

6 Participatory watershed management plan

6-1 Objectives of the participatory watershed management plan

This plan will be made aiming at "continuity of development." Concretely, development will be carried forward while harmonizing with the natural environment from the viewpoint of watershed preservation. At the same time, watershed preservation will be developed by local inhabitants independently and continuously (independent development). This plan should be made so that it will be able to contribute to this aim. Concrete plans will be made individually for each zone. For voluntary preparation and execution of the plans with villagers' participation, the following items should be aimed at.

6-2 Usable land use

(1) Size of usable land

Lands for which a new land use will be determined are shrubbery land and grassland. In order to clarify the prospect of to what degree these lands will be able to be used as cultivated land, pasture or forest land especially from the viewpoint of population increase as a cause of wasting watersheds, an estimate is made on the following assumption.

Land for cultivation: The size of cultivable land per family is assumed as follows:

Mantaoa zone -- 3.5 ha

Tsiazompaniry zone -- 4 ha

A comparison between cultivable area and present area is shown in Table IV-3.

Pasture: It is assumed that the land per one domestic animal (cow) bred at the present should be 1 ha.

Land for tree planting: The size of land for tree planting should be obtained by deducting the size of land for farming (which can be increased in the future) and the size of a pasture from the size of the present grassland. The existing shrubbery land should be included in land possible for tree planting.

Note: If the average family size is 6 or 7, the cultivable area is 2 or 3 ha (the result of interviews with villagers). Therefore, the above-mentioned sizes have been assumed as the future cultivable sizes. For pastures, the dry riverbed, the periphery of cultivated land, etc. are generally used. As villagers do not have a clear and accurate yardstick, 1 ha per cow has been assumed.

Table IV-4 shows the sizes of usable land estimated based on the above-mentioned

assumptions. For the details of the calculation, see Annex 53.

Table IV-3 Sizes of cultivable land per household and the present situation

Unit: ha				
Zone	A	C	D	E
Mantaoa zone				
Size of cultivable land	/	3.5	3.5	/
Present situation	/	3.0	1.7	/
Tsiazompaniry zone				
Size of cultivable land	4.0	4.0	4.0	4.0
Present situation	2.2	3.1	2.9	1.8

Table IV-4 Possible area for land-use

(1) Mantaoa zone

Classification/zone		C	D	Total
Present situation	Grassland	403	1,369	1,772
	Shrubbery land	117	721	838
Plan of use	Grassland with the present conditions	403	1,369	1,772
	For cultivation	34	238	272
	For pasturage	54	90	144
	For tree planting	315	1,041	1,356
	Shrubbery land (for tree planting)	117	721	838
Relevant village (number of households)		Andrefanivorona (67)	Ambohimanjaka (132)	

(2) Tsiazompaniry zone

Classification/zone		A	C	D	E	Total
Present situation	Grassland	2,601	1,576	10,268	3,010	17,455
	Shrubbery land	92	46	631	139	908
Plan of use	Grassland with the present conditions	2,601	1,576	10,268	3,010	17,455
	For cultivation	603	427	1,124	220	2,374
	For pasturage	630	1,071	1,748	30	3,479
	For tree planting	1,368	78	7,396	2,760	11,602
	Shrubbery land (for tree planting)	92	46	631	139	908
Relevant village (number of households)		Andriatsijo Angodon-godona (335)	Morarano etc. 5 villages (474)	Analamihoatra, etc. 5 villages (1,022)	Ankazo-Elo (100)	

(2) Sizes of reforestable land

Among the sizes of usable land mentioned in (1) above, the summary of sizes of reforestable land is as shown in Table IV-5.

Table IV-5 Size of refforestable

Division/zone	A	C	D	E	Total
Mantaoa zone					
Grassland	/	315	1,041	/	1,356
Shrubbery land	/	117	721	/	838
Total	/	432	1,762	/	2,194
Tsiazompaniry zone					
Grassland	1,368	78	7,396	2,760	11,602
Shrubbery land	92	46	631	139	908
Land prepared for tree planting	0	2	14	0	16
Total	1,460	126	8041	2,899	12,526
Total	1,460	558	9,803	2,899	14,720

Note: This table does not include the ZODAFARB target area of 2,330ha which is eastern area of the lake managed by Ministry of Water and Forests.

6-3 Basic concept on formulation of the plan

6-3-1 Unit used for formulation of plans

In making a participatory watershed management plan, the following pilot studies (hereinafter referred to as "PS") were conducted in order to ascertain feasibility. In a PS, after selection of 4 model villages in zones (zonal divisions) that were determined according to the conditions inside the watershed, a plan was made, carried out and evaluated by the villagers themselves (see Part 2).

According to the results of PSs, the contents of plans, scales of projects, outcomes of execution and so on depend on forms of village (socioeconomic conditions and natural conditions). At the beginning, it was considered to use a zone, an area divided according to differences in conditions of areas, as a unit for making participatory plans. It is, however, judged from the results of PSs that utilizing a narrow unit based on a village rather than a wide unit based on a zone will result in a plan more suitable for the actual conditions. Therefore, villages to be covered by the plan are divided into three types (groupings) based on indexes of socioeconomic conditions. Then, with each group as a unit, the comprehensive participatory plan is to be made.

In the stage of execution, investigations of social economic conditions (by RRA or another method) will be carried out for each village. After grasping the characteristics of the village, a detailed plan with villagers as the nucleus will be prepared and executed.

The classification of types of villages is as follows:

Village type	Classification index		Target villages
	Factors of village formation	Structure of working	
Type I	Evacuation due to dam construction	Simple (agriculture + fishery)	Angodongodona Andriantsijio
Type II	Natural formation	Mixed (agriculture + wage labor + charcoal making)	Andrefanivorona Ambohimanjaka
Type III	Natural formation	Simple (agriculture + fishery)	Anosivola Andohariana Morarano Ambohijanaka Kelimafana Ankazotelo

6-3-2 Projects to be covered by the plan

In the PSs, 11 kinds (fruit-tree production, production of compost, hedges, fodder production, production of young plants, tree planting, ZODAFARB, charcoal-making, fish farming in rice fields and small-sized hydroelectric power generation) of projects were executed in 6 fields (agriculture, agroforestry, forestry, forest industry, fishery and social infrastructure). The results were analyzed for the rate of villagers' participation, the degree of spread/achievement of technique and villagers' responses, all of which were classified by zones and projects. Based on those results, projects to be covered by the participatory watershed management plan is to be selected according to the following criteria:

- ① A project should be necessary for the watershed management.
- ② A project should be able to be carried out by villagers.
- ③ A project to which villagers' responses are negative should be excluded.

According to the above-mentioned criteria, among projects executed in PSs, technique in the field of forestry to improve coppice forests and technique in forest industry to make charcoal are excluded from projects to be covered by the participatory watershed management plan. The technique for coppice forests is poor in practical effectiveness because villagers' interest is low and a saw, a tool used in this technique, is difficult to be accepted by villagers. Charcoal-making technique faces difficult acceptance by villagers because it has low technical effect. For these reasons, the above-mentioned operations have been determined to be excluded from projects to be covered by the plan. Small-sized hydroelectric power generation is also excluded from the plan because it was executed as a special case for Analamihotra Village. As a result, the plan is to be made covering 8 kinds of projects in 4 fields.

6-3-3 Projects to be covered by the plan, classified by village types

(1) Projects to be covered by the plan

Projects selected in "1" mentioned above are not equally accepted by all local villagers; there

are differences according to environmental conditions (zonal divisions) where villagers live. A different zone (zonal division) has a different degree of villagers' response (interest). Therefore, it is realistic to make a participatory watershed management plan separately for each zone. At the same time, even in the same zone (zonal division), the degree of interest in each project differs according to the life-running conditions of individual villagers. For these reasons, it is judged reasonable to make project plans with consideration given to the rate of villagers' participation (practice) in and responses to each project, based on the results of the PSs.

According to the aforementioned basic idea, the projects to be covered by plans separately made for each zone have been determined as shown in Table IV-6.

Table IV-6 Projects to be covered by plans separately made for each zone

Village type	Agriculture		Agroforestry		Forestry			Fishery
	Fruit trees	Compost	Hedges	Fodder	Production of young plants	Tree planting	ZODAFARB	Fish farming in rice fields
I	●	●	●	●	●	●	●	●
II	●	●	●		●	●		
III	●	●	●	●	●	●	●	●

Note: ● mark indicates projects to be covered by plans separately made for each zone.

(2) Contents of projects

The contents of projects to be implemented under this plan are as follows:

Agriculture:

Agricultural projects are of two kinds: the planting of fruit trees, and the production of compost.

The results of PSs have proven that the planting of fruit trees is a project in which villagers' interest is high. As species adaptable to the locality, peach, plum, persimmon, apple, pear, etc., which have been already selected by specialists in fruit trees, planted and cultured, are included in the plan. These might be changed, however, according to the future growth of species planted under PSs. Places suitable for planting and culture are those trees will be well cared for, such as in the vicinity of houses. Particularly with future sale taken into consideration as well, half (50%) of participating households should be the target ratio for women's participation. If young plants are obtained from a remote place, they should be cultured in a young plant field for a certain period and should be planted in the actual site after acclimatization to the environment and recovery of vital power.

The production of compost is a project which is by all means necessary for improvement of land productivity, but a shortage of compost materials is a problem. However, combined with the spread of species introduced for agroforestry, active development of the project is

expected. The production of compost will be carried out as women-centric activities partly because it is light work.

Introduced species: Kakier, Pecher, Papayaer, Oranger, Poirier, Prunier, Pommier, Avocatier, etc.

Agroforestry:

We plan two projects that include hedge laying. Hedge laying in this context means the planting and culture of hedge plants such as shrubs and grass in order to prevent soil erosion and soil surface outflow from Tanety cultivating land. It also includes the planting and culture of leguminous plants to recover fertility of the soil of fallow land. Particularly in Tsiazompaniry zone, in order to prevent gullies from generating from waterways in fallow land (tanety), planting and culture of hedges will be executed rigorously in upper waterways. As to the fodder production, villagers' interest is different among districts. It is, however, feasible with use of fallow land and technology similar to farming work. Therefore, it is considered that fodder production will be able to be comparatively well accepted by villagers. Both hedge laying and fodder production are delicate work and should be executed with the target ratio of women's participation of 50%.

As this kind of technique is the first experience for villagers, the project is implemented with technical guidance.

Possible species to be introduced are as follows:

Hedge	<i>Tephrosia vogelii</i> , <i>Crotalaria grallaria</i> , <i>Vetiveria zizanioides</i> , <i>Cassia rotundifolia</i> , etc.
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Fodder production	<i>Penisetum purpureum</i> , <i>Bracharia spp.</i> , <i>Setaria sp.</i> , <i>Avoine sp.</i> , <i>Stylosanthes spp.</i> , etc.
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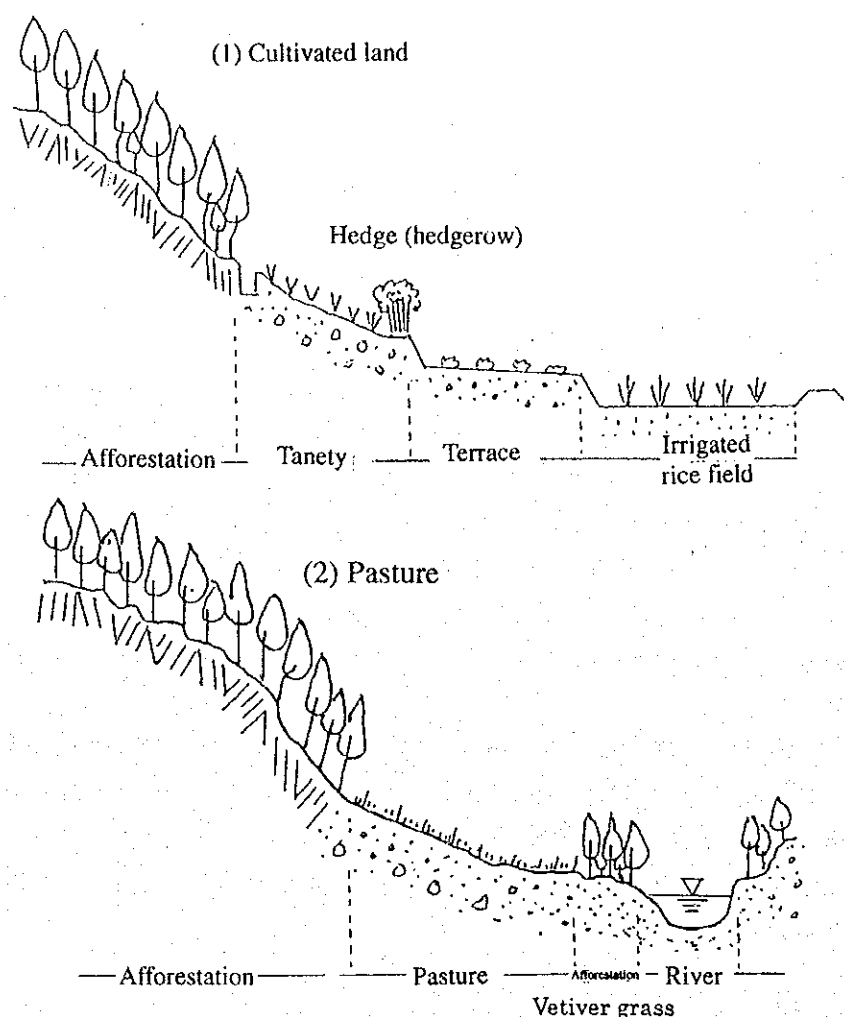


Figure IV-3 Basic uses of land

Forestry:

Forestry activities are production of young plants and tree planting. Tree planting is divided into two kinds according to places of planting: general tree planting in land owned privately, and ZODAFARB (tree planting in state land governed mainly by the Ministry of Water and Forests).

For the production of young trees, joint work is rational from the viewpoint of technical guidance. In almost all villages, hamlets are scattered in a wide area, and joint work is apt to be in name only for young plant work that routinely requires short-time care. Therefore, it is important to locate young plant fields in places that are near hamlets and where work is practically possible for each participant.

It is then judged that the number of young plant fields to be made will be large. In laying plants, it is necessary to pay attention to the fact that the way of laying differs for young plants in pots and for those whose roots are exposed. The economical way in the former case is to lay young plants densely in the young-plant bed, while, in the latter case, it is to lay plants with consideration given to spaces between them. Although in-pot young plants are evaluated to have a high rate of rooting, they are apt to be avoided by villagers because they require much labor.

It is, however, desirable to partly include the production of young plants for the purpose of planting in places with poor soil conditions, such as ridges. Then one third of total young plant production will be planned as in-pot young plants. As the technique of raising young plants is the first such experience for villagers, technical guidance is indispensable for economical and sound production of young plants. Work to culture young plants is suitable for women because daily management is important. In this sense as well, this project should be executed with the target ratio of women's participation of 50%.

Although tree planting activities have been carried out with men as the main participants, it should be executed with the target ratio of women's participation of 50% in the sense of security of women's economic base as well. Tree planting is a technique that villagers themselves have carried out up to now, and can be conducted without special problems. Villagers naturally select planting places that do not hinder cultivation. Furthermore, they tend to select places remote from their hamlets. Forestry activities are to be executed with consideration given not only to only preservation of cultivated land and prevention of erosion but also to the basic placement as shown in Figure IV-2. ZODAFARB is to be carried out according to procedures determined by the Ministry of Water and Forests.

