Handling
Session 8.	Seed Testing and Certification
Session 9.	Seed Storage
Session 10.	Seed Germination
Session 11.	Asexual Propagation Techniques
Session 12.	Nursery Site Selection, Design and Lay-out
Session 13.	Soil/Media Preparation: Mixing and Sterilization
Session 14.	Nursery Cultural Management
Session 15.	Establishing and Managing On-Farm Agroforestry Nursery

Part IV. Specific Seed Technologies and Nursery Management Practices

Session 15.	Field Crops
Session 16.	Vegetable
Session 17.	Fruit trees
Session 18.	Tree Crops
Session 19.	Non-timber forest crops

Part V. Special Concerns

Session 20.	Indigenous Seed Practices in Sustainable Agriculture
Session 21	Indigenous STNM: The RRDP Experience
Session 22.	Application of Biotechnology in Nursery Management
Session 23.	Genetic Resource Conservation

METHODOLOGY:

Lecture, discussion, exercises and laboratory field work/visits

DURATION AND DATE:

Two weeks (14 days)

STAFF INVOLVED:

Training Coordinator
Subject Matter Specialist for Seed Technology
Subject Matter Specialist for Nursery Management
Training Specialist
Support Staff

SCHEDULE OF DAILY ACTIVITIES

TIME	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
7:00 - 8:00		**BREAKFAST**					
8:00 - 8:30		Opening Program	**SYNTHESIS**				
8:30 - 10:00	A R I V A L	Video Showing Group Dynamics Expectation Setting ***Prof. N. R. Lawas***	Importance and Scope of Seed Technology (Lect/Disc) ***Prof. P. G. Lapitan***	Continuation (Practicum) ***Prof. P. G. Lapitan***	Nursery Site Selection, Design and Lay-out (Lect/Disc) ***Prof. A. M. Palijon***	Asexual Propagation Techniques (Lect/Disc) ***Dr. F. B. Javier***	**Visit to Commercial Nurseries around Laguna and Batangas**
10:00 -10:15		**BREAK**					
10:15 -12:00		Course Overview ***Prof. N. R. Lawas***	General Principles of Seed Technology (Lecture/Disc) ***Prof. P. G. Lapitan***	Continuation (Practicum) ***Prof. P. G. Lapitan***	Soil/Media Preparation: Mixing and Sterilization (Lect/Disc) ***Prof. A. M. Palijon***	Continuation (Practicum) ***Dr. F. B. Javier/ Mr. L. Atienza***	
12:00 - 1:30		**LUNCH BREAK**					
1:30 - 3:30		Current Upland Issues and Policies ***For. C. P. Castro***	Continuation (Practicum) ***Prof. P. G. Lapitan***	Importance and Scope of Nursery Management (Lect/Disc) ***Prof. A. M. Palijon***	Nursery Cultural Management (Lect/Disc) ***Prof. A. M. Palijon***	Continuation..... (Practicum) ***Mr. L. Atienza***	
3:30 - 3:45		***BREAK***					
3:45 - 5:45		Agroforestry Concepts and Principles ***Dr. R. V. Dalmacio***	Continuation... (Practicum) ***Prof. P. G. Lapitan***	Visit to NPGRL-IPB ***Prof. A. M. Palijon/ Dr. F. S. de la Cruz***	Continuation... (Practicum) ***Prof. A. M. Palijon***	Continuation... (Practicum) ***Mr. L. Atienza***	
5:45 - 6:00	**DINNER**		**CLINIQUING**				
6:00 - 7:00	**Briefing**		**DINNER**				
7:00 - 8:00							
8:00 - 8:15		DINNER					

TIME	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
7:00 - 8:00		**BREAKFAST**					
8:00 - 8:30		**SYNTHESIS**					
8:30 - 10:00	R E S T D A Y	Specific Seed Technologies and Nursery Mgt. Practices a. Field Crops (Field Lecture) ***Prof. Victoria Laurel***	c. Fruit Trees (Field Lecture) ***Dr. C. A. Protacio***	e. Non-timber forest crops (Field Lecture) ***Dr. J. O. Sargento***	Application of Biotechnology on Nursery Management (Lect/Disc) ***Dr. M. U. Garcia***	**Visit to nursery projects/places** relevant to STNM	Workshop Output Presentation
10:00 -10:15		**BREAK**					
10:15 -12:00		Continuation... (Field Lecture) ***Prof. Victoria Laurel***	Continuation... (Field Lecture) ***Dr. C. A. Protacio***	Continuation... (Field Lecture) ***Dr. J. O. Sargento***	Continuation... (Practicum) ***Dr. M. U. Garcia***		Continuation ...
12:00 - 1:30		**LUNCH BREAK**					
1:30 - 3:30		b. Vegetable Crops (Field Lecture) ***Dr. R. C. Mabesa***	Visit to the LBES-ERDB *Rattan production *Medicinal Plants Collection ***For. M. Lanting***	Indigenous seed technology and nursery management: RRDP Experience (Lect/Disc) ***Dr. J. O. Sargento***	Genetic Resource Conservation (Lect/Disc) ***Dr. W. M. Carandang***		Synthesis Post-Evaluation Closing Program
3:30 - 3:45		**BREAK**					
3:45 - 5:45		Continuation... (Field Lecture) ***Dr. R. C. Mabesa***	Continuation ... *Black pepper production in agroforestry	Continuation... (Lect/Disc) ***Dr. J. O. Sargento***	Continuation... (Lect/Disc) ***Dr. W. M. Carandang***	Re-entry Plan Preparation	
5:45 - 6:00		**CLINIQUING**					
6:00 - 7:00		**DINNER**					

ATTACHMENT B

PRE-COURSE EVALUATION

Please answer the following questions as thoroughly as possible. Your answers would help us make the training course relevant and effective.

