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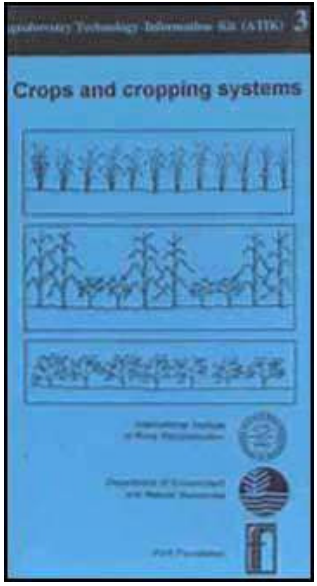

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- Crops and Cropping Systems (IIRR, 1992, 43 p.)
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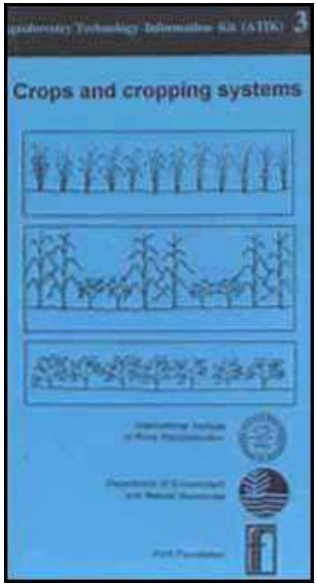

Agroforestry Technology Information Kit (ATIK)
November 1992

International Institute of Rural
Reconstruction (IIRR)
Silang 4118, Cavite, Philippines
Tel. No. (0969) 94-51
Fax No. (632) 522-24-94

Department of Environment
and Natural Resources (DENR)
Visayas Ave., Diliman
Quezon City, Philippines

Ford Foundation (FF)
6th Floor, Dona Narcisa Bldg.
Paseo de Roxas, Makati
Metro Manila, Philippines

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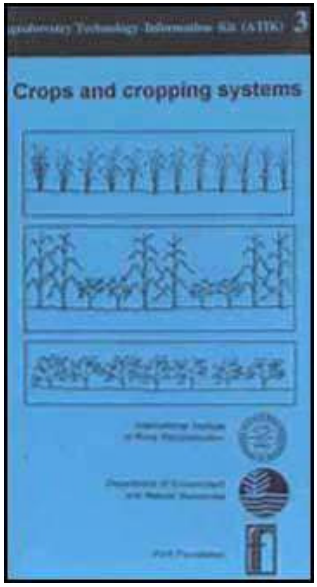

Intercropping under residual or logged-over areas

This technology involves the intercropping of coffee, betel and rattan under the residual or logged-over areas. The residual or logged-over areas are usually cleared of underbrush (vines, shrubs, climbing bamboos, etc.), leaving naturally growing trees at 1418 meters intervals and when necessary supplemental planting of forest trees is resorted to depending on the degree

of shade provided by the canopy. Coffee saplings are planted at 2-3 meter intervals under the forest trees that act as nurse trees.

The technology has been practiced by the migrant Ifugaos in Nueva Vizcaya, Quirino and parts of Isabela. The areas where this technology is being applied are usually with (1) an estimated elevation range of 400-1000 meters above sea level; (2) with rolling to hilly terrain; (3) within the second and third climatic types; and, (4) whose soil are rich in litterfall or accumulated humus.

The technology is an adaptation and/or modification of an indigenous practice of muyong or pinugo system (woodlot) of the Ifugaos. The system is characterized by the following:

- has low inputs and relatively low-to-medium yields;
- minimizes disturbance to the forest ecosystem in terms of vegetation, fauna and physical environment;
- serves, as shelter for wildlife and source of animal protein in terms of trapped bats and squirrels; and
- supports the viability of irrigated rice paddies located downstream.

PROCEDURE

1. Site preparation. This involves the cleaning/slashing and clearing of undesirable underbrush and inhibitor species in the logged-over areas. Supplemental planting of forest is undertaken, maintaining an average distance of 16 meters between the forest trees that serve as nurse trees.

2. Planting stock preparation. Coffee saplings of usually 2-3 years age are carefully chosen, uprooted, trimmed and wrapped with dried banana stalks and then transported to the planting site. Saplings are left in the planting site for 2-3 weeks before the actual planting to acclimatize them in the area.

3. Outplanting coffee saplings. Dig 30-cm holes at 2-3 m intervals under the forest canopy. Two coffee saplings are usually planted in each hole. Rattan and betel wildlings about 30 centimeters tall are collected from mother plants. (See Growing Rattan, pages 48-55 in Trees and their Management). Three to five rattan seedlings are planted beside each naturally growing tree. Betel seedlings are planted along the transition between the forest and the annual cropping area or rice paddies 4-5 meters apart.

4. Maintenance of plantation. Weedings are conducted every three months in the first year and, subsequently, once a year or during harvest. Pruning, bending or pegging of mature coffee stems during harvesting are practiced to promote the development of secondary stems and increase fruitbearing capacity. Betel palm and rattan entails lesser cultural treatments.

5. Harvesting. Coffee trees bear fruits after three years. The initial yield is 0.515 tons per hectare and increases to 0.65 tons in succeeding years. Limuran is primarily cultivated for its poles/canes while littoko is planted for its edible fruits. The nuts of the betel palm are ingredients for betel chewing and also used for medicinal and ritual purposes.

SPECIES USED		
A.	Nurse Trees	
	Naturally Growing	
	Pterocarpus indicus	Narra
	Canarium aspermum	Pagsahingin
	Dracontomelon dao	Dao
	Olstoria macrophylla	Batino
	Palaquim elongatum	Palaquim
	Syzygium nitidum	Makaasim
	Alstonia scholars	Dita
	Supplemental Plants	
	Samanea saman	Acacia
	Swietenia macrophylla	Mahogany

	Swietenia macrophylla	Mahogany
	Leucaena leucocephala Ipil-ipil	
B.	Intercropped Species	
	Coffee robusta	Coffee
	Calamus manillensis	Littoko
	Areca catechu	Betel palm
	Calamus omatus	Limuran

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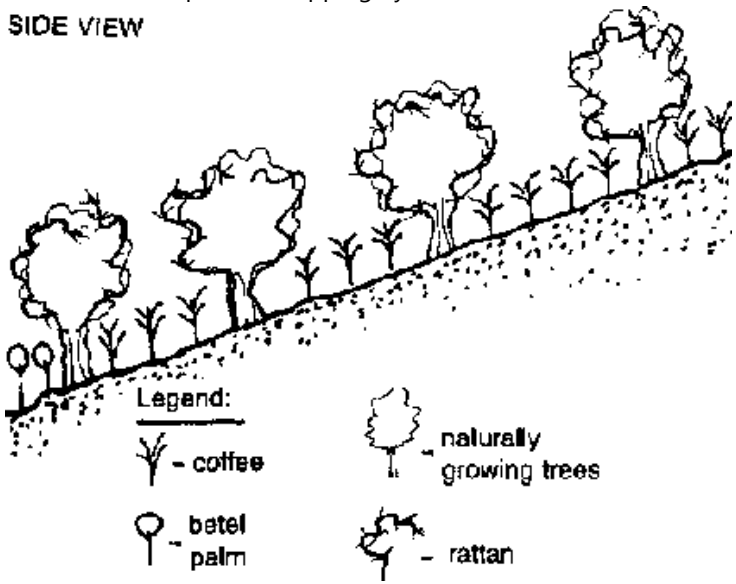
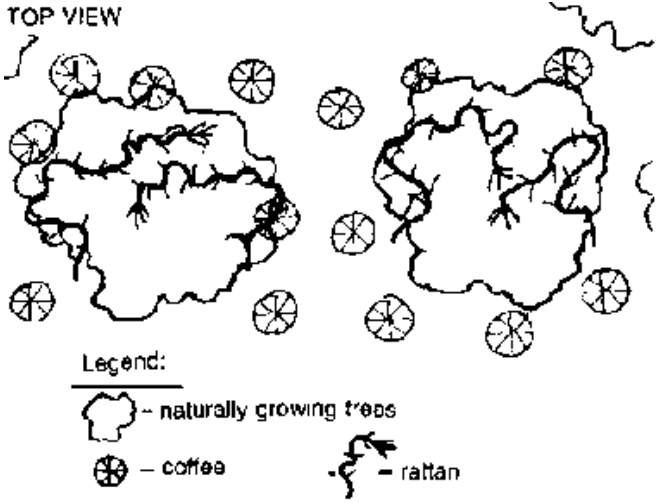

SIDE VIEW
Legend:
- coffee
- naturally growing trees
- betel palm
- rattan

Side view



Top view

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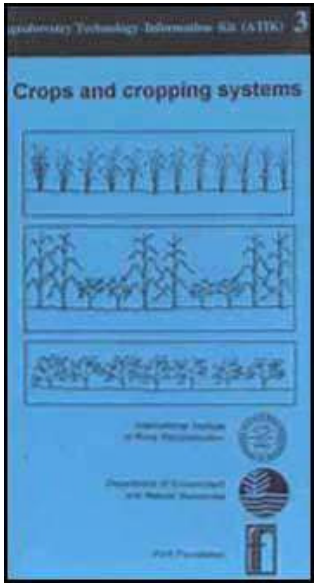

Rice paddy in upland areas

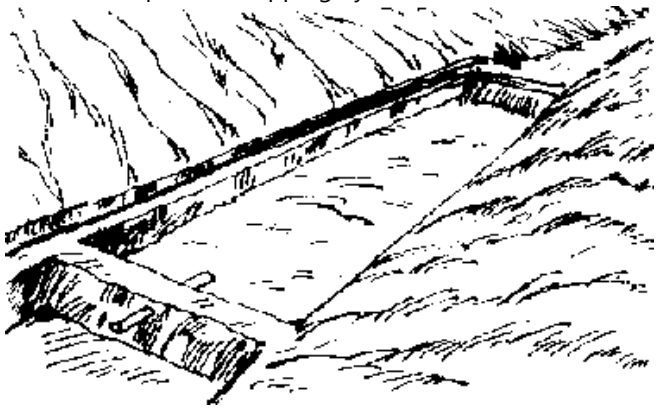

FIG. 1. Rice paddy in upland areas

Upland rice paddy is the conversion of a portion of a live or intermittent creek or gully into an irrigated rice production areas. This addresses the problem of lack of suitable area for crop production, maximizing the use of space and full utilization of limited water supply.

