Chapter III Preparation of the participatory watershed management

1 Analysis of problems regarding watershed management and their solutions

The analysis of problems for the watershed management was carried out through a dialogue between the villagers, based on the natural resources of the hamlets indicated in the hamlet resources map. In their proposed solutions, the villagers referred to their past experiences, errors committed, etc to come up with a solution. At that time, external participants such as NGOs provided assistance, but strictly respected the dialogue between the villagers and any unreasonable pressure was avoided at all cost. This allowed many participants to intervene equitably during the workshop, in spite of the differences in social position, economic power, sex, age, etc., without being influenced by the opinions of particular participants.

1-1 Results of the analysis of problems and measures taken.

The analysis of problems with participation of the villagers did not only search for the ideal solution, but also tried to provide measures within the reach of the villagers by asking them if they are able to implement them. As such, a system was established indicating the process of development per natural resource (past and present), the problems and measures which may be taken by the villagers, recommended measures, etc. The particular points per village under the PS and according to the major natural resource are enumerated below into 3 categories: ① problems, ② measures which may be taken by the villagers, and ③ recommended measures.

(1) Andrefanivorona

a. Afforestation

① Problems: Fires are started due to negligence during the production of charcoal.

② Measures which may be taken by the villagers: They have experience in fire fighting and afforestation.

③ Recommended measures: Improvement of charcoal production techniques and introduction of new species of trees for afforestation.

b. Grasslands

① Problems: The quality of grass has diminished due to the effect of fires. The planting of eucalyptus trees will reduce grasslands.

② Measures which may be taken by the villagers: No particular measure was established.

③ Recommended measures: The setting up of shared grazing land, the appropriate number of grazing cattle heads, and the improvement of grasslands by introducing feed plants, etc.

c. Vodin-Tanety

① Problems: Soil fertility is reduced and fertilizers are insufficient.

② Measures which may be taken by the villagers: Production of organic fertilizers such as manure.

③ Recommended measures: Provision of techniques and materials for organic fertilizer production.

(2) Ambohimanjaka

a. Rice fields

① Problems: The soil is not fertile and there is not enough farmland. Damages occur due to soil accumulation from erosion and parasites.

② Measures which may be taken by the villagers: Supply of the labor force for the production of organic fertilizers, the safeguarding of the slopes and river beds, the spraying of pesticides, etc.

③ Recommended measures: Purchase of cattle to produce organic fertilizer and the introduction of seeds from improved species.

b. Slopes

① Problems: The *Philippia spp.* is developing. There is soil erosion in steep slopes. The degree of soil fertility has diminished and fires occur in grasslands.

② Measures which may be taken by the villagers: Provide the labor force for tree planting operations, for eucalyptus for example, and end smoking operations. If applicable, work can be shared based on the Dina.

③ Recommended measures: Technical trainings for the production of tree young plants and for producing compost.

c. Afforestations

① Problems: Brush fires occur now and then. The techniques for the production of charcoal are insufficient.

② Measures which may be taken by the villagers: Shared work in the Dina, for example for tree planting activities.

③ Recommended measures: Technical training for tree planting and for the production of charcoal.

d. Lake

① Problems: The volume of catches has diminished. Dead trees in the water are obstacles to fishing.

② Measures which may be taken by the villagers: The fishing cooperative may organize shared activities to remove the dead trees.

③ Recommended measures: Improvement of fishing nets.

(3) Angodongodona

a. Afforestations

① Problems: Land adapted to afforestation has diminished. Planted eucalyptus trees have grown old.

② Measures which may be taken by the villagers: Afforestation, particularly in the eastern shore of the lake, is possible.

③ Recommended measures: Replacement with improved species of eucalyptus young plants.

b. Grasslands

① Problems: Grasslands have diminished due to the conversion to afforestation.

② Measures which may be taken by the villagers: It is possible to establish limits between grasslands and afforestation areas.

③ Recommended measures: Supply of young plants for the production of feed plants.

c. Rice fields

① Problems: Insufficient water sources and small watercourses to irrigate the rice fields.

② Measures which may be taken by the villagers: Supply of the labor force.

③ Recommended measures: Support for the building of a small dam.

d. Slopes

① Problems: Land adapted to planting is diminished due to the extension of farmlands.

② Measures which may be taken by the villagers: The extension of cropland by setting up the farms in the eastern part of the lake is the only solution.

③ Recommended measures: Increased productivity of the farmlands within the village.

(4) Analamihoatra

a. Rice fields

① Problems: Insufficient rice fields inside the village.

② Measures which may be taken by the villagers: Rice fields may be acquired from outside the village.

③ Recommended measures: Increasing the yield of rice fields.

b. Water sources

① Problems: Water sources are exhausted during the dry season.

② Measures which may be taken by the villagers: None in particular.

③ Recommended measures: Measures to safeguard water resources.

c. Lavabozaka

① Problems: Brush fires and soil erosion. Insufficient grazing areas due to the

degradation of grasslands.

② Measures which may be taken by the villagers: Shared activities per Dina for planting feed plants, eucalyptus, etc.

③ Recommended measures: Supply of eucalyptus young plants, feed young plants, and grass for pasture.

d. Tampon Tanety

① Problems: Brush fires and soil erosion

② Measures which may be taken by the villagers: Eucalyptus afforestation activities may be assigned to Dina.

③ Recommended measures: Supply of eucalyptus young plants, etc.

e. Afforestation

① Problems: Brush fires. Dead wood due to poor afforestation techniques.

② Measures which may be taken by the villagers: Supply of the labor force for afforestation.

③ Recommended measures: Supply of eucalyptus young plants and technical support for afforestation.

1-2 Principal problems and the root of the problems

Participants in the PRA expressed various opinions regarding problems in villages. The principal problems were selected during workshops and classified according to the order of importance. The reasons and the causal relationship were analyzed for the major problems and presented in the form of a "genealogy" of problems. This series of operations were mainly carried out by the NGO under the direction of the study team. Results of the analysis of problems in the different fokontanys concerned are as follows:

(1) Andrefanivorona

The principal problems in the village, expressed in the workshops were classified as follows.

① deterioration of natural resources

② reduced agricultural output

③ insufficient cash revenue

④ neglect of social infrastructures

Among these problems, the causal relationship of the problem of reduced farm output, classed second, was analyzed to draw up a problem genealogy chart (see annex 65).

(2) Ambohimanjaka

The principal problems in the village, expressed in the workshops were classified as follows.

① reduced agricultural output

② lack of mutual understanding between the villagers of the different hamlets and the isolation of each hamlet.

Among these problems, a problem genealogy chart was drawn up for the diminished agricultural output was established (see annex 66).

(3) Angodongodona

The principal problems in the village, expressed in the workshops were classified as follows.

① reduced agricultural output
② neglect of social infrastructures
③ insufficient income

Among these problems, a problem genealogy chart was drawn up for the first problem, the reduced agricultural output (see annex 67).

(4) Analamihoatra

The principal problems in the village, expressed in the workshops were classified as follows.

① insufficient cash revenue
② reduced agricultural output
③ diseases of domestic animals
④ health problems of villagers

Among these problems, a problem genealogy chart was drawn up for the first problem, insufficient cash revenue (see annex 68).

2 Participatory watershed management plan

2-1 Plan formulation procedure

To ensure the elimination of the principal problems in the hamlets and to concretize the solutions of the problems regarding the watershed management, the watershed management plan (PS project) was formulated according to the following procedure based on a discussion between the villagers.

① The participants established an order of priority for the solution of their problems.
② Referring to the hamlet resources map, the villagers formulated components of the plan which they can carry out themselves.
③ the hamlets to carrry out the plan were designated and the action map established (see annexes 63 and 64).
④ Applicable techniques and the implementation method were studied and formulated.
⑤ The organization of implementation, the implementation period, the diagram (farming schedule, project schedule) were formulated.

2-2 Components of the watershed management plan

Summary of components of the watershed management plan is shown in Table III-1.