I. General Information

1. Name: _____

2. Designation: _____

3. Agency/Organization: _____

4. Address: _____

5. Highest Educational Attainment (specify major field and school graduated from):

_____

_____

II. Nature of Work

6. Please describe briefly your present duties/responsibilities:

_____

_____

_____

_____

7. Have you attended any training course related to Agroforestry Seed Technology and Nursery Management (STNM) before?

If yes, please specify:

Title of Course	Date Held	Venue
a. _____ _____	_____	_____
b. _____ _____	_____	_____
c._____ _____	_____	_____

III. Expectations

8. What do you expect to gain from attending STNM?
(Please state at least 3 expectations)

a._____
b._____
c._____

Present Knowledge on Agroforestry Seed Technology and Nursery Management

9. Please indicate the rate of your understanding and/or knowledge on the following topics scheduled for discussion and their relevance to your present responsibilities. Use the following rating scale:

5 Very High 4 High 3 Moderate 2 Low 1 Very Low

SUBJECT		RATING	
		Understanding/ Knowledge	Relevance to present Responsibilities
I.	Course Overview		
a.	Current Upland Issues and Policies		
b.	Agroforestry Concepts, Principles and Practices		
II.	Importance and Scope of Seed Technology and Nursery Management		
c.	Importance and Scope of Seed Technology		
d.	Importance and Scope of Nursery Management		

III.	General Principles of Seed Technology and Nursery Management		
e.	General Principles of Seed Technology		
f.	Nursery Site Selection, Design and Lay-out		
g.	Soil/Media Preparation: Mixing and Sterilization		
h.	Nursery Cultural Management		
i.	Asexual Propagation		
IV.	Specific Seed Technologies and Nursery Management Practices		
j.	Field Crops		
k.	Vegetable		
l.	Fruit trees		
m.	Tree Crops		
n.	Non-timber forest crops		

V.	Special Concerns		
o.	Indigenous Seed Technology and Nursery Management: RRDP Experience		
p.	Application of Biotechnology in Nursery Management		
q.	Genetic Resource Conservation		

10. What factors do you think would help facilitate your learning process during the training course?

_____
_____
_____

11. What factors do you think would restrain your learning process during the training course?

_____
_____
_____

- Thank You Very Much! -

ATTACHMENT C

POST-COURSE EVALUATION

To: ALL PARTICIPANTS

This questionnaire aims to solicit your feedback on how the course was organized and managed. Your candid answers are therefore very valuable in helping us improve the conduct of future training courses. So, please answer all questions.

I. Attainment of Objectives

Based on the topics presented, to what extent were the objectives of the training course attained? (Please check).

OBJECTIVES	RATING		
	FULLY	PARTIALLY	NOT AT ALL
I. Course Overview 1. To level-off course objectives with participants' expectations.			
2. To provide an overview of current upland issues and policies; and relate understanding of these issues to agroforestry project implementation.			
3. To discuss the strengths and weaknesses of various agroforestry systems.			

II. Importance and Scope of Seed Technology and Nursery Management			
4. To discuss the importance and scope of seed technology			
5. To discuss the importance and scope of nursery management			
III. General Principles of Seed Technology and Nursery Management 6. Understand the general principles of seed technology and nursery management and their importance to Agroforestry.			
7. Explain the principles of nursery site selection, design and lay-out.			
8. Discuss the principles and practices of soil/media preparation.			
9. Discuss the different cultural management practices in the nursery.			
10. Know the different techniques in asexual propagation and perform the required cultural practice(s).			

IV. Specific Seed Technologies and Nursery Management Practices 11. Exposure to different seed technology and nursery management practices for field crops			
12. Exposure to different seed technology and nursery management practices for vegetable crops			
13. Exposure to different seed technology and nursery management practices for fruit trees			
14. Exposure to different seed technology and nursery management practices for tree crops			
15. Exposure to different seed technology and nursery management practices for non-timber forest crops.			
V. Special Concerns 16. Discuss indigenous seed technology and seed technology concerns in sustainable agriculture			
17. Know the different biotechnologies and its application to nursery management			
18. Discuss the principles on genetic resource conservation.			

What other objectives do you think should have been included?

1._____

2._____

3._____

In relation to these objectives, what other specific topics do you think should have been included?

1._____

2._____

3._____

II. Discussion of Various Topics

How would you evaluate the various topics discussed on presentation and discussion?

Please use the following rating scheme:

VS - Very satisfactory
S - Satisfactory
U - Unsatisfactory

SUBJECT	LEVEL OF PRESENTATION		
	VS	S	U
1. Current Upland Issues and Policies			
2. Agroforestry Concepts, Principles and Practices			
3. Importance and Scope of Seed Technology			
4. Importance and Scope of Nursery Management			

5. General Principles of Seed Technology and Nursery Management			
6. Nursery Site Selection, Design and Lay-out			
7. Soil/Media Preparation: Mixing and Sterilization			
8. Nursery Cultural Management			
9. Asexual Propagation			
10. Specific Seed Technologies and Nursery Management Practices for Field Crops			
11. Specific Seed Technologies and Nursery Management Practices for Vegetable Crops			
12. Specific Seed Technologies and Nursery Management Practices for Fruit Trees			
13. Specific Seed Technologies and Nursery Management Practices for Tree Crops			
14. Specific Seed Technologies and Nursery Management Practices for Non-timber forest crops			
15. Indigenous Seed Practices in Sustainable Agriculture			
16. Indigenous Seed Technology and Nursery Management: RRDP Experience			
17. Application of Biotechnology in Nursery Management			
18. Genetic Resource Conservation			

III. Overall Course Management

Please indicate your rating of the course's overall management:

_____ Very Satisfactory
_____ Satisfactory
_____ Unsatisfactory

IV. Suggestions and Recommendations for Course Improvement

1. Course Content

2. Course Delivery/Presentation

3. Administrative Matters

4. Overall Management

V. Training Research Priorities

Please indicate the training and research priorities of your organization.

