CHAPTER 4 COUNTERMEASURES FOR PROBLEM SOLVING

4.1 Approaches to problem solving

Problems and their causes were identified through situational analyses in the Study area in the previous chapter. As a result, problems identified include lack of development of crop production; deterioration and insufficient development of irrigation facilities; lack of market information; lack of high quality fodder grass; degradation of the land resources and soil erosion to the lower basin area caused by degradation of the upper basin; stagnant extension services in agriculture and watershed management; and insufficient services for livelihoods. These issues are the ultimate causes of poverty among the community in the Study area. Thus, from the perspectives of improvement of income, improvement of living conditions; and sustainable use of natural resources, the following approaches, as summarized in Table 4.1.1, will be adopted to solve problems in the areas of agriculture, livestock, post harvest processing, irrigation, watershed management and living environment.

The approach to each sector and counter measures mentioned in section 4.2 are made for 7 development zones based on conditions of present use conditions, water resources, locations, topography and others as follows:

1) PC23 irrigated area;

2) PC23 rainfed area;

3) Irrigated area of river basins of Sahamilahy river, Sahabe river and 4 small/medium rivers;

4) Upland field of river basins of Sahamilahy river, Sahabe river and 4 small/medium rivers;

5) Grass/ shrub area of river basins of Sahamilahy river, Sahabe river and 4 small/medium rivers;

6) Forest of Sahamilahy river, Sahabe river and 4 small/medium rivers and

7) The Study area

Table 4.1.1 Problems and approaches to problem solving: Agriculture and livestock

Area	Problem	Approaches to problem solving
Agriculture		
PC23area (irrigated area)	Delay of plowing/ puddling	Improvement of paddy productivity through 1) improvement of conventional production methods to improve quality of seeds and harvested paddy; 2) introduction of new paddy variety and improvement of cultivation methods
	Delay of seeding on nursery bed	
	Deterioration of quality of paddy seed	
	Differential operation of paddy culture due to various conditions of irrigation, drainage and fields	
	Difficult operation for application of pests and diseases	
	Poor agriculture extension services	
	Shortage of faming cost	
PC23area (rain fed area)	Shortage of irrigation water source	Diversification of agriculture income sources through introduction of appropriate variety for rain-fed paddy cultivation; of legumes for secondary cropping and of poultry farming
	Serious risk for rain fed crops cultivation	
River basins of Sahamilahy river, Sahabe river and 4 small/medium rivers (irrigated area and upland field)	Delay of plowing/ puddling	Improvement of cultivation technology of indigenous paddy variety and introduction of new variety and increase and diversify agriculture income source through double cropping, and poultry and fish farming.
	Difficult access to paddy field	
	Deterioration of quality of paddy seed	
	Poor technology for upland crops, vegetables and horticulture, farmer indifference for soil conservation technology	
	Shortage of farming cost	
	Difficult access to markets	
PC23 area	Delay of development of paddy seeds having early and medium ripening characteristics and upland rice varieties with drought and wet resistance	Enhancement of research and extension system to select the high potential paddy varieties
Livestock		
Study area	The number of livestock, especially cattle is not increased.	Selection of fodder grass and tree varieties suitable to the given environment Developing methods to establish grass land with the newly selected varieties to provide fodder
Study area	Low income of farmers	Promotion of small livestock or poultry (broiler) which can be maintained with low cost Identification and development of market in the surrounding area

Source: JICA Study Team

Table 4.1.2 Problems and Approaches to problem solving: Post harvest processing and irrigation

Area	Problems	Approaches to Problem solving
Post harvest processing		
Study area	Lack of agricultural market information	Dissemination of market price information to the producers concerning the main agricultural products and farm input collected by DRDR of Alaotra/ Mangoro regions Improvement of existing means of dissemination
Study area	No advantageous income of paddy in the lean period	Construction of storage to maintain the paddy for sale before next harvesting Introduction of a credit system to meet the living expenses of the farmers in order to allow them to sell the paddy at its highest price
Sahabe River basin	Shortage of rice mill	Improvement of the system to provide post harvest processing service (Introduction and management of mobile rice mill)
Irrigation		
PC23 area (Irrigated area)	Decrease of intake discharge for irrigation	Stable supply of irrigation water
	Decreases of carrying capacity of irrigation canal	Efficient uses of limited available water sources
	Insufficient irrigation water distribution to secondary/ tertiary area	Improve on-farm irrigation method
	Lack of irrigation water to the paddy field and improper water distribution	Implement systematic irrigation and drainage activities
	Inefficient use of limited irrigation water	
	Local inundation in paddy field and inspection roads	
	Impassable condition on the secondary/ tertiary inspection road along drains and hindrance of transportation of commodities	
	Deterioration of on-farm facilities for irrigation and drainage	Extension of appropriate irrigation technology
	Incomplete O&M for on-farm facilities by farmers' group and farmers themselves	Restructuring of water management system
PC23 area (Rain-fed area)	Rain-fed paddy due to incomplete irrigation system	Appropriate land use
	Local inundation during the rainy season	
	Insufficient land leveling	
	Decrease of function of operation road for irrigation canal	
	Grazing land used on the agricultural land	

Area	Problems	Approaches to Problem solving
Sahamilahy River・Sahabe River・4 small/ mid and small rivers	Unstable supply of irrigation water	Stable supply of irrigation water
	Decrease of irrigation efficiency	
	Poor growth of paddy and decreasing yield of paddy due to delay of transplanting time at drought year	Extension of appropriate irrigation technique
	Insufficient technical extension services on design of facility and construction	
	No organization that is in charge of O&M of the irrigation facilities on the basis of river basin	Restructuring and enhancement of water management system

Source: JICA study team

Table 4.1.3 Problems and approaches to problem solving: Watershed management and living environment

Area	Problems	Approaches to Problem Solving
Watershed management		
Sahamilahy River・Sahabe River・4 mid and small river basins	Lack of proper watershed management activities	Enhancement of watershed management capacity
	Fire for forest and shrub/ grass lands	Prevention of forest fire
	Soil erosion from the river basin	Recovery of vegetation
		Soil conservation
Living environment		
Study area	Low income and stagnant economic activities	Establishing social infrastructures to improve income
	Lack of basic living environment	Creation of healthy living environment
	Overconsumption of forest resources	Reduced loads on environment

Source: JICA Study Team

4.2 Countermeasures based on the Approaches

4.2.1 Countermeasures in Agriculture sector

(1) Countermeasures for improving paddy productivity

In PC 23 irrigated area, countermeasures to solve sluggish paddy yield through increasing paddy productivity were developed.

1) In the short term, deterioration of quality of MK34, the main indigenous variety, shall be dealt with. In order to improve the seed paddy quality, the selection of matured paddy shall be carried out at the farm household level using salt water while the regular renewal of the certified seeds is encouraged. Quality of seed paddy and contamination by the foreign varieties and plants shall be avoided. Currently, direct sowing or random transplanting without weeding are commonly practiced in the Study area. Such practices have caused seed contamination and, therefore, should be replaced by regular transplanting to enable weeding with a push weeder in order to

prevent contamination of the seeds and improve paddy quality to be sold in the market.

2) In the mid term intervention, the rice production system, which is currently unable to cope with climate change, shall be altered. A production system using tested new varieties and early and mid maturing varieties shall be developed. Farmers shall be encouraged to introduce newly developed production system. However, such transformation requires on-farm management of production and that of water. Therefore, prior to the on-farm application of the new production system, irrigation drainage system shall be improved and water users' association restructured. When extending the new production system, key farmers in the area shall be mobilized to establish and manage demonstration plots for disseminating the production technology using newly selected variety.

3) Low land productivity is among the issues to be dealt with in the mid term. In the PC 23 irrigated area, efficient use of the land could contribute to improve the household income. In order to realize higher efficiency in land use, double cropping system using haricot bean and other legumes, which can maintain the soil fertility of the paddy field and also suits the local diet, as a second crop in combination with and mid-maturing paddy varieties can be developed and disseminated.

Basing on the above discussion, countermeasures to improve paddy productivity to solve the problem of low paddy yield in the PC 23 irrigated area were developed. The outline of the countermeasures is presented in Table 4.2.1.

(2) Countermeasures to promote diversification of agricultural income sources in PC 23 rain fed area

In PC 23 rain fed area, countermeasures to solve issues associated with farm management faced by the farmers through diversification of agriculture income sources were developed.

1) In the short term, risks caused by rain fed farming to farm management shall be minimized. At present, farm income source is heavily dependent on crop production. In order to minimize the risks posed by the climate change, it needs to be diversified by introducing other productive activities through effective uses of unused land within the commune in the PC 23 rain fed area. Firstly, fruit tree planting in the backyard garden and establishment of a communal poultry cage can be introduced. In the mean time, farmers who participate in income diversification activities shall be organized as a group. Such groups shall also be helped to acquire legal status as an organization. Opportunities to learn from the experience and knowledge of the farmers in other parts of the country where similar attempts were made shall also be created.

2) In the mid term, low productivity of the rain fed production shall be resolved. Changes in the rain fall have increased the risks of the damage caused by the soil moisture contents, inundation and submergence upon rain fed crops. In order to minimize such risks, the crops and cropping systems shall be selected based on the land use plan suitable for the narrowly divided land by the contour lines which shall be developed in the irrigation sector. The plots under constant inundation during the rainy season shall be used as rain fed paddy plots while other plots which are not could be used as upland or grazing land. The land located between these two types of lands could be divided into two uses of dry paddy plots or upland. In the rain fed plots, double cropping of paddy and haricot beans can be grown. In the mid range plots, drought and moisture resistant paddy or upland rice can be grown. In the upland, mixed planting of leguminous grass and maize without plowing can be introduced.

Basing on the above points, to solve problems of farm management in the PC 23 rain fed area; countermeasures for diversification of agriculture income sources (PC 23 rain fed area) were developed. The description of the countermeasures is provided in Table 4.2.1.

(3) Countermeasures to diversify farm income sources in the upper stream of irrigated area

In order to solve problems in farm management faced by the farmers in the paddy areas located in the upper and mid basins of each river, countermeasures to promote diversification of farm income source were developed.

1) In the short term, risks of farm management posed by the limited size of farm plots shall be resolved. The paddy fields located in the upper and mid basins of each river are not maintained after the paddy production during the rainy season until the production season of the following year. Therefore, the unused land can be effectively put into use to diversify income sources though implementing the following measures. The extension of a second crop as well as rehabilitation of the drainage system will be carried out. Furthermore, in order to use land resources other than farm plots, fish ponds can be constructed where perennial water source is available. Mid and small size livestock sheds can also be constructed in the unused land nearby homesteads. Producers groups can also be organized in order to market their produce. Their organizational capacity building shall also be supported. Study tour to other areas in the country where the diversification of the farm income has been successful. This is expected to create opportunities for the farmers to learn from each other concerning knowledge and skill in enterprise selection, production and marketing.

2) In the mid term, low productivity of paddy and upland crops will be dealt with. A thermosensitive high potential variety shall be introduced. This will also require

alteration in production technology. Upland farming shall introduce non-plowing farming technology, contour farming technology, fencing technology, which could contribute to land conservation. Further, in order to increase land productivity, a multiple cropping system or mixed cropping can be implemented while the application of organic mattes to the farm plots is promoted.

Considering the above points, in order to resolve the issues of farm management in the paddy areas located in the areas of mid and upper river basins, countermeasures to diversify agricultural income through promotion of diversification of agriculture income sources (upper and mid river basins of each river) were developed. The outline of the countermeasures is presented in Table 4.2.1.

(4) Countermeasures to enhance research and extension system

Countermeasures to solve common problems in paddy production found in the entire study area through strengthening the research and extension system were developed.

As a first step, a few varieties will be selected among the ones that are tested in breeding plots of FOFIA regional agricultural research centre of CALA ad that can satisfy the farmers' needs and increase the yield of paddy and straw. The selected varieties will be tested at the experimental plots established in the PC 23 irrigated area for comparing the varietal characteristics at least for the duration of 3 years. The field trial will be done both by transplanting and direct sowing methods. The plots shall be established where accessible to collect results for statistical processing. The experiment will be designed according to the standard of the centre. Transplanting and direct seeding for the field trial will be done in the beginning of December, January and February.

2) Secondly, two of the high potential varieties will be selected based on the varietal characteristics comparison experiment at the experimental field. These two varieties shall be tested for practical use at the on-farm level. Conventional planting technology practiced by the farmers shall be improved. In the improved planting method, agro chemicals and chemical fertilizers will not be used as a principle. This trial will be conducted as a demonstration which will be established on a rented paddy field along the National Route 3a.

3) Thirdly, as a result of the on-farm level trial, thermosensitive a mid-maturing variety which is acceptable to the farmers will be selected. The government will then begin certified seed multiplification while compiling technical guidelines for the use of the farmers on how to cultivate the new variety.

4) For upland rice, a variety having higher resistance to drought and moisture than the recommended variety of B-22 should be looked for. The second crop after paddy

shall be selected among the high potential crops as well as the possibility of double cropping of paddy. However, the above mentioned trial shall gain the priority.

Basing on the above discussion, in order to solve low paddy productivity, which has been the common problem across the Study area, countermeasures in research and an extension of a new variety and high potential crops via enhancing the research and extension system were developed. The contents of the countermeasures are presented in Table 4.2.1.

Table 4.2.1 Countermeasures and components in agriculture

Countermeasures	Components
Improvement of paddy productivity (PC23 irrigated area)	- Introduction and extension of appropriate production technology and high potential paddy varieties - Introduction and extension of double cropping of paddy - Introduction and extension of second crop other after paddy - Improvement of paddy quality - Development of winter crop (haricot beans) market
Promotion of diversification of agriculture income sources (PC23 rain fed area)	- Introduction of second crop after paddy - Introduction of fruits trees and poultry farming - Development of winter crop (haricot bean) market - Legalizing and developing capacity of Farmers' organization - Study tour to the area where similar interventions are carried out successfully
Promotion of diversification of agriculture income sources (Irrigated area in upper and mid basin of Sahamilahy, Sahabe and 4 small/medium rivers)	- Extension of second crop after paddy - Introduction of high potential paddy variety - Introduction of poultry and fish farming - Training on market development - Study tour to the advanced farming areas
Extension of improved upland farming (Upland field in upper and mid basin of Sahamilahy, Sahabe and 4 small/medium rivers)	- Establishment of a research and extension committee - Implementation of field experiments - Training of the staff concerned
Strengthening the research and extension system for new variety and high potential crop (PC23 irrigated area)	- Implementation of various field experiments on paddy and upland crops - Research on double cropping of paddy - Development of paddy production system under large scale irrigation system - Conducting field workshops inviting the local farmers for discussion - Development and dissemination of research report and technical guidelines

Source: JICA Study team

4.2.2 Countermeasures for livestock sector

(1) Countermeasure to develop methods to establish pasture land to supply high nutrition fodder

Countermeasures to develop methods to establish pasture land to supply high nutritional fodder crop were developed in order to solve the problems of livestock nutrition faced by the cattle farmers in the Study area.

1) To start with, experiments on pasture grass and fodder trees shall be conducted to

assess their suitability to the soil and climate in the area and collect primary data. These experiments shall be conducted jointly with FOFIFA regional agriculture research centre of CALA.

2) In the beginning, 20 pasture grass and 10 fodder tree varieties will be selected among the 300 varieties being tested by the center for the purpose of preservation of the variety.

3) In the second stage, trial plots will be established in multiple locations reflecting the local topographic and soil conditions. In these experimental plots, the pre-selected varieties will be tested for long term. The best suited varieties will be identified basing on the results of the experiments.

4) While the long term variety tests are being conducted, methods to develop construction methods for pasture land will be tested. Various methods such as plowing or non-plowing methods will be tested for improving the fodder production and soil conservation. Based on the results, standardized participatory pasture land development methods applicable to the land condition will be finalized.

5) When transforming the degraded grass land into pasture land, cooperation and participation of the large scale livestock farmers are essential. Therefore, sensitization and training will be conducted for them.

Basing on the above, in order to solve the livestock nutrition problems faced by the cattle raising farmers in the Study area, the countermeasures to conduct research on developing methods to establish pasture land to provide high nutritional fodder and fodder grass production were developed. The outline is presented in Table 4.2.2.

(2) Countermeasures for introducing small livestock

In the Study area, countermeasures to solve low income faced by the small scale farmers by introducing small livestock were developed.

1) A group shall be organized by about 20 women in order to effectively utilize the labor force of rural women.

2) A meat broiler poultry farm shall be established on a demonstration basis. Considering the size of the group, the manageable size of the enterprise is 400 broilers to be kept for 8 weeks to a weight of 2 to 2.5 Kgs and to be sold at the local market.

In order to solve the problem of low income among the small scale farmers in the Study area, countermeasures to promote diversification of agricultural income sources through demonstration of income source diversification (poultry farming) were developed. The

outline is presented in Table 4.2.2.

Table 4.2.2 Countermeasures and components for livestock

Countermeasures	Components
Research on developing methods of pasture land establishment and fodder production（upper and mid river basin of Sahamilahy, Sahabe and 4 small/medium rivers）	- Experiment to select the most suitable fodder grass and trees - Experiment on construction methods on participatory pasture land development - Training on innovative farmers
Promotion of diversification of income source (poultry farming) (Study area)	- Organizing women's groups - Trainings on organizational management and technique for the women's group - Construction of poultry farm - Provision of feed and vaccine

Source：JICA Study team

4.2.3 Countermeasures for post harvest processing sector

(1) Countermeasures for dissemination of agricultural market information

Countermeasures to resolve the problem of the market price of the farm produce in the Study area through improvement of dissemination methods of agriculture market information were developed.

1) The information on farm inputs and agricultural produce collected by the government shall be disseminated through radio.

2) A regional agriculture committee shall establish a broadcasting center jointly with Alaotra Mangoro regional DRDR in order to disseminate information to the farmers who are remote and scattered without access to electricity.

3) Not only the agricultural market information, other relevant information, such as farming technology, incidences and prevention of pests and diseases, sensitization towards prevention of forest and wild fire and its status when it occurs, and announcement from the government, shall also be broadcasted.

Basing on the above points, countermeasures to develop agriculture information broadcasting centre was developed in order to resolve the problems associated with market prices of farm produces in the Study area. The outline of the countermeasure is presented in Table 4.2.3.

(2) Countermeasures to sell paddy between crop seasons

In the study area, farmers face difficulties in storing the paddy until the high market price season. The countermeasures to resolve such problems were developed to enable them to sell paddy between the crop seasons.

1) A grain credit system which takes a group of 20 members as a client shall be designed. The group members will have a collective responsibility to repay the loan.

2) In this system, each member farm household will save 2 tons of paddy. The government will give credits to the group members up to 70% of the prices of paddy in storage with the monthly interest of 2% with 6 months repayment period. The government will establish a grain fund for the purpose.

3) In the Alaotra riparian area, the price of a paddy increases by approximately 40% before harvesting in the year of average yield. Once the grain bank becomes operational, the loaner should be able to earn the annual cost of managing the grain storage and revolve the grain funds while the member farmers can gain larger profits even after the interests incurred during the borrowing period compared to what they earned by selling the yield immediately after the harvest.

Based on the above, to resolve the problem of the low profit margin of paddy sales, countermeasures to establish a paddy bank system to enable farmers to sell produce between the crop seasons targeting the area along the National Route 3a where the existing public grain storage facilities can be used. The outline of the countermeasures is presented in Table 4.2.3.

(3) Countermeasures for strengthening the post harvest processing service system

In the upper basin of Sahabe River, countermeasures to resolve the problems faced by the community without sufficient access to milling facilities through strengthening the post harvest processing service system were developed.

1) Milling with charge will be provided in Soalazaina and Besakay by the commune or DRDR or any other public organization.

2) Providing these selected communes will consume approximately 220,000 tons of paddy a year and 50% of the amount to be milled. Considering the economic efficiency, 3 mobile milling machines with a capacity of 1.6 ton/ hr shall be introduced. The mobile milling service team will provide the service in each commune with 10 day interval.

From the above, in order to resolve the issue of the shortage of milling factories in the two selected communes located in the upper basin of Sahabe River, countermeasures to introduce mobile milling machines were developed in order to strengthen post harvest processing services system. The outline of the countermeasures is presented in Table 4.2.3.

Table 4.2.3 Countermeasures for post harvest processing and components

Countermeasures	Components
Establishment of agricultural information broadcasting center (Improvement of means of dissemination of agriculture market information: Study area)	- Establishment of small scale broadcasting station - Procurement of broadcasting equipment and computers - Development of broadcasting programme - Training for agriculture committee and DRDR officers
Introduction of paddy bank system for marketing of paddy between crop seasons: (Areas along National Route 3a)	- Establishment of farmers' groups - Training for farmers' groups - Creation of grain funds
Introduction and management of mobile milling machine for improvement of post harvest processing service system: (Sahabe River basin)	- Purchasing of mobile milling machine - Training on management of mobile milling machine

Source: JICA Study Team

4.2.4 Countermeasures for irrigation sector

(1) Countermeasure to stabilize the supply of irrigation water

In the PC 23 irrigated area and irrigated paddy fields located in the mid and upper stream areas of Sahamilahy River, Sahabe River and four other mid and small size rivers, irrigation water has not been supplied constantly due to the damage or malfunctioning of the intake structure. In order to resolve such problems, countermeasures were developed to achieve a stable irrigation water supply.

1) In order to provide a stable supply of irrigation water to the PC 23 irrigated area, rehabilitation of Sahabe temporary head works, Sahamilahy intake structure and collector canal of four mid and small rivers will be conducted. By this, siltation shall be prevented and the planned intake irrigation water volume can be supplied to the scheme.

2) In order to secure irrigation water to be supplied to the irrigated area of upper and mid basins of Sahamilahy River, Sahabe River, and four mid and small rivers, semi permanent intake structures, for which maintenance is rather straight forward, will be constructed with the farmers' participation using gabion and wet masonry works. Where the existing ponds are used as a water source, reserved water volume will be increased by building higher weirs.

Taking the above points into consideration, in order to resolve irrigation water shortages in the irrigated paddy plots located in the PC 23 irrigated area and in the upper and mid river basins of Sahamilahy River, Sahabe River and 4 mid and small rivers, countermeasures to rehabilitate intake facilities in PC 23 irrigated area and to provide stable irrigation waters supply to the upper and mid river basins of each river were developed. The contents of the measures are summarized in Table 4.2.4.

(2) Countermeasures for effective use of the limited available water resources

Until the full scale rehabilitation works of intake facilities in the PC 23 irrigated area are carried out, countermeasures are developed to resolve the irrigation water shortage in the paddy plots in the lower tertiary bock by making effective use of the limited available water resource.

1) Approximately 2,500 ha will be expected to experience irrigation water shortage in the tertiary command area of PC23 irrigated area. Thus, temporary water re-uses and supply system will be newly established to harvest the water from the drainage canal and to supply irrigation water in the multiple locations within the affected area.

2) Farmers will be organized into groups within each command areas to carry out O&M of the temporary water re-use system.

Basing on the above, in order to resolve the shortage of irrigation water in the PC 23 irrigated area temporarily, countermeasures to reuse drainage water to effectively utilize the limited available water resources were developed. An outline of the countermeasures is presented in Table 4.2.4.

(3) Countermeasures for systematic irrigation drainage activities

In the irrigated area of PC 23 area, irrigation water is not supplied sufficiently in every cropping season due to the damage or malfunctioning of the secondary and tertiary irrigation and drainage canal facilities. Farmers have cut the maintenance road for the irrigation and drainage canal in order to open the canal without permission to obtain irrigation water. This has hindered the traffic during the rainy season. In order to resolve such problems, the countermeasures to implement the systematic irrigation and drainage activities were developed.

1) Irrigation water shall be distributed to the 4,600ha of northwestern part of PC 23 irrigated area as planned via Sahamilahy River intake structure and P1 main canal receiving water from north collector canal intake for 4 mid and small rivers. In order to do so, irrigation water must be secured by rehabilitating structures of P1 main canal, 23.2km of main canal, 10.5km of north collector canal, 16.7km of secondary canal, 70.6km of tertiary canal. 41.2km of main drainage canal, 104.9km of tertiary canal should also be rehabilitated in order to improve the drainage function in the area. Rehabilitation of irrigation and drainage canal system shall be carried out as part of the rehabilitation works of the Sahamilahy gate and north collector canal.

2) Southwestern side of PC 23 irrigated area occupying 3,200ha receives water from P5 main canal linked to Sahabe temporary headwork. In this area, the secondary canal of C5.6 system command area, which has lost its function, requires urgent work. Rehabilitation works are also required for 5.5 km of secondary canal, 4.0 km of

tertiary canal, 6.0km of tertiary drainage canal in the area. Rehabilitation of irrigation canal and drainage canal system will be carried out as part of the rehabilitation of Sahabe temporary headworks and construction of energy dissipating basin in order to stabilize irrigation water supply.

3) In order to improve the transportation within the area, access road to the PC 23 area and maintenance road of main canal and D2 main drainage canal passing through the centre of the area shall be extended up to 4.5 km while maintenance and rehabilitation works will be carried out. Coupled with above mentioned rehabilitation works of secondary and tertiary canals and tertiary drainage canal, approximately 40km of maintenance road will be rehabilitated.

Considering the above points, in order to resolve the issues of irrigation water distribution and transportation during the rainy season in the PC 23 irrigated area, the countermeasures to carry out the systematic irrigation and drainage activities were developed. An outline of the countermeasures is presented in Table 4.2.4.

