

## **CHAPTER 6**

# **BASIC CONCEPT OF WATERSHED MANAGEMENT PLAN FOR FOREST CONSERVATION**



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### **6.1 Impeding Factors of Watershed Management**

There are four main causes of forest degradation and resulting impediments to watershed conservation in the Model Area as described below.

#### **(1) Shortage of Farmland**

In the Model Area, where most of the local people are farmers, people are aware that rice is their principal crop to stabilize their lives. They think that the yield of rice in a specific year affects the family's living standard in the year. Yield of the principal crop is such a serious problem to them. As a large yield of paddy rice give immeasurably affluent lives to a family, much efforts are made to obtain a large area or to expand the area. People have seriously sought lands with a gentle gradient or irrigation water, but most of available lands are already cultivated. As a result, they deforested lands with a gentle gradient as the only remaining lands available for rice farming, and started slash and burn cultivation, which has become a major problem concerning watershed management.

#### **(2) Population Increase**

The population density of the Model Area of 16.9 persons/km<sup>2</sup> (national average: 19.4 persons/km<sup>2</sup>) is not particularly high although the local population has been steadily increasing due to a natural increase and migration from other areas. While this population increase has inevitably increased the necessity for higher food production, centering on rice, the limited availability of suitable land for paddy fields in the Model Area has left only slash and burn cultivation as a viable way of achieving higher production. As a result, the geographical scope of slash and burn cultivation has been extending. In order to sustain the lives of local people based on agricultural income in the Model Area, the present agricultural production system must be changed in view of the limited size of the remaining uncultivated land. Departure from rice-dependent farming practices and the establishment of new farming practices utilising mountain land in an effective manner must be considered. Such new practices must be expected to become established based on co-existence between forest conservation and sustainable agricultural production. In other words, new farming techniques must be introduced to ensure the effective use of available land while breaking away from slash and burn cultivation which is characterised by single cropping.

### (3) Low Labour Absorption Capacity of Other Industries

Apart from a cement factory which recently commenced production, agriculture is practically the only local industry capable of absorbing the local working population, illustrating the dominant status of agriculture in areas around Vangvieng. The shortage of farmland, however, means that local people are forced to rely on shifting cultivation.

### (4) Inadequate Forest Management

Local people point out the necessity to establish village boundaries, to allocate land, to establish forest and farmland boundaries and to introduce and enforce rules for forest utilization as measures to prevent forest degradation. These are basic forest management issues for which administrative inputs are important. The fact that they are pointed out by local people means that forest management up to the present has been inadequate.

These four main impeding factors of watershed management have resulted in "expansion and overuse of uncontrolled slash and burn land", "forest degradation", "frequent flood and decrease of river base flow" and "decrease of agricultural production". It is also possible to argue that these problems form a vicious circle. The expansion and overuse of uncontrolled slash and burn land cause forest fires, soil erosion and the decline of soil fertility, leading to forest degradation which in turn causes floods and a lower river flow rate in the dry season due to the depletion of forest resources and decline of the water yielding function of forests. Floods damage farmland and rural infrastructure while a decline of the river flow rate causes a shortage of both irrigation and domestic water, leading to a decline of agricultural production and a local food shortage to be compensated for by the expansion and overuse of slash and burn land.

The relationship between the impeding factors of watershed management and their vicious circle is shown in Fig. 6-1-1.

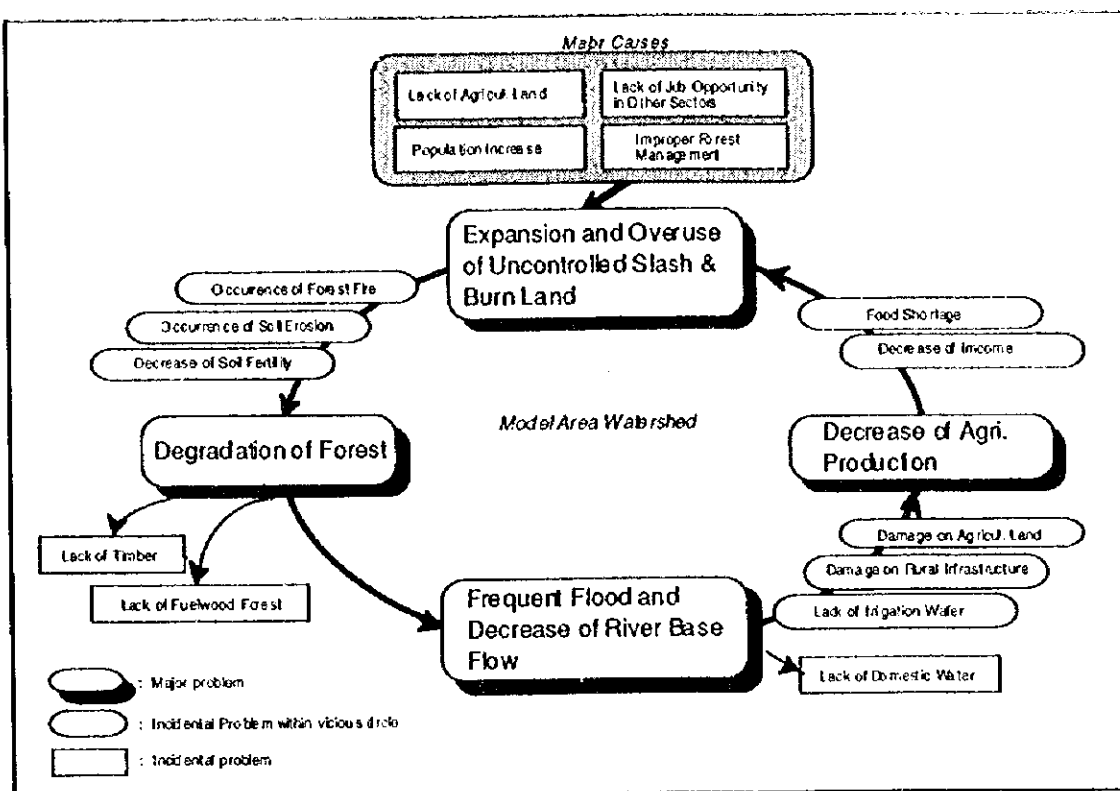


Fig. 6-1-1 Vicious Circle of Worsening Watershed Environment

The following problems are either directly or indirectly related to this vicious circle of a worsening watershed environment.

(1) Cultivation of Limited Number of Species

For local farming households, the stabilisation of daily life primarily means securing a sufficient quantity of food for their own consumption, followed by the need to obtain cash income by means of producing crops for sale. It was frequently noticed during the field survey that the types of crops sold in the local markets or shops were quite limited. As the cultivation of diverse crops and the sale of plentiful food should achieve a better life for both producers and consumers, it is necessary to depart from the monocultural type of land use relying only on rice production by slash and burn cultivation.

(2) Insufficiency of Social Infrastructure

At present, the local road network is not fully developed except for villages along national roads and some other villages. The lack of an efficient distribution system due to the poor road network results in the lower valuation of crops even if the

farming productivity is improved together with diversification of the crops. In addition, many villages still lack water and/or electricity supply systems.

### (3) Insufficiency of Agricultural and Forestry Extension System

There is a distinct shortage of opportunities and locations to actively train/upgrade agricultural and forestry extension workers, illustrating the poor extension system at present. As a result, farming households are unable to improve their cultivation techniques and to adopt new techniques.

### (4) Insufficient Educational Facilities

While primary schools should be constructed using village funding, the actual progress is slow due to shortage of the necessary funds. The resulting poor educational environment is believed to impede improvement of the educational level.

## **6.2 Expectations of Local People**

The findings of the socioeconomic baseline survey and PRA highly rank the following issues among the expectations of local people in regard to their work, daily life and development of social infrastructure, etc. These expectations will be taken into consideration in the formulation of the Plan.

- i) Easing of the work burden : slash and burn cultivation-related work and water fetching
- ii) Issues of strong interest : sufficient food, sufficient drinking water and cash income
- iii) Increase of cash income : rice, livestock, vegetables and fruit trees
- iv) Social infrastructure : roads, domestic water supply facilities and primary schools

## **6.3 Basic Principles of Watershed Management Plan**

Farming households in the Model Area have historically clung to rice-dominated agriculture which is heavily dependent on slash and burn cultivation sites on hillsides and paddy fields created in narrow valleys. The extremely extensive animal husbandry has been unable to have any impact on the constantly unstable management and resulting poverty of farming households. The farming productivity of slope land is naturally low and single cropping on this land cannot produce a sufficient harvest. As individual production increase measures using piecemeal techniques cannot guarantee improvement effects, new farming techniques enabling integrated land management are required. What is necessary in the future is reform of the

conventional land use with a view to developing complex farming practices involving useful trees, grains, vegetables, livestock and fruit trees.

Given the present natural as well as socioeconomic conditions described so far and the development principles adopted by the Government of Lao PDR for the agricultural and forestry field, i.e. (1) increased crop production, (2) stabilization of slash and burn cultivation and (3) promotion of experiments and research on agroforestry, it is decided that the objective of watershed management in the Model Area will be "conservation of the watershed environment in the Model Area stabilizing slash and burn cultivation". This objective cannot be achieved only by forest improvement and also demands conscious efforts to strengthen the agricultural production system and rural community support system and to develop rural infrastructure. The following principles are, therefore, adopted to achieve the objective.

- Introduction of a sustainable production system to replace slash and burn cultivation
- Improvement of the standard of living of local people and their living environment
- Rehabilitation of forests degraded by slash and burn cultivation
- Strengthening of the rural community support system

The necessary approaches to achieve these principles are described below.

- (1) Introduction of a sustainable production system to replace slash and burn cultivation: Improvement of the land productivity and labour productivity will be aimed at through the formulation of a land use plan based on the intentions of local people and diversification of production based on the land productivity evaluation results.
- (2) Improvement of the standard of living of local people and their living environment: Improvement of the local standard of living will be aimed at through improved income based on the measures described in (1) above and the development of social infrastructure, including roads, water supply system and schools.
- (3) Rehabilitation of forests degraded by slash and burn cultivation:  
The conservation of forests will be aimed at by means of planting trees in devastated forests.

(4) Strengthening of the rural community support system:

A plan to provide support which is required at least to achieve the above targets will be formulated.

Under the present Study, a PRA was conducted using each village as the basic unit to clarify the local land use problems with the participation of local people, and their expectations and needs in regard to land use were then identified. A watershed management plan was formulated using the results of this bottom-up approach with the participation of local people. The participation of local people is also an essential feature of the implementation of the said plan. In short, people play a main role in the plan, from planning to implementation.

The basic concept of the plan formulation process is illustrated in Fig. 6-2-1.

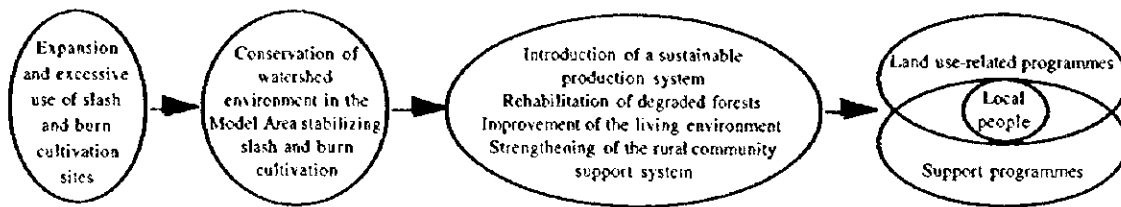


Fig. 6-2-1 Image of Basic Principles



## **CHAPTER 7**

# **WATERSHED MANAGEMENT PLAN FOR FOREST CONSERVATION**



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### **7.1    Framework for Watershed Management Plan**

This watershed management plan (the Plan) has been formulated based on the so-called bottom-up approach with the participation of local people while complying with four basic principles, i.e. "introduction of a sustainable production system", "rehabilitation of degraded forests", "improvement of the living environment" and "strengthening of the rural community support system". The issues taken into consideration in the plan formulation process include the needs and expectations of the public in regard to land use which were identified by the PRA, the legal system concerning land use, the natural environment, including topography and soil, and the living environment and agricultural production of local people. The participation of local people is also assumed for the implementation of the Plan.