The technology needs minimum inputs in terms of manpower and materials; however, it needs a longer time to finish. When constructing a series of rice paddies, it is recommended to start from the lowest portion of the creek or gully.

PROCEDURES

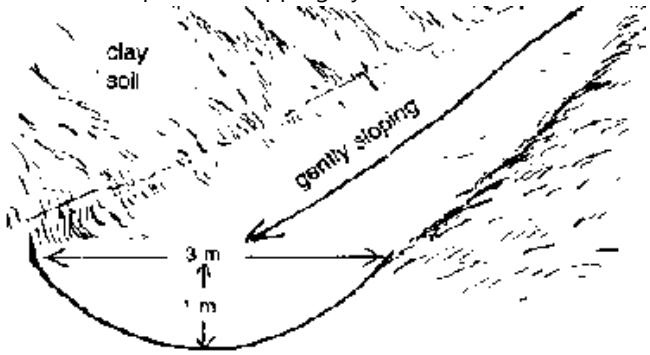

FIG. 1. Site Selection

Select a portion of a live or intermittent creek or gully for conversion into irrigated rice paddy based on the following: (a) creek or gully bed gently sloping; (b) the width and depth of the creek or gully is not more than three meters and one meter, respectively; (c) the soil of the area immediately adjacent to the site is a clay to clay loam type; and, (d) the area is not prone to flash flooding.

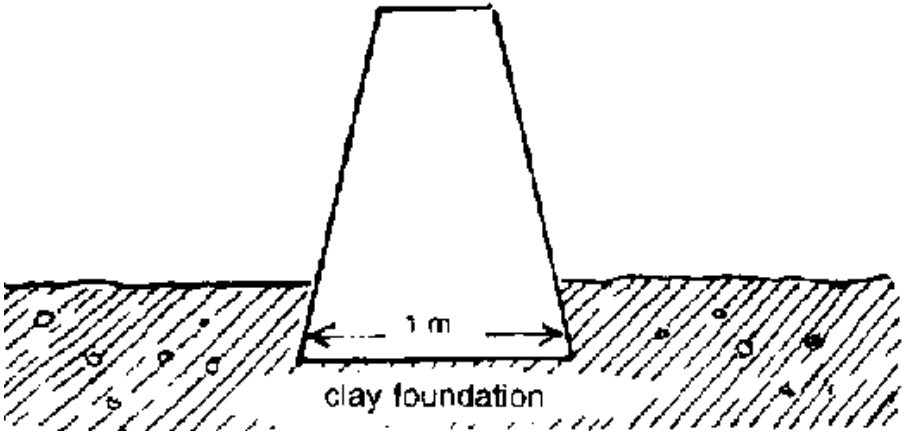

FIG. 2. Construction of Dike.

Lay out on the ground the dike with at least one meter base and half a meter top dimension. For a firmer support, excavate 0.25 to 0.5 m and/or until reaching the clay foundation. Construct the dike using readily available materials in the site. The dike can be either earth or mixed materials. Allow a small opening in the dike in order to drain excess water.

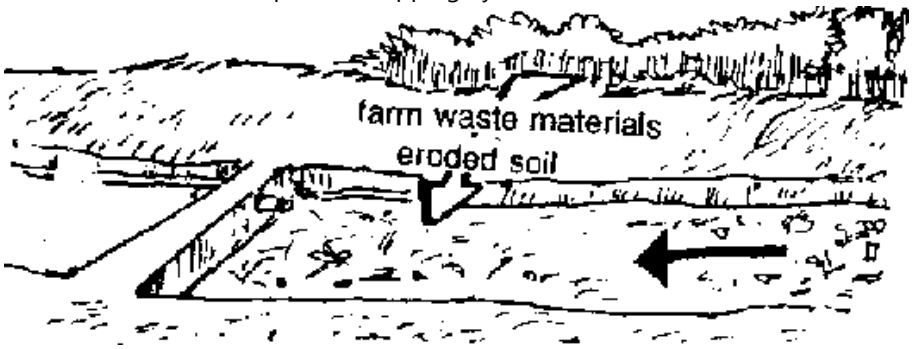

FIG. 3. Filling up the dike.

Dump all farm wastes into the dike, such as leaves, stems, husks and other trimmings. Hasten the filling up of the dike by loosening the soil in the adjacent area with the use of a plow or hoe and allow it to erode into the dike. Adjust the dike opening as it is being filled up with materials. While the dike is being filled up, it can be used as a fishpond, mud hole for working animals, crop production area for water-based plants and/or water catchments.

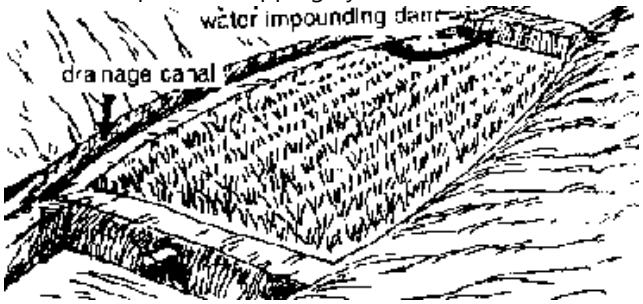

FIG. 4. Construction of Water-impounting Dam and Drainage Canal.

After filling up the dike and converting it into rice paddy, construct a water impounding dam above-the dike in order to control the water flow into the converted rice paddy.

5. Maintenance of the Dike, Water-impounding Dam and Drainage Canal. Regular maintenance should be conducted in the form of checking and repairing for water leakages for the waterimpounding dam, siltation and obstruction of drainage canals and breakages on the dike.

ADVANTAGES

1. When completely finished, the area will serve as an additional area for the production of basic food needs of the household. It usually becomes the prime production area of the farm.

2. While still under construction, the area will serve any or all of the following: (a) dumping site for farm wastes; (b) wallowing holes for working animals; (c) catchment area for eroded soil; (d) fishpond; (e) crop production area for water-based crops; and, (f) water impoundment for watering other crops.

3. The area will also serve as soil erosion measures and will minimize siltation of rivers and streams as well as control the water flow.

DISADVANTAGES

1. When not properly constructed, the area will become a major source of soil erosion that may affect the downstream areas.

2. It takes a longer time (up to a year, in some cases) to fill up the dike, especially when not enhanced.

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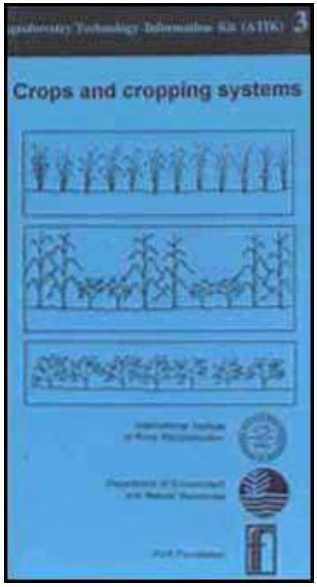

Message

Agroforestry, the land management system of incorporating crop production with tree and/or livestock production, evolved to become one of the most widely promoted tools for sustaining development in the uplands. To supplement the materials used by upland development extension workers in promoting agroforestry, a group of specialists, technicians and farmers from 11 government and nongovernment organizations met at the invitation of the

International Institute of Rural Reconstruction in Silang, Cavite in November 1989 to develop the Agroforestry Technology Information Kit (ATIK). In November 1992, some of the specialists, together with some farmers and an additional number of specialists and technicians, met again at IIRR to revise the ATIK.

The updated kit Is handy, easy-to-understand and full of illustrations. It widely uses indigenous technologies. With this kit, it is hoped that extension workers and upland dwellers develop a better understanding and appreciation of agroforestry. The success of agroforestry as a tool for sustaining upland development, however, will depend on how this tool is introduced and implemented. Sustainable agroforestry systems can only be attained if upland dwellers are involved in the planning and establishment of such systems.

I commend all those involved in the production of this useful kit.

Angel C. Alcala Secretary Department of Environment and Natural Resources


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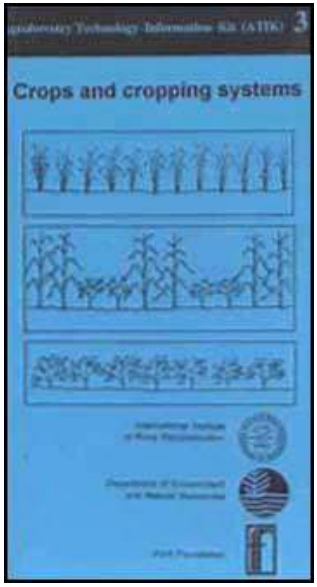

Proceedings of the workshop

WORKSHOP TO REVISE THE AGROFORESTRY TECHNOLOGY INFORMATION KIT (ATIK)

The first workshop to develop the Agroforestry Technology Information Kit - now more popularly known as ATIK - was conducted by the international Institute of Rural Reconstruction (IIRR) in its Silang Campus, Cavite,

Philippines, on November 4-13, 1989. There were 39 participants to this workshop who came from 11 government and nongovernment organizations (GOs and NGOs).

ATIK was produced primarily for use by DENR technicians who have been implementing the Social Forestry Program nationwide. DENR conducted a nationwide survey among its staff who were involved in the implementation of its Integrated Social Forestry Program and also primary users of ATIK. A questionnaire was formulated, focused on the actual experiences of these technicians in using the ATIK and on specific revisions they proposed to make on the kit. A Planning Committee was created to study the technicians' proposed modifications to the ATIK, as well as to plan for the workshop to revise it. The committee was composed of For. Domingo Bacalla of DENR, For. Moises Butic of DENR, Ms. Rowena Cabahug of UPLB College of Forestry, Dr. Romulo del Castillo of UPLB College of Forestry, Ms. Remedios Evangelista of DENR, Dr. Julian Gonsalves of IIRR, Mr. Scott Killough of IIRR and Mr. Jaime Ronquillo of IIRR.

The workshop to revise the ATIK took place also in IlRR's Campus in Silang, Cavite, on November 16-21, 1992, with 45 participants representing 13 agencies. These agencies included: the Department of Environment and Natural Resources; Farm and Resource Management Institute; Southem

Mindanao Agricultural Programme; Mag-uugmad Foundation, Inc.; University of the Philippines at Los Banos; Upland Development Program/Sungay Upland Farmers' Golden Harvest Association; Soil and Water Conservation Foundation; Quirino Livelihood Concept and Development Resource Center, Inc.; Winrock International; Mindanao Baptist Rural Life Center; Visayas State College of Agriculture; International Rice Research Institute; and, IIRR.