(4) Countermeasures for improving on-farm irrigation methods

In the PC23 irrigated area, inefficient uses of irrigation water was partly caused by the lack of maintenance of tertiary irrigation and drainage canal and insufficient leveling of the plots which should be carried out by the farmers themselves. In order to resolve such issues, countermeasures to improve on-farm level irrigation methods were developed.

1) In the P5 main canal command area of PC 23 irrigated area, model rehabilitation works of the irrigation plots to introduce water saving irrigation technology will be carried out at the farmers' plots who are keen on rehabilitation of on-farm irrigation and drainage facilities. Similar works shall be extended through farmer to farmer extension in the surrounding areas. This countermeasure shall be carried out as part of the rehabilitation works of tertiary irrigation and drainage canal.

2) Where the re-use of drainage water is introduced, farmers will be responsible for maintaining the irrigation and drainage canal at the on-farm level.

Basing on the above, in order to resolve the inefficient use of irrigation water use at the on farm level in the PC 23 irrigated area, countermeasures to improve field level irrigation methods through rehabilitation of the on-farm irrigation and drainage facilities were developed. An outline of the countermeasures is presented in Table 4.2.4.

(5) Countermeasure for enhancing water management

In PC 23 irrigated area and paddy fields located in the upper and mid river basin of Sahamilahy River, Sahabe River, and four mid and small rivers, management of irrigation and drainage facilities has been nearly abandoned. Therefore, the government has not carried out appropriate water management at the scheme. Level while the farmers have not done so

at the on-farm level. Therefore, countermeasures to enhance water management were developed to resolve such issues.

1) Following activities will be carried out in order to enhance the PC 23 area irrigation office under DRDR of Alaotra Mangoro region: 1) Increasing the number of staff for the irrigation office; 2) Carrying out maintenance and repair of the maintenance equipments; 3) Conducting training including OJT for the government officers on planning of management of irrigation and drainage facilities.

2) The capacity of farmers shall be developed through organizing farmers into water users' association which should also obtain legal status. Training on organizational management, management of irrigation facilities, and value adding activities shall also be carried out.

Basing on the above, to resolve the no clear definition of the O&M responsibilities in the PC 23 irrigated area and irrigated paddy areas in mid and upper basins of Sahamilahy river, Sahabe river and 4 mid and small rivers countermeasures to strengthen the management of the irrigation system through improved water management were developed. An outline of the countermeasures is indicated in Table 4.2.4.

(6) Countermeasures for appropriate land use

Farmers in the eastern half of PC 23 area will not be able to receive irrigation water until the rehabilitation of the existing irrigation and drainage facilities in the upper stream area is completed. Therefore, countermeasures to resolve the fluctuating yield of rain fed crops were developed from the appropriate land use point of view.

1) The following tasks shall be carried out in order to develop a land use and rehabilitation plan: investigation on the level of submergence and subsidence due to insufficient drainage, a detailed inventory of the existing irrigation faculties, re-estimation of the available irrigation water in the PC 23 areas, a detailed technical study and analysis on rehabilitation of the irrigation facilities, survey on farmers' views on land use and rehabilitation of the scheme.

2) Based on the above plan, irrigable plots will be identified. Countermeasures to provide stable irrigation water and rehabilitation of irrigation and drainage will be carried out in these plots following the rehabilitation of irrigation and drainage canals in the PC 23 irrigated areas.

3) Plots in the area identified as non-irrigable will be categorized in to three categories; 1) plots under constant inundation during the rainy season; 2) plots without inundation during the rainy season; and 3) plots with occasional inundation. Considering these land conditions, appropriate rain fed crops will be selected.

Based on the above, in order to resolve the unstable yield of rain-fed crop, which has been the problem of the farmers in the PC 23 rain fed area, countermeasures to develop appropriate land use plan in the PC 23 rain fed area for appropriate land use were developed. An outline of the countermeasures is presented in Table 4.2.4.

(7) Countermeasures for appropriate irrigation technology and extension

Countermeasures were developed from the perspective of irrigation technology and its extension to resolve the issues of delayed development of technology to improve paddy yield by minimizing the irrigation water and farm input in the PC 23 irrigated area and irrigated paddy areas in the mid and upper river basins of Sahamilahy River, Sahabe River and 4 mid and small rivers.

1) Leveling of the paddy field shall be carried out to enable intermittent irrigation and shallow water irrigation in the plots where farmers' group will apply regular transplanting.

2) Field extension activities on water saving irrigation and paddy cultivation technology shall be carried out.

In order to solve the problem of delays in introduction of water saving irrigation technology in the irrigated paddy fields in the Study area, countermeasures were developed for extension of appropriate irrigation technology. The countermeasures were summarized in Table 4.2.4.

Table 4.2.4 Countermeasures and Components for Irrigation

Countermeasures	Components
Rehabilitation of intake structures in PC 23 area (Stable irrigation water supply for the PC 23 area: PC23 irrigated areas)	- Rehabilitation/ heightening of head works, construction of intake gates and a settling basin in P5 system (Sahabe) - Rehabilitation of Sahamilahy existent intake gate and north collector canal structures
Rehabilitation of intake structures in upper and mid river basins (Stabilize irrigation water supply in the irrigated area in upper and mid basins in Sahamilahy, Sahabe and 4 small/medium rivers: irrigated area located in the upper and mid basins of each river)	- Demarcation of irrigation area - Rehabilitation of intake structures/ main drainage canal and irrigation ponds - Improvement of irrigation facilities carried out by the farmers
Reuse of drainage water (Efficient use of limited available water resources: PC23 irrigated area)	- Construction of small division boxes in tertiary drainage canal - Rehabilitation of existing check gates or construction of new ones in tertiary canal - Establishment of farmers' organizations for of water re-use - Develop capacity of farmers' organizations on O&M of water re-use facilities
Rehabilitation of irrigation and drainage system	- Rehabilitation of main irrigation, drainage and other related facilities

Countermeasures	Components
(Implementation of systematic irrigation and drainage activities: PC23 irrigated area)	- Rehabilitation of irrigation/ drainage 2nd and 3rd canal - Rehabilitation of O&M roads along 2nd /3rd irrigation canal and main drainage canal - Rehabilitation of access roads and canal maintenance roads
Rehabilitation of on-farm irrigation and drainage facilities (Improvement of on-farm irrigation methods: PC23 irrigated area)	- Improvement of on-farm facilities of the core farmers - Extension of rehabilitation of on-farm facilities by the farmers
Enhancement of O&M of irrigation system (Strengthening of the water management system: PC23 irrigated area and irrigated areas in upper and mid basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	- Employment of additional government officers responsible for operation and maintenance - Training for government officers on planning and techniques on operation and maintenance - Procurement of operation and maintenance equipment - OJT on O&M of irrigation facilities - Legalizing Water Users' Association and establishing its office - Training for members of Water Users' Association on organizational management, O&M techniques and value adding activities
Development of appropriate land use plan for PC 23 rain-fed area (Appropriate land use: PC23 rain-fed area)	- Development of draft land use plan and design - Survey on farmers' intention - Conduct workshops based on the draft land use plan - Development of detailed land use plan - Development of area rehabilitation plan basing on the land use plan
Extension of appropriate irrigation technology (PC23 irrigated area and irrigated areas in upper and mid basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	- Establishment of organization to extend appropriate irrigation technique - Training for newly joined farmers - Farmers training conducted by core farmers - Monitoring by the responsible government offices

Source: JICA Study team

4.2.5 Countermeasures for watershed management sector

(1) Countermeasures to improve capacity for watershed management

In the Study area, appropriate watershed management, mainly forest resource management and land conservation has not yet been carried out. To resolve the problems, countermeasures were developed to improve the capacity for watershed management.

1) In order to carry out appropriate watershed management, mostly forest resource management and land conservation in the large basin areas in the Study area, active participation of the community members is indispensable. When mobilizing the community for the purpose, the following two points are critical in the success of the process. First, community organization shall be established as a main actor of the participatory watershed management. Second, a partnership based on the trust shall be nurtured between the community organizations and the government. Since the activities of watershed management activities in the Study area can be many, a forest association will be established to organize and supervise the individual

committees for each corresponding watershed management activity. The association will be registered, following the appropriate procedure with the relevant office, in order to acquire legal status in order for them to carry out the activities with equal status as the government. On the other hand, in order to enable the forest association to take the initiative in the forest management and sustainable use of forest resources with community participation, community members will be organized into groups. The by-laws and activity plan of such groups shall be developed. Their status shall be legalized and their organizational management capacity developed. These will contribute to develop the capacity of the community to carry out watershed management. The target area includes all the villages located in the Sahamilahy River, Sahabe River, four mid and small river basins.

2) In order to improve the function of natural forests and to conserve soil and forest resources, conservation of the remaining natural forests in the most upper basins of each river will be promoted. A natural forest conservation committee will be formed under the forest association and this will carry out workshops for the users of the natural forest resources including the vested right holders to build consensus towards conservation of the natural forest. Based on this consensus, development of the conservation rules, establishment of a protected area, signs and notice boards to mark the border, establishment of protected area management system shall be carried out. The target area includes the villages along the Sahamilahy River and Sahabe River, where the remaining natural forests are found.

3) In order to improve income derived from the forest resources, beekeeping using natural tree varieties and man-made forest of eucalyptus will be introduced. Through the workshops, a beekeeping committee will be formed under the forest association. The committee will take the initiative in training beekeeping technology, procurement of the necessary equipment, and in the planting of flowers and trees. The target area includes the villages along Sahamilahy River and Sahabe River where the relict natural forests are located.

4) In order to strengthen the government capacity to support efficient implementation of participatory water and soil conservation activities, staff members of the local forestry office under MINENVEF responsible for watershed management will be trained in the expertise on the latest watershed management. Further, necessary equipment will also be provided in order to enhance the capacity of the offices. The target offices are Ambatondorazaka and Amparafaravola forestry offices which are responsible for the river basins in the Study area.

5) In order for the government to efficiently carry out watershed management,

monitoring of the basin environment shall be carried out using GIS. The recipient of the assistance will be DREEF of Alaotra Mangoro region under MINENVEF.

Basing on the above discussion, in order to resolve the issues of insufficient implementation of watershed management activities composed of forest resource management and soil and water conservation, 5 countermeasures were developed to develop the capacity to carry out watershed management. Each countermeasure is outlined in Table 4.2.5.

(2) Countermeasures to prevent forest fires

To resolve the rampant forest and wild fires in the study area, a countermeasure to prevent forest fires was developed.

1) Under the forest management association, a forest fire prevention committee will be established through workshops with the community members. The committee will establish a participatory forest fire prevention system jointly with the local forestry offices and commune. The target area includes all the villages along Sahamilahy River, Sahabe River and 4 mid and small rivers.

2) The committee will acquire the following assistance in capacity enhancement; necessary fire extinguishing equipments; training on the primary fire extinguishing activity; enhancement of the management of the fire prevention system; and maintenance of the equipment while conducting sensitization of the community towards fire prevention on the daily basis.

From the above, the countermeasure to prevent forest and wild fire was developed to resolve the rampant forest and wild fires which have caused chronic damage to forest and grass land in the Study area. An outline of the countermeasure is presented in Table 4.2.5.

(3) Countermeasures for soil erosion in the river basin

In the Study area, countermeasures on recovery of vegetation and soil conservation were developed to resolve the soil erosion from the upper basin, which has induced various problems in the lower basins.

Countermeasure for recovery of vegetation

1) Coupled with natural forest conservation, a buffer zone will be constructed in order to develop alternative resources to harmonize the users of the natural forest users including both vested right holders and community members and the intervention. Under the forest management association, a buffer zone development committee will be established through workshops. The committee will carry out identification of the buffer zone areas, production of tree seedlings, planting trees, and demarcation of the fire prevention zone. Training on RFR procedures and development of by-laws and organizational management capacity will also be

conducted. The target area includes the villages where the natural forest conservation measures are being implemented.

2) Surviving natural forests located in the most upper basins where the protection measures are not being implemented, recovery of the forest vegetation lost by the forest fire will be carried out so that they will form a continuous green corridor with the surrounding protected natural forests. Through the workshop, a committee for recovery of degraded natural forests will be formed. The committee will carry out the production of the seedlings, development and fostering of the supplementary natural forests, training on reforestation, and establishment of a corridor management system. The target area of the intervention includes the villages along Sahamilahy River and Sahabe River where the relict natural forests are found.

3) Community or school forests will be established in the surrounding areas of settlements in order to produce timber for communal use and develop awareness towards the recovery of forest resource among the community members. A community and school forest committee will be established under the forest management association. The committee will carry out production of seedlings, planting and nursing of trees, establishing fire prevention zones, technical training, and establishing the reforestation management system. Production of seedlings for school forests will seek active involvement of school children as part of their environmental education. The target area includes the villages having communal land in the grass land and bush along Sahamilahy River, Sahabe River and four mid and small size rivers.

4) Measures to recover the vegetation in the degraded grass lands and forests will be implemented in order to increase the supply of the fuel woods and to recover the function of land and water conservation. A committee for greenization of the degraded grass land will be established under the forest management association. Discussion and coordination with the land owners on the introduction of an RFR system, surveying of the planting area, production of seedlings, planting trees, setting fire prevention zones will be carried out by the committee. The target area includes land in the degraded grass land, which owner agreed would take part in the RFR system.

5) For the sustainable uses of forest resources and improvement of the villagers' income, measures to investigate forest products market will be carried out. A committee for forest product market survey will be established under the forest management association. The committee will carry out sensitization on improvement of forest products market survey and relevant training on survey techniques. The target area will be selected among the villages producing large

amount of fuel woods and forest products for market.

6) From the above, countermeasures to recover vegetation were developed to resolve the problems caused by soil erosion in the Study area. An outline of the countermeasures is presented in Table 4.2.5.

Countermeasures for soil conservation

Countermeasures to resolve soil erosion in the Study area through soil conservation were developed.

1) In the Study area, to minimize the soil erosion from the hilly areas and to create alternative source of income for the community, agriculture for soil conservation will be promoted through promotion of agroforestry. A committee to promote agroforestry will be established under the forest management association through workshops. Training on the technologies to support the planting of fruits trees, fodder trees and fertilizer trees and hedgerow will be carried out under the committee. The target area will be selected from the villages where the majority of the villagers are interested in introducing agroforestry to their own land.

2) In order for land conservation of the degraded grass land and securing the fodder of good quality to improve livestock nutrition in the Study area, silvopastoral will be introduced. A committee for introducing silvopastoral will be established under the forest management association. Training on introduction of good quality pasture grass and fodder trees, and establishment of grazing will be carried out. The target area will be selected from the villages having land in the degraded area and where the majority of the villagers are eager to produce fodder crops of high nutritional value or develop grazing area of better quality.

3) Soil erosion could also be minimized by stabilizing lavaka which are many and scattered in the mid basin of each river. Therefore, the measures to recover vegetation in lavaka will be implemented. Recovery of vegetation in lavaka will be independently established through workshops. For the active lavaka, which is currently losing soil, training on the development of forests by planning cuttings within lavaka and earth retaining works by piling up sand bags as well as greening technology for the lavaka downstream alluvial fan will be carried out. Intermediate lavaka for which vegetation is in recovery, the training on land conservation forest by planting eucalyptus, other beneficial trees and herbaceous plant species will be conducted.

Based on the above, in order to solve the soil erosion in the Study area, countermeasures for soil conservation were developed. The outlines of the countermeasures are presented in Table 4.2.5.

Table 4.2.5 Countermeasures and components for watershed management

Countermeasures	Components
Improvement capacity for watershed management	
Establishment of a forest management association and capacity development (Forest and grass/ shrub areas in upper and mid basins of Sahamilahy river and Sahabe river and 4 small/medium rivers)	- Establishment of a forest management association - Develop capacity of a forest management association
Conservation of natural forest (Forest in Sahamilahy and Sahabe River basins)	- Establishment of the natural forest conservation committee - Development of regulations on natural forest and awareness creation
Introduction of beekeeping (Forest and grass/ shrub areas in upper and mid basins of Sahamilahy river and Sahabe river and 4 small/medium rivers)	- Establishment of the beekeeping committee - Training onbee keeping
Capacity enhancement of local forestry offices (Study area)	- Training for the officers of the local forestry offices on the latest expertise - Provision of necessary equipment
Basin environment monitoring with GIS (all Study area)	- Development of GIS data base - Provision of necessary equipment to collect data on meteorology and hydrology - Training on officers concerned
Preventing forest fires	
Prevention of forest fire (each river basin)	- Establishment of a forest fire prevention committee - Improvement and training of forest fire prevention system
Recovery of vegetation	
Development of buffer zone (Sahamilahy and Sahabe River basins)	- Establishment of a buffer zone development committee - Support for RFR procedure
Recovery of degraded natural forest (Sahamilahy and Sahabe River basins)	- Establishment of a natural forest recovery committee - Enrichment planning and development of forest corridor
Development of community and school forest (Grass/ shrub areas in upper and mid basins of Sahamilahy river and Sahabe river and 4 small/medium rivers)	- Development of the community and school forests - Promotion of participation in tree planting activities to create community and school forests
Promotion of greenization of degraded grass lands (Grass/ shrub areas in upper and mid basins of Sahamilahy river and Sahabe river and 4 small/medium rivers)	- Establishment of a reforestation committee - Implementation of tree planting activities according to the RFR system
Market survey for forest products (Forest and grass/ shrub areas in upper and mid basins of Sahamilahy river and Sahabe river and 4 small/medium rivers)	- Sensitization on market information and survey methods - Establishment of the committee for market survey of forestry products

Soil conservation	
Promotion of agroforestry (Grass/ shrub areas in upper and mid basins of Sahamilahy river and Sahabe river and 4 small/medium rivers)	- Establishment of an agroforestry promotion committee - Training in agroforestry
Introduction of silvopastoral (Grass/ shrub areas in upper and mid basins of Sahamilahy river and Sahabe river and 4 small/medium rivers)	- Establishment of a committee to introduce silvopastoral - Establishment of demonstration silvopastoral plot
Recovery of vegetation in lavaka(Grass/ shrub areas in upper and mid basins of Sahamilahy river and Sahabe river and 4 small/medium rivers)	- Soil conservation through greenization of lavaka - Sensitization towards prevention of soil erosion of lavaka

Source：JICA Study Team

4.2.6 Countermeasures for Living environment sector

(1) Countermeasures for Living environment

In the study area, the majority of the villagers are affected by poverty. Thus, the countermeasures to tackle poverty by creating foundations to improve income were developed.

1) Responding to the needs of the local community, an access road linking the village and National Route 3 a will be rehabilitated to enable vehicle transport during the rainy season. The local community will take responsibility of maintenance of the access road after the rehabilitation. Therefore, a management association will be established by the local community members and its organizational management capacity will be developed. In order to avoid complicated and major maintenance works, the road will be constructed adopting unpaved compacted methods and ditches will be installed as appropriate.

2) Road improvement will be carried out in the following locations: access road in Sahamilahy river and four mid and small rivers (2km); access road in Mahatsinjo village (3 km); access road in Sahanidingana village in Sahabe basin (2km); access road in Mahakary village in PC 23 area (4 km) and local road linking National Route 44 and Soalazaina village via Tanambe-Besakay village (45km).

3) Rural electrification will also be implemented in order to revitalize the economic activities along National Route 3a. Morarano Chrome village, the centre of the local economy, will be the beneficiary village. A small scale hydro power generation plan will be constructed using the 30 m water fall of the Sahamilahy River which is 8 km away from the village. The electricity will be supplied both for the household and public uses in government offices, school, and dispensaries

as well as commercial uses in the milling workshops and shops. This will contribute to enhance local economic infrastructure. A hydro power generation plant with a generation capacity of approximately 200kW and power distribution facilities will be established.

Based on the above, to reduce the level of poverty in the area, countermeasures were developed to create infrastructure to increase income. An outline of the countermeasures is presented in Table 4.2.6.

(2) Countermeasure for securing healthy living environment

In the Study area, countermeasures to resolve the issue of insufficient access to basic needs were developed to ensure a healthy living environment.

1) The countermeasure to improve drinking water supply facilities will target 35 villages in the Study area where the quality and volume of drinking water are not suitable for drinking. The drinking water supply will be constructed as communally shared water point system. The water source can be a combination of well and hand pump or gravity water supply from the spring. The suitable method shall be selected according to the location. O&M of these facilities shall be conducted by the users themselves once they are constructed.

2) The drinking water supply facilities will be established in the 14 villages of Sahamilahy River and four mid and small river basins(Ambodifarihy, Morarano Ouest, Manakambahinikely, Antanimena, Morarano Chrome, Ambaibo, Tsaralaza, Andranobainga, Ambohidelahy, Maheriara, Antanimalalaka, Ambohimanarivo, Antanimafy, Ambodirano) and 13 villages of Sahabe basin (Ankasina, Fiadanana, Ambodiatafana, Ranofotsy, Moratelo, Vohitsoa, Mahatsara, Ambohimiarina, Ranomainty, Ambatobe, Soalazaina, Ambohimasina, Tanambato-Besakay) and 8 villages from and around PC 23 area (Anosyboribory, Ankoririka, Ambohidrony, Ambatomanga, Andrombaza, Antsapananefatra, Vohivola, Mahakary). The total beneficiary households are estimated to be 13,270 households of 72,200 persons.

3) Primary health care receives the first priority in the rural villages to prevent diseases. There are 9 villages which require urgent countermeasures. In these villages, women's groups for primary health care will be established and be supported by being registered as a legal entity. The groups will be trained in first aid and uses of basic medicines for diarrhea and malaria. The access to nearest medical facilities and access to relevant information will also be secured. Training on preventative measures for common diseases and on sales of basic medicines; supply of basic medicines; and monitoring and follow-up of the activities shall be provided.

4) The beneficiary villages for village health and sanitation improvement include 3 villages from Sahamilahy River and four mid and small river basins (Antanimafy、Manakambahinikely、Maheriara) and four villages from Sahabe River basins (Ranofotsy、Sahanidingana、Soalazaina、Tanambao-Besakay) and two villages from PC 23 area (Ambohidrony、Mahakary). The total estimated number of beneficiaries is 4,130 households of 23,600 persons.

From the above, in order to resolve unmet basic needs, countermeasures to improve drinking water supply facilities and village health and sanitation were developed to secure a healthy living environment. The contents of the countermeasures are summarized in Table 4.2.6.

(3) Selection of the countermeasure to reduce the negative impacts on environment

In the Study area, countermeasures to minimize the burden on the environment were developed to resolve the excessive load on forest resources.

1) To reduce the drinking consumption of the fuel woods, the improved stove shall be introduced instead of the traditional stove using three stones. After assessing the natural and social condition of the areas, 10 villages will be selected to pilot the usability of the improved stove. Demonstration and training on production of the improved stove will be conducted.

2) The target areas of extension of the improved stove include 4 villages from the Sahamilahy River and four mid and river basins (Manakambahinikely、Maheriara、Antanimafy 、 Morarano Chrome), four villages from Sahabe River basin (Sahanidingana、Ranofotsy、Soalazaina、Tanambao-Besakay) and two villages of PC 23 area (Ambohidrony、Mahakary). The estimated number of total beneficiaries is at most 5,840 households of 33,900persons.

3) Sensitization towards forest conservation shall be conducted while the extension of the improved stove is conducted. In the future, such information is expected to be disseminated from the villagers to those in the remaining areas in the study area.

From the above, in order to reduce the pressure on the forest resources, countermeasures to promote the improved stove were developed, which reduces the burden on environment. The countermeasures are summarized in Table 4.2.6.

Table 4.2.6 Countermeasures and components for Living environment

Countermeasures	Components
Establishing bases for income generation	
Road improvement-I (Sahamilahy River and settlements in 4 mid and small river basins)	- Rehabilitation of the rural access road - Establishment of a village access road management committee and develop its capacity

Countermeasures	Components
Road improvement-II (Sahabe River settlements)	- Rehabilitation of the rural access road - Establishment of a village access road management committee and develop its capacity
Road improvement III (PC23area settlements)	- Rehabilitation of the rural access road - Establishment of a village access road management committee and develop its capacity
Rural Electrification (Sahamilahy river basin)	- Construction of the small scale hydro power generation plant and power distribution facilities - Establishment of a management committee for power generation and distribution facilities and development of its capacity
Securing healthy living environment	
Improvement of drinking water supply facilities I (Sahamilahy and 4 mid and small rivers)	- Rehabilitation of the drinking water supply facilities or construction of new ones - Establishment of a management committees for drinking water supply facilities and build their organizational capacity
Improvement of drinking water supply facilities II (Sahabe River basin)	- Rehabilitation of the drinking water supply facilities or construction of new ones - Establishment of a management committees for drinking water supply facilities and build their organizational capacity
Improvement of drinking water supply III (PC23 area)	- Rehabilitation of the drinking water supply facilities or construction of new ones - Establishment of a management committees for drinking water supply facilities and build their organizational capacity
Improvement of rural health and sanitation (9 settlements in the Study area)	- Establishment of primary healthcare groups for women and support for their management - Training on primary healthcare
Reducing the negative impacts on environment	
Extension of Improved stove (Study area)	- Demonstration of the improved stove - Training on production of the improved stove - Sensitization on forest conservation

Source：JICA Study Team

In this section, 41 countermeasures were developed to resolve problems encountered by the community in the Study area. These are comprised of; 5 measures in agriculture, 2 in livestock, 3 in post harvest processing, 8 in irrigation, 14 in watershed management, and 9 in living environment.