As a result of the formulation of a land use plan designed to ensure rational land use, the Model Area is divided into the forest zone, symbiosis zone and agriculture zone. The Plan actually consists of projects which are appropriate vis-a-vis the characteristics of individual zones, such as the Forest Zone Conservation Plan, Symbiosis Zone Conservation Plan, Lowland Productivity Improvement Plan, Infrastructure Development Plan and Rural Community Supporting Plan.

### **7.2    Land Use Plan**

Suitable land use must be conducted, taking such relevant conditions as the land productivity (soil type), workability (gradient), environmental conservation (headwater conservation and prevention of soil loss) and legal regulations (conservation of the shores of dam reservoirs, etc.) into consideration. When land is newly developed, suitable land use can be ensured by meeting the above conditions. However, the common reality is that local people have already been cultivating the land and have their own ways of land use and their own expectations of land use. Compulsory land use enforced in the top-down manner may not meet the expectations of local people, resulting in unsuitable land use to meet the principal objectives. Meanwhile, the ideas of local people on land use may not properly reflect the actual site conditions and, therefore, their ideas may require improvement from the viewpoint of, for example, environmental conservation. Under the Study, the expectations of land use on the part of local people have been identified by the PRA and land use which takes such expectations as well as the natural conditions, legal regulations and other relevant issues into consideration is planned. The flow of the land use plan formulation process is summarised in Fig. 7-2-1.

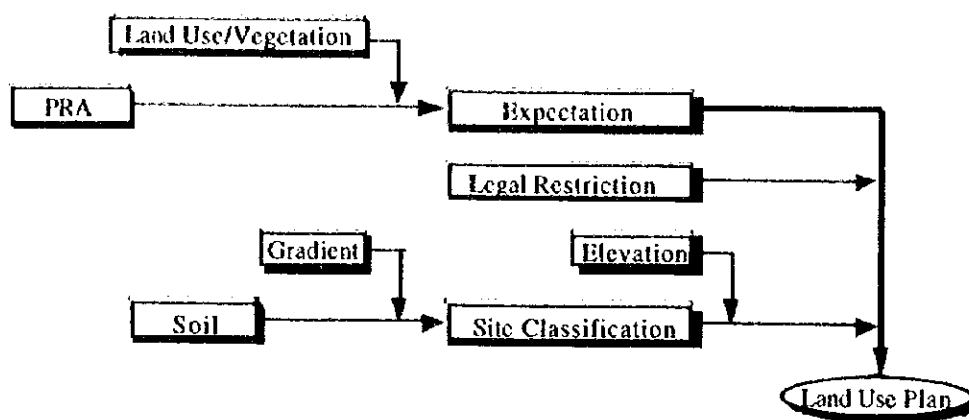


Fig. 7-2-1 Flow of Land Use Suitability Judgement

### 7.2.1 Land Use Based on PRA Results

The PRA survey established the expected land use expansion rate based on the present land use and the anticipated future land use. The rate is 1,100% for orchards, 900% for man-made forests, 400% for grassland (pasture), 150% for paddy fields and 140% for fish culture ponds. The rate for slash and burn sites is some 440% which can be interpreted as maintenance of the status quo when rotation of 4 - 5 years is taken into consideration. The expected expansion rate is particularly high for orchards and man-made forests, mainly because of the virtual absence of such land use at present. The high rate for pasture is attributed to the fact that fields currently used for grazing purposes are not classified as pasture. The priority land use categories for local people are farmland for the cultivation of such annual crops as paddy rice and vegetables (particularly irrigated paddy fields), orchards, pasture (grassland), fish culture ponds and man-made forests (for the production of commercial timber).

### 7.2.2 Land Use Based on Natural Conditions

The Model Area spreads from a hilly area to a mountainous area and the development of forests is essential for watershed conservation. Most local people are engaged in agriculture which is expected to remain the most important local industry in the future. Given these conditions, agriculture and forestry are considered the target land use types. The term "forestry" is used here in a broad sense to include the use of forests in addition to the production of commercial timber.

The soil type which is closely related to plant productivity and the slope gradient which is closely related to workability and soil loss for agriculture and forestry are used to represent the

natural site conditions. Accordingly, the production potential by soil type and slope gradient were combined to classify the site suitability for agriculture and forestry. Details of this classification work are given in Annex 4.

Based on the site classification results, the Model Area is roughly classified as "suitable site for agriculture", "more suitable site for forestry than agriculture", "moderately suitable site for both agriculture and forestry" and "unsuitable site for both agriculture and forestry". Of these, "unsuitable site for both agriculture and forestry" should be preserved as forest and is combined in the category of "more suitable site for forestry than agriculture" to form a new category of "suitable site for forestry". As a result, the Model Area is classified into three categories, i.e. "suitable site for agriculture", "suitable site for forestry" and "moderately suitable site for both agriculture and forestry". The distribution of these three land categories roughly coincides with the existing land use in the Model Area as described below.

- I) Suitable site for agriculture: area in which irrigated paddy cultivation is conducted
- II) Suitable site for forestry: remote area from a village centre or steep hillside where natural forests are observed
- III) Moderately suitable site for both agriculture and forestry: area in which slash and burn cultivation is widely conducted between the above two areas

The "suitable site for agriculture", "suitable site for forestry" and "moderately suitable site for both agriculture and forestry" are called the "agriculture zone", "forest zone" and "symbiosis zone" respectively. The distribution of each zone is shown in Fig. 7-2-2.

Present conditions of land use in the Model Area are indicated in Table 7-2-1. Land use by composition ratio is 37.6% forest, 48.1% present and former slash and burn sites, and 2% permanent farmland. The remainder comprises almost entirely water bodies. Some parts of former slash and burn sites will be again used as slash and burn cultivation sites in some years and some parts will not.



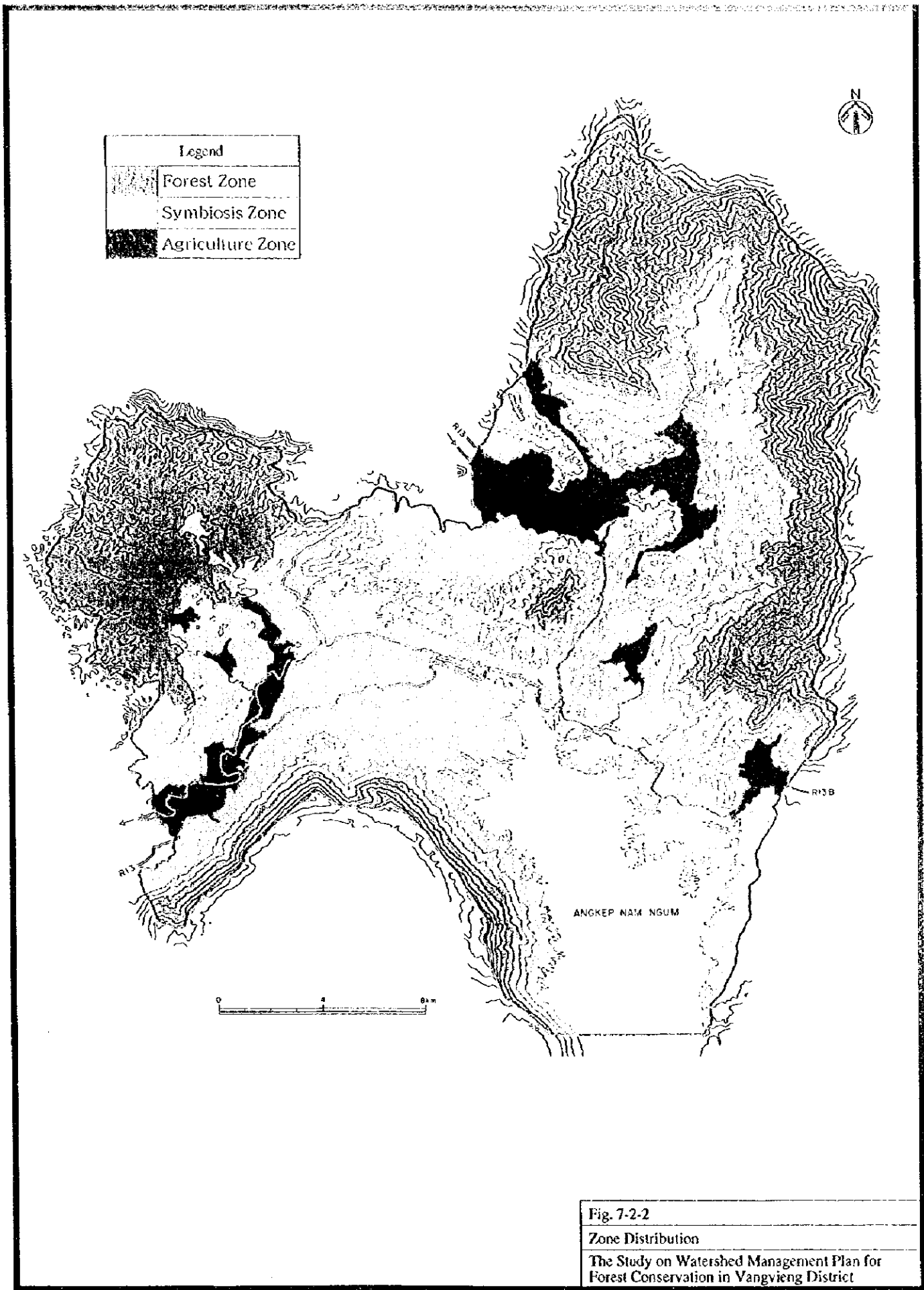


Fig. 7-2-2  
 Zone Distribution  
 The Study on Watershed Management Plan for  
 Forest Conservation in Vangvieng District





Table 7-2-1 Present Land Use in the Model Area

Land Use			Model Area		
Type		Code	ha	%	
Forest	Man-made Forest	Mf	27.5	0.0	
	Natural Forest	Primary	Npd1	455.3	0.8
			Npd2	1490.4	2.5
			Npd3	5004.8	8.4
			Npd4	1463.1	2.5
	Secondary	Nsd1	42.8	0.1	
		Nsd2	842.3	1.4	
		Nsd3	4766.2	8.0	
		Nsd4	6232.8	10.5	
	Bamboo Forest(1)	Bf	1851.9	3.1	
Shrub land	S	136.5	0.2		
Sub Total			22473.5	37.6	
S/B Site & Former S/B Site	Slash and Burn Site	Hs	2293.6	3.9	
	Bush	Bh	8012.4	13.5	
	Bamboo(2)	B2	9997.9	16.8	
	Grass land	G	8276.6	13.9	
	Sub Total			28580.5	48.1
Permanent Farmland	Low land Paddy	Lp	1127.5	1.9	
	Dry Farm land	Df	32.6	0.1	
	Orchard	Od	28.0	0.0	
	Sub Total			1188.1	2.0
Settlement		Co	508.0	0.9	
Bare land		Bc	367.4	0.6	
Water body		Ww	8417.6	14.1	
Total			59375.0	100.0	

The size of area of each zone is shown in Table 7-2-2 (1). Respective percentages of total area are 31.5% forest zone, 62.1% symbiosis zone and 6.4% agricultural zone.

Table 7-2-2 (1) Zone-wise Area

	Forest Zone	Symbiosis Zone	Agriculture Zone	Total
Area (ha)	18,694.0	36,860.6	3,820.5	59,375.0
Proportion(%)	31.5	62.1	6.4	100.0

Note: Figures have been rounded off; hence the discrepancy between the computed total figure and the breakdown

Current land use conditions in each zone are indicated in Table 7-2-2 (2).

In the case of the forest zone, the largest extent of the area is covered by forest (64.1%), with the remainder being entirely present or former slash and burn sites. Neither permanent farmland nor settlement are seen in the forest zone. Present and former slash and burn sites (55.1%) account for the greatest extent of area in the case of the symbiosis zone, followed by forest (26.9%) and water bodies (16.8%). In the agriculture zone, present and former slash and burn sites (40.7%) occupy the largest expanse of area. In comparison to other zones, the proportion of permanent farmland (27.3%) including lowland paddy and dry farm land is higher in this zone, and forest conversely accounts for only 11.4% of the area.