Table III-1 Summary of project components to be carried out under the watershed management plan in the villages covered by the PS

Field	Andrefanivorona	Ambohimanjaka	Angodongodona	Analamihoatra
Agriculture	Planting of fruit trees	Planting of fruit trees	Planting of fruit trees Maintenance of irrigation systems	Planting of fruit trees
Agroforestry	Improvement of soil Fodder production	Prevention of soil erosion Improvement of soil Fodder production	Improvement of soil Fodder production	Prevention of soil erosion Improvement of soil Fodder production
Forestry	Planting of eucalyptus, etc. Improvement of eucalyptus coppice forests	Planting of eucalyptus, etc.	Planting of eucalyptus, etc.	Planting of eucalyptus, etc.
Forestry industry	Improvement of charcoal production techniques	Improvement of charcoal production techniques	Improvement of charcoal production techniques	
Fishery		Fish farming in rice fields	Improvement of fishing equipment	
Improvement of social infrastructures				Installation of Generator

The village villagers discussed with enthusiasm the selection of components among themselves. The operations that they wish to carry out themselves were classified into 3 categories according to the degree of priority: low, medium and high.

Tables III-2 and III-3 indicate the essential points of the watershed management project plan established with the participation of the villagers. The characteristics of this project per village are as follows:

(1) Andrefanivorona

Eucalyptus afforestation (production and planting of young plants) and the production of fruit tree young plants were organized under the leadership of the FRAM of the primary school. Since this is a region where charcoal production is developed, the improvement of production techniques will be ensured through the introduction of improved furnaces.

(2) Ambohimanjaka

Needs are high for the project to counteract soil erosion using leguminous plants and for the improvement of the soil using biomass. The project to produce young plants for beekeeping is

also under way.
Since fishing in the Lake Mantasoa is developed, fish farming in rice fields will be carried out to ensure a source of cash revenue and to improve the nutritional intake of the villagers. Since charcoal production is also developed as in Andrefanivorona, the improvement of production techniques is planned through the introduction of improved furnaces.
For the pilot plan, several hamlets will carry out one plan and 5 hamlets will cultivate fruit tree young plants.

(3) Angodongodona
Needs are high for: eucalyptus afforestation (production and planting of young plants), the production of fruit tree young plants, improvement of soil using biomass and the leguminous plants. Although needs are relatively low, improvement of fishing materials such as nets and installation of irrigation systems accompanied by the construction of a reservoir are planned.
One hamlet will carry out the pilot plan project.

(4) Analamihoatra
The needs to counteract soil erosion and improve the soil to increase farm output are high for this project.
Other needs are low, but an electrical supply project through a small hydroelectric plant is planned under the leadership of a religious congregation.

2-3 Implementation plan

2-3-1 Relation with the overall plan

In this study, the formulation of the participatory watershed management plan will be based on the results of the PS. Projects to be covered by the watershed management plan made with villagers' participation will train the villagers on various techniques for the planning and implementation of the project. This will be implemented upon the initiative and power of the villagers, and expected to be managed autonomously by these villagers even after the end of the PS.
The PS activities carried out here will improve the autonomy of the executing villages. Moreover, the PS can be a stage for the preparation and dissemination of projects to other villages. As such, the PS is an experimental procedure for the implementation of the overall watershed management plan to be formulated during this study. In other words, the results of the watershed management plan tested throughout the PS will serve as a model for the training/dissemination to surrounding villages.

2-3-2 Watershed management plan per village

(1) Quantity of principal works

The project to be carried out as a pilot plan will principally consist of planting operations such as the direct sowing of purchased seeds, the planting of purchased young plants and the production of these young plants in simple mini-nurseries created by the hamlet, the planting of cultivated young plants, etc. In other words, even if it is called a planting project, it will start with the production of young plants. Consequently, the quantity of work will depend on the number of young plants produced and the quantity of seeds purchased, etc. Table III-2 and -3 indicates the quantity of principal works per fokontany. For the planting project in Andrefanivorona, Ambohimanjaka and Analamihoatra, eucalyptus young plants and other species for beekeeping are produced. To improve the soil, species such as Tephrosia will be used, and for the production of fruit tree young plants, peaches, plums, papayas, avocados, etc., will be used.

Table III-2 Quantities of principal work per village covered by PS

Work	Species	Characteristics	Quantities			
			Andrefanivorona	Ambohimanjaka	Angodongodona	Analamihoatra
Afforestation	Eucalyptus	Plants (trees)	150,000	300,000		200,000
	Kesiya pine	Plants (trees)	90,000	1,000		100,000
	Existing species	Plants (trees)	3,000	3,000		3,000
	Beekeeping species	Plants (trees)	2,000	5,000		3,000
	Ornamental species	Plants (trees)	0	350		400
Soil improvement	Tephrosia etc.	Seeds (kg)	250	300	600	350
Fodder production	Bracharia etc.	Plants (trees)	3,000	1,500		3,000
Planting of fruit trees	Peach, plum trees, etc.	Plants (trees)	400	400	400	800

Table III-3 Essential points of the pilot plan for the watershed management plan drawn up with the participation of the inhabitants (Mantasoa zone)

Zone	Fokontany	Field	Content of the project	Degree of priority			Objectives	Method (techniques applied)	Hamlets covered by the pilot study	Organization of implementation	Principal executors	Participants (foyers)	Necessary aid
				Low	Medium	High							
Mantasoa	Andrefanivorona	1 Agriculture	Production of fruit trees			*	Increase in cash income	Establishment of a nursery, raising of seedlings	Ambazimba Antanifotsy	Agricultural and livestock breeding committee	FRAM	20	Seeds, equipment, technical support
		2 Agroforestry	Soil improvement			*	Improvement of agricultural productivity	Production of compost and green manure	Andrefanivorona	Agricultural and livestock breeding committee	Organizations of hamlets	20	Seeds, technical support
		Agroforestry	Planting of fodder		*		Improvement of cattle fodder	Raising of seedlings	Andrefanivorona	Afforestation committee	Organizations of hamlets	10	Seeds, technical support
		3 Forestry	Eucalyptus afforestation, etc.			*	Assurance of materials for charcoal production	Establishment of a nursery, raising of seedlings	Andrefanivorona	Afforestation committee	FRAM	10	Seeds, equipment, technical support
		Forestry	Improvement of eucalyptus coppice forest		*		Assurance of materials for charcoal production	Application tests	Ambohijafy	Afforestation committee	Organizations of hamlets	5	Equipment, technical support
		4 Forest industry	Improvement of charcoal production techniques	*			Increase in cash income	Introduction of improved furnaces	Ambohijafy	Afforestation committee	Organizations of hamlets	10	Equipment, technical support
	Ambohimanjaka	1 Agriculture	Production of fruit trees	*			Assurance of a cash income source	Establishment of a nursery, raising of seedlings	Ankatsaka Aminanosy Antatatra Andranokely Ambohimanjaka	Agricultural and livestock breeding committee	Organizations of hamlets		Seeds, technical support
		2 Agroforestry	Prevention of soil erosion			*	Improvement of agricultural productivity	Use of legumes	Aminanosy Ambohimanjaka Antatatra Ankatsaka	Agricultural and livestock breeding committee	Organizations of hamlets	57	Seeds, equipment, technical support
		Agroforestry	Soil improvement			*	Improvement of agricultural production	Implantation of biomass	Aminanosy Ambohimanjaka Antatatra Ankatsaka	Agricultural and livestock breeding committee	Organizations of hamlets	57	Seeds, equipment, technical support
		Agroforestry	Planting of fodder		*		Improvement of cattle fodder	Raising of seedlings	Aminanosy Ambohimanjaka Antatatra Ankatsaka	Afforestation committee	Organizations of hamlets	57	Seeds, equipment, technical support
		3 Forestry	Eucalyptus afforestation, etc.	*		*	Assurance of materials for charcoal production	Establishment of a nursery, raising of seedlings	Ankatsaka Ambohimanjaka Aminanosy	Afforestation committee	Organizations of hamlets	69	Seeds, equipment, technical support
			Improvement of eucalyptus coppice forest										
		4 Forest industry	Improvement of charcoal production techniques		*		Increase in cash income	Introduction of improved furnaces	Ankatsaka Ambohimanjaka Aminanosy	Afforestation committee	Organizations of hamlets	69	Equipment, technical support
		5 Fishery	Fish farming in rice fields	*	*		Assurance of a cash income source Improvement in the nutrition of inhabitants	Fish farming in rice fields	Fokontany	Fishing committee	Fishing cooperative		Technical support

Table III-3 Essential points of the pilot plan for the watershed management plan established with the participation of the inhabitants (Tsiazompaniry zone)

