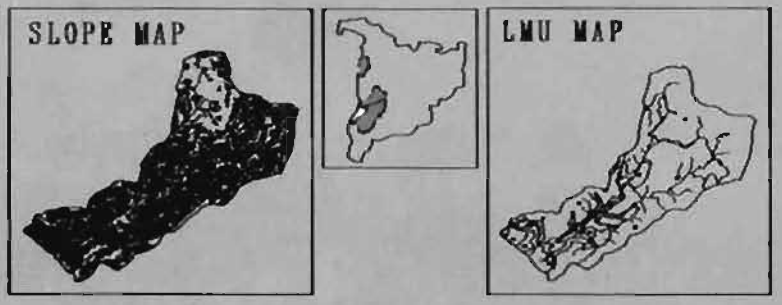
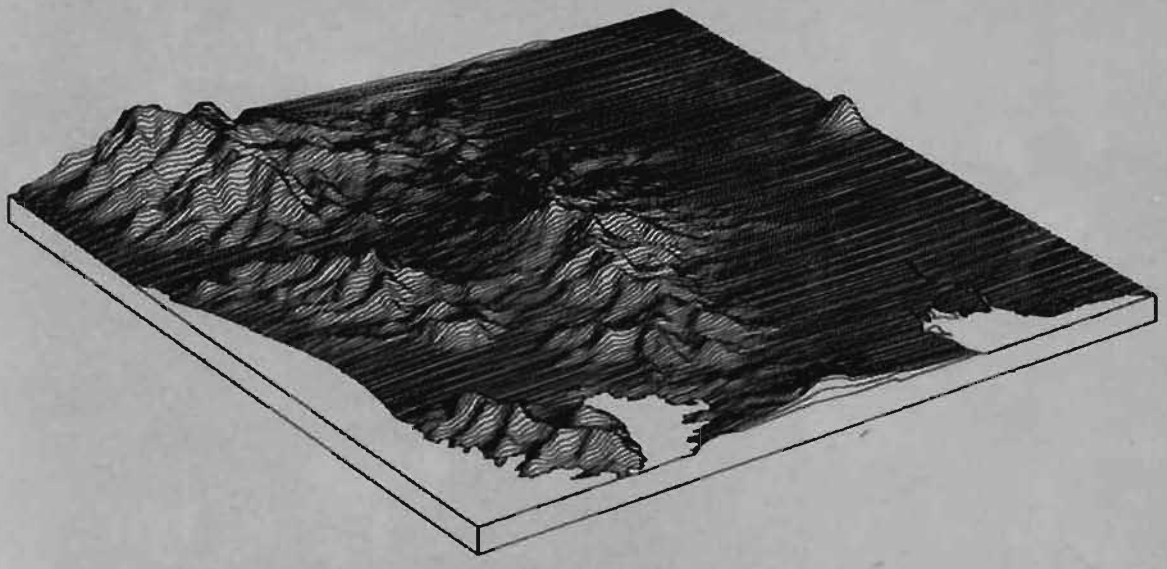
ANTIQUE INTEGRATED AREA DEVELOPMENT (ANIAD)

A Community-Based Program

Physical Planning Study for ANIAD Concentration Areas
(Micro-Geographic Information System for Sibalom, Cangaranan and Tibiao Watersheds)





Prepared by:

ORIENT INTEGRATED DEVELOPMENT CONSULTANTS, INC.

OIDCI

Commissioned by:

ANTIQUE INTEGRATED AREA DEVELOPMENT FOUNDATION INC. (ANIAD)

ANTIQUE INTEGRATED AREA DEVELOPMENT (ANIAD)
A Community-Based Program

PHYSICAL PLANNING STUDY FOR ANIAD CONCENTRATION AREAS

(Micro-GIS of Cangaranan, Sibalom, Tibiao Watersheds)

FINAL REPORT

Prepared by:

ORIENT INTEGRATED DEVELOPMENT CONSULTANTS, INC.

Commissioned by:

ANTIQUE INTEGRATED AREA DEVELOPMENT FOUNDATION INC. (ANIAD)

February 1992

TABLE OF CONTENTS

ANNEXES

1.0 INTRODUCTION

The land resource mapping (Phase 1) and formulation of the physical land use intervention (Phase 2) were conducted to provide substantive technical information and maps for community-based resource management planning in the 3 pilot concentration areas of ANIAD. The preparation and processing of the technical maps and land resources information were basically computer-enhanced using the Remote Sensing (RS) and Geographic Information System (GIS) facilities of the Bureau of Soils and Water Management (BSWM) of the Department of Agriculture. Field works complemented by consultations and discussions with the site staff of ANIAD and other government and private institutions were conducted to validate information, expand the framework of land use analyses as well as to generate participation from the potential users of the technical physical planning maps and information.

2.0 METHODOLOGY AND PROCESS

2.1 Basic Framework and Procedures

The general algorithm followed in the preparation of the various maps and their integration with the physical planning processes are shown in the Flow Chart Matrix Integration of Resource Mapping, Management and Planning Decisions and Physical Planning (Figure 1). Basically, the algorithm matrix showed the step-by-step map overlaying procedure and their corresponding outputs as well as the one-on-one relationship between the technical mapping and the physical planning highlights and procedures.

2.2 Sources of Information

The sources of spatially-defined land resources information are the BSWM Remote Sensing Computer -Enhanced Imageries and the secondary information obtained from various offices such as the DENR, the BSWM, ANIAD, and other local offices in Antique and Iloilo. Remote Sensing (RS) provides both time-specific and location-specific land use data which were digitized and transferred to the GIS-Computer facilities of the BSWM.

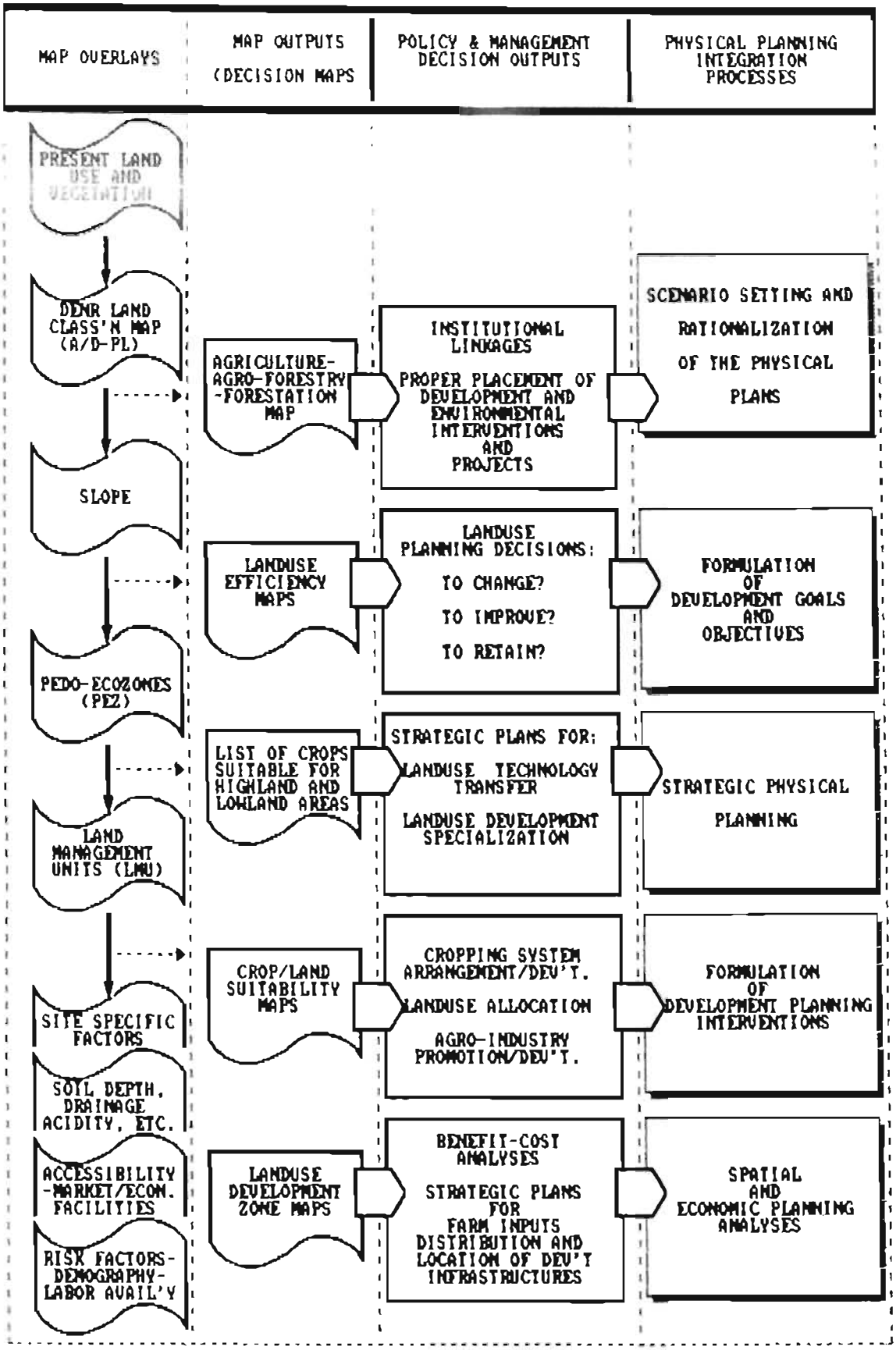


FIGURE 1

MATRIX INTEGRATION OF RESOURCE MAPPING, MANAGEMENT AND POLICY DECISIONS, AND PHYSICAL PLAN FORMULATIONS

2.3 Ground Truthing

The images generated by RS are identified by their tonal/color differentiation signatures of various spatially defined polygonal images derived from the satellite imageries. However, their specific ground identity can be adequately established by (1) the local knowledge of the interpreter about the site; (2) comparing sample points/locations of the RS imageries with existing maps of similar scale; and (3) ground truthing where one selects representative pixel (smallest data storage cell of the satellite image) and conducts field works to establish/validate their actual identities on the ground. Ground truthing was particularly undertaken to validate land use and vegetation data.

2.4 Project Consultations

The computer-aided Geographic Information System provided various thematic maps for the ANIAD areas of concentration. Because of the complex technical processes involved in the map overlaying, significant time and effort were allotted in the step-wise procedures for the effective transfer of information to the end-users, the ANIAD management and technical staff, as well as the NGO's, LGU's and various national and provincial offices in Antique.

Immediately after the development of the land use and interpretive maps, multi-level consultation meetings were held with the ANIAD project management at the project site where the basic philosophies and framework adopted in the map interpretations were extensively discussed. The initial meeting was done with the key project management staff. The comments and suggestions of the ANIAD Project Management were considered and adopted in the preparation of the final maps and reports.

In order to further widen the perspectives in the preparation of physical land use interventions, a second meeting was held with non-ANIAD personalities at the ANIAD Project Management Office. This meeting was attended by the staff of the local DENR, the Office of the Provincial Planning and Development, local NEDA, and a local NGO. The discussions were focused on the highlights of the findings and the implications/applications of the study, especially on the state of the land resources. Discussions were likewise conducted on the impact of the satellite images derived and computer-processed data by the remote sensing facilities. An appreciation of this planning tool has been widely expressed that the Provincial Government representative requested for the conduct of a similar exercise on a province-wide scale.

2.5 Limitations of the Study

The computer-aided remote sensing technology offered a wide range of knowledge of the earth surface and near surface over a large area within a very short span of time of observation. Its strategic value in the immediate formulation and disposition of management decisions has practically far outweighed its current costs especially when one considers the urgency of the agenda for a balance approach to development and the environment. However, while its primary value is in its ability to provide trans-watershed boundaries for comparative analyses, some important special ground details that might be of importance to local planning are not discernible and their spatial properties are not mappable. An example of this limitation is the special interest on the terraced and unterraced wetland rice cultures (rainfed and irrigated) where the very nature of field developments - small sizes (less than one hectare) and non-contiguous - cannot be recorded separately from the other land uses with relatively similar characters during the time of observation. It must be noted that the satellite images are best obtained during the dry months which are the periods where most of these small rainfed rice fields are in fallow and as such, their tonal records are similar to other upland field crops and even those of the native grasses.

Under the above situation, these types of important but unregistered information/map are best handled by using local knowledge on their specific locations and interventions to be delivered should be further refined using the local communities and local organizations.

3.0 THE PHASE I OUTPUTS

The three areas of concentration included under the project covers a total area of about 109,289.85 ha. distributed as follows:

a. Sibalom River Watershed - 62,964.62 ha.
b. Cangaranan River Watershed - 27,973.61 ha.
c. Tibiao - Panganta, Bacong, and Carit-an Rivers - 18,351.62 ha.

The maps generated for the three concentration areas are as follows:

1. Reproducible Base Maps (scale - 1:20,000)
2. Thematic Maps (scale - 1:20,000)

a. Present Land Use
b. Slope Map
c. Erosion Map
d. Land Limitation Map

e. Land Suitability Map
f. Land Management Unit Map (Pedo-Ecological Zone)
h. DENR Program Areas (A & D/Public Land)
g. Proposed Land Use and Zoning Map

3.1 Watershed Resource Characteristics

3.1.1 The Sibalom Watershed

Land use

The Sibalom watershed covers a total area of about 62,964.62. Forest cover represents 54% of the total area of the watershed. The rice areas occupy some 6,065.40 ha. or about 9.6% of the entire watershed. The other economic land uses are coconut (3,264.60 ha.), mixed tree crops (5,317.50 ha.), and others. The watershed has extensive grasslands (18,101.10 ha.) which appear to have been overgrazed as evidenced by the contour trails created by freely grazing livestocks. At the time of the study, the existing pasture land lease was estimated to cover an area of about 409.5 hectares.

Land Management Units and Pedo-Ecological Zones

Significant portions (72%) of the watershed are located at high elevation where the condition for the production of many high value crops are very favorable. The lowland areas are about 11% of the watershed, while the uplands and hillylands have an aggregate total of about 17 percent. The rest of the land areas are under miscellaneous uses.

Slope

The watershed is generally dominated by rolling and mountainous terrains with slopes exceeding 18% accounting for a total land area of about 41,608.40 ha. or 66% of the total watershed. The agricultural lands where slopes are not limiting (0-8% slopes) cover about 8,419 ha. or about 13.2% of the total area of the watershed.

Erosion

The watershed has been subjected to land degrading land uses. Practically all sloping portions of the watershed have been eroded in varying proportions. The land degradation problems are exacerbated by the predominance of subsistence farmers who, in general, employ unsustainable farming practices. The assessment of soil erosion in the watershed revealed the following problems:

a. Only 13,438 ha. or about 21.3% of the total watershed has relatively slight erosion problems. These areas are either located in gentle sloping lands (less than 8 % slopes) or are effectively covered by tree crops and forest trees.

b. The remaining 79% exhibit moderate to severe erosion which are mainly due to steep slope condition and ineffective soil cover (mainly grasslands). Moreover, 9,932.8 ha. or 16% of the uplands with steep slopes (>50 % slopes) suffer from the potential problems related to mass movements (soil creeps).

Land Limitations

The watershed has varied forms and combinations of land limitations which are summarized as follows:

	Land limitations		Area (in ha.)
a.	flooding	-	6,896.5
b.	shallow and stony soils	-	6,197.0
c.	combined problems of erosion, steep slope, and shallow soils	-	1,142.0
d.	combined problems of erosion and steep slopes	-	5,726.0
e.	combined problems of mass movement and steep slopes	-	43,213.5

Proposed Land Use and Development Zoning

Approximately 18,436 ha. or 29.3% can be devoted to various agricultural activities that conforms with the bio-physical condition of the watershed. About 37% of these lands can be safely cultivated to intensive uses. Furthermore, approximately 28% of the arable lands can be devoted to an integrated crop-livestock farming systems.

The forestry-based development schemes represent a total area of approximately 43,493 ha. or 69% of the total watershed area broken down as follows:

a.	Agroforestry	-	14,526.2 ha.
b.	fuelwood production	-	3,845.4 ha.
c.	community-based forest productivity enhancement/development	-	25,770.9 ha.

Table 1. Land Use (Sibalom River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	Paddy-rice irrigated	3,400.48	5.40
2	Trees	5,317.51	8.45
3	Primary forest	12,187.35	19.36
4	Secondary forest	15,262.98	24.24
5	Grassland	18,101.06	28.75
6	River	1,088.37	1.73
7	Rainfed rice	2,664.91	4.23
8	Coconut	3,264.61	5.18
9	Bamboo	562.21	0.89
10	Built-up areas/Urban lands	211.45	0.34
11	Pasture lands	409.46	0.65
12	Sugarcane	204.12	0.32
13	African daisy	290.11	0.46
		62,964.62	100.00

Table 2. Land Management Unit (Sibalom River Watershed)

PEDO-ECO ZONE	LMU	DESCRIPTION	AREA (Ha)	PERCENT (%)
LOWLAND	08	Beach Ridges ad shales	135.63	0.22
<100m elevation	09	Broad Alluvial Plains (Width>500m)	2,071.50	3.29
<8% slope,>25C	12	Lower river terraces	4,650.52	7.39
UPLAND	76	Low Shale/Sandstone Hills	4,850.67	7.70
<100m elevation,8-18% slope or 100-500 elev.,<18%slope 22.5-25C	76TV	Low shale/Sandstone Hills	4,857.68	7.71
HILLYLAND	112	High Shale/Sandstone Hills	1,383.32	2.20
<500m elevation,>18%slope >22.5C				
HIGHLAND	153	Limestone Mountains	1,873.09	2.97
>500m elevation	159	High Meta-sedimentary Mountains	7,824.44	12.43
<22.5C, regardless of slope	160	Low Meta-volcanic Mountains	5,886.64	9.35
	161	High Meta-volcanic Mountains	7,158.44	11.37
	168	Complex Volcanic Mountains	21,889.52	34.76
MISCELLANEOUS	180	Built-up Areas/Urban Lands	211.45	0.34
	186	Riverwash	171.72	0.27
		T O T A L	62,964.62	100.00

Table 3. Slope Classification (Sibalom River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	0 3% Level to nearly level	6,407.52	10.18
2	3-8% Gently sloping to undulating	2,012.83	3.20
3	8-18% Undulating to rolling	12,794.37	20.32
4	18-30% Rolling to moderately steep	13,572.59	21.56
5	30-50% Steep	18,765.14	29.80
6	> 50% Very steep	9,412.17	14.95
		62,964.62	100.00

Table 4. Erosion Classification (Sibalom River Watershed)

	DESCRIPTION	REMARKS	AREA (Ha)	PERCENT (%)
1	None to slight	0-3% slope under any land use 3-8% slope under grassland 3-8% slope under tree crops 8-50% slope under forest	6,462.74	10.26
2	Moderate erosion	8-18% slope under forest	1,707.88	2.71
3	Moderate to severe	8-18% slope used for annual crops	26,007.11	41.30
4	Slight erosion	3-8% slope under annual crops 3-8% slope under paddy-rice 8-18% slope under tree crops 18-50% slope under forest	6,975.93	11.08
5	Severe erosion	18-50% slope under grassland	11,878.10	18.86
6	Slight erosion but with mass movement hazard	Above 50% slope under grassland	7,528.82	11.96
7	Severe erosion with high mass movement hazard	Above 50% slope under grassland	2,404.04	3.82
			62,964.62	100.00

Table 5. Land Limitation (Sibalom River Watershed)

DESCRIPTION	AREA (Ha)	PERCENT (%)
FLOODING		
Slight to moderate	1,141.90	1.81
Moderate to severe	3,814.73	6.06
River flooding	1,939.90	3.08
SHALLOW STONY SOIL		
Shallow and stony	3,716.10	5.90
Shallow and very stony	2,481.00	3.94
SHALLOW SOILS/STEEP SLOPE/EROSION		
Moderately shallow, slight to moderate erosion	550.51	0.87
Moderately shallow, moderate erosion	389.72	0.62
Shallow soils, very steep slope, severe erosion	202.29	0.32
STEEP SLOPE/EROSION		
Steep slope, moderate erosion hazard	3,350.15	5.32
Very steep slope, severe erosion	2,375.84	3.77
VERY STEEP SLOPE/MASS MOVEMENT SUSCEPTIBILITY		
Steep slope, susceptible to mass movement	17,363.66	27.58
Very steep slope, susceptible to mass movement	24,781.29	39.36
DROUGHT		
Droughty	21.88	0.03
Droughty, poor water holding capacity	835.65	1.33
	62,964.62	100.00

Table 6. Proposed Land Use and Zoning (Sibalom River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	Intensive agricultural development	6,824.12	10.84
2	Upland agricultural development	405.20	0.64
3	Multi-storey cropping	5,522.20	8.77
4	Coconut/livestock development	467.63	0.74
5	Crops-livestock development	5,219.79	8.29
6	Agroforestry	14,526.19	23.07
7	Fuelwood production/development	3,845.42	6.11
8	Community-based forest productivity enhancement/development	25,770.90	40.93
888	Built-up areas/urban lands	211.45	0.34
999	Riverwash	171.72	0.27
	T O T A L	62,964.62	100.00
	Declared as forest land (public land)	18,747.02	

Table 7. Land Suitability (Sibalom River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	Rice-based cropping system	1,961.77	3.12
2	Corn-based cropping system	5,094.64	8.09
3	Annuals (corn, vegetables)	1,960.51	3.11
4	Annual food crops with livestock tree crops	11,972.22	19.01
5	Agroforestry	13,000.79	20.65
6	Fruit trees, fuelwoods	16,297.12	25.88
7	IPAS	12,294.40	19.53
	Built-up areas/Urban Lands	211.45	0.34
	Riverwash	171.72	0.27
		62,964.62	100.00

3.1.2 Cangaranan Watershed

Land Use

The Cangaranan river watershed has considerable forest lands which account for approximately 14,470.30 ha. or about 52% of the total watershed. The foodcrop areas, mainly rice, represent a total land area of about 2,293.80 ha. where 58% is primarily dependent on the actual rainfall. The grasslands covering a total area of 5,379.4 ha., are generally idle. With proper technology, these areas can be developed for selected agroforestry based livelihood activities.

The Land Management Units and Pedo-Ecological Zones

The pedo-ecological zone is composed of physical units (LMUs) and each zone has environmental properties (slope, temperature, and elevation) that are important in the transfer of technology packages from one soil environment to the other.

About 69% of the watershed is located in the highland where the environmental condition is favorable for the production of high value crops such as vegetables and fruit crops. The hillyland, or areas with steep slopes occupy an area of about 23.5% of the total watershed.

Slope

Significant areas of the watershed have sloping lands which can be best used for agroforestry and forest-based land use systems. About 83% of the watershed have slopes exceeding 18%, the DENR's slope category for lands identified under public domain or forest lands.

Erosion

About 49.4% of the total lands in the watershed have moderate to severe erosion problems. However, some areas in the watershed have slight erosion problems but are susceptible to soil mass movement (4.7%).

Land Limitations

The physical limitations of the watershed range from steep slopes, soil erosion to flooding and to soil mass movement. Flooding problems occupy a land area of about 14.2% of the total land area of the watershed. The most prominent problems (17,221.78 ha.) are situated in areas with very steep slopes and have soils that suffer from mass movement during heavy and prolonged rains.