Training

1._____

2._____

3._____

Research

1._____

2._____

3._____

VI. Information of Respondent:

NAME : _____

POSITION: _____

OFFICE ADDRESS:_____

_____

TEL. NO:_____

Thank you very much!

2
OVERVIEWS

EXPECTATION SETTING

Course Coordinator

Objective:

To level off the training objectives with the participants' expectations.

Learning Tools:

Transparencies, course design and schedule, pentel pens, Manila paper, cartolina.

Methodology:

The training coordinator discusses briefly the activity to be undertaken. The trainees are conveniently grouped and allowed to discuss on their expectations about the training. The foci are the course content, laboratory practicum, workshops, resource persons, training staff/facilitators, food, accommodations, extracurricular activities and other aspects of the training. Each group elects a leader/presentor to discuss their expectations.

Guide Questions:

1. What are your expectations in this training? You may focus your answer on the course content, resource persons, workshops/practicum, training staff, etc.

2. What factors do you think would hinder your active participation in this training?

3. What can you possibly contribute to the success of this training?

COURSE OVERVIEW

This session follows the presentation of the participants' expectations. The training coordinator discusses the training design with emphasis on the expectations which could possibly be met and explains why some expectations could not be answered. The seed technology and nursery management for agroforestry training rationalizes that:

"... The use of agroforestry as a land-use management system requires the utilization of quality planting materials to insure optimum production. Good quality planting materials can be produced when the people involved in its production also have adequate skills and knowledge in their propagation.

Recent developments such as the use of biotechnology, coupled with the use of indigenous or traditional propagation techniques have also gained importance in seed technology and nursery management. These are essential in order to produce quality planting materials and attain optimum yields."

This training course therefore aims to equip the participants with the necessary knowledge and skills on said recent innovations and techniques in seed technology, including nursery establishment and management.

CURRENT ISSUES IN UPLAND DEVELOPMENT

Napoleon T. Vergara

THE UPLANDS: STATUS AND TRENDS

- "Uplands" are areas with slopes steeper than 18%. They comprise approximately 17.6 million hectares and cover more than half (59%) of the country's total land area -- indicating that the Philippines is relatively mountainous.

- 12 million hectares of uplands are considered "forestlands" -- although some portions no longer contain forests. A small portion of forestlands are mangrove forests which are not situated in the uplands.

- Thus, when we refer to uplands, we also largely refer to the forestlands.

- 5.6 million hectares of the forestlands have been classified by the government as "Alienable and Disposable (A&D)." A&D lands are utilized for agriculture, urban centers, and distributed to private individuals.

- Most of the uplands have been deforested through a combination of:

- ♦ illegal logging;
- ♦ slash-and-burn practices of ethnic minorities;
- ♦ encroachment of landless lowland farmers who migrated to the uplands due to heavy population; and
- ♦ land-grabbing activities.

- Misuse and abuse of the uplands cause severe damage to the environment and human welfare.

- Government and the people should join and take immediate action to protect the remaining forests, rehabilitate the degraded uplands, and reverse the trend of deforestation, ecological deterioration and socioeconomic decline of the country.

IMPORTANCE OF THE UPLANDS

- Serve as vital support systems for the downstream lowlands and aquatic areas.

- Upland forest watersheds provide water to rivers and lakes for irrigation, hydropower and household use.

- Water carries decomposing organic matter to provide lowlands with nutrients through surface runoff and leaching -- replenishing soil nutrients and maintaining the soil's productivity.

- Deforested uplands thereby will disable lowland production systems to function and consequently curtail survival of populations.

- Serve as the abode of indigenous populations and displaced lowland people.

- Land-use systems that conserve the soil and stabilize slopes have been proven to sustain productivity, food security and provision of prime commodities in the uplands and lowlands.

- Hence, such systems can accommodate migrants displaced from the lowlands.

- Mismanagement of the uplands will reduce their ability to produce prime commodities and capacity to absorb migrants. Reduced productivity of the lowlands will cause lowland farmers to migrate to the uplands in search of alternative livelihood opportunities.

- Contain unique tropical forest ecosystems considered the oldest, most productive and protective, and most biologically diverse on earth.

- The tropical forests have provided many plants and animals considered today as principal crops and livestock for consumption and utilization of humans.

- Large gene pools still remain unidentified which can be potential sources of genetic materials that can boost productivity and sustainability in agriculture, forestry, livestock, and medicine.

- Contain vast untapped mineral resources.

- Because of their remoteness, the uplands have yet to be fully explored for metallic and non-metallic minerals.

- These untapped minerals may help push forward the country's industrialization and export capabilities.

- Decide the future socioeconomic progress of the country depending on their appropriate conservation and development.

- Joint, systematic and integrated management by the government and the people can sustain development in agriculture and industry and provide socioeconomic benefits for the rich and the poor in both the uplands and the lowlands.

- With the uplands' ecological and socioeconomic contributions, the people, government agencies and the private sector should be motivated to jointly protect, conserve, develop and manage the uplands.

DEVELOPMENT ISSUES IN THE UPLANDS

- People/Land Ratio

- The ratio of people to land continues to shrink with the rapid rise of the population within the fixed land area.

- Soon, the carrying capacity of the land will be exceeded, lowland and upland resources will be over-exploited, productivity will be reduced, food supply will decrease, human welfare will decline, and survival will become more difficult.