Zone	Fokontany	Field	Content of the project	Degree of priority			Objectives	Method (techniques applied)	Hamlets covered by the pilot study	Organization of implementation	Principal executors	Participants (foyers)	Necessary aid
				Low	Medium	High							
Tsiazompaniry	Angodongodona	1 Agriculture	Production of fruit trees			*	Assurance of a cash income source	Establishment of a nursery	Ambondrona	Agricultural and livestock breeding committee	Organizations of hamlets	64	Seeds, equipment, technical support
		Agriculture	Improvement of irrigation systems	*			Improvement of agricultural production	Building of a water storage tank, etc.	Angodongodona	Agricultural and livestock breeding committee	Organizations of hamlets	52	Equipment
		2 Agroforestry	Soil improvement			*	Improvement of agricultural production	Implantation of biomass	Ankadilalandalina	Agricultural and livestock breeding committee	Organizations of hamlets	64	Seeds, equipment, technical support
		Agroforestry	Planting of fodder		*		Improvement of cattle fodder	Use of legumes Raising of seedlings	Tsaratolotra	Afforestation committee	Organizations of hamlets	25	Seeds, equipment, technical support
		3 Forestry	Eucalyptus afforestation, etc.			*	Assurance of materials for charcoal production	Establishment of a nursery, raising of seedlings	Ambatotsara	Afforestation committee	FRAM	52	Seeds, equipment, technical support
		4 Forest industry	Improvement of charcoal production techniques				Management of eucalyptus coppice forest	Dissemination of charcoal production techniques	Angodongodona	Afforestation committee	Organizations of hamlets	10	Equipment, technical support
		5 Fishery	Improvement of fishing equipment	*			Increased (fish) catches	Improvement of fishing nets	Antokotoko	Fishing committee	Fishing cooperative	150	Equipment, fishing equipment
	Analamihoatra	1 Agriculture	Production of fruit trees	*			Improvement of agricultural production	Establishment of a nursery	Anovondriana	Agricultural and livestock breeding committee	Organizations of hamlets	41	Seeds, equipment, technical support
			Improvement of seeds					Introduction of improved seeds	Analamihoatra				
		2 Agroforestry	Prevention of soil erosion			*	Improvement of agricultural production	Planting of leguminous hedges	Analamihoatra Kelilalina Anovondriana	Agricultural and livestock breeding committee	Organizations of hamlets	64	Seeds, equipment, technical support
		Agroforestry	Soil improvement			*	Improvement of agricultural production	Implantation of biomass	Analamihoatra	Agricultural and livestock breeding committee	Organizations of hamlets	64	Seeds, equipment, technical support
								Production of compost and green manure	Kelilalina				
		Agroforestry	Planting of fodder		*		Improvement of cattle fodder	Raising of seedlings	Anovondriana Kelilalina	Afforestation committee	Organizations of hamlets	5	Seeds, equipment, technical support
		3 Forestry	Eucalyptus afforestation, etc.			*	Increase in cash income	Establishment of a nursery, raising of seedlings	Anovondriana Analamihoatra Kelilalina	Afforestation committee	FRAM	222	Seeds, equipment, technical support
		6 Improvement of social infrastructures	Electrical supply	*			Electrical power supply	Small hydroelectric plant	Anovondriana 90% of households	Social infrastructures committee	Religious organizations		

(2) Implementation period

Annex 71 cites Andrefanivorona as a representative example to show the project implementation period, which is as follows.

a. Afforestation

The afforestation work is scheduled as follows:

① preparation of nurseries, etc. ... June
② sowing, planting trees, etc. ... July - August
③ preparation for planting trees, etc. ... October - December
④ afforestation ... January - February

b. Planting of fruit trees

Planting of fruit trees is scheduled as follows:

① technical training on nurseries ... April
② technical training on grafting ... August
③ planting ... January - February

c. Improvement of charcoal production techniques

Technical training to improve charcoal production techniques will be given in June.

d. Soil improvement

Technical training etc., to improve the soil will be carried out according to the following schedule.

① distribution of seeds ... mid-October - mid-November
② technical training ... end of November
③ sowing ... mid-December - beginning of February
④ technical training for the production of compost and green manure ... April

e. Fodder production

Fodder production will be prepared according to the following schedule.

Technical training ... October
Preparation and planting ... mid-November - January

(3) Implementing organization

Table III-2 indicates the implementing organization for each pilot plan and a specialized committee will be created per type of work to ensure management. The "principal implementing unit" indicated in Table III-2 signifies the groups such as the existing hamlet organization, who will constitute the principal element on the spot for implementation.

The implementing organization must fulfill the 7 following functions:

① represent the entire hamlet
② organize and assist the work as an intermediary
③ manage the activities of the participants
④ guarantee the management and supply of materials introduced such as seeds, young plants

and other means of help

⑤ disseminate information throughout the village

⑥ inform the implementing team of activities carried out, such as work progress and problems

⑦ participate and provide support for the different technical training programs.

(4) Implementing hamlets

Table III-2 indicates the implementing hamlets and the number of participating households per pilot plan.

(5) Applied techniques

Techniques adapted to each pilot study plan were re-assembled into an overall technical package. The principal points are summarized in Table III-2 and the overall technical package for Andrefanivorona is indicated in annex 70.

(6) Diagram

A diagram for durable use of the land combining the farming schedule and principal activities of the project was drawn up for each of the 4 villages covered by the PS. This will adapt the PS project to the daily life of the villagers. These diagrams were drawn up in the form of concentric circles with illustrations including the elements mentioned below. First, the period to carry out principal activities such as farming (cultivation of rice, potatoes, cassava, etc.), fishing, charcoal production, apiculture, etc. are clearly indicated based on the use of land. Second, periods for project activities such as the creation of nurseries, the planting of young plants, afforestation, the planting of fruit trees, measures against soil erosion, improvement of the soil, etc. are indicated in the schedule. Traditional Malagasy services such as secondary funeral called Famadihana and the circumcision service for young boys are also indicated.

Annex 71 gives an example of a diagram for the durable use of land in Andrefanivorona. The following are some explanations concerning this diagram.

① The external circle provides illustrations of monthly provisions for project operations. The principal activity projects and their periods are as follows.

Planting of fruit trees: July - August

Soil improvement: January - April

Planting of feed trees: December - February

Planting of eucalyptus trees, etc.: January - February

Creation of nurseries and management: June - September

② The second circle from the exterior indicates the months.

③ From the third circle inward, illustrations indicate the activities according to use of the land and periods of implementation for each fokontany in the following order:

Afforestation: December - February
Cultivation on slopes: May - December
Rice cultivation: October - January
Potato cultivation: May - September
Charcoal manufacture: throughout the year
Fishing: February - September
Apiculture: November - December
Secondary funerals: June - October

1) Andrefanivorona

Artificial forest - farmlands on slopes - rice fields - charcoal production - fishing, apiculture.

2) Ambohimanjaka

Rice fields - terrace lands - farmlands on slopes - artificial forest - charcoal production, apiculture, fishing, Famadihana.

3) Angodongodona

Artificial forest - farmlands on slopes - rice fields - handicraft industries (mats, etc.) - fishing, etc.

4) Analamihoatra

Rice fields - land on terraces - farmland on slopes - artificial forest - simple construction wood, Famadihana.

2-4 Participation of women

The situations regarding women's participation in workshops held in the villages for preparation of participatory watershed management plans and utterances are as follows.

(1) Andrefanivorona

Table III-4 shows the number of participants in workshops and the ratio of women's participation in Andrefanivorona. Workshops were held at least 5 times in Andrefanivorona. The average number of participants in the five workshops was 22, with 11 men and 11 women. The percentage of women was thus 50%. It is found from the change of the number of women participants that women's participation increased the number of workshops progressed. The number of women's utterances was also more in this village than in the other three. The active participation of women, however, was insufficient. For example, there was an attitude such that women refrained from speaking out of respect for the men, and generally they only

watched mapping by the side of the men.

Table III-4 Number of participants in workshops and the ratio of women's participation

Number of workshops	1st	2nd	3rd	4th	5th	Average
Total number of participants	15	29	27	32	5	22
Men	11	13	14	13	3	11
Women	4	16	13	19	2	11
Percentage of women	27	55	48	59	40	50

(2) Ambohimanjaka

Because data on the number of participants in the workshops and the ratio of women's participation have not been sufficiently put in order yet, numerical values cannot be given. Only a few women participated in each workshop; the majority of participants were men. Women remained almost silent at the workshops.