In the workshop, the same process for materials production was followed. Old sheets and first drafts of new topics were presented by the authors in plenary sessions. These materials then underwent continuous improvements through the critiquing of the other workshop participants. Communication experts (writers, editors, layout and design artists) were on hand to assist the authors in revising/preparing the texts, illustrations and designs of their papers. Before the materials were prepared in a cameraready format, they were submitted to their authors for final review and revision to ensure that the additional corrections were incorporated.

The major revisions of ATIK are the following:

A. Format

1. From a set of loose-leaf single sheets in folder/binder to six, pocket-size (4" × 7") booklets, individually classified and

bound according to major topics

2. Using simple, white, ordinary bookpaper, rather than the thicker, colored and more expensive bristol board

3. Using a thick binder to hold the six booklets, instead of an individual folder for each kit.

B. Content

1. Some old topics which were found not relevant/useful from the survey were dropped from the kit.

2. Other topics were revised, focusing on the specific needs of the DENR technicians.

3. Additional, new topics were included, again to respond to the expressed needs of the technicians.

4. Many old topics -- which were adapted by farmers - remained as they were.

The revised ATIK -- with its new format and content - is expected to further facilitate the work of DENR's 1,200 technicians in its Integrated Social

Forestry (ISF) Program nationwide. Ultimately, the kit will help enable DENR's ISF's program to give the Filipino uplanders access to forest lands for a tenure of 25 years or more.

WORKSHOP TO REVISE THE AGROFORESTRY TECHNOLOGY INFORMATION KIT (ATIK)

November 16-21, 1992
IIRR, Silang, Cavite


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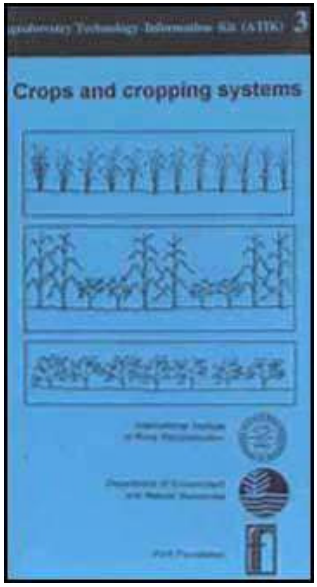
Fiber crops and technologies



- Root crops for food, feed and income
- Upland rice cultivation with agroforestry
- Intercropping under residual or logged-over areas
- Rice paddy in upland areas

List of participants

Authors/Resource Persons

1. Ms. Nita Abena
Veterinarian, Appropriate Technology Unit
International Institute of Rural
Reconstruction (IIRR)

Silang 4118, Cavite

2. Ms. Erma Aguilar Community Development Officer DENRCENRO, Barotac Nuevo, lloilo

3. Mr. Pio B. Apostol CDA/Project Leader Patlabawon ISF Upland Farmers Association, Inc. Patlabawon, Patnongon, Antique c/o DENR Region 6, lloilo City

4. Mr. Laurito Arizala Crops Specialist IIRR, Silang 4118, Cavite

5. Dr. Edwin Balbarino Field Coordinator, Matalom Upland Dev't. Project Farm and Resource Management Institute (FARMI) VISCA, Baybay, Leyte

6. Mr. Carlos S. Basilio Agricultural Administration Specialist IIRR, Silang 4118, Cavite

7. Mr. Cristituto G. Bual Assistant Section Chief, Extension Services Division Southem Mindanao Agricultural Programme (SMAP) Bago Oshiro, Davao City

8. Mr. Agustin Calanao Farmer, NISFFAI Nazuni Dingle, lloilo

9. Mr. Jose D. Cansancio CDA Il/Forest Community Organizer DENRUpland Development Program Region Xl-4A, Digos, Davao del Sur

10. Mr. Lapu-lapu Cema President, Mag-uugmad Foundation, Inc. (MFI) 39-2 Rodriguez Apartment, Pelaez St., Cebu City Tel. No. 220197

11. Dr. Roberto E. Coronel Associate Professor, Institute of Plant Breeding University of the Philippines at Los Banos College, Laguna

12. Mr. Ricardo El. S. Dayrit Specialist, Livestock Production IIRR, Silang 4118, Cavite

13. Ms. Maxima Dandasan Farmer UDP/Sungay Upland Farmers Golden Harvest Assn. Sungay, Alubijid, Misamis Oriental

14. Mr. Terrence E. Davis Extension and Training Specialist Southem Mindanao Agricultural Program (SMAP) Department of Agriculture, Davao City Tel. No. 82-79767; Fax No. 8242766

15. Dr. Reynaldo dela Cruz

Professor, Department of Forest Biological Sciences
College of Forestry, UPLB, College, Laguna
Tel. No. 94-2725/94-2773; Fax No. 94-2721

16. Dr. Zosimo dela Rosa

Associate Professor, FARMI-VISCA
Farmers' Village, VISCA, Baybay, Leyte
Tel. No. 521-2027

17. Ms. Ines Fehrman

Volunteer, Appropriate Technology Unit
International Institute of Rural Reconstruction (IIRR)
Silang 4118, Cavite

18. Dr. Pam Fernandez

Agronomy Department
University of the Philippines at Los Banos
Coliege, Laguna

19. Mr. Rufino C. Garcia

Research Associate
Department of Forest Biological Science
UPLB, College, Laguna

20. Mr. Bill Granert

Managing Director
Soil and Water Conservation Foundation
P.O. Box 309, Cebu City
Tel. No. 92312/95528; Fax No. 922312

21. For. Nick Iscala

Social Forestry Department
Department of Environment and Natural Resources (DENR)
Visayas Ave., Diliman, Quezon City

22. Ms. Aida B. Lapis
Supervising Science Research Specialist
Ecosystem Research and Development
Bureau (ERDB)
College, Laguna
Tel. No. 2269 loc. 267; Fax No. 6394-3628

23. Dr. Rodel Lasco Assistant Professor UPLB Agroforestry Program College of Forestry UPLB, College, Laguna Tel. No. 2599/3657/2657 Fax No. (94) 32-06

24. Dr. Ulysses Lustria Director of Extension and Assistant Professor
University of the Philippines at Los Banos College, Laguna Tel. No. 3358

25. Mr. Roger Magbanua International Rice Research Institute (IRRI) P.O. Box 933, Manila

26. Mr. Dominador A. Martinez Project Director Quirino Livelihood Concept and Development Resource Center,.lnc. Aglipay, Quirino 3403 Tel. No. 076-6925058

27. Ms. Ophelia Q. Naje Community Development Officer 11 DENR-PENRO Suqui, Calapan, Oriental Mindoro

28. Mr. Armando M. Palijon
Assistant Professor
UPLB College of Forestry
College, Laguna
Tel. No. 2599

29. Dr. Ben Parker Institute of Animal Science University of the Philippines at Los Banos College, Laguna

30. Mr. Raquelito M. Pastores Assistant Director/Agroforestry Specialist IIRR, Silang 4118, Cavite

31. Dr. Agustin Pinol Supervising Science Research Specialist ERDB, College,

Laguna Tel. No. 2229

32. Mr. Glorioso Quinones Farmer Liquicia, Caba, La Union

33. Ms. Rosalinda S. Reaviles Science Research Specialist II ERDB, College, Laguna Tel. No. 2229/2269/2481

34. Mr. Gregorio D. Reyes Chief, Science Research Specialist and Division Chief Upland Farms Ecosystem Research Division ERDB, College, Laguna Tel. No. 3481/2269/2229 loc. 230

35. Mr. Nestor Roderno Appropriate Technology Unit IIRR, Silang 4118, Cavite

36. Mr. Romeo San Buenaventura
Agroforestry Technician
IIRR, Silang 4118, Cavite

37. Seed Science and Technology Division Staff Department of Agronomy University of the Philippines at Los Banos College, Laguna

38. Ms. Carol Stoney
Agroforester, Winrock international c/o ARMP, P.O. Box 290, Bogor 16001,

Indonesia
Tel. No. 62 (251) 323-325
Fax No. 62 (251) 328489/325-251

39. Mr. Henrylito D. Tacio Staff Writer Mindanao Baptist Rural Life Center (MBRLC) Kinuskusan, Bansalan, Davao del Sur

40. Dr. Frederico Villamayor Professor PRCRTC, VISCA Baybay, Leyte Tel. No. 521-2027 (Pasay Office)

Steering Committee

41. For. Domingo Bacalla Chief, Social Forestry Division DENR, Visayas Ave., Diliman, Q.C.

42. For. Moises Butic Social Forestry Division DENR, Visayas Ave., Diliman, Q.C.

43. Ms. Rowena Cabahug Research Associate UPLB Agroforestry Program College of Forestry, UPLB, College, Laguna Te. No. 2657/3657

44. Dr. Romulo del Castillo Director, UPLB Agroforestry Program College of Forestry UPLB, College, Lagona

45. Ms. Remedios S. Evangelista Social Forestry Division DENR, Visayas Ave., Diliman, Q.C.

46. Dr. Julian Gonsalves Director Appropriate Technology Unit/Communication Department IIRR, Silang 4118, Cavite

47. Mr. Scott Killough Deputy Director Appropriate Technology Unit IIRR, Silang 4118, Cavite

48. Prof. Nestor Lawas Agronomy Department UPLB, College, Laguna

49. Mr. Jaime P. Ronquillo
Assistant Director
Communication Department
IIRR, Silang 4118, Cavite

Artists

50. Mr. Albert Banez

UGSAD Editorial and Visual Arts Association, Inc.

Lincoln Bend, Parkwood Greens, Pasig, M.M.

51. Mr. Boy Belardo

IIRR, Silang 4118, Cavite

52. Mr. Ric Cantada

IIRR, Silang 4118, Cavite

53. Mr. Henry Cruz

54. Mr. Mitchell Doren

UGSAD Editorial and Visual Arts Association, Inc.