Table7-2-2 (2) Current Land Use by Zone

Land Use			Zone						
			Forest		Symbiosis		Agriculture		
Type	Code	ha	%	ha	%	ha	%		
Forest	Man-made Forest	Mf	0.0	0.0	19.7	0.1	7.8	0.2	
	Natural Forest	Primary	Npd1	435.2	2.3	20.1	0.1	0.0	0.0
			Npd2	1238.8	6.6	251.6	0.7	0.0	0.0
			Npd3	4497.7	24.1	507.1	1.4	0.0	0.0
			Npd4	1180.7	6.3	281.6	0.8	0.8	0.0
	Secondary	Nsd1	10.7	0.1	25.9	0.1	6.3	0.2	
		Nsd2	304.4	1.6	532.5	1.4	5.4	0.1	
		Nsd3	1901.1	10.2	2686.2	7.3	178.9	4.7	
		Nsd4	608.8	3.3	5423.1	14.7	201.0	5.3	
	Bamboo Forest(1)	B1	1698.9	9.1	148.9	0.4	4.1	0.1	
	Shrub land	S	101.0	0.5	4.6	0.0	30.8	0.8	
Sub Total			11977.1	64.1	9901.3	26.9	435.2	11.4	
S/B Site & Former S/B Site	Slash and Burn Site	Hy	349.6	1.9	1829.3	5.0	114.7	3.0	
	Bush	Bh	655.7	3.5	6404.8	17.4	951.9	24.9	
	Bamboo(2)	B2	3352.2	17.9	6249.4	17.0	396.3	10.4	
	Grass land	G	2357.9	12.6	5826.7	15.8	92.0	2.4	
	Sub Total			6715.4	35.8	20310.2	56.1	1554.9	40.7
Permanent Farmland	Low land Paddy	Lp	0.0	0.0	131.6	0.4	995.9	26.1	
	Dry Farm land	Df	0.0	0.0	4.4	0.0	28.2	0.7	
	Orchard	Od	0.0	0.0	10.5	0.0	17.5	0.5	
	Sub Total			0.0	0.0	146.5	0.4	1041.6	27.3
Settlement	Co	0.0	0.0	123.4	0.3	384.6	10.1		
Bare land	Bt	1.5	0.0	198.9	0.5	167.1	4.4		
Water body	Wv	0.0	0.0	6180.4	16.8	237.2	6.2		
Total			18694.0	100.0	35660.6	100.0	3620.5	100.0	

### 7.2.3 Land Use Plan

The land use plan has been prepared incorporating the expectations of local people in regard to such future land use as orchards and grassland (pasture), etc. which were clarified by the PRA. While local people want to continue the slash and burn cultivation of upland rice, the plan envisages the production of upland rice by means of agroforestry and slope land agriculture at permanent sites. The future land use plan is indicated in the separately attached Watershed Management Plan Map (scale: 1/20,000), based on present zone-wise land use conditions and the criteria set out in Table 7-2-3. An abbreviated version of this map is shown in Fig. 7-2-3.

Table 7-2-3 Land Use Plan

Land Use		Code	Forest Zone	Symbiosis Zone	Agriculture Zone	
Forest	Man-Made Forest	Mf		Man-Made Forest (Mfc)		
	Natural	Primary	Npd1	Natural Forest (Nn)	Natural Forest (Nu)	
			Npd2			
			Npd3			
			Npd4			
		Secondary	Nsd1		Agroforestry (Ag)	Dry Farmland (F1)
					Slope Land Agriculture (Sa)	
			Nsd2		Natural Forest (Nu)	
			Nsd3		Natural Forest (Nu)	
		Nsd4	Natural Forest (Nu)			
Bamboo Forest (1)	B1		Bamboo Forest (B)			
Shrub Land	S	Natural Forest (Nr)				
S/B Site & Former S/B Site	Slash and Burn Site	Hy	Man-Made Forest (R)	Agroforestry (Ag)	Dry Farmland (F1)	
				Slope Land Agriculture (Sa)		
	Bush	Bh	Natural Forest (Nr)	Man-Made Forest (R)		
	Bamboo (2)	B2		Improved Bamboo Forest (BI)		
	Grassland	G	Man-Made Forest (R)	Agroforestry (Ag)	Dry Farmland (F1)	
				Slope Land Agriculture (Sa)		
				Man-Made Forest (R)		
Permanent Farmland	Lowland Paddy	Lp		Preservation of present state		
	Dry Farmland	Df				
	Orchard	Oi				
Settlement		Co				
Bare Land		Br	Man-Made Forest (R)	Agroforestry (Ag)	Dry Farmland (F1)	
				Slope Land Agriculture (Sa)		
				Man-Made Forest (R)		



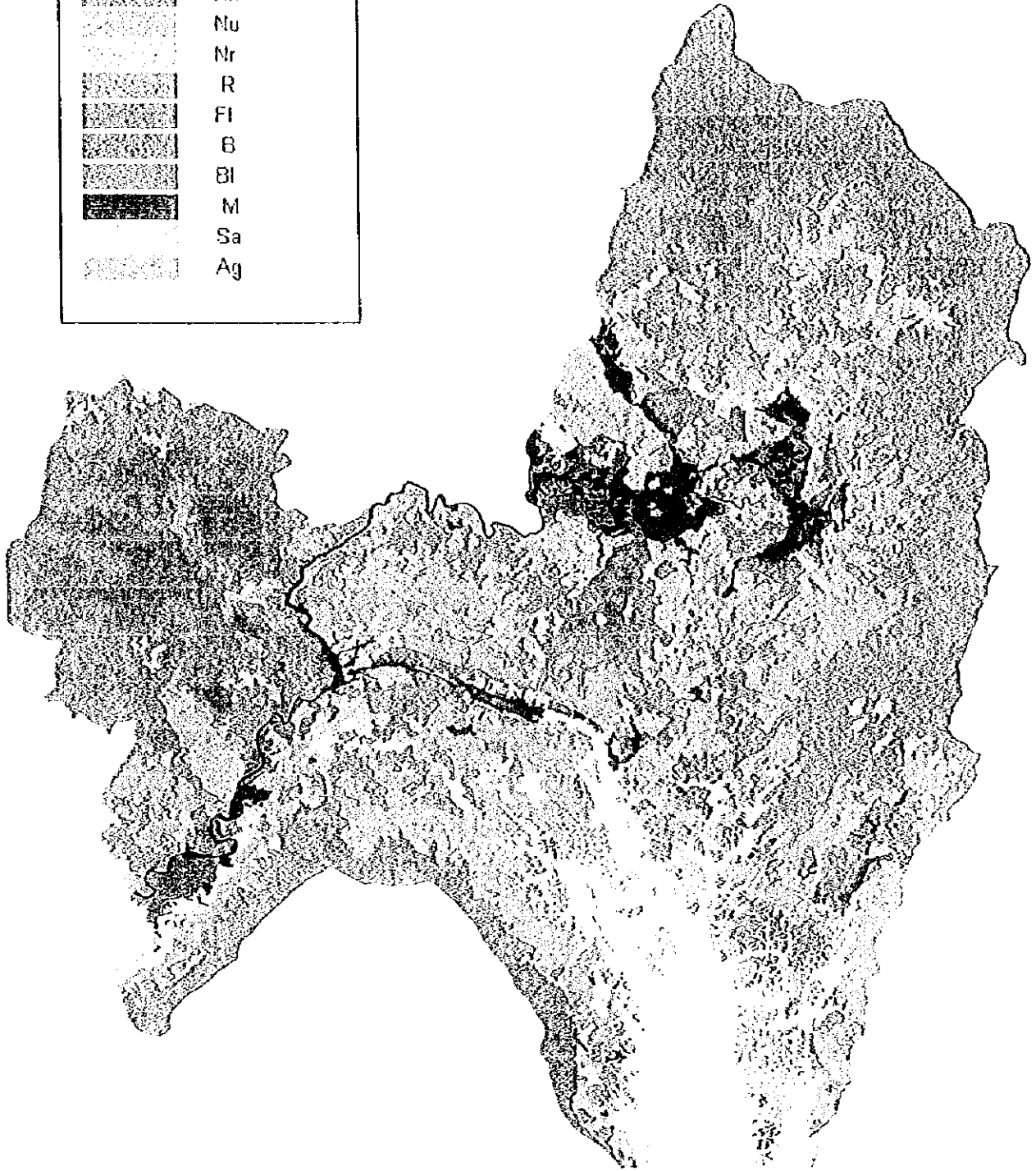
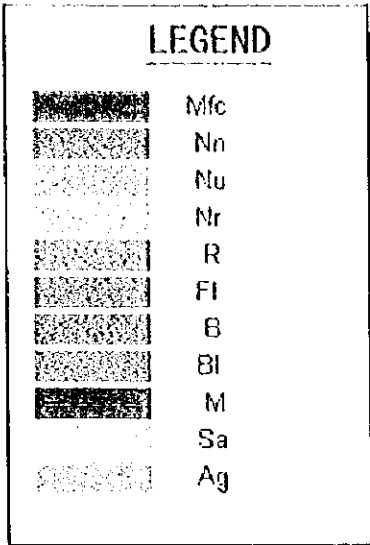


Fig. 7-2-3  
 Land Use Plan Map  
 The Study on Watershed Management Plan for  
 Forest Conservation in Vangvieng District



Current land use in the Model Area comprises 38% forest, 48% present and former slash and burn sites, and only 2% permanent farmland. The remaining 12% of the area is almost entirely water bodies.

Instead of slash and burn cultivation, future land use would entail permanent cultivation in the form of agroforestry and slope land agriculture on present and former slash and burn sites. Permanent cultivation would spare fallow slash and burn sites from the process of repeated burning, making possible forest regeneration.

In Fig. 7-2-4, changes in future land use are indicated by an arrow for that portion of the area which will undergo transition to forest land (broken line) and that portion which will convert to agricultural land (dotted line).

The area which will be forest in the future comprises the majority of present forest land (21,924 ha), some (16,375 ha) of present and former slash and burn sites, and a portion of bare land (53 ha). Total future forest area is 38,352 ha. Of this, 9,962 ha represents area which local residents want to preserve as protection forest.

On the other hand, the area which will be agricultural land in the future comprises a portion of existing forest (390 ha), some (12,205 ha) of present and former slash and burn sites, a portion of bare land (314 ha) and currently utilized permanent farmland (1,188 ha). Total future agricultural area is 14,097 ha.

Development of new farmland in the future agricultural area will be in the form of agroforestry (Ag), slope land agriculture (Sa) and expansion of farmland in agriculture zone (F1). This new farmland will be used as permanent farmland instead of slash and burn cultivation. The currently utilized permanent farmland will continue to be used in the same manner in the future.

Details of the land use plan for each category of current land use are given in Table 7-2-4. Details of the breakdown in Table 7-2-4 for forest zone, symbiosis zone and agriculture zone are shown in the Annex Fig. 4-1 (1). Zone-wise details for the Namon Area, Somboun Area and other areas (areas shared between villages; areas outside village boundaries) are given in the Annex Figs. 4-1 (2)-(4).

Land use planning format in the above figures adopts the designations indicated in Table 7-2-3. Also, land use classification of the area which local residents wish to see preserved as protection forest on the basis of the results of PRA is planned in line with land use under

management of forest zone. Area sizes of protection forest are indicated in parenthesis ( ) in tables indicating land use planning such as Table 7-2-4.