(3) Angodongodona

The situation of women's participation in workshops in Angodongodona was similar to that in Ambohimanjaka. Participation of a small number of elderly women was seen several times, but few young women participated.

(4) Analamihoatra

Because data on the number of participants in the workshops and the ratio of women's participation have not been sufficiently put in order yet, the overall view cannot be shown. The situation of participation in workshops for analysis of problems regarding watershed management was as follows:

Number of participants in workshops: About 30 (about 25 men and 5 women)

Percentage of women's participation: 17%

With this one workshop taken as an example, the percentage of women's participation was below 20%.

In addition, women remained almost silent and a member of an NGO, who was a facilitator, could only elicit a few utterances from women. Among four villages covered by the PS, this village is located in the innermost depths; a pure farm village society has been formed, and many common men-centric practices are prevalent. Therefore, women's participation in the society is limited, and there was a strong impression that they were confined to household affairs, childcare and agricultural work.

Chapter IV Implementation of the participatory watershed management plan

1 Summary of implementation results

1-1 Plan implementation process

Preparations for the participatory watershed management plan established during the study at the first PS period progressed as follows until the project started.

① For the 4 rural communes concerned, the watershed management plan was studied and a review workshop was organized to reconfirm the objectives and content of the project.

② During the first and second workshops, working procedures, the establishment of an organizational system, the working period, and the establishment of the implementation schedule per work, were discussed principally upon the initiative of the villagers.

③ The watershed management plan started according to the schedule at the end of April.

After the start of the project, operations were carried out based on the points given below.

① Discussions were conducted with the watershed management committee and representatives of villages, whenever necessary, to allow the rapid settlement of problems or modifications.

② For the operations in each project, the original project was not strictly in force; flexible modifications were made respecting the daily life of the villagers and the opinions of the watershed management committee.

③ At all implementation stages of the PS study, whenever possible, the operations were carried out upon the initiative and through the participation of the villagers.

Table IV-1 indicates the implementation conditions per hamlet for each project.

TableIV-1 Site number of each operation every hamlets in Pilot Study

Area	Fokontany	Chef hamlet (Sector)	Hamlet	Fruit trees production	Soil conservation	Fodder production	Tree planting	Coppice management	Charcoal oven improvement	Hedge management	Fish farming	Remarks
Mantasoa	Andrefaniborona		Andrefaniborona	1	2		1			1		
			Ambohijafy	1			1			1		
			Ankafatora						1			Joint work with Ambohimanjka F.
	Sub-total			2	2		2		1	2		
	Ambohimanjaka	Ambohimanjaka	Ambohimanjaka	2	2		1			1		
		Andoranokely	Andoranokely		1		1			1		
		Ankatsaka	Ankatsaka		1					2		
			Andakana	1	1		1			1	1	
			Ivondrona		1		1					
		Antatatra	Andranomavo	1	1		1			1		
		Aminanosy	Aminanosy		1		1					
	Sub-total			4	6		6			6	1	
Tsiazompaniry	Angodonngodona		Angodongodona	2	2		2	1	1			
			Tanbonoro	1						1		
			Tsaratatora	1								
			Ambatotsara	1	1		1					
			Ambondrona	1	1		1			1	1	Residents of Antokotoko participate
	Sub-total			6	4		4		1	2	1	
	Analamihoatra	Analamihoatra	Analamihoatra	1	1		1			1		Generator
			Analakely	1								
			Ambositra	1								
	Anovondrina	Anovondrina	Ambato	1								
			Antanimbarinihadiana	1								
			Anovondrina	2	1		1			1		
	Kelilalina	Kelilalina	Kelilalina	2	1		1			1		
			Antsahalava	1								
	Sub-total			10	3		3			3		
Total				22	17	0	15	1	2	13	2	

Table IV-2 Results of execution of PS projects

Field / Village	Agriculture		Agroforestry		Forestry				Forest Industry	Fishery	Social infrastructure
	Planting of fruit trees	*Production of compost*	*Hedge*	Production of fodder	Production of young plants	Afforestation	*Coppice forest*	ZODAFARB	*Charcoal production techniques*	Fish farming in rice fields	Generator
Andrefanivorona											
Participatory households (plan)	20	25	38	8	10	10	5		25		
Participatory households (actual result)	19	15	22	3	9	7			6		
Rate of participation (%)	95	60	58	38	90	70			24		
Executed quantity (tree)	175			P 600, B 1	45,000	11,860	Not executed	No applicable		No applicable	No applicable
No. of participants	27			5	25	21					
Details Man	15			3	9	9					
Woman	7			2	10	7					
Child	5			0	6	5					
Ambohimanjaka											
Participatory households (plan)	70	57	57	8	53	70	5		5	43	
Participatory households (actual result)	18	29	38	8	53	25			5	34	
Rate of participation (%)	26	51	67	100	100	36		No applicable	100	79	No applicable
Executed quantity (trees)	197			P105, B53	48,000	5,500	Not executed			5,400	
No. of participants	73			10	117	59				160 fishes /household	
Details Man	32				36	24					
Woman	22				42	14					
Child	19				39	21					

Note: 1) Figures under items in Italics are the actual number of lecture classes.
2) "P" in the columns of fodder production means "Ponissetum," whose unit is one plant; "B" means "Bracharia," whose unit is one kilogram.

Village \ Field	Agriculture		Agroforestry		Forestry				Forest Industry	Fishery	Social infrastructure
	Planting of fruit trees	*Production of compost*	*Hedge*	Production of fodder	Production of young plants	Afforestation	*Coppice forest*	ZODAFARB	*Charcoal production techniques*	Fish farming in rice fields	Generator
Angodongodona											
Participatory households (plan)	64	64	0	25	52	52	10	*	10	10	
Participatory households (actual result)	12	60	7	7	28	35			7	23	
Rate of participation (%)	22	94	—	28	54	67			70	230	
Executed quantity (trees)	330			P200,B1	7,700	6,200			30kg	3,025fishes	No applicable
No. of participants	70				38	Unknown	Not executed				
Details Man				Unknown	7				Unknown	Unknown	
Woman	Unknown				6						
Child					25						
Analamihoatra											
Participatory households (plan)	41	64	64	64	158	158		153			65
Participatory households (actual result)	230	59	75	53	200	209		153			70
Rate of participation (%)	561	92	117	83	127	132	No	100	No	No	108
Executed quantity (trees)	356			P110,B2	53,700	39,700	applicable	8,100	applicable	applicable	1 unit
No. of participants	335				495			765			210
Details Man					365						120
Woman	Unknown	Unknown		Unknown	102	Unknown		Unknown			40
Child					168						50

Note: 1) "P" means "Penissetum," whose unit is one plant; "B" means "Bracharia," whose unit is one kilogram.
2) The * mark means that ZODAFARB has been started apart from PSs under the control of the Ministry of Water and Forests.
3) Analamihoatra Village includes both Anvondriana and Kelialina Villages.

1-2 Results of execution of the Pilot Study Projects

The results of the execution of the Pilot Study (PS) Projects are shown in Table IV-2. Actual performance of the plan, which was done by households participating in each project, i.e. the rate of participation, generally shows the degree of villagers' interest. In this case, however, it does not exactly show it for the following reasons:

① Although the plan was made by PRA, the will to participate in the project expressed by villagers was beyond their own labor limit because their expectation and hope was large. It resulted in time conflicts with farm work, and some people did not participate (execute).
② Giving information from the Watershed Management Committee of each village was not thorough when each project was carried out. As a result, some could not participate.
③ Though information was given by the Watershed Management Committee when each project was carried out, some people did not have enough time to go to get seeds due to their remote location, and did not participate as a result.
④ In the case of fruit tree planting, the planting area was not suitable for the species of trees that villagers hoped to plant, and the decision was made not to plant trees. Consequently, people could not participate.

Therefore, it is considered difficult to judge the degree of villagers' interest only from the rate of participation.

