

No. 2

Japan International Cooperation Agency (JICA)
Department for Forestry Development (DFD),
Ministry of Agriculture and Rural Development (MARD),
Socialist Republic of Viet Nam

**The Feasibility Study on the Forest Management Plan
in the Central Highland in Socialist Republic of Viet Nam**

Final Report

December 2002

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Japan Overseas Forestry Consultants Association (JOFCA)
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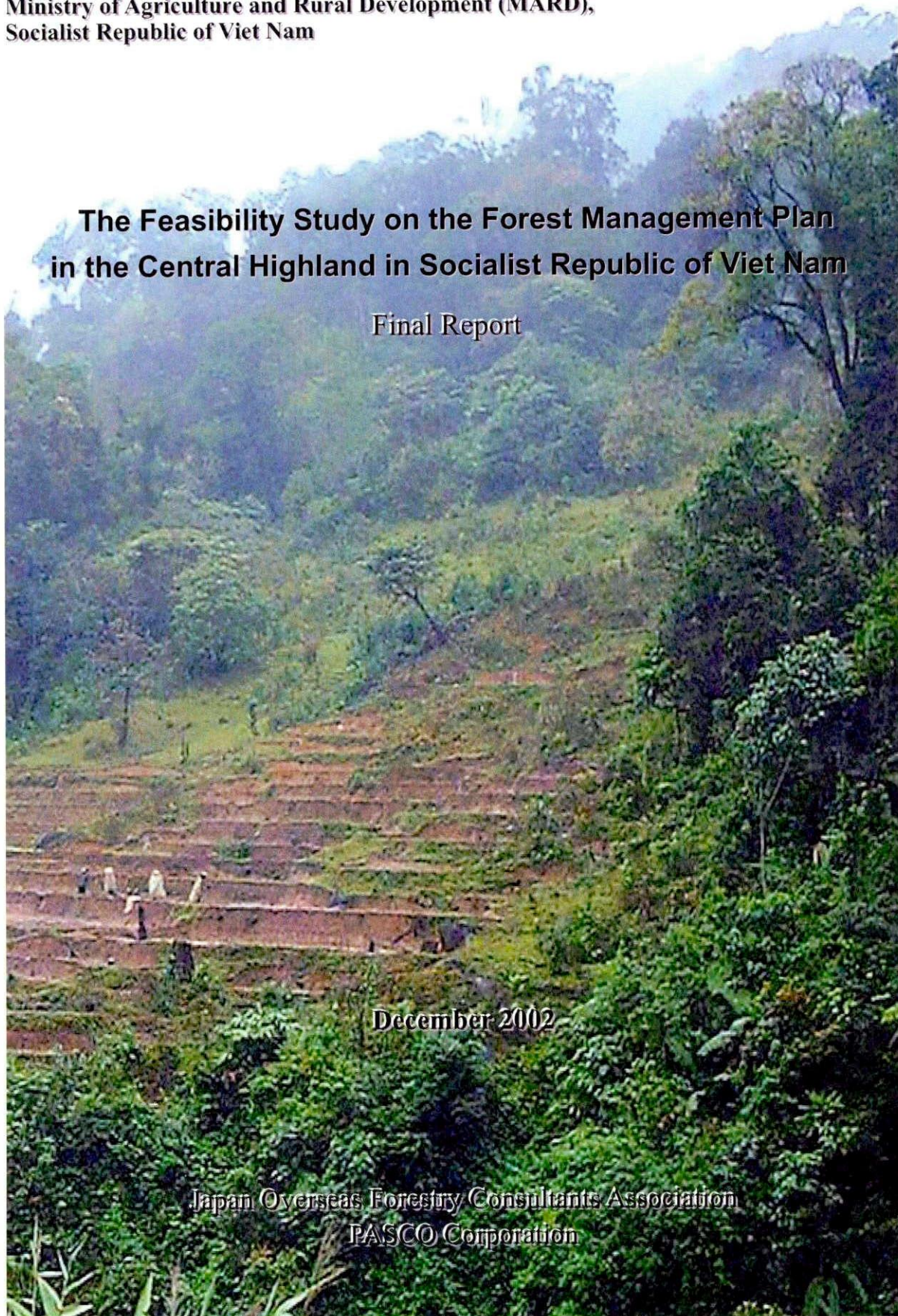
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PREFACE

In response to the request from the Government of Viet Nam, the Government of Japan decided to conduct a development study on the Feasibility Study on the Forest Management Plan in the Central Highland in Socialist Republic of Viet Nam and entrusted the study to Japan International Cooperation Agency (JICA).

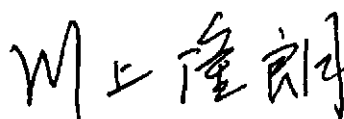
JICA sent to Viet Nam a study team headed by Mr. Nobumitsu Miyazaki, Japan Overseas Forestry Consultants Association, five times between February 2000 and October 2002.

The team held discussions with the officials concerned of the Government of Viet Nam, and conducted field surveys in the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Viet Nam for their close cooperation extended to the team.

December 2002



Takao Kawakami

President

Japan International Cooperation Agency

December 2002

Mr. Takao Kawakami
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Kawakami :

Letter of Transmittal

We are pleased to submit to you a report of the Feasibility Study on the Forest Management Plan in the Central Highland in Viet Nam.

The report covers the outcomes of the Study that have been conducted by our association collaborated with PASCO Corporation during the course from January 2000 to December 2002. The Study was organized to present guidelines on appropriate use of wood resources and forest management by local participation, and the model forest management plan for indicating the implementation methods towards sustainable management of natural forests in the Central Highlands. On the other hand, the Study also aimed to promote technology transfer on accumulation of basic information and planning methodology for formulation of sustainable forest management plan. It is highly expected that the Government of Viet Nam will facilitate forest management in the targeted area applying the outcomes of the Study as guidelines, whilst to extend formulation of sustainable forest management plans at the national level.

We wish to take this opportunity to express our tremendous gratitude to your organization, the Ministry of Foreign Affairs, Ministry of Agriculture, Forestry and Fisheries, and Forestry Agency for helpful cooperation. We also wish to show our deep appreciation to the Ministry of Agriculture and Rural Development of Viet Nam and the Japanese Embassy in Viet Nam for considered advices and cooperation.

Finally, we sincerely hope that your organization will employ the report for further successful cooperation in assisting sustainable forest management in Viet Nam.

Very truly yours,



Nobumitsu Miyazaki
Team Leader

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Abbreviations and Acronyms

| | |
|------------|---|
| BHN | Basic human needs |
| BUSKO | General Business Company of Kon Tum |
| CEA | Commune Extension Agency |
| C&I | Criteria and indicators |
| CMC | Commune Management Committee |
| DARD | Department of Agriculture and Rural Development, Kon Tum Province |
| DBH | Diameter at breast height |
| DFD | Department for Forestry Development |
| D/F report | Draft final report |
| ESMAP | Energy Sector Management Assistance Programme |
| FE(s) | Forest enterprise(s) |
| FIPI | Forest Inventory and Planning Institute, Viet Nam |
| F/S | Feasibility study |
| GIS | Geographic Information System |
| FAO | Food and Agriculture Organization |
| FMU | Forest management unit |
| FSC | Forest Stewardship Council |
| FSIV | Forest Science Institute of Viet Nam |
| GIS | Geographic Information System |
| GOJ | Government of Japan |
| GOV | Government of Viet Nam |
| GPS | Global Positioning System |
| ha | hectare |
| ITTO | International Tropical Timber Organization |
| JICA | Japan International Cooperation Agency |
| KOTIMEX | Kontum Import Export and Investment Company |
| MARD | Ministry of Agriculture and Rural Development, Viet Nam |
| MARDEC | Ministry of Agriculture and Rural Development Extension Centers |
| NGO(s) | Non-governmental organization(s) |
| NIMM | National Institute of Materia Medica |
| NRT | Natural resource tax |
| NTFP(s) | Non-timber forest product(s) |
| OJT | On-the-job training |
| PEC | Provincial Extension Center |
| PFMC | Protection Forest Management Committee |
| PRA | Participatory Rural Appraisal |
| RRA | Rapid Rural Appraisal |
| S/W | Scope of work |
| UNDP | United Nations Development Programme |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| VAT | Value added tax |
| VIFA | Vietnam Forest Science Technology Association |
| VND | Viet Nam Dong |
| VSP | Villager Support Program |
| WFP | World Food Programme |
| WWF | Worldwide Wildlife Foundation |

Introduction

This report presents the technical background, methodology and results of the Development Cooperation Study Program entitled “The Feasibility Study on the Forest Management Plan in the Central Highlands of the Socialist Republic of Viet Nam” (hereinafter referred to as “the Study”). This initiative was a joint effort of the Government of the Socialist Republic of Viet Nam (GOV) and the Government of Japan (GOJ). The Study was based on a Scope of Work document signed by the preparatory study team dispatched by the Japan International Cooperation Agency (JICA) and the Ministry of Agriculture and Rural Development (MARD) of the GOV.

The Study began in February 2000 and will be completed in November 2002. An Inception Report containing the detailed study plan was submitted on 22 February 2000. The Study has been implemented according to this plan. It is being conducted in two phases, the first phase covers the period from February 2000 to June 2001 to prepare a master plan for the forest areas of Kon Plong District, and the second phase covers from February 2002 to November 2002 to prepare a Model Forest Management Plan for the selected Model Area.