Proposed Land Use and Development Zoning

Because of the nature of the terrain of the watershed, the most promising and the most extensive areas are those that have the capability to support community-based forest productivity enhancement and development (17,409 ha. or 62.2% of the total area). In lowland areas where agricultural potential is high, intensive agricultural development (2,522.6 ha.) is recommended. The agroforestry schemes occupy an area of about 4,861 ha., or about 17% of the watershed area.

Table 8. Land Use (Cangaranan River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	Paddy-rice irrigated	958.01	3.42
2	Trees	4,349.41	15.54
3	Primary Forest	8,550.06	30.56
4	Secondary Forest	5,920.17	21.16
5	Grassland	5,379.44	19.23
6	River	574.06	2.05
7	Rainfed rice	1,335.83	4.77
8	Coconut	552.57	1.98
9	Bamboo	332.59	1.19
10	Built-up areas/urban lands	21.47	0.08
	T O T A L	27,973.61	100.00

Table 9. Land Management Unit (Cangaranan River Watershed)

PEZ	LMU	DESCRIPTION	AREA (Ha)	PERCENT (%)
Lowland < 100 m. elevation < 8 % slope, 725 C	12	Lower River Terraces	1,701.21	6.08
	18	Collu-Alluvial Fans	1,643.83	5.88
	19	Narrow Alluvial Plains (Width < 500 m.)	261.13	0.93
Upland < 100 m. elevation, 8-18 % slope, > 25 C or 100-500 m. elevation, < 18 % slope, 22.5 - 25 C	66	Low Limestone Hills	60.27	0.22
	76	Low Shale/Sandstone Hills	4,463.87	15.96
Hillyland < 500 m. elevation, > 18 % slope, 722.5 C	111	High Meta-Sedimentary Hills	64.53	0.23
				23.25
Highland > 500 m. elevation, < 22.5 C, regardless of slope	159	High Meta-Sedimentary Mountains	6,503.54	23.25
	160	Low Meta-Volcanic Mountains	318.70	1.14
	168	Complex Volcanic Mountains	12,198.04	43.60
Miscellaneous	180	Built-up Areas/Urban Lands	21.47	0.08
	186	Riverwash	737.02	2.63
		T O T A L	27,973.61	100.00

Table 10. Slope Classification
(Cangaranan River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	0-3% Level to nearly level	1,944.20	6.95
2	3-8% Gently sloping to undulating	731.94	2.62
3	8-18% Undulating to rolling	2,169.97	7.75
4	18-30% Rolling to moderately steep	4,050.71	14.48
5	30-50% Steep	9,620.64	34.39
6	> 50% Very steep	9,456.15	33.80
	T O T A L	27,973.61	100.00

Table 11. Erosion Classification (Cangaranan River Watershed)

	DESCRIPTION	Remarks	AREA (Ha)	PERCENT (%)
1	None to slight	0-3% slope under any land use 3-8% slope under grassland 3-8% slope under tree crops 8-50% slope under forest	1,955.40	6.99
2	Moderate erosion	8-18% slope under grassland	969.05	3.46
3	Moderate to severe	8-18% slope used for annual crops	9,747.12	34.84
4	Slight erosion	0-3% slope under annual crops 3-8% slope under paddy rice 3-8% slope under tree crops 18-50% slope under secondary and primary forest	9,114.42	32.58
5	Severe erosion	18-50% slope under grassland	2.760.09	9.87
6	Slight erosion but with high mass movement hazard	Above 50% slope under grassland	2,125.29	7.59
7	Severe erosion with high mass movement hazard	Above 50% slope under grassland	1,302.24	4.66
		T O T A L	27,973.61	100.00

Table 12. Land Limitation (Cangaranan River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
	Flooding		
1	Slight run-off flooding	263.88	0.94
2	Slight to moderate	276.95	0.99
3	Moderate to severe	3,435.41	12.28
	Shallow stony soil		
6	Shallow and stony	166.64	0.46
	Shallow soils/Steep slope/Erosion		
10	Moderately shallow, slight to moderate erosion	1,964.88	7.02
11	Moderately shallow, moderate erosion	1,602.71	5.73
	Steep slope/Erosion		
16	Steep slope, moderate erosion hazard	1964.88	7.02
17	Very steep slope, severe erosion	1602.71	5.73
	Very steep slope/Mass movement susceptibility		
21	Steep slope, susceptible to mass movement	2244.62	8.02
22	Very steep slope, susceptible to mass movement	17221.78	61.56
	Drought		
26	Droughty	608.50	2.18
	T O T A L	27,973.61	100.00

Table 13. Proposed Land Use (Cangaranan River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	Intensive agricultural development	2,522.59	9.01
2	Upland agricultural development	357.11	1.28
3	Multi-storey cropping	795.40	2.84
4	Coconut-livestock development	406.08	1.45
5	Crops-livestock development	746.66	2.67
6	Agroforestry	4,681.39	16.73
7	Fuelwood production/development	296.71	1.06
8	Community-based forest productivity enhancement /development	17,409.18	62.23
999	Built-up area/urban lands	21.47	0.08
888	Riverwash	737.02	2.63
	T O T A L	27,973.61	100.00
	Declared as forest land (Public land)	16,366.62	

Table 14. Land Suitability (Cangaranan River Watershed)

	CROPPING SYSTEM	AREA (Ha)	PERCENT (%)
1	Rice-based cropping system	1,863.22	6.66
2	Corn-based cropping system	2,030.73	7.26
3	Annuals (corn vegetables)	402.93	1.44
4	Annual food crops with livestock, tree crops	1,244.40	4.45
5	Agroforestry	3,128.22	11.18
6	Fruit trees, fuelwood	1,602.71	5.73
7	IPAS	16,942.91	60.57
	Built-up areas/Urban lands	21.47	0.08
	Riverwash	737.02	2.63
	T O T A L	27,973.61	100.00

3.1.3 Tibiao River Watershed

Land use

About 54% of the watershed is covered by forest trees of various commercial uses. The irrigated ricelands occupy about 2,925 ha. and the areas grown to mixed tree crops are about 2,796 hectares. The less utilized lands, mainly grown to native grasses, occupy about 11% of the total watershed area.

Land Management Units and Pedo-Ecological Zones

Significant lands in the watershed can be devoted to the production of fuelwood (8,830.80 ha.). The agroforestry and community-based production forest and development have a combined area of 2,935 hectares. The areas that can be devoted to agricultural activities occupy about 34% of the total watershed.

Slope

About 61% of the watershed are too steep (more than 18% slope) to allow intensive use for agriculture. These areas are classified public lands or areas that are supposedly covered by forest trees. The level lands (0-8% slopes) represent a total area of about 23.6% of the watershed.

Erosion

The erosion problems in the watershed are significant: about 10,437.40 ha., or 57% of the watershed suffers from moderate to severe erosion. Unlike the other watersheds in the project, the areas with problems of soil mass movement represent only 842.6 ha. or approximately 4.6% of the watershed area.

Land Limitations

The most outstanding limitation noted is the combined problem of steep slope, shallow soils, and soil erosion which accounts for about 50.5% of the watershed. The lowland areas which are prone to flooding occupy about 23% of the total area of the watershed.

Proposed Land Use and Development Zoning

The upland farming system dominates the land use appropriate for the watershed. About 8% are suitable for agroforestry, 48% for fuelwood production, and 8% for community-led development of forest lands. The areas that are proposed for intensive agricultural development is about 17 percent. The marginal coconut lands that can be transformed into a multi-storey cropping and integrated coconut-livestock development has an aggregate total of 15.5% or a total of 2,176.40 hectares.

Table 15. Land Use (Tibiao River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	Paddy-rice irrigated	2,925.39	15.94
2	Trees	2,796.93	15.24
3	Primary Forest	3,640.93	19.83
4	Secondary Forest	6,327.47	34.50
5	Grassland	2,024.49	11.03
6	River	636.41	3.47
	T O T A L	18,351.62	100.00

Table 16. Land Management Unit (Tibiao River Watershed)

PEZ	LMU	DESCRIPTION	AREA (Ha)	PERCENT (%)
Lowland < 100 m. elevation, < 8 % slope, 725 C	09	Broad Alluvial Plains (Width > 500 m.)	840.72	4.58
	17	Inland/Stream/Enclosed Valleys	76.10	0.41
	18	Collu-Alluvial Fans	7,349.67	40.05
	19	Narrow Alluvial Plains (Width < 500 m.)	419.92	2.29
Upland < 100 m. elevation, 8-18 % slope, > 25 C or 100-500 m. elevation, < 18 % slope, 22.5 - 25 C	66	Low Limestone Hills	37.53	0.20
	76	Low Shale/Sandstone Hills	2,048.77	11.16
	79	Low Basaltic Hills	795.52	4.33
Hillyland < 500 m. elevation, > 18 % slope, 722.5 C	112	High Shale/Sandstone Hills	1,192.56	6.50
	115	High Basaltic Hills	1,836.99	10.01
Highland > 500 m. elevation, < 22.5 C, regardless of slope	159	High Meta-Sedimentary Mountains	3,411.23	18.59
	168	Complex Volcanic Mountains	9.24	0.05
Miscellaneous	180	Built-up Areas/Urban Lands	102.76	0.56
	186	Riverwash	230.61	1.26
		T O T A L	18,351.62	100.00

Table 17. Slope Classification (Tibiao River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
1	0-3% Level to nearly level	3,868.63	21.08
2	3-8% Gently sloping to undulating	453.77	2.47
3	8-18% Undulating to rolling	2,445.13	13.32
4	18-30% Rolling to moderately-steep	3.247.31	17.69
5	30-50% Steep	4,870.91	26.54
6	> 50% Very steep	3,465.87	18.88
	T O T A L	18,351.62	100.00

Table 18. Erosion Classification (Tibiao River Watershed)

DESCRIPTION	Remarks	AREA (Ha)
1 None to slight	0-3% slope under any land use 3-8% slope under grassland 3-8% slope under tree crops 8-50% slope under forest	3,916.73
2 Moderate erosion	8-18% slope used for annual crops	375.89
3 Moderate to severe	8-18% slope used for annual crops	8,968.11
4 Slight erosion	3-8% slope under annual crops 3-8% slope under paddy-rice 8-18% slope under tree crops 18-50% slope under secondary and primary forest	3,387.90
5 Severe erosion	18-50% slope under grassland	860.34
6 Slight erosion but with high mass movement hazard	Above 50% slope under forest	604.42
7 Severe erosion with high mass movement hazard	Above 50% slope under grassland	238.23
	T O T A L	18,351.62

Table 19. Land Limitation (Tibiao River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
	Flooding		
1	Slight run-off flooding	307.51	1.67
2	Slight to moderate flooding	76.10	0.41
3	Moderate to severe flooding	3,551.55	19.35
4	Severe river flooding	230.62	1.26
	Shallow stony soil		
6	Shallow and stony	25.09	0.14
7	Shallow and very stony	14.42	0.08
	Shallow soils/Steep slope/Erosion		
10	Moderately shallow, slight to moderate erosion	269.84	1.47
11	Moderately shallow, moderate erosion	4,616.23	25.15
12	Shallow soils, very steep slope, severe erosion	4,367.79	23.80
	Steep slope/Erosion		
16	Steep slope, moderate erosion hazard	740.27	4.03
17	Very steep slope, severe erosion	744.15	4.05
	Very steep slope/Mass movement susceptibility		
21	Steep slope, susceptible to mass movement	83.78	0.46
22	Very steep slope, susceptible to mass movement	3,324.27	18.11
	T O T A L	18,351.62	100.00

Table 20. Proposed Land Use (Tibiao River Watershed)

	DESCRIPTION	AREA (Ha)	PERCENT (%)
.	Intensive agricultural development	3,075.37	16.76
2	Upland agricultural development	361.30	1.97
3	Multi-storey cropping	1,302.12	7.10
4	Coconut-livestock development	315.50	1.71
5	Crops-livestock development	1,197.84	6.53
6	Agroforestry	1,440.41	7.85
7	Fuelwood production/development	8,830.79	48.12
8	Community-based forest productivity enhancement /development	1,494.92	8.15
999	Built-up areas/urban lands	102.76	0.56
888	Riverwash	230.61	1.25
	T O T A L	18,351.62	100.00

Table 21. Land Suitability (Tibiao River Watershed)

	CROPPING SYSTEM	AREA (Ha)	PERCENT (%)
1	Rice-based cropping system	4,446.07	24.23
2	Corn-based cropping system	116.41	0.63
3	Annuals (corn, vegetables)	330.49	1.80
4	Annual food crops with livestock, tree crops	1,815.37	9.89
5	Agroforestry	3,998.76	21.79
6	Fruit trees, fuelwood	2,190.45	11.94
7	IPAS	5,120.70	27.90
	Built-up areas/Urban lands	102.76	0.56
	Riverwash	230.61	1.26
	T O T A L	18,351.62	100.00

4.0 PHASE 2 - DEVELOPMENT INTERVENTIONS

4.1 General Framework for Project Intervention

Figure 2 illustrates the step-wise process that will generally define project interventions within the context of sustainable development of the various land areas of the project. The framework can be summarized as follows:

a. Definition of the over-all goals and objectives which take into primary consideration the rational interaction between the farmers and their respective farms in the watershed. The fundamental relationship between land tenure and farm productivity in turn influence the pattern of labor utilization in the uplands.

   On the other hand, the upland areas and their general ecology consider the merits of understanding the farm location in the watershed in order to adequately formulate site-specific development interventions that are friendly to the watershed environment.

b. The micro-watershed[1/] will act as the central resource unit for planning site-specific farm development interventions as well as in the integration of soil conservation strategies for the various parts of the watershed.

c. The segregation of the alienable/disposable lands from public lands is given the proper focus in order to properly package cost-effective and environment-friendly interventions that can be implemented by the farmers themselves or by the joint effort of the communities in the watershed. The public lands are further disaggregated into settled or occupied uplands and abandoned uplands and forest lands. The former type will possibly require an individual farmer-approach similar to the interventions for the A/D lands. However, the abandoned uplands and forest lands are areas where the communities can be mobilized to effect a people's approach for the effective and timely rehabilitation of the watershed.

1/ The microwatershed is the gully area and its periphery tilled or occupied or tilled by one or an aggregate of three farmers. It is assumed here that the gully is a simple segment of the river system and thus the most appropriate unit area to address environmental and upland poverty problems.

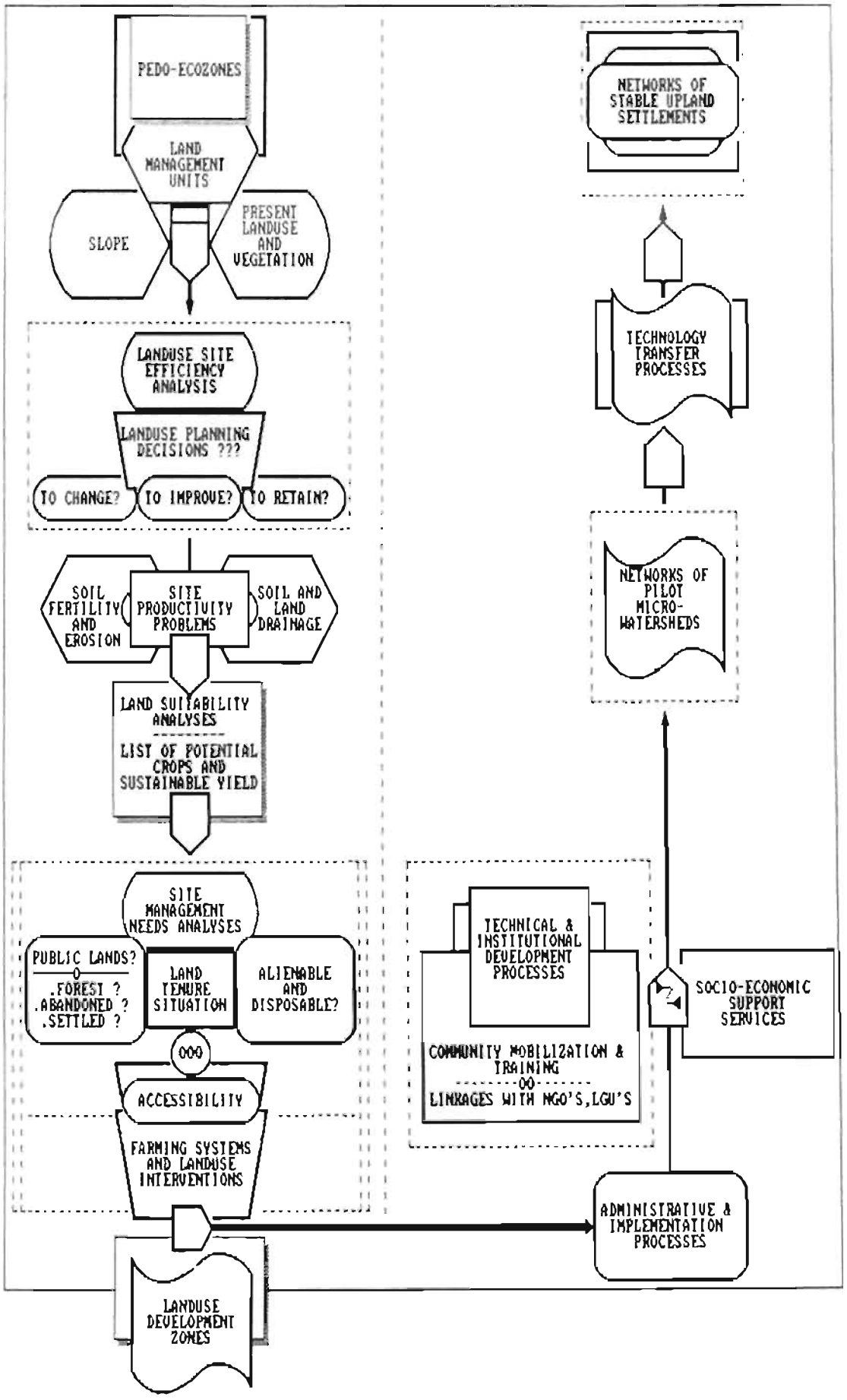


FIGURE 2
A FRAMEWORK FOR
WATERSHED DEVELOPMENT INTERVENTIONS
AND PHYSICAL PLANNING PROCESSES

d. The presence of the "dagyaw" system in the site provides the fundamental basis for the adoption of on-farm sustainable development projects in the alienable and disposable lands as well as in public lands that are already settled and occupied by the upland dwellers. The degree of success in implementing the "dagyaw" in setting up the sustainable farming systems in the settled portions of the watershed will directly measure the potential use of and the effectiveness of the community in undertaking rehabilitation of the abandoned uplands and public lands.

Strategies for clearly abandoned and degraded public lands are directed towards a community effort which shall provide a clear objective for the timely rehabilitation and enhancement of the upland ecosystem.

e. The penultimate task is to develop within the watershed a "network of stable agroforestry farms" for those within the A/D and settled public lands as well as that of a "network of communal forestry development and livelihood projects" which are located in the abandoned uplands and forest lands.

f. The formulation of project interventions consider the interphase between the community and the land tenure situation on one hand and the biophysical resources on the other. However, the tenurial situation of each and every farmer and their location remain the most undefined parameter. Site verification and the review of the official records in the locality indicated the practical difficulties in generating these information relative to the physical planning required for the areas of concentration.

g. Technical interventions that are appropriate for the various areas of concentration are already assessed and are now reflected in map forms in the Proposed Land Use and Zoning Map. The summary of the interventions for each area of concentration are shown in the attached tabulated intervention matrix.

h. Central to the formulation of site interventions is the consultation with the farmers in representative sites especially in the types of crops, land use systems, and the existing tenurial arrangement in pilot sites. This particular phase will be preceded with a shopping list of potential crops that are suitable in the area.

4.2 Spatially Defined Land Use Interventions

Factors Considered

a. Legal Land Classification - The DENR provided the land classification maps for the Areas of Concentration which defined the location of alienable and disposable and public or forest lands. This information is used as the reference for the tenurial situation of the farmers in the project and

therefore provided the "answer" on the access to land issues.

b. Existing Land uses and Vegetation Cover - this information provides the reference on the local land use preferences, existing/indigenous/endogenous crop technologies, as well as the general climatic conditions of the area.

c. Slope - This information provides the reference on the land use allocation schemes of the farmers and provides the initial indication as to the efficiency of the existing uses in relation to the physical conditions of the site.

General Assumptions

1. Maximum Production - the maximum production in the upland is defined in terms of the requirement for long term sustainability and in accordance with the general production capacity of the upland giving due consideration to the following:

   a. The uplands have been subjected to land degradation and upland crop productivity constantly decline.

   This means that even with the best seeds and planting materials, the agronomic yield levels will be comparatively lower than what the lowland farms could produce for the simple reason that the soils have lower organic matter and the top soils are either totally lost or are of insignificant depth to initiate high production. Any attempt to attain maximum agronomic production would entail high input usage which is unacceptable to the farmers from the economic standpoint and can cause serious pollution problems to the nearby river systems (both in the upland and lowland farms) from the environmental perspective.

   b. An attempt to maximize agronomic production in the upland portions of the watershed in the long term will result in serious environmental problems and is therefore non-sustainable. This will mean that the farmers will be highly market-oriented which will require heavy infrastructure support such as roads. Such development would mean heavy traffic going in and out of the uplands which will consequently lead to very serious road erosion problems and will further accelerate encroachment/settlement and urbanization due to its favorable climate.

2. Attainable Production - The production in the uplands is expected to follow a time-trend build up which reflect the success in the soil rehabilitation technologies that will be promoted in the uplands. Thus, the "time - optimum" yields that maybe expected in the uplands are:

a. 1st year - 50 percent of the maximum yields;
b. 2nd year - 55 percent of the maximum yields;
c. 3rd year - 65 percent of the maximum yields;
d. 4th year - 70 percent of the maximum yields; and
e. 5th year and onwards - 80 percent of the maximum yields;

This yield trends follow the yearly improvement and stabilization of the soils in the farms. During the first year of development, the existing state of soil erosion in the farm will limit crop yields. Assuming that required soil conservation practices are in place, then as soil stabilizes over time, crop yields are expected to improve correspondingly.

4.3 Basic Site Development Requirements

a. In order to ensure and protect the ecological integrity of the upland environment, the main thrust of the project is to provide significant emphasis on organic farming. The proposed time-phased development of organic farming in the area are as follows:

Year of Implementation	Amount (kg/ha.) Organic fertilizer	Urea
Year 1	500	150
Year 2	700	125
Year 3	1000	100
Year 4	1250	75
Year 5	1500	50

b. The upland farms will be divided into production blocks for food crops, fruit trees, and forest trees/fuelwood. Each production block is a contour strip of 5 meters wide and 100 meters long (500 sqm) or a total of 20 production blocks in each hectare of farm lands (one hectare farm is 100 m by 100 m). The length of the strip may vary depending on the configuration of the farm. This block arrangement is suggested in favor of the mixed planting based on the following reasons:

1) It promotes easier land preparation and farm administration since the harvesting of crops is facilitated, (mixed planting in a site will mean harvesting schedules of crops in one site may not fall on the same period such that damages on the standing crops are expected while harvesting the other crops).