Species of trees to be planted:

Eucalyptus robusta, *E. camaldulensis*, *Pinus patula*, *Cupressus pyramidalis*, etc.

Fishery:

Fish are an important source of protein for people in hamlets even in places remote from lakes because food materials that are sources of protein are poor.

Therefore, fish farming in rice fields is an important project for improvement of villagers' diet. Fish farming using irrigated fields after paddy rice is harvested (in the dry season) is of high interest to villagers. Water is indispensable for fish farming. For this reason, these operations help to raise interest in forests from the viewpoint of securing water.

Although the production of fry by rearing parent fish is desirable, it is accompanied by technical difficulty and is uncertain. Therefore, under this Management Plan, plans should be made on the assumption that fry will be purchased and distributed to participating villagers. In the selection of fish farming ponds, it is necessary to select places where damage at the time of a cyclone will be able to be reduced. If the upper part of an irrigated field is covered with a forest, it can be expected that damage will be reduced more or less by the time lag of the outflow of rainfall.

Fish farming activities should be executed with women as the main participants similarly to the production of compost because it is suitable for women since it requires daily management including feeding.

Species of fish to be cultured:

Royal carp, Tilapia, etc.

6-3-4 Preconditions on formulation of project plans classified by village types

In making a project plan separately for each zone, it is necessary to carry it forward after certain conditions are satisfied. For this purpose, a plan should be made with the following items as preconditions:

Villages to be covered by the plan:

Ambatolana Village in Zone A is excluded from the plan because it is near a town and under unaided development. In Zone C, villages within the target area only are included, and those consisting only of hamlets are excluded.

Analamihoatra in Zone D is excluded from the plan because independent execution is anticipated. Villages to be included in the plan are shown in Figure IV-1.

Number of households:

As the county office (commune) does not know the accurate number of households, the safety rate is seen and then round numbers are used.

The percentage of households with interest:

The percentage of households with interest in this context expresses the degree of households' interest in each project as a ratio of households with interest to all households in the village. It is the percentage (%) of expected participation in each project in each village. Based on the actual results in PSSs, the percentages of households with interest is expected as follows:

Village type	Agriculture		Agroforestry		Forestry			Fishery
	Fruit trees	Compost	Hedges	Fodder	Production of young plants	Tree planting	ZODAFARB	Fish farming in rice fields
I	10~25	25	5	5	20	20		10
II	30	25	30	/	15	15	/	/
III	36	30	30	30	50	50		30

Note: As to ZODAFARB, it is assumed that half of households will participate in tree planting and culture and one-third in the production of young plants.

Execution of the plan: A plan should be executed in each village over in the term of 3 years. In the first year, the plan should be made (by the PRA method), and in the second and third years, the plan should be executed. Although the organization will be set up in the first year, substantial activities will start in and after the second year. Judging from the results of PSSs, as members of the organization will be short of experience and knowledge and be puzzled in the first organizational activities, the activities will not become completely independent. In order for members to become skillful in organizational activities, it is necessary to repeat the practice in the next year. Therefore, a two-year practice period is to be expected. The plan should be carried out by the self-management of villagers in and after the fourth year. In this plan, projects for three years should be planned for each village.

6-3-5 Implementation schedule of the plan

Areas to be covered by the plan are spread over two districts, Mantsoa and Tsiacompaniry.

The road situation is bad, and travel takes much time. In order to execute the plan efficiently, it is necessary to execute it collectively as much as possible in a sphere of action of each year. Based on the above-mentioned strategy with the execution schedule in each year determined as shown in Table IV-7, plans are to be made. According to the schedule, one round will be made for all villages to be covered by the plan five years after the start of the plan. Then, the situation of execution will be evaluated, and minimum follow-up measures will be discussed if necessary for achievement of independent execution.

Table IV-7 Execution schedule

Type	Village		0	1 st year	2 nd year	3 rd year	4 th year	5 th year	6 th year and after
I	Andriantsijo (60) A			Planning	Execution	Execution	Independent execution	Independent execution	Independent execution
	Angodongodona (280) A			"	"	"	"	"	"
II	Andrefanivorona (70) C			Planning	Execution	Execution	Independent execution	Independent execution	Independent execution
	Anbohimanjaka (130) D			Planning	"	"	"	"	"
III	Morarano soafirai-Sana (140) C				Planning	Execution	Execution	Independent execution	Independent execution
	Ansivola (100) C				"	"	"	"	"
	Andohariana (70) C				"	"	"	"	"
	Ambohijanaka (560) C				Planning	Execution	Execution	Independent execution	Independent execution
	Kelimañana (210) C					"	"	"	"
	Ankazotelo (100) E				Planning	Execution	Execution	Independent execution	"
	Analamihoatra D		Independent execution	Independent execution	Independent execution	Independent execution	Independent execution	Independent execution	Independent execution

Note: Zone D, Analamihoatra, includes two villages, Anovondriana and Kelialina. Figures in parentheses are the number of households.

Total number of households: 1,720 (excluding Analamihoatra)

Number of households starting in the first year: 540

Number of households starting in the second year: 410

Number of households starting in the third year: 770

6-4 Project plan classified by village types

6-4-1 Annual quantity of operations

The annual quantity of operations should be calculated based on the number of households. Each project is to be executed with a household as a unit. If each household has too great a quantity of operations, it will bring about a conflict with agriculture in labor allotment, which will make it impossible to execute the plan. Calculation of annual quantity of operations based on households will also provide materials to judge the possibility of execution.

The quantity of operations per household has been determined for each project from the results of PSs. Based on this, annual quantities of operations have been calculated with the number of participating households, quantities of operations per household, labor required for each unit of operation, required labor per household and so on. Table IV-8 shows an example of the calculation in the case of agriculture. The calculation has been made for each project in the same way. For the results of the calculation, see Annex 55.

Table IV-8 Example of calculation of annual quantity of the project (Example of agriculture)

Agriculture 1) Planting of fruit trees

Village type	I	II	III
Relevant village	Andriantsijo Angodongodona	Andrefanivorona Anbohimanjaka	Morarano Ansivola Andohariana Ambohijanaka Kelimafana Ankazotelo
Number of households	340	200	1,180
Rate of interest (%)	Andrian. 25 Angodon. 10	30	36
Number of households having interest in the project	43	153	425
Quantity of operations (number of trees) per household	20	20	20
Labor per unit (person-days/tree)	0.7	0.7	0.7
Labor required for a household (person-days)	14	14	14
Total labor (person-days)	602	840	5,950
Total quantity of operations (1,000)	0.86	1.20	8.50

Labor per unit: 1 man-day for digging and putting compost, 0.5 man-day for tree; 0.05 man-day/tree for planting, 0.15 for rearing.

2) Production of compost

Village type	I	II	III
Relevant village	Andriantsijo Angodongodona	Andrefanivorona Anbohimanjaka	Morarano Ansivola Andohariana Ambohijanaka Kelimafana Ankazotelo
Number of households	340	200	1,180
Rate of interest (%)	25	25	30
Number of households having interest in the project	85	50	354
Quantity of operations (number of trees) per household	3	2.5	2.5
Labor per unit (person-days/tree)	1.5	1.5	1.5
Labor required for a household (person-days)	4.5	3.75	3.75
Total labor (person-days)	383	188	1,106
Total quantity of operations (unit)	255	125	885

Labor per unit: 1 man-day for loading, 0.5 man-day for mixture; 1.5 man-days in total. As it is assumed that materials are gathered on the way from daily farming work, labor to gather materials was not included.

The summary of (annual) labor per household required for each project is as shown in Table IV-9. Village type III has the most labor, which is about 100 days per year. What requires the most labor of all projects is tree planting. However, tree planting may not be additional new project, because it has been traditionally conducted. With consideration given to the facts that each household rarely participates in all projects and that each household has 3 or 4 producing laborers, it is judged that the quantities are reasonable. According to the schedule shown in Table IV-10, it is also found that the project is possibly implemented without overstrain as a whole..

Table IV-9 Required labor per household for each project (for a year)

Unit: Man-day

Village Type	I	II	III
Agriculture			
Planting of fruit trees	14	14	14
Compost	4.5	3.8	3.8
Agroforestry			
Hedges	2	3	3
Fodder	2	/	2
Forestry			
Production of young plants	8.2	12.3	12.3
Tree planting	25	41	38
ZODAFARB	14	/	20
Fishery			
Fish farming in rice fields	4	/	4
Total	79.7	79.1	102.1

Table IV-10 Crop calendar

(1) Example of Ambohijanaka Village in the Mantasoa zone

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Classification of rainy or dry season	Rainy season		Transition period				Dry season			Transition period		Rainy season
Rice crop		Rice reaping	Rice reaping	Rice reaping					Plowing	Seed sowing, rice planting		
Potato cultivation					Plowing		Harvesting					
Hillside upland farming												
Charcoal making												
Fishery												
Famadihana												
Busy farming season		⊙	⊙		⊙		⊙		⊙	⊙		
Production of young plants								Preparation of nursery				
Afforestation												

(2) Example of Analamihoatra Village in Tsiazonpaniry zone

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Classification of rainy or dry season	Rainy season		Transition				Dry season			Transition		Rainy season
Rice crop		Rice reaping	Rice reaping							Plowing	Seed sowing, rice planting	
Potato cultivation				Plowing		Harvesting	Harvesting-plowing		Harvesting			
Hillside upland farming												
Fishery												
Famadihana												
Busy farming season		○	○		○			○		○	○	
Production of young plants								Preparation of nursery				
Afforestation												

6-4-2 Annual project plan classified by village types

Projects will be executed in each year according to the project execution schedule (Table IV-7) stated above. In all villages, a plan will be made in the first year, and it will be executed in the second and third years. Table IV-11 shows quantities of planned projects classified by village types for each year. The starting year is different among villages, and one round will be completed for all villages 5 years after the start of the plan. For the details of the project plan, see Annex 56.

Table IV-11 Annual project plan classified by village types

	Village type	2 nd year	3 rd year	4 th year	5 th year
I	<u>Agriculture</u>				
	<u>Planting of fruit trees (1000)</u>	0.86	0.86		
	<u>Production of compost (unit)</u>	255	255		
	<u>Agroforestry</u>				
	<u>Hedges (kg)</u>	17	17		
	<u>Fodder production (100)</u>	17	17		
	<u>Forestry</u>				
II	<u>Planting of fruit trees (1000)</u>	1.2	1.2		
	<u>Production of compost (unit)</u>	125	125		
	<u>Agroforestry</u>				
	<u>Hedges (kg)</u>	90	90		
	<u>Production of young plants (1000)</u>	45	45		
	<u>Tree planting (1000)</u>	45	45		
	<u>Fishery</u>				
III	<u>Planting of fruit trees (1000)</u>		2.96	8.50	5.54
	<u>Production of compost (unit)</u>		308	885	578
	<u>Agroforestry</u>				
	<u>Hedges (kg)</u>		185	531	347
	<u>Fodder production (100)</u>		123	354	231
	<u>Forestry</u>				
	<u>Production of young plants (1000)</u>		307.5	885	577.5
	<u>Tree planting (1000)</u>		256.25	737.50	481.25
	<u>ZODAFARB (1000)</u>		51.25	147.50	96.25
	<u>Fishery</u>				
	<u>Fish farming in rice fields (100)</u>		123	354	231

Village type		2 nd year	3 rd year	4 th year	5 th year
Total					
<u>Agriculture</u>	<u>Planting of fruit trees (1000)</u>	2.06	5.02	8.50	5.54
	<u>Production of compost (unit)</u>	380	688	885	578
<u>Agroforestry</u>	<u>Hedges (kg)</u>	107	292	531	347
	<u>Fodder production (100)</u>	17	140	354	231
<u>Forestry</u>	<u>Production of young plants (1000)</u>	113	420.5	855	577.5
	<u>Tree planting (1000)</u>	101.1	357.35	737.50	481.25
	<u>ZODAFARB (1000)</u>	11.9	631.5	147.50	96.25
<u>Fishery</u>	<u>Fish farming in rice fields (100)</u>	34	157	354	231

The results of the calculation of annual quantity of operations related to tree planting are as shown in Table IV-12. Tree planting covering 623 ha (524 ha of privately owned land and 99 ha of ZODAFARB) will be carried out in a year.

Table IV-12 Quantity of annual production of young plants and size of planting

Village type		I	II	III	Total
Quantity of production of young plants (1000 plants)		68	45	885	998
Tree planting (ha)	Land personally owned	35	28	461	524
	ZODAFARB	7	No applicable	92	99
	Total	42	28	553	623

Note: 1. Size is calculated on the assumption that planting space is 2.5 m x 2.5 m.
 $10,000/6.25 \text{ m}^2 = 1,600 \text{ trees/ha}$
2. As 1/2 of the figures in Table IV-13 is shown here, figures of Type III do not correspond with those in Table IV-11. If the projects continue in and after the fourth year, the quantity of annual operations will be as shown in this table.

6-5 Total quantity of operations classified by village types

Table IV-13 shows the total quantity in each village of operation for the two years during which projects will be conducted in this project.

Table IV-13 Quantity of planned operations classified by village types

Village type	Agriculture		Agroforestry		Forestry			Fishery
	Fruit trees (1,000 trees)	Compost (unit)	Hedges (kg)	Fodder (100 trees)	Production of young plants (1000 trees)	Tree planting (1,000 trees)	ZODAFARB (1,000 trees)	Fish farming in rice fields (100 fishes)
I	1.72	510	34	34	136	112.2	23.8	68
II	2.40	250	180	-	90	90	-	-
III	17.00	1,771	1,063	780	1,770	1,475	295	708
Total	21.12	2,531	1,277	742	1,996	1,677.2	318.8	776

Note: Quantity of operations is total of quantity in each village for two years.

On the assumption the 1,600 trees are planted per hectare, the size of tree planting among the total quantity of projects will be 1,247 ha (1,048 ha owned by individuals and 199 ha owned by ZODAFARB). If villagers continue operations independently in the villages in and after the fourth year (see Table IV-7), it is expected that the size of tree planting will be 4,700 ha after

10 years, as shown in Table IV-14.

Table IV-14 Size of tree planting after 10 years (expected)

Village type		I	II	III	Total
Quantity of production of young plants (1000 plants)		612	405	6,503	7,520
Tree planting (ha)	Land personally owned	316	253	3,387	3,956
	ZODAFARB	67	No applicable	677	744
	Total	383	253	4,064	4,700

Note: Size is calculated on the assumption that planting space is 2.5mx2.5m.
 $10,000/6.25 \text{ m}^2 = 1,600 \text{ plants/ha}$

As shown in Table IV-5, the total of afforestable land is about 15,000 ha. The afforestable area is different among areas (zones). Zone C has afforestable area of 558 ha, which is the smallest. There are four villages located in this area whose types of village are II and III. (See Table IV-7.) The expected annual area of planting and culture in these villages is about 150 ha, and execution of tree planting will be completed after about four years. As there is land to which ZODAFARB is applied in the periphery, tree planting will be possible if villagers want to do so. Other areas (zones) have sufficient land so that tree planting will be able to be continuously carried out for 20 years or longer. Tree planting, the main project in the participatory watershed management plans, is actually in the situation where it is possible to continue long-term operations.