In this report, based on the master plan prepared during the Phase I study, guidelines of forest operations towards the sustainable forest management in Kon Plong District are described taking into consideration the importance of maintenance of forest multiple function, local people’s well-being and other various viewpoints. In the Phase II study, a detailed forest management plan is examined in conformity with the principles of the master plan within the management area by Mang La FE designated as the Model Area.

This report will consist of three volumes (Volume I: Main report on the Master plan in the Study Area, Volume II: Main report on the Forest Management Plan in the Model Area, Volume III: Background Data and Analysis Papers). Beside the reports, other related materials such as seven technical manuals, topographic maps, forest management plan maps for the Model Area, and a forest inventory book are being prepared as separate papers or books. As Volume III contains large amounts of data and information, it will be presented by CD-ROM attached with this volume.

Volume I covers forest management planning principles and guidelines for key forest operation programs that will be applied to future forest operations in the forest areas of Kon Plong District and is considered as the master plan. Volume II describes a forest management and conservation plan based on the principles of the master plan for the territory of a nominated forestry enterprise selected for preparing a model plan. Volume III provides various background data and information such as the legal conditions for regulating forest operations, the intentions and expectations of ethnic minority

peoples, and the status of wildlife in the study area collected through field survey activities.

The field surveys were conducted with the full support of counterpart organizations and local consultants, especially MARD, DFD, DARD of Kon Tum, the, the People's Committees of Kon Tum Province and Kon Plong District. FIPI and FSIV surveyors and researchers also contributed to collecting important data and information.

The study team members would like to take this opportunity to thank all the people involved.

Executive Summary

1 Objectives of the Study

The long-term objective of this master plan is to achieve sustainable forest management over the whole of this region. Specifically, it is intended to identify appropriate methods for classifying land use to facilitate sustainable forest use, to select productive forests for timber production in Kon Plong District, and to apply these methods to other regions and to the administration and management of forest enterprises operating in the Central Highlands. This master plan provides procedures for determining which forests should be administered and managed primarily for timber production. When considering a forest management plan in Kon Plong District, various aspects of forest management in specific areas need to be taken into account along with the actual condition of the forests, the socioeconomic environment, and administrative and managerial organizations. The procedures include setting out the principles for planning the sustainable management of the forests under the jurisdiction of each forest enterprise and other organizations responsible for forest management.

2 Principles of forest management

Principles applying to sustainable forest management are not limited to the sustainable extraction of timber. Sustainable administration and management involves maintaining the forest ecosystem and environment in perpetuity, including the forest soil and hierarchy; plants, insects, birds, large mammals and other living things that represent the various levels within the food chain. Moreover, maintaining and conserving the living environment of the people whose lives are intimately related to the forest also falls into the category of sustainable management. It is a fundamental principle of sustainable forest management that forest resources should be utilized without causing irreversible adverse effects on forests and the societies living in their proximity through the exercise of sound forest management, especially as it relates to timber extraction.

According to the Forest Development Program in the Central Highlands (1996-2000 & 2010), the policies for forest development in Kon Plong District are: 1) to protect existing forests to conserve watershed, gene resources and biodiversity, and to improve the sustainability of forest products, 2) to establish concentrated areas for forest plantations, 3) to establish industrial tree plantation areas and wood processing facilities, 4) to assist villagers to improve their living standards through encouraging agroforestry, and provide leadership in order to stop forest degradation, 5) to increase acceptance for transmigration, 6) to promote social forestry policies. These policies, other than item 5) (accepting immigrants) are in accordance with the objectives of sustainable forest management.

3 Current forest status

A land use and vegetation map was prepared from satellite data (TM), aerial photographs, and results from field surveys to show the actual status of land use in Kon Plong District and area aggregation was made by block through the GIS. Land use and vegetation were classified into ten categories (primary forests, evergreen broad-leaved secondary forests 1-3, semi-deciduous broad-leaved forests, dry open forests, man-made forests, bush, grassland, and farmland). As a result, the area of mature forests (primary forests, evergreen broad-leaved forests 1 & 2) that would be suitable for current timber production (logging) was estimated at about 126,000 ha. The areas of farmland, man-made forests, bush and grassland were estimated at 6,800 ha, 5,300 ha, 36,841 ha, and 19,816 ha, respectively. The forms of land use and vegetation are shown in Figure S.1.

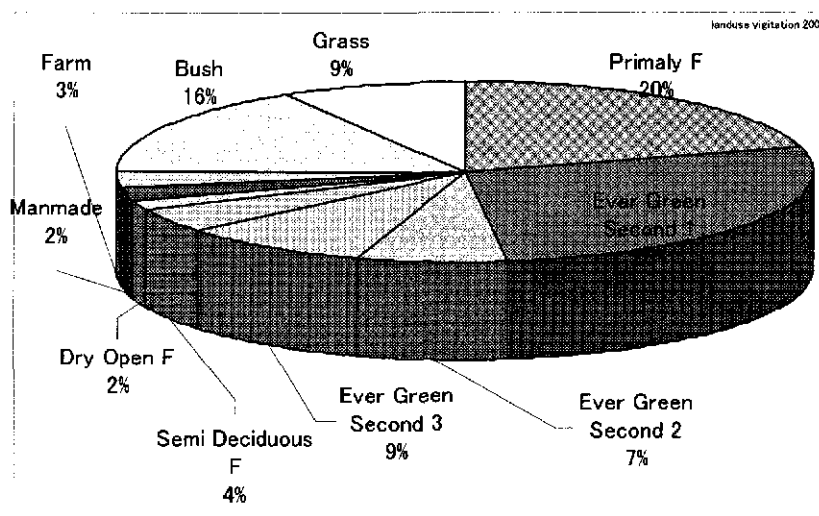


Figure S.1 Estimated current condition of land use and vegetation in Kon Plong District (as of Feb. 2001)

4 Target forests for timber production

Recognizing that timber production temporarily changes forest species and structure, as well as disturbing the forest floor, the team identified and excluded areas that might be particularly affected by the logging operation in terms of forest functions, including water resources, soil and land conservation. This work was conducted using the following procedures:

- (1) Performing a micro-topographical analysis by dividing the Study Area into a 500 m × 500 m mesh (grid squares) on a 1:50,000 scale topographical map.
- (2) Evaluating the possibility that the availability of water, along with soil and land conservation, could be deleteriously affected by removing groundcover.
- (3) Conducting a general evaluation of effects on these three functions and identification of forest areas that should be conserved in order to maintain these functions.
- (4) Making the final determination of forest areas that should be excluded from the logging operation in relation to the topography of areas in the evaluated meshes (grid squares).
- (5) Excluding steep slopes on the same topographical map from logging for the time being because

the current log hauling techniques might disturb the forest floor to an unacceptable degree.

As a result, an area of 12,800 ha for the entire Kon Plong District (including about 4,000 ha of matured forests for logging) was excluded from the logging operation in order to maintain forest functions, and steep slopes with a total area of 4,700 ha (including about 1,200 ha of matured forests) were also excluded.

5 Wildlife protection

The nature reserves of Kon Ka Kin and Kon Ka Lang lie in the southern part of this region, and the nature reserves of Ngoc Linh and the similar area of Son Tan Dak Ninh, which is under consideration for protection, are in the northwestern area near the boundary with Laos. These important areas are sanctuaries for wildlife species in Kon Plong District, and the Study Area is regarded as important wildlife migration forest areas linked with the protected areas. For this reason, those in charge of forest operations should take more care to secure a bio-corridor between the protected areas in the southern and northern parts of this region and maintain natural forest areas as wildlife habitats.

As a result, bio-corridors amounting to about 15,500 ha (including 9,200 ha across the existing protected areas, and 5,300 ha across the productive forest areas) were demarcated as the most important areas for wildlife protection, with a special emphasis on the prevention of poaching. Besides these corridors, natural forests will also be conserved for wildlife protection, including forests in the protected areas, those designated for selective cutting and those under commune management, and these will be excluded from logging for the time being. On the whole, a total of over 100,000 ha of natural forests will be conserved for wildlife protection.

6 Forest decrease and degradation

There are 12 communes divided into 118 villages in Kon Plong District. According to the survey by the People's Committee in 2001, there are 32,700 people in 6,400 households in this district. The Xe Dang ethnic group accounts for slightly more than 50% of the local population, the Ba Na for 18% followed by X Ra, Mon Nam and other ethnic groups. Kinh people live in every commune and account for 15% of the population. Their incomes are generally low, and 41% of all families have difficulty in securing food by themselves. The existence of these poor families is a potential risk factor for forest decrease and degradation. The primary factor which may threaten sustainable forest management is the decrease of forest cover in real terms.

Forest decrease and degradation that have occurred in Kon Plong District are analysed to be derived

from: i) shifting cultivation, ii) strong dependency on forests by immigrants due to the temporary delay of countermeasures, iii) poverty of local households and encroachment on forests to supplement the low productivity of existing farmlands, iv) over-collection of forest products; e.g. fuelwood, in the boarder between forests and farmlands.

During the course of developing this master plan, the actual decrease of forests in this region was analyzed from aerial photographs taken in 1991 and satellite images taken in 2001. Whereas the area of forests replaced by shifting cultivation (including areas which were once sparsely inhabited but are now occupied by shifting cultivation) is estimated at 21,900 ha, the area of regenerated forest is estimated at 9,000 ha. Thus, 12,000 ha of forest (about 8% of 150,000 ha of existing natural forests including secondary ones) have disappeared.