2) It conforms with the scheme known to the farmers themselves.

3) It promotes the "best use allocation principle" and more importantly, it renders the portions of the farms that are best suited to food crops available to farmer all the time and at the same time ensure that the critical portions are devoted to perennials (fruits and forest trees) less disturbed by the recurrent tillage requirements of food and vegetable crops.

4) It promotes biological diversity across the farms and microwatershed while at the same time encouraging site specialization which provides better technology focus in the farm.

c. The "dagyaw" system will be harnessed through the combined efforts of the extension technicians and the NGO's as well as the LGU's especially in the promotion of the micro-watershed as the planning and development unit in the project. The success of the "dagyaw" system can be the useful measure of the potential use of the community in the protection and rehabilitation of the upland watershed resources.

d. The Integrated Pest Management (IPM) approach will be the major instrument in the control of pests and diseases in the upland in order to reduce their dependence on chemical inputs which are hazardous to human health and the ecology.

4.4 Basic Principles and Philosophies

The flow chart which provides the integrated algorithm for technical resources mapping with the physical planning processes (Figure 1) and the matrix for the resource management intervention matrix (Figure 3) stresses the requirement to consider any need for the changes in the actual land uses and farming systems in the ANIAD areas of concentration. The algorithm defines the attainment of sustainable physical structures by providing directions in handling three basic land use optimization issues to wit:

a. to alter and develop new sets of land uses:
b. to retain the present and accept that the present productivity is adequate, and
c. to improve the existing ones by the introduction of new sets of land uses or to provide new technologies.

The matrix for the resource management interventions provide a proactive role in defining interventions specific to optimality of land uses considering slope as the most limiting land factor. This approach strongly advocates physical compatibility of existing uses and farming systems with the local environment, thus, putting into focus the integration of environment with development.

FIGURE 3

FRAMEWORK FOR RESOURCE MANAGEMENT INTERVENTIONS

PRESENT LAND USE	SLOPE CONDITIONS (PERCENT)				
	0 - 8	8 - 18	18 - 30	30 - 50	>50
Annuals Perennials Fruit Crops	Integrated/ Intensive Agricultural Development	Upland Agricultural Development (Integrated Crop- Livestock Development)	Agro-Forestry Module 1 30% - Food 50% - Fruit 20% - Forest	Agro-Forestry Module 2 10% - Food 20% - Fruit 50% - Forest	Agro-Forestry Module 3 20% - Food 30% - Fruit 50% - Forest
Coconuts	Multi-storey Cropping ----- Coco-Livestock Pasture Development	Multi-storey Cropping ----- Coco-Livestock Pasture Development	Agro-Forestry Module 4 Coconut- Livestock based Agro-For. System	Agro-Forestry Module 4 Coconut- Livestock based Agro-For. System	Agro-Forestry Module 4 Coconut- Livestock based Agro-For. System
Grassland with Agricultural/ Settled areas/ (mixed fruit trees)	Integrated/ Intensive Agricultural Development	Agri-Livestock Development	Agro-Forestry Module 1 30% - Food 50% - Fruit 20% - Forest	Agro-Forestry Module 2 30% - Food 20% - Fruit 50% - Forest	Community-based Agro-Refor. 30% - Fruit 70% - Forest
Abandoned and Idle grasslands (abandoned/idle lands)	Agri-Livestock Development	Agri-Livestock Development	Community-based Refo-Fuelwood Development	Community-based Forestation Development	Community-based Forestation Development
Shrubland with Agricultural/ Settled areas/ (mixed fruit trees)	Integrated/ Intensive Agricultural Development	Agri-Livestock Development	Agro-Forestry Module 1 30% - Food 50% - Fruit 20% - Forest	Agro-Forestry Module 2 30% - Food 20% - Fruit 50% - Forest	Community-based Forestation Development
Abandoned and Idle shrublands (abandoned/idle lands)	Agri-Livestock Development	Agri-Livestock Development	Community-based Refo-Fuelwood Development	Community-based Refo-Fuelwood Development	Community-based Refo-Fuelwood Development
Forest lands with agriculture (settled areas)	Community-based Refo-Fuelwood Development	Community-based Refo-Fuelwood Development	Community-based Refo-Fuelwood Development	Community-based Refo-Fuelwood Development	Community-based Forestation Development
Forest lands (No settlement)	Community-based Fuelwood Production Development	Community-based Fuelwood Production Development	Community-based For. Productivity Enhancement- Development	Community-based For. Productivity Enhancement- Development	Community-based For. Productivity Enhancement- Development

In effect the entire philosophy adopted in the study is the acceptance that the entire planning exercise will lead to develop strongly the integration and the congruency of the technical decisions of the professional planners with that of the farm planner-implementors, the farmers themselves.

The physical planning interventions provide the central basis for the development of networks of microwatershed development as opposed to a contiguous pattern of watershed exploitation. The microwatershed network development pattern is sustainable since it optimizes the existence and use of the "dagyaw" system of cooperative farm development. In addition and of equal importance is that the microwatershed approach ultimately stabilizes the gullyheads of the main river systems while at the same time providing for the production of food and cash needs of the upland farmers. On the other hand, the continuous pattern of upland resource exploitation degrades the uplands since many traditional upland uses (which is a lowland-borrowed use) and the production objectives of the upland farmers will not conform to the complex and varied landscape conditions in the different segments of the watershed.

4.5 Problems/Issues and Opportunities in the Physical Planning of the Project Areas

The physical planning of the three areas of concentration are directly influenced by the physical (environmental) problems related to inefficient land uses. This in turn provides insight into the intricate correlation between the historical farming practices and production objectives of the farmers - to ensure their basic needs - and the direct effects of these efforts on the physical conditions of the land.

Problems and Issues

a. Underutilization and the declining productivity of the alluvial lands, particularly that of the unterraced gently sloping alluvial farmlands;

b. Land degradation of the uplands;

c. Low productivity and disorganized planting of perennial crops;

d. Existence of marginal coconut lands;

e. Expansion of underutilized and highly degraded grasslands and shrublands;

f. Agricultural encroachment in the sloping "Public or Forest Lands"; and

g. Poor forest protection and management and the apparent lack of community participation in the judicious use of the forest resources.

Opportunities

a. utilization and transformation of upland family into productive labor force in the rehabilitation of the upland.

b. the physical planning of the watershed widens the options for sustainable development and environmental integration.

c. creation of critical mass of economic-cum-environmental activities through a network of microwatershed development.

d. opportunity to tap and conserve the productive highlands for high value upland products.

e. development of sustainable upland farming systems which will result in the formation of stable upland communities.

4.6 Land Tenure Status and Development Intervention

The Sibalom watershed is predominantly public/forest lands. Based on the DENR land classification map, the total alienable and disposable lands represent only about 859.8 ha. and 250.7 ha. for the Sibalom and Cangaranan watershed, respectively. Table 22 below shows the distribution of the proposed project interventions within the A/D lands.

Table 22. Alienable and disposable lands and the proposed physical land use planning interventions in the ANIAD Areas of Concentration

Interventions	Extent (ha.) Sibalom	Cangaranan	Tibiao
1. Intensive Agricultural Development	19.1	6.2	0
2. Multi-Storey Cropping	43.5	8.4	0
3. Crops-Livestock Dev.	28.8	0	0
4. Agroforestry Dev.	108.5	18.6	0
5. Fuelwood Prod./Dev.	75.0	0	0
6. Community-based Forest Protection/Productivity Enhancement/Development	584.9	217.4	0

Land tenure affects the implementation of projects in the watershed. For instance, in A/D lands, it is clear that the individual farmer approach is necessary since they are farming privately owned lands. On the other hand, in public lands where security of

tenure is a critical issue, the community-based approach is found to be more acceptable and more successful in the attainment of short- and long-term objectives of development. However, in public lands where the area is already farmed and settled, the individual approach is found to be more appropriate.

4.7 Potential Agricultural Crops and Forestry Species

The list of agricultural crops and forestry species (see Annex B) are identified and included in the physical land use intervention. The list specifically identifies crops and forest trees that are appropriate for the lowland and highland conditions. The factors considered in distinguishing the lowlands from the highlands are climate and elevation. Highlands are located in elevations of 500 meters asl or higher. The lowland areas, on the other hand, are located in elevations 0-500 meters asl. The temperature in the highland is about <= 22.5 degree C, while that of the lowlands the temperature is warm (>=25 degree C).

The planting calendars for the different intervention schemes are shown in Figures 5-7. The three areas of concentration have almost similar climate setting and the changes in the choice of crops are directly related to the elevation of the site in the watershed.

4.8 Intervention Schemes Proposed For The Identified Problems on Land use and Farming Systems

The land use intervention schemes (Table 23) were formulated using the resource management intervention matrix. Each of these schemes are identified and their spatial distribution are shown in the computer-generated Land Use and Zoning Map provided for in this study.

The Antique Strategic Upland Study provided comprehensive analyses of the various implementation strategies of broad range of interventions with a well specified examples of potential cropping systems that maybe adopted in the concentration areas of ANIAD. On the other hand, this study provided significant focus on the identification of specific locations in the watershed with significant physical development problems that required immediate attention from the planners and management of ANIAD project.

The areas that may provide the sources of growth in the watershed project sites are defined and situated in the Proposed Land Use and Zoning Map. In this regard, this study added from the Antique Strategic Upland Study the importance of delineating the upland areas where Highland Agroforestation/Agricultural development can be promoted as the additional source of economic-cum-environment development for the project.

Table 23. Zonal Interventions for the ANIAD Areas of Concentration

Zonal Interventions	AREAS OF CONCENTRATION (HECTARES)					
	Balom		Cangaranan		Tibiao	
	Lowland	Highland	Lowland	Highland	Lowland	Highla
1. Intensive Agricultural Development	5,514.74	0.00	2,402.65	0.00	3,041.55	0.
a. Enhancement of Paddy-Rice Based System	2,374.00	0.00	858.65	0.00	2,533.41	0.
b. Enhancement of Rainfed rice-based systems	2,235.56	0.00	1,116.23	0.00	0.00	0.
c. Development of Grasslands	911.41	0.00	428.10	0.00	508.14	0.
d. Others (sugarcane, cutflowers)	393.74	0.00	0.00			
2. Upland Agricultural Development	321.92	0.00	348.59	0.00	352.55	7.
a. Enhancement of Paddy-Rice Based System	0.00	0.00	0.00			7.
b. Enhancement/development of Terrace Rainfed Rice	321.92	0.00	348.59	0.00	352.55	0.
3. Multi-Storey Cropping	3,407.74	0.00	573.34	0.00	1,301.92	0
a. Coconut-Based	2,427.28	0.00	87.37	0.00	0.00	0
b. Mixed Tree	560.25	0.00	380.19	0.00	1,301.92	0
c. Bamboo	420.21	0.00	105.78	0.00	0.00	0
4. Coconut-Livestock Development	401.43	0.00	279.19	0.00	0.00	0
5. Crops-Livestock Development	3,245.03	0.00	558.92	0.00	314.11	1
a. Grasslands	2,452.16	0.00	558.92	0.00	314.11	1
b. Pasture lands	792.87	0.00	0.00	0.00	0.00	0
6. Highland Agricultural Development						
a. Highland Vegetables and Cut-flowers Prod. and Dev.	0.00	1,392.41	0.00	127.91	0.00	0
b. Highland Fruit Crops and Other Orchards Dev.	0.00	5,179.49	0.00	860.97	0.00	0
7. Agro-Forestry Development	2,479.50	0.00	1,886.42	0.00	1,190.98	6
a. Grasslands	2,479.50	0.00	1,886.42	0.00	1,190.98	6
8. Highland Agro-Forestry Development	0.00	11,893.67	0.00	2,794.58	0.00	0
9. Fuelwood Production/Development	558.62	3,144.47	38.58	258.14	1,425.91	7
a. Old Growth Forest	81.39	1,242.81	14.53	148.06	90.00	5
b. Secondary Growth Forest	477.23	1,901.66	24.05	110.08	1,335.91	2
10. Community-Based Forest Productivity Enhancement/Development/Protection	1,959.98	23,009.73	2,300.72	17,040.34	6,604.26	3,30
a. Old Growth Forest	310.18	9,321.31	116.59	8,753.86	1,805.27	2,01
b. Secondary Growth Forest	1,063.68	11,350.75	726.85	6,038.00	3,696.75	1,33
c. Mixed Trees	444.16	2,337.67	1,335.43	2,165.04	1,468.67	2
d. Bamboo	141.96	0.00	121.75	83.44	0.00	

The zonal interventions and the corresponding area estimate for each of the ANIAD areas of concentration are shown in Table 23. The following discussions described the important aspects of the proposed interventions for each problem defined in specific locations in the watershed.

5.0 DEVELOPMENT AND MANAGEMENT OF THE SIBALOM AND CANGARANAN WATERSHEDS

The Sibalom (62,964.6 ha.) and the Cangaranan watershed (27,973.6 ha.) show relatively similar physical planning problems. Based on the analyses of the physical resource situation and the identified critical land development issues/problems, the following physical planning interventions are discussed and their locations are presented in the Land Use and Zoning maps prepared individually for the Sibalom, Tibiao and Cangaranan watersheds.

5.1 Intensive Agricultural Development

The areas included in this intervention are irrigated ricelands, underutilized and degraded idle grasslands as well as alluvial unterraced rainfed farmlands that are suffering from declining productivity.

The Sibalom watershed has about 6,407.5 ha. and 2,012.8 ha. with slopes of 0-3% and 3-8%, respectively. These areas are mainly grown to wetland rice, 3,400.5 ha. are with irrigation facilities, and 2,665 ha. depend on rainfall for its water supply. The suitability analyses however, showed that only about 1,962 ha. or about 58% of the existing paddy fields are highly suitable for rice-based cropping systems and about 5,095 ha. for corn-based cropping systems. This indicates some problems on water supply in the irrigated fields during the dry season cropping periods. Soils data showed that the water holding capacity of the lowland soils are low to medium which means a relatively moderate to high water requirement problem.

The alluvial lands in the Cangaranan watershed is about 9.6% (1,944 ha. for 0-3% slopes and 732 ha. for 3-8% slopes). These lands have about 958 ha. for irrigated paddy rice and about 1,336 ha. of rainfed rice crops. The suitability study shows that about 1,863 ha. and 2,031 ha. in the Cangaranan watershed are highly suitable for the production of irrigated paddy rice and rainfed paddy rice, respectively. In similar manner, the main limitation of the area is the availability of adequate water to sustain year-round production of rice and other food crops.

The Sibalom watershed has about 6,824 ha. or 11% while the Cangaranan watershed has about 2,523 ha. that can be used for intensive agricultural development. This scheme covers the highly utilized level alluvial lands which have a general slope of 0 - 8 percent. These areas are the prime lands for the reliable production of a wide variety of food and vegetable crops. However, in the more economically improved locations, these are the agricultural lands that are most likely to be converted to non-agricultural uses.

This intervention focused mainly on the improvement of the farming systems which will emphasize inclusion of a wide range of crops that can effectively use the residual moisture from the soil. On the basis of the actual land use in the watershed, three specific intervention schemes are proposed as follows:

a. Enhancement of Paddy Rice-based Cropping Systems

These are existing irrigated lowland areas within the 0-8% slopes. In general, these areas are planted to rice during the wet season which normally start in the month of May although in some years rain may start in April.

The cropping patterns shown in Figure 4 illustrates a wide range of cropping mixes possible for the project. Because of critical moisture conditions during the months of January to April, the early maturing, high value vegetable crops can be included in the pattern to make use of the residual moisture during these periods.

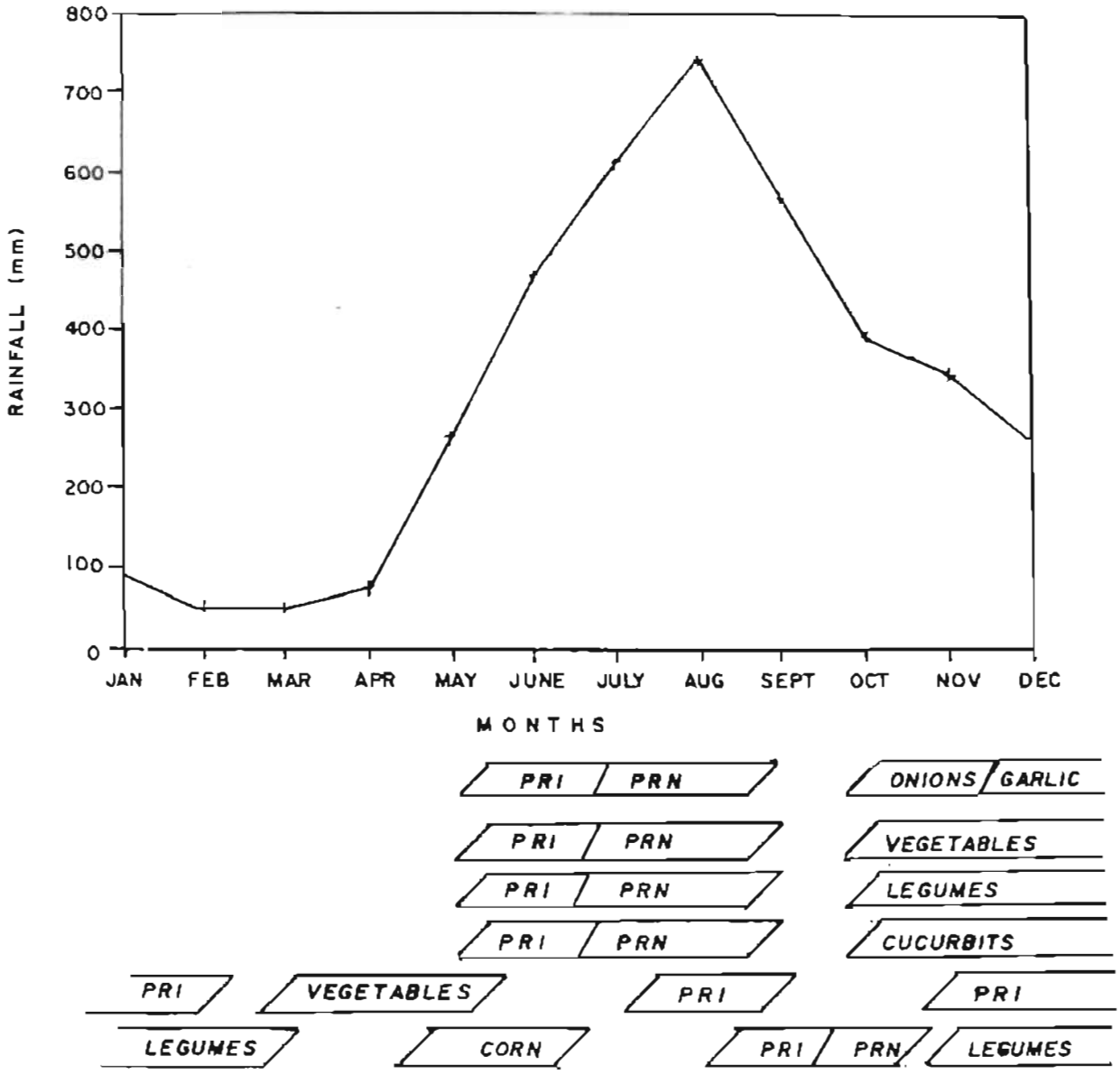
b. Enhancement of the Rainfed Rice-based Cropping systems

These are terraced rice areas within the 0-8% slopes that are dependent on rainfall for their moisture supply. In most instances, the second crops suffer from lack of moisture especially when grown to rice. Figure 4 likewise illustrates the crop mixes and crop calendar for the rainfed rice-based cropping system. The crops identified for the lowland are similarly suitable for the rainfed rice-based system.

c. Development of Grasslands

These are alluvial lands with 0-8% slopes with relatively shallow and acid soils that are now covered by native grasses, mainly cogon. These areas can be developed into either rainfed fields or irrigated where water is available or could be tapped. The cropping patterns for the abovementioned rainfed rice-based systems can be adopted.

RAINFALL. AND CROPPING PATTERN, ANTIQUE



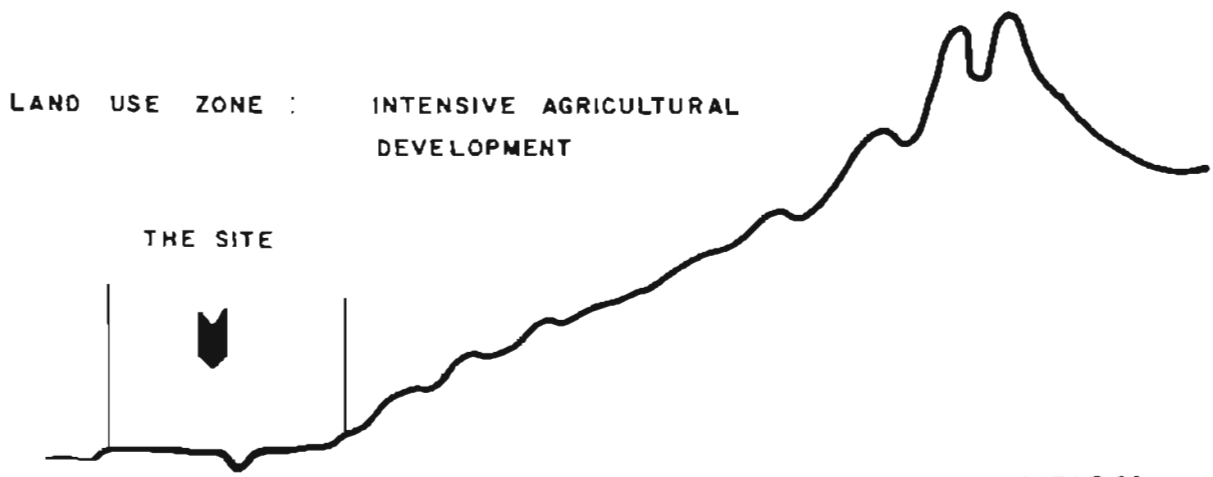


FIGURE 4 **LANDSCAPE SCHEMATIC CROSS SECTION**

5.2 Upland Agricultural Development

These areas include the slightly elevated sloping and degraded lands. These are seasonally fallowed rain-dependent lands with slopes 8-18% and are adjacent to and with elevations higher than the service areas of presently irrigated and rainfed rice fields. In some places, some of these areas are randomly developed into small parcels and terraced fields that are commonly grown to rice during the wet season and to various vegetables and even corn during the closing periods of the rainy months. In areas not developed into terraced fields, growing of field crops is erratic and dependent on the amount of rainfall available during the crop growing periods. These areas, in general, have uneven and complex undulating slopes with erodible soils and the intensity of erosion is accentuated by the use of high tillage-requiring annual field crops.