6-6 Conduct of ZODAFARB

ZODAFARB is a program to transfer national land to villagers on condition of tree planting. It is a measure to promote tree planting and also to preserve forests. This program will be a great incentive to promotion of tree planting because the right to land can be obtained in this program. On the other hand, places of tree planting will play a role as buffer zones for preservation of natural forests left by forest management carried out together with villagers in one united body ("forest management guided by villagers"). From these points of view, this was selected as a project to be covered by this plan.

Places where tree planting is to be carried out according to this program are on land mainly governed by the Ministry of Water and Forests in the target area. In the selection of places to be included in the plan, it is necessary to be mindful of making the placement of forests well balanced with the surrounding environment with hamlets as a center. A place should be selected not merely because it exists but with due considerations given to effective placement from the viewpoint of preservation of the downstream area, securing of water sources and efficiency in transportation of young plants as well as the future way of practice.

Execution of this program is to be carried forward according to a fixed procedure prescribed by the law or the like. Table IV-9 shows the procedure carried out in PSs upon deliberation

with the Ministry of Water and Forests. Tree planting will be carried out in accordance with this. It is necessary to afforest while giving heed not to ignore the procedure due to a rash start of execution. Matters that should be especially kept in mind are preparation of a sketch map of the selected place, indication of the site (with stakes or other markers), obtaining villagers' consent and impartial allocation of the places to be afforested among participants. According to the results of PSs, villagers will be able to make indication of the site and prepare the sketch map by themselves with local guidance. It is judged that, if there is guidance from the Ministry of Water and Forests, execution without causing a burden to villagers will be possible.

Table IV-15 Procedure of execution of ZODAFARB

Procedure of execution	Undertaker of execution
1. Activities to educate/enlighten villagers	Ministry of Water and Forests, NGO
2. Clarification of borders - Confirmation of national or private land - Lot-dividing work Preparation of a map of the project area	Ministry of Water and Forests, NGO Villagers NGO
3. Preparation of request letter (3 kinds of maps, minutes)	NGO, villagers
4. Submission of request letter	Villagers
5. Public disclosure of documents	Prefecture
6. General assembly in the village - Formation of a villagers committee - Allotment of lots - Rule making - Contract between the Ministry of Water and Forests and villagers	Villagers Villagers Ministry of Water and Forests, villagers Ministry of Water and Forests, villagers
7 Joint work	
- Production of young plants	Ministry of Water and Forests, villagers
- Preparation of planting	NGO, villagers
8. Seminar activities - Prevention of forest fire, etc.	Ministry of Water and Forests, villagers
9. Execution of tree planting	NGO, villagers

6-7 Extension activities

6-7-1 Family planning

The purpose of this plan is management of the watershed. The point of watershed management is preservation of the watershed through appropriate land use. For this purpose, the plan includes measures for appropriate land use. One of major causes that actually makes inappropriate land use unavoidable is a sudden increase in population. Even if appropriate measures/ways for land use are taken, it is difficult to achieve the purpose of watershed management. This problem requires time for the spread because it is apt to be considered taboo and needs men's cooperation. As one of the major means for watershed management, it

is necessary to adapt family planning (Planning Familial: PF). For planning and execution of PF, it is also required to give sufficient consideration from the viewpoint of gender, as stated in Section 2-2, Chapter I, regarding the knowledge of the inhabitants, such as misunderstanding of pregnancy and contraceptive appliances, the non-understanding of men and the strong interest of women in PF. For this purpose, family planning should be executed on the initiative of women under the promotion of women's active participation in watershed management activities and improvement of women's status. Of course, it should be carried out with men's cooperation obtained.

With "the existing system" and "action at the village level" as keywords, activities to spread family planning will be taken as follows:

- ① To ask the prefectural medical center (Centre Hospitalier de District: CHD) and basic medical centers (Centre de Sante de Base: CSB) that exist in each county for their cooperation in advance, and schedule the dispatch of personnel in charge of the spread of the PF that is adjusted to the schedule of villagers' regular meetings for watershed management activities.
- ② To carry out enlightenment activities (Information, Education and Communication: IEC) assumed by the PF-spreading staff at villagers' regular meetings.
- ③ To continue this program for a long time because it requires a change of villagers' consciousness.
- ④ To set up a sub-organization of the Watershed Management Committee in each village, and to facilitate the acquisition of contraceptives by community purchase, if necessary.

6-7-2 Technical extension

This plan consists of not only forestry but also two other fields, agriculture and fishery. Execution is impossible without technical guidance from those concerned with agriculture and fishery. Therefore, the plan is to be executed while obtaining cooperation from those in charge of spreading agricultural techniques and those concerned with the Fishery Department. For this purpose, it is indispensable to ask the organs concerned for cooperation in the central stage and to obtain cooperation through the organizations.

6-8 How to proceed in project implementation

The project plans stated above (in 6-4 and 6-5) were made on the fixed conditions, and will be executed with the participation of villagers. In the stage of concrete execution, a plan will be made with sufficient time taken for one year on the assumption of the PRA. Then, after villagers make a detailed plan that is actually feasible, projects will be conducted. At that time, a new plan will be made with the plan of this matter as one of models.

Considering that this plan is based on the assumption of villagers' participation, particularly

women's participation, it is necessary to pay attention to the following items from the viewpoint of the results of PSs carried out.

Stage of preparation:

In order to solve problems related to preservation of the watershed, it is important to make villagers develop an active attitude particularly women's active one, not a passive one. The plan should be executed for villages that will be able to have such an attitude. Concrete execution activities will be taken by an NGO that is rich in experience. Points to be regarded are as follows:

- ① To establish the organizational system where ministries concerned are united as the main body of execution.
- ② To select a qualified NGO that has ability of management and experience in PRA and on-the-spot technique.
- ③ To clearly define the responsibilities of the NGO.
- ④ To make efforts to explain the contents of the plan so that villagers will be able to consent to them fully.

Stage of preparation of the plan:

For plans severally made for each village, it is important to, with their own wits including women, make a plan that will be able to be continuously executed. Assistance is temporary, not continuous. Motivation to make a continual plan by efforts of villagers including women is an important point of plan making. Points to be regarded are as follows:

- ① To make a plan by PRA.
- ② To avoid holding workshops frequently and endeavor for efficient plan making while taking time.
- ③ To make a plan that will not require labor beyond the capacity of participating households, as the plan will be executed in a unit of a household.
- ④ To make a plan by considering geographical conditions and, as a unit, using the area that will allow villagers including women to participate without difficulties.
- ⑤ To clarify places where a concrete project (especially production of young plants and tree planting) will be executed in making an action plan.

Stage of execution:

This plan aims at establishment of villagers' independence including women. For this purpose, it is important to place the nucleus of plan execution on a villagers' organization. It is also vital to respond flexibly so that participating villagers will be able to practice without difficulties through monitoring during execution. Points to be regarded are as follows:

- ① The contents of the plan should be re-confirmed by villagers before the start of the

project.

- ② To execute the project while maintaining independence of the villagers' organization.
- ③ To give consideration to proper and timely preparation of materials according to the project execution schedule in order to secure villagers' trust.
- ④ To positively accept villagers who want to participate after planning.
- ⑤ To carry out monitoring by villagers themselves (under guidance of the NGO).

After becoming independent:

The volume of operations shown in this plan is only for the term of the plan (three years). It is expected in this plan that the villagers will continue to carry out similar projects by themselves after the finish of the term of the plan. Namely, the final goal of this plan is that each project incorporated in it will become firmly fixed in lives of the inhabitants as a daily activity. For this purpose, development of independence of the villages is intended in the improvement of women's status through women's active participation. It is considered that this will enable the continuous practice of watershed management activities including family planning.

It is important to follow up continually in the process of villagers' execution. For the concrete way to carry forward the plan by PRA, "Guideline on the community/villagers participation" is prepared (see annex of "Pilot Study" in Part 2.).

7 Forest management plan

7-1 Forest management principles

The objective of the forest management plan is the conservation of the entire forest conservation area. In concrete terms, these are zones B and E in Mantasoa and zone E in Tsiazompaniry. Zone B in Mantasoa principally has hotels and secondary residences. Since there is only a simple artificial forest, the conservation of the landscape is essential in this area. In zone E of the two areas, the forest plays an essential role for soil and water conservation and the prevention of soil outflow. Natural forests subsist especially in zone E and plays an essential role in water retention. It must therefore be protected by preventing the cutting of existing natural trees which constitute the habitat for precious animal and vegetable species. Consequently, these zones will be designated as reservations for the forest conservation zone. The management of these forests will be even more indispensable in the future.

Based on the points given above (see 5. Overall watershed development plan), the final objectives of the watershed management plan in the forest conservation zone are as follows.

- | | |
|---|--------|
| ① Conservation of the natural environment | Zone B |
| ② Secure supply of water sources | Zone E |

To realize these objectives, the forest management principles must be defined as follows for

the formulation of the plan.

- ① Qualitative improvement of the natural environment Zone B
- ② Extension and conservation of the forests Zone E

7-2 Forest management standards

Table IV-16 indicates the zones covered by the forest management plan, but only the forests will be covered. The forests are divided into national forests (under the responsibility of the Ministry of Water and Forests) and private forests. Private forests are all included in artificial forests. Since their limits are not clearly established, it is impossible to classify them by surface. For cutting trees however, the authorization of the Ministry of Water and Forests is required even for private forests. In this way, management is appropriately carried out by the local official. The local CEF and TEF of the Ministry of Water and Forests are responsible for forest management activities. However, they are limited in implementing these activities and in their management capacity due to lack of finances and personnel. The assignment of new activities will be a problem. As such, the activities to be defined under this plan will only be limited to present activities such as the issuance of permits. Due to this situation, the forest management standards per zone were defined as indicated below. The concrete plan will be established on this basis.

Zone	Forest management principles	Forest management standards
B	Improvement of the natural environment quality	<ol style="list-style-type: none"> 1. Regulations for cuttings and fires 2. Balance between planting/cutting 3. Regulations on development 4. Recommendation for the planting of ornamental trees
E	Extension and conservation of the forest	<ol style="list-style-type: none"> 1. Prohibition of tree-cutting in natural forests 2. Regeneration of vegetation through natural means 3. Management of the forest at the initiative of the villagers

Zone B principally includes artificial forest with a majority of pine trees around hotels and secondary residences, together with many eucalyptus trees planted by the villagers. This zone also has parts used as recreational park by the villagers of Antananarivo and the neighboring areas. As such, forest management to protect the surrounding landscape is required. Not only the Ministry of Water and Forests, but also other Ministries and agencies concerned must take measures to limit development. Furthermore, the planting of ornamental trees is recommended to hotel owners to ensure a qualitative improvement and beautification of the natural environment.

For zone E, the forest management standards will consist of planting artificial forests. The growth of natural forests may be left to natural forces in the surrounding areas, to ensure the

extension and conservation of the forest.

The tree planting structures may provide immediate results for each type of forest based on the management standards mentioned above:

- Grasslands
 - ① Introduction of pioneer species
 - ② Artificial tree plantings
- Shrub areas
 - Introduction of tall trees and acceleration of growth of useful species
- Natural forest (density of original trees: less than 50%)
 - Improved cover in forests through the growth of successor trees
- Natural forest (density of original trees: above 50%)
 - Formation of diploid wood through the growth of successor trees

Table IV-16 Surface covered by the forest management plan

Unit: ha

Division/zone	Mantaoa zone			Tsiazompaniry zone	Total
	B	E	Total	E	
Forest	823 (56)	1,165 (99)	1,988 (75)	2,495 (99)	4,483 (87)
Artificial forest	719 (49)	313 (27)	1,032 (39)	913 (36)	1,945 (38)
Natural forest	- (-)	58 (5)	58 (2)	1,582 (63)	1,640 (32)
Shrub forest	104 (26)	794 (67)	898 (34)	0	898 (17)
Grasslands	377 (26)	0	377 (14)	0	377 (7)
Farm lands	177 (12)	9 (1)	186 (7)	0	186 (4)
Others	84 (6)	6 (-)	90 (4)	30 (1)	120 (2)
Total	1,461 (100)	1,180 (100)	2,641 (100)	2,525 (100)	5,166 (100)

7-3 Items for the implementation of forest management

Table IV-17 classifies the items for the implementation of forest management (content of plan) in accordance with the forest management standards in the preceeding paragraph (7-2). These items will be carried out under the responsibility of the Ministry of Water and Forests, the agency responsible for forest management.

The concrete content of these items is as follows.

Zone B. Improvement of the natural environment quality

a. Restrictions on cutting and fires

① Issuance of cutting permits in consideration of the natural environment

The cutting of private forests also requires a permit from the Ministry of Water and Forests. Zone B is a recreational area for the villagers. The protection of the landscape is essential, but also contributes to the conservation of the soil on the banks. As such, cutting standards must be established. The landscape must be protected by limiting the issuance of cutting permits. As a first condition, these cuttings must not constitute an obstacle for the protection of the landscape.

② Principle of prohibition of burning

The cause of forest fires is often due to human actions such as burning graze lands, slash and burn cultivation, burning of fields for clearing, charcoal production work, as well as arson. Forest fires have considerably reduced the vegetation, with the biological degradation of a soil, factors contributing to outflow of soil. However, we must accept that burning is an important element in the life of the villagers. In principle, the issuance of burning permits is prohibited. They are however issued on a case-by-case basis, if they are in direct relation with the needs of the villagers.

b. Balance between planting/cutting: obligation to replant after cutting

To protect the landscape, the issuance of the cutting permit in the previous paragraph will be accompanied by an obligation to replant after cutting. The Ministry of Water and Forests will give guidelines for planting and will supervise the selection of plant species and the planting method.

c. Regulations for development: required environmental evaluation

We may say that zone B is a very particular area since it is the public garden within the target zone. As such, from the viewpoint of protecting the landscape, maintenance of the natural environment will be ensured by the supervision of the Ministry of Water and Forests and the Ministry of the Environment. For developments other than farming which may modify the relief, authorization will be required from these Ministries. An environmental evaluation will be carried out by a specialized committee created under the Ministry of Water and Forests.

d. Recommendation for the planting of ornamental trees: Conducting of activities to encourage the planting of ornamental trees

Since there is no natural forest in this area mainly occupied by hotels and secondary residences, the planting of ornamental trees is encouraged. There is no habitat for birds, etc., since there are very few trees to shelter and nourish birds and small animals. To enrich this natural landscape, regional organizations such as the Regional Forest Department, and organizations under prefectures and rural communes must encourage the planting of trees and flowers, particular nutritive trees for the villagers and hotel owners, etc. In particular, the collaboration of owners of hotels and secondary residences are requested. The Regional Forest Department will give technical guidelines for planting.

Zone E. Creation and conservation of forests

a. Prohibition to cut trees in natural forests: no more issuance of cutting permits

For natural forests and trees, cutting is presently authorized for villagers but only of wood for domestic use. However, the natural forests are so degraded that the cutting of even a single

tree must not be authorized. Cutting is prohibited in all natural forests of the zone to allow their renewal. If the growth of natural forests blocks the passage of an ordinary road, cutting may be authorized within 2 meters on both sides of the road under the direct supervision of the Regional Forest Department.

b. Renewal of vegetation through the force of nature

① Access to the forests will be prohibited for a fixed period.