4.3 Selection of countermeasures for solving problems

Based on the present aid policy and practices of international and bilateral donor organizations operating in and around the Study area, the status of policy implementation by the government of Madagascar, investment by the private sector and lessons learned from the pilot projects, the following criteria were developed to categorize the 41 countermeasures as identified in Section 4.2. and to select the appropriate ones for further action.

1) Group A (Countermeasures which have already been implemented or are being implemented by donor organizations, the government of Madagascar or by the private sector): The countermeasures which have already been implemented by the

government of Madagascar are the establishment of an agricultural information broadcasting centre and village access road improvements under countermeasures for road improvement II. Concerning the former, Alaotra Mangoro District office has acquired a time slot from an existing FM broad casting station covering the Alaotra Mangoro area and organizations concerned disseminate the relevant information to the listeners on daily basis. Paddy bank system has already been implemented by the OTIV and CECAM as a part of micro credit services for farmers using the revolving fund of grant aid for promotion of food production (2KR) by the Japanese government. Introduction of a mobile milling machine has been partly met by the private sector. A private large scale milling factory established near the Study area provides paddy collection services for the farmers. Now the farmers can hand over the paddy to be sold around their settlement areas. Further, milling services with a charge for domestic consumption have been promoted as agribusiness in each village using the used small milling machines with a loan provided through OTIV or CECAM. Therefore, these interventions will be excluded from the necessary countermeasures under this watershed management and rural development plan.

2) Group B: (Countermeasures approved as donor programme or policy of the Government of Madagascar)

3) Countermeasures on road improvement I have already been approved by the Ministry of Public Works as part of the annual implementation programme based on the 10 year road development plan. Thus, these countermeasures are expected to be implemented by the programme using the government budget. Regarding rural electrification and improvement of drinking water supply facilities I – III, since most of the planned supply area of electricity and drinking water beneficiary area will be included in the plan under development having JIRAMA as an implementation agency and supported by UNDP. Therefore, these countermeasures can also be implemented by the plan supported by UNDP and will be excluded from this watershed management and rural development plan.

4) Group C: (Countermeasures which are learned to be unsuitable for implementation through the pilot projects) Countermeasures for forestry products market study will not be considered for implementation since no remarkable forestry produce except timber and fuel wood which domestic market channel has already been established. Further, countermeasures for rural road improvement under road improvement II will also be excluded from this watershed management and rural development plan since an alternative route to link the target area and National Route 3 has been developed which drastically shortens the distance to the capital Antananarivo compared to the initial plan.

5) Group D: (Countermeasures which are adjusted or newly added based on the lessons learned through the pilot projects) Countermeasures for demonstration of diversification of income sources (poultry farming) have been modified to goose farming instead of poultry. Countermeasures for developing the organizational capacity of forestry agency and basin environment monitoring using GIS will be transformed as a countermeasure to strengthen the fire prevention system for a wider area which corresponds to the restructuring of the local organizations of the Ministry of Environment, Water Conservation and Forestry and will be included in this watershed management and rural development plan.

6) Group E: Countermeasures which are necessary and included in this watershed management and rural development plan.

Countermeasures under Group A, B, and C were excluded from the development plan and those under Group D and E were included. As summarized in the Table bellow, 30 countermeasures were adopted. Sector wise, those are composed of 5 measures on agriculture, 2 on livestock, 0 on post harvest processing, 8 on irrigation, 13 watershed management and 2 on living environment.

Table 4.3.1 Selection of Countermeasures to solve problems

Sector	Countermeasures for problem solving	Pilot project	Group				
			A	B	C	D	E
Agriculture	Improvement of paddy productivity (PC23 irrigated area)						◎
	Promotion of diversification of agriculture income sources (PC23rain fed area)	◎					◎
	Promotion of diversification of agriculture income sources (Irrigated area in upper and mid basin of Sahamilahy river, Sahabe river and 4 small/medium rivers)	◎					◎
	Extension of improved upland farming (Upland in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)						◎
	Strengthening the research and extension system for new variety and high potential crops (PC23 irrigated area)	◎					◎
Livestock	Research on developing methods of pasture land establishment and fodder production (Grass/ shrub area in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)						◎
	Promotion of diversification of income source (goose farming) (Study area)					◎	
Post harvest	Establishment of agriculture information broadcasting center		◎				
	Introduction of paddy bank system		◎				
	Introduction and management of mobile milling machine		◎				
Irrigation	Rehabilitation of intake structures in PC 23 irrigated area						◎
	Reuse of drainage water (Efficient use of limited available water resources: PC23 irrigated area)	◎					◎
	Rehabilitation of irrigation and drainage system (Implementation of systematic irrigation and drainage activities: PC23 irrigated area)						◎
	Rehabilitation of on-farm irrigation and drainage facilities (Improvement of on-farm irrigation methods: PC23 irrigated area)						◎
	Enhancement of O&M of irrigation system in PC23 irrigated area and basins of Sahamilahy river, Sahabe river and 4 small/medium rivers						◎
	Development of appropriate land use plan for PC 23 rain fed area						◎
	Extension of appropriate irrigation technology in PC23 irrigated area and basins of Sahamilahy river, Sahabe river and 4 small/medium rivers						◎
	Rehabilitation of intake structures in upper and mid river basins (Stabilize irrigation water supply in the irrigated area in upper and mid basins in Sahamilahy river, Sahabe river and 4 small/medium rivers)						◎

Sector	Countermeasures for problem solving	Pilot project	Group				
			A	B	C	D	E
Watershed management	Establishment of forest management association and capacity development (Forest and grass/ shrub area in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	◎					◎
	Prevention of forest fires (Forest in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	◎					◎
	Conservation of natural forest (Forest in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	◎					◎
	Development of buffer zone (Forest in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	◎					◎
	Introduction of bee keeping (Forest and grass/ shrub area in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)						◎
	Recovery of degraded natural forest (Forest in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)						◎
	Promotion of agroforestry (Forest and grass/ shrub area in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	◎					◎
	Development of community and school forest (Forest and grass/ shrub area in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	◎					◎
	Introduction of silvopastoral (Grass/ shrub area in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)						◎
	Recovery of vegetation in lavaka (Grass/ shrub area in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)	◎					◎
	Promotion of greenization of degraded grass lands (Grass/ shrub area in basins of Sahamilahy river, Sahabe river and 4 small/medium rivers)						◎
	Market survey for forest products (Study area)				◎		
	Capacity enhancement of local forestry offices (Study area)					◎	
	Basin environment monitoring with GIS (Study area)					◎	
Living environment	Road improvement Plan I (Upper and mid basins of Sahamilahy river)			◎			
	Road improvement Plan II (Upper and mid basins of Sahabe river)				◎		
	Road improvement Plan III (PC23 area)						◎
	Rural Electrification (Upper and mid basins of Sahamilahy river)			◎			
	Improvement of drinking water supply facilities I (Upper and mid basins of Sahamilahy and 4 small/medium rivers)			◎			
	Improvement of drinking water supply II (Upper and mid basins of Sahabe river)			◎			
	Improvement of drinking water supply III (PC23 area)		◎				
	Extension of improved stove (Study area)						◎

Source：JICA Study team

4.4 Implementation Schedule and Target Areas

Based on the priorities given in each sector (the details are attached as attachment 4.1, priorities of development.), all the countermeasures were categorized into three types: those which require urgent implementation; those to be implemented in the mid term and those to be implemented in the long term. Further, considering various envisaged conditions considered while selecting the countermeasures based on the problem solving approaches, target areas for each countermeasure were identified. The implementation schedule and target areas are presented in Table 4.4.1.

Table 4.4.1 Implement schedule and target area

Sector	Counter measures	Implementation area	Implementation period		
			Immediate	Mid term	Long term
Agriculture	Improvement of paddy productivity	PC23 irrigated area		▲	⋯
	Promotion of diversification of agriculture income sources (PC23rain fed area)	PC23 rain fed area	▲	⋯	⋯
	Promotion of diversification of agriculture income sources (PC23each river basin)	Upper and mid basins of each river*	▲	⋯	⋯
	Extension of improved upland farming	Upper and mid basins of each river		▲	⋯
	Strengthening the research and extension system for new variety and high potential crop	All the study area	▲	⋯	⋯
Livestock	Research on developing methods of pasture land establishment and fodder production	Upper and mid basins of each river		▲	⋯
	Promotion of diversification of income sources (poultry farming)	All the settlement areas in the study area		▲	⋯
Irrigation	Rehabilitation of intake structures in PC 23 area	PC23 irrigated area	▲	⋯	⋯
	Rehabilitation of intake structures in upper and mid river basins	Irrigated areas in upper and mid river basis of each river	▲	⋯	⋯
	Reuse of drainage water	PC23 irrigated area	▲	⋯	⋯
	Rehabilitation of irrigation and drainage system	PC23 irrigated area		▲	⋯
	Rehabilitation of on-farm irrigation and drainage facilities	PC23 irrigated area		▲	⋯
	Enhancement of O&M of irrigation system	All the irrigated areas in the study area		▲	⋯
	Development of appropriate land use plan for PC 23 rain fed area	PC23 rain fed area	▲	⋯	⋯
	Extension of appropriate irrigation technology	All the irrigated areas in the study area			▲ ⋯
Watershed management	Establishment of forest management association and capacity development	River basin of each river	▲	⋯	⋯
	Prevention of forest fire	River basin of each river	▲	⋯	⋯
	Conservation of natural forest	Shamilahy river, Sahabe river basins	▲	⋯	⋯
	Development of buffer zone	Shamilahy river, Sahabe river basins		▲	⋯
	Introduction of bee keeping	River basins of each river		▲	⋯
	Recovery of degraded natural forest	Shamilahy river・Sahabe river basins			▲ ⋯
	Promotion of agroforestry	River basins of each river	▲	⋯	⋯
	Development of community and school forest	River basins of each river		▲	⋯
	Introduction of silvopastoral	River basins of each river			▲ ⋯
	Recovery of vegetation in lavaka	River basins of each river	▲	⋯	⋯
	Promotion of greenization of degraded grass lands	River basins of each river			▲ ⋯
	Capacity enhancement of local forestry offices	All the study area		▲	⋯
	Basin environment monitoring with GIS	All the study area			▲ ⋯
Living environment	Road improvement Plan III	PC23 area settlement area		▲	⋯
	Extension of improved stove	All the settlement areas in the study area	▲	⋯	⋯

Note: ▲ ; Implementation period, ⋯ ; Continuous implementation of counter measures

*: Upper and mid basins of Sahamilahy river, Sahabe river and 4 small/medium rivers (Total area that irrgation water source for PC 23 area depends on.)

Source: JICA study team

4.5 Assessment of environmental impact associated with the implementation of countermeasures

4.5.1 Environmental Impact Assessment System in Madagascar

(1) Laws and system concerning the environment

The following laws and systems concerning the environment are enforced in Madagascar.

1) Laws concerning Environment Charter (No. 90-033)
2) Government ordinance on authority and organization of Ministry of Environment (No. 98-962)
3) Government ordinance on establishment of National Environment Secretariat (No. 95-607)
4) Government ordinance on harmonization of development and environment (No. 99-954)
5) Ministerial ordinance on area vulnerable to environmental changes (No. 4355/97)
6) Law concerning regional management of renewable natural resources (No. 96-025)
7) Government ordinance on mitigation of environmental dispute (No. 2000-028)
8) Government ordinance on security of real estate (No. 98-610)
9) Ministerial ordinance to regulate civic participation in the environment assessment (No. 6830/2001)
10) Government ordinance concerning authority and organization of Ministry of Environment, flood control and Forestry (No. 2003-100)
11) Government ordinance on river basin management (No. 2003- 940)
12) Government ordinance on management, monitoring and priority use of water resources for drinking water (No. 2003- 941)

(2) Environmental Impact Assessment System in Madagascar

In Madagascar, two organizations share responsibilities of administering environment. The Ministry of Environment, Flood Control and Forestry is responsible for environment management. The National Environment Secretariat, which is independently established of the Ministry, deals with environmental impact assessment.

Environmental impact assessment system and the procedures to be carried out by the implementing agency are defined by the Government Ordinance concerning the harmonization of development and environment (No. 99-954/ MECIE) based on the Law concerning Environment Charter (No. 90-33/10). The ordinance enforces the submission of

EIA or PREE according to the type and scale of the project and vulnerability of the potential project location by development projects both by private and public investment which may negatively affect the environment.

The attached tables I and II of MECIE show the type and scale of projects requiring EIA or PREE. Table 4.5.1 shows the watershed management and rural development project or programme required of EIA or PREE.

Table 4.5.1 Conditions requiring EIA in Madagascar

Sector	Nature of Development	Type of Development	Conditions require PREE		Conditions require EIA	
Forestry	Clearing	New	(Size of the clearing area) 150 ha and above	(Volume of trees clearing)	(Size of the clearing area) 500 ha and above	(Volume of trees cleared)
	Construction of Forest road	New	*****		All	
		Rehabilitation	Paved road: 20 km and above Unpaved road: 30 km and above		*****	
	Development of Man made forest	New/ Rehabilitation	Reintroduction of original variety		Introduction of variety to the new area	
Agriculture	Irrigation	New/ Rehabilitation	200 ~ 1,000 ha		1,000 ha and above	
	Drainage	New/ Rehabilitation	200 ~ 1,000 ha		1,000 ha and above	
	Farmland development	New/ Rehabilitation	200 ~ 1,000 ha		1,000 ha and above	
	Land reclamation by drainage	New/ Rehabilitation	200 ~ 1,000 ha		1,000 ha and above	
	On-Farm development	New/ Rehabilitation	200 ~ 1,000 ha		1,000 ha and above	
	Settlement	New	*****		500 persons and above	
	Construction of Dam	New	(reservoir area) 200 ~ 500 ha	(Storage capacity)	(reservoir area) 500 ha and above	(Storage capacity)
		Rehabilitation	(reservoir area) 200 ~ 500 ha	(Storage capacity)	(Reservoir area) 500 ha and above	(Storage capacity)
	Conversion of farming	New	Re-introduction of the originally grown variety/ species		Introduction of new variety/ species	
	Livestock	New	Semi commercial or small scale production		Commercial or intensive production	
Others	Hydropower plant	New	50 ~ 150 MW Inundation area : 200～500 ha		150 MW and above Inundation area: 500 ha and above	
	Extraction of ground water with pump	New	*****		30 m^3/hr and above	

Note：*****; No PREE or EIA is required.

Source：Government order for harmonisation of development and environment (No. 99-954)

EIA procedure indicated by MECIE is summarized in Table 4.5.2. The procedures involve

six steps of 1) screening; 2) scoping; 3) impact survey; 4) establishment of technical assessment committee and environment impact assessment based on the MECIE; and 5) supervision of environment mitigation measures and monitoring survey; and 6) environment audit.

Table 4.5.2 Outline of the proceadure of Environemtn Impact Assessment

Project Implementation stage	EIA procedure	Contents
Planning	Screening	Confirmation of legally required conditions Collections of relevant information
Pre FS	Scoping	Review of the potential environmental impact induced by the project Review of the nature of the project
FS	Survey on environmental impact	Projection of potential impacts Analysis and Assessment of scale and importance of the main items to be investigated Identification of mitigation measures
Writing up of EIA report and EIA by the government	Establishment of technical assessment committee and EIA based on MECIE	Analysis of technical and legal compliance Analysis of available data, logic and relevance Assessment by the technical assessment committee members (Field reconnaissance) Writing up of technical assessment report Issuance of the results of assessment by the Ministry of Environment (Environmental approval and requirements)
Implementation	Supervision of environment mitigation measures and monitoring survey	Implement environmental conservation and mitigation measures Implement alternative mitigation measures Prevention of pollution and monitoring
End of mid term evaluation	Environment auditing	Accumulation of lessons for the future projects Environment auditing Issuance of certificate of audit by the Ministry of Environment

Source: EIA, National Environment Secretariat

Article 11 of MECIE indicates that the contents of the EIA report shall include the following six items: 1) land registry document of the project area; 2) type of project and outline of techniques used; 3) analysis of environmental aspects which are and possibly are affected by the project; 4) prospects of the potentially affected environmental aspects; 5) PREE and 6) outline of the project.

Article 29 of MECIE states PREE should include a plan to prevent pollution and monitoring as summarized in Table 4.5.3.

Table 4.5.3 Items to be included in PREE

Items	Contents
Plan for Preventing pollution	- Requirement and obligation of the project with reference to environmental laws and system - Smooth project implementation plan, appropriate operation methods, and any foreseen accident and countermeasures and their methods

Items	Contents
	- Pollution preventative measures and methods - Risk assessment, prevention, protection and security measures - Contracting in carrying out mitigation measures against project impacts - Implementation schedule of mitigation measures - Regular submission of reports on environmental conservation and monitoring to the organizations concerned (Ministry of Environment, National Environment Secretariat and others)
Plan for Environment monitoring	- Selection of environmental monitoring items (project activities and aspects of environments) - Monitoring plan and methods to monitor most vulnerable monitoring items - Necessary survey and methods of analysis - Environment Monitoring schedule - Countermeasures to cope with accidents; coordination of mitigation measures and pollution preventative measure; alteration of management plan as necessary - Name of the implementer and frequencies of publish monitoring results and methods of dissemination

Source: EIA, National Environment Secretariat

(3) Need to apply EIA in Madagascar

As discussed above, EIA or PREE is required in Madagascar depending on the scale of the project and vulnerability of the project area with regard to the environment (Table 4.4.1). Therefore, in the proposed interventions in this report, components of irrigation, livestock, and rural road shall be subject to PREE or EIA.

4.5.2 Initial Environmental Evaluation (IEE) for the selected countermeasures

(1) Interventions to be assessed by the IEE

The study team has carried out scoping adopting the JICA guidelines on environmental impact. Based on the results of scoping, IEE was conducted with the proposed countermeasures of development of man-made forest, nursery, agroforestry, irrigation and drainage, farm conversion, rural roads, drinking water supply, hydro power generation, and introduction of improved stoves.

(2) Outline of the potential environmental impacts

Based on the IEE checklists in the JICA guideline, the level of impacts induced by the project on the following environmental aspects were assessed.

1) Social environment : social and economic activities, health and sanitation, and cultural heritage

2) Natural environment : fauna, ecosystem, soil, land, hydrology and water quality

The results of IEE showed the possible impacts by the project as discussed bellow.

1) Re-negotiation of forest users' rights : When natural forest protection is underway, renegotiation of access and uses of the forests shall be necessary with the vested right holders of the forest resource. Through consultation with the local leaders (i.e.

village chief), it should be determined whether it is necessary to implement alternative measures. When applying the RFR system in order to reforest the degraded grass land, those who plant the trees may differ from the land owners. In such cases, considering the diversity of land tenure system in Madagascar, discussions and consultations shall be carried out among the stakeholders concerned, including government offices.

2) Countermeasures to increased poultry wastes: As part of the diversification of agriculture income, poultry farming is proposed to be introduced. Poultry farming often produces a bulk of wastes. Appropriate treatment is required in disposing of poultry waste. Since the farmers had traditionally applied cow dung to maintain the land fertility, application of chicken manure can also be promoted as a fertilizer for farming and feed for fisheries.

The following impacts are expected against the natural environment.

1) Impact on fauna and flora: Indigenous fauna and flora are only found in the extant natural forests located in the most upper basin of each river. However, they are under the threats posed by the burning of the field and illegal clearing of the forest areas. Natural forest conservation and forest fire prevention measures will positively influence such degrading conditions since biosphere of the wild plants and animals will be protected as appropriate. For reforestation, eucalyptus and grevillea will be used mostly for their fast growing and high survival rates. On the other hand, in the long run, tree varieties shall be diversified. In terms of the Road improvement, village access road is to rehabilitate the surface of the existing road which is of a short distance while local roads in the upper Sahabe River basin and the existing maintenance road to be rehabilitated are entirely located in the pine man-made forest. Therefore, the impact on the living environment of the indigenous fauna and flora is expected to be minimal. However, it is suggested for the latter work that an appropriate construction method be selected.

2) Impact on soil erosion: Soil erosion is often driven from lavaka located in the mid basin of the river where Migmatite soil structure is found and from the degraded grass land which is widespread through the basin. The suggested preventive measures will reduce the level of siltation in the down stream of the river as well as inside the irrigation canals. If the road improvement works may induce soil erosion, slope protection work like sodding should be carried out.

3) Impact on ground water : Beneficiary areas of drinking water supply in the upper and mid river basin and PC 23 area are located on the inclined area. A bore hole or remotely located spring will be used as water sources. Therefore, it is expected to be less likely to be affected by the pollution caused by the ground absorbing waste

treatment. However, the users shall be well educated on the sanitary issues when sharing water points. On the other hand, in the settlements in the PC 23 area, there is a high possibility that human and livestock waste may have contaminated shallow ground water. Therefore, it is essential for them to monitor and manage the water quality of the water points on a daily basis.

4) Impacts on hydrology: Rehabilitation of irrigation facilities may cause impacts on volume of surface running water and ground water level. However, the proposed rehabilitation works intend to maintain the current location and capacity of the facility while newly constructed facilities and structures are at small scale. Therefore, such impacts after the rehabilitation and construction works are expected to be minor. The fishermen catch fish in the Alaotra Lake, rivers and irrigation canals in the study. However, catching fish in the irrigation canal is prohibited by law. Therefore, despite the possibility of negative impacts on the fishermen in the irrigation canal by the temporary blocking of water; they will not be compensated for their loss.

5) Impacts on water quality: Water quality of the rivers flowing into Alaotra Lake may deteriorate due to the countermeasures implemented in agriculture, livestock, fisheries, and irrigation. This may threaten the living environment of fish species. Thus, the appropriate water quality monitoring shall be considered. Since farmers do not use agro chemicals at the moment and the proposed countermeasures will not introduce their use, the contamination of the water shall not be caused by the implementation of interventions for agriculture. However, highly toxic 2, 4, and D are available around the Study area and therefore, uses of agrochemicals by individual households shall be carefully monitored.

(3) Summary of Initial Environment Assessment

As above, the impacts of planned interventions upon environment are considered to be low. However, if the interventions are to be implemented in the entire study area the following environmental concerns may emerge. Thus, the environmental protection programme shall be developed and implemented taking these points into consideration.

1) Impacts on river basin environment through diversification of agriculture income

2) Impacts on hydrology and water quality by establishing drinking water supply facilities

3) Impacts on fauna and flora in the forest by the upgrading of the road network

EXPLANATION NOTE 4-1

Necessity prioritization procedures for counter measures for problem solving in development

NECESSITY PRIORITIZATION PROCEDURES FOR COUNTER MEASURES FOR PROBLEM SOLVING IN DEVELOPMENT

1 General

Necessity prioritization for proposed counter measures for problem solving in the development sectors is determined according to the following procedures.