- Land Inheritance Patterns

- Philippine society is largely agriculture-based, hence people are strongly attached to the land.

- It is customary for a Filipino to ensure that each of his/her children inherits at least a small piece of his/her farm.

- This inheritance pattern among typically large-sized Filipino families leads to partitioning of farms into small, inefficient and uneconomic lots.

- Tenurial Agreements

  - Private ownership of agricultural and residential lands is allowed in the Philippines, with private ownership of forestlands banned.

  - Government grants "Stewardship Certificates" allowing individuals or communities to utilize public forestlands from 25 to 50 years for agroforestry or small-scale forestry production. The land will be returned to the government at the end of the agreement.

- Appropriate Educational Programs for the Uplands

  - Education and training for development of the uplands adopted some technologies from developed countries.

  - These technologies can be used as long as indigenous knowledge and technologies that made traditional land-use systems stable and sustainable are also retained.

  - Application of inappropriate technologies may bring disastrous results.

- People Empowerment

  - Local people and communities should actively participate in decision-making, formulation of plans, implementation of management plans, and sharing of benefits.

  - Local empowerment is essential in ensuring a balanced application of locally suitable imported and indigenous knowledge, skills and technology.

- Equity in Access, Responsibilities and Benefits

  In managing the uplands, the government aims to:

- provide equal access to natural resources among the local people;

- require equal sharing of responsibilities in the management of such resources; and

- assure equitable distribution of benefits to the participants.

  This equitability should motivate local people to actively participate in the development and management of the uplands.

- Lowland/Upland Linkages and Interactions

- Attention should always be given to the interdependence between the lowlands and the uplands.

- Economic goods (wood and non-wood products) and ecological services (erosion control, slope stabilization, maintenance of streamflow) emanate from the uplands. Manpower, capital and technological inputs originate from the lowlands.

- Policy makers should ensure that upward/downward flows of benefits are balanced to enhance and maintain this lowland/upland symbiosis.

- Peace and Order Conditions in the Uplands

- ♦ Development activities in the uplands can continue only under safe and peaceful conditions. Only then will efforts to promote the people's welfare proceed without interference.

- ♦ Rising economic inequalities will lead to ideological clashes that will hinder development efforts stagnating or degenerating the uplands.

- Credit and "Bankability" of Upland Development Programs

- ♦ Upland projects often have low benefit/cost ratios due to remoteness and lower productive capacity.

- ♦ Hence, bankability or the ability to obtain credit for upland projects becomes limited, severely restricting flow of investments for the implementation of development projects.

- ♦ Government assistance in the form of ready credit at low or no interest would be necessary.

- Government Decentralization

- ♦ The devolution of responsibilities in upland management and conservation from the national agencies to the local government units (LGUs) created confusion.

- ♦ LGUs are closer to the grassroots and can be more responsive to the local needs.

- ♦ However, many LGUs do not have sufficient human and financial resources to maintain assistance to local communities -- hence uplanders eventually suffer.

GOVERNMENT PROGRAMS FOR UPLAND DEVELOPMENT

- Proactive development programs act on anticipated future difficulties and prevent them from escalating into serious problems.

- Reactive development programs simply respond to immediate and urgent problems that require a quick fix.

- Important development thrusts developed for the uplands are largely reactive as they rapidly respond to urgent problems of deforestation, environmental degeneration and decline in productivity and sustainability.

- They are also partly proactive as they call for the replacement of the corporate-based forest management scheme practiced during the last 50 years with community-based forest management systems.

- This pioneering approach is seen to effectively protect and manage the forests in the uplands.

People-oriented forestry and upland development programs being pursued by the Department of Environment and Natural Resources (DENR) and the local government units (LGUs) are the following:

1. *Integrated Social Forestry Program (ISFP)*

- Initiated in the 1980s based on the DENR Upland Development Program (UDP).

- Incorporated the Forest Occupancy Management (FOM), Communal Tree Farming (CTF), and the Family Approach to Reforestation (FAR) programs.

- Upland occupants were provided Certificate of Stewardship Contract (CSC) for individuals and Community Forestry Stewardship Agreement (CFSA) for communities lasting 25 years, renewable for another 25 if the first period is satisfactory.

- Farmers were provided technical and material aid in the initial five years to make the land productive without depleting it.

- Assists farmers to obtain secure land tenure, design and implement suitable agroforestry systems, strengthen community capabilities to build local institutions, mobilize resources, organize, plan, implement and monitor development strategies and programs.

- Participatory strategies were used to gather data, diagnose field situations, and monitor technical problems.

- Farm visits and training courses helped develop farmers' skills in agroforestry techniques and organization activities.

- Community leaders become better prepared to assume responsibilities for continued development upon termination of project assistance.

2. *The National Forestation Program (NFP)*

- Commenced in 1988 to include reforestation of denuded forestlands with indigenous and exotic forest species, rehabilitation of degraded watersheds, and improvement of residual stands.

- Strategies used are the Assisted Natural Regeneration (ANR) for reforestation, replanting and ANR for watershed rehabilitation, and timber stand improvement (TSI) for growth of residual stands.

- Carried through three-year contracts between DENR and the upland settler-families, community groups, religious organizations, entrepreneurs, or NGOs.

3. *Forest Land Management (FLM)*

- Upon expiration of NFP contracts, established plantations with at least 80% survival may be covered with FLM contracts between DENR and persons, families or organizations.

- The contractor may intercrop the young plantations with cash crops, fruit trees or agroforestry and sustained-yield forest management.

- Family contractors are required to organize into associations or cooperatives covering a total of at least 100 hectares.

- DENR tapped local NGOs to help organize communities and train them in forest management.