The vegetation, even grass, may be naturally renewed through the introduction of pioneer species (plant transition) if they are left in their natural state for a long period without human intervention. As such, entry into the forest will be prohibited for a certain period to allow the renewal of the forest.

② No issuance of burning permits

For the same reason as the preceding paragraph, issuance of burning permits will be stopped.

③ Activities to raise the awareness of the villagers

For the two paragraphs above, the comprehension and collaboration of the villagers are indispensable. Activities to raise their awareness must be carried out to obtain their agreement. As such, the following activities will be implemented by the persons responsible.

- i Request for the collaboration of regional administrative organizations, including the police force
- ii Activities to disseminate information during market days
- iii Activities to raise awareness through the mass media such as radio
- iv Request for police patrol surveillance
- v Placement of signs at the limits of natural forests

c. Management of the forest at the initiative of the villagers: promotion of tree planting by ZODAFARB

There are vast grasslands in zone E, but their tree planting by the Ministry of Water and Forests is financially impossible. During the pilot study, villagers of the study area are willing to plant trees on the eastern shore of the lakes. Tree planting activities at the initiative of the villagers may also eliminate the pressure to enter the existing natural forests. As such, the ZODAFARB tree planting program will be included in the participatory watershed management plan in order to promote the program in consideration of the topographical conditions of the hamlets and strategic locations

Table IV-17 Items for the implementation of forest management

Zone	Principle	Management standards	Implementation items
B	Improvement of the natural environment quality	1. Regulation of tree cutting	1. Issuance of cutting permits in consideration of the natural environment 2. Principle of prohibiting burning
	Final objective (conservation of the environment)	2. Balance between planting and cutting 3. Regulations for development 4. Recommendation for planting ornamental trees	1. Obligation to replant after cutting 1. Required environmental evaluation for non-agricultural development which may modify the relief 1. Activities to encourage the planting of ornamental trees in sections by the Regional Forest Department and the rural commune and prefectural authorities
	Creation and conservation of forests	1. Prohibition of cutting trees in natural forests	1. No more issuance of cutting permits
	Final objective (assurance of water sources)	2. Renewal of vegetation through the force of nature 3. Forest management at the initiative of the villagers	1. Prohibition of access for a certain time 2. No issuance of burning permits 3. Raising the awareness of the villagers a. Request for the collaboration of regional administrative organizations including the police force b. Activities to raise awareness during market days c. Activities to raise awareness through the mass media such as radio d. Request for a police patrol e. Placement of signs at the natural forest limits 1. Tree planting by ZODAFARB will be actively encouraged to ensure forest management under the responsibility of the villagers and use of the tree planting area as a buffer zone. Tree planting for grasslands will be included in the participatory watershed management plan.

7-4 Implementation schedule

All items to be executed under the forest management plan are considered to belong to matters to be ordinarily controlled under the present organization system. Therefore, it is judged realistic to carry forward these items while coordinating from the viewpoint of time or time period in the local daily affairs. Rational practice is judged possible in this way. For this reason, these items are not specially mentioned here.

8 System to execute Watershed management plan

(1) Executing organization

The Participatory watershed management plan planned here has contents of projects extending to various fields. The plan cannot be implemented by the Ministry of Water and Forests only.

Even if the ministry takes the initiative, it is necessary that organs concerned be united to execute it. For this reason, the plan is to be practiced at the central and local level by establishing organizations so that the organs concerned are united.

The Watershed Management Promotion Council will be set up at the central level, and the Watershed Management Offices (two) will be set up at the local level.

In the Watershed Management Promotion Council, the Watershed Management Promotion Office composed of the ministries concerned will be established.

For concrete development of a participatory watershed management, what is necessary is carefully thought-out guidance that steps into the daily activities of the inhabitants. For example, particularly during preparation of the plan by the PRA, staying in the actual place will be necessary. As inhabitants are the nucleus of the projects, it is impossible without cooperation of an NGO(s) to fix projects in the future daily activities of the inhabitants. Therefore, an NGO(s) shall be made to participate in executing organizations.

Operation of the organization is as follows.

Watershed Management Promotion Council

It is composed of organs concerned with the Ministries of Water and Forest, Land Improvement, Health and others, and makes the whole plan and guides and administers execution of the plan.

Watershed Management Promotion Office

This office carries out projects according to the plan after receiving the decision of the Watershed Management Promotion Council.

Head office

Local office

Organization of the Executive Office

Manager (Member of a ministry--full-time)
Assistant manager (Member of a ministry--full-time)
Two NGO members

Mantaoa Watershed Management Office
(Majokandoriana Local Office for the
Management of Water and Forest)
(in charge of forest management plans only)

Tsiazompaniry Watershed Management
Office (Andramasina)
(in charge of forest management plans and
watershed management plans of the
participation type)

Organization of the office (FDP facility
is used for the office.)

Composed of members of local agencies
of central ministries and agencies and 2
NGO members.

A manager (a permanent post) is a
member of an outpost agency.

The term of NGO's engagement in the head office should be one year (12 months) and that of engagement in the local office should be 8 months when a substantial project is carried out. Watershed Management Committee will be established in each target village. The target constitution ratio of women members in the Committee should be 50%.

The main work for operation of an executing organization is as follows. (For details, see Annex74.)

	Watershed Management Promotion Council	Watershed Management Promotion Office	NGO	Watershed Management Committee in each village
Head office	<ul style="list-style-type: none"> • Formulation of broad policies of the plan 	<ul style="list-style-type: none"> • Coordination among ministries concerned • Management of progress of the overall plan • Guidance for and supervision of NGOs 	<ul style="list-style-type: none"> • General control of field affairs • Conduct of field affairs 	
Local office		<ul style="list-style-type: none"> • Coordination of relevant officials in charge • Execution of the forest plan • Execution of the participatory plan 	<ul style="list-style-type: none"> • Conduct of field affairs • Guidance for preparation and execution of plans for each village 	<ul style="list-style-type: none"> • Preparation and execution of plans for each village

(2) Execution process

Organizations to execute this plan are as stated above in (1). Table IV-18 shows an outline of the execution process to concretely develop this plan, including the formation of these organizations.

Table IV-18 Process for the execution of the plan

Execution step	Organizations in charge of the execution			
	Ministry of Water and Forests	Council (Central)	NGO	Village committee
1. Foundation of the Watershed Management Promotion Council				
① Proposal of inauguration of the said Council	○			
② Decision-making of foundation and execution of the said Council		○		
③ Determination of affairs to be undertaken by each ministry		○		
④ Determination of measures for the introduction of original capital		○		
⑤ Foundation of the Executive Office of the said Council (Head office and local office)	○	○		
2. Planning of broad outline of Watershed Management				
1) Preparation of broad outline of the plan	○	○		
2) Determination of 1)		○		
3) Explanation about 1) to local administrative organs		○		
3. Participatory Watershed Management Plan				
3-1 Decision of the TOR for selection of NGOs				
1) Preparation of the TOR for NGOs		○		
2) Selection of NGO(s) and a contract of commission of work		○		
3-2 Preparation of the execution plan				
1) Field survey		○	○	
2) Preparation of the execution plan based on broad outline		○	○	

3) Determination of matters to be executed and persons in charge		<input type="radio"/>	<input type="radio"/>		
3-3 Preparation of the plan execution schedule					
1) Determination of executing villages for each fiscal year		<input type="radio"/>	<input type="radio"/>		
2) Preparation of the schedule for preparing Watershed Management Plans for each village		<input type="radio"/>	<input type="radio"/>		
3) Explanation of preceeding 2) to administrative organs concerned		<input type="radio"/>	<input type="radio"/>		
3-4 Field work					
1) Field guidance in preparation of plans for each village (prepared by PRA)				<input type="radio"/>	
2) Collection and arrangement of plans for each village				<input type="radio"/>	<input type="radio"/>
3) Re-confirmation of plans for each village				<input type="radio"/>	<input type="radio"/>
4) Decision of plans for each village		<input type="radio"/>	<input type="radio"/>		
3-5 Execution of projects					
1) Execution of projects by participating inhabitants					<input type="radio"/>
2) Field guidance			<input type="radio"/>	<input type="radio"/>	
3) Activities for the spread (local administrative organs)			<input type="radio"/>	<input type="radio"/>	
4. Forest Management Plan					
4-1 Preparation of the Forest Management Plan					
1) Decision of matters to be executed for forest management	<input type="radio"/>		<input type="radio"/>		
2) Determination of persons in charge of 1)	<input type="radio"/>		<input type="radio"/>		
3) Preparation of execution standards for forest management (Standards of permission for timber-felling, controlled burning, development etc.)	<input type="radio"/>				
4) Preparation of the plan of activities to instruct the inhabitants	<input type="radio"/>		<input type="radio"/>		
4-2 Execution of matters for forest management					
1) Preparation of schedules classified by execution items				<input type="radio"/>	
2) Start of execution				<input type="radio"/>	
5. Management of progress					
1) Preparation of monthly progress reports			<input type="radio"/>		<input type="radio"/>
2) Analysis of and field guidance in problems			<input type="radio"/>		
3) Generalization of the state of progress		<input type="radio"/>			
6. Field verification of details of execution					
1) Field verification based on progress reports (once a quarter)		<input type="radio"/>	<input type="radio"/>		
2) Discovery of problems and discussion on measures against them		<input type="radio"/>	<input type="radio"/>		
7. Evaluation of results of execution					
1) Evaluation of results of annual execution			<input type="radio"/>		
2) Evaluation at the time of the end of plans for each village			<input type="radio"/>		
3) Evaluation at the time of the end of the overall plan		<input type="radio"/>			
4) Discussion on necessity of follow-up and supporting measures		<input type="radio"/>			

9 Project cost

(1) On-site operating expenses

Premises of addition:

- ① Plans of the participation type should not include the labor portion (wages) because of villagers' voluntary participation.
- ② The following unit prices should be anticipated as direct material expenses. (For grounds of addition, see Annex 57.)

Project	Unit	Unit (fmg)	Remarks
Production of fruit trees	unit	7,500	
Production of compost	33 units	99,000	49,500 fmg in the second year
Hedges	Kg	9,500	
Fodder production	unit	750	
Production of young plants	1000 units	38,643	36,238 fmg in the second year
Fish farming in rice fields		200	

- ③ For tree planting and ZODAFARB, material expenses should not be particularly included.
- ④ As miscellaneous expenses, 20% of direct materials should be anticipated.

The results of calculation of on-site operating expenses on these premises are as shown in Table IV-19. For the details of addition of materials, see Annex 58.

Table IV-19 On-site operating expenses

Village type	2 nd year	3 rd year	4 th year	5 th year	Total
I Direct material expenses	11,960	11,413	0	0	23,373
Miscellaneous expenses	4,784	4,565	0	0	9,349
Sub-total	16,744	15,978	0	0	32,722
II Direct material expenses	11,969	11,673	0	0	23,642
Miscellaneous expenses	4,788	4,669	0	0	9,457
Sub-total	16,757	16,342	0	0	33,099
III Direct material expenses		48,251	138,080	88,586	274,917
Miscellaneous expenses		19,300	55,232	35,434	109,966
Sub-total		67,551	193,312	124,020	384,883
Total					
Direct material expenses	23,929	71,337	138,080	88,586	321,932
Miscellaneous expenses	9,572	28,534	55,232	35,434	128,772
Sub-total	33,501	99,871	193,312	124,020	450,704

(2) Management expenses

Premises of addition:

- ① As management expenses, expenses related to the NGO and office operating expenses should be added up.
- ② For NGO expense, the period of engagement of one of four persons should be 12 months,

and that of the other should be 8 months.

- ③ Vehicle expenses of 4WD should be added up as rental rates.
- ④ Items for forest management shown below should be added up as purchase rates
 Motorbike (125 cc) 2 units
 Motorboat with outboard motor 1 unit
- ⑤ As office operating expenses, 10% of the total operating expenses should be anticipated.
 This includes expenses of signboards (about 10) at the boarder of national forests for forest management.

According to the above-mentioned premises, management expenses are calculated (see Table IV-20). See Annex 59 for the details of addition.

(3) Summary of expenses

The summary of expenses is shown in Table IV-20.

Table IV-20 Summary of expenses

Unit: 1,000 fmg

Item of expenditure	1 st year	2 nd year	3 rd year	4 th year	5 th year	6 th year
On-site operating expenses	0	33,501	99,871	193,312	124,020	450,704
Management expenses						
NGO	164,000	164,000	164,000	164,000	164,000	820,000
Vehicle rental	211,200	211,200	211,200	211,200	211,200	1,056,000
Motorbike, etc.	79,520	0	0	0	0	79,520
Office operating expenses	37,520	40,870	47,507	56,856	49,922	232,675
Sub-total	492,240	416,070	422,707	432,056	425,122	2,188,195
Total	492,240	449,571	522,578	625,368	549,142	2,638,899

Expenses related to members of ministries concerned who will participate in execution of this plan shall be borne by the ministries concerned. Therefore, the said expenses are not included in the expenses mentioned here. With consideration given to the financial conditions of the Ministry of Water and Forests and other ministries concerned, it is judged that expenses added up here would not be able to be borne only by the ministries themselves. For this reason, it is unavoidable that original capital from the outside be introduced.

The project expenses calculated for each village are as shown in Table IV-21.