(1) Setting evaluation indicators for necessity prioritization for proposed counter measures

(2) Preparing numerical evaluation criteria for evaluation indicators

(3) Calculating overall score

(4) Setting criteria of three necessity prioritization grades; (i) immediate term, (ii) mid term and (iii) long term

(5) Determination of necessity prioritization grade based on calculated overall score

2 Agriculture sector

2.1 Setting evaluation indicators

Thirteen evaluation indicators for necessity prioritization for proposed counter measures for problem solving in the agriculture sector are set as follows:

(1) Contribution to PRSP

(2) Contribution to objects of this Study

(3) Strengthening research works

(4) Increasing capacity of governmental staff in CIRAPV

(5) Increasing unit yield of paddy

(6) Improvement of farming practices for small scale farmers

(7) Improvement of quality of rice

(8) Demonstration effects

(9) Accord with needs of rural peoples

(10) Time required for implementation

(11) Overlapping to the existing project (or countermeasures)

(12) Risk on enlargement of the gap between rich and poor

(13) Environmental affects

2.2 Results of necessity prioritization grade

The numerical evaluation criteria for necessity prioritization for the proposed counter measures consist of 5 grades giving 5 points at maximum and 1 point at minimum. The overall score is calculated at each counter measure. The grade for necessity prioritization is determined based on the following grade criteria as follows:

- Grade I (65-57 points in overall score)、Grade II (56-50 points in overall score)、Grade III (49-13 point in overall score)
- Grade I (Immediate term), Grade II (mid term) and Grade III (long time for implementation)

The results are shown in table 2.1

Table 2.1 Results of necessity prioritization for counter measures (Agriculture sector)

Counter measures / Evaluation indicators	Extension of improved upland farming (upland field in upper and mid basin of each river)	Improvement of paddy productivity (PC23 irrigated area)	Promotion of diversification of agriculture income sources (PC23 rain fed area: second crops after paddy, horticulture, poultry, etc)	Promotion of diversification of Agriculture income sources (irrigated area in upper and mid basin of each river; second crops after paddy, poultry and fisheries, horticulture, etc)	Strengthening the research and extension system for new variety and high potential crop (the Study area)
1) Contribution to PRSP	5	5	5	5	5
2) Contribution to objects of this Study	5	5	5	5	5
3) Strengthening research works	5	4	4	4	2
4) Increasing capacity of governmental staff in CIRAPV	3	4	4	4	4
5) Increasing unit yield of paddy	2	5	5	5	5
6) Improvement of farming practices for small scale farmers	4	4	4	5	4
7) Improvement of quality of rice	3	5	5	5	3
8) Demonstration effects	3	4	5	5	5
9) Accord with needs of rural people	4	5	5	5	5
10) Time required for implementation	3	3	4	4	5
11) Over lapping to the existing project (counter measures)	5	5	5	5	5
12) Risk on enlargement of the gap between rich and poor	4	3	3	3	4
13) Environmental affect	4	4	4	3	5
Overall score	50	56	58	58	57
Grade for necessity prioritization					

Source：JICA study team

The numerical evaluation criteria for necessity prioritization for the proposed counter measures consist

of 3 grades giving 3 points at maximum and 1 point at minimum. The overall score is calculated at each counter measure. The grade for necessity prioritization is determined based on the following grade criteria as follows:

- Grade I (15-14 points in overall score)、Grade II (13-10 points in overall score)、Grade III (9-1 points in overall score)
- Grade I (Immediate term), Grade II (mid term) and Grade III (long time for implementation) for implementation

The results are shown in table 3.1

Table 3.1 Results of necessity prioritization for counter measures (livestock sector)

Counter measures / Evaluation indicators	Research on developing methods of pasture land establishment and fodder production (grass and shrub land in upper and mid river basin of each river)	Promotion of diversification of income sources (poultry farming) (all settlements in the Study area)
1) Degree of desire of farmers for implementation of counter measures	2	2
2) Contribution to improvement of farming practices for farmers	3	3
3) Scale of investment cost for counter measures	2	2
4) Time required for implementation for counter measures	3	1
5) Negative impacts	3	3
Overall score	13	11
Grade for necessity prioritization	II	II

Source：JICA study team

4 Post harvest processing Sector

4.1 Setting evaluation indicators

Five evaluation indicators for necessity prioritization for proposed counter measures for problem solving in the post harvest processing sector are as follows;

(1) Degree of desire of farmers for implementation of counter measures

(2) Contribution to improvement of farming practices for farms

(3) Scale of investment cost for counter measures

(4) Time required for implementation of counter measures

(5) Negative impacts

4.2 Results of necessity prioritization grade

The numerical evaluation criteria for necessity prioritization for the proposed counter measures consist of 3 grades giving 3 points at maximum and 1 point at minimum. The overall score is calculated at each counter measure. The grade for necessity prioritization is determined based on the following grade criteria as follows:

- Grade I (15-14 points in overall score)、Grade II (13-10 points in overall score)、Grade III (9-1 points in overall score)
- Grade I (Immediate term), Grade II (mid term) and Grade III (long time for implementation) for implementation

The results are shown in table 4.1

Table 4.1 Results of necessity prioritization for counter measures (Post harvest processing sector)

Counter measures / Evaluation indicator	Establishment of agriculture information broadcasting center (improvement of means of dissemination of agriculture market information: (All settlements in the Study area)	Introduction of paddy bank system for marketing of paddy between crop seasons (Areas along National Route 3a)	Introduction and management of mobile milling machine for improvement of post harvest processing service system: (Sahabe river basin)
1) Degree of farmer's desire for implementation of counter measures	2	3	2
2) Contribution to improvement of farming practices for farmers	3	1	1
3) Scale of investment cost for counter measures	3	2	1
4) Time required for implementation of counter measures	3	2	3
5) Negative environmental impact	3	3	3f
Overall score	14	11	10
Grade for necessity prioritization	I	II	II

Source：JICA study team

5 Irrigation sector

5.1 Setting evaluation indicators

Six evaluation indicators for necessity prioritization for proposed counter measures for problem solving in the irrigation sector are set as follows:

(1) Basic counter measures for irrigation activities should have higher prioritization: rehabilitation and/or new construction of irrigation water supply facility takes precedence of that of on farm irrigation and drainage facility.

(2) Basic counter measures for implement of other counter measures have higher prioritization (for

example plan of irrigation system can not be conducted without appropriate land use plan in the rain fed land in PC23 area)

(3) Shorter time required for a preparatory woks and easiness of construction

(4) Faster realization of benefit from the counter measures

(5) Having function required for performing other counter measures safely and continuously

(6) Easiness of integration of the other sectors for implementation

5.2 Results of necessity prioritization grade

The numerical evaluation criteria for necessity prioritization for the proposed counter measures consist of 3 grades giving 3 points at maximum and 1 point at minimum. The overall score is calculated at each counter measure. The grade for necessity prioritization is determined based on the following grade criteria as follows:

- Grade I (18-10 points in overall score)、Grade II (9-8 points in overall score)、Grade III (7-6 points in overall score)

- Grade I (Immediate term), Grade II (mid term) and Grade III (long time for implementation) for implementation

The results are shown in tables 5.1, 5.2 and 5.3.

Table 5.1 Results of necessity prioritization for counter measures (PC23 irrigated areas)

No.	Counter measures	Evaluation factor						Overall score	Grade for necessity
		A	B	C	D	E	F		
1	Re-use of drainage water	1	1	3	3	1	1	11	I
2	Rehabilitation of intake structures in PC23 irrigated areas	3	3	1	1	1	1	10	I
3	Rehabilitation of irrigation and drainage system	2	2	1	1	1	1	8	II
4	Rehabilitation of on-farm irrigation and drainage facilities	1	1	1	1	2	2	8	II
5	Enhancement O&M of irrigation system	1	1	1	1	3	2	9	II
6	Extension of appropriate irrigation technology	1	1	1	1	1	2	7	III

Table 5.2 Results of necessity prioritization for counter measures (PC23 rain fed areas)

No.	Counter measures	Evaluation indicators						Overall score	Grade for necessity prioritization
		A	B	C	D	E	F		
7	Development of appropriate land use plan for PC23 rain fed area	3	3	1	3	1	1	11	I
(3)	Rehabilitation of irrigation and drainage system	1	2	1	1	1	2	8	II
(4)	Rehabilitation of on farm facilities and enhancement of O&M irrigation system	1	1	1	1	2	2	8	II
(6)	Extension of appropriate irrigation technology	1	1	1	1	1	2	7	III

Table 5.3 Results of necessity prioritization for counter measures (Irrigated areas in upper and mid basins in each river)

No.	Counter measures	Evaluation indicators						Overall score	Grade for necessity prioritization
		A	B	C	D	E	F		
8	Rehabilitation of intake structures in upper and mid river basins	2	2	2	1	2	1	10	I
(4)	Rehabilitation of on farm facilities and enhancement of O&M irrigation system	1	1	1	1	2	2	8	II
(6)	Extension of appropriate irrigation technology	1	1	1	1	1	2	7	III

6 Watershed management sector

6.1 Setting evaluation inidicators

Evaluation indicators for necessity prioritization for proposed counter measures for problem solving in the watershed management sector are seven evaluation indicators for forest and six for soil conservation of lavaka as follows;

Table 6.1 Evaluation indicators for watershed management

Forest	Soil conservation of lavaka
1. Protection and conservation for natural forests	1. Higher necessity of faster implementation of counter measures
2. Land and water conservation	2. Possibility of implementation of counter measures only by local people
3. Continuous use of forest resource	3. Higher incentive for farmers' participation for the project
4. Higher incentive for farmers' participation for the project	4. Shorter construction time

5. Higher necessity of faster implementation of counter measures	5. Protection and conservation for natural resources
6. Access to performance of implementation counter measures	6. Effects for control of soil disasters and soil erosion
7 . Easiness on access to land for implementation of counter measures	

6.2 Results of necessity prioritization grade

The numerical evaluation criteria for necessity prioritization for the proposed counter measures consist of 3 grades giving 3 points at maximum and 1 point at minimum. The overall score is calculated at each counter measure. The grade for necessity prioritization is determined based on the following grade criteria as follows:

(a) Forest

- Grade I (21-19 points in overall score)、Grade II (18-16 points in overall score)、Grade III (15-7 points in overall score)

- Grade I (Immediate term), Grade II (mid term) and Grade III (long time for implementation) for implementation

(b) Soil conservation of lavaka

- Grade I (18-16 points in overall score)、Grade II (15-13 points in overall score)、Grade III (12-6 points in overall score)

- Grade I (Immediate term), Grade II (mid term) and Grade III (long time for implementation) for implementation

The results are shown in tables 6.2 and 6.3

Table 6.2 Results of necessity for counter measures (forest)

	Counter measures	Evaluation indicators							Overall score	Grade for necessity prioritization
		1	2	3	4	5	6	7		
1	Establishment of forest management association and capacity development (each river basin9	3	3	3	3	3	3	3	21	I
2	Prevention of forest fire (each river basin)	3	3	3	2	3	3	3	20	I
3	Conservation of natural forest (Sahamilahy and Sahabe river basins)	3	3	3	2	3	2	3	19	I

4	Development of buffer zone (Sahamilahy and Sahabe river basins)	3	3	3	2	2	2	2	17	II
5	Recovery of degraded natural forest (Sahamilahy and Sahabe river basins)	3	3	2	1	2	1	2	14	III
6	Promotion of greenization devastated grass field	3	3	3	2	2	1	1	15	III
7	Development of community and school forest (all river basins)	3	2	3	2	2	2	2	16	II
8	Promotion of agro-forestry (all river basins)	2	3	3	3	3	2	3	19	I
9	Introduction of silvo pastoral (all river basins)	2	3	2	3	1	1	1	13	III
10	Introduction of bee keeping (all river basins)	2	2	3	3	3	2	3	18	II
11	Market survey for forest products (all river basins)	1	1	2	2	2	3	3	14	III
12	Capacity enhancement of local forestry offices (all study area)	3	2	2	1	2	3	3	16	II
13	Basin environment monitoring with GIS (all Study area)	2	2	3	1	3	2	1	14	III

Table 6.3 Results of necessity for counter measures (soil conservation of lavaka)

	Counter measures	Evaluation factor						Overall score	Grade for necessity prioritization
		1	2	3	4	5	6		
1	Recovery of vegetation in lavaka (all river basins)	3	3	3	2	2	3	16	I

7 Living environment sector

7.1 Setting evaluation indicators

Evaluation indicators for necessity prioritization for proposed counter measures for problem solving in the living environment sector are set to be four evaluation indicators as follows;

(1) Degree of desire of local people for implementation of counter measures: Higher precedence is given to counter measures having higher degree of desire of local people

(2) Urgency of implementation of counter measures: Higher precedence is given to counter measures that satisfy basic needs for living environment and improve living environmental conditions.

(3) Implementation cost: Precedence is given to counter measures having lower implementation cost. Generally it is difficult to qualify the effects of counter measures for problem solving in living environment sector and internal rate of return is not always appropriate for evaluation.

Then the counter measures are evaluated by comparison of cost in view of easiness of implementation of counter measures.

(4) Contribution to reduction of poverty: Higher precedence is given to counter measures that effects are realized directly and in shortly.

7.2 Results of necessity prioritization grade

The numerical evaluation criteria for necessity prioritization for the proposed counter measures consist of 3 grades giving 3 points at maximum and 1 point at minimum. Details are shown in the following table. The overall score is calculated at each counter measure. The grade for necessity prioritization is determined based on the following grade criteria as follows:

Table 7.1 Criteria for necessity prioritization (living environment sector)

Evaluation indicators	criteria
i) Degree of desire of local people for implementation of counter measures *	3: Over 60% of local people desire counter measures as needs. 2: Over 40% of local people desire counter measures as needs. 1: Less than 40% of local people desire counter measures as needs.
ii) Urgency of implementation of counter measures	3: Counter measures are very important factors for basic needs or/and are urgently required to improve the present condition. 2: Counter measures are considered to be implemented with a long term view compared with urgent implementation of counter measures, but they are desired to be implemented early. 1: Basic needs are almost satisfied. Counter measures are required when necessity of development for living environment occurs in the future.
iii) Implementation cost	3: Counter measures with relatively lower implementation cost 2: Counter measures that require large scale of implementation cost with foreign loan having lending period of more than one year. 1: Counter measures that require larger scale of implementation with foreign loan having lending period of more than two years.
iv) Contribution to reduction of poverty	3: Counter measures that are considered that effects of reduction of poverty are realized within 2 years. 2: Counter measures that are considered that effects of reduction of poverty are realized within 3~5 years. 1: Counter measures that are considered that effects of reduction of poverty are realized within more than 5 years.

*: % of needs of local people is from the results of the detail village survey conducted by JICA study team

The overall score is calculated at each counter measure. The grade for necessity prioritization is determined based on the following grade criteria as follows:

- Grade I (12-11 points in overall score)、Grade II (10-8 points in overall score)、Grade III (7-4 points in overall score)

- Grade I (Immediate term), Grade II (mid term) and Grade III (long time for implementation) for implementation

Table 7.2 Results of necessity prioritization for counter measures (living environment sector)

Counter measures	Degree of desire of local people for implement ation of counter measures	Urgency of implement ation of counter measures	Implementatio n cost	Contribution to reduction of poverty	Overall score	Grade for necessity prioritization
	Point	Point	Point	point		
Road improvement-I (Sahamilahy river basin and 4 mid/small river basins)	2	2	1	2	7	III
Road improvement-II (Sahabe river basin)	3	2	1	2	8	II
Road improvement-III (PC23 area)	3	2	1	2	8	II
Rural electrification (4 mid/small river basins)	1	1	1	1	4	III
Improvement of drinking water supply facilities-I (Sahamilahy river basin and 4 mid/small river basins)	3	3	1	3	10	II
Improvement of drinking water supply facilities-II (Sahabe river basin)	3	3	1	2	9	II
Improvement of drinking water supply facilities-III (PC23 area)	3	3	1	2	9	II
Improvement of rural health and sanitation (8 settlement s in the Study area)	3	3	2		11	I
Extension of improved stove (Study area)	2	3	3	3	11	I

8 All development sectors

Counter measures for all development sectors are 41 in total. Necessity prioritization for proposed counter measures for problem solving in all the development sectors are summarized in the following table.

Table 8.1 Necessity prioritization for proposed counter measures for problem solving

Sector	Counter measures	Area	necessity prioritization for counter measures		
			immediate term	mid term	long term
Agriculture	Improvement of paddy productivity	PC23 irrigated area		; preparatory	; implementation
	Promotion of diversification of agriculture income sources	PC23 rain fed area	; preparatory	; implementation	
	Promotion of diversification of agriculture income sources	Irrigated area in upper and mid basin of each river	; preparatory	; implementation	
	Extension of improved upland farming	Upland area in upper and mid basin of each river		; preparatory	; implementation
	Strengthening research and extension system for new variety and high potential crops	Study area	; preparatory	; implementation	
Livestock	Resarch on developing methods of pasture land establishment and fodder production	Upper and mid river basin of each river		; preparatory	; implementation
	Promotion of diversification of agriculture income sources (poultry farming)	All settlements in Study area		; preparatory	; implementation
Post harvest processing	Establishment of agriculture information broadcasting center	All settlement in Study area	; preparatory	; implementation	
	Introduction of pady bank system for marketing of paddy	Area along the National road 3a		; preparatory	; implementation
	Introduction and management of mobile milling machine	Sahabe river basin		; preparatory	; implementation
Irrigation	Rehabilitation of intake structures	PC23 irrigated area	; preparatory	; implementation	
	Reuse of drainage water	PC23 irrigated area	; preparatory	; implementation	
	Rehabilitation of irrigation and drainage system	PC23 irrigated area		; preparatory	; implementation
	Rehabilitation of on-farm irrigation and drainage facilities	PC23 irrigated area		; preparatory	; implementation
	Enhancement of O&M irrigation system	All irrigated area in Study area		; preparatory	; implementation
	Development of appropriate land use plan for PC23 rain fed area	PC23 rain fed area	; preparatory	; implementation	
	Extension of appropriate irrigation technology	All irrigated area in Study area			; preparatory ; implementation
	Rehabilitation of intake structures in irrigated area in upper and mid basin of each river	Upper and mid river basin of each river	; preparatory	; implementation	
Watershed management	Establishment of forest management association and capacity development	Upper and mid river basin of each river	; preparatory	; implementation	
	Prevention of forest fire	Upper and mid river basin of each river	; preparatory	; implementation	
	Conservation of natural forst	Basins of Sahamilahy rive and Sahabe river	; preparatory	; implementation	
	Development of buffer zone	Basins of Sahamilahy rive and Sahabe river		; preparatory	; implementation
	Introduction of bee keeping	Upper and mid river basin of each river		; preparatory	; implementation
	Recovery of degraded natural forest	Basins of Sahamilahy rive and Sahabe river			; preparatory ; implementation
	Promotion of agroforestry	Upper and mid river basin of each river	; preparatory	; implementation	
	Development of community and school forest	Upper and mid river basin of each river		; preparatory	; implementation
	Introduction of silvopastral	Upper and mid river basin of each river			; preparatory ; implementation
	Recovery of vegetation in lavaka	Upper and mid river basin of each river	; preparatory	; implementation	
	Promotion of greenization of degraded grasslands	Upper and mid river basin of each river			; preparatory ; implementation
	Market survey for forest products	Upper and mid river basin of each river		; preparatory	; implementation
	Capacity enhancement of local forestry offices	Study area		; preparatory	; implementation
	Basin environment monitoring with GIS	Study area			; preparatory ; implementation
Living environment	Road improvement-I	Sahamilahy river basin and 4mid/small river basins			; preparatory ; implementation
	Road improvement-II	Sahabe river basin		; preparatory	; implementation
	Road improvement-III	PC23 area		; preparatory	; implementation
	Rural electrification	4mid/small river basins			; preparatory ; implementation
	Improvement of drinking water supply facilities-I	14 settements in 4mid/small river basins		; preparatory	; implementation
	Improvement of drinking water supply facilities-II	13 settlements in Sahamilahy river basin		; preparatory	; implementation
	Improvement of drinking water supply facilities-III	8 settlements in PC23 area		; preparatory	; implementation
	Improvement of rural health and sanitation	9 settlements in Study area	; preparatory	; implementation	
	Extension of improved stove	10 settlements in the Study ara	; preparatory	; implementation	

Remarks : ; preparatory ; implementation

Source: JICA study team

CHAPTER 5 VALIDATION OF COUNTERMEASURES THROUGH IMPLEMENTATION OF PILOT PROJECTS

5.1 Objectives and selection of pilot projects

5.1.1 Objectives of the pilot projects

As discussed in the previous chapter, 41 countermeasures were selected based on an analysis of problems faced by farmers in the study area in agriculture, livestock, post harvest processing, irrigation, river basin management and livelihood/social infrastructure. The technical effectiveness and feasibility of the activities are required to be validated to assess their contribution in resolving the identified problems. For this purpose, pilot projects were designed and implemented during the study period to assess the practicality and applicability of the identified interventions.

Five perspectives of relevance, effectives, efficiency, impact and sustainability constitute the framework of assessment of the countermeasures. These are defined as follows: the appropriateness of countermeasures in relation to the needs of beneficiaries (Relevance); the level of contribution to problem solving (Effectiveness); timing and effectiveness of input and alternative means (Efficiency); level of achievement in the long term, indirect, negative and positive economic impact (Impact); and sustainability of countermeasures from the technical, organizational, and financial perspectives (Sustainability). The practicality and adoptability will be assessed using the above framework. The result of the assessment shall be reflected in the implementation plan of countermeasures and development of a Master Plan.

5.1.2 Basic approach to the selection of pilot projects

Pilot projects were selected considering the following criteria, for countermeasures receiving higher priority as discussed in Chapter 4.

(1) Title Necessity of validation

In order to identify feasible and realistic solutions to the identified problems, countermeasures requiring the validation of technicality, type of required input of machineries and materials, methods of implementation, participation of beneficiaries are selected for the pilot project.

(2) Validation of coordination between upper and lower basins

When selecting the pilot project sites, the validation of coordination between the upper and lower basins with regard to basin management and rural development was considered. At

first, rivers supplying irrigation water to the PC 23 area were identified. Among these rivers, sites were selected considering the following points; the volume of supplied irrigation water and of silt delivered from the upper basins, urgency of soil and water conservation works; also that the area falls within one commune administratively. By these criteria, validation of the upper and lower basin coordination between Sahamilahy River, 4 mid and small rivers and PC 23 area was carried out during the pilot projects.

(3) Selection of beneficiaries

The pilot projects are implemented adopting a participatory approach in which success depends on the level of participation and collaboration by the beneficiaries. Therefore, the selection of the beneficiaries was carried out based on the following criteria.

1) Community members who are interested in participating in the pilot projects and willing to cooperate

2) Any existing local organizations for certain objectives in the community

3) Willingness to contribute land and other resources where tree planting, soil conservation and farm management activities are to be carried out as pilot projects

(4) Contribution to conservation of river basin

The countermeasures, which are expected to be effective in basin management through appropriate management of forest resources, will be implemented as pilot project irrespective of sector.

(5) Urgency and necessity

In Chapter 4, countermeasures have been selected in various technical areas and categorized into three based on the urgency of the implementation; urgent/ immediate, mid term and long term. In principle, the countermeasures to be implemented as pilot projects are selected among the ones categorized under urgent/ immediate, while some of the mid term interventions requiring validation are also included.

5.1.3 Selection of Pilot Projects

(1) Procedure of selection

The selection procedure of the pilot projects is discussed bellow while taking the criteria and basic approaches presented above into consideration. To note, consideration for selection of the beneficiaries was adopted when the project was set to be implemented and, therefore, is not discussed as part of the following procedure.

(2) Priorities considering the level of urgency and contribution to the river basin conservation

According to the level of urgency and contribution to the river basin conservation, scores were given separately for these criteria. The weighted total of each score was calculated (60% for urgency; 40% for contribution to problem solving). The definitions of the scores for each criterion are indicated bellow.

Score	Level of urgency to implement the countermeasures	Level of contribution to river basin conservation
3	The countermeasures identified as urgent/ immediate in each technical area	The effects of the countermeasures for river basin conservation can be direct or expected to be observed in the relative short term.
2	The countermeasures identified as mid-term in each technical area	The effects of the countermeasures for river basin conservation can be direct but may take longer to be observed.
1	The countermeasures identified as long term in each technical area	The countermeasures which may not have direct impacts but could contribute indirectly to basin conservation

(3) Relevance of Pilot Project

Once the above scoring for selection was done, feasibility, costs and relevancy of the possible pilot projects were assessed. The selected pilot projects by this assessment were implemented for validation.

(4) Selection of the pilot project sites

Potential pilot projects sites were selected before the commencement of the pilot projects. Since the validation of coordination between the upper and lower basins is required, the pilot project sites were selected in Sahamilahy River, and 4 mid and small river basins, and PC 23 area. However, the pilot project site could include the entire study area or Sahabe River basin depending on the nature of the pilot projects and those relevant to the localized problems,

(5) Results of the scoring

31 identified countermeasures, as discussed in Chapter 4, were assessed by giving scores using the 2 criteria of level of urgency and contribution to river basin conservation. Table 5.1.1. shows the results of this assessment.

Table 5.1.1 Results of Scoring according to the level of urgency and contribution to river basin conservation in each technical area

Sector	Countermeasures	Priority for implementation	Level of Urgency	Level of contribution	Total	Weighted total
Agriculture	Improvement of paddy productivity	Mid term	2	1	3	1.6
	Promotion of diversification of agriculture income sources (PC23 rain-fed area)	Urgent/ immediate	3	2	5	2.6
	Promotion of diversification of agriculture income sources (Each upper and mid river basin)	Urgent/ immediate	3	2	5	2.6
	Extension of improved upland farming	Mid term	2	1	3	1.6
	Strengthening the research and extension system for new variety and high potential crop	Urgent/ immediate	3	2	5	2.6
Livestock	Research on developing methods of pasture land establishment and fodder production	Mid term	2	2	4	2.0
	Promotion of diversification of income sources (Poultry farming)	Mid term	2	1	3	1.6
Irrigation	Rehabilitation of intake in PC 23 area	Urgent/ immediate	3	1	4	2.2
	Rehabilitation of intake structures in upper and mid river basins	Urgent/ immediate	3	1	4	2.2
	Reuse of drainage water	Urgent/ immediate	3	2	5	2.6
	Rehabilitation of irrigation and drainage canal system	Mid term	2	1	3	1.6
	Rehabilitation of on-farm irrigation and drainage facilities	Mid term	2	1	3	1.6
	Enhancement of O&M of irrigation system	Mid term	2	1	3	1.6
	Development of appropriate land use plan for PC23 rain-fed area	Urgent/ immediate	3	1	4	2.2
	Extension of appropriate irrigation technology	Long term	1	1	2	1.0
Watershed management	Establishment of forest management association and capacity development	Urgent/ immediate	3	3	6	3.0
	Prevention of forest fire	Urgent/ immediate	3	3	6	3.0
	Conservation of Natural forest	Urgent/ immediate	3	3	6	3.0
	Development of buffer zone	Mid term	2	3	5	2.4
	Introduction of bee keeping	Mid term	2	1	3	1.6
	Recovery of degraded natural forests	Long term	1	3	4	1.8
	Promotion of agro-forestry	Urgent/ immediate	3	3	6	3.0

Sector	Countermeasures	Priority for implementation	Level of Urgency	Level of contribution	Total	Weighted total
	Development of community and school forests	Mid term	3	3	6	3.0
	Introduction of silvopastoral	Mid term	1	3	4	1.8
	Recovery of vegetation in lavaka	Urgent/ immediate	3	3	6	3.0
	Promotion of greenization in degraded grassland	Long term	1	3	4	1.8
	Capacity enhancement of local forestry offices	Mid term	1	3	4	1.8
	Basin environment monitoring with GIS	Long term	1	3	4	1.8
Living environment	Road improvement plan III	Mid term	2	1	3	1.6
	Improvement of rural health and sanitation	Urgent/ immediate	3	1	4	2.2
	Extension of improved stove	Urgent/ immediate	3	3	6	3.0

Source: JICA Study team

(6) Results of selection

The countermeasures which received scores above 2.4, which is 80% of the weighted total points were selected as pilot projects. The results of the selection included 12 countermeasures comprised of 3 in agriculture, 1 in irrigation, 7 in river basin management and 2 in livelihoods/ social infrastructures.