Viewing the rate of participation on the assumption of the above-mentioned matters, projects whose rate of execution was generally low were fruit tree planting, fodder production and afforestation. Fruit tree planting is a project in which villagers are highly interested. But, because the species of trees that villagers hoped to plant were not in conformity with the conditions of the site, preparation of compost was inadequate and the number of young plants prepared was insufficient. As a result the rate of participation (execution) was low. It is judged that interest in fodder production is not so strong because many villagers use grass on the dry riverbed or around cultivated land, or agricultural leftover as fodder for cows. Regarding afforestation, the rate of participation was low although villagers' interest is strong. The reasons include that the start of rain was late and that the young plants were too small at the time of planting (which is a matter of technique in raising young plants). Consequently, many projects were not carried out.

Unexpectedly, interest in the production of compost was low. This production is routinely carried out, regardless of the quality of compost. It is considered that, for this reason, the rate of participation was low although a will to participate was expressed. According to the individual investigation (interview), the interest of villagers participating in this project was very high and they had great expectation of improvement of land productivity and substitutes

for chemical fertilizer. In lecture classes in improvement of charcoal-making technique, there was extreme difference between two villages. As villagers' reactions, antithetical evaluation was also made. Some said that no effect was obtained for much labor and time, while others said that positive effect was obtained. Generally, as charcoal-making work takes many days, the result shows that villagers' reactions were not good.

No lecture class was conducted in coppice forest technique, the technique to properly control sprouting branches (a technique similar to picking the fruit of fruit trees) according to purposes of timber production. These lecture classes were not conducted because villagers, who typically used axes, expressed disapproval of the use of a hand saw, which is the tool used in this technique. Another reason was insufficient time.

Fish farming in rice fields is carried out in the no-farming period after harvesting of paddy rice. Fish farming was a project to which attention was also paid by the Joint Executive Committee from the strategic point of view to raise villagers' interest in forests for the purpose of securing water sources. Villagers' interest was also high. Production of fry, however, was not successful (it was slightly successful only in Angodongodona Village). Therefore, fry were separately arranged and fish farming was carried out. There was damage to fry in a partial area due to visitation of a cyclone (in February 2000). Fish farming is a project that requires further technical guidance.

The village with the highest rate of participation is Analamihoatra Village. It is an inland village where it is harder to obtain information from other areas, and development is more behind than in the other three villages. Its villagers still have a sense of simplicity and homeliness, and are less suspicious and move active in introduction of new techniques. It is also a village whose villagers seem to have a high consciousness of partnership with which they try to do anything. Therefore, each member of the Watershed Management Committee grasps matters and conditions of the whole village regarding the business in his/her charge.

The state of participation in other three villages was generally similar.

Andrefanivorona Village had the lowest rate of participation in lecture classes in improvement of charcoal-making technique, although charcoal making is active there, while villagers have high interest in planting trees that will become the wood material of charcoal. There are many artificial plantations (accounting for 73% of the village area), and it is the most active charcoal-making village of the four. The village is near the town and has many wage workers. Therefore, it is judged that villagers do not keenly feel the necessity of improvement of charcoal-making technology that requires labor and time. On the other hand, villagers have a zest for the culture of fruit trees that will bear cash crops.

In Ambohimanjaka Village, the rates of participation in planting and the culture of fruit trees were extremely low. This is because there are few places suitable for fruit trees to be planted, and the number of young plants obtained was limited. Interest in planting and the culture of

fruit trees is high, and many villagers expressed their discontent with the limitation of the number of fruit trees distributed. The rate of execution of afforestation was also low because the planned place of planting was remote and the raining season was largely late.
As this village is active in fishery with the lake used, interest in fish farming in rice fields was high. The rate of participation, however, was limited to about 80% because the number of fry was small.
In Angodongodona Village,the rate of execution was low on the whole except for fish farming. That of planting and the culture of fruit trees was also extremely low. This was not caused by low interest, but instead resulted from lack of places suitable for the species of the trees that villagers hope to plant, the limited number of young plants prepared and an inequality in the distribution of young plants to those who wanted to participate. Villagers expressed discontent with these conditions. The rate of execution of fodder production was also low, because the distribution of seeds was delayed and the period of production conflicted with the busy farming season when potatoes were planted after harvesting of rice crops. The low rate of execution of afforestation resulted from the small quantity of production of young plants (caused by insufficient planning and problems related to the technique of raising young plants).

The rate of execution of PS (Pilot Study) projects depends on villagers' zeal and functioning of the Watershed Management Committee. Villagers' zeal is not uniform but differs according to natural and socio-economic conditions. Functioning of the Watershed Management Committee is subject to the attitude toward, and responsibility and zeal for, members' mission. In addition, geographical features of the areas where members reside cannot be overlooked. If all members live next door to each other, good understanding among the committee is easy. But, in two villages in Mantasoa area with geographical features such that each valley is dotted with two or three houses, it was difficult to secure functioning of the committee as well as good communication with participants and execution of group work (young plant work). This shows the limitation of judging the degree of villagers' interest only from the rate of participation in PS projects. What is necessary is considered to be execution based on hamlets instead of the whole village, with geographical features taken into consideration at the stage of planning.

1-3 Situation of women's participation

The situation of women's participation in PS projects is as shown in Table IV-3. In Mantasoa zone, the average percentage of women's participation in the villages was 33% in Andrefanivorona and 31% in Ambohimanjaka. Thus, one of three participants was a woman. As to Tsiazompaniry zone, because projects in which the number of women participants could be grasped were only the manufacture of compost and production of seedlings, valid

percentages of women's participation could not be determined. It is, however, estimated that the said percentage was 20% or lower in Angodongodona and similar to Mantasoa zone in Analamihoatra. It is considered from the above-mentioned situation that women's participation in Angodongodona is smaller than in other villages.

Percentages of women's participation per project are shown with the results of execution of each project in the next item. Distinctive features of women's participation in projects are summarized as a whole as follows:

① In two villages in Mantasoa zone, there was a tendency that the ratio of women's participation was relatively higher than in the two villages in Tsiazompaniry.

② The average ratio of women's participation in the manufacture of compost in the four villages was the highest (43%) of all projects.

③ More than 20% of the total number of participants in all projects were women.

Table IV-3 Ratio of women's participation in PS projects classified by villages and projects

Unit: %

Village	Agriculture		Agroforestry	Forestry		Improvement of the social foundation	Average ratio of participation
	Planting and culture of fruit trees	Manufacture of compost	Production of livestock feed	Production of young plants	Afforestation	Power generator	
Andrefanivorona	26	--	40	40	33		33
Ambohimanjaka	30	34	--	36	24		31
Angodongodona	--	17	--	16	--		--
Analamihoatra	--	77	--	21	--	19	--
Average of four villages	29	43	40	24	26	19	32

Note: The ratio of women's participation shows the ratio of women among participants in each project.
A "-" mark means that "Percentage is unknown."
The average of villages is an average excluding villages where the percentage is unknown.

2 Results of execution of each sector of project

2-1 Agriculture

1) The planting of fruit trees

The planting of fruit trees is a project of primary concern among PS projects, although the results show villages with a low rate of execution. It is considered that fruit trees gained popularity as cash crop items and, at the same time, for home consumption.

Points of execution of projects:

- Determination of kinds of adaptable trees through local investigation by fruit-tree specialists.
- Preparation of planting holes (1 m x 1 m x 1 m) and composting by villagers.
- Confirmation of the presence of compost.

- Guidance of planting.

As a result of judgement of the suitability of land and examination for the presence of compost, some villagers did not participate.

Kinds of trees to be planted and cultured:

The number of tree kinds reached 13; the main kinds are peach, plum, Japanese persimmon, apple, and pear. The remaining trees include mandarin, avocado and orange.

Degree of achievement of technique:

The rate of rooting of almost all villages is 100% because trees are cultured around houses or churches and can be well cared for. Generally, trees show good growth, while there are trees that have rooted but not started growth in some places. Trees have grown about twice as large as those at the time of planting in well-tended places (for example, oranges in Ambohijafy Hamlet.)

Spread:

Because fruit trees bear cash crop products, villagers' demand for fruit planting and culture is strong and it is easy to spread. However, individual guidance of culture technique will become necessary.

Characteristics of villages:

Ambohijanaka Village

There is a plan to increase trees by distributing grafts to those who did not participate.