Table IV-21 Project expenses in each village

Project type	Type/Zone	Target village/Area	Content of the project	Quantity of the project	Project expenses										Total
					Ministry of Water and Forest			Resident			NGO				
					Management expenses	Project expenses	Sub-total	Labor cost	Project expenses	Sub-total	Management expenses	Project expenses	Sub-total		
Participatory watershed management plan (36,801ha)	Village type I	Angodongodona (280 households)	Agriculture	Fruit trees	708 trees	24,514,101	0	24,514,101	2,744,000	10,623,529	13,367,529	15,680,151	2,462,396	18,142,517	53,280,177
				Compost	210 units	5,775,885	0	5,775,885	2,203,000	944,588	3,149,588	3,694,477	580,177	4,274,654	10,995,127
				Hedge	14 kg	864,479	0	864,479	196,000	375,400	471,400	552,954	86,835	639,789	1,779,668
			AF	Fodder production	1,400 trees	4,210,529	0	4,210,529	196,000	2,100,000	2,296,000	2,693,215	422,940	3,116,155	9,426,684
			Forestry	Production of young plants	56,000 trees	13,584,846	0	13,584,846	3,214,400	4,193,412	7,407,812	8,689,385	1,364,573	10,053,958	27,832,216
				Afforestation	46,200 trees	17,971,770	0	17,971,770	9,800,000	0	9,800,000	11,495,429	1,805,231	13,300,660	31,272,430
			ZODAFARB	1,120 trees	5,032,096	0	5,032,096	2,744,000	0	2,744,000	3,218,720	505,465	3,724,185	8,756,381	
		Fishery	Fish farming in rice fields	2,800 fishes	3,491,659	0	3,491,659	784,000	1,120,000	1,904,000	2,233,398	350,731	2,584,129	7,195,768	
		Agriculture	Fruit trees	152 trees	5,253,021	0	5,253,021	388,000	2,276,471	2,864,471	3,360,032	527,656	3,887,688	11,417,180	
			Compost	45 units	1,237,690	0	1,237,690	472,500	202,412	674,912	791,673	124,324	915,997	2,356,099	
			Hedge	3 kg	166,147	0	166,147	42,000	48,600	90,600	106,274	16,689	122,963	337,710	
		AF	Fodder production	1,800 trees	1,287,366	0	1,287,366	252,000	450,000	702,000	823,448	129,313	952,761	2,690,127	
		Forestry	Production of young plants	12,000 trees	2,911,039	0	2,911,039	688,800	898,588	1,587,388	1,862,011	292,408	2,154,419	5,964,046	
			Afforestation	9,900 trees	3,851,094	0	3,851,094	2,100,000	0	2,100,000	2,463,306	386,835	2,850,141	6,701,335	
			ZODAFARB	240 trees	1,078,306	0	1,078,306	588,000	0	588,000	689,726	108,314	798,040	1,876,346	
		Fishery	Fish farming in rice fields	600 fishes	748,212	0	748,212	168,000	240,000	408,000	478,585	75,157	553,742	1,541,954	
		Sub-total (340 households)	Agriculture	Fruit trees	860 trees	29,767,122	0	29,767,122	3,332,000	12,900,000	16,232,000	19,010,183	2,990,052	27,030,235	64,697,357
				Compost	255 units	7,013,575	0	7,013,575	2,677,500	1,147,000	3,824,500	4,486,150	704,501	5,190,651	13,351,226
			Hedge	17 kg	1,030,626	0	1,030,626	238,000	324,000	562,000	659,228	103,524	762,752	2,117,378	
	AF		Fodder production	3,200 trees	5,497,895	0	5,497,895	448,000	2,550,000	2,998,000	3,516,663	552,253	4,068,916	12,116,811	
	Forestry		Production of young plants	68,000 trees	16,495,885	0	16,495,885	3,903,200	5,092,000	8,995,200	10,551,396	1,656,981	12,208,377	33,796,262	
			Afforestation	56,100 trees	21,822,864	0	21,822,864	11,900,000	0	11,900,000	13,958,735	2,192,066	16,150,801	37,973,665	
		ZODAFARB	1,360 trees	6,110,402	0	6,110,402	3,332,000	0	3,332,000	3,908,446	613,778	4,522,224	10,632,626		
	Fishery	Fish farming in rice fields	3,400 fishes	4,239,871	0	4,239,871	952,000	1,360,000	2,312,000	2,711,983	425,887	3,137,870	8,737,741		
	Village type II	Andrefanivonana (70 households)	Agriculture	Fruit trees	420 trees	15,327,353	0	15,327,353	2,058,000	6,300,000	8,358,000	9,803,958	1,539,604	11,343,562	32,970,915
				Compost	44 units	1,203,146	0	1,203,146	439,375	196,700	636,075	769,578	120,853	890,431	2,290,277
				Hedge	32 kg	1,906,292	0	1,906,292	441,000	598,500	1,039,500	1,219,337	191,483	1,410,820	3,915,612
			AF	Fodder production	0 trees	0	0	0	0	0	0	0	0	0	0
			Forestry	Production of young plants	15,750 trees	3,820,927	0	3,820,927	904,050	1,179,500	2,083,550	2,444,010	383,805	2,827,815	7,838,242
				Afforestation	15,750 trees	5,526,319	0	5,526,319	3,013,500	0	3,013,500	3,534,844	555,108	4,089,952	9,616,271
			ZODAFARB	0 trees	0	0	0	0	0	0	0	0	0	0	
		Fishery	Fish farming in rice fields	0 fishes	0	0	0	0	0	0	0	0	0	0	
		Ambohimanjaka (130 households)	Agriculture	Fruit trees	780 trees	28,465,084	0	28,465,084	3,822,000	11,700,000	15,522,000	18,207,351	2,859,265	21,066,616	61,231,700
				Compost	81 units	2,234,414	0	2,234,414	853,125	365,300	1,218,425	1,429,216	224,443	1,653,659	4,253,373
				Hedge	59 kg	3,540,255	0	3,540,255	819,000	1,111,500	1,930,500	2,264,482	355,612	2,620,094	7,271,849
			AF	Fodder production	0 trees	0	0	0	0	0	0	0	0	0	0
	Forestry		Production of young plants	29,250 trees	7,096,007	0	7,096,007	1,678,950	2,190,500	3,869,450	4,538,876	712,781	5,251,657	14,538,164	
			Afforestation	29,250 trees	10,263,165	0	10,263,165	5,596,500	0	5,596,500	6,564,711	1,030,916	7,595,627	17,858,792	
		ZODAFARB	0 trees	0	0	0	0	0	0	0	0	0	0		
	Fishery	Fish farming in rice fields	0 fishes	0	0	0	0	0	0	0	0	0	0		
	Sub-total (200 households)	Agriculture	Fruit trees	1,200 trees	43,792,437	0	43,792,437	5,880,000	18,000,000	23,880,000	28,011,309	4,398,869	32,410,178	94,202,615	
			Compost	125 units	3,437,560	0	3,437,560	1,312,500	562,000	1,874,500	2,198,794	345,296	2,544,090	6,543,650	
			Hedge	90 kg	5,446,547	0	5,446,547	1,260,000	1,710,000	2,970,000	3,483,819	547,095	4,030,914	11,187,461	
		AF	Fodder production	0 trees	0	0	0	0	0	0	0	0	0	0	
		Forestry	Production of young plants	45,000 trees	10,916,934	0	10,916,934	2,583,000	3,370,000	5,953,000	6,982,886	1,096,586	8,079,472	22,366,406	
			Afforestation	45,000 trees	15,789,484	0	15,789,484	8,610,000	0	8,610,000	10,099,555	1,586,024	11,685,579	27,475,063	
		ZODAFARB	0 trees	0	0	0	0	0	0	0	0	0	0		
	Fishery	Fish farming in rice fields	0 fishes	0	0	0	0	0	0	0	0	0	0		
	Village type II	Anosivola (100 households)	Agriculture	Fruit trees	720 trees	26,253,704	0	26,253,704	3,528,000	10,788,135	14,316,135	16,792,868	2,637,135	19,430,003	56,471,842
				Compost	75 units	2,063,785	0	2,063,785	787,500	337,881	1,125,381	1,320,075	207,304	1,527,379	3,929,045
				Hedge	45 kg	2,724,984	0	2,724,984	630,000	855,932	1,485,932	1,743,003	273,720	2,016,723	5,597,639
			AF	Fodder production	3,000 trees	9,418,863	0	9,418,863	420,000	4,716,102	5,136,102	6,024,665	946,109	6,970,774	21,105,739
			Forestry	Production of young plants	75,000 trees	18,193,854	0	18,193,854	4,305,000	5,616,102	9,921,102	11,637,481	1,827,538	13,465,019	37,274,975
				Afforestation	62,500 trees	24,390,262	0	24,390,262	13,300,000	0	13,300,000	15,600,940	2,449,956	18,050,896	42,441,158
			ZODAFARB	1,000 trees	6,418,489	0	6,418,489	3,500,000	0	3,500,000	4,105,511	644,726	4,750,237	11,168,726	
		Fishery	Fish farming in rice fields	3,000 fishes	3,741,064	0	3,741,064	840,000	1,200,000	2,040,000	2,392,927	375,782	2,768,709	7,709,773	
		Andohariana (70 households)	Agriculture	Fruit trees	505 trees	18,377,593	0	18,377,593	2,469,600	7,551,695	10,021,295	11,755,008	1,845,995	13,601,003	39,530,291
				Compost	53 units	1,444,650	0	1,444,650	551,250	236,517	787,767	924,053	145,112	1,069,165	2,750,332
				Hedge	32 kg	1,907,488	0	1,907,488	441,000	599,153	1,040,153	1,220,102	191,604	1,411,706	3,918,347
			AF	Fodder production	2,100 trees	6,315,794	0	6,315,794	294,000	3,150,000	3,444,000	4,039,822	634,410	4,674,232	14,140,026
			Forestry	Production of young plants	52,500 trees	12,735,697	0	12,735,697	3,013,500	3,931,271	6,944,771	8,146,237	1,279,277	9,425,514	26,092,482
				Afforestation	43,750 trees	17,073,182	0	17,073,182	9,310,000	0	9,310,000	10,920,657	1,714,969	12,635,626	29,708,808
			ZODAFARB	700 trees	4,492,943	0	4,492,943	2,450,000	0	2,450,000	2,873,857	451,308	3,325,165	7,818,108	
		Fishery	Fish farming in rice fields	21,030 fishes	12,338,904	0	12,338,904	5,888,400	840,000	6,728,400	7,892,433	1,239,420	9,131,853	22,310,757	
		Morarano (140 households)	Agriculture	Fruit trees	1,009 trees	36,755,187	0	36,755,187	4,939,200	15,103,390	20,042,590	23,510,016	3,691,890	27,202,006	79,060,583
				Compost	105 units	2,889,299	0	2,889,299	1,102,500	473,034	1,575,534	1,848,106	290,225	2,138,331	5,500,664
			Hedge	63 kg	3,814,976	0	3,814,976	882,000	1,198,305	2,080,305	2,440,204	383,207	2,823,411	7,836,692	
	AF		Fodder production	4,200 trees	12,631,587	0	12,631,587	588,000	6,300,000	6,888,000	8,079,644	1,268,819	9,348,463	28,280,050	
Forestry	Production of young plants		105,000 trees	25,471,395	0	25,471,395	6,027,000	7,862,542	13,889,542	16,292,474	2,558,554	18,851,028	52,184,965		
	Afforestation		87,500 trees	34,146,364	0	34,146,364	18,670,000	0	18,670,000	21,841,314	3,429,939	25,271,253	59,417,617		
	ZODAFARB	1,400 trees	3,985,885	0	3,985,885	4,900,000	0	4,900,000	5,717,714	902,615	6,650,329	15,636,214			
Fishery	Fish farming in rice fields	4,200 fishes	5,237,487	0	5,237,487	1,176,000	1,680,000	2,856,000	3,359,096	526,096	3,885,192	10,793,679			

Project type	Type/Zone	Target village/Area	Content of the project	Quantity of the project	Project expenses											
					Ministry of Water and Forest			Resident			NGO			Total		
					Management expenses	Project expenses	Sub-total	Labor cost	Project expenses	Sub-total	Management expenses	Project expenses	Sub-total			
Forest management plan	Village type III	Ambohijanaka (560 households)	Agriculture	Fruit trees	4,033 trees	147,020,746	0	147,020,746	19,756,800	60,413,559	80,170,359	94,040,065	14,767,960	108,808,025	316,242,330	
				Compost	420 units	11,557,198	0	11,557,198	4,410,000	1,892,136	6,302,136	7,392,133	1,160,899	8,553,322	22,002,656	
				Hedge	252 kg	15,259,904	0	15,259,904	3,528,000	4,793,220	8,321,220	9,760,816	1,532,829	11,293,645	31,346,769	
			AF	Fodder production	16,800 trees	50,526,350	0	50,526,350	2,352,000	25,200,000	27,552,000	32,318,576	5,075,278	37,393,854	113,150,204	
				Forestry	Production of young plants	420,000 trees	101,885,580	0	101,885,580	24,108,000	31,450,169	55,558,169	65,169,894	10,234,217	75,404,111	208,739,860
					Afforestation ZODAFARB	350,000 trees	136,585,457	0	136,585,457	74,480,000	0	74,480,000	87,365,257	13,719,755	101,085,012	237,670,469
		ZODAFARB	5,600 trees		35,943,541	0	35,943,541	19,600,000	0	19,600,000	22,990,857	3,610,462	26,601,319	62,544,860		
		Fishery	Fish farming in rice fields	28,000 fishes	26,700,916	0	26,700,916	7,810,000	6,720,000	14,530,000	17,078,922	2,682,057	19,760,979	53,181,893		
			Agriculture	Fruit trees	1,513 trees	55,132,780	0	55,132,780	7,408,800	22,655,085	30,063,885	35,265,024	5,537,985	40,803,009	118,590,874	
				Compost	158 units	4,333,949	0	4,333,949	1,653,750	709,551	2,363,301	2,772,159	435,337	3,207,496	8,250,996	
		Hedge		95 kg	5,722,464	0	5,722,464	1,323,000	1,797,458	3,120,458	3,660,306	574,811	4,235,117	11,755,039		
		Kellimafana (210 households)	AF	Fodder production	6,300 trees	18,947,381	0	18,947,381	882,000	9,450,000	10,332,000	12,119,466	1,903,229	14,022,695	42,420,076	
				Forestry	Production of young plants	157,500 trees	38,207,092	0	38,207,092	9,040,500	11,793,814	20,834,314	24,438,710	3,837,831	28,276,541	78,277,447
					Afforestation ZODAFARB	131,250 trees	51,219,546	0	51,219,546	27,930,000	0	27,930,000	32,761,971	5,144,908	37,906,879	89,126,425
			ZODAFARB		3,100 trees	13,478,828	0	13,478,828	7,350,000	0	7,350,000	8,621,571	1,353,923	9,975,494	23,454,322	
			Fishery	Fish farming in rice fields	6,300 fishes	7,856,231	0	7,856,231	1,764,000	2,520,000	4,284,000	5,025,144	789,144	5,814,288	16,190,519	
				Ankazotelo (100 households)	Agriculture	Fruit trees	720 trees	26,253,705	0	26,253,705	3,528,000	10,788,136	14,316,136	16,792,869	2,637,136	19,430,005
		Compost	75 units			2,063,785	0	2,063,785	787,500	337,881	1,125,381	1,320,076	207,303	1,527,379	3,929,045	
	Hedge	45 kg	2,724,983			0	2,724,983	630,000	855,932	1,485,932	1,743,003	273,719	2,016,722	5,597,637		
	AF	Fodder production	3,000 trees		9,022,562	0	9,022,562	420,000	4,500,000	4,920,000	5,771,174	906,300	6,677,474	20,200,036		
		Forestry	Production of young plants		75,000 trees	18,193,854	0	18,193,854	4,305,000	5,616,102	9,921,102	11,637,481	1,827,539	13,465,020	37,274,976	
			Afforestation ZODAFARB		62,500 trees	24,390,260	0	24,390,260	13,300,000	0	13,300,000	15,600,939	2,449,956	18,050,895	42,441,155	
	ZODAFARB		1,000 trees	6,418,490	0	6,418,490	3,500,000	0	3,500,000	4,105,510	644,725	4,750,235	11,168,725			
	Fishery	Fish farming in rice fields	3,000 fishes	3,741,062	0	3,741,062	840,000	1,200,000	2,040,000	2,392,926	375,783	2,768,709	7,709,771			
		Sub-total (1,180 households)	Agriculture	Fruit trees	8,500 trees	309,793,715	0	309,793,715	41,630,400	127,300,000	168,930,400	198,155,851	31,118,201	229,274,052	666,367,767	
				Compost	885 units	24,352,666	0	24,352,666	9,292,500	3,987,000	13,279,500	15,276,892	2,446,180	18,023,072	46,362,738	
	Hedge			531 kg	32,154,799	0	32,154,799	7,434,000	10,100,000	17,534,000	20,567,433	3,229,890	23,797,323	66,052,122		
AF	Fodder production		35,400 trees	106,466,237	0	106,466,237	4,956,000	53,100,000	58,056,000	68,099,857	10,694,335	78,794,192	238,360,429			
	Forestry		Production of young plants	885,000 trees	214,687,472	0	214,687,472	50,799,000	66,270,000	117,069,000	137,322,278	21,564,956	158,887,234	439,844,706		
			Afforestation ZODAFARB	737,500 trees	287,805,071	0	287,805,071	156,940,000	0	156,940,000	184,091,077	28,909,483	213,000,560	500,805,631		
ZODAFARB		11,800 trees	75,738,176	0	75,738,176	41,300,000	0	41,300,000	48,445,020	7,607,759	56,052,779	131,790,955				
Fishery	Fish farming in rice fields	65,530 fishes	59,615,664	0	59,615,664	18,348,400	14,160,000	32,508,400	38,132,448	5,988,282	44,120,730	117,896,394				
	Total (1,720 households)	Agriculture	Fruit trees	10,560 trees	383,353,274	0	383,353,274	50,842,400	158,200,000	209,042,400	245,207,343	38,507,122	283,714,465	825,267,739		
			Compost	1,265 units	34,803,801	0	34,803,801	13,282,500	5,696,000	18,978,500	22,261,836	3,495,977	25,757,813	66,257,614		
Hedge			638 kg	38,631,972	0	38,631,972	8,932,000	12,134,000	21,066,000	24,710,479	3,880,510	28,590,989	79,356,961			
AF		Fodder production	38,600 trees	111,964,131	0	111,964,131	5,404,000	55,650,000	61,054,000	71,616,520	11,246,588	82,863,108	250,477,239			
		Forestry	Production of young plants	998,000 trees	242,100,290	0	242,100,290	57,285,200	74,732,000	132,017,200	154,856,560	24,318,523	179,175,083	496,007,373		
			Afforestation ZODAFARB	838,600 trees	325,417,419	0	325,417,419	177,150,000	0	177,150,000	208,149,366	32,687,573	240,836,939	566,254,358		
ZODAFARB	13,160 trees		81,848,578	0	81,848,578	44,632,000	0	44,632,000	52,353,466	8,221,537	60,575,003	142,423,581				
Fishery	Fish farming in rice fields	68,930 fishes	63,855,535	0	63,855,535	19,300,400	15,520,000	34,820,400	40,844,430	6,414,170	47,258,600	126,634,135				
	Total					1,281,975,000	0	1,281,975,000	377,128,500	321,932,000	699,060,500	820,000,000	128,772,000	948,772,000	2,929,807,500	
	Forest management plan	Zone B						43,110,000	0	43,110,000	0	0	0	0	0	43,110,000
Zone E								43,110,000	0	43,110,000	0	0	0	0	0	43,110,000
			Total					86,220,000	0	86,220,000	0	0	0	0	0	86,220,000
Total watershed management plan (44,297ha)		Total					1,368,195,000	0	1,368,195,000	377,128,500	321,932,000	699,060,500	820,000,000	128,772,000	948,772,000	3,016,027,500