1) Agriculture : Promotion of diversification of agriculture income sources (PC 23 rain-fed area), Promotion of diversification of agriculture income sources (each river basin) and Research and extension of new varieties and potential crops

2) Irrigation : Re-use of drainage water

3) Watershed management : Establishment and enhancement of forestry management association; Conservation of natural forest; Prevention of forest fire; Development of buffer zone; Promotion of agro-forestry; Development of community and school forests; and Recovery of vegetation in lavaka

4) Living environment: Extension of improved stove

In order to validate practicality and applicability of interventions, the above selected 12 pilot projects were reviewed for their feasibility, costs and relevancy. As a result, all the selected projects were assessed as appropriate for implementation. Thus, the pilot project sites from the pre selected area were selected as follows.

In order to validate coordination between upper and lower river basins, 9 pilot projects were implemented in Sahamilahy River, 4 mid and small river basins and PC 23 area. Those projects were; establishment and enhancement of forestry management association; natural

forest conservation; prevention of forest fire; development of buffer zone; recovery of vegetation in lavaka; promotion of diversification of agriculture income sources (PC 23 non irrigated area); promotion of diversification of agriculture income sources (each river basin); re-use of drainage water; and extension of improved stove. To note, recovery of vegetation in lavaka was implemented in 4 mid and small river basins where active lavaka was highly influential downstream was found.

The pilot projects concerning river basin management were carried out targeting natural forests in Sahamilahy river basin. Those of Sahabe river basin lay over administrative borders which makes the management of the projects difficult. However, pilot projects to recover vegetation in degraded grassland under different natural condition, and to develop community and school forests and promotion of agro-forestry were implemented to validate their effectiveness and applicability. Furthermore, pilot projects to establish and enhance forest management association and to prevent forest fires were carried out in the same area. These two projects were to validate the effectiveness and applicability of these interventions in grassland and bush, and to recover vegetation in intermediate lavaka.

Countermeasures to research and extend new varieties and high potential crops were implemented in the entire study area aimed at improving paddy productivity. The experimental plots were selected depending on the farm conditions and effectiveness of demonstration.

Taking the above conditions into consideration, 12 pilot projects were selected in the selected areas. Table 5.1.2 summarizes the pilot projects and selected pilot project sites.

Table 5.1.2 List of Pilot projects and pilot project sites

Name of the Pilot Project	Technical area	Project sites	
1. Promotion of diversification of agriculture income source (Mahakary)	Agriculture	PC23 area	Mahakary village
2. Promotion of diversification of agriculture income source (Maheriara)	Agriculture	Sahamilahy River basin	Maheriara village
3. Research and extension of new varieties and high potential crops	Agriculture	All study area	PC23 area and its surrounding
4. Re-use of drainage water	Irrigation	PC23 area	C5.5.2 tertiary irrigation canal command area
5. Establishment of forest management association and capacity development	Watershed management	Sahamilahy River basin Sahabe River basin	Antetezantany village Sahanidingana village
6. Natural forest conservation	Watershed management	Sahamilahy River basin	Antetezantany village
7. Prevention of forest fire	Watershed management	Sahamilahy River basin	Antetezantany village

Name of the Pilot Project	Technical area	Project sites	
		Sahabe River basin	Sahanidingana village
8. Development of buffer zone	Watershed management	Sahamilahy River basin	Antetezantany village
9. Development of community and school forests	Watershed management	Sahabe River basin	Sahanidingana village
10. Promotion of agro-forestry	Watershed management	Sahabe River basin	Sahanidingana village
11. Recovery of vegetation in lavaka	Watershed management	4 mid and small river basin Sahabe River basin	Manakambahinikely village Ranofotsy village
12. Extension of improved stove	Living environment	Sahamilahy River basin PC23 area Sahabe River basin	Antanimafy village Ambodhidrony village Soalazaina village

Source：JICA Study team

5.2 Implementation of the Pilot Projects

5.2.1 Outline of the pilot projects

The background to countermeasures to be validated through pilot projects has been discussed in Chapter 4. Based on the discussion, each pilot project was designed. The overview of each pilot project is presented in Table 5.2.1. PDM (ver. 0) is attached at the back of the report as Attachment 5-1.

Table 5.2.1 Outline of the Pilot Projects

Name of the Pilot Project	Outline of the Project
1. Promotion of diversification of agriculture income sources (Mahakary area)	Introduction of double cropping in upland (paddy in rainy season and haricot beans in dry season); planting of fruit trees and poultry farming in vacant space in household compound; Identification of market for haricot beans and poultry (broiler); Establishment of producers' cooperatives for paddy double cropping, fruits and poultry and development of their capacities for sustainable management
2. Promotion of diversification of agriculture income sources (Maheriara area)	Introduction of new varieties of paddy; double cropping of paddy and haricot beans, poultry farming (broiler) in spare land in household compound; construction of fish ponds using natural lake as a water source and fresh water fish farming; identification of market for haricot beans, poultry (broiler) and fresh water fish; establishment of producers' cooperatives for double cropping, poultry farming and fish farming and capacity development for sustainable organizational management.
3. Research and extension of new varieties and high potential crops	Production tests on cropping season of the provided mid maturing paddy; experiments on selection of second season crop; field visits on production test plots; demonstration of high potential mid maturing varieties; experiments on adoptability of NERICA in uplands of upper basin; development of crop production manual for extension
4. Re-use of the drainage water	Rehabilitation of existing irrigation and drainage facilities and construction of new ones in the fifth and sixth field blocks; improvement works of farm road; establishment of Water Users' Association by organizing irrigation users in the fifth and sixth field

Name of the Pilot Project	Outline of the Project
	blocks; training for Water Users' Association on O&M of irrigation and drainage facilities
5. Establishment of forest management association and capacity development	Conducting workshops to build consensus among the participating community members towards establishing forest management association; establishment and registration of forest management association; practical guidance on organizational management and activity planning; and enhancement of organizational capacity
6. Conservation of natural forests	Conducting workshops to educate about the value of natural forests; promotion of natural forest conservation activities by the members of natural resource conservation committee; training for the committee on establishment of natural forest protection system; demarcation of natural forest protection area; establishing borders and signs; sustainable management of the natural forest protection activities by the committee
7. Prevention of forest fire	Conducting workshops concerning forest and wild fire and its implication to environment to develop awareness among the community members; provision of the most updated information on the regulations concerning forest and wild fire; promotion of forest and wild fire prevention activities by the community; training for the committee to establish forest and wild fire prevention system; provision of fire fighting equipments in the community
8. Development of buffer zone	Conducting workshops on the role and necessity of a buffer zone; development of capacity of the buffer zone committee; training for the committee members on development and management of buffer zone; designation of buffer zone development area jointly with CIREEF; establishment of fire prevention zone around buffer zone; provision of equipment necessary for buffer zone development
9. Development of community and school forests	Awareness creation in the community regarding implications and effects of community and school forests; practical guidance on capacity development of community/ school forest committee; development of community/ school forests with community participation; establishment of management system of reforested areas
10. Promotion of agro-forestry	Hedgerow and crop production; production of fruits and fodder crops; conducting workshops to promote agro-forestry; practical guidance on activities by agro-forestry committee; selection of the areas where agro-forestry is to be implemented; on-farm training on agro-forestry; provision of necessary equipments; monitoring of the activities; follow up
11. Recovery of vegetation in lavaka	Stabilizing collapsed soil in lavaka by re-vegetation; reduction of volume of soil erosion by tree planting in the surrounding areas of lavaka; stabilization of soil in the alluvial fan; effective uses of the alluvial fan by fruit tree planting; fodder crop production and grazing
12. Extension of improved stove	Designing of the improved stove made of locally available materials; demonstration on production of prototype of the improved stove; introduction of the improved stove in the model households; extension of the improved stove in other households; promotion of extension activities of the improved stove by the community

Source: JICA Study team

5.2.2 Overview of the pilot project sites

In selecting the pilot project sites, a detailed village survey was conducted. In addition to natural conditions, living environment and productive activities, social customs and norms of each village were investigated. An overview of the pilot sites is presented in the remaining section and their locations are indicated in Figure 5.2.1.

1) Mahakary village：The village belongs to the Ambatomainty commune administrative area and located on an isolated hill in the rain-fed paddy field area of the eastern half of the PC 23 area. Its population is 876 persons and the total number of households is 119. Mixture of flat rain-fed paddy fields and grazing areas is found around the hill. To reach the centre of the village, branching off the National Route 3a, the local road is available up to Ambatomainty village. Beyond the point, main farm road in the PC 23 north western area can be used. The distance between the National Route 3a and Ambaidoho, the branch off point at National Route 33, is 26 km. In the dry season, the National Route 3a can be reached via D2 main drainage canal maintenance road in PC 23 area, which could shorten the distance to Ambaidoho to 12 km.

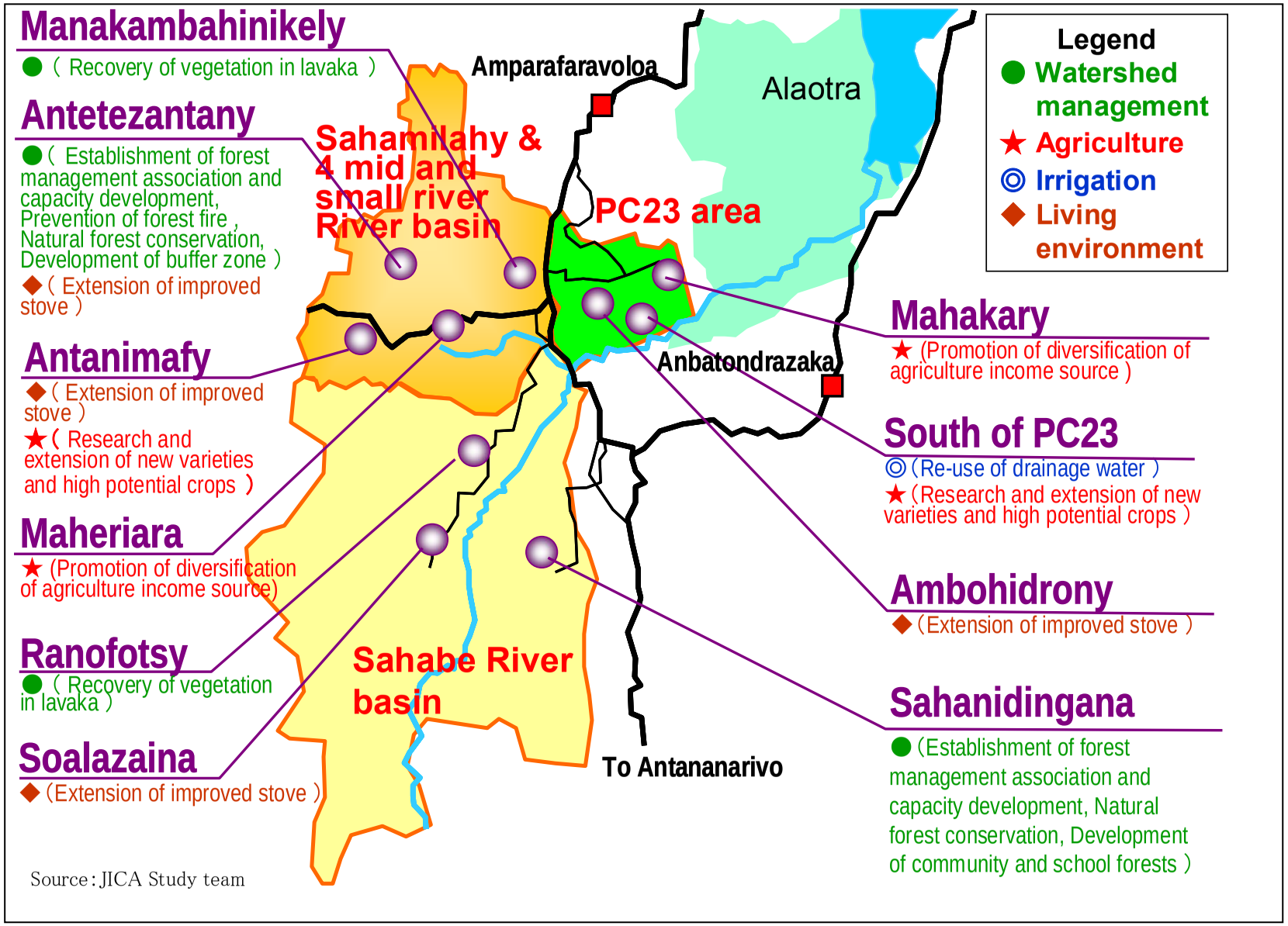


Figure. 5.2.1 Pilot Projects Location Map

2) Maheriara village: Maheriara village falls under the administration of Morarano Chrome Commune with the population of 1,600 persons of 270 households. It is located in the hilly area in mid basin of Sahamilahy River. Fuelwood forest of Eucalyptus. Hilly areas covered with degraded grasslands and paddy fields in the hilly and mountainous area coexist in the surrounding area of the village. The National Route 33 cuts through the centre of the village. The distance to Ambaidoho is 11 km.

3) The C5.5.2 tertiary canal command area in PC 23 area: The C 5.5.2 tertiary canal command area in PC 23 area is located in the C 5.5 secondary canal command area irrigated by the P5 main irrigation canal using Sahabe river water system. It includes the fifth field block of the upper stream and the sixth field block of downstream bordering the D102 tertiary drainage canal running parallel to C.5.5.2 tertiary canal. Since the irrigation water supply is scarce, the upper stream of each block is used as irrigated paddy field while the downstream area is used as rain-fed paddy field. After branching off the National Road 3a, the local road will lead up to Antanandava village. Beyond this point, D1 main drainage canal maintenance road in PC 23 can be used. The distance to Ambaidoho is 8 km.

4) Antetezantany village: Antetezantany village belongs to the administrative area of Morarano Chrome commune and is located in uppermost river basin of Maheriara River, a branch of Sahamilahy River. Its population is 535 persons in 190 households. Remaining natural forest mountains, degraded mountains covered with grassland and bushes, and paddy fields in the hilly and mountainous areas surround the village. The National Route 33 is available up to Maheriara. Beyond the point, an old forest road leads 10 km to the village. The distance to Ambaidoho is 21 km.

5) Sahanidingana village : Sahanidingana village is located in the Andilanatoby commune administrative area located in the mid river basin of Sahabe River. Its population is 2,375 persons in 333 households. In the surrounding area of the village; fuelwood forests of Eucalyptus, hilly area covered with degraded grassland and paddy fields in the hilly and mountainous area are found. The distance to Ambaidoho is 25 km using 17 km of local road branching off the National Route 3a.

6) Manakambahinikely village : Manakambahinikely village is located in Morarano Chrome administrative area and in Ampasimena river basin, which is among the 4 mid and small rivers. Its population is 1,492 persons with 249 households. In the surrounding area, fuelwood forest of Eucalyptus, hilly area covered with degraded grassland and paddy fields in the hilly and mountainous area are found. Much lavaka also exists in this area. The distance to Ambaidoho is 3 km using the 1.5 km of local road extending from National Route 33.

7) Ranofotsy village : Ranofotsy village falls under the administration of Ranomainty commune and is located in the mid-river basin of Sahabe River. Its population is 2,130 persons of 290 households. Eucalyptus forest for fuelwoods, a hilly area covered with degraded grassland and paddy fields in the hilly and mountainous area surround the village. Many lavaka also exist in the area. The distance to Ambaidoho is 18 km using the local road linking National Route 3a and Soalazaina village.

8) Antanimafy village : The village of Antanimafy is located within Morarano Chrome commune. It has the population of 4,500 persons with 1,000 households and found in the upper basin of Sahamilahy River. Natural forest mountain, man-made hilly forest area owned by a public forestry company, degraded hilly area covered with grass and bush and paddy fields in the hilly and mountainous area are found in the local landscape. The distance to Ambaiboho village is 20 km via 1.5 km of road branching off the National Route 33.

9) Ambodhidrony village : Ambodhidrony village belongs to the Morarano Chrome commune administrative area. The village is located in the western half of the PC 23 area and in the isolated lower plateau of irrigated area by the P1 main irrigation canal of Sahamilahy River water system. Its population is 1,894 persons in 350 households. The plateau is surrounded by the irrigated paddy fields. The distance to Ambaiboho village is 4.5 km using the D2 main canal maintenance road which leads to Mahakary village after branching off the National Route 3a.

10) Soalazaina village : Solazaina village is under the administration of Soalazaina commune and located in the upper river basin of Sahabe River. The population of the village is 3,637 persons in 534 households. In the neighboring area, natural forest mountain, man-made pine forest hills owned by the public forest cooperation, and paddy fields in the hilly and mountainous area exist. The distance to Ambaiboho village is 33 km using the local road off the National Route 3a. This local road becomes a shortcut during dry season with a distance of 160 km to the capital of Madagascar. The route passes through Sahabe River border and Anjozorobe where the National Route 3 ends.

5.2.3 Method of implementation of the pilot projects

10 out of 12 pilot projects were implemented between October 2004 and January 2007 for three years. The remaining two projects of re-use of drainage water and promotion of agro-forestry commenced in September 2005 and were completed in January 2007.

In implementing the pilot projects, national NGOs, consultants and construction companies were subcontracted to implement the pilot project activities and construction works under the

supervision and monitoring carried out by the study team. These subcontractors were selected by competitive bids by designated companies for each year in principle. However, some adjustment was made according to the implementation plan for the projects. The pilot project on research and extension of new varieties and high potential crops was planned for three years and therefore a negotiated contract was given to the subcontractor after the 1st year bid. The pilot projects on development of buffer zone; establishment of community and school forests; and promotion of agro-forestry were directly supervised by the study team in the third year. The list of subcontractors for each pilot project is provided in Table 5.2.2.

Table 5.2.2 Subcontractors of the pilot projects

Name of the pilot project	Technical area	2004/05	2005/06	2006/07
1. Promotion of diversification of agriculture income sources (Mahakary area)	Agriculture	Tanymaitso	Tanymaitso	Tanymaitso
2. Promotion of diversification of agriculture income sources (Maheriara area)	Agriculture	Ho Avy Soa	Ho Avy Soa	Ho Avy Soa
3. Research and extension of new varieties and high potential crops	Agriculture	FOFIFA (Continuous)		
4. Re-use of drainage water	Irrigation	-	EGECA	EGECA
5. Establishment of forest management association and capacity development	Watershed management	A.N.A.E.	A.N.A.E.	Ezakz Vaovao
6. Protection of natural forests	Watershed management	A.N.A.E.		Ezakz Vaovao
7. Prevention of forest fire	Fire prevention			Ezakz Vaovao
8. Development of buffer zone	Watershed management	-		JICA
9. Development of community and school forests	Watershed management	A.N.A.E.		
10. Promotion of agro-forestry	Watershed management	-		
11. Recovery of vegetation in lavaka	Watershed management	A.N.A.E.		Ezakz Vaovao
12. Extension of improved stove	Living environment	Ezakz Vaovao	Ezakz Vaovao	Ezakz Vaovao

Source: JICA Study team

5.3 Achievement of the pilot projects

5.3.1 Outline of the pilot project activities

The pilot project plans were altered according to the progress of the activities. The following points were considered for adjustment: the capacity and reaction of the beneficiaries, support system with the government organizations concerned; experience and expertise of subcontractors; and natural and environmental condition of the project sites. The outlines of the pilot project activities carried out during the study period are presented in Table 5.3.1.

Table 5.3.1 Overview of the Pilot Project activities

Name of the Pilot Project	Outline of the activities
1. Promotion of diversification of agriculture income sources (Mahakary area)	・ The pilot project on double cropping in the rain-fed area, the plots which were not inundated during the rainy season were selected from the narrowly divided landscape. The drought resistant upland rice (B-22) in rainy season and Lingot Blanc, a superior variety of haricot bean, in dry season were planted in the selected area. ・ The first season B-22 (improved upland rice variety) was damaged by the pests and excessive moisture. Some plots had no yield due to the damage. The farmers selected SEBOTA-41 for the second season of upland rice, which has been extended by the CIRAD and had a better coping mechanism against rain, precipitation, and soil moisture. The second season, the yield have reached to 0.64 ton/ ha while that of the first season was 0.18 ton/ha. However, the seeds bought from the market had some impurities and their quality deteriorated. Therefore, the yield only achieved 40% of what was expected. ・ The yield of haricot beans in dry season was 361 kg/ ha for the first cropping season and 458 kg/ha in second cropping season. These results have almost reached that of rainy season. A part of the yield was sold at the Alaotra Mangoro area farm produce exhibition by the cooperative. The earning from the sales was used to compensate its member farmers who had no yield of upland rice. ・ Poultry (broiler) farming was managed by the participating farmers after 3rd breeding and continued up to the 6th one. During the period, a multiple number of poultry farms were established around the local market. Since the poultry cooperative has less market competitiveness due to the location, it spent the available capital and switched to breeding of geese which is well known in distant markets such as in the capital city. The gross profit rate for 6 poultry breeding after labor cost of cooperative members was 26%. Due to the remote distance, without good access to means of transportation, the cost of transportation of chicks, dressed and fresh chicken was high and therefore decreased the gross profit rate. ・ 120 trees made up of mangoes, lychees, and avocadoes were planted in the backyard garden at the households of participating farmers in double cropping activities. These were still in the fruiting stage and therefore the contribution to diversify income sources was not yet visible.
2. Promotion of diversification of agriculture income sources (Maheriara area)	・ Improvement of conventional paddy production methods and introduction of second crop after paddy were carried out in the irrigated paddy fields. ・ Seed selection with salt solution, regular transplanting, manual weeding, and application of forcing manure were practiced among the participating farmers. As a result, the average yield was 2.22 ton/ ha in the first cropping season and 2.87 ton/ha in the second cropping season. (2.0 ton/ ha was the average yield achieved by the conventional paddy production method.) The application of forced manure has contributed to a further increase of the yield in the second cropping season. The production method of forcing manure has been introduced by an expert from Indonesia working under

Name of the Pilot Project	Outline of the activities
	JICA south to south cooperation program and practiced by the participating farmers as a way of securing organic matter as a substitute to manure which price has been on the rise. ・ The yield of the haricot beans planted after paddy could not achieve what was expected and was 175 kg/ha. In selecting an appropriate second crop to be planted after paddy, soil moisture in the plot is a key criterion. Further, the low yield was caused by the delayed sowing which should take place at the beginning of the dry season since the plot remained soggy after harvesting of paddy since there were no drainage facilities. ・ Broiler production was similar to Mahakary village. The size of the cooperative was reduced and geese farming was introduced. Due to high initial investment for breeding equipment in addition to transportation cost, the poultry farming did not produce gross profit after totaling the earning of 6 breeding. The rate of gross profit after labor cost of the cooperative members was 0.9%. ・ Breeding of royal carp fries began in the 3 newly constructed fish ponds of 600 m2 using water from a fresh water lake which water source is a spring. Long period of breeding and difficulties in obtaining feeds, in addition to the trading practices of fish which makes no difference by the fish species and weight, posed difficulties in breeding of royal carp. Thus, based on the decision of the fish farming cooperative, Tilapia requiring shorter breeding period were introduced instead of royal carp. The daily weight gain by the fish increased to 0.83g from 0.42g. ・ Royal carp were sold at the fish pond by the limit price of the middlemen while Tilapia was directly sold by the cooperative at a regular market in Morarano Chrome which is 10 km away from the village. By this, the stock was sold at an 80% higher selling price than the royal carp. While royal carp was cultivated, it was not possible for the fish farming cooperative to accumulate capital and distribute dividend to its members. However, farming of Tilapia with self-multiplification of fish fries will make it possible to achieve both.
3. Re-use of drainage water	・ Some works were carried out to solve the irrigation water shortage in the lower side of the sixth field block using the drainage water from the tertiary drainage canal (D102) which drains water from the fifth and sixth field blocks in the P5 main canal command area of PC 23 area. ・ Prior to the implementation of the pilot project, a meeting was held to explain the project to the land owners and tenant farmers of the both blocks with participation of relevant government officers. Each one of the participants agreed to establish and participate in an organization to carry out construction works and water management at the block level. ・ Construction works were contracted to a national construction company selected by a competitive bid. The supervision of the works was done by the Madagascan engineer employed by the study team. ・ The construction works carried out by the contractor included rehabilitation of tertiary canal (C 5.5.2); rehabilitation and construction of weirs in

Name of the Pilot Project	Outline of the activities
	tertiary drainage canal (D102); partial heightening of dike cum maintenance road of main drainage canal (D1); construction of new drainage culvert between the field block 5 and main drainage canal (D1); partial rehabilitation of tertiary canal maintenance road. The members of the organization carried out rehabilitation and construction of field canal and drainage canal in the field block 6 and leveling of the plots. ・ The construction works were carried out during the dry season of 2006. Additional works of the heightening of dike cum maintenance road for main drainage canal (D1) and partial rehabilitation of tertiary canal maintenance road were conducted during the dry season of 2007.
4. Research and extension of new varieties and high potential crops	・ In the demonstration plot established in the field block 4 in the PC 23 area, cropping test of the mid maturing variety of paddy; selection of second crop; field visit to production test were conducted. In the paddy field nearby the crossing of P1 main canal located at the downstream of Sahamilahy intake and National Route 3a, a mid maturing high potential paddy variety was demonstrated. An adoptability test of NERICA rice was implemented in upland located in the upper basin of Sahamilahy river. ・ 3 varieties were selected as high potential ones among the 7 mid maturing varieties tested in the cropping season experiment and were planted in the demonstration plot. ・ The yield from the demonstration plot, where common plantation method practiced in the paddy field in the Alaotra Lake riparian area was adopted, was 5.7 ton/ha. The timing of the harvesting was shortened by 45 days compared to that of the conventional late maturing variety. Therefore, the impact of the demonstration appears very influential and increased the interest among the farmers toward seed multiplification and the timing of distribution of certified seeds. ・ Adoptability test of NERICA rice was discontinued after first cropping season since the necessity to consult WARDA emerged concerning the design of the experiment and variety selection including their perspectives on adopting upland rice variety developed for low land. ・ Introduction of upland crops was to be tested for the second crop after paddy. However, the experimental plot required some time and funds to improve drainage condition. Therefore, the double cropping of paddy using early maturing variety was conducted. The first yield (dry season) at on-farm level was 2.1 ton/ ha.
5. Establishment of forest management association and capacity development	・ A community organization was established to implement the participatory river basin management activities in the future and to take part in the government' basin management activities. Necessary assistance to build its organizational capacity was provided. ・ In Antetezantany village, an association was organized to lead the relict natural forests in the upper river basin of Sahamilahy River. In Sahanidingana village, an association to carry out re-vegetation and soil conservation in the grass and bush areas in the Sahabe River basin was established. Under each association, committees to take responsibilities of

Name of the Pilot Project	Outline of the activities
	conducting each basin management activity were formed. ・ The guidance on organizational management was provided in line with the social norm and traditional rule Dina, and in partnership with the Commune, the lowest level of the local administration structure.
6. Conservation of natural forest	・ ・The surviving natural forests in Antetezantany village were designated as protected areas by marking the border and establishing the sign post and observation tower. ・ Regular inspection was carried out by the members of the natural forest protection committee. ・ Conflicts were observed between the users of the non timber forest products with vested rights and others in the protected area. Thus, meetings were held to coordinate the executives of the forest association, village elderly, commune, CIREEF and vested rights holders.
7. Prevention of forest fire	・ ・Workshops were conducted by the forest associations of Antetezantany and Sahanidingana to develop awareness of fire prevention among community members. ・ Necessary equipments and their storage facilities were provided. Training on forest and wild fire prevention were carried out for the forest association. ・ Training on the drafting of by-laws and the maintenance of fire extinguishing devices were conducted.
8. Development of buffer zone	・ A buffer zone was developed in the communally owned land to provide a substituting forest resource to the natural forest protection area in Antetezantany village. A fire prevention zone was also developed surrounding the buffer zone. ・ ・ ・In order to improve the income of the community, fruit trees were included among the planting varieties. Bee keeping was also introduced using Eucalyptus Greberia as source of honey.
9. Development of community and school forests	・ ・A community forest was established in the communal land of Sahanidingana village as a source of construction materials for public facilities in the village in the future. ・ As an incentive for the community members who participated in tree planting in the community forest, seedlings produced at the nursery were provided and supported their tree planting on their own land intending to conserve the land by expanding the reforested surface in the degraded grassland. ・ School forest development was integrated in the school curriculum. Pupils and students participated in the preparation of seedlings and deepened their understanding on importance of environmental conservation.