Lincoln Bend, Parkwood Greens
Maybunga, Pasig, Metro Manila

55. Mr. Bernabe Remoquillo

Institute of Development
Communication
UPLB, College, Laguna

Editors

56. Mrs. Lyn C. Doren

IIRR, Silang, Cavite

57. Ms. Carmenia May Magno

IIRR, Silang, Cavite

Administrative Support Staff

58. Lhai Kasala

59. Jel Montoya
60. Gigi Naval
61. Angie Poblete
62. Ariel Madlangsakay
63. Secretarial Support Services

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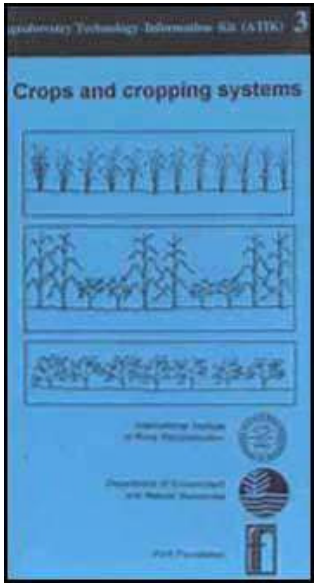

Current program thrusts in upland development

Human greed, abuse and misuse of the country's forest resources have resulted in the sad state of our uplands today. Resource depletion, environmental degradation, inequitable access to resources, tenurial issues, upland poverty and the continuous influx of lowland migrants into the uplands are among the current issues in natural resources management.

In recent decades, the Philippines witnessed an unprecedented commercial exploitation of the timber resources leading to an annual rate of deforestation reported to have reached an average of 119,000 hectares during the declining years of the timber boom between 1969 to 1987 From a leading exporter of precious "Philippine Mahogany", the Philippines has become a timber deficit country where the cost of a board foot of lumber is beyond the means of an average wage earner. The disappearance of forests has resulted in the loss of jobs and livelihood in neighboring communities; destructive floods and drought during wet and dry seasons, respectively; and, landslide and siltation of rivers and dams. Other consequences of deforestation have become common occurrences in many parts of the country.

Through the years, landlessness and unemployment have driven hundreds of thousands of poor families in the lowlands to migrate and eke out a living in upland areas where they have become "squatters" by operation of law. In many cases these have resulted in the total destruction of remaining forest vegetation in the area. The land has become marginally productive as the top soil continues to be lost through erosion brought about by improper agricultural practices. The result is poverty and a degraded upland environment affecting not only the people who subsist in these areas, but even the poor farmers in the lowlands who likewise suffer from the inevitable consequences of forest destruction Latest estimates show that as much as

8.25 million hectares are now severely eroded.

In view of these problems, the government has in recent years formulated programs directed at arresting resource depletion and environmental degradation while searching for solutions to the issues of secured access to land, poverty alleviation and increased sustainable productivity. Among the major programs being implemented by the Department of Environment and Natural Resources are the Integrated Social Forestry Program (ISFP) in noncritical areas of the public domain that are under various forms of cultivation; the National Forestation Program (NFP) in degraded areas and in residual stands that are inadequately stocked; the Forest Land Management Agreement (FLMA) in newly reforested areas under the NFP that need to be maintained and cared for; and, the Community Forestry Program (CFP) in residual forest lands occupied by farming families.

1. INTEGRATED SOCIAL FORESTRY PROGRAM (ISFP)

Initiated about a decade ago, the ISFP draws strength from the DENR Upland Development Program (UDP) started by the Bureau of Forest Development in 1980 which was aimed at distilling lessons and developing methodologies for participatory management of the uplands. The ISFP incorporates the best features of three people-oriented forestry programs implemented in the 1970's, i.e., Forest Occupancy Management, Communal Tree Farming and

Family Approach to Reforestation. The major features include granting long-term tenurial arrangements to qualified applicants, technical and modest material assistance and institution building aimed at developing capability for community-based resource management.

ISFP addresses the twin problems of rural poverty and ecological stability in occupied forest lands. Through ISFP, forest land occupants are provided secure access to land as well as technical and material aid to make the land productive without depleting it. Secure land tenure comes through either the Certificate of Stewardship Contracts (CSCs) for individuals, or the Community Forest Stewardship Agreements (CFSAs) for community organizations. In both cases, farm families are granted renewable 25-year leases on the public land which they occupy and cultivate. In the first years of the lease, the farmer receives technical assistance for developing selfsufficiency and sustainable farming practices.

The program provides assistance in the areas of agroforestry, land tenure and community organizing. Community organizing is applied to mobilize groups to obtain stewardship contracts, promote agroforestry and soil/water conservation and build local institutions. ISFP emphasizes improvement of existing farmer practices, not introduction of new ones except in situations where such may be necessary. Participatory strategies are used to gather

data, diagnose field situations and monitor technical problems. Farm visits and training courses develop farmers' skills in agroforestry and organization. In the process, community leaders are prepared to take responsibilities for continued development after the end of the project, tentatively set at five years.

Recently, the implementation of the Local Government Code obligated the DENR to devolve to the Local Government Units (LGUs) the management of all ISF project sites except some of the "model sites" (one model site per province) and the UDP sites. These projects will remain under the care of the DENR for use as learning sites where new technologies and approaches are expected to be generated. These sites will also be used as training areas for LGU technicians and other development workers as part of the outreach program of me DENR.

2. NATIONAL FORESTATION PROGRAM (NFP)

In 1988, the DENR implemented the NFP which consists of three major components, namely: reforestation, watershed rehabilitation and timber stand improvement. The reforestation component is concerned with the replanting of denuded forest lands with indigenous and exotic forest species, including fruit trees, bamboos and minor forest species. One of the reforestation strategies used is assisted natural regeneration (ANR) where

augmentation planting of climax species is done to improve future yield at minimum cost. The timber stand improvement (TSI) involves the removal of over-mature and inferior trees to improve growth in logged-over areas. Reforestation, ANR and TSI are approaches used in rehabilitation of identified critical watersheds and catchment areas.

DENR enters into contract with upland settler families, community and civic/religious organizations, entrepreneurs, local and other government offices and other NGOs for any of the above NFP activities in areas identified by DENR. The contract may be for survey, mapping, planning, community organizing/training, monitoring and evaluation or actual comprehensive site development of a given area.

3. FOREST LAND MANAGEMENT AGREEMENT (FLMA)

FLMA provides a long-term tenure to the people who plant and care for trees in newly reforested areas by granting farmers access to these areas for purposes consistent with sound ecological principles. When the reforestation contract terminates after three years, the contractor may apply for an FLMA if at least 80 percent of the trees planted are surviving and properly maintained. Family contractors must organize into associations or cooperatives covering a total of at least 100 hectares. DENR employs local NGOs to help organize communities and train them in forest management.

Like stewardship contracts under ISFP, FLMAs are for 25 years, renewable for another 25 years. The contractor may use the area to grow and harvest minor forest products or interplant cash crops, fruit trees and other agricultural crops using sound agroforestry practices. The contractor may also harvest, process and sell timber when the trees mature, following the principles of sustained yield forest management. In return, the contractor provides DENR 30 percent of the total proceeds until the whole cost of reforesting the area has been recovered. The proceeds will be deposited into a "trust fund. for expanding reforestation activities.

4. COMMUNITY FORESTRY PROGRAM (CFP)

The need to democratize access in the use of the forests and allow organized upland communities to benefit from the resource compelled the government to adopt policies that would enable communities to protect, manage and rehabilitate fragmented residual and old growth forests. CFP is emerging as a community-based approach in managing certain portions of abandoned, canceled and expired areas of Timber License Agreements (TLAs).

CFP makes upland dwellers stewards of residual forest areas. Communities are awarded 25-year Community Forestry Management Agreement (CFMA). Again, these agreements are renewable for another 25 years if mutually agreeable to DENR and the community. The community organization can

harvest, process and sell forest products from the area according to a management plan submitted to DENR beforehand. The plan must comply with prescribed rules and follow principles of sustained yield management.

Under the CFP, DENR assists the holder organization to set up and strengthen the community organization. This includes on-the-job training in resource inventory, preparation of forest management and conservation plans and developing livelihood opportunities. For this assistance, DENR employs qualified NGOs.

ROLE OF NGOS

Through the years, the NGOs have been doing a proactive role in upland development through advocacy, training and technical assistance. However, the latter part of the 1980s offered greater opportunities for their direct involvement in the implementation of government programs such as reforestation, social forestry and community forestry. In addition to their traditional roles, the NGOs are now involved in technical work such as survey and mapping; resource appraisal and planning; community organizing; reforestation; resource management; and, harvesting, processing and sale of forest products.

A TOOL IN UPLAND DEVELOPMENT

Agroforestry is an important tool in the development of the uplands. If practiced properly, it helps promote soil and water conservation while increasing productivity and sustainability of upland farms to the benefit of the people.

There are traditional astute agroforestry practices being employed mostly by indigenous people in the uplands. The great majority of the population, however, remains in need of improving their system of farming the uplands to increase income and protect the environment.

Meanwhile, the number of people being engaged in promoting appropriate agroforestry technologies has dramatically increased in recent years. They come from national government agencies, various nongovernment organizations and, more recently, technicians of local government units to whom the upland development functions have been devolved

This Agroforestry Technology Information Kit (ATIK) has been developed for use by these types of development workers as a quick reference. It consists of simple, illustrated technologies being used in various parts of the country. It is a product of a week-long materials production workshop among agroforestry practitioners in the government and nongovernment organizations, farmer groups and the academe.

TABLE 1. SUMMARY PROFILE OF DENR'S PEOPLE-ORIENTED UPLAND DEVELOPMENT PROGRAMS.

	ISFP	NFP	FLMA	CFP
Target areas	Occupied forest lands except national parks and critical watersheds	Denuded and understocked areas	NFP contracted areas	Fragmented residual and old growth forest areas
Target participants	Upland farmers and communities	POs, NGOs, LGUs and families	Community contractors with at least 80% survival after 3 years	Upland resident POs
Stewardship contract	25 years	3 years	25 years	25 years
Funding source	DENR and CARP	ADB	ADB	ADB and USAID-NRMP
DENR office concerned	National ISF Secretariat/Social	NPCO Forestry	NPCO	CFP Secretariat

		Division		
Project implementor	DENR,NGOs and LGUs	Contractors	FLMA awardees	Communities
Implementing strategies	Co-drievev agroforestry intervention	Reforestation contract	Management contract	Management contract/agreement


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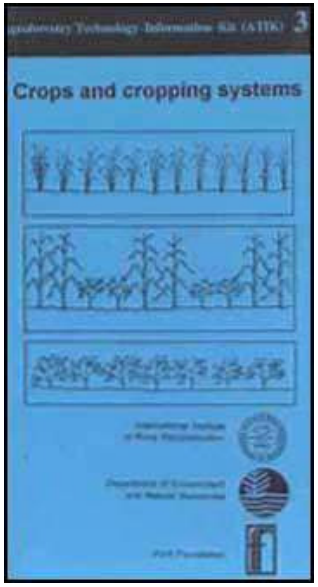

- Upland rice cultivation with agroforestry
- Intercropping under residual or logged-over areas
- Rice paddy in upland areas

Cropping systems: an overview

Crop production has traditionally been the most important land use, source of sustenance and livelihood in the lowlands. Perhaps, crops also constitute the most dominant component in most of our upland farms.