Shifting cultivation areas have increased in the Dak Ruong, Dak Pnc, Mang Canh, Hieu, Po E and Tan Lap Communes and Kon Plong Town. In other communes, forests have not significantly decreased in area. On the other hand, forests have recovered in the remotest Dak Ring Commune. Judging from these results, it is debatable whether uncontrolled shifting cultivation by ethnic minorities in the mountains is the sole cause of the decline in the whole forest area. Presumably, the number of people who moved to other areas or communes is closely related to the increase in shifting cultivation areas, whether these movements are a result of policy or are occurring naturally.

7 Selection of forest operation units and principles of forest operations

With all of the above in mind, the following criteria, which are objectives of the master plan, were determined for selecting sites for timber harvesting, planting, stand improvement and the Villager Support Program prior to forest operations.

(1) Maintain the forest functions of water, soil and land conservation

In order to conserve water, soil and land, the following areas should be excluded from the normal level of selective cutting. The construction of access roads for logging should also be avoided.

- a. Steep slopes with an inclination of over 30 degrees
- b. Forest areas which are more likely to be functionally degraded by the removal of groundcover.

(2) Selection to reserve lands for the local people

Suitable land should be provided for improving the lives of those who have lived in forest areas and maintained a traditional lifestyle. For this purpose, the following forests should be excluded from normal logging operations.

- a. An area of grassland surrounding villages of sufficient size to allow the villagers uninterrupted use of their agricultural land
- b. Small flats and slopes along the valleys suitable for cultivating paddies near villages
- c. Grasslands near villages suitable for agroforestry
- d. Pastures for domestic animals surrounding houses.

(3) Set aside forests necessary for conserving biodiversity from logging operations

To protect wildlife and biodiversity, forests should be conserved and maintained in a natural condition so as to provide suitable habitats for protected wildlife species. The following forests should also be kept closed and in a natural state in order to facilitate the movement and migration of these species from one protected area to another.

- a. Bio-corridors for large animals to move and migrate from one nature reserve to another
- b. Small natural forests (about 100 ha) which provide designated animals and plants (endangered, rare and indigenous species) with habitats and sites for breeding, nesting and propagation
- c. Small areas of bush along rivers for small animals to breed, rest and hide.

(4) Select harvesting systems for sustainable management on production forest of productive forests

When logging and extracting timber, much care should be taken to avoid significant damage to forest functions. Even in productive forests other than the areas in Item (1) above, constant care should be taken to maintain forest functions. The following points should be taken into consideration when selecting logging systems for productive forests (selective cutting with yield percentage, clear cutting, etc.). In areas at altitudes of over 1,000 m, the existing natural forests should not be felled and converted into single-layered pine forests.

(a) Clear cutting—Afforestation system

In General, the clear cutting of old growth forests to convert highly productive plantations is effective in improving timber productivity. However, natural forests in Kon Plong District are almost all distributed at altitudes of over 1,000 m, where there are only a

limited number of suitable sites for fast-growing Eucalyptus species. Pine trees are harvested 30 years after planting, and if these trees are not able to achieve a volume of about 400 m³/ha, which is the minimum required to be economically viable, employment of the clear cutting—man-made forest operation system should be avoided .

(b) Selective cutting with limitation (Lower than usual logging rate)

Around bio-corridors, the level/ratio of selective cutting should be lower than usual. In the upper reaches of streams that are sources of water for paddy fields and drinking water, areas on both sides of streams about 1 km above the water-fetching site, the yield percentage should be limited to half of the normal cutting ratio not to disturb the forest floor and not to lead sediment to streams and paddies.

(c) Production forests mainly for timber production

Production forests of natural forest other than the areas in Items (1) to (3) above will be defined as the target areas for selective cutting. As shown in Item (4) (a) above, the “clear cutting and manmade forest” approach is not recommended for these areas.

(5) Grasslands and bush

The existing grasslands and bush should be reforested. The reforestation and improvement of grasslands and bush other than the areas covered by the Villager Support Program (see the Item below) should be promoted as follows.

The existing grasslands and bush should be reforested as far as possible. The reforestation and improvement of grasslands and bush other than the areas covered by the Villager Support Program (see the Item below) should be promoted as follows.

(a) Industrial afforestation areas (Low-altitude)

Grasslands at altitudes of 1,000 m or less are mainly within the range suitable for the planting of Acacia and Eucalyptus species. There is some optimism that active investment will take place in these areas. However, they are also arable and differ from shifting cultivation sites or slopes where cassava is cultivated to make up for shortages of farmland and paddies. When private companies are entrusted with afforestation, they should be assiduous in avoiding any disputes with the local people and plan future development with their full participation.

(b) Areas to be reforested for functional recovery

Grasslands and bare areas at altitudes over 1,000 m are mostly small areas already abandoned or lying fallow after shifting cultivation. Since areas outside the coverage of the support programs are inaccessible, it is extremely difficult to persuade the local people voluntarily to reforest these areas even with the permission of the FEs or other authorities. Accordingly, for the time being, these areas will be patrolled to prevent the expansion of shifting cultivation and natural regeneration will be allowed to continue.

(c) Sites for afforestation and stand improvement

Most extensive grasslands are considered to be abandoned lands or fallows after shifting cultivation. It is ideal for foresters that all these grasslands convert to forest by artificial or natural regeneration. However, there is a strong possibility that many such grasslands are occupied by people who already have customary rights to cultivate are waiting the next cultivating period. Even if villagers who have traditional land use rights plant trees in the same way, the expected benefits for the villagers are completely different between production forest and protection forest (one can harvest the planted trees the other can not). In addition to this, the afforestation species differ in accordance with the geographical and socio-economical conditions of each area. Consequently, taking such differences into account, it should be specifically determined according to the characteristics of each area whether the existing grasslands should be reforested, or whether agroforestry is more appropriate, or whether the expansion of farmland should be accepted.

The afforestation project will cover existing grasslands, bare areas and bush except for the coverage areas of the Villager Support Program. In areas under the jurisdiction of the FEs, it is a normal practice that the FEs will take the initiative to employ farmers or to conduct contract-planting with farmers. However, in keeping with the spirit of Government Ordinance 661, it is advisable to entrust groups of villagers as contractors with responsibility for the implementation of the plantation activities as far as possible. In this respect, the afforestation project is inseparable from the Villager Support Program. Those who implement the afforestation should always consider and give priority to the provision of income opportunities to complement the Villager Support Program.

(6) Forests for timber production

Six FEs and one PFMC manage and are responsible for the forests in Kon Plong District. Other forests are managed by the forest section in each commune.

Of course, the PFMC, being entrusted with the management of the protected forest areas, mainly in the role of conservator, will not be included in the logging operation. Areas under the jurisdiction of the forest sections in communes (Mang But, Dak Koi, Dak Ruong, Tan Lap and Dak Tre communes and Kon Plong Town) are the centers of agricultural activities in Kon Plong District. Forest areas are scattered and the remaining natural forests have been extensively felled or degraded by burning. These areas will not be included in the timber production plan for the following reasons: i) the forest section in each commune is primarily concerned with forest maintenance and conservation, ii) there is no systematic basis for evaluating the logging operation and supervising its implementation, iii) there is only an extremely limited area of natural forest with an adequate stock of suitable trees for selective cutting.

(7) Villager Support Program

Supporting the local people is an effective means of promoting sustainable forest management, in that it aids in the prevention of uncontrolled forest utilization. One policy, which is fundamental to the master plan, is supporting improvement in the lives of the local people in an active way. Certain pieces of land will be provided to them for production activities so that their basic requirements can be met. Supportive measures for the local people should be planned through discussion between the local people and the FEs and communes in charge of forest management. The master plan presents a menu of specific programs as the basis for this discussion.

(a) Objectives of Villager Support Program

The objectives of the programs are as follows:

- 1) The project secures land for rice paddies that is sufficient for achieving the target volume of annual food production per head set by the government (350 kg/year/head, in rice conversion) and guarantees the right to use land.
- 2) FEs and the forest management service support the improvements in land productivity mentioned above in cooperation with regional administrative bodies (communes). Ideally the land should be prepared near existing communities.
- 3) Shifting cultivation would be controlled with measures; i) to convert shifting cultivation land to permanent farms with agroforestry practices and ii) to reduce in

dependency on shifting cultivation for food production. At the same time, collaborative sales would also be promoted in order to enhance cash income generation.

- 4) The annual income of low-income minority ethnic groups would be raised to 80% of the present average income in communities by activities to convert grasslands into agroforestry farms, promote two periods cropping of paddy rice in flatlands, cultivate fodder trees and promote stall feeding of animals.
- 5) In the sever areas with forest degradation whose altitude is below 1,000 m in the southern region, industrial afforestation would be promoted in order to rehabilitate forests and enhance job opportunities in cooperation with local people as well as relevant authorities.
- 6) FEs and the commune forest service conduct afforestation in accordance with Government Ordinance 661 and provide opportunities to generate income through contracting with people living in rural communities for afforestation work. The use of forests by villagers for agriculture and animal husbandry during afforestation should be permitted until planted trees close the forest canopy. FEs make efforts to spread technologies in cooperation with the organization for spreading agricultural technologies in communes.
- 7) Communes conduct various activities to ensure BHN for rural communities. The forest management service cooperates in the construction of facilities that are necessary for these activities, such as water supply, health care and electricity, and supports maintenance and management of these facilities.

(b) Target groups of the Villager Support Program

Various activities to achieve the purposes mentioned above are to be conducted for villagers who would be in desperate circumstances without support. Communities both of mountainous ethnic minorities and immigrants who are likely to seek ways of survival for forest resources would be covered by the program.