Name of the Pilot Project	Outline of the activities
10. Promotion of agro-forestry	・ ・In the uplands on the slope area in Sahanidingana village, one demonstration plot of agro-forestry and four extension areas were established to disseminate the methods of prevention of soil erosion and recovery of soil productivity. ・ Agro-forestry promotion committee implemented construction of hedgerow along contour line and planting of fruit and legume fertilizer trees in order to prevent soil erosion and create opportunities to earn cash income. ・ ・As an alternative income source for the participating farmers, bee keeping was introduced. Flower trees were planted as source of honey. ・
11. Recovery of vegetation in lavaka	・ ・In order to stabilize collapsed soil in lavaka through recovery of vegetation, methods of re-vegetation in lavaka which can be implemented by the community with locally available materials were tried out in two sites of different categories of lavaka. One site was selected from Manakambahinikely village (Active lavaka) in 4 mid and small river basins. The other was an intermediate lavaka in Ranofotsy village in Sahabe river basin. ・ ・Activities included construction of soil retaining net fence to prevent soil erosion from lavaka; reforestation around lavaka to reduce soil erosion from slopes; reforestation of alluvial fan in the downstream of lavaka to stabilize soil; and effective land use of alluvial fan. ・ Farmers who owned the farm plots in the downstream of lavaka participated in the production of seedlings to be used for reforestation. ・ ・As an incentive for the participating farmers, effective land use of alluvial fan was planned. Fruit trees were also planted during reforestation and pasture grass seeds were sown to create grazing land and enhance livestock production.
12. Extension of improved stove	・ ・In addition to 3 villages initially selected, Antetezantany village in the upper river basin of Sahamilahy river was included as participating village to the pilot project on extension of improved stove and sensitization on effective fuelwood resources for environmental conservation ・ ・Three prototypes of improved cooking stoves were provided for the community members. Those were clay stove for fuelwoods; brick made stove for dual use of fuelwood and charcoal; and portable clay cooking stove. The participating community members selected one among these. A part of the materials and instructions on how to make the selected stove were given. ・ The brick stove for which design can easily be adjusted according to the plan of the kitchen gained high popularity in the community. On the other hand, having less durability compared to the brick one, the clay stoves of two types earned fewer interests.

Name of the Pilot Project	Outline of the activities
	・ The participated community members estimated that the improved cooking stove could reduce the cost of fuelwoods in a year as much as that of equivalent of one heifer. ・ As the improved stove can retain fire for longer, the women in the participating households in the pilot project boiled water for drinking, which had previously not been of good quality. This has prevented infants and children from contracting infectious diseases and improved the household health and sanitation. ・ ・The community members who were exposed to the improved stove at first voluntarily sensitized communities in the surrounding area and shared their experiences.

Source: JICA Study team

5.3.2 Inputs and outputs of the pilot projects

Major equipment and costs invested during the pilot projects and the outputs and the number of participating community members are summarized in Table 5.3.2. The detail is presented in the Attachment 5-2 Summary of the achievements by the pilot projects.

Table 5.3.2 Overview of the inputs and outputs of pilot projects

Input (Total)		Output	Number of participating farmers/ community members(Maximum)
Major equipments/ inputs	Cost in thousand		
1. Pilot project on promotion of diversification of agriculture income sources (Mahakary area)			
Upland rice for double cropping; haricot bean seeds for two cropping; fruit tree seedlings; poultry cage and breeding equipments; poultry farming materials for two production	Direct cost 2,685 Cost of subcontractor 4,692	Double cropping of upland rice（First cropping: planted area 5.00 ha; harvested area 2.13 ha; yield 0.90 ton. Second cropping: planted area 14.00 ha; yield 8.96 ton） Double cropping of haricot beans (First cropping: planted area 6.00 ha; yield 2,165 kg. Second cropping: planted area 3.00 ha; yield 1,374 kg） Poultry farming(2 sales under management support: quantity sold 733 birds; sales 234,000 JPY; total cost of production 180,000 JPY; gross profit 54,000 JPY. 4 sales under own management: quantity sold 1,300 birds; sales 345,000 JPY; total cost of production 251,000 JPY; gross profit 94,000 JPY)	Double cropping 28 Poultry16
2. Pilot project on promotion of diversification of agriculture income sources (Maheriara area)			
Paddy for double cropping; haricot bean seeds for two	Direct cost 4,274	Double cropping of paddy (First cropping: planted area 5.00 ha; yield 11.08 ton. Second cropping: planted	Double cropping2 8 Poultry 16

Input (Total)		Output	Number of participating farmers/ community members(Maximum)
Major equipments/ inputs	Cost in thousand		
cropping; poultry cage and breeding equipment; poultry farming materials for two production; Royal carp fries for two production; tilapia fries for one production; fish farming materials for three productions	Cost of subcontractor 7,228	area 11.15 ha; yield 32.04 ton） Double cropping of haricot beans (First cropping: planted area 4.90 ha; yield 859 kg） Poultry farming (2 sales under management support: quantity sold 776 birds; sales 306,000JPY; cost 259,000JPY; gross profit 47,000 JPY. 4 sales under own management: quantity sold 1,519 birds; sales 569,000 JPY; cost 608,000 JPY; loss 39,000 JPY) Fish farming (Royal carp 1st production: 1,200 fries cultured for 10 months; yield 140 kg; sold volume 70kg; sales 8,000 JPY. 2nd production: 1200 fries cultured for 6 months; yield 99kg; sold volume 60 kg; sales 7,000 JPY. Tilapia 1st production: 626 fries cultured for 2.5 months; yield 40 kg; sold volume 30kg; sales 5,000 JPY. 2nd production: fries of own multiplification were kept for 4 months; sold volume 70 kg; sales 14,000 JPY)	Fish farming15
3. Pilot project for re-use of drainage water			
No input of materials	Direct cost 22 Cost of subcontractor 8,213	Rehabilitation of tertiary canal division works (2 sites); rehabilitation of weir for recycling the tertiary drainage water (1 site; new construction); heightening of main drainage canal embankment (500 m) and new construction of culvert (1 site); maintenance of farm road 1,500 m which dried the poor drainage paddy area of 20 ha located in the lower side of field block 5 and conversion of rain-fed paddy plots in the lower side of field block 6 into irrigated plots.	69
4. Pilot project on research and extension of new varieties and high potential crops			
Farm input for crop Experiment	Direct cost 947 Cost of sub contractor 3,420	3high potential mid maturing Thermosensitive paddy varieties were selected. The transplanting was carried out in early January and yield was compared between that of crop experimental plot and demonstration plot.（ton/ha） MR10684-45-1-1-1 experimental plot 3.71; demonstration plot 5.28 MR10985-61-1-2-2 experimental plot 3.65; demonstration plot 5.01 MR10985-76-2-1-2 experimental plot	---

Input (Total)		Output	Number of participating farmers/ community members(Maximum)
Major equipments/ inputs	Cost in thousand		
		3.23; demonstration plot 6.62	
5. Pilot project on establishment of forest management association and capacity building			
No input of materials	Direct cost 27 Cost of subcontractor 1,417	Establishment of forest association in Antetezanatiny・Sahanidingana as a legal entity; The members of the associations participated in the pilot project activities through each committee.	123 persons in 2 areas
6. Pilot project on conservation of natural forest			
Materials for sign posts to demarcate the border of protected area; equipments required for inspection; and materials to establish observation tower	Direct cost 339 Cost of subcontractor 853	Approximate area: 600 ha; demarcation of protected area with extended border of 10.2 km; regular inspection; reporting to the government office in the case of illegal cutting of trees.	50
7. Pilot project on prevention of forest fire			
Fire fighting equipments; water storage tank; construction materials for building storage	Direct cost 527 Cost of subcontractor 1,891	10 fire extinguishings carried out in 2 sites in 3years	The total number of participants from 2 sites: 123 persons
8. Pilot project on Development of buffer zone			
Seeds for seedling production; pots for seedlings; development of nursery; equipments for tree planting; fruit tree seedlings; bee's boxes	Direct cost 491 Cost of subcontractor 372	Reforestation for resource development including privately owned forest 56 ha; fruit tree planting 480 seedlings; harvested honey 3.5 lit.	50
9. Pilot project on development of community and school forests			
Seeds for seedling production; pots for seedlings; nursery development; equipments for tree planting	Direct cost 890 Cost of subcontractor 709	Production of seedlings 90,000 seedlings; area developed for community forest 47 ha; area developed for school forest 2.0 ha; privately owned forest 3 ha; supplementary planting 2,500 seedlings	42
10. Pilot project on promotion of agro-forestry			
Seedlings of fruit trees; seeds of fertilizer tree to be used at counter line hedgerow; upland crop seeds	Direct cost 821 Cost of subcontractor 340	Construction of hedgerow along contour lines; fruit tree planting; seeding of corn, legume ground nuts and upland rice were carried out in demonstration sites 2,100 m²; extension 1st site 600 m²; extension 2nd site1,000 m²; extension 3rd	15

Input (Total)		Output	Number of participating farmers/ community members(Maximum)
Major equipments/ inputs	Cost in thousand		
		site 500 m²; extension 4th site 800 m²	
11.Pilot project for recovery of vegetation in lavaka			
	Direct cost 367 Cost of subcontractor 1,351	Intermediate lavaka: Tree planted 9,300 seedlings; sand bag and construction of net fence 20 sites and maintenance 1 site; fruit tree planting 130 seedlings; fodder crop planted area 800 m². Active lavaka: Tree planted 4,400 seedlings; sand bag and construction of net fence 7 sites and maintenance 4 sites; fruit tree planting 100 seedlings	15 totaling the number of participants from both sites
12. Pilot project on extension of improved stove			
Iron bars and steel boards to place pans over brick stove; ceramic plates to place pans over portable clay stove; metal sheets to retain warmth	Direct cost 149 Cost of subcontractor 1,280	Antanimafy village : trial model 15 households; voluntary introduction 25 households Ambohidorony village：76 households Soalazaina village：119 households Antetezantany：112 households	347nhouseholds

Source: JICA Study team

5.3.3 Evaluation of the pilot projects upon completion

The following points were assessed upon completion of the 12 pilot projects: relevance of the technology examined; organizations involved in implementation and supporting system; and capacity of the participating community members. Based on the results of these assessments, overall relevance of the pilot projects were assessed in a holistic manner. The results of the final evaluation of each pilot project are summarized in Table 5.3.3. The details can be found in Attachment 5-2, the summary table of achievements of the pilot projects.

Table 5.3.3 Summary of the results of the final evaluation of the pilot projects

Relevance of the assessed technology	Participating organizations and supporting system	Capacity of the participating community members
1. Pilot project on promotion of diversification of the agriculture income sources（Mahakary area）		
・ The relevance of the introduction of haricot beans as second crop after paddy could be secured when the appropriate variety is selected; recommended varieties are distributed; and the seeds are sown at the appropriate timing. The technical relevancy of the introduction of upland rice	・ When the new productive activity is introduced as a collective action, external assistance from the initial stage could help the farmers to launch and sustainable manage the organization and activities.	・ Creating a foundation to receive external technical guidance by organizing farmers who are keen on learning new productive agriculture productive activities is effective in developing their capacity.

Relevance of the assessed technology	Participating organizations and supporting system	Capacity of the participating community members
may not be secured. This is because the yield of upland rice depends on the selection of a variety which has high adoptability to varying precipitation during the cropping season and soil moisture condition at the field level. ・The relevancy of the poultry farming (broiler) is affected by the distance to the local market since the profitability is determined by the transportation of chicks and chickens.		
2. Pilot project on promotion of diversification of agriculture income sources（Maheriara area）		
・ The condition of on-farm drainage affects the relevancy of the double cropping in the paddy field. However, it is relevant from the crop production point of view. ・ The technical relevancy of poultry farming (broiler) is as same as previous pilot project. ・In fresh water fish farming, cultivation of Tilapia is technically relevant after considering the procurement of fish fries, conditions given by the middlemen, and profitability.	・ In addition the above conditions, collaboration with other external organizations supported by donor agencies can be effective in continuation of the productive activities by the farmers.	・ Once the management of the productive activities becomes stabilized and the capital accumulated, the capacity to expand and convert the enterprises based on the farmers' own decisions can be developed.
3. Pilot project on re-use of drainage water		
・ The intervention was adopted as a tentative emergency measure to cope with the irrigation water shortage at the on-farm level. However, its technical relevancy can be secured since the intervention can be a lasting solution for the irrigated area affected by the fluctuating river flow.	・ The following procedure to develop consensus among the stakeholders was adopted before the implementation of pilot project. Firstly, a Water Users' Association was newly established based on the agreement between the plot users in the pilot project site, government offices concerned and DRDR and developed a common understanding of issues concerning irrigation water. The WUA also understood	・ Since each farmer has already had the skills to manage water in their own plot, advice and guidance from the government disseminated through WUA could be effective in developing farmers' capacity on block level water management.

Relevance of the assessed technology	Participating organizations and supporting system	Capacity of the participating community members
	and confirmed its responsibility in O&M of the facilities after rehabilitation. All the WUA members, then agreed to the implementation of the pilot project. ・ Through voluntary discussion among the farmers, future management system was established. The existing water users' organizations was resolved and reorganized. The federation of WUA was established taking the WUA organized for each field block as its member.	
4. Pilot project on research and extension of new varieties and high potential crops		
・ Field experiments and demonstrations are the conventional methods to confirm the field adoptability of the potential varieties; stabilization of varietal characteristics; and to develop new varieties to be disseminated to the farmers and stakeholders. Therefore, if the experiments are designed appropriately, these are technically relevant.	・ FOFIA regional agriculture research centre conducting breeding of new paddy varieties can carry out the range of production experiments including the field adoptability test.	・ The farmers who collaborated in the field level demonstration received training on production management techniques. This was effective in developing the capacity of those who were involved and are around the demonstration plots.
5. Pilot project on establishment of forest management association and capacity development		
・ Since river basin management intends to reform the land use in the area as a whole, it is indispensable to establish an organization and to develop its capacity to implement various management activities in an integrated and sustainable manner. ・ In order to ensure the organizational sustainability, it is essential to acquire a legal status to be eligible for applying new projects to the organizations concerned.	・ As the community increases its understanding on pilot project through instruction by the external organization on the daily basis, the level of self sustainability of the community organization increases. Thus, it is effective to establish a partnership between the commune and the external organization which can make the best use of the potential of community based on its experience.	・ The social norms governing the entire community and participation in the collective work (Dina) are still valid in the area. Therefore, the community members have the potential adaptability to take part in collective work. This shows the possibility to increase the level of community participation by giving the incentives corresponding to the local needs to the participants. ・ Active community participation can be expected by providing an alternative

Relevance of the assessed technology	Participating organizations and supporting system	Capacity of the participating community members
However, this is the first time for the community to manage an organization. Therefore, time and accumulation of experience are required before it becomes self reliant.		income earning opportunity as part of the project activities since the participating individuals have to bear the opportunity cost.
6. Pilot project on conservation of natural forest		
・ Local community has potentially high interest in natural forest conservation. Therefore, the conservation system which can both serves protection of natural forests and sustainable use is likely to be accepted by the community.	・ Natural forest conservation often means the regulation of the customary use. This often leads to conflicts between the community members. Therefore, it is necessary to coordinate and build consensus between the conflicting interest parties with involvement of Commune, DREEF and other government offices concerned.	・ Motivation and capacity of the community can be developed by implementing the interventions to serve both the natural forest conservation and creation of alternative sources of natural resource.
7. Pilot project on prevention of forest fire		
・ Prevention of forest fires is a technical issue, which should be dealt with immediately, in order for the government to provide practical guidance on it. ・ Fire prevention is a traditional communal activity. It is possible for the community to acquire skills on forest fire prevention through the sensitization and technical training.	・ Public relations and extension activities carried out by the Commune, DREEF and other relevant government offices can increase the awareness of the community towards preventing forest fire. ・ Repeated practical training based on systematic technical guidance and provision of equipments with external assistance are effective.	・ The community has the capacity to carry out fire fighting activities which can easily be replicated as self preventative measures. ・ The cost borne by the community of participating in the fire fighting in remote area could be reduced by the provision of lunch and assistance on transportation.
8. Pilot project on Development of buffer zone		
・ Development of buffer zone is a way to create an alternative source of natural resource when the access to natural forest gets limited. It can be done by the combination of the tree and fruit tree planting activities. ・ As the community learns that natural forest conservation is a way of creating alternative sources of natural resource, it will accept the idea of conservation.	・ In order to gain the community's understanding, well organized guidance using the external support is effective.	・ It is difficult for the community members to acquire necessary skills via temporary training. A step-by-step approach to training could effectively develop the community's capacity.

Relevance of the assessed technology	Participating organizations and supporting system	Capacity of the participating community members
9. Pilot project on development of community and school forest		
・ Community participation could easily hit the ceiling by only planting trees on the communally owned land. In order to increase technical relevance, activities where the community has higher incentives to plant trees or planting trees on private land could also be carried out in parallel to the tree planting in the communal land. ・ Development of school forest has technical relevance since it could be considered as a way of environmental education for school children.	・ External support is effective until the planned and efficient reforestation is carried out. ・ Since the production of seedling and reforestation overlap with the farming activities, work plan taking account of both farming and reforestation activities should be designed. Based on such a plan, supervision of activities by the external organization is effective.	・ Practical training on reforestation technique which is applicable to development of private forest in addition to community forest is effective in order to develop capacity of the community.
10.Pilot project on promotion of agro-forestry		
・ Agro-forestry is a combination of the existing technologies of flower tree planting for bee keeping; fruit tree planting and upland farming. Once the farmers understand its profitability, it can be extended.	・ Agro-forestry is new to the farmers. Therefore, well organized practical training for a certain duration with external assistance is necessary.	・ Agro-forestry could intensify the farming activity and directly contribute to income. The actual field activity and on-farm training could develop the farmers' capacity.
11. Pilot project on recovery of vegetation in lavaka		
・ Fruit tree planting and fodder crop cultivation using the alluvial fan in the downstream of intermediate lavaka gave high incentive to the community and earned high interests and will of participation of the community members. Therefore, it has technical relevance. ・ The effect of the technology tried out for preventing soil erosion in active lavaka remained similar to the conventional method.	・ In order to recover the vegetation in lavaka and to efficiently use the land in alluvial fan, integrated project design is necessary taking into account holistic perspectives including forestry, agriculture and civil engineering. The use of expertise accumulated in the external organization is necessary.	・ The work will include simple construction works. However, hands on training could sufficiently increase the capacity of the community.
12. Pilot project on extension of improved stove		
・ If the means to develop the	・ In adopting a community	・ Technology to produce

Relevance of the assessed technology	Participating organizations and supporting system	Capacity of the participating community members
interest and motivation of community such as introducing the benefits of improved stoves and provision of part of the materials, extension of improved stoves can be done rather easily. Since the technology has high replicability, it gains high technical relevance.	participatory approach, it is necessary to develop a sense of ownership by conducting meetings to explain the nature of the activities at the early stage of the project. Externally assisted input is effective in order to disseminate the production technology properly to the improved stove extension committee organized by the community.	improved stoves is simple. What is more important is to establish and manage a group to extend the improved stove from the perspective of community capacity development.

Source: JICA Study team

5.3.4 Sustainable implementation system by the pilot area and participating community

The system, which enables the area, village and organization involved in the pilot projects to continue the activities, was discussed below. At first the required capacity of the stakeholders was assessed. Once they were regarded capable, the implementation system as indicated in Table 5.3.4 can be adopted.

Table 5.3.4 Sustainability of the activities and implementation system of the pilot project

Name of the pilot project	Sustainability	Sustainable implementation system
1. Promotion of diversification of agriculture income sources （Mahakary area）	Double cropping using haricot beans as a second crop is sustainable in the plots which have the suitable condition in the dry season. After converting to geese farming from poultry farming (broiler), it became sustainable.	Cooperative organized by the farmers who wish to continue with geese farming
2. Promotion of diversification of agriculture income sources （Maheriara area）	The tested technology of double cropping was not appropriate to the plot condition in dry season. Therefore, it is not sustainable. After convertsion to geese farming by a small number of farmers from poultry farming (broiler), it became sustainable. Tilapia cultivation using self multiplied fries can be widely extended.	Cooperatives organized by interested farmers of each enterprise of geese farming and Tilapia farming
3. Re-use of drainage water	Sustainable	Water Users' Association at each tertiary canal
4. Research and extension of new varieties and high potential crops	With condition of financial investment to continue production tests	FOFIFA
5. Establishment of forest management association and capacity development	Activities which do not require procurement of new equipment can be continued by organization.	To certain extent, activities can be continued within the existing organizational framework. In order for the community organization to be self sustainable, regular administrative guidance and technical training by the Commune and DREEF will be effective.
6. Protection of natural forest	Other activities should be integrated to increase sustainability.	
7. Prevention of forest fire	Organized activities not requiring procurement of new equipments can be continued.	
8. Development of buffer zone	With the incentive of creating income sources such as fruit tree planting and bee keeping, continuation of activities is secured.	
9. Development of community and school forest	Sustainability of reforestation activities depends on the availability of forestry inputs such as seeds and chemicals. If their own seeds are harvested from some of the tree species such as Eucalyptus and pines, activities can be continued.	
10. Promotion of agro-forestry	Depending on the profitability, activities can be continued.	Community members who selected activities which do not cause problems

Name of the pilot project	Sustainability	Sustainable implementation system
11. Recovery of vegetation in lavaka	Management activities can be continued in the intermediate lavaka where the planted fruits and fodder trees, and pasture grass will become the assets of the participated individuals. It may be difficult to continue activities in active lavaka.	Community organization formed for intermediate lavaka
12. Extension of improved stove	Voluntary continuation of activities by the farmers motivated by learning the benefits of improved stove from the preceding farmers	Guidance by the preceding households

Source: JICA Study team

5.4 Lessons learned from the pilot projects

5.4.1 Effectiveness and applicability of countermeasures to solve the problems

In this section, practicality and applicability of interventions to solve problems in river basin management and agriculture and rural development in the study area are examined based on the previously presented detailed results of assessment adopting the evaluation framework of relevance, effectiveness, efficiency, impact and sustainability. The summary of the practicality and applicability of interventions and results of evaluation basied on the five elements of evaluation is found in Table 5.4.1.