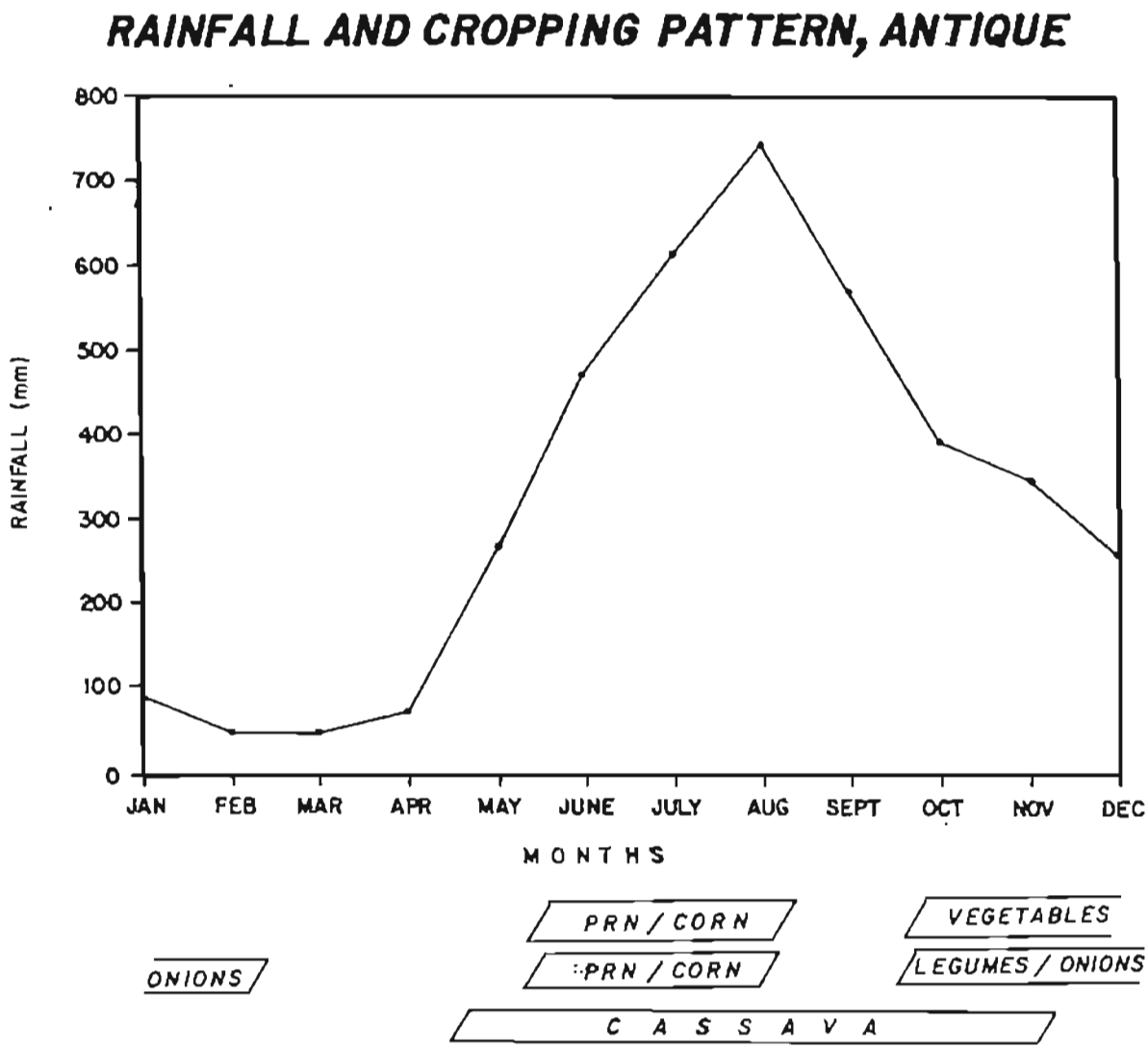
Under this general development intervention, the lower portions (footslopes) of the uplands can be developed into bunded farms in order to efficiently utilize rainwaters during the rainy season. The use of organic fertilizers and the incorporation of leguminous crops in the cropping calender is highly favorable to sustain fertility. The proposed crop calendar under this intervention is shown in Figure 5.

5.3 Highland Agricultural Development

These are extensive areas in the watershed of Sibalom and Cangaranan that are situated in elevations of 500 meters or higher. The area suffers from soil erosion, less inaccessibility, and are situated mostly in the Public/Forestlands. However, because of highly favorable temperature and moisture conditions, these areas are the most productive lands for high value vegetables (cabbage, white potato, carrots, green pepper and others and cutflowers).

a. Highland Vegetables and Cutflower Production and Development

These are areas presently used for the marginal production of food crops, mainly rice, with some grasslands. The use of compost and other organic fertilizers and the implementation of the Integrated Pest Management scheme are important technologies that must be established and impressed upon the farmers and field technicians. Training of the farmers and technicians, including the conduct of on-farm trials will be a part of this intervention.



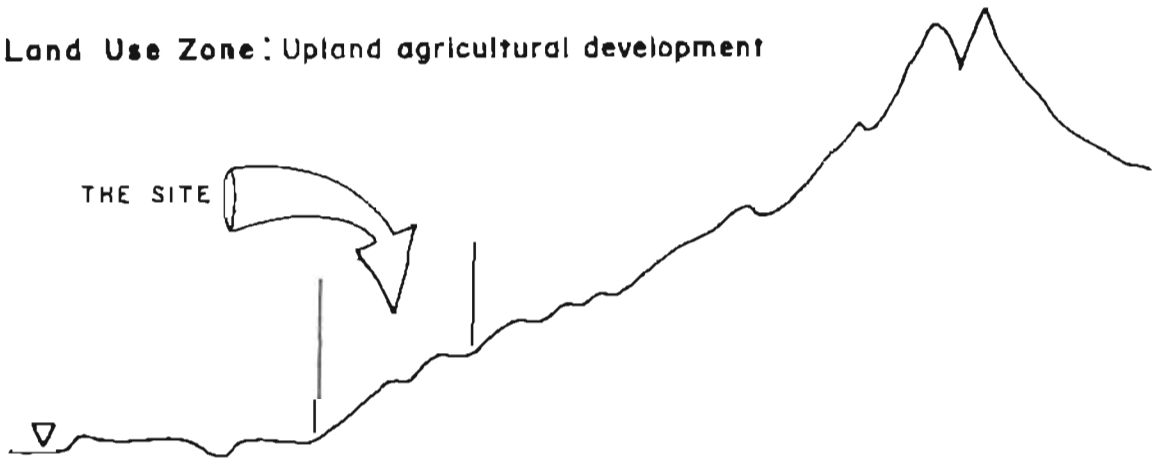


FIGURE 5 **Landscape schematic cross section**

b. Highland Fruit Trees and other Orchard Production and Development

These are highland areas included in the development interventions for the sloping, degraded, and underutilized areas of the Sibalom and Cangaranan watersheds (e.g. Multi-Storey cropping, Coconut-Livestock Development, and Crops-Livestock Development). The total area identified for the Sibalom watershed is about 5,179.44 ha. and for the Cangaranan, 860 hectares.

5.4 Multi-storey Cropping Development

These are level and slightly sloping areas (8-18% slopes) and include lands with low land productivity. The general areas are characterized by the sparse, random, non- contiguous, relatively disorganized planting of upland perennial (tree) crops that are interspersed by cogon and other native grasses. These areas are suffering from various forms of soil erosion and soil creeps and are generally acidic. The random planting in the Sibalom watershed is relatively extensive in areas which have about 5,317.5 ha. for mixed fruit trees, 3,264.6 ha. for coconut, and 562 ha. for bamboo, or a total area of 9,143 hectares. The same situation is noted in the Cangaranan watershed which shows that the areas cultivated to mixed trees, coconut, and bamboo are 4,349.4 ha., 553 ha., and 333 ha., respectively. The actual land areas in these watersheds that are effectively utilized and covered by extensive perennial crops is low (interspersed by patches of cogon and other native grasses) and the opportunity to use the idle spaces must be highly considered if only to maximize the cultivation of these arable lands.

Multi-Storey Cropping Development is a viable intervention and in fact one of the interventions that is already practiced in the area as shown by the Antique Strategic Upland Study. This scheme will require close consultations with the farmers especially in the choice of tree crops that will be used to fill up the unused farmlands. The use of organic fertilizers and the incorporation of legumes in these areas are important factors for soil rehabilitation in order to sustain productivity. Figure 6 shows the crop calendar for the field crops that can be incorporated as understoreys for the multi-storey cropping schemes and its location relative to other upland intervention schemes.

5.5 Integrated Coconut-Livestock Development

These are coconut lands planted on marginal sloping areas (greater than 18% slopes). Under the present technology and the financial resources of the farmers, these coconut lands have relatively marginal productivity. The Sibalom and Cangaranan watersheds have about 467 and 406 ha., respectively of marginal coconut lands located in shallow, eroded, and low fertility soils. Inasmuch as the soils cannot sustain intensive crop

RAINFALL AND CROPPING PATTERN, ANTIQUE

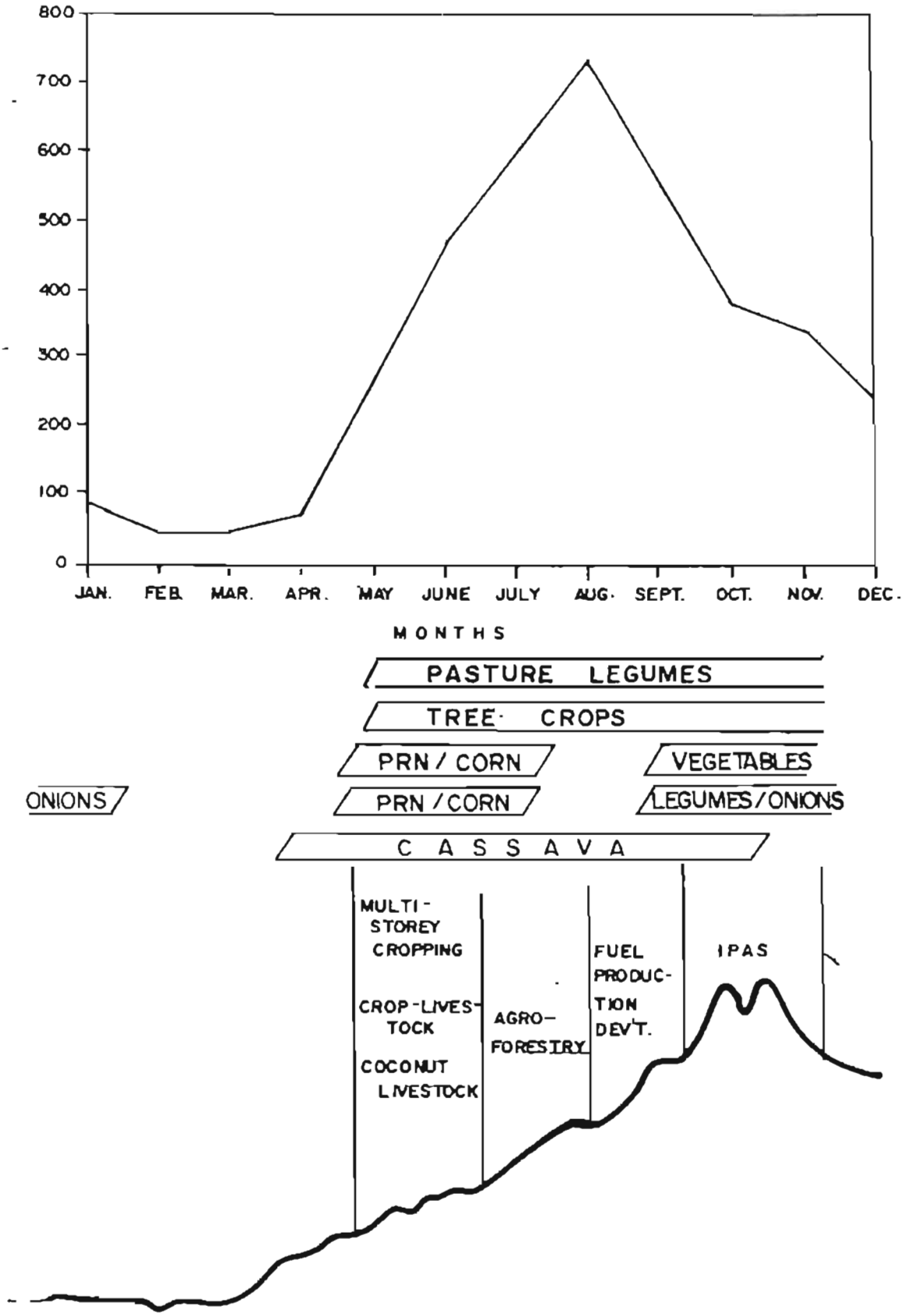


FIGURE 6 **LANDSCAPE SCHEMATIC CROSS SECTION**

production, these marginal coconut lands can be best used and even rehabilitated by planting mixed pasture-legumes to support limited number of ruminants (mainly cattle) or even goats and sheep. The stocking rate can be increased over time as the pasture-legumes mixture becomes fully established. With proper stocking rate and proper pasture management, the mixed grasses-legume pastures will enhance the rehabilitation of the soils and eventually improve the yields of the coconut.

5.6 Integrated Crops-Livestock Development

These are underutilized and highly degraded sloping grasslands (8-18% slopes). The grassland in the Sibalom watershed is very extensive and is now occupying 29% of the watershed or 18,101 hectares. These lands are affected by serious soil erosion and the negative effects of overgrazing in the hillsides are very evident as indicated of "contour trail erosion" and mass slides (soil creeps or solifluction).

This will form the buffer agricultural zone that will emphasize the integrated production of livestock, fruit crops and/or fuel-wood, and food crops. The prepared land allocation per hectare under this intervention is:

a. Food crops - 40 percent (4000 sqm or 8 production blocks);

b. Fuelwood and/or Fruit crops - 30 percent (3000 sqm or 6 production blocks);

c. Livestock/pasture - 30 percent (3000 sqm or 6 production blocks).

5.7 Agroforestry Module Development

The Sibalom and Cangaranan watersheds are besieged with the traditional problems of agricultural encroachment on the sloping "Public or Forest Lands" and this problem is even made more difficult to control because of the problem of poor forest protection and management and the apparent lack of community participation in the judicious use of the forest resources.

The Agroforestry development intervention requires an individual farmer approach and are covered by areas that are dominated by grassland and shrubland vegetations with varied and complex slopes (generally over 18% slopes). Settlements and small patches of subsistence cultivation occur at random in these areas. This intervention prescribes the optimum combination of foodcrops, fruit crops, and forest/fuelwood in a farm. At any given time and any given location, the farm will have 70% of the farmlands covered by perennials and tree crops to ensure the protection of the upland environment. This will also release significant family labor for other economic livelihood opportunities in the village since after establishment of the fruit and forest trees, most of

the family labor will be available for other economic livelihood opportunities. Only 30% of the farm (those devoted to foodcrop production) will require recurrent and seasonal labor inputs. The emphasis for foodcrops and fruit trees in the Agroforestry modules will enhance the return of biological diversity in the watershed. The proposed land allocation per hectare are as follows:

a. Food crops - 30 percent (3000 sqm or 6 production blocks)

b. Fruit crops - 50 percent (5000 sqm or 10 production blocks)

c. Forest trees or Fuelwood - 20 percent (2000 sqm or 4 production blocks)

Since a great portion of the areas under this intervention are located in the highland environment, it is important to consider the prescribed crops and forestry species that will thrive well in the highlands.

5.8 Highland Agroforestry Production and Development

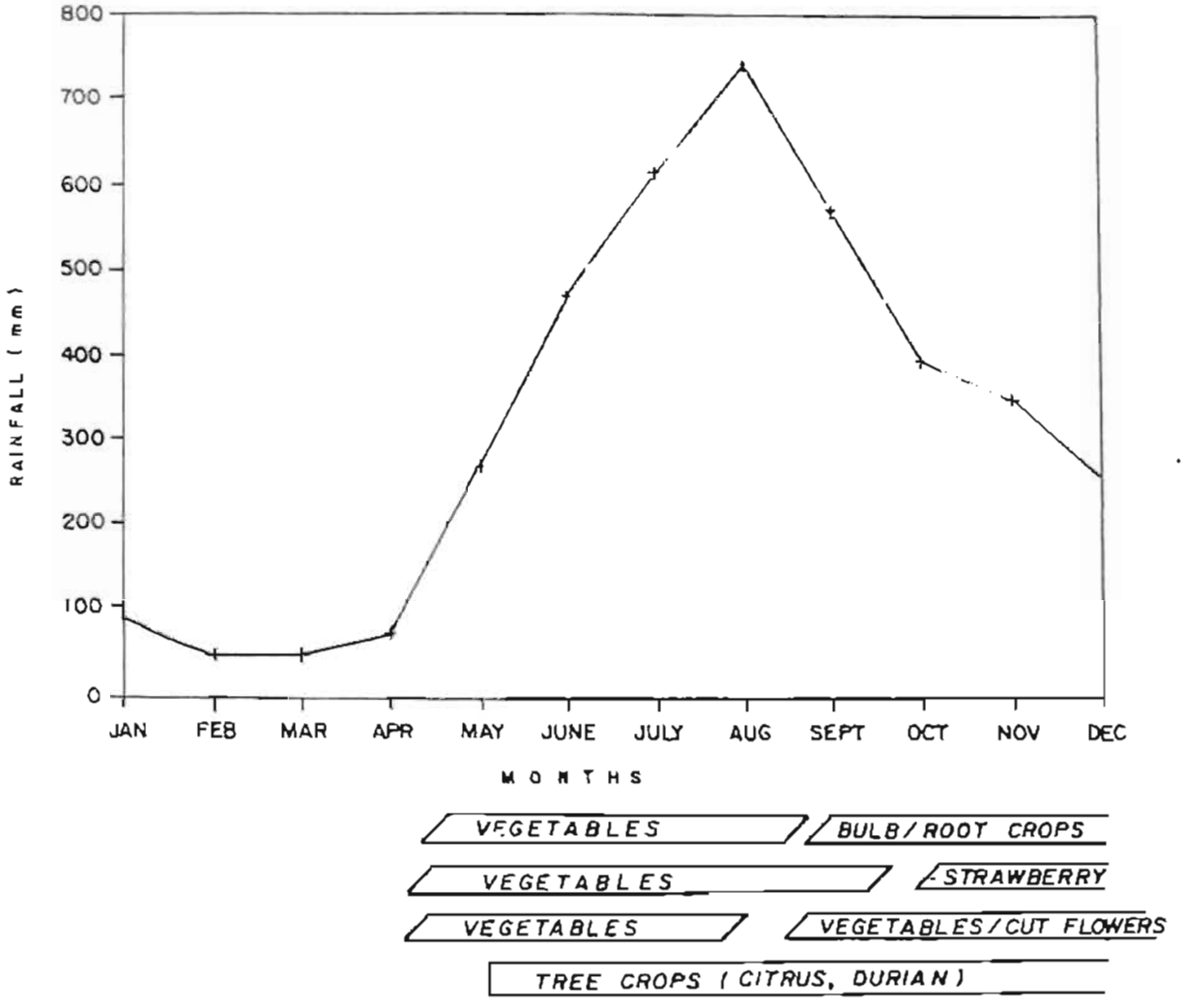
This physical development intervention is similar in all respects with the Agroforestry scheme, except that this intervention considers the high value highland agricultural crops and forestry species (Figure 7). These areas are mainly idle grasslands that have been used, abandoned and are now degraded and are progressively affected by soil erosion and loss in soil fertility.

5.9 Fuelwood Production/Development (development and management of production forests)

These are mainly second growth forest lands of varying ages, stand, and economic values, which are located in highly inaccessible areas with steep slopes, severe soil erosion and are prone to mass movement (soil creeps).

In order to optimize the use of this degraded, sparsely populated upland watershed resources, these areas will be developed into a Community-Managed Production Forest to provide the maximum social, economic and ecological benefits. This intervention prescribed the establishment of mixed forest trees such as medium-rotation forest species (*Gmelina arborea*, *Eucalyptus camaldulensis*, and *Acacia mangium*), high value forestry species (Narra and mahogany), and even fruit trees. The inclusion of fruit trees in this mixed forest production and management intervention will attract varieties of birds and wildlife and thereby effectively enhance the biological diversity in the watershed. A quick reference of Forestry Development Component has been prepared for ANIAD provided in Annex A.

RAINFALL AND CROPPING PATTERN, ANTIQUE



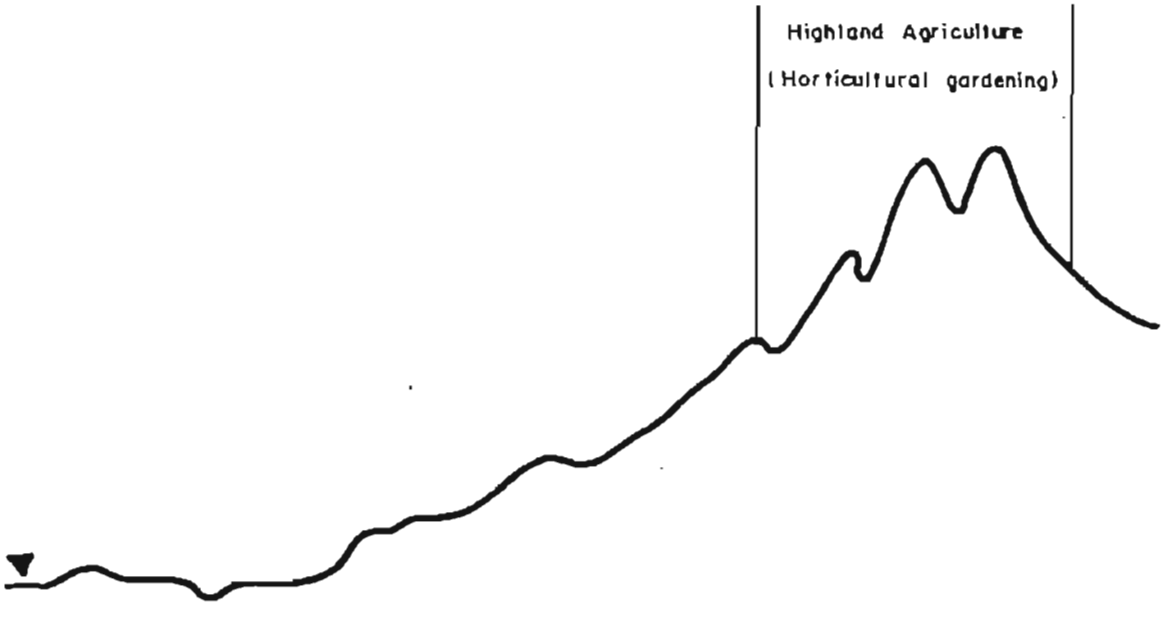


FIGURE 7 **LANDSCAPE SCHEMATIC CROSS SECTION**

5.10 Community-based Forest Protection, Productivity Enhancement and Development.

These are reserved for the development and management of Protection Forest in order to preserve the remaining forest vegetations that have varied economic and ecological importance. These isolated and inaccessible watershed protection sites are dominantly occupied by primary and secondary forests as well as with mixed forest trees. Because of its importance to the residual ecology and hydrology of the Sibalom watershed, these remaining forest resources will be protected, stabilized, and sustained following the concept of the Integrated Protected Areas system (IPAS) of the DENR.