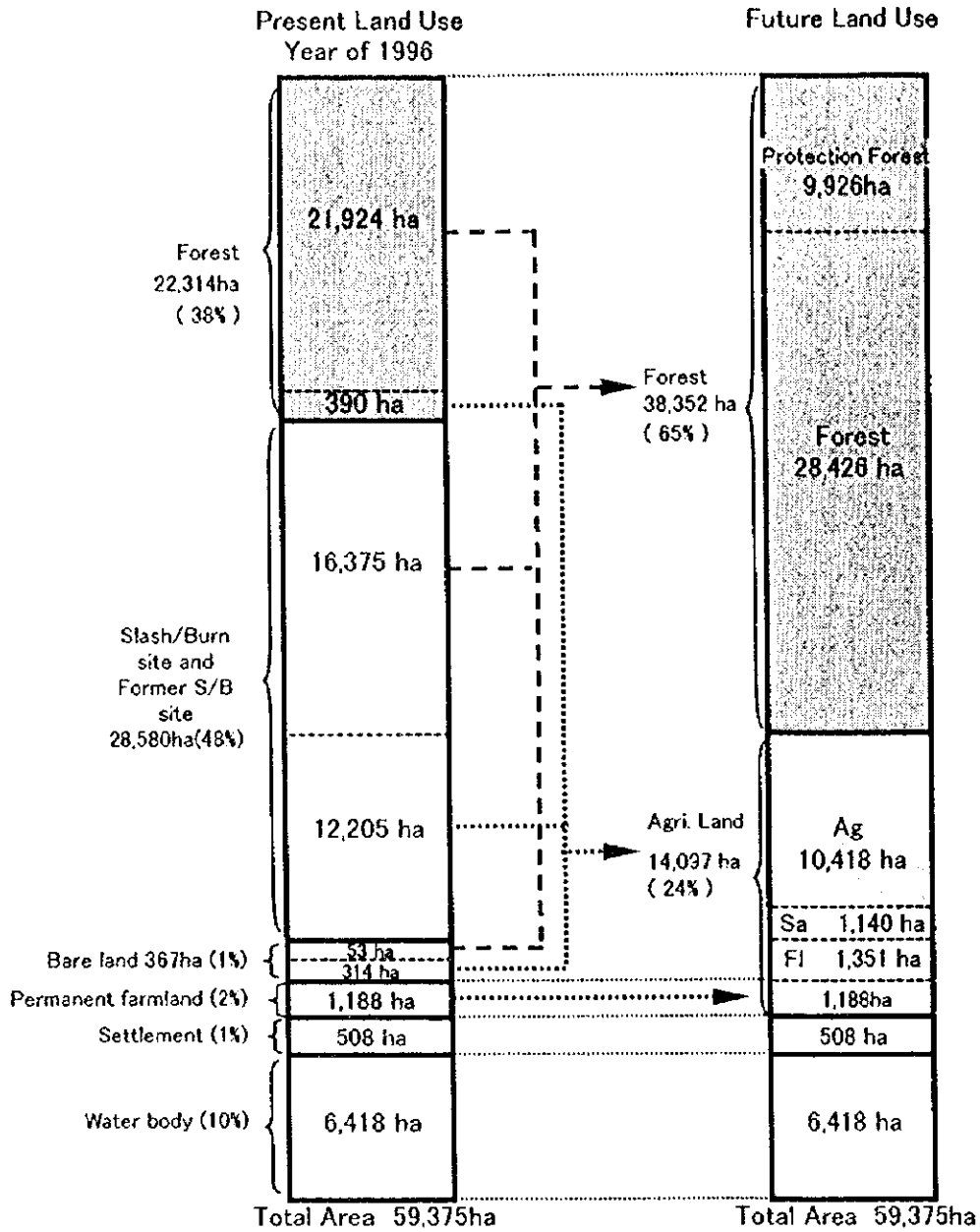


Fig.7-2-4 Land Use Change





The land use plan for the Model Area is shown in Fig. 7-2-4, taking into consideration watershed conservation in 10 years by means of converting the current practice of slash and burn cultivation with a three year rotation to cultivation permanent farmland. Assuming that one household is engaged in slash and burn cultivation for example, the conversion process from slash and burn cultivation to permanent farmland cultivation is examined here. In this hypothetical model, terraces are created for the permanent farm cultivation of upland rice and the unit yield is assumed to be the same as that of slash and burn cultivation. The conversion period is assumed to be five years with a gradual increase of permanent farmland while permitting slash and burn cultivation on a gradually diminishing scale during this period.

This model farming household has three slash and burn cultivation sites, i.e. A, B and C, of 1 ha each which is the average size of this type of site, as shown in Fig. 7-2-5. It is also assumed that a different site is cultivated each year under the slash and burn cultivation cycle, that slash and burn cultivation will come to an end after five years and that cultivation at a permanent farmland of 1 ha will produce the same yield as the present slash and burn cultivation.

As farmers will find it difficult to accept the outright conversion of 1 ha of land to permanent farmland in a single year, the permanent farmland should be increased by 20% annually with conducting slash and burn cultivation on a diminishing scale over a five-year period.

#### **Process of Conversion (See Fig.7-2-5)**

- 1<sup>st</sup> Year: Assuming commencement of permanent cultivation at location A, 20% of the area of A would be converted to terrace farm land and cultivated upland rice. Nevertheless, in order for the farmer to achieve his usual annual yield, slash and burn cultivation of 80% of the area of location B would be permitted.
- 2<sup>nd</sup> Year: Terrace farm land would be expanded to 40% of the area of A and upland rice cultivated. Cultivation of upland rice by slash and burn would be carried out in location C to provide the remaining 60% of usual annual yield. This year, the farmer would plant 20% of location B with bamboo in addition to upland rice.
- 3<sup>rd</sup> Year: Terrace farm land would be expanded to 60% of the area of A and upland rice cultivated. Cultivation of upland rice by slash and burn would be carried out in another location of C to provide the remaining 40% of usual annual yield. Bamboo plantation would be expanded to 40% of the area of B.

4<sup>th</sup> Year: Terrace farm land would be expanded to 80% of the area of A and upland rice cultivated. Cultivation of upland rice by slash and burn would be carried out in location B to provide the remaining 20% of usual annual yield. In the remaining area of B, fruit trees would be planted. From this year, slash and burn cultivation would be completely stopped in location C to allow for natural forest regeneration.

5<sup>th</sup> Year: Terrace farm land would be further expanded to cover the entire area of location A, and upland rice cultivated. This would mark the end of the farmer's need to engage in slash and burn cultivation, and the remaining area of location B would accordingly be planted with trees.

In the above manner, transition from slash and burn to permanent cultivation would be achieved in a 5-year period. Furthermore, location B would be available for planting with bamboo, fruit and trees or grazing live stocks. Under the subject model, planting of location B is envisioned at 40% bamboo, 40% fruit trees and 20% arboreal crops. Actual cropping pattern, however, would of course be in line with the aspirations of the farmers involved. Location C would ultimately be freed from slash and burn as well as permanent cultivation, and would be expected to naturally revert to forest.

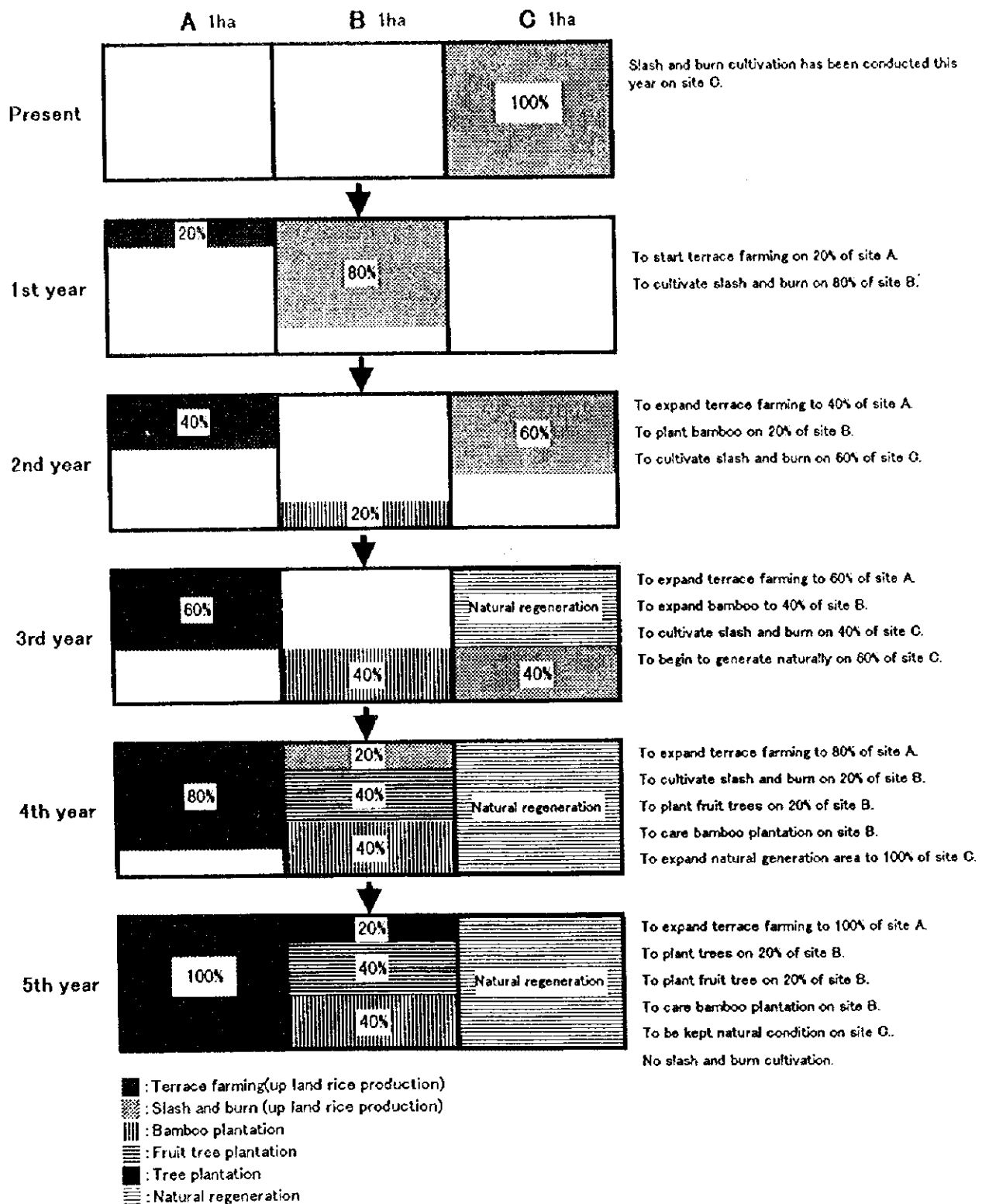


Fig.7-2-5 Procedure for Conversion from Slash and Burn to Permanent Cultivation

## 7.2.4 Land Use by Zone

### (1) Forest Zone

This zone is located in the upper reaches of the watershed and consists of steep slopes and areas which are remote from a village centre. As a result, few people enter this zone and most areas have been left as natural forests. Slash and burn cultivation has been taking place, however, at gently sloping areas in the zone. As the zone is distributed in a headwater area, the preservation of forests is intended to maintain the water yielding function.

Primary natural forests, secondary natural forests and Bamboo forest (1) will be preserved as forests (symbol: Nn) while shrub land and bush will be converted to natural forests (symbol: Nr) relying on the force of nature. At slash and burn sites, bamboo forest (2) sites and grassland, the planting (symbol: R) of local tree species is desirable for their early conversion to forests. Because of the difficult access to these remote areas, however, the restoration of natural forests will be attempted relying on the force of nature. In principle, cutting to produce timber or firewood will not be conducted in natural forests in order to consolidate their water yielding function but dying trees may be cut to maintain the vitality of forests. At those sites in the forest zone where local people want to conduct slash and burn cultivation, adoption of the types of agriculture which employ conservation measures to prevent soil loss will be encouraged. No man-made forest, permanent cultivation site or settlement currently exists in this zone.

### (2) Symbiosis Zone

The symbiosis zone is located between the forest zone and agriculture zone. Slash and burn cultivation is the main form of agriculture in this zone, causing a general decline of the land productivity. There are current slash and burn cultivation sites, fallow land and abandoned land due to the depletion of soil nutrients. The creation of symbiosis between forest and agriculture is planned for this zone by mixing such land use categories as natural forests, slope land agriculture (including pasture and orchards), man-made forests and bamboo forests in a mosaic manner.