- FLM Agreements (FLMA) were for a period of 25 years, renewable for another 25.

- During the contract, the farmers may harvest, process and market timber from the mature trees using sustained-yield management techniques. In turn, the contractor will provide DENR 30% of the proceeds until the whole cost of reforestation is recovered by DENR.

4. *Community Forestry Program (CF)*

- Democratizes access to forest resources and provides organized upland communities equitable shares of forestry benefits.

- Encourages communities to participate in the protection, rehabilitation and management of denuded uplands, residual or logged-over stands, and old-growth forests.

- Effectively re-establishes the management and control over abandoned, canceled or expired Timber Land Agreements (TLAs).

- Grants 25 years, renewable for another 25, for communities to establish agroforestry farms, apply ANR, and protect and manage watersheds and other protected areas.

- DENR hires an Assisting Organization (could be an NGO) to assist the communities' organization, and provide on-the-job training in resource inventory, preparation of forest management and conservation plans, and developing livelihood opportunities.

5. *Certificate of Ancestral Domain Claims (CADC)*

- Government recognizes the rights and capabilities of indigenous cultural communities (ICCs) to protect and manage their ancestral domains.

- Government assists ICCs in the survey and delimitation of ancestral lands. This serves as basis in the granting of CADC that extends on an indefinite period.

- Security of land tenure will encourage ICCs to manage their domains sustainably.

6. *The Community-Based Forest Management Program (CBFMP)*

- Established in July 1995 through Executive Order No. 263 as the flagship program of forest conservation and development in the Philippines.

- Unifies and integrates all earlier DENR people-oriented forestry programs.

- Basic rules of operations are very similar with that of CFP.

- Various tenure instruments applied to earlier programs will be gradually converted to Community-Based Forest Management Agreements (CBFMAs).

THE ROLE OF NGOs

- NGOs assist local communities in upland development through advocacy, training and technical assistance.

- Multilateral agencies have become partners with NGOs in promoting the participation of local communities in people-centered forestry projects.

AGROFORESTRY: A TOOL FOR UPLAND DEVELOPMENT

- Agroforestry is a sustainable land-use system that integrates annual crops and livestock with woody perennial crops.

- Although an old system of production, agroforestry only gained the interest of researchers and policy makers during the last two decades.

- Earlier agroforestry systems practiced by traditional farmers were shifting or nomadic agriculture, slash-and-burn cultivation, kaingin farming, swidden cultivation, etc.

- These cyclical traditional systems start with cutting and burning of forest vegetation during the dry season, planting and harvesting of food crops for three consecutive years leaving the soil fertility depleted, and fallowing of the area for about ten years to allow soil rejuvenation. While the first site is being fallowed, other sites are utilized for subsistence.

- The efficiency of the long fallow period led to the development of improved or modern agroforestry systems. These systems can be continuously productive without shifting locations and allow upland cultivation without causing ecological degradation on-site and downstream. They can also sustain production of basic and other necessary needs over time.

- Agroforestry systems can incorporate multipurpose nitrogen-fixing trees for erosion control, maintenance of site productivity, and production of necessary materials.

- Combinations of agroforestry species vary depending on site conditions, compatibility of species, end uses, and market demands for the products.

- Spatial and temporal placements of the trees and food crops depend on topography, need for erosion control, symbiotic relationships among species, and relative shade tolerance of the plants.

- Agroforestry systems are site-specific.

SUGGESTED READINGS

"Agroforestry Technology Information Kit." 1992. Published by IIRR (Cavite), DENR (Quezon City), and the Ford Foundation (Manila).

Cruz, C. and I. Zosa-Feranil. 1988. "Policy Implications of Population Pressure in the Philippine Uplands." Prepared for the World Bank-CIDA Study on Forestry, Fisheries and Agricultural Resource Management (FFARM).

DENR. 1996. Administrative Order No. 96-29. Rules and Regulations for the Implementation of the Community-Based Forest Management Program.

Office of the President. 1995. Executive Order No. 263. Adoption of Community-Based Forest Management as the National Strategy to Ensure Sustainable Management of the Country's Forestlands.

Ramirez, D.M. 1993. "Agroforestry as an Alternative Upland Development Strategy: Basic Features, Concepts and Principles."

AGROFORESTRY CONCEPTS, PRINCIPLES AND PRACTICES

Roberto V. Dalmacio

DEFINITIONS OF AGROFORESTRY

- Agroforestry is using trees on farms. It is a dynamic, ecologically based natural resources management system that, through the integration of trees on farms and in the agricutlural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels (ICRAF, 1998)

- A sustainable land management system which increases the overall yield of the land, combines the production of crops (including tree crops) and forest plants and/or animals either simultaneously or sequentially on the same unit of land, and applies management practices that are compatible with the cultural patterns of the local population (Bene et al., 1977)

- An approach to land use in which woody perennials (trees, shrubs, palms, bamboos) are deliberately grown on the same land management unit as agricultural crops and/or animals, either on some form of spatial arrangement or temporal sequence. In agroforestry systems, there are both ecological and economic interactions between the different components (Lundgren and Raintree, 1983)

- A system of land management whereby forest and agricultural products are produced on appropriate and suitable areas simultaneously or sequentially for the social, economic and ecological benefits of the community (PCARRD, 1979)

ATTRIBUTES OF AGROFORESTRY

- Sustainable land management system (i.e. promotes conservation and enrichment of soil and water on sloping lands).

- Increases yield and services per unit area (intensifies land use; addresses land scarcity issue).
- The cropping scheme combines the production of forest and agricultural crops and/or animals, either simultaneously or sequentially on the same unit of land (note: there are several forms or variations of agroforestry systems due to diverse conditions in the uplands).