This particular intervention shall require strong commitment from the LGU's to translate these into a meaningful community effort.

Since a great portion of the areas under this intervention are located in the highland environment, it is important to consider the prescribed crops and forestry species that will thrive well in the highlands.

6.0 DEVELOPMENT AND MANAGEMENT OF THE TIBIAO WATERSHED

6.1 Intensive Agricultural Development

The areas included in this intervention are irrigated ricelands and underutilized and degraded idle grasslands that are suffering from declining productivity. The watershed has about 3,868.6 ha. and 453.8 ha. with slopes of 0-3% and 3-8%, respectively. These areas are mainly grown to wetland rice, 2,925.4 ha. are with irrigation facilities, and 2,024.5 ha. are degraded grasslands. The suitability analyses however, showed that about 4,446.1 ha. are highly suitable to the production of lowland rice provided irrigation water is available. Soils data showed that the water holding capacity of the lowland soils are low to medium which means a relatively moderate to high water requirement problems.

The Tibiao watershed has about 3,075.4 ha. that can be used for agricultural development. This scheme covers the highly utilized level alluvial lands which have a general slope of 0-8%. These areas are the prime lands for the reliable production of wide variety of food and vegetable crops. However, in the more economically improved locations, these are the agricultural lands that are most likely to be converted to non-agricultural uses.

This intervention focused mainly on the improvement of the farming systems which will emphasize the inclusion of a wide range of crops that can effectively use the residual moisture from the soil. On the basis of the actual land use in the watershed, three specific intervention schemes are proposed as follows:

a. Enhancement of Paddy Rice-based Cropping Systems

These are existing irrigated lowland areas within 8% slopes. In general, these areas are planted to rice during the wet season which normally starts in the month of May although in some years rain may start in April.

The cropping patterns shown in Figure 4 illustrates a wide range of crop mixes which are possible for the project. Because of critical moisture conditions during the months of January to April, the early maturing, high value vegetable crops can be included in the patterns to make use of the residual moisture during these periods. The list of crops suitable are shown in Annex B.

b. Enhancement of the Rainfed Rice-based Cropping systems

These are terraced rice areas that are dependent on rainfall. In most instances, the second crops suffer from lack of moisture especially when grown after rice. Figure 5 likewise illustrates the crop mixes and crop calendar for the rainfed rice-based cropping system. The crops identified for the lowland are similarly suitable for the rainfed rice-based system.

c. Development of the Grasslands.

These are alluvial lands with 0-8% slopes with relatively shallow and acid soils that are now grown to native grasses, mainly cogon. These areas can be developed into either rainfed fields or irrigated where water is available. The cropping patterns for the above-mentioned rainfed rice-base systems maybe adopted.

6.2 Upland Agricultural Development

These are areas with 8-18% slopes adjacent to the paddy rice fields and which are currently used for marginal production of food crops. During the dry months, most of these areas are fallowed and are grown to various grass species. The production levels of foodcrops and other crops are variable and decline with time because of the progressive soil erosion that affect these areas. Tillage properties of the soils are not favorable since in many places, the surface soils are very minimal and these affects its organic matter content and subsequently, the soil fertility. Most of the lands delineated under this intervention schemes are unterraced and this limits the yield levels of any crops that may be promoted in these areas. In order to improve the physical condition of the upland farms, the establishment of contour hedgerows and the use of organic fertilizers are important considerations. The proposed crop calendar is similar to the other areas of concentration of the project (Figure 5).

6.3 Multi-storey Cropping Development

These are areas devoted to randomly planted mixed fruit trees which are located in gently sloping and sloping lands (8-18% slopes). Because of inadequate cover and its association with grasslands, many of these lands are suffering from soil acidity and soil erosion. The present land area devoted to this relatively disorganized planting of fruit trees is about 2,797 ha. or about 15% of the Tibiao watershed.

While this intervention is practiced/adopted in the project, it is important to consider the consultation with the watershed communities especially in the selection of crops that maybe promoted in the project. Dialogues with the local NGO's and with the LGU's are equally important in the implementation of technologies and development projects in the watershed. Figure 5 shows the crop calendar that maybe used as guide in the development of crops in the area. One of the important activities in this intervention is the replanting of existing fruit trees which can bring in early benefits to the farmers in the watershed.

6.4 Integrated Crops-Livestock Development

These are highly degraded, overgrazed sloping grasslands (8-18% slopes) which will require immediate rehabilitation. This is a part of the extensive grasslands (2,024.5 ha.) in the Tibiao watershed where majority are located in steep, severely eroded slopes.

This will form the agricultural buffer zone that will emphasize the integrated production of foodcrops, fruits, livestock and fuelwood/light construction materials. The land allocation per hectare under this intervention are as follows:

a. Food crops - 40 percent (4000 sqm or 8 production blocks)
b. Fuelwood/or fruit crops - 30 percent (3000 sqm or 6 production blocks)
c. Livestock/pasture - 30 percent (3000 sqm or 6 production blocks)

6.5 Agroforestry Module Development

Highly degraded grasslands on steep slopes are prominent in the hillsides of the Tibiao watershed. The encroachment of the fragile portions of the unstable "Public or Forest" lands remain a crucial issue in the sustainability of the upland ecology and this has become more imminent because of the inadequate enforcement of laws concerning the judicious use of the forest resources.

Since this portion of the watershed are farmed by individual settlers, the individual farmer approach must have to be considered in the implementation of the agroforestry projects. This intervention prescribes the optimum combination of food crops, fruit crops, and fuelwood/forest trees in order to ensure its long term sustainability as well as the protection of the remaining forests in the upper watershed areas.

This agroforestry module prescribes the following use allocation:

a. Food crops - 30 percent (3000 sqm or 6 production blocks)
b. Fruit trees - 50 percent (5000 sqm or 10 production blocks)
c. Fuelwood/forest trees - 20 percent (2000 sqm or 4 production blocks)

6.6 Fuelwood Production/Development (development and management of production forests)

These are mainly second growth forests of varying ages, stand, and economic values, and are located in very inaccessible portions of the upper watershed. Most of the areas are eroded, located on steep slopes, and are prone to soilslides (mass movement or soil creeps).

In order to stabilize, rehabilitate, and optimize the use of these fragile ecological resources, these areas will be developed into Community-managed production forest which are projected to provide significant social, economic, and ecological benefits not only to the resident communities but also the downstream communities. This intervention provides for the establishment of mixed forest trees such as the medium-rotation forest species (*Gmelina arborea, Eucalyptus camaldulensis,* and *Acacia mangium*) and high value forestry species such as narra and mahogany with selected fruit trees. The fruit trees such as duhat, guava, and others are promoted not for their cash values but more on biodiversity aspect (i.e., attracting varieties of wildlife).

6.7 Community-based Forest Protection, Productivity Enhancement and Development

This intervention provides for the development and management of Protection Forest in order to preserve the remaining forest vegetations and improve the over-all watershed biodiversity, both flora and fauna.

These are isolated and inaccessible portions of the watershed that are occupied by old and second growth forests with varying economic and ecological values. The presence of variety of fruit trees even in highly inaccessible portions of the watershed indicate serious encroachment of the public/forest lands. Because of their importance to the improvement of the watershed, these remaining forest resources shall be protected, stabilized, and sustained following the concept of IPAS of the DENR. This particular intervention shall require strong commitment from the local NGO's, LGU's and most of all the entire organization of the DENR.

Since a great portion of the areas under this intervention are located in the highland environment, it is important to consider the prescribed crops and forestry species that will thrive well in the highlands.

ANNEX A

ANNEX A

FORESTRY DEVELOPMENT COMPONENT
PHYSICAL DEVELOPMENT PLAN

EXECUTIVE SUMMARY

The physical development plan under the forestry development component of the Antique Integrated Area Development (ANIAD) emphasizes specific intervention strategies wherein the upland areas could be developed and managed under community-based approaches. The success of the forestry development plan rests primarily on the community resolution of land tenure and land-use issues for the maximum benefit of the greater number of people who are either fully or partially dependent on this very important natural resource.

The proposed forestry development interventions are focused on the identified priority upland areas for: (1) protection under similar strategies being used for the Integrated Protected Areas System (IPAS) of the government; (2) limited use of forest buffer zones; and (3) upland rehabilitation cum improvement of the living conditions of the involved upland communities.

The development of Protection Forests is recommended on upland sites that are relatively less accessible and about 50° and above in slope. These shall be considered protected areas and shall be surrounded by extension and social forest buffer zones for additional protection. The more accessible upland sites with slopes between 30% to about 50% shall be developed as Production Forests under the community-based reforestation strategy.

The development of Protection Forests shall be undertaken by the local government units (LGUs) covering the target development sites at a cost of about P 20,410.00 per hectare. On the other hand, the Forest Buffer Zones and the Production Forests shall be developed and managed by the local communities within and around the target development sites at P 19,905.00 per 100 linear meters and P17,438.50 per hectare, respectively.

The specific target sites for initial development shall be determined by the ANIAD Project Management Office in consultation with the appropriate LGUs and local community organizations.

PLAN I
DEVELOPMENT AND MANAGEMENT OF PROTECTION FORESTS

I RATIONALE

Development of Protection Forests under the ANIAD Project refers to the rehabilitation and management of degraded watershed areas that are critically located on less accessible sites and on very steep slopes usually over 50% within the three (3) concentration areas. These sites are currently posing environmental risks not only to the agricultural production areas but also to the settlement areas where the main bulk of the population resides. These degraded watersheds are also critically affecting the regimen of water supply both as surface runoff and groundwater, thereby causing unregulated waterflow and accelerated soil erosion. Such a situation has caused a tremendous amount of crop losses and untold miseries brought about by the continuing destruction of roads, bridges and waterways resulting from excessive flashfloods and streambank erosion.

In all the cases of the three concentration areas, these sites include abandoned grasslands that are highly prone to erosion and landslides and are relatively marginal in terms of supporting high-value crops such as agricultural annuals and economic plantation crops.

II OBJECTIVES

The establishment of protection forests within the concentration areas aims to rehabilitate the degraded watershed areas into permanently forest-vegetated uplands similar to the Integrated Protected Areas System (IPAS) concept of the government.

In specific terms, this upland development strategy will be implemented to:

1. bring back forest cover on critically located upland sites for improved and regulated water yield and quality;

2. stabilize and protect these forests through the establishment of permanent forestry and related vegetation for the protection of human productive infrastructures such as dams, irrigation systems, croplands, and transportation networks; and

3. involve the local government units in forest resources development and conservation.

III DESCRIPTION

The development and management of protection forests under the ANIAD shall involve the reforestation of identified sites within the three concentration areas through the locally existing government units and their residents. While the approach shall be primarily reforestation, its acceptability shall depend much on the ability of the local government units to translate the activity into short-term economic opportunities, then into long-term productive opportunities to ensure sustained agricultural production and over-all development in the surrounding areas.

As a reforestation activity, this will involve the planting of 100% perennial woody vegetation in two stages. The first stage (Phase I) will involve the planting of medium-rotation forestry species like **Albizzia procera** (Akleng Parang), **Gmelina arborea** (Yemane) and **Acacia auriculiformis** together with some fruit trees like duhat (**Syzigium cuminii**) and mango (**Mangifera indica**) in limited number. The fruit trees will be an added incentive to the local communities plus a strategy to ensure protection from fires that are very prevalent in the area. Under the IPAS concept, the fruit trees are also necessary to attract wildlife species to promote biodiversity to a certain extent.

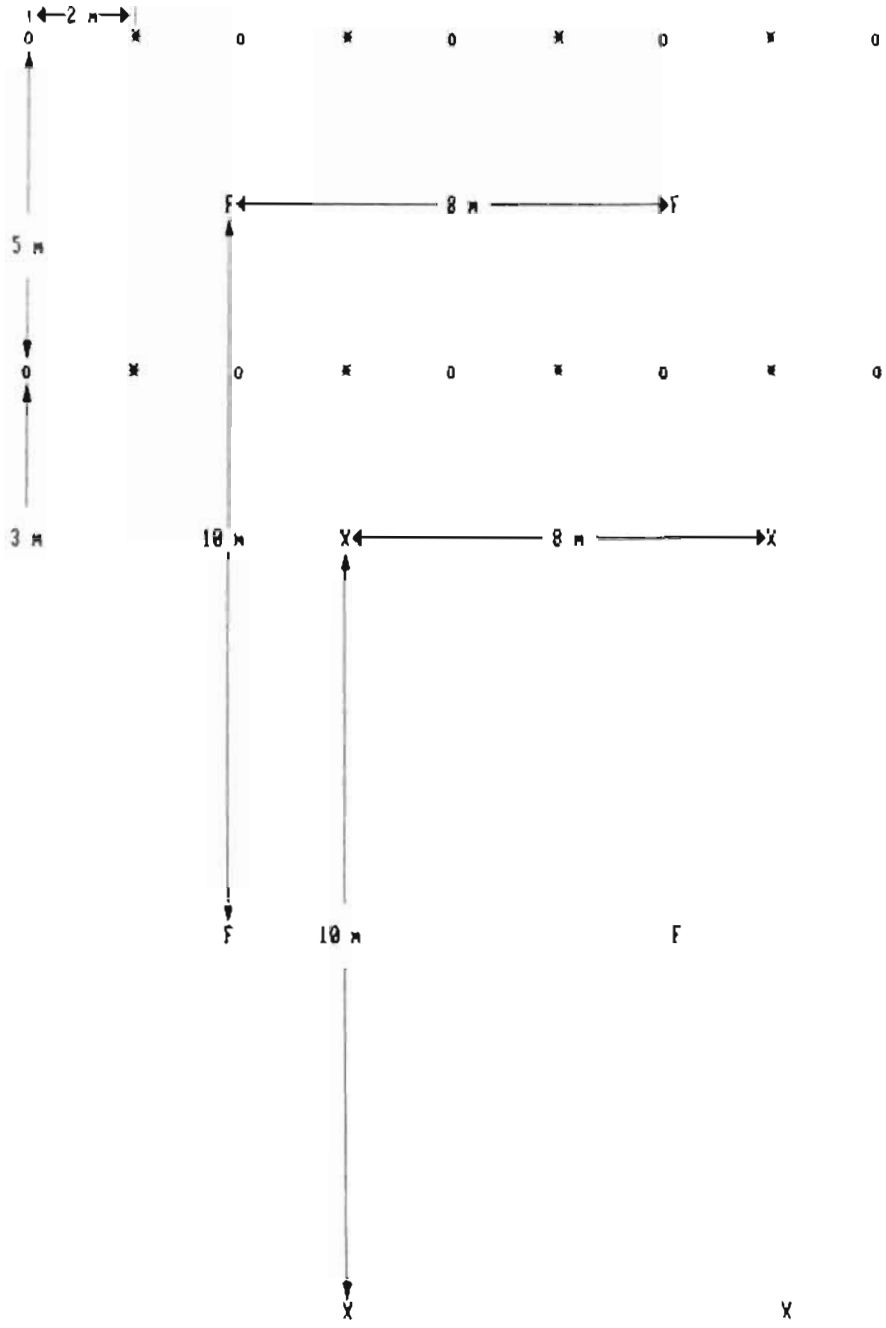
The medium-term forestry species will be planted at an initial spacing of 2m by 5m (1,000 trees per hectare) following the contour of the land. On the other hand, the fruit trees will be established at a spacing of 8m by 10 m (125 trees per hectare) in a quincunx arrangement. After five years, 50% of the forest trees will be harvested to liberate the other trees. At this stage, the microclimate of the area should have been improved and will allow for the introduction of permanent climax forestry species involved in Phase II.

Phase II in the physical development plan involves the planting of climax forestry species like the Dipterocarps that used to cover these areas. Dipterocarp seedlings will be planted at a spacing of 8m by 10 m (125 trees per hectare) in quincunx arrangement with the fruit trees. With the improvement of the site quality, these dipterocarp species will be expected to co-exist with the other vegetation and hopefully will be established as the permanent forestry cover to protect these watersheds for generations to come.

Figure 1 shows the spatial arrangement of the tree components under Phases I and II of the Protection Forests Development and Management activity of ANIAD.

The breakdown of the trees in one hectare will be as follows:

Phase I	1,000 medium-rotation forest trees
	125 fruit trees
	1,125 trees per hectare



Legend:

- o - medium-rotation forestry species (to be left)
- * - medium-rotation forestry species (to be cut after 5 years)
- X - long rotation forestry species to be introduced in Phase II
- F - fruit trees

FIGURE 1. SPATIAL ARRANGEMENT OF THE TREE COMPONENTS UNDER THE PROTECTION FORESTS DEVELOPMENT AND MANAGEMENT ACTIVITY

After five years, 500 medium-rotation forest trees will be harvested before the introduction of the climax dipterocarps to be implemented in Phase II.

Phase I	500 medium-rotation forest trees (left by the harvesting operation)
	125 dipterocarp trees (to be introduced)
	125 fruit trees (existing)
	750 final number of trees per hectare

Under this protection forest concept, no trees shall be cut after the liberation cutting (fifth year) unless it will be extremely necessary. This principle shall be observed to ensure continuous protection of the watershed sites.

IV IMPLEMENTATION

The establishment of the **Protection Forests** in all the critical watersheds in the three concentration areas will be undertaken following the **Local Government Unit (LGU) Contract Reforestation Approach of the National Forestation Program.** Since most of the areas are more or less large-scale in nature, the activity will involve the putting up of infrastructural components like graded trails, fire look-out towers, firebreaks and others as required by large-scale reforestation activities. This means that the cost of establishing such protection forests will involve about P 20,410.00 per hectare.

To ensure success, however, the local government units that will be involved shall undergo social and technical preparation activities before any step is undertaken. These preparations will include trainings on community-based reforestation strategies, nursery operations, plantation establishment and management techniques and most ideally, community-based management of protected areas system.

V TARGET AREAS

The sites that will be developed into protection forests under this ANIAD will be areas that are critically located in the uplands such as those that are 50% and above in slope, less accessible, and marginally productive in terms of high value crops. These may also include abandoned grazing lands that are annually subjected to grass fires.

Limited target sites may be identified for initial development.

VI DEVELOPMENT COST

Table 1. Cost of development of one-hectare of upland area under the ANIAD Protection Forests Development and Management activity.

ACTIVITY	COST PER HECTARE (P)			
	Yr. 1	Yr. 2	Yr. 3	Total
I. NURSERY OPERATIONS	5,847.08	-	-	P 5,847.08
- procurement of plantimg materials - nursery site preparation - preparation and maintenance of seedlings - etc.				
II. PLANTATIONS ESTABLISHMENT	3,905.06	-	-	3,905.06
- perimeter survey and mapping - preparation of planting spots - transport of seedlings - actual planting				
III. MAINTENANCE AND PROTECTION	1,734.12	1,680.50	1,680.50	5,095.12
- brushing and fertilization - replanting - fertilizer cost				
IV. INFRASTRUCTURE	3,345.68	305.56	305.56	3,956.80
- road construction - road maintenance - firebreak construction - footpath construction - patrol work - bunkhouse (1 unit/200 ha) - lookout tower (1 unit/100 ha)				
V. ADMINISTRATION AND SUPERVISION	-	803.00	803.00	1,606.00
TOTAL	14,831.94	2,789.06	2,789.06	20,410.06

ASSUMPTION

All figures are based on the "GUIDE FOR COST ESTIMATES" of the DENR National Project Coordination Office which implements the Contract Reforestation Projects of the National Forestation Program.

PLAN II
DEVELOPMENT OF PROTECTION FOREST BUFFER ZONES

I RATIONALE

Buffer zones are areas adjacent to protected areas on which land use is partially restricted in order to give an added layer of protection to the protected area itself while providing valued benefits to the neighboring local communities. The protection forest buffer zones will serve two purposes under the ANIAD. Extension buffering will in effect extend the area of those habitats contained within the protected area into the buffer zone, thus allowing larger total breeding populations of plant and animal species than could survive within the reserve alone. Socio-buffering, on the other hand will provide products of use or value to the local community people such as fuelwood, light construction wood, economic agricultural crops and the like. Under both purposes, the land use within the buffer zone shall not be in conflict with the objective of the protection forests such as improvement and regulation of water yield and quality.

In all the ANIAD concentration areas, forest buffer zones are very important to limit people's activities within the protection forests once they are fully established. Limited gathering of fuelwood, light construction wood and production of cash crops will be allowed within these forest buffer zones.

II OBJECTIVES

The protection forest buffer zones will be developed to:

1. extend natural bio-dynamics beyond the limits of the protection forests;

2. absorb uncontrolled community activities that tend to threaten the existence of the protected areas; and

3. develop and upgrade community awareness on the significance of protected areas system for sustained productivity and ecological stability.

III DESCRIPTION

The development of the forest buffer zones under the ANIAD will involve the establishment of 100-meter wide plantations of mixed forest trees and perennial agricultural crops for limited community use. Species that are not degrading to the soil and at the same time, possess ameliorative characteristics for protection and rehabilitation will be planted in an appropriate scheme.

From the actual boundary of the protection forests, ten rows of medium-rotation forestry species will be established five meters apart between trees and five meters apart between contour rows to compose the first vegetative layer of the buffer zones. **Albizzia procera** will be used for this purpose since the species is indigenous to all the three concentration areas.

The next layer in the forest buffer zone will be composed of a mixture of fuelwood species such as **Acacia auriculiformis** and fruit trees like jackfruit and cashew. The fuelwood species will be planted in five rows, five meters apart following the contour of the land, with the fruit trees interplanted at 10 m by 10 m with the fuelwood trees in a quincunx manner.

The last 25-meter layer will be devoted to the establishment of a mixture of banana and kakauate (**Gliricidia sepium**) rows for at least three major reasons: (1) effective firebreak system; (2) continuous source of firewood for domestic purposes; and (3) source of additional income from banana.