(c) Coverage areas of the Villager Support Program

The Villager Support Program primarily targets those areas of land capable of producing food equivalent to 350 kg of rice per person (or equivalent grains). A fundamental aim of the support is to improve the productivity of the existing paddies. In villages lacking paddies, the programs will target flats or gentle slopes to create terraced fields in the adjacent area. Upland fields will make up for the shortage. Since they are used on a regular basis, priority will be given to improving the activities in home gardens. Plans

include the planting of fruit trees and fodder plants.

Once food production targets have been met, such land as is necessary will be provided to generate incomes for improving the standard of living. Local people will be encouraged to change from shifting cultivation to permanent field cultivation employing combinations of trees, perennial crops and vegetables. Land for this purpose will be almost entirely used by the local people and excluded from forest management. It is preferable that such land be located near villages to become permanent fields for labor-intensive use (not large in area but aiming at high productivity). When providing assistance for land use, priority will be given to grasslands around villages, followed by bush and fallow areas. For the local people to use the land, they need to follow allocation procedures under the Land Law and receive approval or support from commune administration agencies and all the members of the village concerned.

(d) Menu of Activities under the Support Programs

1) Program for alleviating food shortages

This program gives preference to villagers, mainly mountainous ethnic minorities and some immigrants, who depend heavily on shifting cultivation and communities where impoverished villagers might conduct these activities in the future. The program supports these villagers and communities in improving productivity by constructing small dams and waterways, establishing rice paddies, and raising two crops a year. Forest managers distribute newly developed land for rice paddies and crop fields, assist villagers in executing engineering works for logging operations, and engage in activities related to maintenance of waterways.

2) Program for the control of shifting cultivation

This is the activity chiefly for mountainous ethnic minorities conducting shifting cultivation. Each support activity is the same as the content of Program (a) mentioned above, but support for conversion from shifting cultivation to permanent crop fields is of primary importance. Promotion of agroforestry practices is required. Guidance from an agricultural management system that integrates the planting of perennial crops and the raising of livestock by guaranteeing the use of land near houses plays a leading part in this program.

3) Program for income generation

This program creates opportunities to generate cash income through the producing and selling of products and cash crops other than crops for self-consumption, and gives preference to mountainous ethnic minorities that can lead self-sufficient lives but basically covers immigrants who are under similar situation. Basically the program strengthens the production capacity of grasslands on hillsides by introducing agroforestry and promoting the production of crops to produce cash income by conversion to permanent crop fields. The program is concurrent with the agroforestry program or divided into some independent subprograms according to variations in natural conditions of areas where the target communities are located, and requirements for their market access. Subprogram items are livestock, beekeeping, NTFPs, fruit trees, vegetables, other products related to agriculture, bamboo and rattan work and other processed goods.

4) Program for industrial afforestation

This program promotes industrial afforestation using land (grassland or bush on hillsides) distributed to villagers, and provides opportunities for employment and income growth using land other than limited arable land. In cooperation with the FEs and afforestation companies, this promotion and provision is carried out in areas less than 1,000 m above sea level where fast-growing trees such as acacias can be raised. The program mainly targets families who have grown-up children, have been distributed a limited amount of arable land, and have surplus labor except for farm work.

5) BHN program

This program gives preference to mountainous ethnic communities which are far from roads. Activities include cooperation with and support for the establishment and maintenance of drinking water resources (wells or purified water tanks), sanitation (construction of toilets) and small-sized generators in small streams.

(e) Priorities in program implementation

The Villager Support Program needs to be comprehensively promoted, combining various elements from the menus in response to the different natural and socioeconomic conditions faced by the villagers. Although individual programs may benefit a limited number of people, ideally all the local people should receive some benefit from the realization of their individual objectives but must also be prepared to provide the services

that are required for the whole plan to enjoy success.

The support programs are not necessarily limited to forestry-related activities such as farmland development, agroforestry support and participation in planting activities. Nevertheless, they all have the overarching objective of encouraging the local people to participate in reforestation through various supportive activities. To activate reforestation with the participation of the local people, it is not only the FEs who will play a major role in extending these activities. Rather, work-sharing and cooperation with all the people involved over a wide range of educational areas and related activities, including agricultural development through communes, family planning, sanitary promotion, social education and anti-illiteracy programs are vital.

8 Long-term targets of forest improvement in the district

A vision of forests in Kon Plong District has been described along with specific targets (Table S.1) on the assumption that these forests will be properly managed and reforested for a long time and the local people will participate in their maintenance and management under this master plan. These targets are ideal ones taking a long-term perspective. An implementation plan which determines the extent to which they can be achieved in one or two decades should be developed by verifying the current situation, the available human and financial resources and other essential factors.

Table S.1 Target land use and forest condition

(unit: ha)

| Year | Matured natural | Secondary natural | Young secondly | Man-made | Rehabilitation |
|------|-----------------|-------------------|----------------|------------|----------------|
| 2001 | 109,825.58 | 16,203.87 | 33,874.73 | 5,301.25 | 0.00 |
| 2036 | 126,029.44 | 20,018.43 | 43,350.68 | 15,076.23 | 9,593.11 |
| 2071 | 146,047.88 | 43,350.68 | 9,593.11 | 15,076.23 | 0.00 |
| 2106 | 189,398.56 | 10,049.73 | 0.00 | 14,619.60 | 0.00 |
| Year | Grass | Bush | Agri & Agro | Total | |
| 2001 | 19,816.36 | 36,840.95 | 6,783.37 | 228,646.11 | |
| 2036 | | | 14,578.21 | 228,646.11 | |
| 2071 | | | 14,578.21 | 228,646.11 | |
| 2106 | | | 14,578.21 | 228,646.11 | |

Note: The matured natural forest is equivalent to primary forest and evergreen broad-leaved secondary forest I and the forest contains stocking volume for ordinary logging. The secondary natural forest is equivalent to evergreen broad-leaved secondary forest II while the young secondary forest includes evergreen broad-leaved secondary forest III, semi-deciduous forest and dry open woodland. The rehabilitation forest means a stand that is improved from bush by human intervention and is assumed to grow secondary natural forest after 70 years. Grassland and bush which are expected to be attended by natural regeneration are assumed to grow young secondary natural forest.

9 Targets of operational plans

Based on the fundamental principles in the master plan, work volumes were estimated as long-term targets on the assumption that forests would be properly administered and managed from a long-term perspective. The target of operational plans in terms of area are shown in Table S.2 Timber production operation, Table S.3 Afforestation and stand improvement operation, and Table S.4 Villager Support Program.

Table S.2.a Target area for logging operation and excluded area by land use category (unit: ha)

| | Primary F | EG S-I | EG S-II | Total |
|--------------------------------|-----------|--------|---------|---------|
| Protection forest | 17,417 | 18,864 | 2,054 | 38,335 |
| Commune product forest | 6,382 | 13,422 | 7,488 | 27,292 |
| Water, soil, land conservation | 1,624 | 1,976 | 302 | 3,902 |
| Steep area in production | 480 | 319 | 392 | 1,191 |
| Bio-corridor | 1,415 | 1,423 | 127 | 2,965 |
| Hamlet water protection | 679 | 75 | 40 | 794 |
| Logging operation area total | 18,775 | 26,975 | 5,800 | 51,550 |
| Total forest area | 46,771 | 63,055 | 16,204 | 126,029 |

Table S.2.b Target area for logging operation by forest enterprise

| FEs | Prod/prot | Forest area (ha) | | | | Logging area (ha) | | | | Logging rate (%) | | | |
|----------------|------------|------------------|--------------|------------|--------|-------------------|--------------|------------|--------|------------------|--------------|------------|-------|
| | | Primar y F | EG Second ly | EGSec ond2 | Total | Primar y F | EG Second ly | EGSec ond2 | Total | Primar y F | EG Second ly | EGSec ond2 | Total |
| 11Mang Canh II | Protect Cr | 1,305 | 748 | 80 | 2,133 | 1,188 | 709 | 73 | 1,969 | 91% | 95% | 91% | 92% |
| 12Mang Canh I | Protect Cr | 1,412 | 541 | 235 | 2,188 | 1,217 | 472 | 176 | 1,865 | 86% | 87% | 75% | 85% |
| 13DaK Ruong | Protect Cr | 1,076 | 1,868 | 637 | 3,581 | 1,003 | 1,766 | 585 | 3,354 | 93% | 95% | 92% | 94% |
| 15Mang Den | Protect Cr | 0 | 38 | 210 | 248 | 0 | 36 | 168 | 204 | - | 95% | 80% | 82% |
| Sub-Total | | 3,793 | 3,195 | 1,162 | 8,150 | 3,408 | 2,983 | 1,001 | 7,393 | 90% | 93% | 86% | 91% |
| 10Tan Lap | Product F | 5,978 | 7,018 | 266 | 13,262 | 4,412 | 5,751 | 173 | 10,337 | 74% | 82% | 65% | 78% |
| 11Mang Canh II | Product F | 3,191 | 4,730 | 714 | 8,635 | 2,889 | 4,444 | 683 | 8,016 | 91% | 94% | 96% | 93% |
| 12Mang Canh I | Product F | 2,073 | 3,739 | 327 | 6,138 | 1,818 | 3,332 | 326 | 5,477 | 88% | 89% | 100% | 89% |
| 13DaK Ruong | Product F | 1,584 | 2,910 | 115 | 4,610 | 1,479 | 2,684 | 88 | 4,251 | 93% | 92% | 77% | 92% |
| 14Mang La | Product F | 4,626 | 6,331 | 287 | 11,244 | 3,292 | 5,106 | 173 | 8,571 | 71% | 81% | 60% | 76% |
| 15Mang Den | Product F | 1,727 | 2,846 | 3,790 | 8,362 | 1,476 | 2,674 | 3,356 | 7,506 | 85% | 94% | 89% | 90% |
| Sub-Total | | 19,179 | 27,574 | 5,499 | 52,252 | 15,367 | 23,992 | 4,799 | 44,157 | 80% | 87% | 87% | 85% |
| Total | | 22,972 | 30,769 | 6,661 | 60,403 | 18,775 | 26,975 | 5,800 | 51,550 | 82% | 88% | 87% | 85% |