Through the years, upland farmers have evolved various crop production practices out of actual experiences and experimentation over diverse farm

conditions and situations. In time, they have developed various systems in coping with their farm resources and the farm environment.

Multiple cropping, or the practice of growing several crops on the same piece of land, is one of the oldest crop production strategies among upland farmers. Aside from promoting farm diversity, both in terms of plant stock and products, it has proven to enhance farm stability and efficiency in the use of land and labor. It is also considered to be the best alternative to monocropping (the practice of growing only one crop per year).

The crops or cropping pattern can vary from year to year, or follow an arrangement for a certain number of years after which some changes are made. This is commonly referred to as crop rotation.

The wide diversity of crop species that can adapt to the varying environment conditions in the uplands has allowed farmers to practice multiple cropping in various ways. Given the dimensions of time and space in a farm and the varying crop life cycles and growth habits, farmers follow cropping patterns of different designs

The simplest multiple cropping pattern is sequential cropping, or the growing of two or more crops in succession within the one-year growing period. In this pattern, the following crop is planted only after the preceding crop is

harvested (Figure 1). Since there are a lot of annual crops with very short maturity, three to four crops can be grown and harvested with this pattern in one year.

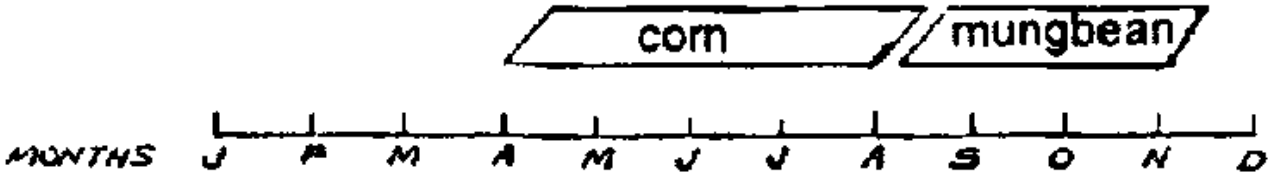

Figure 1. Sequential Cropping.

Intercropping, or the growing of two or more crops simultaneously on the same field, is a more complicated cropping pattern but is probably the most common in upland farming. This practice allows for mixing annual crops, annual plus perennial crops, or mixed perennials either in random or row arrangement over the farm area (Figure 2). Certainly with this pattern, there will be growth overlaps among the crops that can make management a little complicated. A special option for growing two or more annual crops simultaneously on the same field with the following crop planted after the preceding crop has flowered is the practice of relay cropping (Figure 3).

Strip or alley cropping (Figure 4) is essentially a variant of row intercropping, with the strips or alleys consisting of 2 or more rows. Likewise, multistorey cropping (Figure 5) is mixed or row intercropping with the structure of the

tree-crop mixture made up of different canopy layers or plant heights, thus giving the multiple-storey effect.

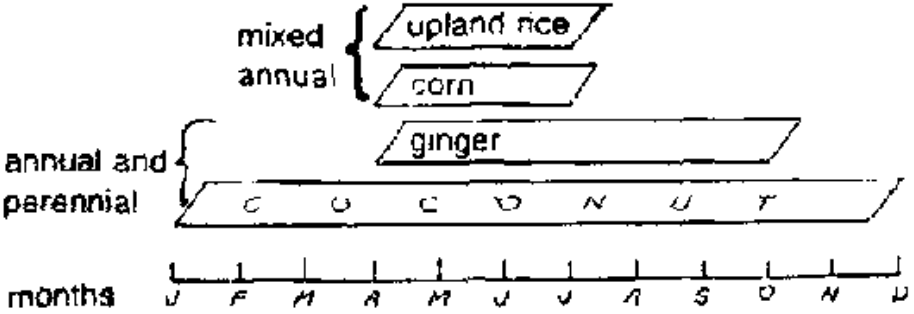

Figure 2. Intercropping.

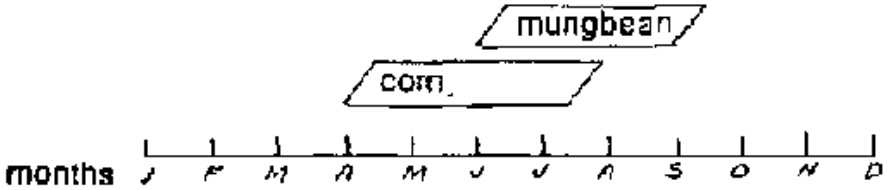

Figure 3 Relay cropping.

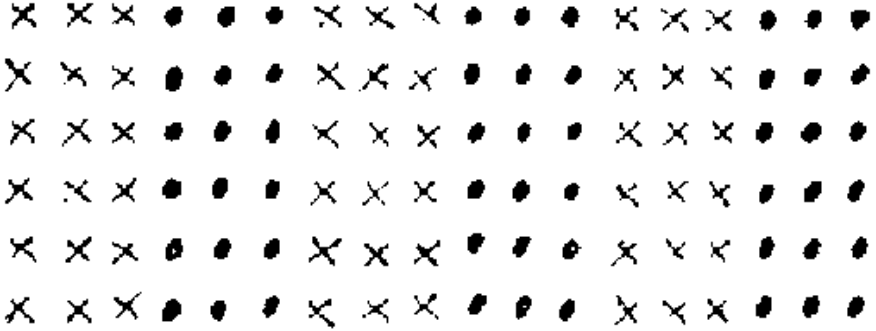

Figure 4 Strip or alley cropping.

Figure 5. Multistorey cropping.

As a farmer follows a cropping pattern, he also has to devise and organize his crop production practices and management activities. In most cases, cropping patterns are determined by given big-physical factors and the available

resources that can be managed. Over and above these considerations, however, the farmer's goal and objective can be the ultimate determinant.

The fact that the cropping system is only part of the whole farm, as in the context of an agroforestry farm, should, therefore, always be considered in appreciating and understanding the various technological options.


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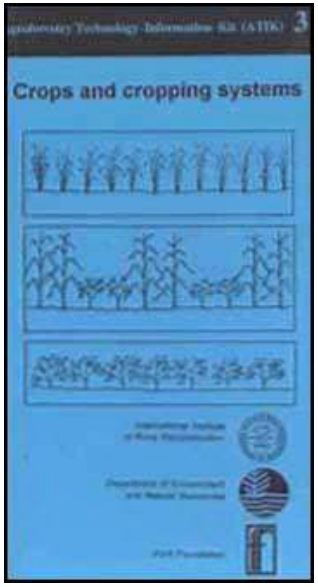


- Intercropping under residual or logged-over areas
- Rice paddy in upland areas

Fiber crops and technologies

Salago (Wikstroemia species) is a slowgrowing native shrub in Eastern Asia. At present, it is classified as a forest crop based on its ability to become a very sturdy plant which can withstand long drought, rainy season Asia. At present, it is classified as a forest crop based on its ability to become a very sturdy plant which can withstand long drought, rainy season and typhoons. It grows to a height ranging from one to three meters. The leaves are opposite,

leathery, widest near the middle, rounded at the tips and 1.5 to 7 cm. Iong. The best is light colored and has a silky appearance and long strong fibers.

Salago is mostly found in thickets as well as in primary and secondary forests at low and medium altitudes. Thus, it is a good agroforestry crop and a good material for hedgerow planting.

Salago is popularly known in the Visayas as Siapo. The fiber was discovered by the Japanese as an excellent material in the manufacture of money, bank notes, stencils, ad paper and documentary papers. It is also used for rope-making, fishing lines and nets, clotheslines, sacks, wallets, colorful hats and others.

FIG. 1. SALAGO

Propagation

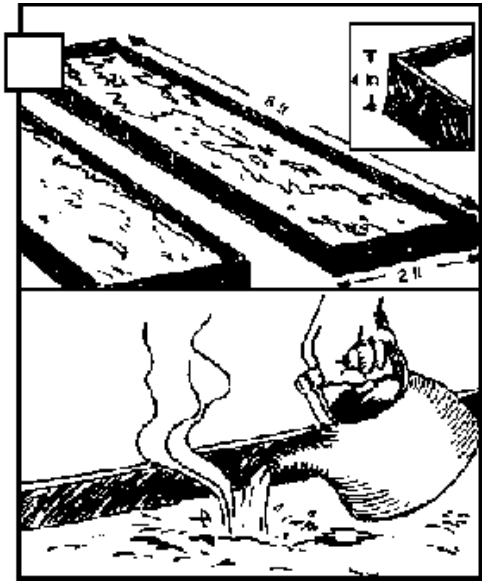
Salago is normally propagated through its seeds.

However, its seeds cannot be stored for a long time because it is a recalcitrant. Seed germination is done through the following steps:

1. Prepare two seedboxes four inches thick, two feet wide and eight feet long. Use a 50 percent limesoil and 50 percent sand mixture,

2. Sterilize the soil by pouring boiling water twice over it before sowing the seeds. Seeds usually germinate from 15-20 days after sowing.

3. Salago seeds could also be sown directly on the farm with comparable results to the above



Preparation

Care of seedlings and planting

To minimize the effect of transfer shock and root injury, seedlings should be planted in individual plastic bags when the first pair of leaves appear.

Seedlings could be transplanted to the field when they are between two to four months old. With a spacing of 1 × 1 meters, 10,000 plants can be accommodated in one hectare. The best time for planting salago is at the beginning of the rainy season.

Maintenance

FIDA (Fiber Industry Development Authority) recommends optional use of commercial fertilizer. In fact, areas recommended for salago planting are those which have fumed less productive (e.g., cogonal areas).