The components of the protection forest buffer zone is illustrated in Figure 2. On a per 100 linear meter distance around the protection forest, the Forest Buffer Zones will involve the following:

First layer - 50 meters wide:

200 medium-rotation forestry species

Second Layer - 25 meters wide:

100 fuelwood species
25 fruit trees

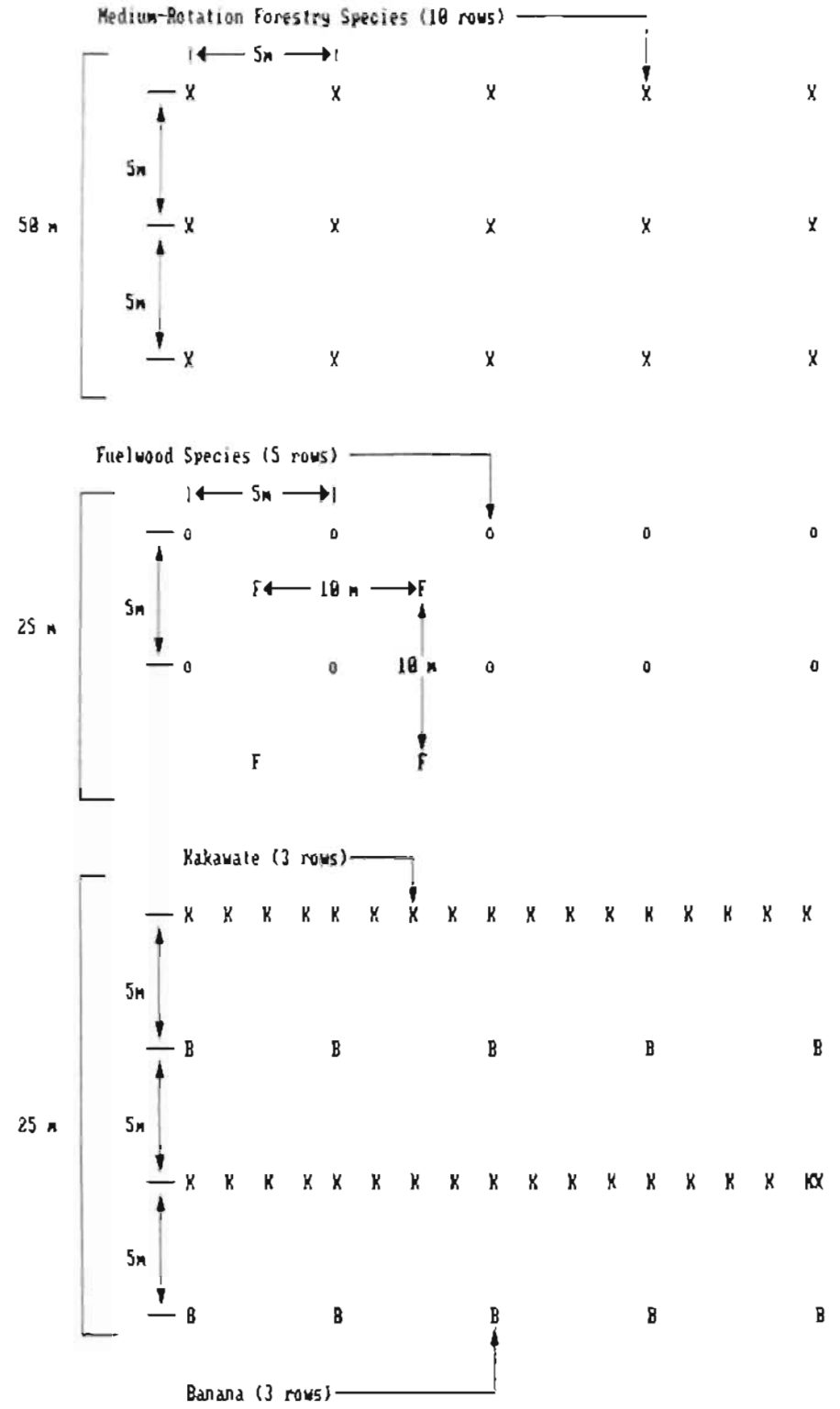
Third Layer - 25 meters wide:

300 trees of kakauate in three 5-m apart rows
60 banana plants in three 5-m apart rows

IV IMPLEMENTATION

Under ideal conditions, the forest buffer zones should be developed and managed by the local communities, themselves who are settled around the protection forests. This will ensure the success of the undertaking which basically operates under the atmosphere of mutual understanding and cooperation among people and related local institutions.

PROTECTION FOREST



PRODUCTION FOREST

FIGURE 2. SPATIAL ARRANGEMENT OF THE VEGETATION TO BE ESTABLISHED UNDER THE FOREST BUFFER ZONE DEVELOPMENT ACTIVITY

Like an ordinary reforestation activity, the buffer zone system development will involve nursery and forest plantation operations, from planting materials procurement and production, plantation establishment and maintenance and protection activities. The local communities will set up the best strategies by which all of these activities could be undertaken by their respective constituents.

Compared to large-scale reforestation, however, the development and management of the forest buffer zones will involve less cost since most of the infrastructural requirements will not have to be put up and labor could be provided by the community people for free.

V TARGET AREAS

The forest buffer zones will be established around the identified protection forests in all the concentration areas.

VI DEVELOPMENT COST

Table 2. Cost of developing a 100-linear meter forest buffer zone by the local community around the protection forests under the ANIAD.

ITEM/ACTIVITY	UNIT COST (P)	COST/100 METERS (P)
A. Survey and Mapping		200.00
B. Nursery Operations		3,500.00
a. 300 seedlings of medium-rotation and fuelwood species	3.00	900.00
b. 25 seedlings of fruit trees	20.00	500.00
c. 300 poles of kakauate	5.00	1,500.00
d. 60 banana suckers	10.00	600.00

C. Plantation Establishment		16,205.00
a. layout	(2 man-days)	130.00
b. clearing	(100 man-days) 10 m x 10 m/day/person	6,500.00
c. hole digging	(20 man-days)	1,300.00
d. hauling and planting	(10 man-days)	650.00
e. fertilization and mulching	(10 man-days)	650.00
f. replanting	(15 man-days)	975.00
g. maintenance (brushing/ weeding)	(60 man-days) 6 times for at least 1 year	3,900.00
TOTAL		P 19,905.00 per 100 linear meter

ASSUMPTIONS

1. Survey and mapping operations will be done by the community members with some technical assistance from the local DENR staff.

2. Seedlings are raised by the community and its residents in community and individual backyard nurseries.

3. Cost of plantation establishment operations are based on the DENR's recommended activities with some rate modifications.

NOTE: The cost of labor has been included in the calculation. This could be minimized if the community residents will give their labor inputs for free.

PLAN III
DEVELOPMENT AND MANAGEMENT OF PRODUCTION FORESTS

I RATIONALE

The scarcity of forest-based products like wood, fuel and non-timber based forest products is also a major issue that need to be addressed by the ANIAD. It is in this light that production forests need to be developed in appropriate upland areas within the three concentration areas and managed by the community residents themselves for maximum economic and ecological benefits.

Unoccupied and marginally productive sites for agriculture will be set aside for the establishment of forest plantations mainly to produce a variety of forest goods and services for the majority of the local populace. Land tenure issues covering these areas will be settled according to the most acceptable arrangements before the actual plantation operations will be started.

II OBJECTIVES

Compared to Plan I of the Forest Development component of ANIAD, the establishment of production forest areas will hope to attain the following objectives:

1. to produce locally needed forest-based products like lumber for various construction purposes, fuelwood for industrial and domestic needs, and other non-timber based products like rattan, bamboo and others;

2. to augment the income of the local population through forest production and forest product processing activities;

3. to institutionalize forest conservation in local communities; and

4. enhance the upland environment through appropriate land use activities for sustained productivity and ecological stability.

III DESCRIPTION

Since the proposed sites involve patches of hillsides that are not necessarily contiguous, blocking by species will not be done. Instead, the forest plantation parcels will be developed using the strategy of mixed species planting.

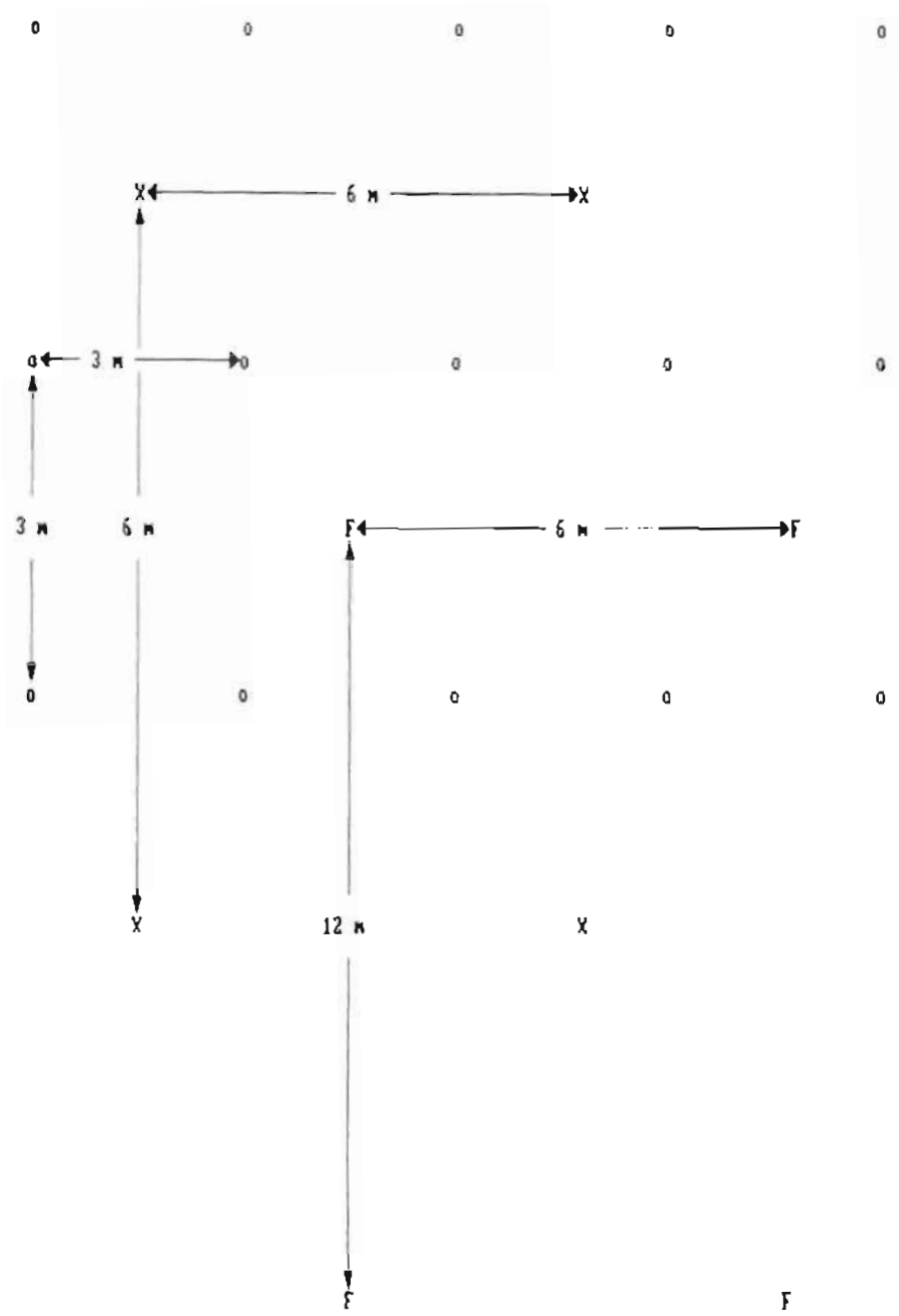
Medium-rotation forestry species like **Gmelina arborea**, **Eucalyptus camaldulensis** and **Acacia mangium** will be mixed with high-value forestry species such as Narra and Mahogany and fruit trees in the plantation sites. Such mixture will be able to provide the community with the much needed financial benefits from the fruit trees; the fuelwood and the light construction wood benefits from the medium-rotation species; and the premium wood benefits from the long-rotation species not to mention the environmental rehabilitation benefits from these perennial vegetation. Such a mixture will also minimize the possibility of widespread infestations which are normally prevalent under monoculture plantations.

The long-rotation forestry species will be established at a spacing of 6m by 6m while the medium-forestry species, at a closer spacing of 3m by 3m. On the other hand, the preferred fruit trees will be intermixed at a spacing of 6m by 12m in a quincunx arrangement (Figure 3). The mixture of all these species will compose a total of 1,525 trees per hectare broken down as follows:

277	long-rotation forest trees
1,110	medium-rotation forest trees
138	fruit trees
1,525	total trees per hectare

Under this production forest plantation scheme, the medium-rotation forestry species will serve as the nurse vegetation for the long-rotation forestry species and the fruit trees which are relatively slower in growth during the initial plantation establishment phase.

The community residents can integrate rattan species within the established forest plantations if they want, after at least five years. Planting of bamboos on both sides of the major rivers within the production forest areas will be a compulsory activity for streambank protection purposes.



Legend:

o - medium rotation forest trees

X - long rotation forest trees

F - fruit trees

FIGURE 3. SPATIAL ARRANGEMENT OF THE TREE COMPONENTS UNDER PRODUCTIVE FORESTS DEVELOPMENT AND MANAGEMENT ACTIVITY

IV IMPLEMENTATION

The implementation of this production forestry development component will be based on the Community Contract Reforestation Approach of the National Forestation Program of the government. The cost of forest establishment may be lower, however, than that specified by the DENR because of some revisions of strategies in the actual implementation.

Before the start of any undertaking related to the activity, the local community leaders and residents will undergo a series of preparation activities under a well-planned community organizing program. The program will include, among other things, appropriate training on the technical aspects of community-based reforestation as well as the managerial, administrative and cooperative aspects of running community forestry projects. All the target communities will play a very strong supportive role to the National Forestation Program of the country through actual establishment of permanent vegetation on critically located areas directly affecting their upland farming activities. Priority sites will be identified by the communities themselves, together with the ANIAD Project Implementation Staff. Such prioritization will be based on the sites' immediate effects on actual upland agricultural production and watershed potentials for community water needs.

Under ideal conditions, each member-household involved in this community-based undertaking will be assigned to specific tasks to be determined by a core group of local community leaders and members.

The next step will be the delineation of actual sites to be developed as production forests. The communities involved will be assisted by the local DENR staff in the survey and mapping of the target community reforestation sites. They will also be required to raise their own planting materials in community and individual backyard nurseries to be financed by the Project under the most appropriate financing scheme/arrangement. Purchase of planting materials from commercial nurseries will not be allowed unless extremely necessary. This strategy will somehow instill the value of such activities in reforestation and similar upland development projects.

When the required planting materials are already available, actual field preparation and plantation establishment will be started. The succeeding development and management activities required by the production forests will be fully undertaken by the local community itself under the supervision, guidance and assistance of the ANIAD as well as local line agencies, institu tions and non-government organizations (NGOs) present in the area. Such management activities will involve forest plantation maintenance, protection, harvesting and forest products utiliza-tion, including the necessary marketing and processing schemes.

V TARGET AREAS

Areas between 30% to 50% in slope will be targeted for the development of community production forests in the three concentration areas. Highest priority will be given to grassland areas that have been abandoned and lying idle for the last several years.

VI DEVELOPMENT COST

Table 3. Cost of developing one hectare of upland area by the community for production forestry under the ANIAD.

ITEM/ACTIVITY	UNIT COST (P)	COST/HA (P)
YEAR 1		
A. Survey and Mapping		200.00
B. Nursery Operations		
a. 138 fruit tree seedlings	20.00	2,760.00
b. 1,387 seedlings of medium-rotation and long-rotation forestry species (277 + 1,110)	3.00	4,161.00
C. Plantation Establishment		
a. spot clearing, with lodging and pressing	1.00	1,525.00
b. hole digging	0.50	762.50
c. staking (including stakes)		230.00
d. actual planting (including transport)		460.00
Total for Year 1 - -		P 10,098.50
YEAR 2		
A. Maintenance		
a. ring weeding, cultivation, and fertilization	1.00	1,525.00
b. replanting (20% at P5.00/seedling)		1,525.00
B. Forest Protection Incentive		2,000.00
Total for Year 2 - -		P 5,050.00

YEAR 3

A. Maintenance

a. ring weeding, cultivation, and fertilization	1.00	1,525.00
b. replanting (10% at P5.00/seedling)		765.00
Total for Year 3 - -		P 2,290.00

GRAND TOTAL FOR 3 YEARS ---	P 17,438.50 PER HECTARE

ASSUMPTIONS

1. Survey and mapping operations will be done by the community members with some technical assistance from the local DENR staff.

2. Seedlings are raised by the community and its residents in community and individual backyard nurseries.

3. Cost of plantation establishment and maintenance operations are based on the DENR's recommended activities with some rate modifications.

4. The forest protection incentive is only for one year when such activity is very critical. Forest protection during the succeeding years will be undertaken by the community itself at no cost at all to the Project.

5. Supervision, monitoring, evaluation and other management activities will be done by the community organization, itself. Only Technical assistance will be expected from the local DENR staff since it is assumed that the community has been trained to undertake these activities during the earlier years of the ANIAD Project Implementation.

NOTE:Labor cost will be minimized if rendered by the community residents for free.

ANNEX B

ANNEX B
REFERENCE LIST OF RECOMMENDED
SPECIES FOR PUBLIC FOREST LANDS

	SPECIES	POTENTIAL YIELD
I	PROTECTION FORESTS	
A.	Medium-rotation Forest Trees	
1.	Akleng Parang (Albizzia procera)	0.05 cu m/tree-fuelwood (5 years) 0.11 cu m/tree- light construction wood (12 years)
2.	Yemane (Gmelina arborea)	0.02 cu m/tree- fuelwood (5 years) 0.14 cu m/tree- sawtimber (12 years)
3.	Acacia auriculiformis	0.20 cu m/tree- fuelwood (4 years) 0.60 cu m/tree- pulpwood (8 years)

B. Long-rotation Dipterocarp Trees (50 to 100 years)

1. Palosapis (Anisoptera thurifera)
2. Apitong (Dipterocarpus grandiflorus)
3. Bagtikan (Parashorea plicata)
4. White Lauan (Pentacme contoria)
5. Red Lauan (Shorea nergrosensis)
6. Guijo (S. guiso)
7. Almon (S. almon)
8. Yakal (S. gisok)
9. Tanguile (S. polysperma)
10. Mayapis (S. squamata)
11. Etc.

C. Fruit Trees (for wildlife, biodiversity and human consumption)

1. Duhat (Syzigium cuminii)
2. Mango (Mangifera indica)
3. Other fruit trees

II FOREST BUFFER ZONES

A. First 50-m layer

1.	Akleng Parang	(same as above)

B. Next 25-m Layer

1.	Acacia auriculifurmis	(same as above)
2.	Jackfruit	
3.	Cashew	
4.	Mango	

C. Last 25-m Layer

1.	Kakauate	0.015 cu m/tree for fuelwood (cut every 4 years)
2.	Bananas	

III PRODUCTION FORESTS

A. Medium-rotation Forest Trees

1.	Yemane	(same as above)
2.	Eucalyptus camaldulensis	1 8-m post/tree after 12 years
3.	Acacia mangium	0.5 cu m/tree-light construction wood (8-10 years)

B. Long-rotation Forest Trees

1.	Narra (Pterocarpus indicus)	0.50 cu m/tree-sawtimber (25 years)
2.	Mahogany (Sweitenia macrophylla)	0.50 cu m/tree-sawtimber (25 years)

C. Fruit Trees

Any fruit trees that are recommended by the local communities and are suited to the conditions prevailing in the different concentration areas of ANIAD.

NOTE ALL FORESTRY SPECIES CAN BE ESTABLISHED UNDER BOTH LOWLAND AND HIGHLAND CONDITIONS EXCEPT THE DIPTEROCARPS WHICH GENERALLY PREFER HIGHLAND CONDITIONS

IV RECOMMENDABLE HEDGEROW SPECIES

1.	Leucaena leucocephala	Ipil-ipil
2.	Gliricidia sepium	
3.	Flemingia congesta	
4.	Desmodium gyroides	
5.	Cassia villosa	
6.	Acacia auriculiformis	
7.	Sesbania grandiflora	Katurai

NOTE: EXPECTED WOOD YIELD FROM CONTOUR HEDGEROWS IS NORMALLY INSIGNIFICANT SINCE THEY ARE CUT (POLLARDED) PERIODICALLY TO MINIMIZE COMPETITION WITH HIGHER ECONOMIC CROPS. HOWEVER, HERBAGE YIELD FOR FODDER, ORGANIC MATTER AND MULCH IS USUALLY HIGHER THAN NORMAL.

LIST OF SUITABLE CROPS
IN ANTIQUE AREAS OF CONCENTRATION

I WARM LOWLAND AND UPLAND AREAS

1. Rice
2. Corn
3. Mungo
4. Peanut
5. Stringbeans
6. Ampalaya
7. Watermelon
8. Melon
9. Soybean
10. Okra
11. Eggplant
12. Tomato
13. Onion (green, bulb)
14. Ginger
15. Garlic
16. Sweet potato
17. Cassava
18. Gabi
19. Ubi
20. Sugarcane
21. Banana (Saba)
22. Bamboo
23. Asparagus
24. Jackfruit
25. Mango
26. Longan
27. Achuete
28. Cashew
29. Guyabano
30. Santol
31. Papaya
32. Robusta Coffee
33. Calamansi
34. Guava

II HIGHLAND CROPS

1. Cabbage
2. White Potato
3. Onions (green, bulb)
4. Garlic
5. Ginger
6. Carrots
7. Pechay
8. Chinese Cabbage/Pech
9. Raddish
10. Strawberry
11. Broccoli
12. Carrots
13. Peanut
14. Soybeans
15. Cucumber
16. Coffee (Arabica and robusta)
17. Cacao
18. Black Pepper
19. Rambutan
20. Lanzones
21. Mango
22. Mangosteen
23. Longan
24. Rubber tree
25. Palm
26. Green pepper
27. Corn (Vegetable)
28. Orange
29. Citrus
30. Bangkok Santol
31. Durian
32. Cutflowers
33. Asparagus
34. Bell pepper

ANNEX C

ANNEX C
ROLES AND USES OF MAPS IN THE PHYSICAL PLANNING OF THE ANIAD AREAS OF CONCENTRATION

This section explains the purposes, roles, and uses of each of the mapping parameters used in the physical planning study of the ANIAD areas of concentration.

A. THE HIERARCHY OF PHYSICAL UNITS

The BSWM-ALMED after 15 years of resource mapping has developed a hierarchy of physical units that can be used to map land resources as follows:

a. the analyses of land use suitability;
b. the assessment of the effects of the agricultural and non-agricultural uses on the land productivity and the environment;
c. the formulation of physical plan for land use allocation and development.

The hierarchy of the Map Units are as follows:

a. 1st order - The Pedo-Ecozone (PEZ)
b. 2nd order - The Land Management (LMU)
c. 3rd order - The LMU phases which include location specific soil/land properties such as:

    c.1 Drainage;
    c.2 Flood Hazard;
    c.3 Soil Depth;
    c.4 Slope;
    c.5 Erosion;
    c.6 Toxicity;
    c.7 Severe deficiency in major and minor plant food nutrients;
    c.8 Soil Acidity/Alkalinity;
    c.9 Typhoon and Drought hazards; and
    c.10 Other factors such as surface stoniness and rockiness.

B. DATA BASE INTEGRATORS

1. The Pedo-Ecozones

The Pedo-Ecozones are supra-zonal environmental units composed of sets of LMU's that have relatively similar range of temperatures, elevations, and slopes.

Each Pedo-Ecozone is developed under similar geomorphological conditions which therefore locate and aggregate each zonal units with relatively similar geology (parent materials) and topography. These are initial information required in grouping of crops with similar growth requirements that will perform optimally in one broad location with similar bio-physical properties (i.e. temperature, soils, slopes, and elevations).