Table S.3 Forest operation plan by forest management body

| Management unit | Plant/Grass | Plant/Bush | Plant total | Rehabilitation | Natural regeneration |
|-----------------|-------------|------------|-------------|----------------|----------------------|
| 01PFM Area | 38.26 | 0.00 | 38.26 | 53.69 | 554.96 |
| 02Dak Ring C | 8.28 | 0.00 | 8.28 | 363.07 | 101.40 |
| 03Ngoc Tem C | 30.20 | 82.99 | 113.19 | 0 | 0.00 |
| 04Mang But C | 7.57 | 361.17 | 368.73 | 0 | 659.60 |
| 05Dak Koi C | 541.71 | 665.04 | 1,206.76 | 813.78 | 817.05 |
| 06Dak Ruong C | 511.10 | 0.00 | 511.10 | 2,232.93 | 470.79 |

| | | | | | |
|----------------|----------|----------|----------|----------|----------|
| 07Kon Plong | 0.00 | 0.00 | 0.00 | 14.63 | 0.00 |
| 08Tan Lap C | 0.00 | 0.00 | 0.00 | 365.24 | 0.00 |
| 09Dak Tre C | 176.48 | 11.19 | 187.66 | 2,388.87 | 88.24 |
| 10Tan Lap | 28.44 | 0.00 | 28.44 | 249.63 | 201.48 |
| 11Mang Canh II | 105.11 | 7.92 | 113.03 | 0 | 0.00 |
| 12Mang Canh I | 349.55 | 0.00 | 349.55 | 77.26 | 289.08 |
| 13DaK Ruong | 3.53 | 0.00 | 3.53 | 256.85 | 790.33 |
| 14Mang La | 29.17 | 0.00 | 29.17 | 50.69 | 186.00 |
| 15Mang Den | 965.04 | 0.00 | 965.04 | 131.61 | 488.04 |
| Total | 2,794.43 | 1,128.32 | 3,922.75 | 6,998.26 | 4,646.96 |
| FE Total | 1,480.84 | 7.92 | 1,488.76 | 766.04 | 1,954.92 |

Table S.4 Target area of the Villager Support Program by program and forest management body

| Management unit | Target area total | | Food shortage reduction | | | | | |
|-----------------|-------------------|-----------|-------------------------|--------|----------|----------|----------|----------|
| | Grass | Bush | Grass | Bush | Total | Grass | Bush | Total |
| | | | Paddy | Paddy | Paddy | Farm | Farm | Farm |
| 01PFM Area | 1,019.91 | 1,127.85 | 174.15 | 35.24 | 209.39 | 148.48 | 284.19 | 432.67 |
| 02Dak Ring C | 152.35 | 5,017.61 | 49.36 | 146.09 | 195.45 | 63.54 | 384.32 | 447.86 |
| 03Ngoc Tem C | 97.55 | 700.11 | 21.96 | 21.10 | 43.06 | 72.15 | 40.62 | 112.77 |
| 04Mang But C | 114.16 | 108.18 | 2.58 | 36.17 | 38.74 | 81.65 | 13.64 | 95.29 |
| 05Dak Koi C | 1,767.73 | 2,294.37 | 10.01 | 0.00 | 10.01 | 36.27 | 0.00 | 36.27 |
| 06Dak Ruong C | 2,150.00 | 2,615.51 | 0.00 | 0.00 | 0.00 | 231.69 | 77.96 | 309.64 |
| 07Con Plong C | 39.40 | 745.99 | 0.00 | 0.00 | 0.00 | 0.00 | 126.61 | 126.61 |
| 08Tan Lap C | 137.50 | 352.62 | 0.00 | 0.00 | 0.00 | 63.97 | 0.00 | 63.97 |
| 09Dak Tre C | 525.56 | 1,493.50 | 0.00 | 0.00 | 0.00 | 359.55 | 167.60 | 527.15 |
| 10Tan Lap | 312.65 | 367.34 | 26.66 | 19.60 | 46.27 | 77.90 | 172.92 | 250.82 |
| 11Mang Canh II | 1,001.46 | 559.23 | 70.79 | 8.79 | 79.58 | 47.53 | 0.00 | 47.53 |
| 12Mang Canh I | 1,960.15 | 667.34 | 97.49 | 2.79 | 100.28 | 182.25 | 0.00 | 182.25 |
| 13DaK Ruong | 409.60 | 737.57 | 0.00 | 0.00 | 0.00 | 0.00 | 191.54 | 191.54 |
| 14Mang La | 730.52 | 386.14 | 142.44 | 42.83 | 185.27 | 58.05 | 0.00 | 58.05 |
| 15Mang Den | 1,383.33 | 804.87 | 71.39 | 26.76 | 98.15 | 172.66 | 24.34 | 197.00 |
| Total | 11,801.86 | 17,978.24 | 666.82 | 339.37 | 1,006.19 | 1,595.69 | 1,483.74 | 3,079.44 |

| Management unit | Slash & burn reduction | | | Income generation | | | Industrial Plantation | | |
|-----------------|------------------------|--------|--------|-------------------|----------|----------|-----------------------|----------|----------|
| | Grass | Bush | Total | Grass | Bush | Total | Grass | Bush | Total |
| | Bush | Bush | Agro F | Agro F | Agro F | Agro F | Forest | Forest | |
| 01PFM Area | 63.33 | 0.00 | 63.33 | 108.10 | 139.50 | 247.60 | 0.00 | 0.00 | 0.00 |
| 02Dak Ring C | 0.00 | 72.17 | 72.17 | 26.99 | 241.81 | 268.80 | 0.00 | 0.00 | 0.00 |
| 03Ngoc Tem C | 0.00 | 0.00 | 0.00 | 3.44 | 50.56 | 54.00 | 0.00 | 0.00 | 0.00 |
| 04Mang But C | 19.87 | 0.00 | 19.87 | 8.99 | 37.20 | 46.19 | 0.00 | 0.00 | 0.00 |
| 05Dak Koi C | 214.18 | 0.00 | 214.18 | 206.80 | 0.00 | 206.80 | 942.16 | 591.03 | 1,533.19 |
| 06Dak Ruong C | 189.02 | 0.00 | 189.02 | 230.80 | 185.60 | 416.40 | 1,284.54 | 1,057.33 | 2,341.86 |
| 07Con Plong C | 0.00 | 0.00 | 0.00 | 0.00 | 148.40 | 148.40 | 0.00 | 26.00 | 26.00 |
| 08Tan Lap C | 0.00 | 0.00 | 0.00 | 68.00 | 27.20 | 95.20 | 5.53 | 162.71 | 168.23 |
| 09Dak Tre C | 55.19 | 32.26 | 87.44 | 62.09 | 165.51 | 227.60 | 48.72 | 564.07 | 612.79 |
| 10Tan Lap | 44.90 | 50.31 | 95.21 | 100.00 | 103.20 | 203.20 | 0.00 | 0.00 | 0.00 |
| 11Mang Canh II | 10.04 | 0.00 | 10.04 | 70.00 | 0.00 | 70.00 | 0.00 | 0.00 | 0.00 |
| 12Mang Canh I | 0.00 | 0.00 | 0.00 | 154.57 | 32.23 | 186.80 | 0.00 | 0.00 | 0.00 |
| 13DaK Ruong | 0.00 | 0.00 | 0.00 | 39.41 | 48.00 | 87.41 | 97.70 | 132.47 | 230.17 |
| 14Mang La | 41.02 | 0.00 | 41.02 | 110.80 | 0.00 | 110.80 | 0.00 | 0.00 | 0.00 |
| 15Mang Den | 169.93 | 0.00 | 169.93 | 312.40 | 106.40 | 418.80 | 656.94 | 305.95 | 962.88 |
| Total | 807.48 | 154.73 | 962.21 | 1,502.40 | 1,285.60 | 2,788.00 | 3,035.58 | 2,839.55 | 5,875.13 |

10 Current target operational volume

These targets are long-term ones. Targets for the immediate future (the next decade or so) will be shown below. As for the immediate targets, it is necessary to aim at gradually increasing operational scale from current levels to complete realization of the annual average while considering the content and work volumes represented by the operations currently carried out by the FEs and communes, their administration/management systems and market conditions. Of course, any operational plan needs to meet the scale of available resources, including technicians, the staff handling extension programs, management departments, and funds. The work volumes estimated for the time being will be specifically examined in the Model Area. Then, the manner in which the figures in the master plan should be reflected in specific plans will be summarized and presented.

In Table S.5, the ranges of annual cutting volumes to be allocated to each FE are examined in the light of the demand side based on the current average annual cutting volume in the Study Area and the capacity of its sawmills. The exact volume for the logging will be decided every year, taking the market's trend into consideration.