Do ring weeding and underbrushing twice a year, especially during the early stage of growth of the plant. Being relatively resistant to pests and diseases, salago may not need pesticide spraying.

Seed extraction

After six to eight months from planting, salago begins to bear fruits or berries. Thereafter, it will bear fruits once a year from October to November. Seed collection will start on December to early January, that is about 30-35

days from flowering. Berries are considered mature when it turns red or yellow.

To prepare viable seeds, put gathered berries in a basin and thoroughly squeeze them until the seeds are separated from the pulp. Rinse with water. Seeds that sink are viable ones while those that float are rejected by draining the water.

To store seeds without losing their viability, dry them properly by spreading them on any fat container under the sun for six to eight hours. If sowing is to be done in a day or two, two to four hours drying would suffice.

Fiber extraction

Fiber extraction is done either by "handcleaning" or "steaming" method.

"Handcleaning" is done by directly peeling off the bark as soon as the outermost epidermis (thin portion) is scraped out by using a knife. This method of fiber extraction produces white fiber. However, the fiber could not be stored for a longer period due to its susceptibility to mold attack.

FIG. 1. Handcleaning method.

"Steaming" process is done by subjecting the whole stem of salago to steam for about two hours in a big container.

The stem must not touch the water, hence a support for the stem must be provided to avoid staining. The container has to be covered properly while the water level is maintained at three inches. To produce good quality fiber, the outermost dead bark or meristematic cells are removed thoroughly.

This literature aims only to guide agroforestry technicians in their search for appropriate materials to be planted in their project areas. For more information, please contact Fiber Industry Development Authority - Region Vll, S.L. Tanchan Building, Colon St., Cebu City or Ecosystem Research and Development Bureau (ERDB), College, Laguna 4031.

FIG. 1. ABACA

Abaca (Muse textilis Nee) is the local name of a perennial plant which has been grown in the Philippines for centuries. The commercial significance of the plant then was not generally known by most of me natives, much less outside m-e Philippines It took more than 100 years for abaca to be known as a source of fiber for rope manufacture and, later, for fibercraft and specially pulp and paper.

Abaca, internationally known as Manila hemp, is a member of Musaceae family and has close resemblance to banana. Compared to banana, abaca has more slender stalk as well as smaller, narrower and more

pointed leaves. A distinguishing dark line on me right hand side of the upper surface of the leaf blade is pronounced in abaca. Its fruits are smaller, nonedible and contain many seeds.

Soil and climatic requirement

Abaca grows in virtually all types of soil in the Philippines but it is most productive in areas where the soil is:

- volcanic in origin;

- rich in organic matter;
- loose, friable and well-drained;
- of the clay loam type; and,
- less than 1,000 m from sea level.

Propagation

Abaca is propagated by bits of seedpieces. Seedpieces are obtained by separation or division of the rootstocks and corms. From a single seedpiece, a mat or clump of from 10 to 15 suckers develop in one year. About 20 plantable pieces can be obtained from this mat either by separating the small and medium-eke suckers and cutting the corms of larger stalks into bits or seedpieces. Each piece should contain one to three prominent eyes.

Planting

Staking. After preparing me land, mark the places (where abaca will be planted) with bamboo stakes or other suitable materials. The recommended distance of planting is 2 × 2 m.

Holing. The size of the hole depends upon the propagating materials used. Make the holes about 10 cm deep or large enough to accommodate me seedpiece.

Maintenance

Fertilizer application. Abaca requires large amounts of N and K but less of P. To improve the growth of abaca, apply annually 100-200 kg N and 150 to 200 kg. K20/ha in two to four-split applications. Apply the fertilizer around the hill about 15 cm from the base of the pseudostem, the region where the roots are most concentrated. There is no need to bury them since the roots of abaca are shallow.

Pests. Identified pests attacking abaca are brown aphids (Pentalonia nigronervosa), corm weevil (Cosmopolites sordidus) and slug caterpillar (Thosea sinensis). Control the pests with any suitable contact insecticide. Keep the abaca farm clean. Gather, chop and spray corms of harvested stalks.

Diseases. To date, some 17 diseases of abaca have been recorded. Two of these are caused by bacteria, nine by fungi, four by nematodes and two by viruses. The importance of one disease varies from one area to another but, in general, bunchy-top, mosaic and wilt are considered either important or potentially dangerous to abaca production in the Philippines.

Bunchy-top

Symptoms. Shortening of the pseudostem, crowding or bunching of the

leafoleaths at the crown or top of the plant, accompanied by transparent streaks of the main and secondary veins at the leaf when viewed against the light.

Control measures. Roquing of infected plants in like manner as in bunchy-top is essential to maintain a low rate of disease spread.

Wilt

Symptoms. The most noticeable symptom of this disease is the wilting of the leaves, particularly the lower leaves. Eventually, the wiltted leaves turn pale yellow to yellow- brown. When cut open, corms of infected abaca exhibit reddish-violet color.

Control measures. Methods of controlling fusarial wilt are by quarantine and exclusion, or by planting resistant cultivars, if available.

Harvesting and handling

Commence harvesting before the flagleaf appears. Indications that the flagleaf is about to appear are the slowing down of growth of the plant and gradual shortening of the leaf blades. Also, the petiole bridge appears much shorter than the preceding ones.

Keep the surrounding area of the base of the stalk clear of grasses and other obstructions. Then, cut the leaves of the abaca plant with a topping knife attached to a pole. Topping not only facilitates harvesting put also minimizes the damage on follower stalks in the vicinity as well. Cut the stalk with a sharp tumbling bole at about 5 cm. from the corm. A clean, slightly slanted cut is desirable.

Pile the tumbled stalks (10 to 20 stalks per pile) with distal ends on one side. It is ideal to process the stalks immediately after harvesting to obtain fibers of superior quality.

Fiber Extraction. There are two common methods of fiber extraction in the Philippines: (1) hand-stripping and (2) spindle-stripping.

Hand-stripping is the process of extracting fiber in which a narrow strip of abaca leaf sheath (tuxy) is placed under the serrated knife with pressure. Fiber is then extracted by wiling the leafsheath by hand.

Spindle-stripping is a process wherein the tuxy is fed into the machine's stripping knife.

Tuxying - insert a tuxy knife between the outer and middle layers of the leaf sheath and then pull off the entire length to completely separate the layers.

Each leaf sheath produces 2 to 4 tuxies of 5 to 10 cm wide.

Tuxies from different leaf sheaths produce fibers which vary in color, length, texture and tensile strength. Preclassify them as outer, middle and inner for easier classification of fibers after stripping.

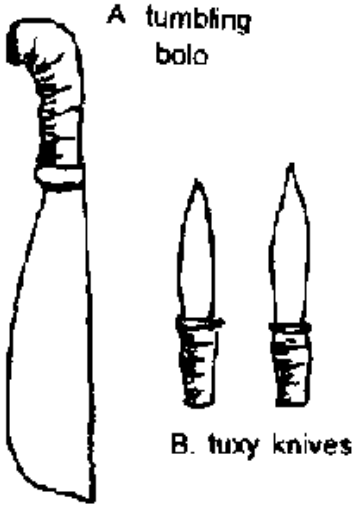


FIG. 1. Tuxying

Fiber Grades

Abaca fiber has 15 grades classified into: Excellent (AD, EF, S2, S3); Good (I,

G, H); Fair (JK, Ml); Coarse (L); and, Residual (Y1, Y2, O. T. WS).

Costs and returns

Assuming that there is no intercropping, establishing a hectare of abaca costs P27,000. No income can be expected from an abaca farm during the first and second years of planting. However, during the first two years, abaca farmers are encouraged to plant cash crops like corn, rice or any root crops to provide food and income

for the family while waiting for the abaca to become productive. During this period. the direct costs incurred in a hectare of abaca plantation is about 8,000/yr. In the third year of operation, there is a gross income of P15,000. On the fourth year and onwards, profit may be expected with the highest gross income of P60,000 (at P28./kg.) against an annual expense of P8,000.

RAMIA

FIG. 1. RAMIE

Ramie (Boehmeria nivea (V Gaud) is a best fiber plant which was introduced to the Philippines from Japan in 1911. Its commercial production started in 1930 in the Mindanao area. Today, the Philippines is one of the top three ramieproducing countries in the world.

Ramie belongs to Urticeae family. The plant produces a large number of erect and slender stems or stalks, usually non-branching and grows from four to seven feet at maturity. It has heart-shaped, lustrous green leaves which are silvery white underneath, 7.5 to 15 cm. Iong with clusters of small greenish flowers, ranging from 8 to 16 mm in diameter.

Propagation

Commercial propagation of ramie uses asexual plant material, the rhizomes. Rhizomes are underground stems from where the stalks grow. To collect rhizomes from existing plantations, dig the root masses with the aid of animal-drawn plow or tractor. Bring these masses immediately to shaded areas. Cut them into pieces of 25 to 30 cm long.

Climatic and soil requirements

The distribution and the total amount of rainfall are both important in the production of ramie. This crop is best suited in places with Type IV climate where distribution of rainfall is uniform throughout the year and where it is not less than 100 mm/month. Ramie will not thrive in areas frequently visited by typhoons or constatnly flooded since it cannot endure inundation for any length of time.

Ramie is best suited in light, but not sandy, to moderately heavy loam soils with high amount of organic matter, excellent drainage and a pH range of 4.8 to 6.4. It can also be planted in acidic soil provided the pH is corrected by liming. Ramie thrives well in soil with high organic matter that enriches the soil and improves its waterholding capacity.

Planting, spacing and plant density

Plant rhizome cuttings within two to three days after digging them out to insure high percentage of germination. If immediate planting is not possible, keep rhizomes moist by sprinkling with water, then cover with plant leaves while still in the shaded area. The recommended spacing for ramie is 75 by 20 cm which need 66,666 planting materials/hectare. The recommendation, however, may vary from place to place, say 100 × 40 cm.

Cutting of first growth

The first growth of stalks after planting is usually uneven in size and bushy or branched. Therefore, cut stalks and leave them in the field when they reach about 20 to 25 cm in height or higher.

Subsequent waste cutting promotes denser stalks of more uniform growth. The new growth that follows such cuttings will be more even with greater number of stalks and fewer or no branches at all. It usually turns out better quality fibers because it has low pectin content.