The effect of each parameter on crop growth are as follows:

a. slope - soil erosion and fertility.

b. elevation - pests and diseases, rainfall distribution and moisture storage efficiency (e.g. the evapo-transpiration is low in high elevation areas and therefore more moisture storage efficiency when compared to similar soils in the lowland).

c. temperature - areas in high elevations have lower and more stable temperature but the solar radiation is low and can be unfavorable to some lowland crops like corn and legumes which are sensitive to the length and amount of solar radiation. Some crops are pre-disposed to fungus attack and the maturity periods are delayed.

Role in Resource Use and Environmental Analyses

The PEZ are the bio-environmental integrators of various physical and socio-economic data base that are required in the initial formulation of transferable land use and production technologies.

The environmental factors, namely, temperature, elevation, and slopes, were infused into the Pedo-Ecozones in order to provide adequate basis for the grouping of land use locations that are capable of supporting crop groups with relatively similar agronomy and phenology.

The PEZ can be used to transfer site-specific production technologies, where one can identify the potential locations which can grow crops with similar agronomy and phenology. For instance, researchers in Cebu was able to grow strawberries of Baguio, the typical area for the Highland PEZ, by locating production/research site in the Highland PEZ mapped by the BSWM for Cebu Island.

The PEZ Classes

1) The Lowland PEZ

These are LMU's which are located in areas within the 8% slopes, with elevations not exceeding 100 meters asl, and with an average daily temperature of 25 degrees or higher.

These are the areas where most of the best arable lands in the country are located. In areas with inadequate rainfall, irrigation facilities are required in order to ensure a year-round crop production, particularly that of rice and other fieldcrops. These are also the areas where flooding, salinity and alkalinity are likely to occur.

2) The Upland PEZ

These are LMU's which are located in areas with 8-18% slopes, with elevations not higher than 500 meters, and with average daily temperature ranging from 22.5 to 25degrees C.

These are the areas where most of the upland and rainfed crops are located. In some areas, the LMU's have soils that are acidic and are subjected to various degrees of soil erosion. Irrigation, where feasible, is a major requirement, especially in areas with inadequate and unreliable rainfall.

3) The Hilly and Mountainous PEZ

These are the LMU's which are located in areas with more than 18% slopes, with elevations not higher than 500 meters, and with average daily temperature ranging from 22.5 to 25 degrees C.

These areas are also prone to soil erosion. When used for agriculture, the farmer will have to adopt good soil conservation practices and an appropriate farming system. This is especially true for most annual field crops which require intensive soil cultivation. However, soil erosion is lesser when the steeper slopes of the PEZ are planted to vegetation like matured fruit trees and forest trees, because tree crops and other perennials provide more cover and require less tillage.

4) The Highland PEZ

These are the LMU's which are located in areas with more than 500 meters elevation, with varying and complex slopes, and with relatively stable average daily temperature of less than 22.5 degree C.

These are the relatively fragile uplands, but with the judicious application of appropriate land use technologies, these PEZ can be the site for most high value crops such as vegetables, fruit trees and others.

The Land Management Units (LMU)

The LMU's are the sub-units of the PEZ that were developed in similar parent materials and are geomorphic surface units that have similar sets of soil properties and recurring crop/land uses over various specific locations/micro-terrains in the LMU's.

Role in the Resource Use Analyses and Environmental Assessment

a. The LMU's are the basic unit for land use interpretation.

b. The LMU's are likewise used as key integrators of the bio-physical and socio-economic data bases that are used in the identification of specific crops and land uses and the assessment of their respective potential influences on the productivity of the site and surrounding environment.

c. The LMU's provide the initial assessment of the development needs of the specific land uses and production inputs required of the crops.

d. The LMU's provide the key parameters in the identification of the farming systems that are appropriate to specific locations.

Attributes of LMU's and their Specific Uses in Physical Planning

1) Slope

The land slope percentage refers to the rise of the land surface for every plane distance of 100 meters.

Classes of Slopes

For mapping purposes, the land slope percentages are divided into the following classes:

a. 0-3 percent - Level or nearly level
b. 3-8 percent - gently sloping to sloping
c. 8-18 percent - sloping to moderately sloping
d. 18-30 percent - moderately sloping to steeply sloping
e. 30-50 percent - steeply sloping to very steeply sloping
f. > 50 percent - extremely sloping

The slope condition indicates the degree of hazard the area may have for various forms of soil erosions. Table 1 shows the potential uses and hazards related to the various slope classes.

2) Present Land Use and Vegetation

The present land use and vegetation are important economic and biological attributes of the LMU. The pattern of land uses and vegetations are the direct manifestation of the prevailing climate patterns as well as the economic conditions in a given area. For instance, the dominance of rice shows that the area is

prone to seasonal flooding and has a generally poor land and soil drainage condition. In some areas, the almost complete dominance of rice and other seasonal crops and the minimal occurrence (or mainly backyards) of fruit crops can indicate an evenly distributed rainfall which normally cause flower abortion in the case of mango trees or the area is located in a typhoon prone area. In addition, the appearance of cashew or tamarind in an area can mean that the area has distinct long, dry season. In similar manner, the presence of bamboo may indicate that the area is situated between the wet and dry region.

Some crops and vegetation also indicate soil anomalies and climate aberrations. For instance, cassava crops may indicate a marginal soil area, nipa palms, a saline soil area. Areas with coconut as the only fruit or tree crops may mean that the area is located in a typhoon prone region.

3) Soil Erosion

Soil erosion is the removal of surface soils by run-off or excess water that are not absorbed by the soil and whose rate of movement downslopes causes soil erosion.

The base productivity of the crops, especially in the uplands, are practically related to the degree of soil erosion. The amount of top soils removed by soil erosion in turn determine the relative soil fertility because the greater bulk of available organic matter, which provide the efficient storage of plant nutrients, are found in the top soil.

The knowledge on the amount and extent of soil erosion is important for the following decisions:

a. The type of soil conservation measures needed to rehabilitate and/or sustain crop productivity.
b. The types of crops and the cropping patterns that will provide the best results in terms of yield and income.
c. The type of land preparation appropriate in the farm.

4) Soils and Land Drainage

Soil drainage refers to the ability of the soil profile to remove excess sub-surface water (water table) in the sub- soil. Land drainage, on the other hand, refers to the effective removal of run-off water (floodwater) out of the land surface of the farms and onto the natural drainage ways. Soil drainage therefore is a function of soil properties where coarse soils drain excess water than the soils with very high clay content. On the other hand, land drainage is a function of topography and the presence of surface outlets in the forms of creeks and rivers. Flat lands with poorly drained soils are most likely to suffer from poor land drainage or flooding.

Soil drainage affect the growth of roots of crops and the prolonged presence of high water table can cause rotting of roots of many upland crops, with relative exception of rainfed rice. Land flooding will reduce crop yields by prolonged submergence and effectively cut-off the supply of sunlight to the plants, especially if the flood waters are turbid or have enormous sediments or silts.

C. THE INTEGRATION OF RESOURCE MAPPING PARAMETERS WITH THE WATERSHED PHYSICAL PLANNING

Figure 1 illustrates the over-all framework for the formulation of interventions for the various watershed areas of concentration as well as the step-wise integration of the various technical map information with the physical planning exercises. The various stages of analyses are discussed below.

1. Analyses of the Bio-Physical Environments and the General Ecological Situation

In order to situate properly the physical planning process, the spatial distribution and the structures of the present land use are mapped and (1) each crop/land use type are made to match with the physical conditions of the site using the (2) Pedo-Ecozones as the environmental boundaries; (3) the LMU as the site-specific unit that support biological life and determine native soil and land productivity; (4) the slope as the main site-specific criteria that determines the extent of land degradation [(4a) soil erosion, (4b) declining fertility, (4c) drainability of the farm] caused by the "wrong crops-in-the-site".

2. Land Use Efficiency Analyses

The present and future performances of the existing uses are appraised in terms of their long term sustainability as well as in terms of their cumulative effects on the site and the downstream environment. Under this planning phase, the pattern of the existing uses are located on the map and for each site the present level of degradation and/or enrichment are individually documented. The identification of the physical setting requires the following maps:

a. Pedo-Ecozone and LMU Maps, to provide the information about the soils and their environment. In general the Pedo-Ecozone provides the information about the general agro-environment, most particularly on elevation, slope, and temperature. These are the technical parameters that will define the sustainable yields of the present crops and the present cropping system.

b. The Present Land Use and Vegetation Maps, to identify crops grown and their locations in the watershed. The locations in the watershed refer to the PEZ and LMU which have specific bio-physical properties that control the productivity of the crops and the resulting effects on the soil and its environment. The present land use and vegetation are superimposed on the PEZ- LMU map and the resulting composite map will show the spatial patterns of land mis-use or areas where crops have low production and the surrounding environs suffering from land degradation and declining productivity.

   The upper watershed of the three areas of concentration are now suffering from severe land degradation caused by overgrazing and possibly from the extensive use of these lands to sugarcane in the past.

The major task in this stage of land use analysis is the identification gaps between the existing crop yield or/land use performance under the existing technologies and the attainable potential yield/performance of the same crop/land use under similar and/or improved technologies.

The result of the initial matching of PEZ-LMU and Present Land Use maps provide the initial tasks of the land use planner to resolve the land use issue which are as follows:

a. to retain the existing land use structures in areas where the crops are suitable to the site and the productivity of the farms are "adequate", "reasonable", and "high" and "sustained" by the existing technologies.

b. to change the existing land use structures in areas where the crops and the location are not compatible and the further continuance of the cropping activities will result in a more serious loss in soil fertility, land productivity and further land degradation; and

c. to improve the existing land use structures in areas where the inclusion of new crops (adjustment/improvement of crop calendar) will enhance the over-all productivity of the area and the adoption of low cost corrective technologies is enough to sustain the long term productivity of the area.

3. Site Productivity Problem Assessment

The productivity of the farms and the farmers themselves provide the bottom line in all planning exercises. After a thorough analyses of the bio-physical factors, the PEZ, LMU, and the present land use, the management phase of the LMU (soil erosion, soil fertility, and drainage) becomes the primary maps that will best provide the estimate of farm level assessment of production constraints. The specific role of these map information are as follows:

a. Soil Erosion Map indicates the need for corrective soil conservation measures and the level of land degradation that maybe attributed to the mismatch between the location and the crops grown by the farmers. It will explain the low soil fertility of the farm which will likewise provide the basic reasons for low and declining crop productivity.

b. Soil and Land Drainage map provide the information of seasonal problems in the farm. It will provide the degree of annual production efficiency of the various farms in the project. This information will also provide some basis for the adjustment of crop calendars to avoid the possible damage caused by poor land for rice plants and poor soil drainage for water-logging sensitive upland crops such as vegetables, corn, and other similar crops.

4. Land Suitability Analyses

This calls for the understanding of the basic agronomic requirements and the phenology of the crops that maybe planted or promoted in specific locations (PEZ and LMU) of the watershed. This particular phase of the analyses of the interventions for the project is important in providing the range of crop and use options that one might want to consider in project implementation. It provides for the rationalization of the environment-friendly land uses since it is based on the optimum use of a particular land resources that are compatible to and can sustain the productivity of any given use.

Traditionally, the physical planning process considers the land suitability at the very start of the selection process for the types of uses possible in the planning area. However, when one considers sustainable use, the land suitability can be best considered after the analyses of the productivity situation as the primary basis for the need to change, improve, or maintain a status quo in the land use as discussed above.

The primary purpose of land suitability in a development-cum-environment scheme is to provide the shopping list of a full range of uses/crops that can be promoted in the project area. The final decision as to the types of uses in a any specific location in the project will be a product of integration of farmers' preferences, the existing and the desired bio-physical and economic environment, and the existing and future tenurial situation.

The result of the land suitability for the three areas of concentration are shown in the Land Suitability Map prepared for the project. The list of crops suitable for each area of concentration are shown in annex Table SC-1.

5. Site Management Analyses

After defining the potential use of the area, then the next step is to identify the site management needs of the area. The factors considered in the analyses and identification of the management requirements for the sites or areas of concentration are as follows;

a. Land Tenure situation

It has been established that security of tenure is a fundamental requirement that the farmers' consider before they make any decision to invest in farm development and crop production in the public land portion of the watershed. In other words, the primary reason for the farmers' subsistence farming in the watershed is the common belief among the upland settlers that their investment do not warrant ownership of the land they are tilling in the foreseeable future.

b. Accessibility

This is a basic map information (roads, trails, navigable rivers, and others) that influence the types of crops a farmer may be produced or a planner may consider in the physical planning exercise. In farm areas that are highly accessible, farmers may plant high value crops and even the more perishable crops. However, in areas with poor accessibility, the farmers would normally opt for the subsistence production of food crops just enough or barely above the needs of their respective families.

D. LAND USE PLANNING DECISIONS

The initial step in the physical planning exercise requires:

a. the identification of the SOURCE OF GROWTH; and
b. the identification of areas which cause the DECLINE OF PRODUCTIVITY in the watershed.

The sources of growth in the watershed are those areas where settlement and livelihood activities can be promoted without causing negative effects on the surrounding environs.

On the other hand, the areas where the productivity has declined and/or likely to decline when put into use are the land areas where the bio-physical setting is not stable and is not capable of sustaining basic human uses such as farming, grazing and other land-based livelihood activities.

In areas where land has been exploited and had shown signs of declining productivity and land degradation, the most direct approach is the identification of the land use patterns and crop production systems and matched them with the site or location where they are being undertaken.

The basic rule that will guide land use planners are as follows:

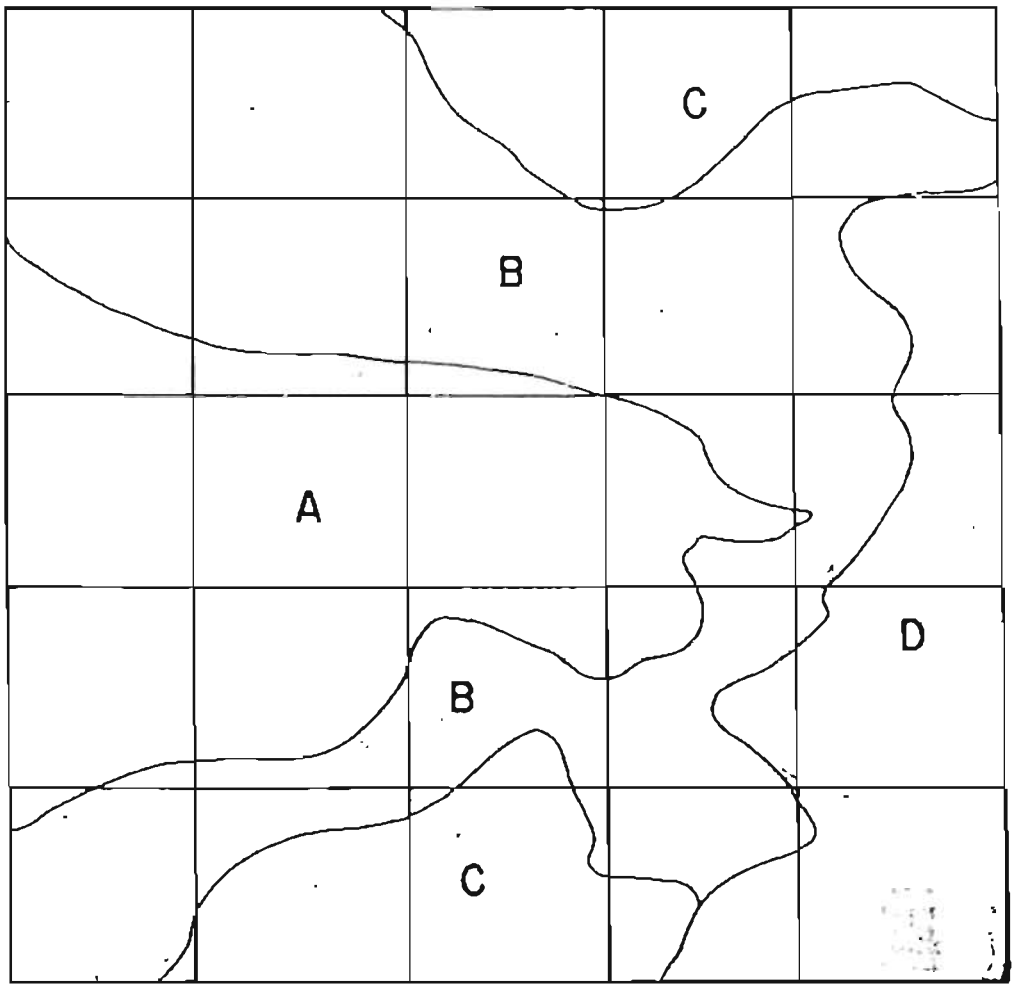
a. For Human settlements:

- a.1 Sources of fuelwood and construction supplies;
- a.2 Sources of potable water;
- a.3 Sources of food production;
- a.4 Accessibility to socio-economic and marketing facilities;
- a.d Absence or presence of breeding places of pests and diseases.

b. For Crop Production

- b.1 Presence of good soils and lands with favorable slope and topography
- b.2 Presence of good sources of irrigation water
- b.3 Presence of favorable rainfall and good over-all climate conditions (stable cool temperature, good supply of sunlight)
- b.4 Absence of serious pests and diseases
- b.5 Availability of low cost indigenous technologies
- b.6 favorable peace and order
- b.7 Land Tenure situation (public lands or alienable and disposable lands)