In regard to natural forests, all primary natural forests and secondary natural forests with a stand density of 40% or more will be preserved as forests with a view to providing the necessary forest resources for local people (symbol: Nu).

The subject land for agriculture will be relatively sparse secondary natural forests with a crown density of less than 40%, shrub land, slash and burn cultivation sites, bush,

grassland and bare land. As this zone is situated on a hilly area without any flat land, slope land agriculture will be conducted. In the case of land with a gradient of less than 10°, farmland can be created on natural slopes. Slope land agriculture would be carried out on slopes with gradient less than 10° (symbol: Sa). In the case of land with a gradient of 10°-25°, agroforestry systems (symbol: Ag) would be introduced. Areas targeted for this type of agriculture would be terraced farmland to prevent soil erosion. The planned agroforestry systems are Silvi-Agriculture with the planting of firewood and fodder trees and the cultivation of crops and/or vegetables between these trees or the mixture of fruit trees with these trees, and silvo-pasture with stock raising among the trees.

All of the existing man-made forests(symbol: R) are teak forests. For those villages where the villagers want to plant trees to produce commercial timber, the creation of teak forests is planned with a view to future harvesting by means of clear cutting.

Bamboo forests (symbol: B) classified in the category of Bamboo Forest (1) with large diameter bamboo trees will be used to provide materials for housing and bamboo crafts. In the case of bamboo forests classified in the category of Bamboo Forest (2) with such low use value bamboo as May Shoth, the growth of large diameter bamboo will be encouraged or such large diameter bamboo as May Phaibaan will be planted to change the type of bamboo forest (symbol: BI).

The development principles for the forest zone will, in principle, apply to those areas where local people are considering the designation of protection forests. However, the details will be decided by each village.

### (3) Agriculture Zone

This zone represents areas in which irrigated paddy fields have been developed in the Model Area and, therefore, sites judged suitable for irrigated paddy fields have mostly already been developed as such. As the productivity and yield of lowland paddy are decisive factors in the livelihood of local farmers, the existing lowland paddy fields will almost certainly remain permanent farmland. There are some sites, albeit small in size, of which the conversion to dry farmland (symbol: Fl) will increase the farmland area in the agriculture zone. These include relatively sparse secondary natural forests with a crown density of less than 40%, shrub land, slash and burn sites, bush and grassland.

All primary natural forests, secondary natural forests with a stand density of 40% or more, those forests classified as Bamboo Forest (1) and Bamboo Forest (2) and man-made forests will be dealt with in the same manner as in the symbiosis zone.

The planned development patterns for various types of land use are summarised in Table 7-2-5.

Table 7-2-5 Planned Land Use Patterns

Land Use		Code	Forest Zone	Symbiosis Zone	Agriculture Zone	
Forest	Man-Made Forest	Mf		Clear cutting permitted (Mfc)		
	Natural	Primary	Npd1	Use of dead/damaged trees, hunting and collection of mushrooms, etc. permitted (Nn)	Possible use as firewood forest (Nu)	
			Npd2			
			Npd3			
			Npd4			
		Secondary	Nsd1		Gradient of less than 10°: slope land agriculture (Sa); gradient of 10°-25°: agroforestry (Ag)	Conversion to dry farmland (Fl)
			Nsd2			
			Nsd3		Possible use as firewood forest (Nu)	
			Nsd4			
	Bamboo Forest (1)	B1	Remains as bamboo forest (B)			
Shrub Land	S	Natural Regeneration (Nr)	Gradient of less than 10°: slope land agriculture (Sa); gradient of 10°-25°: agroforestry (Ag)	Conversion to dry farmland (Fl)		
S/B Site & Former S/B Site	Slash and Burn Site	Hy			Forest restoration by means of planting of local species or natural regeneration; agroforestry if so desired by local people (R)	
	Bush	Bh	Natural Regeneration (Nr)			
	Bamboo Forest (2)	B2	Forest restoration by means of planting of local species or natural regeneration (R)	Improvement of bamboo forests (BI)		
Permanent Farmland	Grassland	G	Forest restoration by means of planting of local species or natural regeneration (R)	Gradient of less than 10°: slope land agriculture (Sa); gradient of 10°-25°: agroforestry (Ag)	Conversion to dry farmland (Fl)	
	Lowland Paddy	Lp				Tree planting (R)
		Dry Farmland		Df	Preservation of present state	
Orchard	Oj					
Settlement		Co				
Bare Land		Br	Forest restoration by means of planting of local species (R)	Gradient of less than 10°: slope land agriculture (Sa); gradient of 10°-25°: agroforestry (Ag)	Conversion to dry farmland (Fl)	
				Tree planting (R)		

### **7.3 Forest Zone Conservation Plan**

When forest land is designated as protection forest pursuant to the Forest Law, local people are prohibited from not only the cutting and removal of trees but also from the removal of dead/damaged trees and windfalls from the designated area. The further prohibition of gathering mushrooms, wild plants and other non-wood forest products as well as hunting means that local people are practically banned from entering the area. These prohibitions are very effective to protect forests but may not necessarily prove effective forest conservation measures because of the fact that forest conservation requires proper forest management. Accordingly, no designation of protection forests will be conducted in the forest zone so as to enable the removal of naturally dead/damaged trees, hunting and the gathering of wild plants and mushrooms by local people if this is the case.

The planting of trees at bare land and land which has become grassland due to poor soil may be desirable in the forest zone to facilitate the quick restoration of forests. Given the facts that 1) the Model Area has suffered few landslides and, 2) enjoys the relatively quick recovery of vegetation due to a high level of rainfall provided and, 3) the forest zone is located in a remote area, however, natural regeneration will be selected for forest restoration purposes.

The current slash and burn sites in the forest zone will be dealt with in the same manner as sites in the symbiosis zone and agroforestry will be introduced to reduce the further degradation of forests due to slash and burn cultivation. The different types of agroforestry are described in the next section.

### **7.4 Symbiosis Zone Conservation Plan**

#### **7.4.1 Conservation of Natural Forests (symbol: Nu)**

All primary natural forests and secondary natural forests with a crown density of 40% or more will be made usable by local people for the collection of firewood and other purposes. When trees are cut to serve local people, the sites in question will be restored through natural regeneration by sprouting. Rules on the diameter of trees subject to cutting to produce firewood and also on the handling of protection forests to be established by villagers will be introduced to meet the intentions of villagers so that these forests can be protected by the villagers themselves.



## 7.4.2 Afforestation

### (1) Planting of Timber Trees (symbol: R)

The PRA found that people in 10 villages in the Namon Area and 13 villages in the Somboun Area want to plant trees to produce commercial timber. The feasible species for planting are *Tectona grandis* (teak) and *Pterocarpus macrocarpus*, *Azelia xilocarpa* and *Terminalia catappa*. Suitable species for planting in the Model Area are currently being examined by the FORCAP and no final decision has yet been made. For the present purposes, teak is assumed to be the planting species as teak is a local species which is popularly used for afforestation purposes in the Model Area.

The subject sites for planting are slash and burn sites, shrub land, bush, grassland and bare land as shown in Table 7-2-3. Since teak grows well either on gently sloping or flat land, it will not be planted on slopes with a gradient in excess of 25°. Appropriate sites for teak planting include the later discussed areas for introduction of agroforestry, slope land agriculture, expansion of field in the agriculture zone, etc. Within these areas, teak would be planted at locations where upland rice cultivation is not being practiced. The planting area is some 1,300 ha which is the total figure of areas suggested by various villages. This figure does not include planting at sites which appear to belong to shared area. At these overlapping sites, the village boundaries will firstly be decided based on the Land Forest Allocation Programme and a planting programme for each site will then be decided. The planting priority will be given to gently sloping land which is suitable for the planting of teak. Assuming that suitable sites for planting account for 70% of the subject sites, the total planting area will be approximately 900 ha.

The common planting density is 1,100 trees/ha based on a planting distance of 3 m × 3 m or 625 trees/ha based on a planting distance of 4 m × 4 m. A planting density of 1,100 trees/ha is adopted under the plan, taking the planting density recommended by the Forest Regulation into consideration. The total number of trees to be planted will be approximately one million.

The expectations of local people in regard to tree planting which were clarified by the PRA survey involve a planting schedule of five years, making the supply of 200,000 seedlings/year necessary. As the FORCAP intends the production of 200,000 seedlings/year from nurseries belonging to the afforestation centre and district office, these seedlings will be supplied to meet the demand from the nurseries. Local people will be responsible for planting work and for the erection of fencing to protect the planted areas from domestic animals.

As one component of efforts to extend artificial afforestation technology (planting methods and tree care) to the local population, suitable sites in the above planted areas which are favorable for tree growth will be designated as demonstration forests cum future seed orchards. These seed orchards will provide another source of income for local people through the sale of seeds.

Table 7-4-1 Planting for Timber Production

Namon Area		Somboun Area	
Village	(ha)	Village	(ha)
Vangmiang	54	Houaymo-Tai	55
Namon-Tai	39	Thahua-Nua	5
Namon-Nua	64	Thahua-Tai	1
Phonsavang	14	Houaypamom	50
Phonkeo	28	Nampat	18
Ngiou	7	Vangkhi	310
Nalao	60	Taothan	84
Nakhom	33	Nampath-Tai	80
Nangeun-Nua	160	Houayxi	34
Nampath-Nua	14	Namphao	2
		Phakoub	54
		Sivilai	210
Total	473	Total	903
Seedlings No.=(473+903)×0.7×1,100=1,000,000			

(2) Improvement of Bamboo Forests (symbol: B1)

Bamboo, often Mai Shoth, often start to grow at former slash and burn sites. Under the Study, these bamboo growing sites are classified in the category of Bamboo Forest (2) and the resulting area of this category totals some 10,000 ha in the Model Area. As monsoon areas in Southeast Asia provide the best habitat for bamboo growth in the world, there is no factor impeding the planting and growth of bamboo in the Model Area. Mai Shoth is characterised by a thin and slender culm and is considered to have little use value. Bamboo forests of low quality bamboo will be improved to high quality bamboo forests by means of increasing the diameter of culm of Mai Shoth or introducing other large bamboo species to replace Mai Shoth.

The improvement of Bamboo Forest (2) will be conducted at those villages along a national road in view of the convenience of transporting bamboo materials by road (refer to 8.1.1-(2)). The area of Bamboo Forest (2) in the subject villages is shown in Table 7-4-2. The total area is approximately 3,400 ha. Bamboo which is cut down during the bamboo forest improvement period will be used as fuelwood.

Table 7-4-2 Subject Villages of Bamboo Forest Improvement and Area

Namon Area		Somboun Area	
Village	(ha)	Village	(ha)
Namon-Nua	113	Houaymo-Nua	130
Phonkeo	106	Somsanouk	480
Nalao	556	Nampat	141
Nangeun-Nua	91	Vangkhi	757
Nangeun-Tai	110	Houayxi	491
Nampat-Nua	90	Namphao	353
Total	1066	Total	2352

1) Enlargement of Mai Shoth

Mai Shoth which naturally regenerates at former slash and burn sites consists of 4 - 6 culms per clump in the first year. Although the number of clumps is large to start with, they are quickly reduced to some 400 - 500 clumps/ha through the natural selection process.

Bamboo shoots appear approximately three times a year in the Model Area and the diameter class and length of the bamboo shoots increase each time they regenerate. To encourage this process, the number of clumps will be reduced to 350 - 400 in the fourth or fifth year in accordance with the state of growth. By cutting older, small diameter bamboo previously regenerated, usable culms can be produced in the fourth or fifth year. When the culms reach a usable diameter, they will be cut for use at a rate of approximately 25%. Cutting at a higher rate would reduce the supply of nutrients, disrupting the sustainability of bamboo growth and resulting in the decline of the bamboo forest.

2) Conversion to other large diameter species

Suitable species for the conversion of low quality bamboo forests to large diameter, high quality forests are Mai Hock and Mai Phaibaan, both of which are observed in the Model Area.