Harvesting and yield

The ramie plants are ready for harvesting when they display these

characteristics:

a. The lower part of the stalk turns to light brown.

b. The stalks break easily and the bark can be separated readily from the woody central part.

c. The stalks stop growing in height, the top begins to sprout from the nodes along the length of the stalks.

d. The lower leaves turn yellow and begin to dry off

e. The petioles of the leaves, except those at the very top of the stalks, may easily detach at touch and running of the hand along the stalks.

f. Tips of new sprouts begin to appear just above the ground.

Harvest the crop with the use of a bolo or a scythe and cut the stems and new sprouts at ground level. Be careful not to damage the tips of the sprouting rhizome buds. Pile harvested stalks in bundles and bring to a nearby shed for decortication. Decorticate the stalks as soon as they are harvested for easy fiber extraction and quality fiber production.

With sufficient soil moisture and adequate sunlight, ramie matures earlier in 45 days, thereby allowing more harvest cycle per year. Ramie can yield as much as 2,000 kg if drybrushed fiber per hectare in the first year of planting. At the second to subsequent years, such yield can increase to almost 3,500 kg/ha.

Fiber Extraction and Fiber Grades

Processing of ramie fibers requires two operations, namely decortication and degumming:

Decortication means the removal of the fibrous layer of the ramie stem. The ramie stem comprises an inner woody layer and an outer layer, the bark. The fibers are located in the best layer beneath the bark.

In decortication, the operator feeds the stalks into the decorticator, starting with the upper tip. As the stalks are drawn into the machine, they are crushed between the beater plates and beater blades on the revolving beater drums. After 1/2 to 2/3 of the stalk's length has been fed into the machine, the operator pulls the whole length fed to the machine during which the woody parts, bark and parts of the gums and waxes are scraped from the fiber. Gripping the decorticated part, he feeds the butts stalks into the machine until the remaining length of the stalks are crushed. He then

withdraws them from the machine and the decorticated fibers are placed on the rack situated on the left hand side of the machine prior to drying.

FIG. 1. Decortication and degumming

Decorticated ramie has the following grades:

a. RD - A - ramie special
b. RD -1 - ramie good
c. RD - 2 - ramie fair
d. RD - 3 - ramie short

e. RD - 0 - (string)
f. RD - T - low
g. RD - W - waste

Degumming is the process of separating and softening the gums that bind the fibers together and of freeing the individual fibers from surrounding tissues while retaining the strength and other characteristics of the fiber.

Ramie fiber has to be degummed to attain high industrial value. Only a fraction of the gums, waxes, pectins and resins are removed from the fibers in the process of decortification and brushing. The presence of a high percentage of these components make the decorticated line fiber stiff and brittle The major objective in degumming is to separate the individual fibers and make them soft and clean without sacrificing fiber strength and other good characteristics. This process is done either by chemical methods or by bacterial action (biological process).

The biological process of degumming ramie makes use of water impregnated with bacteria in a large vat or big containers. Bacteria attack the gums and waxes of ramie but leave the cellulose fiber intact. This process is not commonly used because it is time-consuming, laborious and produces poor quality fiber.

Chemical degumming is becoming popular and each industrialist has his own degumming method which is kept a trade secret. The available technology at present is found only in Japan, Taiwan, U.S. and some European countries.

Degumming is usually accomplished by subjecting the fibers to dilute solutions of sodium hydroxide at elevated temperatures in the absence of air. Alkali, particularly sodium hydroxide, readily react with hemicellulose. In the presence of air, oxidation of the cellulose to oxycellulose rapidly occurs resulting in greatly weakened fibers. Alkali concentration, temperature, time and presence of antioxidants are factors to be considered in conducting degumming experiments.

The exact chemical changes occurring during the alkaline boil have not yet been verified; but in a somewhat oversimplified manner, the following changes could be deduced to happen: the hemicellulose which are largely made up of mixed polysaccharides are converted to their soluble simple sugars; saponifiable gums and waxes are saponified into soluble soaps; and, unsaponifiable oils are emulsified by these soaps and the wetting agent.

Seresinhe (1978) said that all degumming methods are based on common principles and differ only in small details. The general method is discussed below.

Steps

1. Cook decorticated ramie fibers for 1 hour at 6 kg/cm2 pressure and 160°C water to dry fiber ratio of 6:1 with 6 percent sodium hydroxide; 3 percent sodium sulphate; 3 percent sodium tripolyphosphate and 3 percent organic phosphate penetrant.

2. Blow off cooking liquor and discard. Wash fiber with water.

3. Same as first step.

4. Blow off cooking liquor, saving some for first step of next batch and wash the fiber with water.

5. Bleach for one hour with 1 percent hydrogen peroxide at 83°C and pH of 9.0.

6. Rinse fiber with diluted acetic and water.

7. Mix fiber with an oil emulsion such as sulphurated hydrocarbon using 34 percent of the weight of the dry fiber.

8. Centrifuge fiber, saving excess emulsion for the next batch.

Cost and return

The cost and return analysis of ramie production showed a negative income in the first year of operation. This can be attributed to the high initial expenses which totaled to P71,168.00. However, in the second and succeeding years, net income was P47, 898.00

Sources:

Fiber Industry Development Authority - unpublished brochures and reports.

The Philippines Recommends for Abaca. PCARRD Technical Bulletin.

Salago Production and Processing in Cebu. An undertaking by the Family and School Hillyland Development Project - Jampang, Argao, Cebu.

The Philippines Recommends for Ramle Production. PCARRD Technical Bulletin Series No. 62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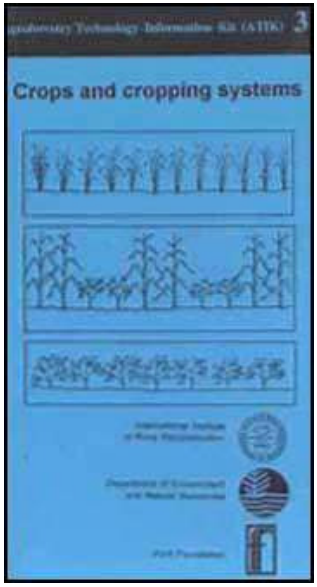
Crops and Cropping Systems (IIRR, 1992, 43 p.)



Root crops for food, feed and income

WHY ROOT CROPS?

FIG. 1. Rootcrops

- Can grow over a wide range of soil and climatic conditions.
- The leaves can also be used as foods/feeds (except for arrowroot).
- Easy to grow, good staple and easy to prepare as food.
- Planting material does not compete as food source (except for ubi/tugui).
- Long-harvest duration. Produce can stay in the ground long without much decline in quality.

- Availability of simple processing technologies provided for increase crop value and decreased risk of crop perishability of production surplus.

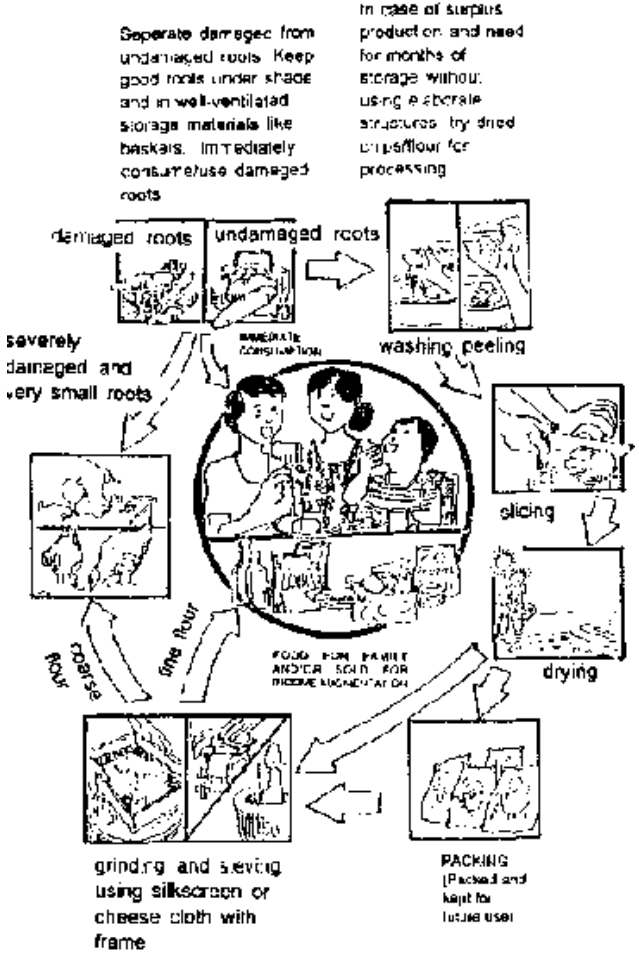

Seperate damaged from undamaged roots. Keep good roots under shade and in well-ventilated storage materials like baskets. Immediately consume/use damaged roots
In case of surplus production and need for months of storage without using elaborate structures, dry dried chips/flour for processing
damaged roots
undamaged roots
IMMEDIATE CONSUMPTION
washing, peeling
severely damaged and very small roots
slicing
drying
fine flour
coarse flour
FOOD FOR FAMILY AND/OR SOLD FOR INCOME GENERATION
grinding and sieving using silkscreen or cheese cloth with frame
PACKING (Packed and kept for future use)

FIG. 1. Processing and utilization of root crops

BRIEF DESCRIPTION OF SITE REQUIREMENTS AND PRODUCTION PRACTICES OF FIVE MAJOR ROOT CROPS

CASSAVA

Manihot esculenta

Kamoteng-kahoy, kalibre, balinghoy

Soil Requirement

Sandy to clay good internal drainage

Light Requirement

Full sunlight, yield reduced by shading

Water Requirement

At least 1000 mm/season with less later in the season

Land Preparation

Conventional, 1 to 2 plowing and harrowing

Planting Materials

At least 8 mo old, 20-30 cm long with 5 nodes or more and free from pests

Time for Planting Onset of the rainy season
Planting Method

Singly, vertically buds up, 113 below the ground on the ridge

Spacing

60-100 cm between rows and between hills

Weed Control

Combination of handweeding and cultivation during the first two months of growth. Hill-up 2 months after planting.

Harvesting

Depends on need/situation but optimum time is about 10 most Harvest only the amount that can be used/disposed within 3 days.

Shelf-life

Can last for one week if basal part of root is not injured

Cropping Systems

Should be rotated with other crops like legumes/cereals. Can also be intercropped.