Angodongodona Village

Many expressions of discontent were heard from villagers because of the limitation of the number of distributed plants while there were many villagers desirous of participating.

Analamihoatra Village

There is a group that jointly plants and cultures fruit trees and will obtain grafts and increase the number of trees.

Participation of women:

The average percentage of women's participation in two villages in Mantasoa zone was 29%. As planting and culture of fruit trees was a project with high needs, it is estimated that the percentage of women's participation in Tsiazompaniry was around 30%.

2) Manufacture of compost

For the manufacture of compost, lecture classes were conducted. Technical guidance was given through demonstration by using materials that had been prepared by participating

villagers in advance.

Spread:

The execution by each resident after the lecture classes is shown in Table IV-3. Although the rate of participation in the classes was unexpectedly low (Table IV-2), the results were judged as moderate except for Angodongodona Village. This village is active in potato culture (for sale) and has been using chemical fertilizer up to now. On the other hand, vegetation to be used as the material of compost is poor, and a shortage of biomass is pointed out by villagers. It is considered that these were the reasons for the small number of those who participated.

Table IV-4 Production of compost

Village	Andrefanivorona	Ambohimanjaka	Angodongodona	Analamihoatra
Households participating in lecture classes (a)	15	29	60	59
Executing household (b)	12	29	20	14
Percentage of the spread % (b/a)	80	100	33	-
Quantity of execution (unit)	27	64	100	20
Number of people engaged	29	106	Unknown	98

Note: One unit of quantity of execution is about capacity.

Degree of achievement of technique:

Compost has been produced so far, and the aim regarding production of compost carried out as a pilot project its technical improvement. It is considered that a moderate result was obtained.

Villagers production compost in their own way. For example, those who do not own cows use fowl droppings. The key point of the preparation of compost, however, is temperature control. It was judged that repeated technical guidance was necessary for the production of compost of good quality. Some villagers expect that harvests of paddy rice will double if compost whose material is pruned Tephrozia is used (Ambohimanjaka Village). Though it is difficult to believe this unconditionally, it is considered that the beneficial effect will be great if compost has not been used yet.

Villagers' response:

Villagers made very favorable criticism as their response. There are villagers who welcome compost as a substitute for chemical fertilizer (Ambogodongodona Village). This area, however, is poor in vegetation and it is difficult to gather materials for compost. Therefore, many villagers want to use Tephrozia, which is introduced into agroforestry, as biomass for compost manufacture. It is judged that the manufacture of compost will further spread together with the spread of Tephrozia.

Participation of women:

The average percentage of women's participation in this project was the highest of all projects at 43%. In particular, the percentage of women's participation in Analamihoatra was 77%, and two of three participants were women. It is considered that the reason for this is that the production of compost is routinely and mainly done by women, and, therefore, it is considered that this shows that women work much in the application of manufacture compost.

2-2 Agroforestry

1) Hedge (hedgerow)

Hedges are made by sowing seeds of the pulse family around or within cultivated land in order to prevent erosion of cultivated land and to improve soil. Some people plant and culture to shorten the fallow period by sowing seeds on land in fallow. Before execution, lecture classes were conducted for participants in this project, and the selection of places to sow seeds and methods to sow seeds were practically carried out by all participants in order to promote technology transfer.

Introduced species:

Introduced species are *Tephrozia vogelii, Cassia rotundifolia, Crotalalia gralemiana,* and *Vetiveria zizanioides*. The main species are *Tephrozia* and *Crotalalia.*

Spread:

As villagers' execution in all four villages, after lecture classes, seeds were sowed by attendants in lecture classes or by those with the higher level of knowledge (Table VI-4).

In Analamihoatra Village, participants in lecture classes were 75 households, and 235 households sowed seeds for hedges after lecture classes. Villagers consider using hedges to shorten the fallow period of land (according to a person in charge of promotion of agricultural improvement of Mantasoa Village, the period can be shortened from 5 years, the existing period, to 3 years). They also consider using hedge for improvement of soil and as raw material of compost. From the fact that seeds can be easily obtained and sowed, it is considered that the spread will advance easily.

Degree of achievement of technique:

In seed-sowing places, most villagers sow seeds surrounding Tanety. It is observed that some people sow seeds in a lump in land in fallow or in a certain place as for seed harvesting. As the technique is similar to that of farming and germination after sowing is uniform, there are no major technical problems.

However, it is necessary to carry out economic agroforestry through guidance of the method of seed harvesting and efficient seed sowing.

Villagers' response:

Expectation of *Tephrozia* is strong, and many people expect its uses not only for prevention of erosion but also as compost material or for soil improvement of land in fallow.

Table IV-5 Agroforestry

Village	Andrefanivorona	Ambohimanjaka	Angodongodona	Analamihoatra
Hedge				
Households participating in lecture classes (a)	22	38	7	75
Executing household (b)	23	48	30	235
Percentage of the spread % (b/a)	105	126	429	313
Quantity of execution	T 35 kg V 300 roots	T 63 kg	T 7.5 kg	T&C 273kg
Number of people engaged	46	285	Unknown	540
Fodder production				
Executing household (b)	3	8	7	53
Quantity of execution	P 600 trees B 1 kg	P 105 trees B 53 kg	P 200 trees B 1 kg T, S, etc. 32kg	P 110 trees B 2 kg
Number of people engaged	5	10	Unknown	Unknown

Note: "T" means Tephrozia, "P" is Penissetum, "B" is Bracharia, "V" is Vetiveria and "S" is Stylosanthes. Although species other than those listed in the table are used for fodder, there are no descriptions of them here.

2) Fodder production

Though conditions of cow breeding differ, among the villages, cows are commonly bred in each village. The number of households producing fodder is very small except in Analamihoatra Village (Table IV-4). As the actual situation, there are many people who use agricultural leftovers, or grass on farming land or around rivers. Therefore, the necessity of fodder production seems not to be so high.

Analamihoatra Village has the highest percentage (71%) of households breeding cows of the four villages, and the number of executing households is large. This is because many people want fodder since grass that cows like is sparse although there is much grassland around this village. At present, there are groups that have an idea of jointly sowing seeds, then gathering seeds newly borne or cuttings in a certain lot and expanding this system to more households gradually.

Introduced species:

Penissetum purpureum, Kizozi sp., Stylosanthes spp., Bracharia sp., Avoine sp., Setaria spp.

These are not woody but herbaceous plants.

Spread:

Penissetum, which can be proliferated by cuttage, has the possibility of easy spread. Other species are also relatively easy to gather, and the spread of future proliferation is also possible.

Degree of achievement of technique:

As the method of culture of feed plants is similar to that of farm products, there are no technical problems and villagers' execution is sufficiently possible. For the future, however, in order to rationally secure fodder, what is considered necessary includes acquisition of appropriate technique related to culture, gathering and proliferation.

Villagers' response:

Although production of fodder is the first experience for villagers, their expectation is large. Whether or not it will be accepted depends on future results. It is necessary to watch future development.

Participation of women:

In Andrefanivorona, 40% of participants were women.

2-3 Forestry

Contents of forestry activities are the production of young plants, tree planting, improvement of technique for coppice forests and ZODAFARB. Improvement of coppice forests, however, has not been made, as mentioned above. While the rate of villagers' participation is different according to villages, it is an activity of high interest among by villagers. Particularly, Angodongodona and Analamihoatra Villages show a high interest in forestry.

1) Production of young plants

The production of young plants is carried out mainly with young plants with naked roots, while those in pots are partly cultured. Though people say that in-pot plants have the high rate of rooting, they have been apt to be avoided because work for them takes much time. The main tree species is *Eucalyptus robusuta*. In addition, *E. camaldulensis*, *E. citriodora*, *Pinus patula* and *Cupressus pyramidalis* are cultured, although only a little.

While the number of produced plants is about 154 thousand, that of plants actually set and raised is 73 thousand. The other plants still remain. Although there is a difference among

villages, the reasons for this include that young plants were too small at the time of planting (caused by insufficient work to raising young plants) and that the planting period was short due to a delay of the rainy season. In both Angodongodona and Analamihoatra Villages, almost all quantity was carried out from the mountain. This can be considered to show participants' strong interest.