- Contributes to the socioeconomic and ecological upliftment of the community and is compatible with the cultural patterns of the local communities (increases income and satisfies basic needs while at the same time protecting/rehabilitating the watershed).

- The practice is consistent with sound ecological principles (e.g. enhances nutrient cycling; less dependence on costly and non-environmentally safe inputs; culturally compatible).

The great potential of agroforestry is based on two premises:

1. Ecological Premise -- based on the advantages of trees on soil and environment

- soil conservation and amelioration
- water conservation
- microclimate amelioration
- other benefits (e.g. aesthetics, wildlife sanctuary, biodiversity)

2. Socioeconomic Premise -- based on the potential of agroforestry in helping alleviate the socio-economic conditions of poor and landless upland farmers who lack resources/inputs, are unemployed and are forced to cultivate marginal lands.

- source of employment/income
- source of raw materials for handicraft/cottage industries
- source of food, energy (fuelwood), feed or fodder for livestock, medicine, etc.,
- source of raw materials for housing, farm implements, etc.

CRITERIA OF A GOOD AGROFORESTRY SYSTEM

1. Productivity

- production of direct benefits such as food, fodder, feed for fish and livestock, fuel, fiber, polewood/wood, other products such as gums, resins, latex, oil, herbal medicine, etc.

- indirect benefits or "service roles" such as soil and water conservation (erosion control, mulch, etc.), fertility improvement (organic fertilizer, green manure, nutrient pump/cycling), microclimate amelioration (shelterbelt, shading), live fencing, etc.

- increases farmer's income

2. Sustainability

- employs soil and water conservation strategies to ensure long-term productivity

- can withstand sudden changes in weather, epidemics and market prices

- requires putting some forms of incentive into the technology to ensure adoption of conservation practices especially those farmers who operate close to margin of subsistence (e.g., security of land tenure, technical and financial support)

3. Adoptability/Social Acceptability

- should be culturally acceptable/adoptable (compatible with the customs, traditions, beliefs)

- to ensure adoption, the farmers should be involved directly in planning and designing agroforestry systems

- consistent with technical, financial and manpower capabilities of the local people/target clients

CLASSIFICATION OF AGROFORESTRY SYSTEMS

A. Based on ICRAF's Method (Torres, 1983)

- Agri-silvicultural System – concurrent production of agricultural crops and tree (woody perennial) crops

  Forms and Examples:

a) improved fallow system (example: Naalad style farming in Naga, Cebu)
b) alley cropping system (example: Sloping Agricultural Land Technology or SALT 1)
c) multi-storey systems (example: coffee or cacao and gabi (taro) as understorey crops in tree plantations or natural forests)
d) taungya system (example: Family Approach to Reforestation scheme piloted by the then Bureau of Forest Development).

e) trees planted along farm boundaries either as boundary marker, live fence/posts, and/or shelterbelts
f) Trees as live trellis of climbing crops (example: kakawate as live trellis of black pepper).

- Silvipastoral System – integration of tree (woody perennial) crops with livestock production

Forms and Examples:

a) protein bank (fodder bank) system (example: Intensive Feed Garden)
b) live fence system
c) tree-crop grazing systems (example: Silvipasture scheme of the then NALCO)
d) alley cropping using fodder trees or shrubs and/or improved pasture grasses as alley crops (Example: Simple Agro-Livestock Technology or SALT 2)

- Agri-silvi-pastoral System – production of agricultural crops, tree (woody perennial) crops and livestock in the same unit of land

Forms and Examples:

a) conversion from "agri-silvicultural" to "silvi-pastoral" system (example: from taungya to tree-crop grazing system)
b) multistorey system with free grazing
c) alley cropping system using pasture grasses/fodder crops and agricultural crops as alley crops

- Agroforestry Integrated with other Production Systems

Forms and Examples:

a) Agroforestry-Tree Plantation Integrated Production Systems (example: Sustainable Agroforest Land Technology or SALT 3)
b) Agroforestry-Aquaculture-Livestock Integrated Production System.

B. Based on Combe and Budowski's Method (Combe and Budowski, 1979)

CRITERIA	AGROFORESTRY SYSTEMS					
	I Combined Agrosilvicultural System		II Simultaneous Combination of Forestry with Crops and Grazing		III Combined Forestry and Grazing	
Main Function of Forest Component	Production	Protection and Service	Production	Protection and Service	Production	Protection and Service
Temporal distribution (e.g. whether combination is temporary or permanent)*	TEMPORARY / PERMANENT	TEMPORARY / PERMANENT	TEMPORARY / PERMANENT	TEMPORARY / PERMANENT	TEMPORARY / PERMANENT	TEMPORARY / PERMANENT
Regular**	1***	4	1	2	1	
SPATIAL	2	5	2	3	2 3	
	3				4	4
					5	5
					6	
					7	
		6			6	8
L Irregular Distribution		7				9
		8				

* Combination is temporary when agricultural component is not renewed; permanent when forestry component has rotations of equal durations or when one or even all components are renewed from time to time.

** Distribution is regular when the forest component is grown plant by plant in association with the farm crops, or rather scattered regularly among it. This includes natural regeneration as well as planting of forest trees. Distribution is irregular when the forest component is placed alongside or around the farm crop with which it is associated. This is particularly true of trees in rows or strips.