Special Features

Cut the plant about knee high under storm signal #2 and plants more than 1 m in height. Old plants can be rejuvenated by pruning and allowing regrowth. These also serve as live fence for corn and upland rice (tribal practice).

SWEET POTATO

Ipomoea batatas

Kamoteng-baging, kamote

Soil Requirement

Sandy to clay with good infernal drainage

Light Requirement

Full sunlight, yield reduced by shading

Water Requirement

At least 400 mm/season with less later in the season

Land Preparation

Conventional, 1 to 2 plowing and harrowing

Planting Materials

Terminal vine cutting 25-35 cm long with at least 5 nodes and free from pests

Time for Planting

Onset and/or towards end of rainy season

Planting Method

Singly, vertically, 1/2 buried on ridge during rainy season and in furrow towards dry season

Spacing

75-100 cm between rows and 20-30 cm between hills

Weed Control

Combination of handweeding and cultivation during the first month of growth. Hill-up one month after planting.

Harvesting

Depends on need/situation but optimum time is about a month. Avoid injuring the roots for longer shelf-life.

Shelf-life

Can last for two weeks to four months depending on variety

Cropping Systems

Should be rotated with other crops like legumes/cereals. Not advisable for intercropping, very competitive

Special Features

Can be pruned of shoot tips (10 cm) during first month of growth for vegetable vine lifting for those with lateral roots can increase yield of main roots

TARO/YAUTIA

Colocasia esculenta/Xanthosoma sagittifolium

Gabi, gabing San Fernando, Takudo

Soil Requirement

Sandy to clay with good internal drainage and with high organic matter

Light Requirement

Can tolerate shading up to 25 percent

Water Requirement

At least 1500 mm/season uniformly distributed

Land Preparation

Conventional, 1 to 2 plowing and harrowing

Planting Materials

Upper 1-2 cm corm plus lower 20-25 cm petiole weighing 100-200 9 and free from pests; sucker for yautia

Time for Planting

Onset of rainy season

Planting Method

Singly in furrows about 10 cm deep

Spacing

75 cm between rows and 50 cm between hills

Weed Control

Combination of handweeding and cultivation during the first two months of growth. Hil-up 2 months after planting.

Harvesting

Depends on the need/situation but the optimum time is about 9 months for Colocasia (true gabi) and one year for Xanthosoma. Avoid injuring corms for longer shelf life.

Shelf-life

Can last for two weeks with part of petiole attached

Cropping Systems

Should be rotated with other crops like legumes/cereals. Can be planted with other crops like trees/annual crops

Special Features

Removal of suckers/rhkomes for colocasia increased yield of mother plants mulching contribute to better weed control

ARROWROOT

Maranta arundinacea

Uraro

Soil Requirement

Sandy to clay with good internal drainage

Light Requirement

50 percent shading to full sunlight

Water Requirement

At least 1500 mm/season uniformly distributed

Land Preparation

Conventional, 1 to 2 plowing and harrowing

Planting Materials

Suckers and rootbits about 10-20 9

Time for Planting
Onset of rainy season

Planting Method

Singly, vertically on the furrow about 10 cm deep

Spacing

75 cm between rows and 30-50 cm between hills

Weed Control

Combination of handweeding and cultivation during the first two months of growth. Hill-up 2 months after planting.

Harvesting

Depends on the need/situation but optimum time is about 10 months. Avoid injuring rhizomes for longer shelf-life.

Shelf-life

Can be stored for one month

Cropping Systems

Should be rotated with other crops like legumes/cereals and can be planted under trees

Special Features

No pests observed, not eaten even by goats, flour is first class, good for children and convalescent

GREATER YAW/LESSER YAM

Dioscorea alata/D. esculenta

Ubi/Tugui

Soil Requirement

Sandy to clay with good internal drainage and with high organic matter content

Light Requirement

Can tolerate shading up to 25 percent

Water Requirement

At least 1000 mm/season with less later in the season

Land Preparation

Conventional, 1 to 2 plowing and harrowing

Planting Materials

Whole or sliced presprouted tubers 100-250 9 for ubi and 100-150 9 for tugui (whole only) free from pests

Time for Planting

Onset of rainy season and when dormancy is broken

Planting Method

Singly on ridges about 10-15 cm deep

Spacing

100 cm between rows and 50-75 cm between hills

Weed Control

Combination of handweeding and cultivation during the first two months of growth. Hill-up 2-3 months after planting.

Harvesting

Depends on the need/situation but the optimum time is about 7 months when leaves start falling. For tugui, basal leaves appear yellowish when mature. Avoid injuring tubers for longer shelf-life.

Shelf-life

From 3-5 months depending on variety

Cropping Systems

Same as for gabi

Special Features

Needs trellis for good production. Horizontal trellis adviseable for areas frequented by typhoons; mulching also good for weed control.

TABLE 1. USES OF ROOTCROPS AS FEEDS FOR DIFFERENT ANIMALS.

CROP			ANIMALS		
	Swine	Poultry	Ducks	Goat	Carabao/Cattle
Cassava and sweet potato	Raw leaves, dried ground leaves, raw/cooked roots, dried ground roots	Dried ground leaves, dried ground root	Dried root chips, raw roots, dried ground leaves	Raw leaves, raw roots, dried root chips	Raw leaves, raw roots, dried root chips
Gabi	Sliced and cooked leaves and corms	Dried ground corms	Dried ground corms	-	-
Ubi/Tugui	Cooked tubers, dried ground tubers	Dried ground tubers	Dried tuber chips	Dried tuber chips, raw leaves	Dried tuber chips
Arrowroot	Cooked rhizomes	Dried ground rhizomes	Dried ground rhizomes	Dried rhizome chips	Dried rhizome chips

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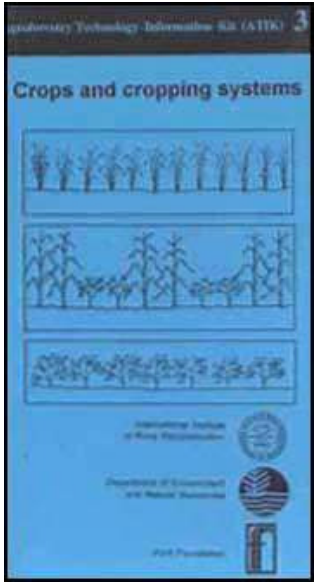

Upland rice cultivation with agroforestry

FIG. 1. Agroforestry

Wherever possible, introduce hedgerow strips of tree legumes every 6-7 m of about 1 m deep to provide green-leaf fertilizer for upland rice. Suggested tree legumes are Kakawati, Cassia spectabilis or ipil-ipil.

Select a rice variety with a growth season well within the rainfall duration. The variety should mature by the time rainfall recedes.

Sow the rice seeds at the onset of the rain. A rainfall of 55-60 mm is desirable to ensure uniform and adequate plant population. Planting can be done either by broadcasting, dibbling, hilling or drilling.

- The land is prepared moist or dry. A modified broadcasting method is done by furrowing a harrowed field with a lithao. Seeds are broadcast uniformly and then a peg-toothed harow, kalmot is used to pass diagonally across the furrows.

- Thorough land preparation can effectively control weed population during the rice vegetative stage. Plow the field and leave it for a week to allow weeds to germinate. Harrow the field twice. Allow weed seeds to germinate. Then harrow for the third time to incorporate the weeds into the soil.

When hedgerows of tree legumes are tall, prune to hedges and leave the branches on the strips to allow leaves to decompose.

Keep the field free from weeds for about 40-60 days after emergence to minimize yield losses.
Competition for light, nutrients and soil moisture begins early.

- Hand-weeding is done if seeds were broadcast.

However, in modified broadcasting or row planting, mechanical weeding using a hoe can be done.

- In slopey areas where plowing is not possible, the use of crop residues as mulch can help control weed growth.

The leaves of legumes serve as fertilizer. If there is a large amount of biomass applied into the field at pruning time, it is not necessary to put chemical fertilizers. Using a legume-cereal rotation can also help improve fertility.

Pest control can be done as the need arises.

Integrated pest management (IPM) is highly recommended.

As soon as the grains are ripe (about 80-85 percent is mature), harvest the crop.

Increase productivity by intercropping and crop rotation. Legumes planted with rice or planted before or after rice can substantially improve yields with reduced external inputs.

CROPPING POSSIBILITIES

OPTION 1

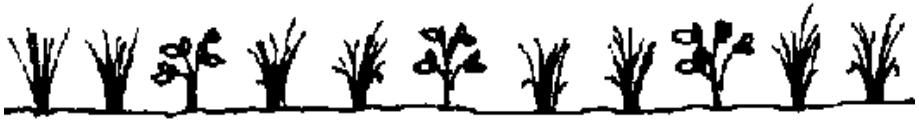

FIG. 1. Start of the season

Plant alternating 2-3 rows of upland rice with a row of bush-type legume (preferably a shortmaturing one). About 16-20 kg legume and 50 kg of upland rice is needed to plant a hectare.

FIG. 1. Two months after

When the rice is at its late vegetative stage, the legume is harvested. The space occupied by the legume can be planted to corn or other crops like cassava or vegetables.

FIG. 1. Four to five months after

After the rice harvest, plant a short-duration legume crop where the rice was planted. If the field is free from weeds, the legume seed can be drilled or dibbled. Or, plant lablab or velvet bean following upland rice.

FIG. 1. Towards the dry months

Plant legumes that cover the soil during the dry season. Good potential cover crops include rice bean, batao and velvet bean.

OPTION 2

FIG. 1. Plant rice in strips during the onset of the rainy season.

FIG. 1. After the rice harvest, plant 1-2 rows of legumes for every 2-3 rows of corn.
Peanut, mungbean or cowpea can be planted as intercrop.

FIG. 1. Before the crops are harvested, plant legume cover crop to protect the soil during summer.

OPTION 3

FIG. 1. Plant the whole field with upland rice.

It is suggested that more than one variety of rice in one field should be planted to spread the risk from calamity.

FIG. 1. After the rice harvest, plant legumes.

If the rice was planted in rows and the field is free from weeds, the succeeding crop can be relayed one week before harvesting rice. Cowpea, mungbean and peanut may be planted.

FIG. 1. Corn can be planted just after the legumes in case there is still sufficient soil moisture.

FIG. 1. But if the soil moisture cannot support corn growth, a third crop of cover crop like rice bean or lablab is suggested.