The propagation of bamboo can be conducted using seeds obtained after flowering or using cuttings. For the present purpose, the use of cuttings is selected in view of the easier process. A thick section of a 1 - 2 year old culm is used as cutting after removing the thin end. This should be horizontally planted some 30 cm below the surface of the ground. An original cutting can be cut into sections with one or two nodes each for planting in the above manner. After the cutting has been covered by

soil, it should be well watered. Young new culms start to appear approximately one month later but should be left for another two months or so and can then be dug up for use as bamboo seedlings.

The planting density should be 400 seedlings/ha. After tending for four years, they will grow sufficiently large enough for use as building materials for hedging, walls and roofs.

### **7.4.3 Agroforestry Development (symbol: Ag)**

Many farmers in all of the villages have so far relied on slash and burn cultivation to produce upland rice. This traditional farming method used to be an ideal way of obtaining grains from land other than lowland paddy fields when a long fallow period was possible. However, the repeated use of this method with a short rotation period in recent years has made it difficult for the vegetation to recover, causing loss of the top soil and lack of nutrient supply. In the worst case, destruction of the environment has resulted. The lack of trees and ground vegetation in particular has adversely affected the continuous supply of water, necessitating the introduction of appropriate forest conservation measures from the viewpoint of effective watershed management. In the case of the symbiosis zone, as this zone is important as a production area of grains and other agricultural products, any attempt at farming or stock raising must make the best use of the existing trees to achieve the required objectives. Under the present Plan, the introduction of an agroforestry system is envisaged based on such local conditions. Consequently, planting will not aim at forest restoration in the future but at assisting agriculture through the positive functions of trees. Two patterns of agroforestry are considered, i.e. silvi-agriculture which combines the planting of trees and crops (including fruit trees) and silvo-pastoral which combines the planting of trees and stock raising.

The subject agroforestry sites are shrub land, bush, grassland, bare land and sparse secondary natural forests with a slope gradient of 10° - 25°. Sites with a gradient of less than 10° are separated from the subject sites for agroforestry and slope land agriculture will be introduced at these sites. (See Annex 5 (AF) for details.)

#### **(1) Silvi-Agriculture**

There are two feasible sub-patterns, i.e. the combination of trees and agricultural products and the combination of trees and fruit trees. In the case of the former, the primary crop will be upland rice which is the most important crop for farmers. Such other crops as pulses, peppers, tomatoes, cabbages, melons, cassava and sweet potatoes can also be cultivated. The cultivation of diverse agricultural products in the shade of trees while growing upland

paddy on the slope is possible. When soybeans were cultivated under Eucalyptus trees, under a project of BURAPHIA in Lao PDR, the soybean production volume amounted to 300 - 400 kg/rai which translates to 940,000 - 2,000,000 kip/ha in terms of the sales price. As the income from upland rice is around 400,000 - 500,000 kip/ha, there is much room for improved income.

In the case of the sub-pattern combining trees and fruit trees, some time will be required to achieve the intended result as both are perennial plants. The introduction of this sub-pattern, therefore, requires a long-term commitment in terms of the local economy or surplus land which is not required to make an immediate return. Steady annual income can be generated once the fruit trees reach their fruit bearing age. This is the reason for the high expectations of this sub-pattern among farmers. The likely fruit trees for planting are banana, pineapple, papaya, mango and breadfruit.

As the subject areas of agroforestry have a slope gradient of  $10^{\circ}$  -  $25^{\circ}$ , measures to prevent soil loss will be required. The most effective way of preventing soil loss is the cutting of slopes to create stepped flat terraces. However, this requires a huge labour input. The fact that the geology of the Model Area is characterized by a deep weathered zone of sedimentary rock means few stones in hilly areas, making it difficult to locally obtain stones for the building of stone walls to protect the sloping sections of terraces. The planned solution is the contour planting of grass to create simplified terraces. This would be done at 3-meter intervals on slopes. With regard to type of grass species, local farmers express concern that it be a species which would not cause weed invasion of cultivated areas. It is further recommended that the selected species be drought resistant, with robust above ground as well as below ground plant growth, and that the species be a perennial type requiring no tending over the long term. In consideration of the foregoing, Lemon Grass (*Cymbopogon citratus*) and Weeping Lovegrass (*Eragrostis curvula*) would be appropriate species. The process of creating simplified terraces is illustrated in Fig. 7-4-1. The trees to be planted will be those of the Leguminosae family as these are both short and compact and have a small shaded area. They are also effective for soil improvement purposes. Once mature, they can be used as firewood and their branches and leaves can be used as animal fodder. Three lines of these trees will be planted in a zigzag manner for every five lines of pasture grass. When the subject site is a sparse secondary natural forest, useful trees will be kept.

The maintenance of farmland as permanent cultivation sites requires the supply of nutrients to the soil. The planting of leguminous trees is one measure to meet this requirement. Although the primary requirement is to make compost, the transportation of compost on a

slope is hard work. Therefore, Gramineae grass growing around farmland will instead be cut and buried on farmland to act as simple compost. This will not only reduce the adverse impacts of rain to prevent soil loss but will also supply necessary nutrients to the soil.

From the results of analyzing reports<sup>1) 2)</sup> regarding watershed management projects in Indonesia, a feasibility study report<sup>3)</sup> identified that terrace construction results in an average 15% increase in yield for cropping of upland rice, maize, kidney bean, peanut and soybean.

In the case of the above, chemical fertilizers were used in conjunction with terrace construction, implying that the resultant increased yield is not the effect of terrace farming alone. Nevertheless, it can be assumed that use of manure along with the planting of Leguminosae varieties would result in around a 10% increase in yields.

The PRA found that there are many villages which hope to plant fruit trees as listed in Table 7-4-3.

Table 7-4-3 Villages Hoping to Plant Fruit Trees and Planting Area

Namon Area		Somboun Area	
Village	(ha)	Village	(ha)
Namon-Nua	47	Houaymo-tai	9
Phonsavang	2	Thahua-Nua	4
Phonkeo	21	Thahua-Tai	6
Ngiou	5	Houaypamom	70
Nalao	33	Somsanouk	221
Nakhom	11	Nampat	43
Phongnang	3	Vangkhi	233
Nangeun-Nua	88	Phonthong	5
Nangeun-Tai	18	Taothan	87
Vanhua	6	Nampat-tai	12
		Houayxi	15
		Namphao	5
		Phakoub	172
Total	234	Total	882

<sup>1)</sup> Feasibility Study on Soil and Water Conservation Project for Upper Simalungun Watershed, Volume 1 Main Report, Watershed Management Consultants Korea and Indonesia, 1988

<sup>2)</sup> Institutional Strengthening for Evaluation and Effectiveness of The Upper Solo (Wonogiri) Watershed Protection Project, Project Planning and Implementation Unit, 1992.

<sup>3)</sup> The Feasibility Study on Upland Plantation and Land Development Project Citarik Sub-Watershed in The Republic of Indonesia, JICA 1993.

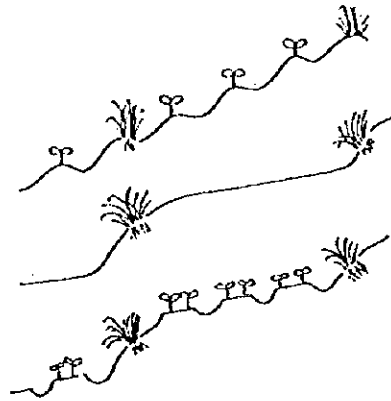


Fig. 7-4-1 Process of Creating Simplified Terraces

## (2) Silvo-Pastoral

Stock raising (particularly cattle) in the Model Area has so far relied on free grazing and households engaged in this practice have high expectations of a high income without the cost of animal feed. In contrast, other households have suffered serious damage as the animals feed on upland rice and other crops as well as grass. These households have erected fencing at farming sites to protect their crops. The strong concern in regard to animal damage is illustrated by the suggestion that one of the reasons why slash and burn cultivation is conducted in remote areas. However, the scale of stock raising will certainly increase in the future as more households acquire surplus capital. This trend has already been detected by the village survey results. The encouragement of an enclosed ranch system in the future is essential while analysing the optimal relationship between the land area and number of livestock to be raised and a desirable fodder production method, etc. Here, the introduction of silvo-pastoral is proposed from the viewpoint of introducing stock raising which reflects the local characteristics and which will contribute to forest conservation and watershed management.

### 1) Enclosure fencing

Naturally grown bamboo and/or trees on mountain land can be used as fencing materials together with barbed wire. However, the need for initial investment and constant repair due to poor durability are disadvantages of this type of fencing. The creation of hedges is proposed here as permanent fencing using such leguminous species as *Gliricidia sepium*. Apart from acting as enclosure fencing, such hedges

have the advantage of producing branches and leaves which can be used as fodder. To create hedges, such bamboo as Mai Shoth will firstly be used to make simple fencing, followed by the planting of suitable leguminous species at 70 - 80 cm intervals. Five hundred seedlings will be required per hectare.

## 2) Creation of shaded area for livestock

Small stands will be created on pasture land to allow livestock to avoid scorching sunshine. If small forests already exist in an enclosed area, they will be used for this purpose. One small stand of some 30 trees randomly planted at intervals of approximately 3 m will be created for each 2 - 3 ha. At the early stage of tree growth, it will be necessary to fence off the planted trees to protect them from the cattle. As it is unnecessary to consider the shading effect on crops as in the case of silviculture, those species which will grow sufficiently large to produce timber will be planted.

## 3) Grassland improvement

The cultivation of grass on pasture land is important to increase the productivity of livestock raising and, therefore, the introduction of high quality grass is desirable. While the full-scale cultivation of grass requires the use of a bulldozer to till the land, a simpler method which can be employed by local farmers will be used to improve the grass under the Plan in view of the principle of participation by local people.

As the mixed existence of gramineous grass and leguminous grass is desirable for pasture, the seeds of leguminous grass will be sown at grassland dominated by Gramineae grass to improve the grassland quality. Firstly, the Gramineae grass will be moved and holes will be made at 1-m intervals at the planned improvement site using a 15-cm diameter wood pile shaped like a sharpened pencil. Leguminous grass seeds will then be sown in these holes. Such holes will have a depth of approximately 10 cm and a diameter of approximately 5 cm. Fodder seeds can be purchased at the Namsoan Livestock Research Centre at a cost of 1,000 - 2,000 kip/kg. However, these seeds are unpopular among local farming households because their existing livestock prefer wild grass to fodder. The proposed solution is the collection of seeds of such leguminous grasses as *Alysicarpus* for sowing the following year and the amount of seeds collected in this manner should be gradually increased.

The PRA survey found that the villages listed in Table 7-4-4 hope to develop/improve grassland for stock raising.



Table 7-4-4 Villages Hoping to Improve Grassland and Subject Area

Namon Area		Somboun Area	
Village	(ha)	Village	(ha)
Vangmiang	113	Houaymo-Nua	68
Namon-Nua	155	Houaymo-Tai	37
Phonkeo	169	Houaypamom	147
Nalao	147	Somsanouk	206
Nakhom	44	Nampat	39
Phongnang	136	Vangkhi	452
Nangeun-Nua	98	Phonthong	40
Nangeun-Tai	48	Taothan	11
Vanghua	86	Nampat-tai	123
		Houayxi	258
		Namphao	148
<b>Total</b>	<b>996</b>	<b>Total</b>	<b>1529</b>

### (3) Planned Area for Agroforestry

The total subject area of agroforestry is 2,113 ha in the Namon Area and 4,283 ha in the Somboun Area based on the figures shown in Table 7-2-3. As some of this land is earmarked for fruit tree cultivation (Table 7-4-3) and grassland improvement by local people, the actual area subject to agroforestry where upland rice and vegetables are cultivated is 2,755 ha, consisting of 883 ha in the Namon Area and 1,872 ha in the Somboun Area. Calculation in the same manner indicates 3,564 ha for agroforestry development including upland rice and vegetable cultivation in the areas shared between villages and areas outside village boundaries.