Note: The total amount of the overall plan of watershed management includes the labor cost for the labor of the residents. Therefore, it is not equal to the total amount in Table IV-20 "Summary of Costs and Expenses".
Labor cost is calculated by multiplying the quantity of labor shown in Attached Material 56 by 8,000 rmg/man-day.

Chapter V Evaluation of projects

Projects were qualitatively evaluated from the viewpoints of villagers' technical ability, the legal system, operation of the organization, and natural and social environments, and also quantitatively evaluated on expenses and benefits. Judgement was then made on possibilities and appropriateness of execution of plans.

Data related to the results of qualitative evaluation of projects are shown in Annex 60.

1 Method of evaluation

The method of evaluation is as follows:

- (1) To qualitatively and quantitatively evaluate influences and potentialities to be given by watershed management plans by analogizing based on the results obtained from execution and evaluation of PSs.
- (2) To evaluate each project plan and forest management plan included in assumed participatory watershed management plans.
- (3) To qualitatively evaluate the Mantasoa zone and the Tsiazompaniry zone separately because they are different in local social and economic conditions.
- (4) To determine evaluation indexes suitable for evaluation items upon occasion.
- (5) To clearly state grounds and reasons in the contents of the results of evaluation.

2 Appropriateness evaluated from the viewpoint of villagers' technical ability

The results of qualitative evaluation of villagers' technical ability from the viewpoint of the above-mentioned five points of view are as follows. Evaluation indexes used were "High (Large)," "Low (Small)," and "Cannot be determined."

(1) Necessity of fosterage of technical ability

The necessity of fosterage of technique is high for projects related to agriculture, agroforestry and fish farming in rice fields in the Mantasoa zone. The necessity regarding fodder production belonging to agroforestry, however, is low because the number of bred cows is small there. That for *Eucalyptus robusta* tree planting in forestry is also low as the district is advanced in these operations and has sufficient technique to raise young plants and plant trees.

In the Tsiazompaniry zone, the necessity of fosterage of technique is high in all projects. Particularly, technique concerned with forestry is immature in most of places, and the necessity of fosterage is high.

Among projects for which fosterage of technical ability is highly necessary, for projects related to agriculture and agroforestry, it is planned that technical ability will be fostered by technical experts and the staff in charge of the spread of agriculture at the Ministry of Agriculture. For fish farming in rice fields, the head office of the Ministry of Fishery will take measures as a main figure. For forestry, the Ministry of Water and Forests will be able to deal with this matter sufficiently, and NGOs also will be able to assist with the fosterage of technical ability at need.

(2) Possibility that technique will be practiced.

In the Mantasoa zone, evaluation of the possibility that technique will be practiced is similar to that of the necessity of fosterage of technical ability. In forestry, local techniques are used such as use of wild young plants and tree planting with young plants with naked roots. Therefore, even if a new technique is introduced, the possibility that it will be practiced is low. Therefore, in such a case, it has been decided to make responses by combining the two methods: the raising of seedlings in pots and the raising of seedlings with roots by the traditional technique. According to the plan, seedlings in pots will be used for one-third of the quantity of seedling production, and seedlings with roots to be raised by the traditional technique will be used for the remaining two thirds.

In the Tsiazompaniry zone, too, evaluation of the possibility that technique will be practiced is similar to that of the necessity of fosterage of technical ability; the possibility is high in all projects. As villagers in this district are active in participation in and working on projects, the possibility of practice was judged high.

(3) Possibility of that technique will spread

In the Mantasoa zone, it was judged that the possibility that techniques for agriculture and hedges will spread is high because ① it is planned to raise young plants of fruit trees, and gather and widely distribute their branches for grafting, ② harvesting of seeds of Tephrosia for hedges can be expected and ③ since persons in charge of the spread of agriculture are permanently stationed in the Mantasoa rural commune, there is a structure to give technical guidance.

In the Tsiazompaniry zone, the possibility of the spread of techniques for agriculture and agroforestry is also high because it is planned to raise young plants of fruit trees, and gather and widely distribute their branches for grafting, and because harvesting of seeds of Tephrosia for hedges can be expected. The possibility of the spread of technique for forestry is also high as villagers' needs are great.

As to fish farming in rice fields, it was found from the results of the PS that it requires a high-grade technique of culture in the method through which fry are produced by culturing parent

fishes. Those results also showed that there is a great risk in the percentage of spawning. Therefore, it was decided to purchase fry and deliver them to the inhabitants. It is deemed to be easier to spread the technique by delivery of fry rather than the culture of parent fishes.

(4) Possibility of improvement of ability to solve problems

Improvement of the ability to solve problems cannot be judged unconditionally as it depends much on the level of villagers' education and village leaders' ability. Based on the experience of PSs, however, improvement can be generally expected since the ability to solve problems has improved in all villages through preparation and execution of preparatory plans. On the other hand, as to fodder production and forestry in the Mantasoa zone, it was judged indefinite at that time because the necessity for fosterage of technique was low. For fish farming in rice fields, the possibility of its improvement cannot be judged because the project is the middle of execution.

(5) Influence to be exerted upon traditional technique

Except for forestry in the Mantasoa zone and fish farming in rice fields in the Tsiazompaniry zone, the influence to be exerted upon traditional technique is judged small. As there are local techniques related to forestry in the Mantasoa zone, if a new technique is introduced, it is judged that its influence upon the local one is large. Therefore, it has been decided to make responses by combining the two methods: the raising of seedlings in pots and the raising of seedlings with roots by the traditional technique. According to the plan, seedlings in pots will be used for one-third of the quantity of seedling production, and seedlings with roots to be raised by the traditional technique will be used for the remaining two thirds. As to fish farming in rice fields in the Tsiazompaniry zone, although the influence to be exerted is considered small, appropriate judgement cannot be made because the project is the middle of execution.

3 Appropriateness from the viewpoint of the legal system

As a common legal system is applied to the whole country of the Madagascar, appropriateness was judged in common with both districts.

(1) Land ownership system

No problems regarding the land ownership system will arise because individuals' private land will be used as land covered by these plans for execution of planting of fruit trees in agriculture, agroforestry, tree planting and fish farming in rice fields. The production of young plants in forestry requires land for preparation of young plant fields, and the land to be used for this will be selected by participating villagers. As the selection will be made by consent of

villagers, it is proper in terms of the land ownership system. For ZODAFARB, since it is a system applied to national land controlled by the Ministry of Water and Forests, confirmation and classification of national land and private land and also division of the used land are necessary. There is the possibility that these operations will bring about a land dispute. But the procedure of execution is presented and we consider that, with proper execution according to the procedure, no problems will arise. In the experience in the PS in Analamihoatra Village, there was confusion regarding the procedure in some cases because it was the first attempt for villagers. However, ownership of land will be granted if tree planting activities is re-confirmed after five years, and this acted as an incentive and villagers participated in operations actively and worked with a strong will. As a result, an outcome beyond expectation was produced. Considering such experience, it is expected that application of ZODAFARB will have a positive influence upon watershed management plans through an increase in the area of forests. At the same time, it is expected that a grant of land ownership will act as an incentive for villagers and, therefore, proper forest management by villagers will be promoted. From the reasons mentioned above, it is judged that no problems regarding the land ownership system will arise.

(2) PE-2

In PE-2, its comprehensive aims are presented as follows, and it is judged that projects in watershed management plans are consistent with these aims.

- ① To improve sound and sustainable operational technique for natural resources (soil, water and vegetation)
- ② To develop techniques to maximize productivity of soil and vegetation aiming at the most efficient uses of water resources, and to spread them
- ③ To facilitate villagers' adaptation of techniques of management and reproduction of agricultural production factors, i.e., as water, soil and vegetation, with consideration given to correlation
- ④ To prevent the destruction and malfunctioning of infrastructure (such as dams, roads and the periphery of irrigated land)

The two strategic policies stated below have been worked out. Because the plans of all projects are participatory, those plans will improve productivity in watersheds. Therefore, it is judged that projects of watershed management plans are also consistent with PE-2 in terms of strategic policies.

- ① A highly reliable diagnosis of conditions should be established in the participatory way.
- ② Intervention in river watersheds is to protect various kinds of infrastructures that have already been confirmed and to heighten the productivity of watersheds.

It is judged from the above that projects in watershed management plans are consistent with PE-2.

(3) Legal forest system

Projects related to forestry have been planned in conformity with the National Forest Plan and the Forest Law.

4 Appropriateness from the viewpoint of organizational operation

Possibilities were analyzed from two aspects, that is, establishment and continuation of organizational systems of the administration side, such as the Ministries of Water and Forests, Agriculture and Fishery, and those of villagers' organizations. Appropriateness of execution of projects was then judged.

Evaluation indexes used were "High (Large)," "Low (Small)," and "Cannot be determined."

(1) Organizational system of the administration side

Evaluation was done from the following four aspects.

1) Human aspect

As a watershed management plan has contents of projects extending over several fields including agriculture, forestry and fishery, it has been determined that the Watershed Management Promotion Council should be placed at the center level as a scheme to execute plans under the cooperation of the ministries concerned. It has been also determined that the Watershed Management Promotion Office should be set up under this Council, and two Watershed Management Offices should be established at the local level. It is judged that such transversal incorporation of the execution scheme will result in establishment of guidance in the human aspect and, therefore, effective organizational operation will be possible.

Technical support in each project will be given in such a structure as follows.

In projects related to forestry, technical support will be given by the home office of the Ministry of Water and Forests, Antananarivo Local Office for the Management of Water and Forest and Camps for the Management of Water and Forest (two).

In projects related to agriculture and forestry, technical support will be given by technical experts at the Ministry of Agriculture and people in charge of the spread of agriculture.

For fish farming in rice fields, technical support will be given by the home office of the Ministry of Fishery and the Mantasoa Local Fishery Office.

2) Financial aspect

Financial conditions of the Ministry of Water and Forests, which takes charge of not only agriculture, agroforestry and fishery but also forestry, is insufficient. As a matter of course, it is judged that financial support from external organization is necessary.

3) Technical aspect

All of the Ministries of Water and Forests, Agriculture and Fishery have a high technical level.

4) Aspect of facilities

In the aspect of facilities, seeds for forestry and agroforestry can be purchased from the Seed Center (SILO National Des Graines Forestieres Madagascar: SNGF) set up in Antananarivo, the capital, with cooperation of the Swiss in 1986. Therefore, the system to supply seeds has been already established. In the case of PSs, young plants of fruit trees for agriculture were purchased from private seed and young plant companies, but the system of supply was not sufficient. Therefore, discussion will be necessary. For procurement of fry for fish farming in rice fields, it is possible to purchase fry from the Ministry of Fishery and private consultants. It is, however, necessary to discuss if a sufficient number of fry will be able to be obtained.

For a means of travel to the site, such as vehicles, aid is necessary because no individual ministry has sufficient facilities. Among the local staff in charge of the spread of agriculture, some are provided with motor bikes. Their mobility depends on maintenance of the motor bikes. Therefore two motor bikes and one motorboat will be purchased in the watershed management plan.

(2) Establishment and continuation of villagers' organization

Evaluation was done from the following three aspects.

1) Degree of difficulty in organization

It is judged from the experience of PSs that, generally, the degree of difficulty in organization is high in the Mantasoa and low in the Tsiazompaniry zone. Villagers in the Mantasoa zone are blessed with opportunities to find employment due to geographical conditions; this district is near towns and cities such as those in Manjakandoriana Prefecture. As they can go to towns or cities for work as a household unit or an individual, there is lack of necessity to act systematically. On the other hand, villagers in the Tsiazompaniry zone are not blessed with opportunities to find employment because this district is distant from towns and cities. In addition, we consider that this situation results from the fact that social links such as territorial relationship are relatively weak in Mantasoa zone, since the Mantasoa zone has a longer history of development than the Tsiazompaniry zone.

The organization of all projects is judged as relatively easy in the Tsiazompaniry zone. In the

Mantasoa zone, it is expected that organization of projects related to forestry will have difficulties because, for example, in the fokontany there is a group that adheres to the traditional technique and a group that is active in raising young plants in pots. If agreement is reached after sufficient time has been taken, to organize the Watershed Management Committee is possible.

2) Continuation of organizations

It is judged from the results of PSs that the possibility of organizations continuing is low in the Mantasoa zone and high in the Tsiazompaniry zone. Although this point is also related to the degree of difficulty of organization, the above-mentioned judgement is made because the Watershed Management Committee in the Tsiazompaniry zone has better unity and works on projects more actively than the Committee in the Mantasoa zone.