Table S.5 Ranges of annual cutting volumes to be allocated for each FE

| FE | cutting volume (m ³) | | |
|--------------|----------------------------------|---|--------|
| Tan Lap | 3,294 | — | 7,693 |
| Mang Canh II | 2,781 | — | 6,495 |
| Mang Canh I | 2,024 | — | 4,728 |
| Dak Ruong | 1,906 | — | 4,452 |
| Mang La | 2,684 | — | 6,270 |
| Mang Den | 1,311 | — | 3,062 |
| Total | 14,000 | — | 32,700 |

Silviculture operations by the FEs such as rehabilitation on bush lands and afforestation will be conducted for the total target area over approximately 10 years. However, for the Mang Canh I FE, of which the total target area for afforestation operation exceeds 200 ha, the afforestation operation will be carried out in consideration of the earnings performance. Table S.6 shows the target areas for the silviculture operations by each FE for 10 years. Regarding the 38 ha for afforestation and 54 ha for rehabilitation on bush lands under control of the Thach Nham PFMC, the silviculture operation will be carried out for the next 10 years by using of the funds obtained in accordance with Decision 661.

Table S.6 Target volume of afforestation for 10 years by FEs

| FE | Volume for afforestation (ha) | | | Volume for rehabilitation on bush lands (ha) |
|--------------|-------------------------------|---|-----|--|
| Tan Lap | | | 28 | 250 |
| Mang Canh II | | | 105 | 0 |
| Mang Canh I | 200 | — | 350 | 77 |
| Dak Ruong | | | 4 | 257 |
| Mang La | | | 29 | 51 |
| Mang Den | | | 11 | 132 |
| Total | 377 | — | 527 | 767 |

Development of the forestry infrastructure includes the construction of road networks, nurseries, logging yards in the forests and field offices. Regarding the road network, the total length of public roads, forest roads, spur roads and skidways per hectare has been estimated to be 50 m.

The Villager Support Program will be implemented for the total target area over 35 years. During the first 10 years, for enhancing the motivation of the villagers, the program will be implemented over 60% of the total target area.

Concerning the wildlife protection and conservation program, Kon Plong District is divided into strict wildlife protection area, wildlife rehabilitation area and wildlife respect area. Activities to be implemented in each area include training for officials from relevant organizations, workshops, and the organization of local anti-poacher patrol teams.

The system reinforcement project includes the changing of the system structure, the operation of various training programs, and the improvement of monitoring and evaluation of management by third party organizations for the 6 FEs.

The estimated revenues and necessary funds for implementing the target projects mentioned above are shown in Table S.7. Three estimates have been given for three different annual cutting volumes: maximum, minimum, and a volume at which revenue and necessary funds are equal. It has been assumed that all the revenues are derived from standing tree sale.

Table S.7 Project fund plan

(Unit: \$1,000)

| | Annual cutting volume of 32,700 m ³ | Annual cutting volume of 24,700 m ³ | Annual cutting volume of 14,000 m ³ |
|--|--|--|--|
| Revenues | 3,991 | 3,015 | 1,709 |
| Funds required to be covered by the FE | 3,389 | 3,009 | 2,423 |
| (1) Logging costs | 1,762 | 1,351 | 796 |
| 1) Cruising costs | 436 | 329 | 187 |
| 2) Costs for road network construction | 1,254 | 948 | 537 |
| 3) Costs for field office construction | 74 | 74 | 74 |
| (2) Silviculture costs | 186 | 186 | 186 |
| (3) Costs for the Villager Support Program | 595 | 595 | 595 |
| (4) Costs for the wildlife protection and conservation program | 93 | 93 | 93 |
| (5) Costs for the institutional enhancement program | 94 | 94 | 94 |
| (6) General management costs | 690 | 690 | 690 |
| Balance | 569 | 6 | -747 |
| Funds not to be covered by FE | 6,598 | 6,598 | 6,598 |
| External funds | 381 | 381 | 381 |
| Silviculture project costs to be covered by external funds | 22 | 22 | 22 |
| Villager Support Program costs to be covered by external funds | 359 | 359 | 359 |
| Industrial afforestation funds | 2,520 | 2,520 | 2,520 |
| Afforestation costs | 2,454 | 2,454 | 2,454 |
| Land rental | 66 | 66 | 66 |
| Public roads construction funds | 3,697 | 3,697 | 3,697 |

11 Model forest management plan on the Mang La FE

The jurisdiction of the Mang La FE was selected as the model area, and the project was studied in detail. The target area for logging was classified into forest blocks according to the procedure given in the master plan. The project team identified and excluded areas that provide forest functions such as water catchments, soil and land conservation, and nature conservation, including steep slopes, bio-corridors and water sources for villagers. The forest area was also categorized according to the following forest types (including tree-covered areas with less than 10% of crown density) from the aerial photographs in order to estimate the timber volume and growth that provides the criteria for calculating the standard cutting volume for sustainable timber production.

Table S.8 Forest type classification

| Crown size | Crown density | | | |
|------------|---------------|--------|--------|---------|
| | scarce | low | medium | dense |
| | 0-10% | 10-40% | 40-70% | 70-100% |
| Small | E | E | D1 | C1 |
| Medium | E | D2 | C2 | B1 |
| Large | D3 | C3 | B2 | A |

- Note : 1) The 'Forest type A' belongs to the single category and 'Forest type E' has no sub-classification.
 2) Mixed ratio of Podocarpus, valuable tree species, was evaluated by another classification described with P1 or P2, then the classification was merged with the above one.

As a result, the Model Area covers 18,292 ha, and the total stand volume is estimated at 3,368,000 m³ (Tables S.9 and S.10).

Table S.9 Forest conditions in the Model Area (Area: ha, Volume: 1,000 m³)

| Compartment | Protection forest | | | | | Production forest | | | | | | | | Sub-total | Total |
|-------------|-------------------|-------|-----|-------|-----------|-------------------|-----|-------|-----|-------|-------|-------|-------|-----------|--------|
| | 439 | 440 | 493 | 500 | Sub-total | 495 | 496 | 497 | 498 | 499 | 501 | 502 | 503 | | |
| Area | 1,127 | 1,821 | 866 | 1,874 | 5,688 | 1,316 | 948 | 1,398 | 944 | 1,923 | 1,823 | 1,865 | 2,386 | 12,604 | 18,292 |
| Volume | 193 | 284 | 119 | 265 | 861 | 254 | 158 | 246 | 216 | 373 | 372 | 356 | 533 | 2,507 | 3,368 |

Note: The area includes land use other than forests (1,730 ha) such as paddy, etc.

Table S.10 Area and stocking volume by land use and forest type (Area: ha, Volume: 1,000 m³)

| Forest type | A | B1 | B2 | C1 | C2 | C3 | D1 | D2 | D3 | E |
|-------------|---------|-------|-------|------|-------|-------|--------|--------------|--------|--------|
| Area | 6,585 | 2,809 | 1,602 | 957 | 2,027 | 423 | 407 | 686 | 44 | 731 |
| Volume | 1583 | 611 | 313 | 211 | 394 | 63 | 61 | 87 | 3 | 42 |
| Land use | Planted | Paddy | Farm | Bush | Grass | Water | Garden | Forest total | Others | Total |
| Area | 291 | 474 | 570 | 321 | 250 | 11 | 103 | 16,562 | 1,730 | 18,292 |
| Volume | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | 3,368 |

(1) Target area for timber production

As for target area for timber production, following the same procedure as given in the master plan for sustainable forest management, the team used the GIS data to identify and exclude areas in terms of forest functions, such as water catchments, soil and land conservation, and in terms of nature conservation, including steep slopes, wildlife habitats, water sources for villagers and areas to be set aside for the Villager Support Program (future set-aside). As a result,

the target area for logging (including immature forest for cutting) covers 8,596 ha, the stand volume is estimated at 1,877,000 m³ and the growth increment is 28,900 m³ (Table S.11).

Table S.11 Forest targeted for logging operation

| Compartment | 495 | 496 | 497 | 498 | 499 | 501 | 502 | 503 | Total |
|-------------------------------|---------|---------|---------|---------|----------|---------|----------|----------|-----------|
| Area (ha) | 515.81 | 676.81 | 988.02 | 668.27 | 1,535.60 | 625.82 | 1,479.83 | 2,105.69 | 8,595.85 |
| Volume (m ³) | 106,558 | 137,820 | 200,607 | 162,353 | 316,486 | 152,852 | 322,494 | 477,763 | 1,876,933 |
| Growth rate (m ³) | 1,737 | 2,195 | 3,229 | 2,455 | 4,798 | 2,340 | 4,889 | 7,223 | 28,866 |

(2) Cutting volume limit

Logging is the operation of most interest in sustainable forest management, and it also provides the funds required for promoting the Villager Support Program. In addition, continuous logging is essential for sustainable forest management. Consequently, the annual standard cutting volume was estimated for ensuring continuous logging operations without reducing the forest resources as mentioned above. On the basis of this annual standard cutting volume limit, the team divided the target forest area into logging blocks, one block for each five-year period (in the 35-year cutting cycle). On condition that each logging block has an almost equal cutting volume, and the stand volume in 35 years time will be greater than the current one, the cutting volume limit for each five-year period was finally estimated at 90,000 - 100,000 m³ (stem volume). However, the actual cutting volume is controlled to a level that is much less than this estimation, in consideration of the current cutting volume and demand.

(3) Long-term goals for afforestation

The afforestation plan was developed based on the conceptual framework of the Master Plan. The target areas were determined in four areas: i) designated areas for the Villager Support Program, ii) village adjacent areas except for the area mention in i), iii) remote areas, iv) intermediate areas between the village adjacent areas and remote areas and responsible bodies were determined in each area. Afforestation that is to be implemented by the FE mainly targets grassland and bush except for certain remote locations. The long-term target areas are shown in Tables S.12.