Table 7-4-5 Planned Area for Agroforestry

Category	Village area		Sharing/Out of Village Area	Model area Total
	Namon	Somboun		
Agroforestry	2,113	4,283	4,022	10,418
Fruit Orchard	234	882	65	1,181
Pasture land	996	1,529	393	2,918
Upland Rice/Vegetable	883	1,872	3,564	6,319

#### 7.4.4 Slope Land Agriculture (Gradient of Less than 10°) (symbol: Sa)

Relatively gentle slopes with a gradient of less than 10° will be used as permanent farmland and these gentle slopes will still require soil loss prevention measures. To be more precise, the contour planting of grass at 3-m intervals on the slope will be conducted to create simplified terraces. The agricultural products to be grown on these terraces will be upland rice, pulses, peppers, tomatoes, cabbages, melons, cassava and sweet potatoes, etc. The maintenance of these terraces as permanent cultivation sites will require the supply of soil nutrients. While the

use of compost is desirable, the transportation of compost on slope land will be hard work and, therefore, Gramineae grass growing around the terraces will be cut and buried on the terraces to act as a compost substitute. This will not only reduce the adverse impacts of rain but will also supply the soil with necessary nutrients. The planting of such leguminous shrubs as *Sesbania sesban* around terraces should also prove effective to preserve the soil. The subject area of slope land agriculture is 199 ha in the Namon Area and 578 ha in the Somboun Area, totaling 777 ha. (see Annex 5 (AF) for details)

#### **7.4.5 Non Wood Forest Products Production**

A survey conducted by the Department of Forestry in Lao PDR estimates that the export value of non-wood forest products is at least US\$ 4.3 million (1996), amounting to 2.5% of Lao PDR's total export value. The main non-wood forest products are cardamon (*Amomun* spp.), kisi damar resin (*Shorea obtusa*) and sugar palm fruit. Cardamon is the primary non-wood forest product in Lao PDR, accounting for approximately half of the total export volume of non-wood forest products. Most of these products grow naturally.

The field survey conducted under the Study found that such non-wood forest products as bamboo shoots, mushrooms and cardamon are traded in local markets in the Vangvieng District. These products constitute a valuable source of cash income for minority ethnic groups. As the marketed products are naturally grown, however, the trading volume of each product is rather small.

There are seven key points to be considered for the extension of non-wood forest product cultivation as listed below.

- ① Site suitability : suitable for the climatic, soil and topographical conditions of the cultivation site
- ② Cultivation techniques : clarification of the cultivation requirements of each product and the systematic establishment of cultivation techniques
- ③ Labour : availability and combination of labour required for complex management
- ④ Profitability : production cost and profitability
- ⑤ Distribution system : buyers, shipment channels and transportation distance
- ⑥ Marketability : future marketing prospects

- ⑦ Growth potential : promising potential to form a special production area in the future

When planning the cultivation of cash crops, including non-wood forest products, it is generally difficult to select products which meet the above conditions for a mountainous area because of low land productivity and inferior marketing conditions. Cash crop production in such an area is, in fact, constantly threatened by market price fluctuations which are determined by the ever-changing supply and demand situation. Under these circumstances, it is believed that the implementation of the following three programmes will contribute to improving cash income in the Vangvieng District in view of the local natural conditions and marketability of the products involved.

- (NF-1) Charcoal Production
- (NF-2) Bamboo Production
- (NF-3) Cardamon Production

#### Charcoal Production

Firewood collected from neighbouring mountain forests and slash and burn cultivation sites in the Model Area is virtually the only fuel for most villages. Although the use of charcoal is not particularly popular in the Model Area, its use by restaurants in such commercial areas as Thahua-Nua and Thahua-Tai is an exception. The charcoal used in these areas is produced in the neighbouring Hineheup District as charcoal making is virtually non-existent in the Model Area. However, secondary forests from which local people obtain firewood are limited and the depletion of forests will be inevitable if the present situation continues.

In order to use forest resources more efficiently, the use of charcoal is recommended as charcoal has a better fuel efficiency than firewood, promising a reduction of the use of resources. In addition, charcoal is suitable for indoor use as it produces less smoke than firewood, contributing to the health of women who are responsible for cooking. The price of charcoal sold in Hineheup is 4,000 - 5,000 kip/bag (approximately 40 kg) but the price in Vientiane is as high as 7,000 - 9,000 kip/bag. As the use of charcoal is expected to increase in urban areas, locally produced charcoal can be marketed not only in the Vangvieng District but also in Vientiane in the future, providing local people with a valuable source of cash income.

There are various charcoal making methods, such as the kiln method, pit method and drum kiln method. Of these, the pit method has many advantages, such as a short time required to produce charcoal (approximately 10 hours), simplicity, low cost and compactness, making the use of

this method easier. Given these advantages, the pit method will be introduced in the Model Area.

When the development of charcoal wood forests has significantly progressed in the future with the establishment of a system to supply a sufficient quantity of charcoal wood, it may be feasible to plan the fostering of charcoal manufacturers to produce charcoal using the more advanced kiln method. However, the immediate task should be the widespread use of the pit method.

The supply of charcoal wood will be made using surplus wood at the time of creating farmland at agroforestry sites. In view of the fact that Mai Shoth, which is the main species of Bamboo Forests (2), is not particularly useful, the planting of more useful, large diameter bamboo species, such as Mai Phaibaan, Mai Hia and Mai Samphai, should be actively conducted to create superior quality bamboo forests to produce raw materials for bamboo charcoal. As bamboo is fast growing, harvesting will be possible in the fourth year after planting. Accordingly, it should be possible to use existing trees to produce charcoal wood while improving the quality of bamboo forests which will start to provide the raw materials for charcoal in the fourth year. (See Annex 5 (NF-1) for details.)

#### Bamboo Production

Bamboo is a very promising local resource because of its (i) suitability vis-a-vis the natural environment of the Model Area, (ii) ease of cultivation which does not require advanced technologies and (iii) ease of transportation to and marketability in Vientiane which is not far from the Model Area. Efforts will, therefore, be made to increase the cash income of local people by encouraging local bamboo production. (See Annex 5 (NF-2) for details.)

The improved bamboo forests will not only produce bamboo for use as bamboo but will also provide raw materials for bamboo charcoal. It will also be possible to increase income by means of creating added value in the form of bamboo crafts. There is currently no bamboo crafts producer in the Vangvieng District (including the Model Area) and bamboo crafts will be promoted in the future with the availability of high quality bamboo materials. (See Annex 5 (LS-7) for details.)

#### Cardamon Production

Cardamon is currently traded in Vangvieng albeit in a small quantity, suggesting that the local conditions are suitable for cardamon production. Although the price of this cash crop is significantly affected by market trends, earnings of 765,000 - 1,800,000 kip/ha can be

anticipated based on an average unit price of 4,500 kip/kg in 1996, making cardamon an attractive crop for farmers.

The ideal environment to grow cardamon is shady areas under trees on wind-free slope land and the cultivation of cardamon in forests or as part of agroforestry will be promoted. Under the programme, cardamon seeds will be distributed using the Village Revolving Fund System Establishment Programme to expand the cultivation of cardamon. (See Annex 5 (NF-3) for details.)

## **7.5 Agriculture Zone Plans**

### **7.5.1 Lowland Productivity Improvement Project**

According to the PRA results, villagers' needs are extremely high for expansion of lowland paddy land and increase of unit lowland paddy yield. However, the potential for lowland paddy expansion is considerably low in the Model Area due mainly to its steep topography and limited availability of irrigation water. Under such conditions, land productivity increase is the only possible approach to the development of lowland paddy land, and thus the following three programmes are proposed for implementation.

- (AP-1) Lowland Paddy Seeds Multiplication and Supply System Establishment
- (AP-2) Second Cropping Promotion in Lowland Paddy Land
- (AP-3) Fish Culture Expansion in Lowland Paddy Land

The paddy production system in the Model Area can be distinguished into two, i.e. slash and burn upland paddy production and lowland paddy production. And the number of farmers producing both upland and lowland paddy is small at only 12% of the paddy production farmers according to the PRA results. Therefore, productivity improvement of lowland paddy land would not directly affect the decrease of slash and burn land area. Through the implementation of the proposed programmes, however, gradual increase of slash and burn land due to the reduction of per capita lowland paddy land made by the generation changes would be hampered to a certain extent.

The Lowland Paddy Seeds Multiplication and Supply System Establishment will bring unit yield increase of lowland paddy through utilization of improved seeds recommended by MAF instead of deteriorated self-produced seeds. According to the result of first trial made by ARDP in 1997, the unit yield of the improved seeds was about 10% higher than that of farmers

self-produced seeds. It is thus proposed to promote this programme for implementation (see to Annex 5 (AP-1) for details).

The Second Cropping Promotion in Lowland Paddy Land will diversify crops in the existing lowland by introduction of short-growing crops which will be cultivated with limited irrigation water in the dry season. In the short-term, objective crops will be mainly for home consumption and/or local markets. With such crops, farmers are expected to learn cultivation and marketing techniques. In the medium-term, the objective crops will gradually be converted aiming at larger markets, e.g. Vientiane (see Annex 5 (AP-2) for details).

The Fish Culture Expansion in Lowland Paddy Land will increase the land productivity of lowland paddy land in which fish cultivation will be combined. This will bring additional income to the farmers and improve their nutrition. The existing production system practiced in Namon-Nua village will be applicable for the expansion. Since recent fish marketing prices are increasing due to the decreasing trend of fish catches in the Nam Ngum reservoir, this programme is expected to generate higher cash income for the farmers (see Annex 5 (AP-3) for details).

The above three programmes are proposed for implementation for 25 target villages where lowland paddy land is available. The priority order of the 25 villages for implementation has been decided based on selected criteria (e.g. proportion of lowland paddy households, cash income level, and unit yield of lowland paddy) using the SEBS and PRA results (see Annex 5 (AP-1) for details).

In the implementation, a demonstration farm will be established and operated under each programme for each target village. The demonstration farm establishment and operation will be carried out in cooperation with a farmers' group. The Project will provide a part of the costs for establishing the farm and technical assistance to the farmers' group. The farmers' group will provide farm land, and also a part of the costs for establishing the farm. In addition, the farmer group will be responsible for the farm/ crop operation and management. As a core of the village extension body, the farmers' group will work with the Project for the dissemination of crops and techniques demonstrated in the farm.

### **7.5.2 Expansion of Dry Farmland (symbol: F)**

Almost all flat land accessible to water in the agricultural zone has already been developed as paddy fields. However, some 993 ha of land (480 ha in the Namon Area and 513 ha in the Somboun Area) which may be developed as farmland still exists among bush land, grassland,

bare land and shrubland, etc. in this zone which is assumed not to have been developed as paddy fields because its generally high position from the riverbed makes the construction of suitable irrigation facilities difficult. This land could be used for grazing and the cultivation of fruit trees, etc. in the future.

## 7.6 Infrastructure Development Plan

Taking into consideration the results of the inventory survey for existing rural infrastructure and the villagers' preference for social infrastructure identified through PRA as shown in Table 7-6-1, three (3) development programmes, i) Improvement of local road (ID-1), ii) Improvement of domestic water supply (ID-2), and iii) Upgrading of primary school (ID-3), are proposed as components of the infrastructure development plan.

Table 7-6-1 Summary of the Preference Ranking of Villagers' Needs

Infrastructure	Preference ranking (Nos. of villages)				
	No.1	No.2	No.3	No.4	Total
Local road	8	2	2	1	13
Domestic water supply	9	7	6	1	23
Primary school	7	8	6	3	24
Electricity supply	5	3	2	1	11
Health service	0	6	7	8	21
Community hall	0	0	0	1	1
No reply	0	3	6	14	23
Total	29	29	29	29	94

### Improvement and new construction of local road

The objective of this programme is to expand the economic activities in the Model area through upgrading the existing local roads and constructing new ones, connecting the remote villages with Route 13. The programme consists of three main components: i) gravelling the existing earth roads (4.96 km in total length); ii) upgrading the existing cart road by gravelling (1.6 km in total); and iii) constructing new local roads (13.4 km in total), and bridges or crossing structures related to those roads. The improvement programme is planned and designed in accordance with the Road Design Manual (1996) applied by CTPC.