Projects for agriculture and agroforestry in the Mantasoa zone are, however, actively worked on in some aspects. Therefore, the evaluation "Cannot be determined" at present. The Watershed Management Committees in both districts are positively involved in fish farming in rice fields, and the possibility of continuation is judged to be high.

3) Independence of organizations

For independence of organizations, judgement is made on the possibility that the Watershed Management Committee will be able to develop projects independently without support from the outside. Concretely, it is judged whether or not independence in and after the fourth year will be possible. This is because, according to the project execution schedule of the Watershed Management Plan, projects will be carried out with support from the outside for three years in total; one year for preparation of plans and the following two years for the execution of projects. With the results of PSs taken into consideration, the possibility of independence of the Tsiazompaniry zone can be judged as high. On the other hand, that of the Mantasoa zone is judged as "Cannot be determined" because there are uncertain elements in agriculture, agroforestry and fishery at present. For forestry in the Mantasoa zone, though individuals' active work on tree planting is observed, the possibility of independence is judged low in systematic activities such as setting-up of young plant fields by the group. In the Mantasoa zone, however, it is expected that the possibility will change largely according to the Watershed Management Committee's performance for three years. In the watershed management plan, it is planned to discuss measures by carrying out monitoring for five years.

5 Appropriateness from the viewpoint of natural and social environments

(1) Aspect of natural environment

Regarding the natural environment, evaluation was made on the possibility of influence to be given by watershed management plans in three aspects; influence upon forests, influence upon soil and influence upon hydrology and water quality.

1) Influence upon forests

Discussion was made on preservation of forest resources and quantity of charcoal production.

It is judged that the plans will exert good influences directly upon preservation of forest resources because the size of forests will be increased under forestry projects. As the production of compost and agroforestry will result in improvement of fertility of soil and heightened productivity of land, it is expected that farming away from home and migration will decrease. There is also the possibility of expansion of farmland and a decrease in the size of forests accompanying it. Because forest resources will be indirectly preserved in this sense, it is judged that the plans will have a great influence. On the other hand, it is forecast that fish farming in rice fields will bring about an incentive to preserve forests, one of the important water sources, and will have a great positive influence.

An increase in the size of forests will increase the opportunity of charcoal production by villagers and also the quantity of its production, and is expected to lead to an increase in villagers' cash income.

2) Influence upon soil

It is judged that projects of compost production and hedges will lead to improvement of soil fertility and improvement of agricultural productivity, i.e. an increase in agricultural production.

Particularly, projects of hedges and forestry are judged to prevent soil erosion and promote proper land uses as well as to be helpful to maintenance and promotion of quantity of agricultural production.

3) Influence upon hydrology and water quality

It is judged that projects of hedges and tree planting will contribute to improvement of the conservation of water quality and/or function of soil and water conservation as well as improve sources of potable water and be helpful for increasing the volume of water kept in dams. In addition, an increase in the volume of water kept in dams is expected to lead to improvement of a stable and continuous supply of electricity and potable water to the capital in the future.

(2) Aspect of social environment

Regarding the social environment, evaluation was made on the influence to be given to villagers' lives and traditional social organizations by watershed management plans.

1) Influence upon villagers' life

Discussion was made on improvement of the life level, increase in cash income, reduction of farming away from home, decrease of migration, improvement of inheritance of farmland and elevation of the status of women.

In the Mantasoa zone, what can be expected is as follows: ① self-supply and sale to be realized by planting of fruit trees after several years, ② the possibility of an increase in quantity of agricultural production by production of compost, ③ the possibility of an increase of timber for charcoal by continuous operation of forests and increase of the area of plantations to be brought about by tree planting, and ④ improvement of the life level and an increase in cash income by self-supply and sale of fish to be produced by fish farming in rice fields.

In the Tsiazompaniry zone, the following can be expected: ① self-supply and sale of fruits by planting of fruit trees in few years, ② the possibility of increase in quantity of agricultural production by the production of compost and hedges, ③ an increase in the area of forests and owned land by tree planting and application of ZODAFARB, and ④ improvement of life and an increase in cash income by self-supply and sale of fish to be produced by fish farming in rice fields.

For these projects (except planting of fruit trees), the expenses and benefits of villagers were quantitatively estimated in financial analysis.

In both districts, production of compost and hedges can be expected to lead to a reduction of both farming outside the village and migration because the increase in quantity of agricultural production will be possible accompanying improvement of fertility of soil.

In addition, what can be expected is improvement of land productivity by projects of compost production and hedges, and improvement of fertility of farmland by the increase in quantity of agricultural production, although the size of farmland becomes smaller due to equalized inheritance.

As the general reasonable judgement, influence to be exerted upon elevation of the status of women by each project will be small or cannot be determined, although there is the possibility

that women's voices will be strengthened in the process of plan participatory investigation.

2) Influence upon traditional social organizations

Traditional social organizations exist more stable in the Tsiazompaniry zone than in the Mantasoa zone. In both districts, it is judged that direct influence upon Dina (a hamlet autonomous guarding organization), Faritanana (an organization for mutual aid of farm work), and Indorana (a mutual aid organization) will be small. This judgement was made from the following circumstances. First, these organizations and relationships are generally formed not by hamlets but by units of territorial/blood relationship whose size is smaller than that of hamlets. Second, these are qualitatively different from the Watershed Management Committees organized under PSs. Third, the Watershed Management Committees are new organizations. It is judged, however, that watershed management plans will influence these organizations in the sense that these plans will further strengthen religious and local custom of respecting elders as typically seen in PS in Analamihotra.

6 Appropriateness from the viewpoint of financial affairs

In the execution of these watershed management plans, it is necessary to grasp effect and rationality of investment in advance as well as to monitor investment effect according to circumstances also during the execution and to correct the plans. In order to objectively measure such investment effect, it is necessary to quantitatively seize it as much as possible. From this point of view, after showing the relation between inputs and outputs in these plans, quantitative output indexes to be monitored should be presented. Furthermore, quantitative evaluation (estimate) should be made on the effect to be brought about by a certain quantity of constituent elements of projects.

The relation between inputs and outputs and output indexes in this plan are as shown in Figure V-1. These as a whole compose a watershed management plan. Regarding fruit tree culture, production of compost, fish farming in rice fields, fodder production and hedges, the inputs are not directly related to watershed preservation. Therefore, it is necessary to give farmers some incentive such as increase in income and, at the same time, to measure and monitor the investment effect as a "sub-project" that will become linked to formation of community. The relation between inputs and outputs and quantitative indexes to be monitored for each level of projects are shown below.

(1) Indexes of final outputs

The final aim of projects is the preservation of watersheds in the investigation area. It can be said that there are two expectations to be brought about by this: (1) the volume of water kept

in the dam lakes will be stabilized by the effect of soil and water conservation of forests, therefore, electricity and water will be able to be supplied to the capital stably and lastingly and water for agriculture will be also supplied to irrigated land stably, and (2) the outflow of soil in the upper watersheds will be reduced and agricultural production in this area will be stabilized. But, in order to quantify the economic effect of watershed preservation in relation with inputs, it is necessary to, for example, metrically grasp the causal relation between changes of the size of forests and changes of the volume of water in the dam lakes. What is necessary for this purpose is data of secular changes of parameters such as precipitation, quantity of soil outflow, species of trees and the crown density of forests. As acquisition of the data is extremely difficult, it can be said to be impossible in reality to quantify economic benefits (electricity, water service, water for irrigation, quantity of agricultural production) of watershed preservation. Therefore, it has been determined that economic benefits should not be used as final outputs of these plans.

What shows the degree of achievement of watershed preservation are the increase in size of forests and rationalization and normalization of land uses of villagers. These can be regarded as final outputs of the plans. Proper land uses by villagers, however, can be induced but depend on the self-will of landowners in actuality. Although the size of land to be aimed at is determined, quantitative monitoring is difficult. Therefore, as indexes to be quantitatively monitored as final outputs, the size of forest preservation areas managed by the Ministry of Water and Forests and the size of tree planting in participatory watershed management areas should be used. The degree of achievement of rationalization and normalization of land uses should be qualitatively monitored in lands other than tree planting zones of the participatory watershed management area.

Based on the circumstances mentioned above, the comparison between inputs as public investment projects and expected outputs is as follows. (Labor costs of villagers are excluded from expenses to be used for the purpose of watershed management because these costs will be borne by the villagers themselves who expect direct receipt of benefits and will not be paid as public investment.)

Input of projects

Item	Expense (million FMG)	Percentage
Material cost	322	12 %
Indirect cost (20% of material cost)	129	5 %
Operation/management cost by NGOs and others	2,188	83 %
Total	2,639	100 %

Final outputs of projects

Project area	Size to be aimed at	Monitoring method
Participatory watershed management area	39,131 ha	Quantitative
Possibly afforestable area	14,720 ha	Quantitative
Forest conservation area	5,166 ha	Quantitative
Total	44,297 ha	

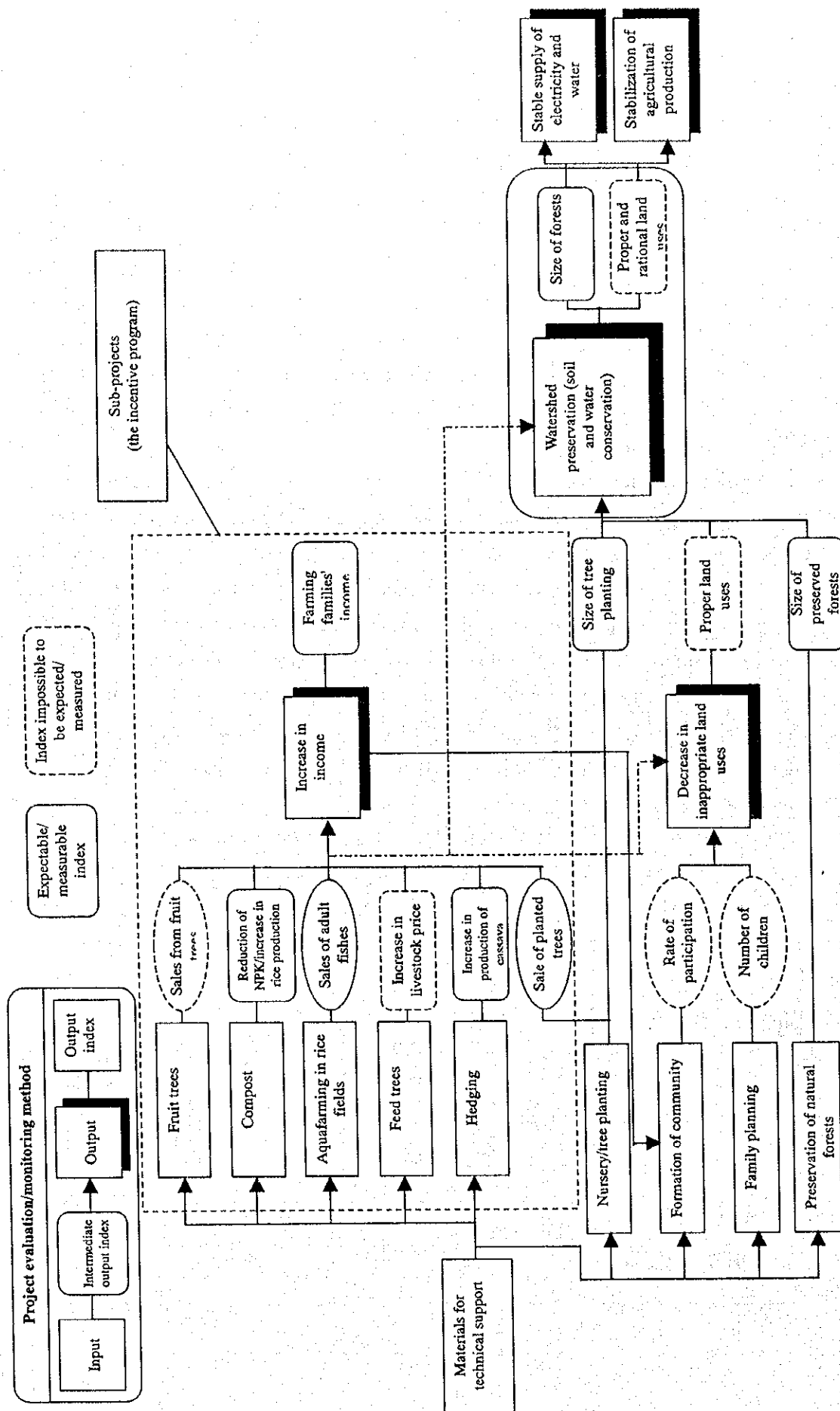


Figure V-1 Project composition and output indexes

(2) Intermediate output indexes

Achievement of watershed preservation requires an increase in the size of forests and rationalization and normalization of land uses, as mentioned above. What will bring about these is an increase in the size of tree planting and maintenance of the forest preservation area for the former, and a decrease in inappropriate land uses and villagers' execution of culture of fruit trees, feed trees, hedges and others for the latter. In addition to material and indirect costs, expenses to produce these outcomes are management and operation costs by NGOs. Expenses that hold much in management and operation cost are those for the whole operation of projects starting with execution of PRA and including support for villagers' organizations. Therefore, it is difficult to divide such expenses into components.

1) Increase in size of tree planting

Increase in the size of tree planting resulted from introduction of ZODAFARB, and production of young plants directly means an increase in the size of forests. Although the actual contents of sub-projects could be largely changed according to villagers' intentions, there is the expectation that an increase of the size of tree planting by a planned area of 1,247 ha (see Table IV-13), will be achieved. Quantitative monitoring is possible. The reason for this expectation is that it has been already confirmed from actual results of PSs that great interest was shown in tree planting activities through the introduction of ZODAFARB.

As inputs of public investment for this, in addition to material and indirect costs for the production of young plants shown below, there are expenses for technical guidance for the production of young trees and tree planting, which should be partially borne by NGOs.

Expenses for production of young trees and tree planting (Except for NGO costs)

Material cost for production of young trees	75 mil. FMB
Indirect cost	15 mil. FMB
Total	90 mil. FMB

2) Maintenance of the forest preservation area

If appropriate measures for the protection of natural forests will be taken by the Ministry of Water and Forests, it will be able to stop the decrease in the size of natural forest. The size of this preservation area is 5,166 ha in this plan, and quantitative monitoring is possible. Among estimated expenses to maintain the forest preservation area, those estimated for additional measures other than existing ordinary expenditure include expenses to purchase motor bikes for making rounds, expenses to purchase motorboats with outboard motor, and expenses to place signs of the borderline of forests to be preserved.

3) Decrease of inappropriate land uses

Land uses that may decrease forests and cause outflow of soil will be restrained in the following way. First, villagers in the watershed will consult about land uses through the Watershed Management Committee, and then will introduce rational land uses into that area. On the other hand, spreading family planning in the area will restrain the sudden increase in population. This restraint will have the effect of restraining the expansion of farmland to land that is inappropriate for agriculture in terms of watershed management.

As mentioned above, villagers' proper land uses depend on landowners' will from the realistic point of view. Furthermore, it is difficult to monitor if each way of villagers' land uses is proper. Therefore, the quantitative subject of monitoring should be restricted to grasping the degree of villagers' participation (the rate of participation), while influences of projects upon actual land uses will need to be qualitatively known through workshops with villagers or interviews with villagers.