PROCEDURES IN USING MAP OVERLAYS FOR LAND USE SUITABILITY INTERPRETATIONS



LAND MANAGEMENT UNIT MAP

LOWLAND

A- Alluvial fan

UPLAND

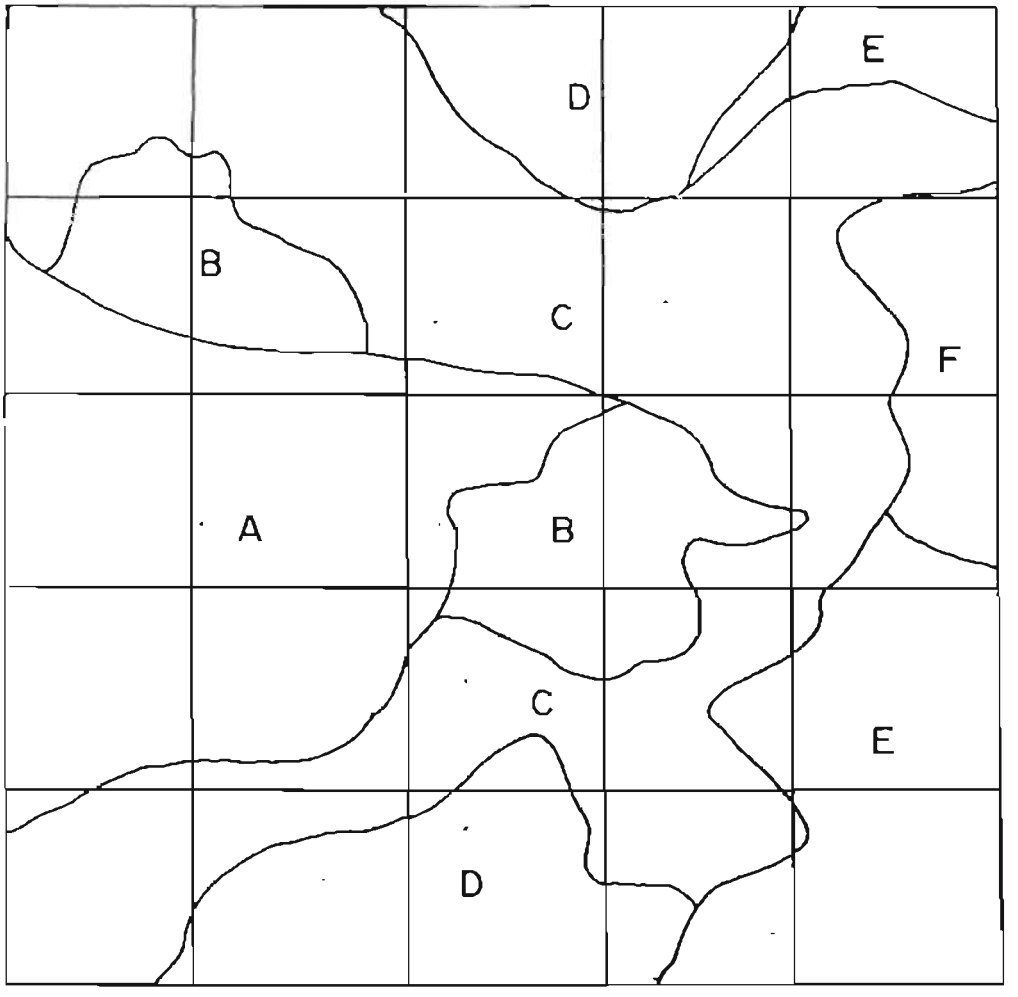
B- Low shale /sandstone hill

HILLYLAND

C- High basaltic hills

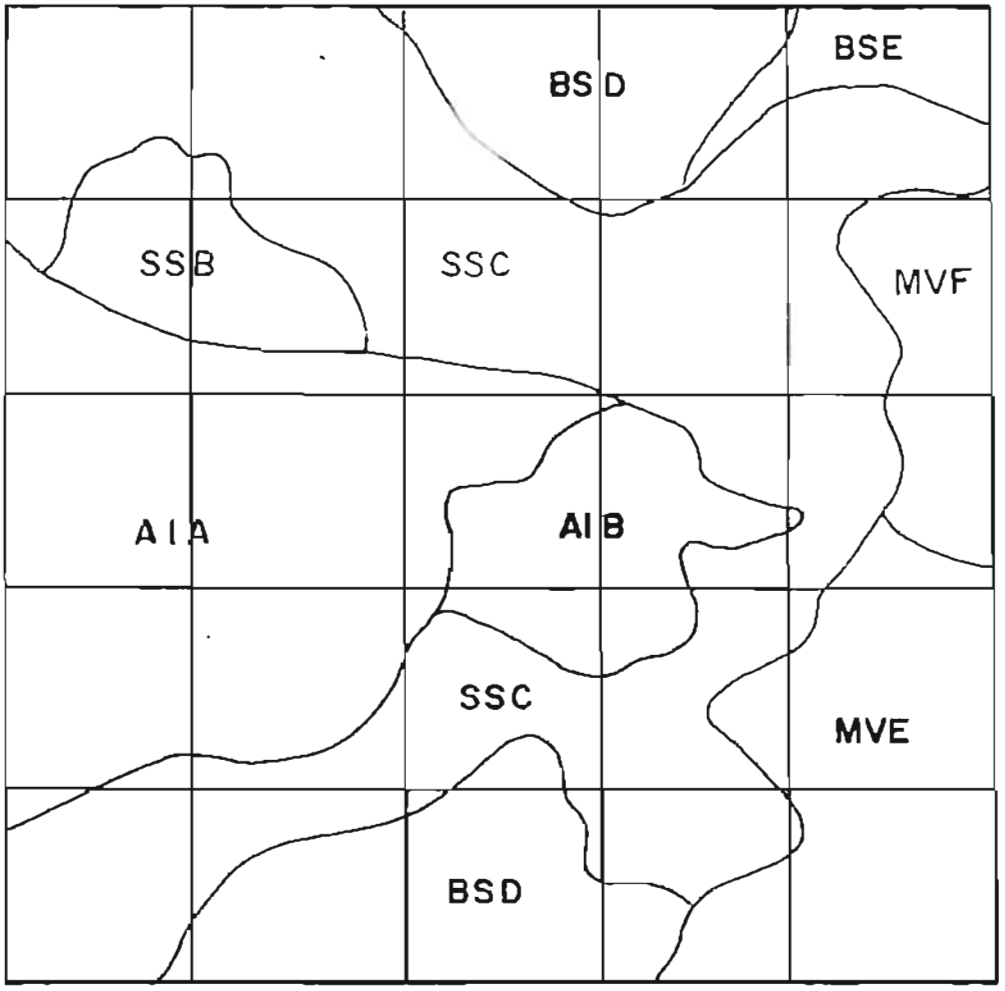
HIGHLAND

D- Meta-Volcanic mountain



SLOPE MAP

A	0 – 3
B	3 – 8
C	8 – 18
D	18 – 30
E	30 – 50
F	> 50



CROP SUITABILITY ASSESSMENT FOR VARIOUS CROPS AND LAND MANAGEMENT UNIT

LITHOLOGY

AI — ALLUVIAL
SS — SHALE / SANDSTONE
BS — BASALT
MV — META-VOLCANIC

SLOPE

A = 0 - 3
B = 3 - 8
C = 8 - 18
D = 18 - 30
E = 30 - 50
F = >50

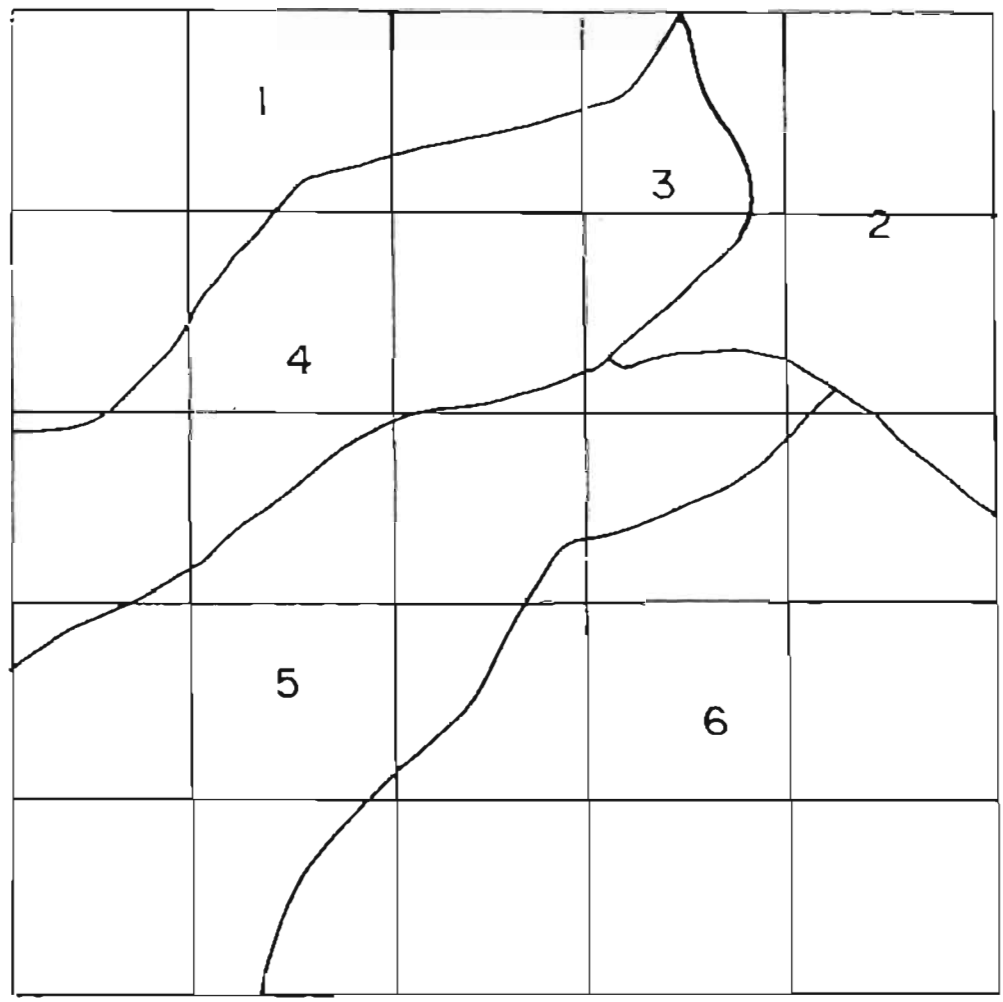
SUITABILITY RATING

CROPS / LMU	PRI	CORN	CF (ARABICA)	MANGO
AIA	S1	S2	S1	S1
AIB	S2	S3	S1	S1
SSB	S3	S3	S1	S1
SSC	NS	NS	S3	S3
BSD	NS	NS	NS	S3
BSE	NS	NS	NS	S3
MVE	NS	NS	NS	S3
MVF	NS	NS	NS	NS

NOTE:

S1 — HIGHLY SUITABLE
S2 — MODERATELY SUITABLE
S3 — MARGINALLY SUITABLE
NS — NOT SUITABLE

DERIVATIONS OF PROPOSED LAND USE AND ZONING MAP THROUGH GIS BASED ON SLOPE AND PRESENT LAND USE



LAND USE AND ZONING MAP

1 INTENSIVE AGRICULTURAL DEVELOPMENT

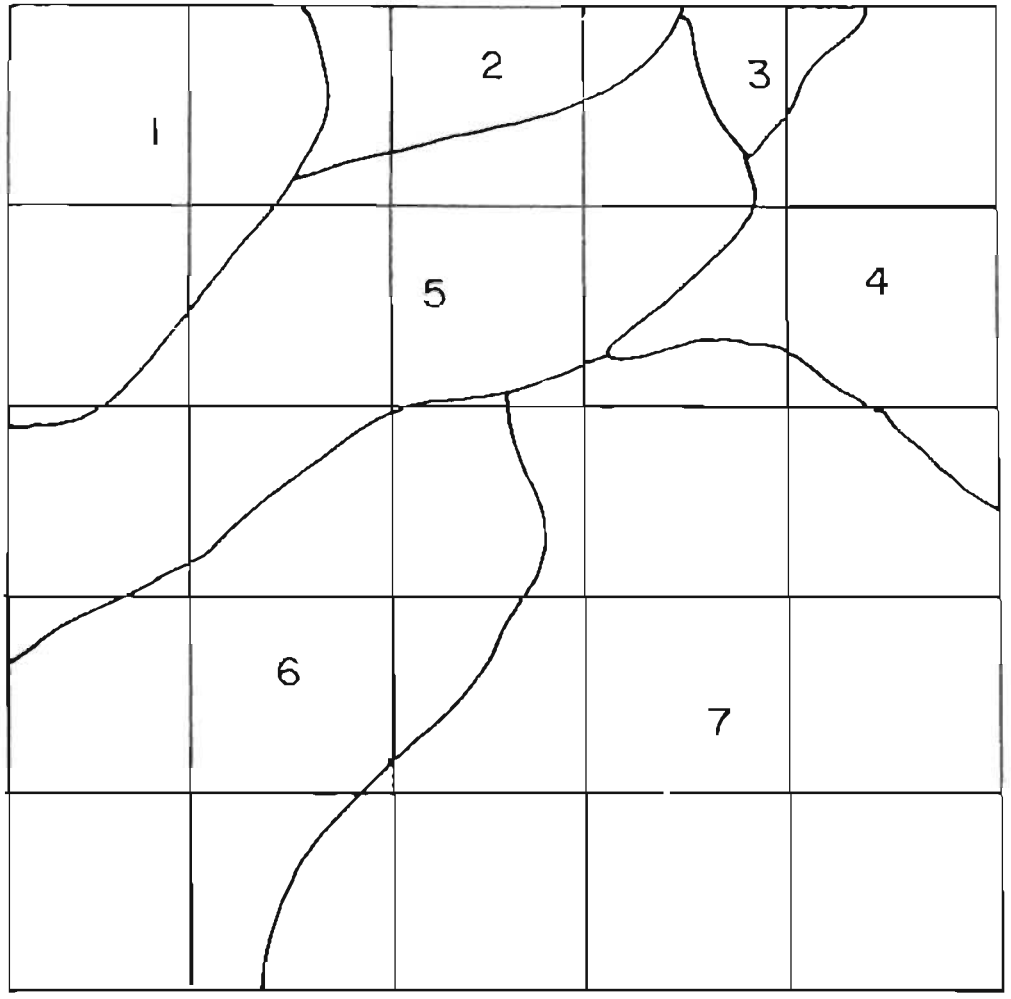
2 MULTI-STOREY CROPPING

3 CROP-LIVESTOCK DEVELOPMENT

4 AGRO-FORESTRY

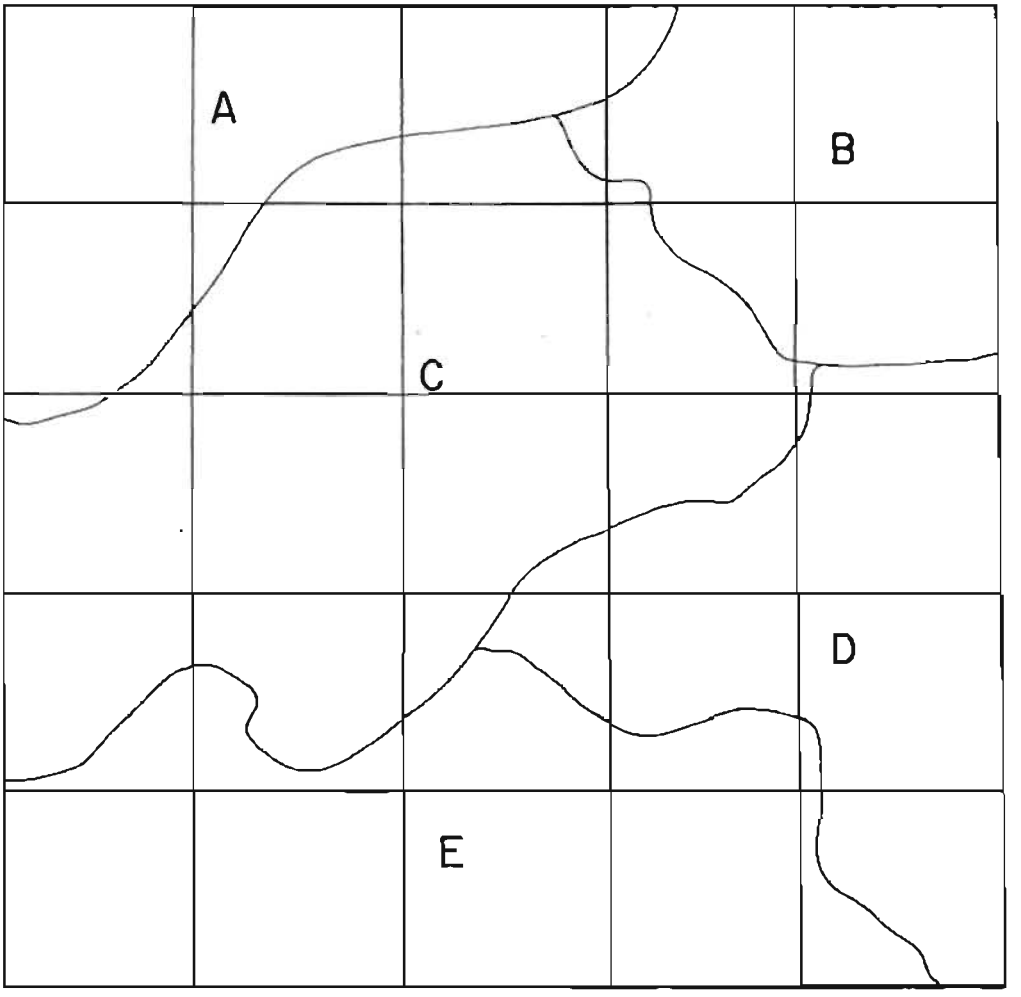
5 FUELWOOD PRODUCTION/DEVELOPMENT

6 COMMUNITY-BASED FOREST PRODUCTIVITY ENHANCEMENT/DEVELOPMENT



LAND USE

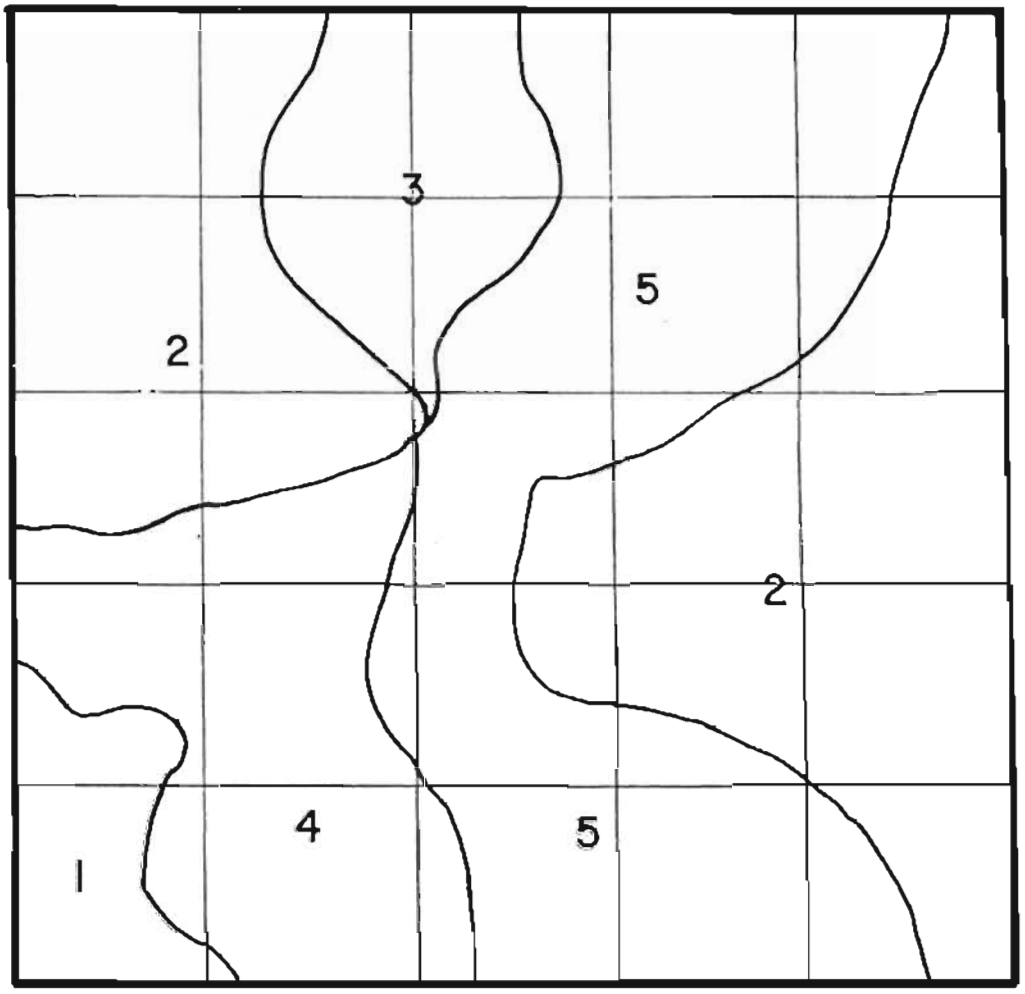
1. PADDY RICE . IRRIGATED
2. PADDY RICE . RAINFED
3. COCONUT
4. MIXED TREES
5. GRASSLAND
6. SECOND GROWTH FOREST
7. OLD GROWTH FOREST



SLOPE MAP

A - 0 - 8 %
B - 8 - 18 %
C - 18 - 30 %
D - 30 - 50 %
E - > 50 %

DEVELOPMENT APPROACH BASED ON PRESENT LAND USE AND LAND CLASSIFICATION (A & D AND PUBLIC LANDS)



DEVELOPMENT APPROACH BASED ON
PRESENT LAND USE AND LAND
CLASSIFICATION (PUBLIC Vs PRIVATE LAND)

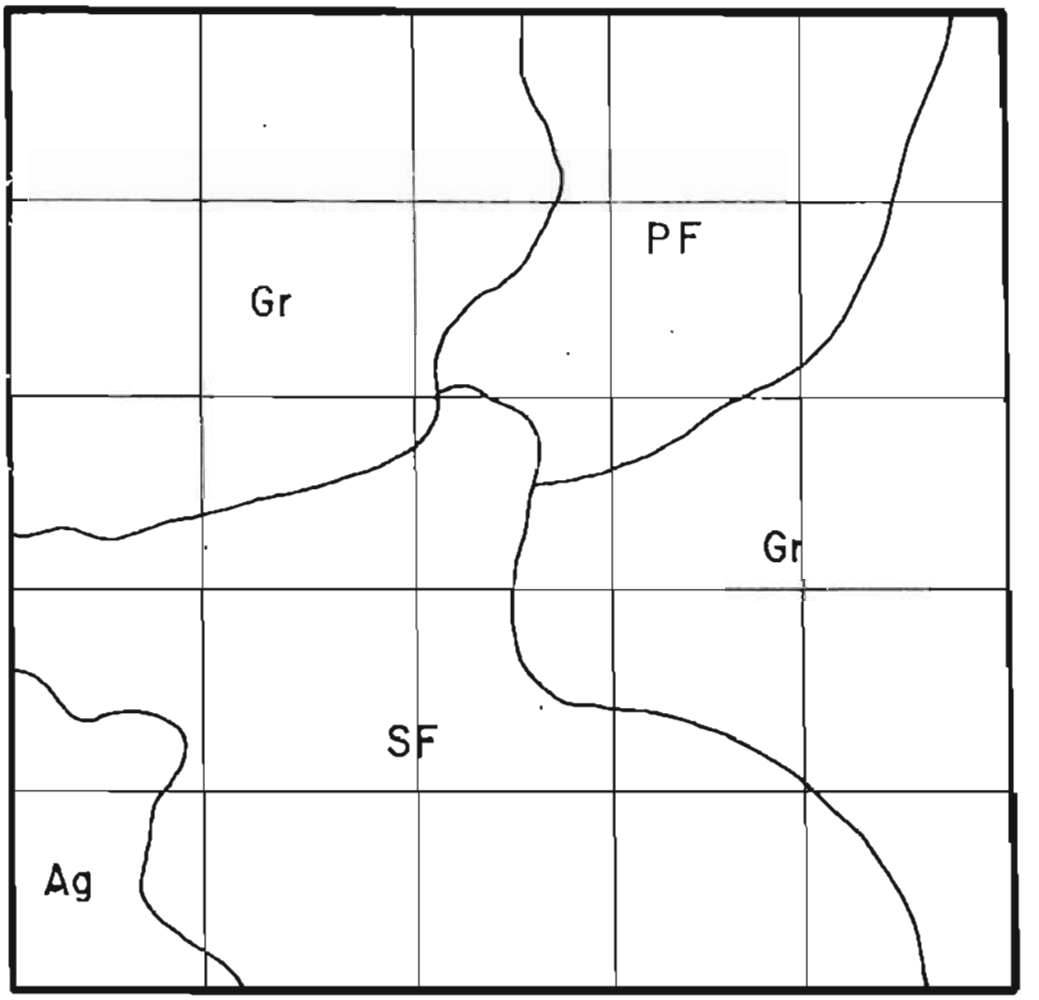
1 - Upland agricultural development

2 - Farmer-based upland development

3 - Community-based forest development

4 - Farmer-based forest productivity dev't

5 - Community-based forest productivity development/enhancement



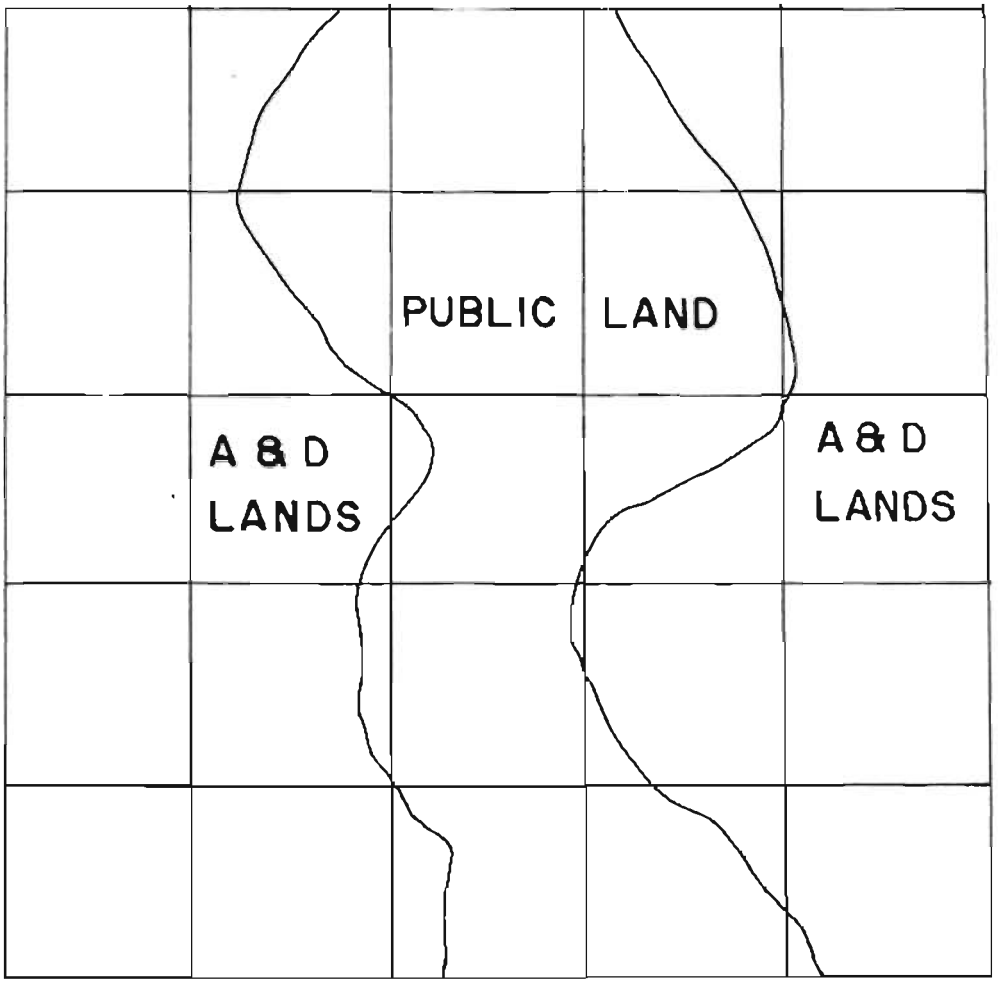
· LAND USE MAP ·

Ag - Agricultural

Gr — Grassland

SF -- Second growth forest

PF - Primary forest



MAP SHOWING THE DISTRIBUTION OF A & D AND PUBLIC LANDS