Table S.12 Long-term afforestation target area by FE (ha)

| | Commune | Grassland | Bush | Shifting cultivation | Total |
|------------|---------|-----------|--------|----------------------|--------|
| Protection | Po E | 129.79 | 102.41 | 149.89 | 382.09 |
| | Hieu | 0 | 0 | 57.1 | 57.1 |
| Sub-total | | 129.79 | 102.41 | 206.99 | 439.19 |
| Production | Hieu | 63.82 | 27.96 | 293.25 | 385.03 |
| Total | | 193.61 | 130.37 | 500.24 | 824.22 |

Note: If FE directly conduct afforestation in the areas under shifting cultivation, it will be a problematic factor of disputes for land tenure. It is recommendable to apply agroforestry practices in mutual communication with local farmers.

(4) Project fund plan for the decade

From the long-term viewpoint, as mentioned above, a project plan for the decade was produced.

1) Timber production

This section shows the annual cutting volume and cutting volume by logging block in the first and second blocks designated for selective logging, as mentioned above. This is based on the assumption that the funds required for carrying out the various programs of this project and the total amount from timber sales are in balance. In connection with logging, the construction of forest and spur roads is planned. This includes 9 km and 12 km of road construction in the first and second blocks, respectively.

Table S.13 Amount of designated cutting by implementation period

| Implementation periods | | Sub-compartment areas (ha) | Areas for cutting (ha) | Stand volume (stem basis)(m ³) | Stand volume (log basis) (m ³) | Cutting volumes (m ³) |
|---|-----------|----------------------------|------------------------|--|--|-----------------------------------|
| The first period (the first five years) | Sub-total | 647.76 | 380.76 | 100,399 | 65,259 | 19,578 |
| The second period (the second five years) | Sub-total | 536.57 | 433.79 | 123,749 | 80,437 | 24,131 |
| Total | | 1184.33 | 814.55 | 224,148 | 145,696 | 43,709 |

2) Afforestation

From the long-term target areas for afforestation as mentioned above, some places where the vegetation needs to recover were designated as areas to be afforested during the decade.

Table S.14 Planned afforestation areas over the 10 year period

| Afforestation functions | Planned afforestation areas (ha) | Sub-compartment areas including zones with public functions and so on among the planned areas (ha) |
|-------------------------|----------------------------------|---|
| Production forests | 60.49 | 13.22 (Zones for watershed, soil and land conservation) |
| Protection forests | 102.01 | 5.19 (Zones for watershed, soil and land conservation) 20.22 (Zones for water source security) 25.41 (Subtotal) |
| Total | 162.50 | 38.63 |

3) Villager support

Under the concept of the master plan, the team studied the determination of the contents and schedule of the food shortage alleviation program and income enhancement program targeted for Hieu and Po E Commune. Fundamental problems in both communes are shown in Figure S.5. Particulars such as the target areas and scale of activities under the programs will be decided through agreement with the villagers in the meetings to be held by each village. Regarding the funds required for the programs, the target levels are estimates.

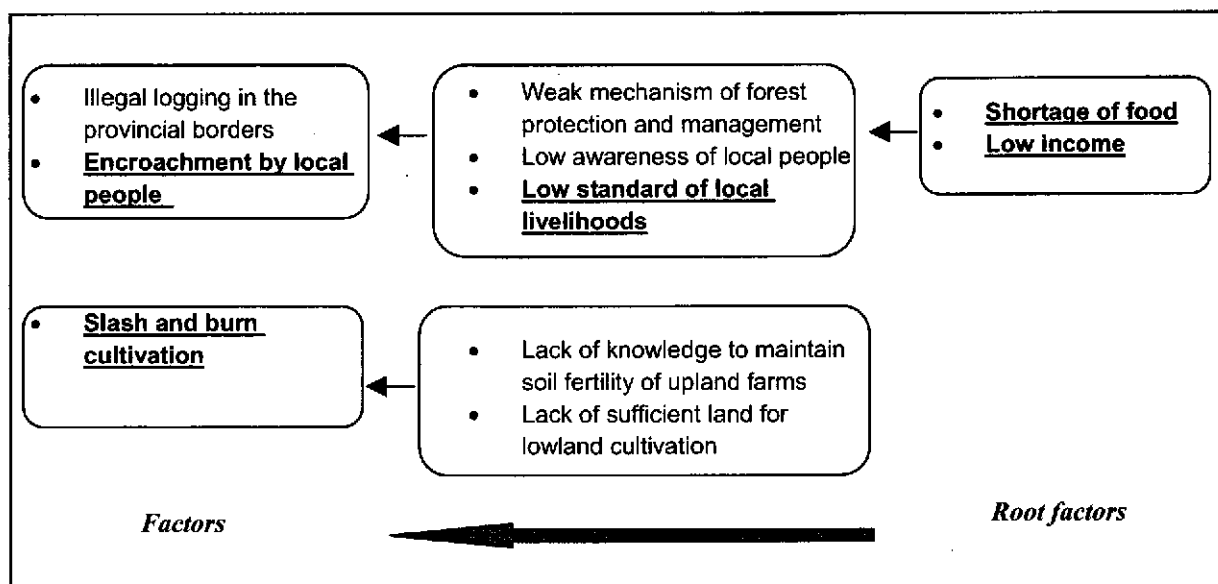


Figure S.2 Main factors influencing the situation of forests in Hieu and PoE commune

Source: Analysis based on the Village Profile and Household Survey, RRA Survey, and Participatory Workshops, Feb – May 2002.

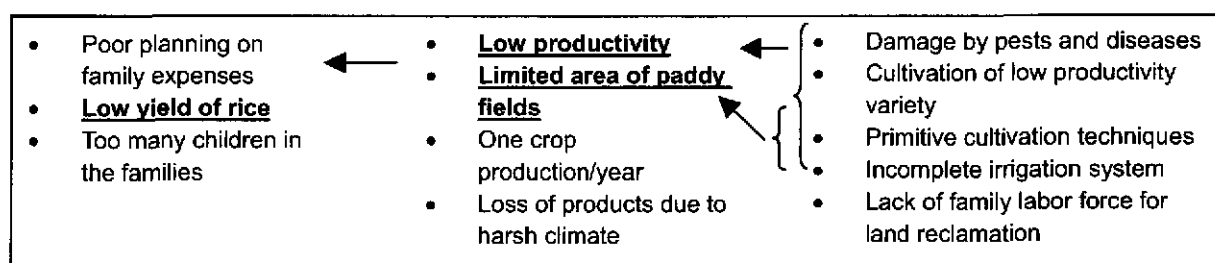


Figure S.3 Main underlying causes of food shortage

Source: Analysis based on the Village Profile and Household Survey, RRA Survey, and Participatory Workshops, Feb – May 2002.

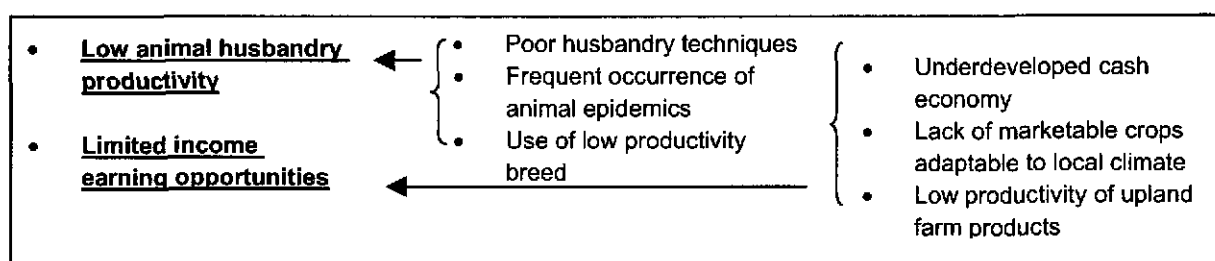


Figure S.4 Main underlying causes of low income

Source: Analysis based on the Village Profile and Household Survey, RRA Survey, and Participatory Workshops, Feb – May 2002.

On the basis of the present situation and problems, activity goals for the Villager Support Program are shown below.

Table S.15 Outputs, activities, and target beneficiaries of the food security component

| Outputs and activities | Target beneficiaries |
|--|--|
| 1. All households in the commune have sufficient size of paddy field. | |
| <ul style="list-style-type: none"> ➤ Conduct village land use planning ➤ Identify potential areas for opening new paddy field ➤ Design and construct small scale irrigation system (gabions and gravity pipeline system) ➤ Establish and strengthen irrigation management groups ➤ Conduct training and provide follow up guidance on management and maintenance of irrigation systems at the village level | <ul style="list-style-type: none"> ➤ 155 households (26% of total households) over 10 years (On average, 8.6 households per village). ➤ Training on management and maintenance of irrigation systems can be extended to all farmers. |
| 2. Productivity of lowland rice is improved. | |
| <ul style="list-style-type: none"> ➤ Establish village level agricultural extension network (one extension worker in each village) ➤ Build capacity of commune agricultural extension officer and village extension worker on: <ul style="list-style-type: none"> (a) Disease prevention and eradication (b) Advanced techniques on cultivation (c) Extension skills ➤ Conduct training for local farmers on subjects (a) and (b) and provide follow-up guidance (by commune extension officer and village extension worker) ➤ Study local soil and climate conditions to identify suitable crop variety and cropping pattern ➤ Introduce suitable crop variety and cropping pattern <ul style="list-style-type: none"> ◇ Establish model demonstration plot ◇ Expand models for application | <ul style="list-style-type: none"> ➤ 598 households plus new households that will be established during the project period. ➤ While training is envisaged for all farmers, priority will be given to households that are facing food shortage (65% - approx. 390 households, or 21 households per village on average). |