Table 5.4.1 Effectiveness and applicability of countermeasures to solve the problems

Countermeasures/ pilot project	Practicality and applicability
Countermeasures on promotion of diversification of agriculture income sources in the PC23 rain-fed area Pilot project on promotion of diversification of agriculture income sources（Mahakary area）	Double cropping 1) Relevance : In the PC 23 rain-fed area, it is effective to introduce the haricot bean recommended variety for the dry season production. Paddy yield during rainy season fluctuates every season depending on the precipitation and plot surface condition. Thus the selection of moisture and drought resistant varieties of paddy and upland rice is the key to the successful implementation of the intervention. 2) Effectiveness: In addition to the improvement of production technology, land use classification for each crop based on topographic survey and improvement of drainage facilities as appropriate could lead to the successful implementation of double cropping. 3) Efficiency : Implementing land use classification by crop in advance could enhance the efficiency of the intervention to introduce double cropping. 4) Impact : Selection of suitable land based on the land use classification by crop could enhance the diversification of agriculture income sources through haricot beans production. 5) Sustainability : Production of haricot beans could be continued by encouraging the selection and regular renewal of seeds by the farmers'

Countermeasures/ pilot project	Practicality and applicability
	groups. Practicality and applicability : Cultivation of haricot beans in dry season can be effective both in paddy fields and upland in the PC 23 rain-fed area if the improved variety and superior seeds are secured. In order to improve rainy season production, development of land use classification by crop should be implemented in advance. The intervention is applicable to the plots where rain-fed paddy and upland rice production is conducted during rainy season. Poultry farming 1) Relevance : The poultry farming will increase its practicality if the production area is closer to the local market since the market competitiveness of the enterprise depends on the cost of transporting material inputs and produce. 2) Effectiveness : Poultry farming (broiler) contributed to diversification of agriculture income sources. However, the limitation of the local market prevented its successes. The positive outcome of the intervention was enjoyed within a limited geographical area. 3) Efficiency : Farming of layer chicken and local breed was not included in the intervention after considering the market saturation and breeding efficiency. Farming of broiler was converted to geese farming for the following reasons: the breeding efficiency was high by using the water source and fodder grass in the area as feed and has been the specialty of the locality. 4) Impact : In a limited area, farming of broiler chicken was introduced and continued as an agribusiness 5) Sustainability : If there are no incidences of infectious diseases such as avian flue, farming of broiler chicken is sustainable as a form of agribusiness to a limited extent. Practicality and applicability : There is no possibility of new application of broiler production since its success depends on the geographical location and the market is already saturated.
Countermeasures on promotion of diversification of agriculture income sources in the upper and mid river basins of each river Pilot project on diversification of agriculture income sources (Maheriara area)	Double cropping 1) Relevance : Introduction of haricot bean production after production of light sensitive conventional paddy variety cultivated in rainy season could be affected by the on-farm drainage condition of the paddy fields at the beginning of the dry season. Therefore, its relevance can be increased by including the improvement of drainage facilities. Improvement of the conventional production method of paddy agrees with the needs of the farmers and therefore considered to be relevant. 2) Effectiveness : The yield of the indigenous variety was confirmed to have increased by improving the conventional paddy production method. 3) Efficiency : In the area where the water source is available in the dry season, double cropping of paddy was cost effective compared to introducing upland crop after paddy which required the improvement of drainage facilities. 4) Impact : Forcing manure production method, introduced as a part of improvement of conventional paddy production method, can be done near the plots. Many farmers who could not apply manure due to the

Countermeasures/ pilot project	Practicality and applicability
	high cost of transportation enjoyed its impact. 5) Sustainability : Improvement of conventional paddy production methods could contribute to increase yield to a certain level and be sustainable among the farmers. Further, improvement of yield and profitability, and introduction of thermosensitive early and mid maturing varieties can be considered. Practicality and applicability : For a certain period, improvement of conventional paddy production method is an effective intervention for paddy fields in the mid and upper river basins of each river. Double cropping of paddy in the area becomes effective once the drainage condition is improved or thermosensitive early and mid maturing varieties are introduced. Poultry farming : Same as presented under Mahakary area Fish farming 1) Relevance : In an area where a perennial water source with suitable water quality for fish farming is available, fresh water fish farming corresponds to the needs of producer and consumer. 2) Effectiveness : Fish is commonly traded in the local market by the total weight irrespective of the quantity or species. Thus, the selection of fish species of short maturing period requiring small volume of feeds and of easy cultivation methods can increase the effectiveness of the intervention of the diversification of agriculture income sources. 3) Efficiency : Efficiency of the intervention depends on the selection of fish species. Thus, Tilapia, the species which can meet the needs of the producers and consumers, is suitable for cultivation. 4) Impact : Once the appropriate fish farming method for each fish species, the impact can be expected in the existing fish ponds. 5) Sustainability : Since the fish fries supply system is not yet established, Tilapia cultivation is sustainable using the self propagated fish fries. Practicality and applicability : If a water source is readily available, farming of Tilapia is effective in diversifying agriculture income sources. In the study area, the intervention is applicable to the area where the perennial water source with suitable water quality for the purpose is available.
Countermeasures on efficient uses of limited available water resources Pilot project on re-use of drainage water	1) Relevance : The intervention to resolve shortage of irrigation water in irrigated paddy fields via re-use of limited available water source respond to the needs of the community. Their effect to increase yield contributes to the national policy. 2) Effectiveness : Once the rain-fed production is converted to irrigated one, the yield of paddy will effectively achieve the purposes of stabilizing cropping condition and increasing the yield. 3) Efficiency : The intervention is efficient in solving the short term irrigation water shortage. Continuous implementation of the measure will increase the efficiency in the mid term. 4) Impact : Implementation area should correspond to the appropriate water management unit, which could rationalize water management. As a result, impact on efficient use of limited water resources and restructuring and capacity building of Water Users' Association could manifest itself.

Countermeasures/ pilot project	Practicality and applicability
	5) Sustainability : Reorganized Water Users' Association will take the initiative to carry out water distribution and O&M of the facilities in the area. Practicality and applicability : This intervention is effective in resolving short term water shortage in the irrigated paddy fields. A precondition of selecting the target area in PC 23 area is the existence of a Water Users' Association organized by the tenants and land owners in the tertiary canal command area.
Countermeasures on strengthening research system on new varieties and potential crops Pilot projects on research and extension of new varieties and high potential crops	1) Relevance : Improvement of paddy yield through promotion of practical use of high potential thermosensitive mid maturing paddy varieties corresponds to the needs of the community and to the national policy. 2) Effectiveness : Development of seed multiplification and distribution system of high potential variety shall be a pre condition to improve yield through the intervention. 3) Efficiency : Breeding, selection, stabilization of varietal characteristics and practical application of the high potential varieties shall be continued in the long term. Thus, the efficiency of the intervention can be increased by the partnership with the research organization in charge of breeding. 4) Impact : Establishing demonstration plots on-farm will help impact to emerge in a short term. 5) Sustainability: Until the multiplification of certified seeds for distribution to farm households begins, the partnership with the research organization in charge of breeding will ensure the sustainability and effectiveness of the intervention. Practicality and applicability: This intervention is essential to increase the paddy productivity in the area known as granary of the country. The practical use of the potential variety can target the study area and also the riparian paddy production area of Alaotra Lake.
Countermeasures on developing capacity on river basin management Pilot project on establishment of forest association and capacity development	1) Relevance : The intervention is necessary to create the foundation for implementing the community based river basin management activities. 2) Effectiveness : Under this intervention, the communally organized forest association was assisted to acquire status as a legal body, which enables the organization to apply and participate various policy programme prepared by the government. Therefore, this was an effective intervention in conducting autonomous river basin management activities. 3) Efficiency : The level of efficiency relies on the capacity of NGOs which are subcontractors to carry out formation of the association and to provide necessary assistance to develop its capacity. 4) Impact : If the activities responding to the community needs which also serve as voluntary river basin management activities will give the community incentive. By this, the impact of the intervention will be induced. 5) Sustainability : The organized activities can be continued by the association members within the organizational capacity. Practicality and applicability : The intervention is essential in creating a

Countermeasures/ pilot project	Practicality and applicability
	foundation for the community to carry out self governed river basin management in partnership with the government organizations. The improvement of the soil and water conservation function, a purpose of river basin management, can take effect once the various basin management activities are carried out in combination with incentives for activities in a wider area. Thus, the target area of the intervention shall be defined basing on the water system.
Countermeasures to develop river basin management capacity Pilot project on conservation of natural forest	1) Relevance : Protection of natural forest is indispensable to retain the function of water and soil conservation of the river basin. This also corresponds with the national forest policy. 2) Effectiveness : Demarcation and public notification of the protected area and establishing monitoring prevent the illegal encroachment and cutting of trees. However, in order to retain the effects of the intervention, appropriate compensation to the vested right holders in the area or alternative measures shall be implemented as a part of intervention. 3) Efficiency : The intervention can retain the function of the relict natural forest with minimum input. 4) Impact : Negative impacts can be avoided by identifying the non timber forest products and their vested rights holders and appropriate countermeasure for them in the area prior to the implementation. 5) Sustainability : The protection measure can be sustainably conducted by the association once the farming activities, which gives an incentive to the participating members, are integrated with the various basin management activities defined in the by-laws of the association. Practicality and applicability : The intervention can effectively prevent further loss of the forest area. Thus all the surviving natural forest areas will be targeted by the intervention.
Countermeasures to prevent forest fire Pilot project on prevention of forest fire	1) Relevance : Forest fire is a major cause of the degradation of soil and water conservation function of the river basin. Therefore, preventative measures of forest fire agree with the national forest policy and contributes to protect the community asset. 2) Effectiveness : Awareness creation towards fire prevention has reduced incidences of fire caused by accidents. Establishment of fire fighting system became effective in fire extinguishing. Both measures prevented the spread of forest fire. Thus this intervention is effective in preventing forest fire. 3) Efficiency : Since the government is not capable of provising mobile firefighting services, community initiative is indispensable. Thus, the sensitization of fire prevention and development of fire fighting capacity of the community is efficient. 4) Impact : To cope with forest fires spreading from outside of the river basin, the impact of the intervention was rather minimal. Thus, the government intervention applicable to wider area is necessary. 5) Sustainability : Fire fighting system can be maintained once the activities are limited to take place around the settlements of the association members. Practicality and applicability : The intervention is effective in preventing degradation of soil and water conservation function of the river basin. Therefore, the target area shall be all the villages within the river basin.
Countermeasures on	1) Relevance : The intervention meets the community needs by

Countermeasures/ pilot project	Practicality and applicability
recovery of vegetation Pilot project on developing buffer zone	implementing the intervention as part of natural forest protection. 2) Effectiveness : It is rather beneficial for the community to develop forest resources to harvest forest products to improve income rather than depending on the natural forest in the protected area. 3) Efficiency : The achievement of the intervention will be amplified by providing inputs to create income source needed by the community. 4) Impact : A possibility of an immediate impact will increase by diversifying the alternative sources. 5) Sustainability : Giving an incentive to community as a part of the intervention will secure sustainable continuation of the activities by the community. Practicality and applicability : This intervention is effective when implemented as a part of natural forest protection. All the surviving natural forest area in the river basin will be targeted as a part of natural forest conservation.
Countermeasure on recovery of vegetation Pilot project on developing community and school forests	1) Relevance : Implementing the recovery of the vegetation in the degraded land where easily accessible from the settlements and activities to be implemented as part of an environmental education programme meets the national forest policy. 2) Effectiveness : The effects of participatory community forest development can be created by giving incentives to the participating individuals (i.e. providing the seedlings for the privately owned land). 3) Efficiency : For the community, having forest resources to be used as construction materials to build communal and public facilities is more cost effective in the mid and long term compared to collecting taxes when needed. 4) Impact : Integrating school forest development activities into environmental education programme will actively educate the importance of the environmental conservation to the school children. 5) Sustainability : Community and school forests can be maintained by the participating individuals through activities to nurture sense of ownership. Practicality and applicability : The intervention is effective both in recovery of forest resources by re-vegetation in the degraded land, and in developing awareness among the future generation towards environmental conservation. The community having suitable land for community and school forest development and being highly motivated to participate in voluntary collective action will be targeted.
Countermeasures on soil conservation Pilot project on promotion of agro-forestry	1) Relevancy : Prevention of soil erosion from the forest and uplands in the hilly area and improvement of the land productivity give high incentive to the participating individuals. These interventions thus meet the community needs. 2) Effectiveness : With the limited plot area owned, use of upland for productive use is effective though it has rather less land productivity compared to the paddy field. 3) Efficiency : The efficiency of the intervention can be amplified by selecting the farm produce which have high prevention effect of soil erosion and profitability. 4) Impact : Depending on the outcomes generated by the preceding

Countermeasures/ pilot project	Practicality and applicability
	participants, both negative and positive impacts in the surrounding area will emerge. 5) Sustainability : The participating individuals who enjoy benefits from the activities will continue with the implementation. Practicality and applicability : The intervention can create an alternative source of cash income for the community and is highly efficient as a prevention measure to prevent soil erosion. Thus the target area will be the villages where the surrounding hilly area is used as upland and fuelwood forest.
Countermeasures on soil conservation Pilot project on recovery of vegetation in lavaka	1) Relevance : The intervention is effective in intermediate lavaka where the soil of the collapsed surface is stabilized to certain extent. However, the beneficiaries of the intervention are limited to stakeholders around lavaka. It is rather less effective in active lavaka where the bulk of soil is being washed away. 2) Effectiveness : The effectiveness of the intervention amplifies through soil stabilization of the alluvial fan formed in the downstream of lavaka and its use as farm land. 3) Efficiency : The inputs to the reforestation around lavaka and use of alluvial fan in the downstream as farm land will yield higher efficiency compared to the civil engineering work to block the erosion path from lavaka. 4) Impact : Ripple effects of the intervention will be increased by conducting information dissemination among the stakeholders around lavaka having similar problems. 5) Sustainability : If the use of the alluvial fan as farm land gives incentives to the participating individuals, the intervention can be sustainably continued. Practicality and applicability: Use of the alluvial fan as farm land in the downstream gives an incentive to the stakeholders around lavaka, which will secure its effectiveness. Thus, the intervention will target the lavaka which satisfies such condition.
Countermeasures to reduce load on environment Pilot project on extension of improved stove	1) Relevance : Housework can be rationalized and the household economy improved by reducing the fuelwood consumption. Therefore, the intervention responds to the community needs. 2) Effectiveness : The reduction of fuelwood consumption is an effective intervention to recover productivity of the limited forest resources. 3) Efficiency : The improved stove can be made locally with available materials. Its design can also be adjusted according to the needs of the community. Therefore, the intervention is highly efficient. 4) Impact : Heat retention effect of the improved stove enabled drinking water to be boiled. By drinking the boiled water, the incidences of contracting infectious diseases among infants and children is expected to reduce (impact on the household health and sanitation). 5) Sustainability : Awareness promotion by the users of the improved stove promoted the voluntary extension of the stove among the community members. Thus, the sustainability of the intervention is high. Practicality and applicability : The intervention can improve household economy, health and sanitation.

Countermeasures/ pilot project	Practicality and applicability
	Thus it can be implemented in all the area where the efficient use of limited forest resources is required. This will bring the benefits to the larger population.

Source: JICA Study team

5.4.2 Lessons learned to be reflected in the basin management and rural development plan

This section summarizes the lessons learned through the results of evaluation of pilot projects upon completion and the assessment of practicality and applicability of countermeasures in solving problems in river basin management and rural development in the study area. These lessons shall be reflected in the master plan for river basin management and rural development.

(1) Improvement of income by increased production of agriculture produce

The majority of households totaling 12,700 in the study area earn their living through agriculture. Thus the increased yield of agriculture produce is indispensable. The results of the pilot project to assess practicality and applicability of countermeasures for agriculture income sources suggested that the three factors of increase in land use efficiency and crop productivity; and promotion of diversification of agriculture produce could contribute to improve income generated by agriculture are important in designing the development plan. The lessons learned are as discussed bellow.

1) Increase in land use efficiency:

In the study area, the land resource suitable for paddy field has already been exploited both in the upper and lower river basins in the study area. Thus, yield of paddy cannot be increased by the development of new paddy field area. As an alternative measure, double cropping of paddy or that of paddy and other crop can be introduced to the existing paddy area in order to increase the yield of paddy and upland crops by improving land use efficiency. The double cropping of paddy can be introduced in the area where irrigated water is available during dry season. That of paddy and other upland crop is applicable to the area where the soil moisture can be retained for the second crop production in dry season. In the existing upland, land use efficiency shall be improved through mixed cultivation and rotation cropping due to the following three reasons. 1) The surface soil in the hilly area has already been lost by the prolonged erosion. 2) The distribution of upland with high land productivity is limited. 3) Most available land for cultivation has already been used by the farmers.

2) Improvement of crop productivity:

Existing cultivation methods of paddy and upland crops which are widely adopted in the

study area has a lot of potential for innovation. It is effective to improve unit yield by extending improved production methods which can easily be accepted by the farmers. The methods of improving crop productivity shall have the high replicability and sustainability combining the following interventions: selection of varieties having characteristics to suit the topography and soil condition; introduction of mid and early maturing paddy varieties; use of superior seeds; development of soil fertility; improvement of farm management; introduction of water saving irrigation; and improvement of post harvest processing. Especially, it is necessary to implement interventions to achieve commercialization of mid and early maturing paddy varieties and certified seed multiplication in order to support the productivity of paddy which is the main crop in the area.

3) Promotion of diversification of agriculture produce:

Introduction of farm management in combinations of crop production and fishery or livestock is an effective way to diversify agriculture produce. Considering the situation in study area and its surrounding, the following interventions should be considered; freshwater fish farming (i.e. Tilapia) in the area where the perennial water source is available; geese farming which is recognized as "Geese of Alaotra"; fodder crop production for cattle which can also provide organic manure as well as assets of the villagers.

(2) Increase of income by enhancement of agriculture production infrastructure

In the study area, in order to improve the income of farm households by increasing the production of farm produce, development of agriculture infrastructure is essential. The results of the pilot projects to assess practicality and applicability of the measures to efficiently utilize limited available water source strongly suggested that the development plan shall integrate appropriate land use to suit the topographic condition; efficient use of limited water resource; and strengthening of the O&M of the irrigation system. The lessons to be integrated into development plan are explained in detail as follows.

1) Appropriate land use : Based on the existing condition of irrigation, the PC 23 area shall be divided into three: irrigated area of 3,800 ha under P5 main canal system as PC 23 south west area; irrigated area of 5,400 ha under P1main canal system as PC 23 northwest area; and tail end of PC 23 area covering 7,100 ha as PC 23 east area. Interventions to cope with the issues in each area shall be developed for the time being. In the long run, interventions to integrate three areas into one are required. Especially, in the PC 23 east area, improvement of condition of rain-fed upland crop production is important through developing appropriate land use plan for the narrowly divided landscape by counter line. In the mid and upper stream of each river, the following interventions shall be considered: innovative use of paddy field; development of suitable area for fresh water fish farming; effective use of unused land such as alluvial fan in the downstream of lavaka; introduction of hedgerow planting method and terracing in the upland using the slope area; and development of upland in the moderate slope area surrounding the settlements.

2) Effective use of limited available water resources : In order to solve the irrigation water shortage in the south west and north west area of PC 23 area, by taking advantage of the given condition of the facilities, existing irrigation system shall require urgent improvement work by re-use of the drainage water. Further, from the mid and long term perspective, for the effective use of water resources, major rehabilitation of irrigation and drainage facilities shall be conducted while using the drainage water re-use system. By the use of re-use system, the appropriate timing for paddy production in rainy season and introduction of paddy or upland crop for dry season production will be possible. Mid and small scale irrigation schemes spread in the hilly and mountainous areas of upper river basin require rehabilitation of existing facilities and development of water management capacity of the farmers in order to effectively utilize water resources.

3) Strengthening of O&M of irrigation system : In order to strengthen water management organization, reformation of the existing Water Users' Association is necessary. In the PC23 area, land owners and tenants will organize Water Users' Association in each tertiary field block. Federation of the block based Water Users' Association will be established at each secondary canal. Such reform is the precondition of the rehabilitation of infrastructure. In the irrigation area in the upper river basin, establishment and enhancement of water management organization must be done prior to the rehabilitation of the facilities.

(3) Retention of soil and water conservation and improvement of forest resource management by developing river basin management capacity

In the river basins of Shabe, Sahamilahy and 4 mid and small rivers, vegetation in the basin

as a whole has been degraded by the unregulated and irresponsible exploitation of land and natural resources. Since the natural forest still remaining in the small area is critical in conserving water and soil, establishment management body of the forest and coordination of the natural forest conservation and uses of resources are to be done urgently. From the results of the pilot project, in order to maintain degraded land and recovery of function of forest resource management through developing capacity of river basin management, it is important to design a development plan emphasizing the 2 factors of 1) enhancement of stakeholder organizations and improvement of basin management capacity; and 2) development of management method of forest resources. These two points are further explained bellow.

1) Enhancement of organizations concerned and development of river basin management capacity：

In order to increase effectiveness of the river basin management activities targeting a large geographical area, a community participatory approach based on the understanding and cooperation between the villagers in the basin shall be introduced instead of government-led interventions which often impose many limitations. In order to adopt the participatory approach, coordination and enhancement of stakeholder organizations and development of their basin management capacity are required. Further, to enable sustainable natural forest conservation and forest resource management by the community organizations, community organization shall be established. It is important to provide practical trainings for the community members to acquire river basin conservation technology and developing organizational management capacity. At the same time, interventions to develop capacity of forest management and organizational management of the government officers concerned shall also be considered.

2) Conservation of natural forest and development of method for forest resource management：

In order to conserve natural forest, functions of the relict natural forest in each river basin to conserve soil and water in the river basin shall be maintained while the methods of forest resource management are required to be developed. For man-made forest, nursery management technology shall be extended for sustainable use.

(4) Prevention of degradation of forest resources by reducing the damage caused by forest fire

Damage caused by the repeated forest fire degrade the recovery of the vegetation in the river basin and accelerate degradation and loss of the grass and bush. This has indirectly caused soil erosion in the river basin. The results of the pilot projects to assess practicality and applicability of forest fire prevention measures strongly suggested that it is important to

incorporate preventative and fire extinguishing measures in the development plan. The lessons learned are explained bellow.

1) Prevention of forest fire：Most cases of forest and wild fire have been caused by the villagers living in the surrounding area by accident. Community and government offices concerned shall cooperate and carry out sensitization activities that the prevention of forest also benefits the local community. It is necessary to organize the community; sensitize on the needs of fire prevention, and how to deal with wild fires; establishment of fire prevention zone; regular monitoring for fire prevention; establishment of fire alarm system; and provision of necessary equipments and tools for fire fighting. To minimize the damage caused by the spreading of fire, it is important to carry out fire prevention activities in a larger geographical area.

(5) Reduction of soil erosion from the river basin by recovering the forest resource

It is indispensable to recover and develop forest resources through various reforestation activities in order to minimize soil erosion from the surrounding river basins caused by degradation and deterioration of vegetation in the entire study area and to improve agriculture productivity. The results of the pilot projects strongly suggested the following points to be reflected in the development plan: 1) development of forest resources; 2) promotion of reforestation; and 3) soil conservation by re-vegetation. The lessons learned are as discussed bellow.

1) Development of forest resources : In order to designate relict natural forest in the river basin as protected area and limit the uses of non-timber forest products as vested rights, it is necessary to create new forest resources to provide alternative income sources. Thus, the intervention should take effects in short period and also integrate diversification of natural resources to meet the community needs.

2) Promotion of reforestation : In order to recover forest resources in both river basins, it is important to promote reforestation in the degraded grassland around the settlements by community participation. Development of system and framework to give incentive to the community members to take part in forest management and reforestation activities; community rights and obligation; clarification of procedure to apply for the system are required to be done. Further, sensitization of RFR reforestation system and framework, promotion of reforestation and establishment of support are to be given to the land owners in the remote degraded grassland from settlements.

3) Soil conservation via recovery of vegetation : In order to improve water and soil conservation function of grassland and bush covering the large part of the hilly area in each river basin, elimination of the irresponsible land use, and appropriate land

use taking re-vegetation into consideration is required. For this purpose, appropriate land use technology for grazing, reforestation and upland farming is required to be extended. In the hilly area, the following measures are important: prevention of degradation of vegetation by introducing fodder crop production technology and improving grazing method by demarking the grazing plot; prevention of soil erosion by selecting the appropriate crop to suit the land condition and practice of rotational cropping; and extension of conservation agriculture by introducing agro-forestry. In lavaka, direct sowing of tree seeds, reforestation, planting of fodder tree and grass to develop alluvial fan in the downstream, and prevention of soil erosion by recovering vegetation around lavaka are necessary.