*** The numbers stand for the following agroforestry systems:

- Combined Agro-silvicultural Systems

1. Agrosilviculture (taungya system)
   Ex. *Tectona grandis* with rice or corn (Thailand)

2. Commercial trees among crops
   Ex. *Cordia alliodora* with coffee or cacao (Costa Rica)

3. Fruit trees among crops
   Ex. *Cocos nucifera* with sorghum or *Lycopersicon* or rice (Philippines)

4. Shade trees among crops and/or for improving fertility
   Ex. *Erythrina spp.* with coffee or cacao (South America)

5. Pisciculture in mangrove forests
   Ex. *Rhizophora sp.* & *Avicennia spp.* with fish and mollusks

6. Live fence posts
   Ex. *Gliricidia sepium* around annual or perennial crops or to enclose grazing animals (Costa Rica and Central America)

7. Shelterbelts
   Ex. *Leucaena leucocephala* as shelterbelts for *Gossypium hirsutum* (Nicaragua)

8. Trees on bunds of fish-breeding ponds

- Simultaneous Combination of Forestry with Crops and Grazing

1. Simultaneous crops and grazing in plantations
   Ex. *Cocos nucifera* with rice or corn and muscovy ducks (Thailand)

2. Trees combined with crops and grazing
   Ex. *Eucalyptus spp.* with vegetables and small livestock (pigs, poultry)

3. Live fence posts around rural dwellings
   Ex. *Ficus spp.* with various crops and various fodder/animal species

- Combined Forestry and Grazing

1. Pasture (or fodder production) in forest plantation
   Ex. *Pinus caribaea* with fodder species such as *Centrosema pubescens, Pennisetum polystachium, Desmodium heterophyllum, Brachiaria* sp.

2. Pasture (or fodder production) in secondary forests
   Ex. *Cordia alliodora* with fodder species (Costa Rica)

3. Commercial trees in pastures
   Ex. lumbang (*Aleurites mollucana*) trees with grasses (NALCO, Philippines)

4. Timber in pastures to improve soil fertility by fixing nitrogen
   Ex. *Alnus acuminata* with *Pennisetum sp* (Costa Rica)

5. Trees in pastures for producing shade and/or improving soil fertility
   Ex. *Erythrina poeppigiana* with *Panicum maximum* (Costa Rica)

6. Fodder-producing trees (fruits or leaves)
   Ex. *Leucaena leucocephala, Pithecelobium dulce*

7. Fruit trees in pastures
   Ex. *Cocos nucifera* with grasses or other fodder species (Philippines)

8. Live fence posts (see agrosilvicultural system)

9. Shelterbelts (see agrosilvicultural system)

C. Based on Temporal and Spatial Arrangement of Crops (Vergara, 1984)

1. Based on Temporal Arrangement of Crops

   Crop Rotation System -- includes all agroforestry systems where agricultural crops are alternately grown with tree crops over time. Two types under crop rotation system:

a) Swidden or Shifting Cultivation -- type of farming in which the forest is cleared, dried, and burned and the land is either cultivated/tilled extensively or not (depending on labor availability, degree of slope, etc.) for growing agricultural crops. Crop rotation lasts for about 2-3 years or more after which the land is left for a longer period (8-10 years) for bush fallow in order to rejuvenate the soil. After the fallow period, the vegetation is again cleared, dried and burned for another cycle of agricultural cropping.

b) Taungya System – a cost-effective reforestation strategy wherein annual agricultural crops are intercropped with tree seedlings for about 3-4 years. Once the tree canopies close, the participating farmers are moved to another reforestation site for undertaking the same taungya system.

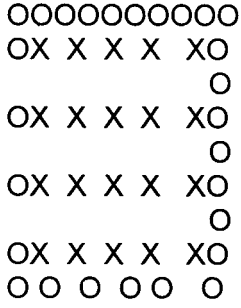
Example: "Modified" taungya method is the Family Approach to Reforestation adopted by BFD in Pantabangan, Nueva Ecija. Incentives are both in terms of produce from crops grown and "wages" for site preparation and planting of tree seedlings. Comments:

a) the necessity for farmers to move from one area to another for so short a time is a limitation of the taungya system
b) no guarantee for long-term tenure

2. Based on Spatial Arrangement of Crops

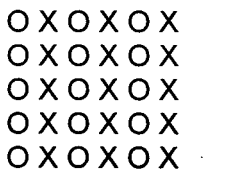
Types of Intercropping System

a) Trees Along the Border



Lines of trees are used either as boundary markers, live fences, windbreaks or firebreaks, source of green manure, source of fodder for livestock, and source of fuelwood.

b) Alternate Rows



c) Alternate Strips (Alley Cropping)
Note: strip if >2 rows

OOXXXOOXXX
OOXXXOOXXX — O - trees
OOXXXOOXXX
OOXXXOOXXX — X - agricultural crops
OOXXXOOXXX

Note: Both alternate rows and alternate strips are very effective systems for erosion control and slope stabilization especially when grown following the contours.

They can serve as sources of food, fuelwood, organic fertilizer, fodder and for site stabilization.

d) Random Mix

O X X X X O
X X X O X X — O - trees
X X O X X O
X X X O X X — X - agricultural crops

Disorderly arrangement of component crops

Multi-storeyed structure and diversiified crops that approximates tropical rainforest

Ex. Homegardens of Java, Indonesia and the Philippines

D. Based on Tree Planting Niches on the Farm (Macklin, 1990)

The different agroforestry systems under each farm niche are as follows:

1. Trees Along Farm Borders

   a) Hedges
   b) Living fence posts
   c) Windbreaks

2. Trees in Crop Fields

   a) Alley cropping (hedgerow intercropping)
   b) Wide row intercropping
   c) Shade trees or nurse trees
   d) Support trees

3. Trees in Livestock Systems

   a) Fodder bank*
   b) Pasture improvement**
      (e.g. tree crop grazing system)

   * source of fodder
     (leaves, flowers, pods)

   ** livestock are known to digest food
      more efficiently when shade
      is available, particularly in
      hot climates