The production of young plants requires daily care. It is very hard that participants actually manage to do sprinkling work everyday, even if a person in charge is determined, because villagers' houses are scattered widely across a valley. For this reason, there were villages (two in the Mantasoa zone) where daily work was concentrated upon specific persons and was a heavy burden for them. It is judged that production of young plants should have been carried out by dispersing places of production where it would be realistically feasible, with consideration given to geographical conditions. There were cases where sprinkling of water was carelessly omitted since these operations required work in the intervals of farm work.

Degree of achievement of technique:

The technique for raising young plants is still in the immature stage. There is room for improvement of the methods of seed sowing and young plant culture. While the method of seed sowing is a problem, the method of young plant culture in particular requires more technical guidance. It is important to raise strong young plants in order to improve initial growth after planting and the rate of rooting. For this purpose, the important considerations include sprinkling of water, control of sunshine and work to strengthen young plants before they are carried out from the mountain. Some cases of young plants showing useless, unproductive growth and young plants that grew insufficiently were seen due to insufficient sprinkling of water, incomplete sunshine control, narrow spaces between young plants, and so on. These resulted from immature technique; therefore, it is necessary to continue technical guidance hereafter.

Response:

Tree planting has been carried out with wilding. Villagers who have used young plants raised in young plant fields said, they valued the rate of rooting improvement very much. Young plants in pots were also partly cultured, and the evaluation was that the rate of rooting had become much higher than that of young plants with naked roots. But the evaluation of in-pot young plants was varied. Some people sidestep the use of them because it takes too much time, while others try to use them actively.

Participation of women:

The average percentage of women's participation in four villages was 24%. The village with

the highest percentage of women's participation was Andrefanivorona, with 40%. The village with the lowest percentage was Angodongodona, with 16%. In Analamihoatra, the number of women participating exceeded 100, while nearly 400 men and 200 children participated. As a result, the percentage of women's participation was 21%, which is relatively low.

2) Tree planting

There are two kinds of tree planting; tree planting in privately owned land and tree planting in land subject to ZODAFARB. The actual results of these are shown in Table IV-5.

The rate of practice is the lowest in the Mantasoa zone (Table IV-2). While the interest of people in the district is not low, it is lower than that of the Tsiazompaniry zone. In the two villages, there are many young plants unused partly because the rainy season was late and the size of young plants was too small at the time of planting. It had been planned to plant young plants when the small rainy season started. There was a tendency to select areas remote from the periphery of hamlets, because many villagers think that the periphery of their hamlet should be kept as cultivated land for the next generation. On the other hand, in Analamihoatra Village, tree planting is carried out under the land use plan to keep the upper part of irrigated rice fields as Tanety and to make the periphery of ridges in the further upper part of rice fields a plantation.

The space between planted trees is generally 2.5 m x 2.5 m. The way of planting is spot planting. The size of a hole is generally 30 - 40 cm x 30 - 40 cm.

Degree of achievement of technique:

Tree planting has been carried out by a wilding technique, and almost all villagers have acquired the skill. In particular, there is a case in which a measure for fire prevention (ground surface fire) is taken by turning over soil dug up in a semicircle of a planting hole. This is the technique traditionally employed (Analamihoatra Village). The percentage of rooting is generally high. For to *Eucalyptus*, the percentage of rooting of in-pot young plants is 100%, and that of young plants with naked roots is 90% or higher. Even on watersheds (ridges) whose conditions are severe, the percentage is 70% - 80%. Rooting of *Pinus* (in-pot young plants) is 95% or higher, and the shown results in all places are higher than those of *Eucalyptus*. As to wilding, the percentage of rooting of 90% can be seen if weather conditions are good after planting, but the percentage is judged to be usually about 50% at highest.

Participation of women:

The average percentage of women's participation of two villages in Mantasoa zone was 26%. Of these villages, the percentage in Andrefanivorona was 33%; thus, one of three

participants was a woman. Although the ratio of women's participation in Tsiazompaniry zone is unknown, it is considered that there is a tendency similar to the production of seedlings, and that the percentage is low in Angodongodona and relatively high in Analamihoatra.

Table IV-6 Sizes of tree plantation

Unit of size: ha

Village	Land personally owned		ZODAFARB		Total	
	Number of planted trees	Size of land	Number of planted trees	Size of land	Number of planted trees	Size of land
Andrefanivorona	11,860	7	No applicable		11,800	7
Ambohimanjaka	5,500	3	No applicable		5,500	3
Angodongodona	6,200	4	1,200	1	7,400	5
Analamihoatra	39,700	25	8,100	5	47,800	30
Total	63,260	39	9,300	6	72,500	45

Note: 1) Size of tree plantation was calculated using the planting space that villagers popularly use, 2.5 m x 2.5 m.
2) ZODAFARB in Angodongodona Village was carried out under control of the Ministry of Water and Forests apart from the PS.

3) ZODAFARB

The place where ZODAFARB was conducted as a PS is Analamihoatra Village only. In Angodongodona Village, villagers themselves carried it out while receiving guidance from the Ministry of Water and Forests.

ZODAFARB is complicated in matters related to procedures. Therefore, in the PS, it had been carried out based on the procedure of execution (Table II-6) determined after consultation with the Ministry of Water and Forests so that villagers would be able to execute it by themselves. Annex 54 shows the details of application of ZODAFARB.

In Analamihoatra village, 153 households participated and 8,100 trees were planted (in 10 places). Although the result of execution in this year is inconsiderable, it has been determined to continue afforestation with the execution of the PS as a momentum. In this village, land readjustment in the area to be covered by the plan has been already completed, and it is planned to expand the area of afforestation gradually.

In the case of Angodongodona Village, touched off by execution of the PS, villagers themselves made a plan and carry out ZODAFARB on their own will.

Table IV-7 Procedure of execution, undertakers and the schedule of ZODAFARB

Procedure of execution	Undertaker of execution	Schedule (planned)
(1) Activities to educate/enlighten villagers	Ministry of Water and Forests, NGO, JICA	Nov. 16
(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, JICA Villagers JICA	Late Nov. Early Dec. Early Dec.
(3) Preparation of request letter (3 kinds of maps, minutes)	NGO, villagers	Middle Dec.
(4) Submission of request letter	Villagers	Middle Dec.
(5) Public disclosure of documents	Prefectural office	Jan. - Feb.
(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	In Feb. In Feb. In Feb. In Feb.
Joint work - Production of young plants - Work to prepare for planting	Villagers Villagers	Jul. – Feb. Dec.
Seminar activities - Prevention of forest fire, etc.	Ministry of Water and Forests, villagers	Not determined
Execution of afforestation	NGO, villagers	Mar. – Apr.

Degree of achievement of technique:

On watershed parts where conditions are bad, consideration is observed including digging larger planting holes (70 - 80 m x 70 - 80 m). Percentages of rooting of Eucalyptus and Pinus show 80% and 100%, respectively. In places where wilding is planted due to a shortage of them, however, the percentage of rooting is 50% or lower (in Analamihoatra Village).

In Angodongodona village, the result is poor; the percentage of rooting is about 50% or lower because young plants with spindly growth were planted. This is a matter of technique for young plant fields in 1) stated above and indicates the necessity of further technical guidance.

2-4 Forestry

For forestry, lecture classes on charcoal-making technique where charcoal was practically made were conducted. The classes were conducted in two places; one class was jointly held for Andrefanivorona and Ambohimiadana Villages, and the other was in Angodongodona Village. In Andrefanivorona, although there were many households that wished to participate, the rate of participation was low in the result (Table IV-2) because of each resident's judgement of the value in the stage of execution. In Ambohimiadana Village, interest in making charcoal was originally low. There are people who specialize in charcoal making with

purchased wood. In this area, therefore, owners of afforested trees can secure earnings by selling their forest woods. Because of such a background, villagers can choose selling afforested trees or making charcoal by themselves according to the situation at the time. Their needs of improvement of charcoal-making technique seem not to be so keen.

Spread: Development of the spread is little.

General villagers' response is not good because the rate of charcoal making increases by only about 10%, with some difference among villages, while the number of working days almost doubles in number compared with the existing method. In Angodongodona Village, only one person practiced the operations after the lecture class. According to him, the result is good. As participants' general evaluation, however, this technique is not easily accepted because it is difficult to obtain materials for chimneys and the number of working days is double the present one.