For the spread of family planning, it will be possible to quantitatively grasp the effect of the spread by monitoring the number of households that prevent conception continuously. "The spread of family planning," however, influences "restraint of inappropriate land uses" only indirectly and takes a long time. Therefore, it is difficult due to the framework of this project to measure the effect on watershed preservation.

As expenses necessary for "decrease of inappropriate land uses," NGO expenditure for support of villagers' organization (a part of 4,431 million FMG for the whole project) will be used. The total size of land to be aimed at is 19,227 ha.

4) Villagers' culture of fruit trees, feed trees, hedges, etc.

As a result of villagers' culture of fruits trees, feed trees, hedges, etc., soil conservation will improve and, at the same time, land uses will be rationalized and stabilized. In terms of soil conservation, it is difficult to grasp influences upon watershed preservation because the area is very limited. On the other hand, these operations are the main constituent elements of (3) in the sense of rationalization and stabilization of land uses. Therefore, it will be necessary to quantitatively seize the rate of participation and to qualitatively grasp influences upon land uses through workshops with villagers or interviews with villagers.

(3) Output indexes of sub-projects and estimates of benefits

In order to promote villagers' participation and achieve "the proper land uses" through formation of community, it is necessary to show that sub-projects such as the culture of fruit trees, compost production, fish farming in rice fields, fodder production and hedging will actually connect to an increase of profits or income for villagers. As these watershed management plans will be executed with villagers' participation, possibly, the actual contents of sub-projects may change entirely according to villagers' intention. Therefore, even if the

summed-up expenses of all sub-projects are compared with total benefits corresponding to them, the rationality of investment will not be shown. For this reason, expenses and economic benefits that these sub-projects possibly will produce for average households participating in the project are estimated in this item.

While the estimation includes the production of young plants and tree planting, the culture of fruit trees and fodder production are excluded because it is difficult to estimate benefits from these at present. As labor cost in sub-projects, general wages in the area are added up as additional labor cost for the purpose of calculation. This is because conditions differ according to households. For example, some participating households use home work since usual job opportunities are relatively poor, and some people employ laborers from outside the household because they are busy with many field operations. For households with poor job opportunity (that is, small income) in the first place, the motivation to participate in sub-projects is high because they can obtain cash income by their own labor, even if calculated expenses exceed benefits. Although material cost is reckoned up as expenditure on the project side in this plan, some villages can raise actual expenses and regard the said cost as a budget for community activities. Therefore, there are also descriptions about comparison with benefits in the case where labor and material costs are summed up.

1) Culture of fruit trees

Activities to spread the culture of fruit trees are being carried out after confirmation of land suitable for culture with technical assistance (T/A). The estimate of benefits is, however, not made in the present stage. This is because 1) it will take several years until trees bear fruits and, in addition, it is difficult to estimate the yield and quality of fruits, and 2) it is difficult to presume market values due to few sales markets at the local level. It is necessary to form a clear view of investment effect in the monitoring hereafter.

Labor cost:

Number of fruit trees per household (a)	Labor per fruit tree (man-days) (b)	Labor per household (man-days) (c)=(a)x(b)	Labor cost per household (FMB) (d)=(c)x7,000
20	0.7	14	98,000

Material cost (borne by the project)

Material cost per fruit tree (FMG) (e)	Material cost per household (FMG) (f)=(a)x(e)
7,500	150,000

Benefits to villagers: Difficult to estimate

2) Production of compost

Regarding compost, the following figures are obtained according to the actual results of PSs. On the assumption that an average of two units are produced by one household for one year, reduction of chemical fertilizer (NPK) of about 2 kg, equivalent to 6,000 FMG, will be able to be achieved by using produced compost in a potato field of one are. If the same amount of compost is introduced into irrigated rice fields (where the harvests are relatively small) of one are, increase in harvests by about 25% can be expected, and an increase in income of 7,500 FMG will be able to be achieved.

Excluded from expenditure is labor cost for work to gather materials (biomass) of compost because it will be done on the way to home from plowed fields or by children. As this labor cost is excluded from calculation, only loading and turning works are added up. Although expenses in the initial fiscal year, including material cost, will exceed benefits by about four times, almost all expenses will be labor cost because materials will be able to be re-used in and after the second year. Use of compost does not bring about an effect in the short term in comparison with chemical fertilizer in some cases. However, since an investment effect can be expected because of fertilization of land in the long term, it is necessary to ascertain the coming investment effect.

Labor cost:

Number of units per household (a)	Labor per unit (man-days) (b)	Labor per household (man-days) (c)=(a)x(b)	Labor cost per household (FMB) (d)=(c)x7,000
2	1.5	3	21,000

Material cost (borne by the project)

Material cost per unit (FMG) (e)	Material cost per unit (FMG) (f)=(a)x(e)
3,000	6,000

Benefits to villagers:

<Option 1> Reduction of NPK in potato fields

Area of potato culture per two units of compost (ares) (g)	Reduced quantity per are of NPK (kg) (h)	NPK price (FMG/kg) (i)	Economic benefits from compost production (FMG) (j)=(g)x(h)x(i)
1	2	3,000	6,000

(Usual weight of use of NPK: 4 kg/are)

<Option 2> Compost in irrigated fields

Area of rice culture per two units of compost (ares) (g')	Increased quantity of harvested rice per are (kg) (h')	Rice price (FMG/kg) (i')	Economic benefits from compost production (FMG) (j')=(g')x(h')x(i')
1	5	1,500	7,500

(Weight of harvests on sterile land: 20 kg/are)

3) Fish farming in rice fields

Although there are as yet no actual results of the sale of fishes cultured in rice fields in PSs, as fishes that naturally flow into irrigated rice fields from rivers and become adult are sold in the local market, benefits from fish farming in rice fields can be estimated. The average price of adult fishes is 1,500 FMG, and the percentage of the growth from fry to adult fish is about 75%. Therefore, if one household raises 100 fry, cash income of 110,000 FMG can be expected.

The only expenditure is labor cost, which is one-fourth of benefits. Even if expenses to purchase fry are added, the expenditure will be the half of benefits or lower. Therefore, fish farming has a strong participation incentive for farmers.

Labor cost:

Number of fry per household (a)	Labor per 100 fry (man-days) (b)	Purchase price per fry (FMG) (c)=(a)/100x(b)	Labor cost per household (FMB) (d)=(c)x7,000
100	4	4	28,000

Material cost (borne by the project)

Purchase price per fry (FMG) (e)	Material cost per household (FMG) (f)=(a)x(e)
200	20,000

Benefits to villagers:

Price per adult fish (g)	Survival rate of adult fishes (h)	Economic benefits from fish farming in rice fields (FMG) (i)=(a)x(g)x(h)
1,500	75%	112,500

4) Fodder production

The effect of fodder production is that sales prices of livestock increase because of improvement of nutrition. However, it is difficult to estimate how much this production will lead to improvement of nutrition in comparison with the present pasturage or straws and how

much it is reflected in prices. Therefore, benefits are not estimated in the present stage, and it is necessary to form a clear view of investment effect in the monitoring hereafter.

Labor cost:

Number of feed trees per household	Labor per 100 feed trees (man-days)	Labor per household (man-days)	Labor cost per household (FMB)
(a)	(b)	(c)=(a)x(b)	(d)=(c)x7,000
100	2	2	14,000

Material cost (borne by the project)

Material cost per feed tree (FMG)	Material cost per household (FMG)
(e)	(f)=(a)x(e)
750	75,000

Benefits to villagers: Difficult to estimate

5) Hedges

For valuation of the effect of hedging, it is assumed here that one household sows seeds of 1.5 kg are on land of 2 are on average for one year. According to the actual results of PSs, if plants are cut down after three-year growth and cassava is cultured there, the yield will increase by about 60 kg on originally sterile land of 2 are, and an increase in income of 24,000 FMG will be obtained.

Regarding expenses, labor cost is comparable to benefits. Although the total of labor cost and material cost will exceed benefits in the first year since there will be the expense of seeds, the expenditure will be labor cost only after that because home-grown seeds will be able to be used. Furthermore, as hedging will result in prevention of outflow of soil and outside economic effect such as the value of use as materials of compost will be obtained from hedges, it is considered that actual benefits will be more than expenses.

Labor cost:

Weight of sowed seeds per household (kg)	Labor per sowed seeds of 1 kg (man-days)	Labor per household (man-days)	Labor cost per household (FMB)
(a)	(b)	(c)=(a)x(b)	(d)=(c)x7,000
1.5	2	3	21,000

Material cost (borne by the project)

Material cost per kg (FMG)	Material cost per household (FMG)
(e)	(f)=(a)x(e)
9,500	14,250

Benefits to villagers:

Area of cassava culture per sowed seeds of 1.5 kg (ares)	Weight of increase of cassava per are (kg)	Cassava price (FMG/kg)	Economic benefits of hedges (FMG)
(g)	(h)	(i)	(j)=(g)x(h)x(i)
2	30	400	24,000

(Weight of harvests on sterile land: 30 kg/are)

6) Production of young plants and tree planting

From the actual results of PSs, it is considered practicable to produce 1,500 young plants per household on average and then plant them on land of 0.94 ha. It is presumed to be possible to sell them to charcoal burners as standing timber at an average price of about 470,000 FMG after four years.

Almost all the expenses to be spent for these operations will be labor cost. Therefore, expenditure will be less than benefits on the average (though there is great difference in the growth of eucalyptus) and will be comparable to benefits even if material cost is added. But as outside economic effect such as prevention of outflow of soil will be obtained from tree planting operations, it is considered that actual benefits will be more than expenses.

Labor cost:

Number of young plants per household	Labor per 1,000 young plants (man-days)	Labor per household (man-days)	Labor cost per household (FMB)
(a)	(b)	(c)=(a)x(b)/1,000	(d)=(c)x7,000
1,500	38	57	399,000

Material cost (borne by the project)

Material cost per 1,000 trees (FMB)	Material cost per household (FMG)
(e)	(f)=(a)/1000x(e)
37,441	56,161

Average material cost in the first and second years

Benefits to villagers:

Area of tree planting per 1,500 young plants (hectare) (f)=1,500/1,600	Standing-timber value per hectare (FMG) (g)	Economic benefits from tree planting (FMG) (h)=(f)x(g)
0.94	500,000	468,750

(4) Appropriateness of investment

As mentioned in (1) above, it is impossible to quantify the economic effect of watershed preservation in relation with inputs. In addition, it is very difficult to objectively judge if it is reasonable that "the total investment to preserve watersheds of 28,000 ha in size amounts to 53 billion FMG." It is, however, considered that the following possibilities will come about if this project does not exist: ① The Ministry of Water and Forests will need to plant trees in the said area and control land uses of villagers by regulations at the same time. Expenses for these measures will be much larger in comparison with this project which only requires expenses to promote villagers' participation and material cost. ② As outflow of soil will result in the rise of the beds of Lakes Mantasoa and Tsiazompaniry and then decrease in the volume of water, large-sized ground works such as excavation of both lakes will be required in the future. ③ As the function of soil and water conservation will become lower as a result of a decrease of forests, floods will occur frequently in the lower watershed. In addition, it will become necessary to make a new artificial lake in another place because the level of water of Lakes Mantasoa and Tsiazompaniry will fall in the dry season, and sufficient electricity and water will not be able to be supplied to the capital. Although these phenomena are difficult to be metrically estimated, it is judged that they are enough to prove that the investment size of 44 billion FMG is not an excessively large amount for the effects.

7 Comprehensive judgement

The result of comprehensive judgement of the appropriateness of this plan discussed above is as shown in Table V-1.

Table V-1 Comprehensive judgement of appropriateness

	Mantasoa zone	Tsiazompaniry zone
Villagers' technical ability	○	◎
Legal system	◎	◎
Organizational operation	○	◎
Natural environment	◎	◎
Social environment	◎	◎
Financial affairs	○	○
Comprehensive judgement	◎	◎

Note: ◎Very high, ○High, △Cannot be determined

In the Mantasoa zone, the degree of progress of *Eucalyptus robusta* tree planting is higher than in Tsiazompaniry. Therefore, projects related to tree planting are expected to have some matters requiring sufficient examination in the aspects of both villagers' technical ability and organizational operation. Success or failure depends on development of a participatory plan. Judging comprehensively, according to qualitative valuation, there are no factors to hinder appropriateness in terms of execution of the plan. On the other hand, financial analysis shows that expenses after adding labor cost and material and mechanical equipment cost will exceed benefits in projects of compost production and hedging because material and mechanical equipment cost will be added in the first year. But benefits will exceed expenses in these projects in and after the second year, and in fish farming in rice fields and tree planting from the first year. For this reason, it is judged that the incentive to villagers' participation will be strong. Furthermore, outside economic effects, such as prevention of soil outflow and improvement of the function of soil and water conservation, will be obtained from execution of these projects. Therefore, although it is difficult to evaluate economic effect with pecuniary inputs and outputs, it is judged that the investment effect of watershed management plans will be sufficiently appropriate.

This plan has total appropriateness of execution, and success or failure depends on the practicability of villagers' participation and proper local guidance.

Suggestions

This investigation area is the important water-source area for the Antananarivo Metropolitan area. At the same time, it is the more important area for local villagers who live there. Preservation and continuous use of these watersheds are benefits that will continue to the future for local villagers, and such benefits will then lead to secure benefits for villagers in the lower watersheds. It was proven from the results of PSs (pilot studies) that those who recognize devastation inside the watersheds more than anybody else are local villagers. Therefore, watershed management plans made based on villagers' participation in this investigation have contents of projects covering not only forests but also various fields. The contents are beyond the control of the Ministry of Water and Forests. On the other hand, watershed management plans must be managed and operated continuously, not just for a limited period of time. Management and operation must have continuity into the future.

In order to execute these management plans steadily in the future, the following matters are strongly hoped for.

- ① Decision-making and cooperation of ministries concerned for the purpose of execution of plans
As these plans are made from the viewpoint of villagers' lives, the contents of projects extend to various fields. These are really a comprehensive local development plan. It is self-evident that the Ministry of Water and Forests cannot execute them alone. Therefore, execution should be started in the following way. First, organs concerned will, on their organizational responsibility, confirm decision-making for and mutual cooperation in execution of these plans. Then, an executing organization system consisting of the organs concerned will be established upon the initiative of the Ministry of Water and Forests.
- ② Continuous assistance to Analamihoatra Village in succession of the PS
Analamihoatra Village is within point-blank range to the goal of independence. It is judged that the village will be able to become independent with slight assistance. For this reason, it is excluded from these plans. The assumption of execution of these plans is that this village is positioned as a model of execution of these plans and that assistance will be given by the Ministry of Water and Forests in succession of the PS.
- ③ Appropriate loads of beneficiary groups
Watershed preservation is necessary for the future. The financial conditions of organs concerned with these plans are severe. Therefore, financial support of these plans by the organs cannot be expected. In order to preserve watersheds in this investigation area for the future, it is judged that appropriate loads of beneficiaries will become necessary as a future subject. The increase of a new load is a big problem, even if it is only a little, and is accompanied by difficulties. We consider, however, this will not be able to be avoided in the future. It is judged necessary to immediately work on this matter as a future problem.