4. Trees Around the House

   a) Home Gardens

5. Trees in Temporal Systems

   a) Improved fallow
   b) Taungya system

GENERAL GUIDELINES/CONSIDERATIONS IN THE SELECTION OF SPECIES AND SPACING FOR AGROFORESTRY

The major features that have to be known are:

1. Climatic Factors

   - rainfall
   - solar radiation
   - wind movement (direction and speed)
   - frequency of occurrence of natural calamities (typhoons, fires, etc.)
   - temperature
   - air humidity

2. Soil Factors

   - fertility
   - pH
   - depth
   - texture
   - nature of parent material
   - permeability/drainage/aeration
   - moisture regimes
   - soil faunal composition

3. Topographic Factors

   - elevation
   - slope
   - exposure or aspect

4. Biotic Factors

   - vegetation cover
   - fire
   - domestic and wild animals
   - pests, diseases
   - tree and crop preferences

The existing vegetation gives a valuable indication of site quality, itself being a result of the interaction of climate, soil, topography and biotic factors.

Considerations in choosing species for planting:

1. adaptability to the site
2. productivity in relation to objective of management
3. resistance to pests and diseases
4. seed supply availability
5. establishment, whether easy or difficult
6. regeneration characteristics (e.g. coppicing ability)
7. economic returns, whether early or not
8. tree and crop preferences

Since crops are mixed in an agroforestry system, it is also important to know whether the species to be planted are compatible or not. In this respect, the following guidelines may be used:

1. Define

   - dominant crop(s)
   - cash crop(s)
   - secondary crop(s)
   - subsistence crop(s)

2. Choose shade-tolerant species as understorey of sun-loving, upper-storey species.

3. Choose species not known to be hosts of pests and diseases of any of the other species in the mixture.

4. All species in the mixture should be adapted to the site.

To minimize competition between species and mixture, the following guidelines on spacing may be considered:

1. For permanent crops (e.g. trees)

   - the spacing is governed by the width of the crown and extent of the root system at the peak of development (maturity)

2. In multi-storey system

   - consider the canopy positions. Spacing that will maintain appropriate crown stratification will lessen competition for light and crown space

- the spacing is governed by their desired maximum spatial development

4. Choose species which occupy different root horizons

CURRENTLY USED AND POTENTIAL AGROFORESTRY CROPS IN THE PHILIPPINES

- Fuelwood/Nurse Trees/Hedgerow Trees

1. Ipil-ipil (*Leucaena leucocephala*)
2. Agoho (*Casuarina equisetifolia*)
3. Kakawate (*Gliricidia sepium*)
4. *Acacia auriculiformis*
5. Katurai (*Sesbania grandiflora*)
6. Kamachile (*Pithecelobium dulce*)
7. Anchoan dilau (*Cassia spectabilis*)
8. Dapdap (*Erythrina orientalis*)
9. *Flemingia congesta*
10. *Desmodium rensonii*
11. *Alnus* sp.

- Pulpwood/Nurse Trees/Timber/Polewood

1. Benguet Pine (*Pinus kesiya*)
2. Moluccan sau (*Paraserianthes falcataria*)
3. Yemane (*Gmelina arborea*)
4. Narra (*Pterocarpus indicus*)
5. Mahogany (*Swietenia macrophylla*)

- Fruit Trees

1. Cacao (*Theobroma cacao*)
2. Nangka (*Artocarpus heterophylla*)
3. Coffee (*Coffea arabica, C. robusta*)
4. Kalamansi (*Citrus microcarpa*)
5. Suha (*C. grandis*)
6. Mandarin (*C. nobilis*)
7. Cashew (*Anacardium occidentale*)
8. Avocado (*Persea americana*)
9. Mango (*Magnifera indica*)
10. Coconut (*Cocos nucifera*)
11. Rambutan (*Nephelium lappaceum*)
12. Durian (*Durio zebethinus*)

- Agronomic Crops

1. Abaca (*Musa textilis*)
2. Banana (*Musa spp.*)
3. Papaya (*Carica papaya*)
4. Black Pepper (*Piper nigrum*)
5. Cadios (*Cajanus cajan*)
6. Cassava (*Manihot utilissima*)
7. Gabi (*Colocasia spp.*)
8. Ginger (*Zingiber officinale*)
9. Kenaf (*Hibiscus cannabinus*)
10. Corn (*Zea mays*)
11. Kapok (*Ceiba pentandra*)
12. Mungbean (*Vigna radiata*)
13. Peanut (*Arachis hypogea*)
14. Pineapple (*Ananas comosus*)
15. Tomato (*Lycopersicon esculentum*)
16. Sweet Potato (*Ipomea batatas*)
17. Eggplant (*Solanum melongena*)
18. Mulberry (*Morus alba*)
19. Beans

TECHNOLOGIES AND SUPPORT SYSTEMS FOR AGROFORESTRY

- Soil and Water Conservation (SWC) Measures

a) contour canals and drainage canals
b) rock walls
c) check dams
d) bench terracing
e) wattling
f) fascine
g) small water impoundment systems

- Soil Amelioration Strategies

a) Composting
b) Biofertilization (nitrogen fixing and mycorrhizal inoculants)
c) use of green and animal manures
d) cover cropping
e) crop rotation
f) relay cropping
g) mulching

- Support Systems for Agroforestry

a) Technical support
b) Financial support
c) Extension support/training
d) Market support
e) Infrastructure support
f) Community organizing/strengthening
g) Legal Assistance

- Other Related Livelihood Opportunities

a) Contract projects with DENR (e.g. reforestation, ANR, TSI, trail/road construction, etc.)
b) Livestock and poultry raising
c) Basket weaving, wood carving and other handicrafts
d) Mushroom culture
e) Apiculture
f) Food processing

Suggested Readings

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