2-5 Fishery

(1) Culture of parent fish

With consideration given to the continuity of fish farming in rice fields, the culture of parent fish was started first. For this purpose, persons in charge of culture were determined and fish farming ponds were made. Culture was then started under the guidance of a technical expert in fish farming. (For details of the execution process, see the Interim Report.) Little spawning, however, was observed, and the production of fry resulted in failure (Table IV-7). It is not sufficient merely to stock a pond with parent fish; proper management is necessary. It was found that a matter of baits and preparation of environment for spawning were important for spawning. According to experts at the Fishery Department, possible causes of the failure in fry production are ① stress of parent fish due to movement, ② preparation of environment for spawning and ③ selection of baits. Therefore, it is judged that the failure in fry production was caused by insufficient follow-up of technical experts in fish farming after the start of parent fish breeding. But guidance given to people in remote places by experts has a limit. Therefore, it is considered realistic to take measures such that fish are cultured in rice fields with fry separately arranged instead of using fry produced with parent fish.

Table IV-8 Breeding of parent fish

Village	Ambohimanjaka	Angodongodona
Number of bred parent fish		
Female (number)	4	3
Male (number)	4	2
State of hatching	Because of no spawning, fry could not be produced.	In spite of spawning and hatching, mother fish ate fry, resulting in the production of only 25 fry.

Note: The kind of fish is carp (Royal carp).

(2) Fish farming in rice fields

The situation of execution of fish farming in rice fields is as shown in Table IV-8.

As production of fry failed, fry were separately obtained and distributed to each participant. As the way of fish farming, using irrigated rice fields after harvesting paddy rice, fry were stocked there after making their habitat by digging the border of irrigated fields to the depth of about 50 cm and sprinkling rice hulls. Each participant bred fry with bait (e.g., cassava and sweet potatoes) individually at their own discretion.

There was damage with some fry dispersed due to a cyclone that hit in the period of breeding (February 2000). Water control at the time of a cyclone is difficult, and it must be especially taken into consideration in the selection of fish farming ponds. If the upstream of an irrigated rice field is covered with forest, as there is a time lag of outflow of rainfall the effect of damage will more or less be reduced. It can be said that the presence of a forest is important also for fish farming from the viewpoints of both securing water during the dry season and reduction of damage at the time of flood.

Fry grew to be about 10 cm in length 6 months after the start of stocking (example of Angodongodona Village). The kind of fish is royal carp.

Table IV-9 Fish farming in rice field

Village	Ambohimanjaka	Angodongodona
Number of delivered fry	5,400	3,025
Number of participating households	34	23
Number of delivered fry per household	160	80~1,000

Note: 1) In Ambohimiadana Village, spawn was gathered from the lake, and fry after hatching were delivered to participants.

2) In Angodongodona Village, according to the decision of members of the Watershed Management Committee, 1,000 fry were delivered to breeders of parent fish and the remainder was delivered to other participants. A large majority received about 80 fry.

Villagers' response:

Their response is very good. Some people are considering not only self-consumption but also the sale of fish. There are also people who originally plan to produce fry by moving fish to another place when they become adults. In this area, there has been a habit of culturing natural small fish in rice fields after harvesting rice. Therefore, fish farming in rice fields where fry are actively stocked is an activity that is easily accepted by villagers.

2-6 Improvement of the infrastructure

This project is to supply power by small scale hydraulic power generation using falling water. It was carried out only in Analamihoatra Village. Execution was launched after research on market conditions and a feasibility study were conducted in advance, and then detailed design was made according to local conditions.

This project was executed by entrusting expert consultants with expert items such as designing, manufacture and installation of power generating devices. Charge of construction of a power-generation house and simple labor work were undertaken by villagers. (See Fig. VI-1.)

The project was conducted with the participation of 70 households, while 65 households had been expected. Villagers' labor was as follows: 1 man-day for construction and installation of waterways, 59 man-days for a water tank and 150 man-days for the power-generation house, or 210 man-days in total.

Laborers were 120 men, 40 women and 50 children. As a result, the percentage of women's participation was 19%, which is low. It is considered that this is because men offered labor more than women since the most part of work is heavy and physical.

It has been determined that the entire maintenance and management of the power generating devices was generalized by the Watershed Management Committee. Concretely, 3 persons are to be exclusively posted and to take charge of their maintenance and management on a shift system.

Villagers' response:

Having electricity for the first time in the village where before there was no electricity is a great pleasure for villagers. This is the most popular project in Analamihoatra Village.

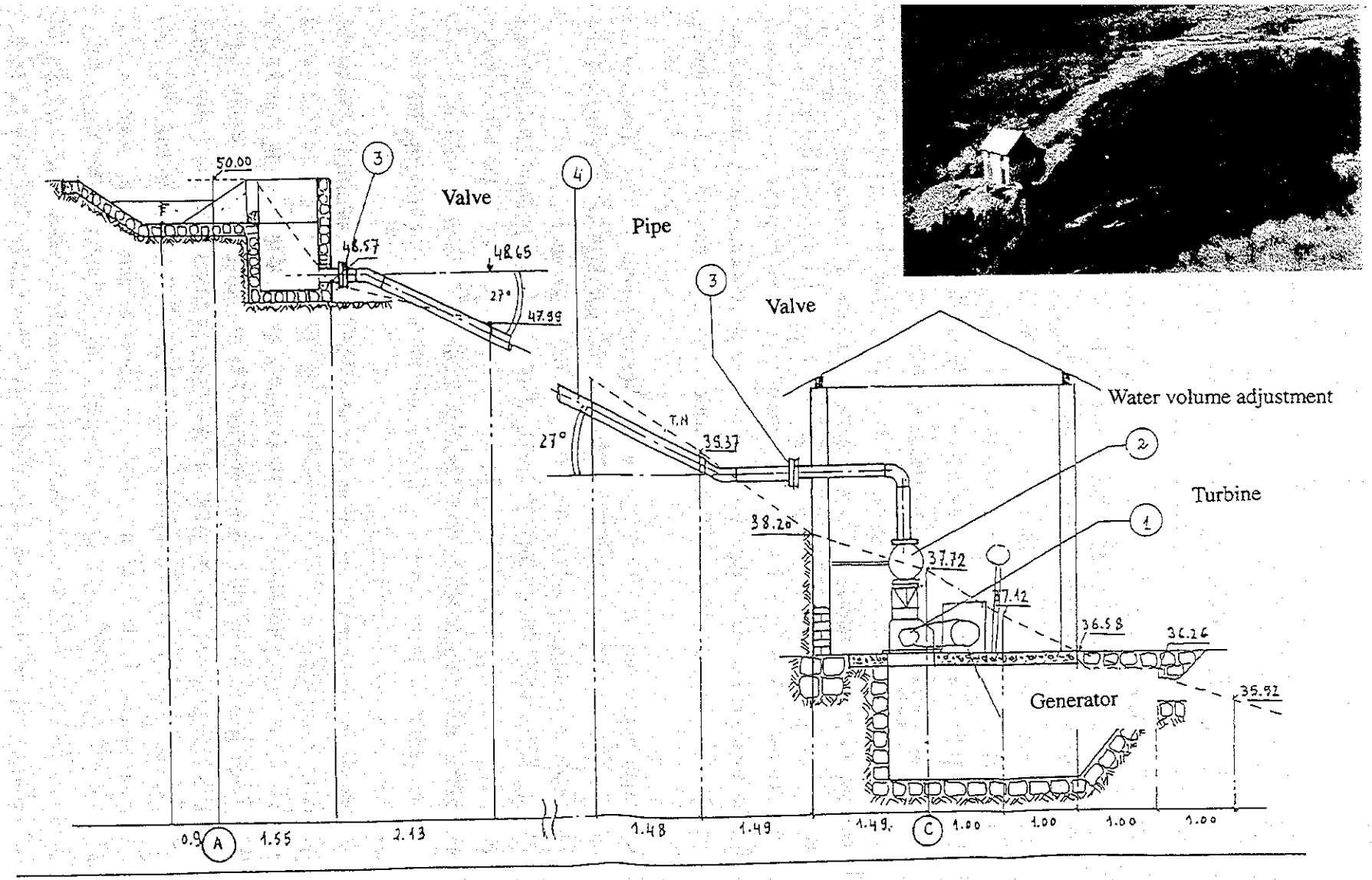

Figure IV-1 Installation diagram of small scale hydraulic power generation