The villages involved in this programme are 11 villages in the Namon Area, of which three (3) villages are rather remote from Route 13 and no local roads connecting to those villages. According to the results of PRA, the villagers of the above three villages give high priority on

road improvement among the social infrastructure development works (see Annex 5 (ID-1) for details).

#### Construction of rural domestic water supply system

The target of this programme is to ensure the supply of domestic water to villagers in the Model area by means of either a gravity fed pipe water supply system (the pipe system) or dug wells/shallow tube wells. Where possible, the pipe system will first be examined in accordance with the guidelines of the Water Supply and Environmental Sanitation Programme, then construction of the wells will be considered for the villages where the pipe system is not feasible or not applicable.

This programme is proposed for 8 villages in the Namon Area and 13 villages in the Somboun Area, taking the present condition of the water supply system and villagers' preference in the Model Area into account. It is expected to relieve women and children from the daily work of handing domestic water and to improve the sanitary environment through selecting suitable water sources by implementation of the programme (see Annex 5 (ID-2) for details).

#### Existing primary school upgrading

Under this programme, the existing primary schools in the Model area would be upgraded to national standard level applied by the Ministry of Education. A total of 25 school buildings, consisting of 14 buildings in the Namon Area and 11 in the Somboun Area, would be improved, excepting school buildings in Sivilai and Somsanuk villages since these are presently under construction. Out of the 25 buildings, 2 in Houaypamon and Nampat villages would be renovated completely, because those school buildings are very temporary and very old (see Annex 5 (ID-3) for details).

#### Other Programmes

Other development programmes of rural electrification, the health service and irrigation facilities are not included in the social infrastructure development plan. The reasons are described in the following paragraphs.

- The rural electrification plan will be in accordance with the one which the EDL has.
- As for the irrigation development plan, since the lands suitable for irrigated paddy cultivation in the Model Area have been developed already or are being developed under such projects as the Upland Agriculture Development Project, a new development plan is not formulated in this Study. Upgrading the existing semi-permanent weirs such as wooden weirs or gabion



weirs is not considered because possible sites have been proposed to be included into the Community Irrigation Development Project (CIDP) and the upgrading of other sites are not promising in respect of double cropping of paddy, which is the minimum requirement for the upgrading. Other rehabilitation works required for the existing facilities are minor and should be carried out as part of routine maintenance.

- In order to improve the health service at the village level, it is advisable to install a health post into the villages which have no health center. It also would play a role of a base for medical volunteer's extension works. It is, however, recommended that the conference rooms to be constructed under the "Programme of upgrading of primary school" be used for the purpose of health post as well for the time being.

### **7.7 Rural Community Supporting Plan**

In the Rural Community Supporting Plan, the following seven programmes are planned.

- (LS-1) Land- Forest Allocation
- (LS-2) Village Revolving Fund System Development
- (LS-3) Weaving Entrepreneurship Development
- (LS-4) Skill-Based Informal Education
- (LS-5) Improved Cookstove Dissemination
- (LS-6) School Forest Establishment
- (LS-7) Bamboo Craft and Wood Craft Promotion

The on-going Land- Forest Allocation Programme will be implemented in the Model Area so as to support the forest conservation and development of upland farming in permanent agricultural land through clarification of the village boundaries and granting land use rights to individual families. The programme will cover all 29 villages in the Model Area. In the implementation, priority villages of the programme will be selected in accordance with the development programmes for agroforestry made in the permanent land. The PRA results will be of great use in reducing the cost and time for the implementation, because village boundaries and future land use confirmed with the villagers are available for all 29 villages in the Model Area (see Annex 5 (LS-1) for details).

The Revolving Fund System Development will basically support the expansion of agroforestry development in the permanent land through provision of investment and production loans to the

farmers who will lack funds for their land development and crop production. Although institutional credit services of APB are available in the Model Area at present, the farmers' capacity usually doesn't meet the APB's requirement (which generally requires collateral, most often in the form of land or housing). Under the programme, a village organization responsible for the management of the revolving fund system will firstly be established in each village. The Project will train the management staff for the system management in detail. The Project will then provide the initial fund of the organization, may be in kind particularly at the initial stage based on the requirement of the member farmers. The management staff will have to examine the propriety of members' loan requirements before making loans. The member farmers will have to repay the loan under certain conditions to be established. The repayment amounts will be loaned again to other member farmers. The Project will provide guidance periodically on proper fund/loan management to the management staff and effective production activities to the member farmers. Two auditors consisting of a village chief (or an other capable person) and DAFO staff will audit the fund/loan management of the organization. The programme will cover all 29 villages giving priority to the ones in which emphasis will be put on agroforestry development (see Annex 5 (LS-2) for details).

The Weaving Entrepreneurship Development will strengthen the village weaving system by providing training of trainers to selected village weavers. Under the programme, a capable weaver for the special training programme will be selected from each village. The training will cover various fields including quality control, book keeping, marketing, etc. The trained weaver will then take responsibility for training of other weavers in her village. With this programme, village women are expected to increase their cash income and improve vocational skills in a wider range of activities relevant to weaving. The programme will be implemented in all 29 villages (see Annex 5 (LS-3) for details).

The Skill-Based Informal Education will be implemented to improve the adult literacy rate particularly of women and improve women's technical skills in management of village level small projects. Under the programme, villagers interested in attending literacy class will be organized into a group. Teaching on writing and reading will be made by selected villagers or school teachers on a voluntary basis using materials to be provided by the Project. As an incentive, the Project will provide several training courses to the group members beside the literacy class. As one of the most important training courses, improved cookstove making is proposed to be undertaken by the programme as described in the next paragraph. As an alternative, training on home garden management is also proposed to be taken into account in order to improve the nutrition level of villagers, improve their technical level for crop diversification and increase their cash income. The programme will cover all 29 villages

giving priority to the ones in which emphasis will be put on agroforestry development (see Annex 5 (LS-4) for details).

The Improved Cookstove Dissemination will support the above programme of Skill-Based Informal Education. However, this programme alone can be promoted in villages having higher potential for development (may be in availability of materials) and expectation of villagers' participation. Under the programme, training on how to make an improved cookstove using locally available materials will be provided giving priority to the members of the literacy class group. The group will make the stoves and sell them to other villagers. Profit from the sale of stoves will be spent for purchasing of materials required for the operation of the literacy class, e.g. textbooks, notebooks and pencils. The operation of this programme will have effects on reduction of fuelwood consumption, mitigation of villagers' work load in fuelwood collection, and increase forest conservation potential at the village level. (see Annex 5 (LS-4) for details).

The School Forest Establishment will be implemented as one of the environmental education programmes mainly for primary school children and their parents. It will enlighten them the importance of the forest through the school forest establishment and its operation in cooperation with the Project. Tree planting and forest management techniques will be provided to them by the Project. Such techniques will possibly be utilized for the recovery of degraded forests existing in and around the villages in the future. Timber to be produced in the forests (after about 20 years) will possibly be utilized for school renovation, and fruits will possibly be consumed by the pupils or sold for cash income also for school renovation. This programme will be implemented in 12 villages in which complete primary schools (which are for five-year schooling) are located (see Annex 5 (LS-6) for details).

The "promotion of bamboo crafts and wood craft" will be put into practice when the production of high quality bamboo commences following the conversion of the Mai Shoth bamboo forests observed at former slash and burn cultivation sites to high quality bamboo forests. The main purpose will be to increase cash income by selling bamboo crafts using readily available bamboo (see Annex 5 (LS-7) for details). Also, wood carving and other woodworking handicrafts are another method to effectively utilize forest resources and at the same time improve villagers' income, and in this regard would be promoted along with bamboo crafts. A study would be made of extending this technology via the JICA overseas volunteer programme.

## **7.8 Relationship between Basic Policies and Development Programmes**

A number of programmes are planned based on the four principles described in Chapter 6. The relationship between the basic policies and the planned programmes is illustrated below.

There are six programmes, including the Agroforestry Development Programme, which are sustainable production systems. The Man-Made Forest Development Programme and Bamboo Plantation Programme aim at achieving the rehabilitation of degraded forests. Infrastructure development consists of the Improvement and New Construction of Local Roads Programme, Construction of Rural Domestic Water Supply Facilities Programme and Existing Primary School Upgrading Programme. There are seven programmes, including the Land Forest Allocation Programme and Village Revolving Fund System Establishment Programme to enhance the rural community support system.

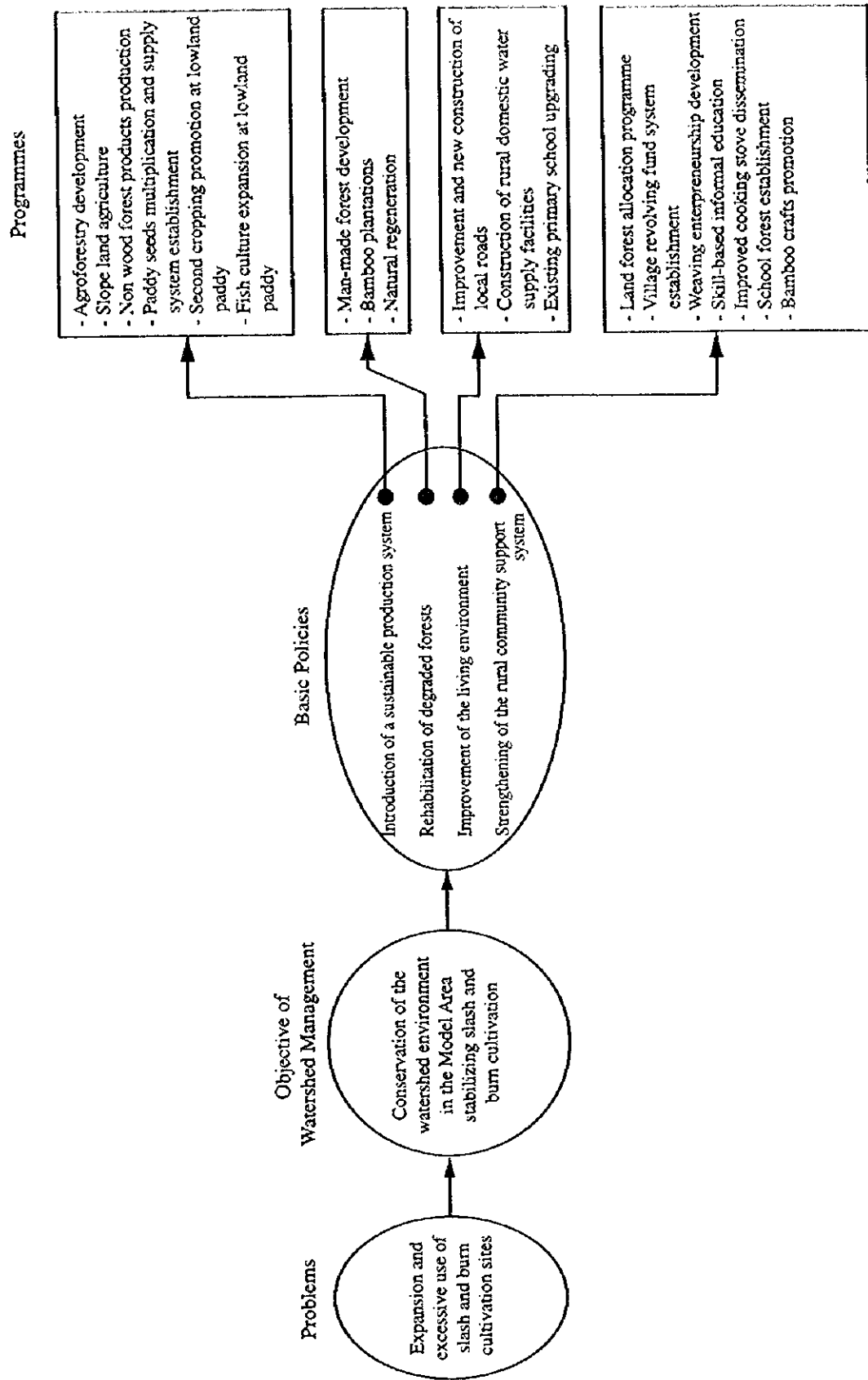


Fig. 7-8-1 Relationship between Basic Principles and Development Programmes