Table S.16 Outputs, activities, and target beneficiaries of the income generation component

| Outputs and activities | Target beneficiaries |
|---|---|
| <p>1. Productivity of animal husbandry is improved.</p> <ul style="list-style-type: none"> ➤ Establish/strengthen village level animal husbandry extension network (one extension worker in each village) ➤ Identify animal cage materials and design that are affordable by local people ➤ Train commune veterinary officer and village level husbandry extension worker on: <ul style="list-style-type: none"> (a) Caging construction methods (b) Animal feeding methods (c) Extension skills ➤ Conduct training for local farmers on subjects (a) and (b) and provide follow-up guidance (by commune veterinary officer and village level husbandry extension worker) | <ul style="list-style-type: none"> ➤ Approximately 480 households who are engaged in livestock husbandry (80% of the total households). |
| <p>2. Productivity of upland farms is improved.</p> <ul style="list-style-type: none"> ➤ Train commune agricultural extension officer and village extension worker on: <ul style="list-style-type: none"> ◇ Organic and composting fertilizers ◇ Agroforestry methods (tree garden, hedgerow intercropping, alley cropping, silvopastoral, agrosilvopastoral, agrosilvo fishery, and aquaforestry) ◇ Soil erosion control methods ➤ Conduct training for local farmers on the above subjects and provide follow-up guidance (by commune agricultural extension officer and village level extension worker) ➤ Introduce contractual agreement between the FE and households that guarantees user rights (and responsibilities) of upland farms | <ul style="list-style-type: none"> ➤ Approximately 420 households who are engaged in upland farming (70% of the total households). <p>Note: Assurance of user rights will contribute to strengthening farmer's sense of ownership of the land, thereby encouraging permanent cultivation and higher investment in their farms.</p> |
| <p>3. Alternative income earning opportunities are introduced.</p> <ul style="list-style-type: none"> ➤ Identify crops, perennials, and trees that have a potential market, and are suitable for local climate ➤ Identify livestock (species and breed) that have a potential market, and are suitable for local climate ➤ Identify other income earning sources (e.g., beekeeping, handicraft, etc.) that have a potential market, and are suitable for the local conditions ➤ Identify model villagers and conduct trials ➤ Introduce successful activities to local villagers ➤ Assist local villagers in managing small scale income-earning activities (budgeting, saving, marketing, etc.) | <ul style="list-style-type: none"> ➤ Initially 10 to 20 households (model villagers), and later expanded at village level. |

The team will adopt the “village clusters approach” to implementing this program, in which the 18 targeted villages are divided into clusters, one cluster consisting of 2-4 villages, in order to carry out the plan over a 2-year period for each cluster. This will be carried out according to the yearly plan shown in Figure S.5.

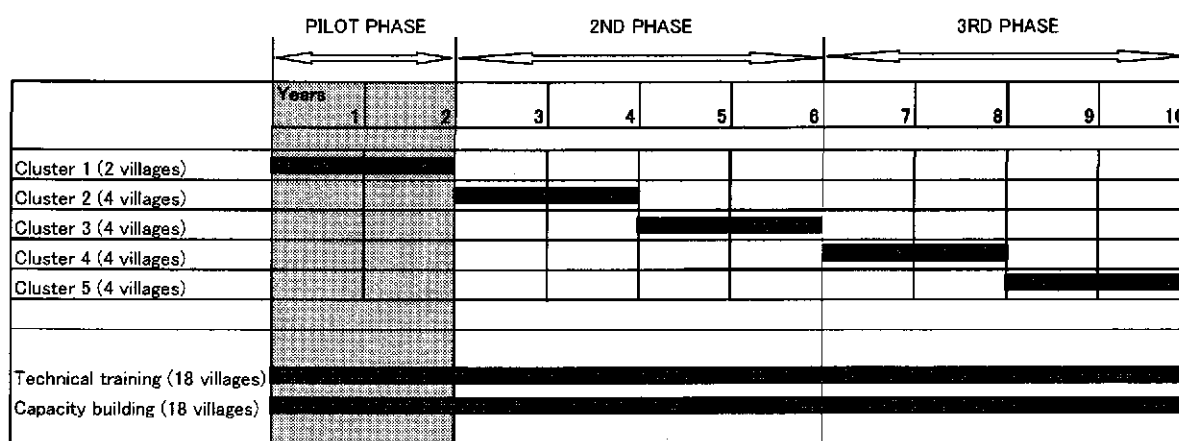


Figure S.5 The 10-year activity schedule of the VSP based on the village cluster approach

4) Wildlife protection and conservation program

The wildlife protection and conservation program will be conducted with a focus on an educational campaign, along the lines of the master plan.

5) Project funds and the balance

The funds required for the programs, and the potential revenues and expenditures were calculated. The required funds are estimated to be US\$1,016,000, but outside financing from foreign aid agencies is not necessary. This is because the cutting volume (timber sales / FE's income of US\$562,000) is adjusted so that the logging income and funds required for the plans, including the Villager Support Program, are kept in balance, on the assumption that funds based on the Decree 661 and 135 programs are provided from the central and local government. The budget forecast and profit and loss statement are as follows:

Table S.17 Annual profit and loss account over the ten years

(Unit: US\$)

| Item | 1st yr. | 2nd yr. | 3rd yr. | 4th yr. | 5th yr. | 6th yr. | 7th yr. | 8th yr. | 9th yr. | 10th yr. | Total. | |
|--|--------------------------|----------------|----------------|----------------|----------------|----------------|---------------|---------------|---------------|---------------|------------------|------------------|
| Revenues | | | | | | | | | | | | |
| Operation revenues | 57,299 | 57,299 | 57,299 | 57,299 | 57,299 | 70,624 | 70,624 | 70,624 | 70,624 | 70,624 | 639,615 | |
| External funds | 84,972 | 85,496 | 86,020 | 86,020 | 86,020 | 2,889 | 2,889 | 2,889 | 2,889 | 2,889 | 442,971 | |
| Total | 142,271 | 142,795 | 143,318 | 143,318 | 143,318 | 73,513 | 73,513 | 73,513 | 73,513 | 73,513 | 1,082,586 | |
| Expenditures | | | | | | | | | | | | |
| Cost of the cutting | 5,743 | 5,743 | 5,743 | 5,743 | 5,743 | 7,078 | 7,078 | 7,078 | 7,078 | 7,078 | 64,105 | |
| Cost of developing the forestry infrastructure | 22,158 | 22,158 | 22,158 | 22,158 | 22,158 | 34,126 | 34,126 | 34,126 | 34,126 | 34,126 | 281,420 | |
| Silviculture costs | Funds provided by the FE | 1,206 | 1,516 | 1,827 | 1,827 | 1,827 | 1,827 | 1,827 | 1,827 | 1,827 | 17,338 | |
| | External funds | 1,842 | 2,365 | 2,889 | 2,889 | 2,889 | 2,889 | 2,889 | 2,889 | 2,889 | 27,318 | |
| Cost of the wildlife conservation program | 453 | 4,749 | 9,283 | 1,135 | 2,089 | 1,135 | 43 | 1,135 | 43 | 1,135 | 21,201 | |
| Cost of the VSP | Funds provided by the FE | 9,473 | 9,473 | 10,403 | 10,403 | 10,403 | 10,403 | 10,403 | 10,403 | 10,403 | 102,170 | |
| | External funds | 83,131 | 83,131 | 83,131 | 83,131 | 83,131 | 0 | 0 | 0 | 0 | 415,653 | |
| Cost of the institutional enhancement program | 2,378 | 1,001 | 3,494 | 715 | 715 | 1,001 | 715 | 3,494 | 715 | 1,001 | 15,229 | |
| Management and administrative cost | 11,279 | 11,279 | 11,279 | 11,279 | 11,279 | 11,279 | 11,279 | 11,279 | 11,279 | 11,279 | 112,790 | |
| Total | Funds provided by the FE | 52,691 | 55,919 | 64,187 | 53,260 | 54,214 | 66,849 | 65,471 | 69,343 | 65,471 | 66,849 | 614,253 |
| | External funds | 84,972 | 85,496 | 86,020 | 86,020 | 86,020 | 2,889 | 2,889 | 2,889 | 2,889 | 442,971 | |
| | Total | 137,663 | 141,415 | 150,206 | 139,280 | 140,233 | 69,738 | 68,359 | 72,231 | 68,359 | 69,738 | 1,057,224 |
| Balance | Funds provided by the FE | 4,608 | 1,380 | - 6,888 | 4,039 | 3,085 | 3,775 | 5,154 | 1,282 | 5,154 | 3,775 | 25,362 |
| | External funds | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Total | 4,608 | 1,380 | - 6,888 | 4,039 | 3,085 | 3,775 | 5,154 | 1,282 | 5,154 | 3,775 | 25,362 |

6) Benefits to the villagers

The direct benefits to villagers brought about by this project are estimated at 21,587,369,000 VND (approx. 1,439,200 USD) in total, and 10,878,000 VND (approx. 725 USD) / year per household.

(5) Indicators established by the ITTO

The objective of a forest management plan is to achieve sustainable forest management. All of the programs in this project should be carried out on the basis of the indicators established by the ITTO.

This project conducted a questionnaire to check adherence to the indicators in the case of Mang La FE. On the basis of the results, problems were analyzed, and the remedial measures were incorporated into the plan. The plan encourages villagers to attend meetings and monitor the

project, stressing the importance of transparency, villager participation, and assessment through monitoring. Putting these proposals into practice ensures the full implementation of the plan, making it possible for sustainable forest management to be achieved.