4) Integration of soils and water conservation in the river basins into measures to improve the income of the community households: The majority of the households in the upper and mid river basins in the study area earn their living both from agriculture and forestry. Implementing participatory river basin management without incentive is not attractive to the villagers, which also threatens the sustainability and replicability of the intervention. Therefore, the development plan shall include the intervention which serves both purposes by integrating the income generation opportunities as a part of soil and water conservation activities in the river basin.

(6) Improvement of livelihoods condition by rationalizing housework

In all the settlements in the study area, village households still use a traditional three stone cooking stove. In the village in the upper basin, women and children take the responsibility for time-consuming house work and collection of fuelwood. Communities in the downstream, villagers buy fuelwood for which cost has been a burden on the household economy. The results of the pilot project draw our attention to the value of minimizing the household consumption of fuelwood through extension of the improved stoves which can improve the household living condition of the villagers in the study area and beyond when designing the development plan. The lessons learned are as bellow.

1) Extension of improved stove : In order to improve the livelihood of village households in the study area, efficient household fuel use through introduction of improved stoves which have a high heat retention rate and fire is necessary. This intervention can improve the nature of house work and reduce the work load of women and children. The time spent on collection of fuelwood in the upper stream basin can be reduced. The cost of buying household fuelwood of the households in the downstream river basin can also be minimized. Extension of improved stove is expected to generate ripple effects of conservation and effective uses of forest resources. This can also improve the household health and sanitation by encouraging villagers to boil water for drinking using the retained heat of the stove which is likely to reduce the incidences of infants and children contracting infectious diseases.

5.4.3 Lessons learned for management of pilot projects

In achieving the objectives of the pilot projects, some considerations for management are required in addition to technical consideration. Some of the previously implemented projects in Madagascar with bilateral and multilateral assistance could not manage to achieve their objectives due to some limitations. Due to these precedents, the government of Madagascar is well aware of the difficulties in project management. Thus, the assumptions made prior to the project implementations and lessons learned are presented in Table 5.4.2.

Table 5.4.2 Lessons learned through pilot project implementation (Project management)

Points of consideration	Lessons learned from pilot projects for project management
Management/ administrative procedures	
1. Cooperation with the counterparts	A counterpart team was organized by technical staff of Alaotra Mangoro DRDR and DREFEE. The team attended the steering committee meetings held during the field survey and in the capital city as a stakeholder of Madagascar. Good working relationship was maintained between the study team and the team.
2. Cooperation with the community leaders	Regular reporting was made to the Commune, the lowest administrative body of Madagascar. Villagers are invited to participate in the meetings. Community leaders are instructed and advised as required.
3. Management of project funds	Per diem of the counterparts was processed according to the JICA regulation. All the costs of pilot projects are appropriated as the cost of subcontract. The progress of spending of the subcontractors was monitored.
4. Communication	The communications to develop consensus and share information between the study team, counterpart team and subcontractors were facilitated through meetings. Regular meeting was held on a weekly basis between the study team and counterpart team. The meetings with subcontractors were held according to the progress of the projects.
5. Human resources	Subcontractors were employed to carry out pilot project activities involving community participation with monitoring by the study team. When the study team was away from Madagascar, the local staff employed by the study team carried out by the monitoring.

Points of consideration	Lessons learned from pilot projects for project management
6. Utilization of local resources	In order for the local community to sustain the activities implemented by the pilot projects, utilization of local resource is prerequisite. Thus, the project objectives were set to the level which can be achieved with input of sustainable level.
7. Record of activities	Subcontractors were instructed to ensure a written record of the activities to be kept by the secretaries of the cooperative and groups organized by the community.
Consideration for community	
8. Good understanding for needs of the local community	Meetings were held with the community to explain the objectives of the pilot projects and methods of implementation as well as to understand the reaction of the community and their needs. The information gained through such meetings was reflected on the project activity plan as appropriate.
9. Respect for local culture	When selecting the subcontractors, their understanding of the behaviors and social norms was considered as a selection criteria. This was to minimize the risks of incidences of miscommunication with the community once the projects commenced. However, some of the subcontractors placed priorities on cost efficiency of the subcontracted activities and lacked considerations to the local culture. The subcontracts were not given to these firms and organizations when the bid was conducted in the following year.
10. Consideration for Gender	Pilot project on extending improved stove was to improve the household environment. Thus the target population was women in the households.
11. Dissemination of information	In order to avoid unnecessary misunderstandings among the villagers outside of the study area, information was provided to the Commune and disseminated through radio.
12. Clarification on land ownership	In principle, public or communally owned land was used for reforestation and developing facilities during the pilot projects. However, some of the privately owned land was also rented through subcontractors. In this case, the rent decided through negotiation was paid to the leaser. Furthermore, in the case of using the land owned by participating individuals, the decision was made by the association.

Source: JICA Study team

EXPLANATION NOTE 5-1

PDM FOR PILOT PROJECTS

Attachment 5-1 PDM for Pilot Projects (1/12)

Pilot projects on promotion of diversification of agriculture income sources (Mahakary area)

Name of the pilot project:
Promotion of diversification of agriculture income sources(Mahakary area)

Implementation period: 2004.10～2007. Ver. No.: 1

Target area: Mahakary village

Target group: Farmers' groups in Mahakary commune

Date: 2004.10.27

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
Income of all the villagers in Mahakary commune is increased.	1. The number of households adopted income diversification system increase by 30% by 2012 compared to the beginning of the pilot project. 2. Average income of the households adopted income diversification system increases by more than 30% compared to the beginning of the pilot project.	Annual report (Anparafarabra CIRAPV office)	
Project Purpose			
Income of the farmers' group is increased by diversification of income sources. (introduction of double cropping of paddy, fruits tree growing, poultry farming)	Average income of the farmers' group is increased by more than 30% by August, 2007 compared to the beginning of the pilot project.	Baseline survey report produced by the subcontractor and annual report	1. Majority of the farmers including the villagers in the surrounding will keep motivated to self-sustain income sources diversification system. 2. No critical diseases of livestock and pests will occur. 3. No critical natural disaster will occur. 4. Marketing channel of the farmers' group will not be disturbed.
Outputs			
1. Double cropping of paddy and fruits tree production are carried out by the farmers' group. 2. Poultry farming is implemented by the farmers' group. 3. Marketing channel for their produces is identified by the farmers' group.	1.More than 80% of the initial members of the farmers' group implements double cropping of paddy/ fruits tree production in August, 2005. 2. More than 80% of the initial members of the farmers' group carry out poultry farming in August, 2005. 3. More than 80% of the farm produces are marketed through the channel identified by the farmers' group in August, 2005.	Monthly and annual report of the subcontractor Monthly and annual report of the subcontractor Report on the marketing channel identification and annual report of the subcontractor	1. More than 80% of the members of the farmers' group will remain in the original settlement and not relocate to the remote areas. 2. No fatal epidemic of livestock or pests will occur. 3. No fatal natural disaster will occur. 4. Marketing channel identified by the farmers will not be disturbed.
Activities	***Inputs***		
1. Double cropping of paddy/ Fruits tree production group 1.1 Beneficiaries are selected. 1.2 Baseline survey is conducted. 1.3 Farmers actually carries out double cropping/ fruits tree production under the sensitisation and technical guidance of the specialists. 1.4 Field visits to the progressive farmers are conducted. 1.5 Monitoring and evluation are carried out. 1.6 Guidance for the farmers' group to acquire legal status is conducted. 1.7 Manual for the farmers' group is developed. 2. Poultry Farming (Broiler) Group 2.1 Beneficiaries are selected. 2.2 Baseline survey is conducted. 2.3 Marketing survey is carried out. 2.4 Farmers carry out poultry farming (broiler) under the sensitisation and technical guidance of the specialists. 2.4 Field visit to the progressive farmers is carried out. 2.5 Monitoring and evaluation are conducted. 2.6 Guidance for the farmers' group to acquire legal status is conducted. 2.7 Manual for the farmers' group is developed. 3. Identification of marketing channel 3.1 Training for the farmers' group to identify marketing channel for the produces is carried out.	***Japan side*** ***Human resources*** - Farm management/ extension specialist - Agriculture/ Participatory development specialist - Community mobilisation specialist - Subcontractor (NGO) Funds - Subcontracting fees for the NGO	***Madagascar side*** ***Human resources*** - Officer in charge of farm management - Officer in charge of community relations Land (villagers) - Construction of poultry cage, paddy double cropping and fruits tree production Funds (villagers) - Cost sharing (villagers)	1. More than 80% of the members of the farmers' group will remain in the original settlement and not relocate to the remote areas. 2. No fatal epidemic of livestock or pests will occur. 3. No fatal natural disaster will occur.
			Pre conditions Farmers will agree to the objective of the pilot project and are willing to establish a group.

Attachment 5-1 PDM for Pilot Projects (2/12)

Pilot projects on promotion of diversification of agriculture income sources (Maheriara area)

Name of the pilot project: Promotion of diversification of agriculture income sources (Maheriara area)	Implementation period: 2004.10～2007	Ver. No.: 1
Target area: Maheriara village	Target group: Farmers' group in Maheriara commune	Date: 2004.10.30

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
Income of all the villagers in Maheriara commune is increased.	1. The number of households introduced income sources diversification system by 2012 is increased by more than 30%. 2. The average income of the households adopted income sources diversification system is increased by more than 30% compared to the beginning of the pilot project.	Annual report (Anparafarabra CIRAPV office)	
Project Purpose			
Income of the farmers' group is increased by income sources diversification (introduction of double cropping of paddy, poultry farming and fish farming).	By August 2007, the average income of the farmers' group increases by more than 30% compared to the beginning of the pilot project.	base line survey report and annual report by the subcontractor	1. Majority of the farmers including the villagers in the surrounding will keep motivated to self-sustain income sources diversification system. 2. No critical diseases of livestock and pests will occur. 3. No critical natural disaster will occur. 4. Marketing channel of the farmers' group will not be disturbed.
Outputs			
1. Double cropping of paddy is carried out by the farmers' group. 2. Poultry farming is implemented by the farmers' group. 3. Fish farming is carried out by the farmers' group. 4. Marketing channel for their produces is identified by the farmers' group.	1. More than 80% of the initial members of the farmers' group carry out double cropping of paddy in August, 2005. 1. More than 80% of the initial members of the farmers' group carry out poultry farming in August, 2005. 1. More than 80% of the initial members of the farmers' group carry out fish farming in August, 2005. 4. More than 80% of the farm produces are marketed through the channel identified by the farmers' group in August, 2005.	Monthly and annual report of the subcontractor Monthly and annual report of the subcontractor Monthly and annual report of the subcontractor Report on the marketing channel identification and annual report of the subcontractor	1. More than 80% of the members of the farmers' group will remain in the original settlement and not relocate to the remote areas. 2. No fatal epidemic of livestock or pests will occur. 3. No fatal natural disaster will occur. 4. Marketing channel identified by the farmers will not be disturbed.
Activities	***Inputs***		
1. Double cropping of paddy group 1.1 Beneficiaries are selected. 1.2 Baseline survey is conducted. 1.3 Market survey and training on identification of marketing channel for rice/ haricot bean are carried out. 1.4 Farmers actually carrie out double cropping under the sensitisation and technical guidance of the specialists. 1.5 Field visits to the progressive farmers are conducted. 1.6 Monitoring and evluation are carried out. 1.7 Guidance for the farmers' group to acquire legal status is conducted. 1.8 Manual for the farmers' group is developed. 2. Poultry farming group (Broiler) 2.1 Beneficiaries are selected. 2.2 Baseline survey is conducted. 2.3 Market survey and training on identification of marketing channel re carried out. 2.4 Farmers actually carrie out poultry farming under the sensitisation and technical guidance of the specialists. 2.5 Field visits to the progressive farmers are conducted. 2.6 Monitoring and evluation are carried out. 2.7 Guidance for the farmers' group to acquire legal status is conducted. 2.8 Manual for the farmers' group is developed. 3. Fish Farming group 3.1 Beneficiaries are selected. 3.2 Baseline survey is conducted. 3.3 Farmers actually carrie out fish farming under the sensitisation and technical guidance of the specialists. 3.4 Field visits to the progressive farmers are conducted. 3.5 Market survey and training on identification of marketing channel are carried out. 3.6 Technical training, monitoring and evluation are carried out. 3.7 Guidance for the farmers' group to acquire legal status is conducted. 3.8 Manual for the farmers' group is developed.1. Double cropping of paddy/ Fruits tree production group	***Japan side*** ***Human resources*** - Farm management/ extension specialist - Agriculture/ participatory development specialist - Community mobilisation specialist - Subcontractor (NGO) Funds - Subcontracting fees (NGO)	***Madagascar side*** ***Human resources*** - Officer in charge of farm management - Officer in charge of community relations Land (Villagers) - Land for poultry cage, construction of fish ponds, and double cropping of paddy Funds (Villagers) - A part of the costs of activities (Villagers)	1. More than 80% of the members of the farmers' group will remain in the original settlement and not relocate to the remote areas. 2. No fatal epidemic of livestock or pests will occur. 3. No fatal natural disaster will occur.
			Pre conditions Farmers will agree to the objective of the pilot project and are willing to establish a group.

Attachment 5-1 PDM for Pilot Projects (3/12)
Pilot project on re-use of drainage water

Name of the pilot project : Re-use of drainage water		Implementation period : 2004.10～2007	Ver. No. : 1
Target area : PC23area P5 main canal	Target group : Land owners and tenants of C5.5.2 area		Date : 2004.10.27

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Re-use system of drainage water in the model area create ripple effect to the area of 1,600 ha where irrigation is difficult.	1. Facilities for efficient water ruse are constructed in 5 sites. 2. More than 5 farmers' organisations are established. 3. Agreement of water distribution in 1600(ha) is established and water is distributed to 60% of the area accordingly.	1. Irrigation Monitoring record 2. Data from DIRDR	1. Natural disaster including drought will not occur. 2. Budget for monitoring is allocated to the responsible DIRDR. 3. Funds for construction of re-use of drainage water facilities and rehabilitation of irrigation facilities are produced.
Project Purpose Efficient water use system in the model area takes root.	1. Water distribution based on the agreement is carried out by 60% of farm households. 2. 60% of farm households participate in the maintenance activities during off seasons. 3. Government officers will collect and process irrigation monitoring data and make it readily available for reference.	1. Irrigation monitoring record 2. Maintenance record 3. Data from DIDRDR	1. Natural disaster including drought will not occur. 2. Budget for monitoring is allocated to the responsible DIRDR. 3. Sufficient irrigation and drainage water is supplied by the upper stream farming area.
Outputs 1. Re-use facilities of drainage water planned through the initiative of farmers is established. 2. Sense of ownership among the farmers' group towards irrigation and drainage facilities is nurtured. The group can carry out the O&M activities. 3. Farmers' group has the capacity to plan water distribution by themselves and to manage rotational irrigation system. 4. Capacity of government staff members to carry out relevant works is increased.	1-1. More than 50% of the target farmers attend the ratification meeting. 1-2. Constructed facilities are handed over to the farmers' group. 2-1. More than 50% of the target farmers participate in developing O&M plan and O&M training. 2-2. More than 50% of the target farmers take the initiative to carry out O&M activities during the off season. 3-1. More than 50% of the farmers take part in development of a plan and training of water management. 3-2. Water distribution following the plan is carried out in 50% of the area. 4-1. Monitoring data is recorded in the office.	1-1. List of attendants to the ratification meeting 1-2. Certificate of transfer of facilities 2-1. Record of participants to the O&M training 2-2. Record of O&M 3-1. Record of participants to the water management 3-2. Irrigation monitoring record 4-1. Data from DIDRDR	1. Natural disaster including drought will not occur. 2. Budget for monitoring is allocated to the responsible DIRDR. 3. Sufficient irrigation and drainage water is supplied by the upper stream farming area.
Activities 1-1. Meeting to confirm the needs of the farmers in the target area and explain participatory development 1-2. Implementation of the field reconnaissance to assess the present condition of beneficiary farmers, paddy field and irrigation faciliteis 1-3. Profile and cross levelling of the target drainage and tertiary canal by DIDRDR staff 1-4. Development of a plan for efficient water use by the initiative of farmers' group 1-5. Development of provisional facilitiy design report, provisional cost estimate and construction schedule 1-6. Survey on capacity of contractors around project area 1-7. Approval at the ratification meeting on provisional design report, cost estimate, implementation schedule, cost sharing and demarkation of O&M responsibilities 1-8. Preperation of tender document, PQ and tender procedure 1-9. Contract of constructio 1-10. Construction management (quality, progress, budget, and safety) 1-11. Final inspection and payment 1-12. Handing over of the faciltieis to the farmers' group 2-1. Situational survey on O&M of the facilities 2-2. Preperation of O&M plan (draft) by the initiative of the farmers' group 2-3. On-site training on O&M 2-4. Finalisation of O&M plan of the faciltieis 3-1. Suryve on present water use 3-2. Preperation of the water distribution plan (draft) by the initiative of the farmers 3-3. On-site training on water distribution 3-4. Finalisation of water distribution plan 4-1. PCM training for the governmetn staff 4-2. Identification of monitoring items by the government staff 4-3. Agreement on the monitoring items with the farmers 4-4. Preperation of project monitoring plan	***Inputs*** ***Japan side*** - Motorcycle to be used for monitoring of the pilot project - Cost of O&M training for the farmers' group - Cost of water management training for the farmers' group - Cost of conducting workshops with the farmers and government staff - Construction supervisor (Japanese) - Construction of irrigation and drainage facilities by the contractors (provision of cost of construction) - Cost of employing site assistants	***Madagascar side*** - Cost sharing of the construction costs by the beneficiary farmers - Development of tail end canal by the beneficiaries - Implementation of profile and cross levelling - Cooperation for conducting workshops - Cooperation for field reconnaissance - Cost of monitoring of pilot project	1. Natural disaster including drought will not occur. 2. Sufficient irrigation and drainage water is supplied by the upper stream farming area. ***Pre conditions*** 1. There is a need of re-use of drainage water in the model area. 2. Sufficient drainage water to be used for irrigation is supplied by the upper stream farming area.

Attachment 5-1 PDM for Pilot Projects (4/12)
Pilot Project on research and extension of new varieties and high potential crops

Name of Pilot Project: Research and extension of new varieties and high potential crops	Implementation Period: 2004.10～2007 Ver. No.: 1	
Target area: All the study area	Target group: small scale farmers in the study area	Date: 2004. 10.29

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
1.Income of the small scale farmers in the study area is improved.	1.Double cropping system of paddy is extended. 2.Early and mid maturing varieties for varying farming systems are identified and disseminated.	1.Annuarl Report/DIRDR 2.Annual Report/CIRAPV	
Project Purpose			
1.Double cropping of paddy is extended around the experimental plot.	1.10% of the farmers participated in the field study visit will apply double cropping system in their plots.	1Annaul Report of the Subcontractor	1.Farmers who participated the field study visit and workshops will apply the research results to their own plots. 2. Appropriate agriculture supporting services will be developed to create a conducive environment for the farmers to adopt the research results. 3.No unexpected and serious damages will be caused by pests and sudden climate change.
Outputs			
1.High potential early and mid maturing paddy varieties including Erica which can be adopted to the study area are selected. 2. Second crop after paddy, suitable to the study area, is selected. 3.Double cropping system of paddy suitable to the study area is verified. 4.Appropriate production systems of paddy, upland rice, and second crop are developed. 5.Research outputs are shared with the farmers in the area through field study visits. 6.Research outputs are shared with the relevant agriculture supporting organisations through workshops. 7.Annual report and guidelines for crop production to report the research outputs are prepared.	1.One variety is selected from each of the high potential paddy varieties and NERICA varieties. 2.High potential second crop after paddy is selected. 3.Production period of double cropping of paddy reaches 9 months. 4.Unit yield is increased by 30% compared to the conventional farming method. 5.Each visit has more than 50 participants. 6.Each workshop has more than 50 participants from the relevant agriculture supporting organisations. 7. Reports on the research outputs and guideline for crop production are distributed to the stakeholders.	1.Annual Report from the subcontractor 2.Annual Report from the subcontractor 3.Annual Report from the subcontractor 4.Annual Report from the subcontractor 5.Report on the field study visit from the subcontractor 6.Monthly Report from the subcontractor 7.Monthly Report from the subcontractor	1.Farmers who participated the field study visit and workshops will apply the research results to their own plots. 2. Appropriate agriculture supporting services will be developed to create a conducive environment for the farmers to adopt the research results.
Activities	***Inputs***		
1.Cropping test of early and mid maturing paddy varieites（1st -3rd year） 1-1 First cropping test（Transplanting and direct seeding） 1-2 Second cropping test (Translplanting and direct seeding) 1-3 Third cropping test (Transplanting and direct seeding) 1-4 Conduct field study visits 2. Second crop cropping test（Haricot bean, irish potatoes to be conducted between 2nd and 3rd year） 2-1 First cropping test 2-2 Second cropping test 2-3 Third cropping test 2-4 Conduct field study visits 3. Varietal selection tests of NERICA Rice（to be condcted between 1st - 3rd year） 3-1 Varietal selection test is conducted in PC23 area. 3-2 The same is conducted in Maheriara area. 3-3 Field study visits 4. Establishment of demonstration plot for double cropping of paddy (2006) 4-1 3 sites in PC 23 area 4-2 1 site in A zone 4-3 1 site in B zone 4-4 Conduct field study visits 4-5 Conduct workshops 4-6 Prepearation of reports and production guidelines	***Japan side*** ***Human resources*** - Farm management/ extension specialist - Agriculture/ participatory development specialist - Community mobilisation specialist - Subcontractor (NGO) Funds - Subcontracting fees for the NGO	***Madagascar side*** ***Human resources*** - Officer in charge of farm management - Officer in charge of community relations Land (villagers) - Land where the poultry cage and fish ponds are to be constructed; where the double cropping of paddy is adopted. Funds (villagers) - Part of the costs of activities (villagers)	1.Seed paddy of early and mid maturing varieties suitable to the condition of Arocha Lake riparian area can be obtained. 2.NERICA variety to be used for experiment can be obtained. 3.Seeds to be provided as second crop can be procured. ***Pre conditions*** 1.Implementation agency subcontracted by the study team will carry out the field experiment according to the contract.

Attachment 5-1 PDM for Pilot Projects (5/12)

Pilot Project on establishment of forest management association and capacity development

Name of Pilot Project:
Establishment of forest management association and capacity development

Implementation period: 2004.10～2007. Ver. No.: 1

Target Area:
Antetezantany village
Sahadiningana village

Target Group: Villagers in the target area (160 households)

Date: 2004. 10. 29

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
Natural resources are conserved well and functions of land and water conservation are maintained well.	1. Forest area in the target area is increased more than 150 ha in 2014 compared to the present. 2.The level of soil erosion is reduced in 2014 compared to the present level.	1. Forest survey and analysis of Landsat images 2. Survey on soil erosion and river flow	Policy concerning forest conservation in Madagascar will not change.
Project Purpose			
Forest and natural resource conservation in the target area is promoted by the initiative of villagers.	1. The number of incidences of forest fire is reduced by 2007 compared to the present. 2. Illegal cutting of trees is reduced in 2007 from the present. 3. Vegetation of the degraded land in the target area is partly recovered in 2007 through reforestation compared to the present condition.	1. Report from the responsible forest office 2. Report on the inspection visits and interview with the farmers during the natural forest conservation project 3. Field reconnaissance	1.The inspection and survey by the forest officers will not be hindered. 2. Report on regular inspection can be reviewed without problems. 3. Non hindrance will not occur when carrying out field reconnaissance.
Outputs			
1. Forest conservation project implementation committee is organised in the target area. 2. Pilot project implementation committee acquires the capacity to autonomously manage the project activities in efficient and sustainable ways.	1-1. Executive members of the committee are selected and their duties clearly defined. 1-2. Official registration procedures of the committee begins by February, 2005. 2-1. Internal regulations of the committee aiming at self reliant and sustainable management of the organisation is developed by February, 2005. 2-2. One or more project(s) other than pilot project is/are proposed in 2007.	1-1. Interview with the members, relevant documents 1-2. Copy of the application document for registration 2-1. Interview with the members, relevant document such as internal regulation 2-2. Copy of the new project proposal	No strong objections or problems against establishing a new association will not arise.
Activities	***Inputs***		
1-1. Through workshop to establish forest conservation committee by sensitisation of the villagers, roles of the committee members are defined. 1-2. Committee members are supported so that it can be officially registered. 2-1. Training of the members is carried out to develop self sustainable reliant capacity. 2-2. Committee members are trained to acquire capacity to develop project proposal. 2-3. Follow up is carried out to improve the organisational management capacity.	***Japan side*** ***Human resources*** - watershed management/ participatory forestry specialist - Subcontractor (NGO) Project cost - Workshop to sensitise farmers - Training - Follow up	***Madagascar side*** Human resources - Officer in charge of watershed management - Contribution of labour by the beneficiaries	Villagers will establish organisation for forest conservation and show strong interests in participating in activities.
			Pre conditions Villagers will not object against implementation of the pilot project in the target communes.

Attachment 5-1 PDM for Pilot Projects (6/12)
Pilot Project on natural forest conservation

Name of Pilot Project: : Natural forest conservation | Implementation Period: 2004.10～2007 Ver. No.: 1

Target Area: Antetezantany village | Target Group: Villagers in the target river basin | Date: 2004. 10. 29

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
Natural resources are conserved well and functions of land and water conservation are maintained well.	1. Forest coverage rate in the upper river basin of the pilot project is maintained or exceed the present level in 2014. 2. The level of soil erosion in the target area is reduced in 2014 and water resources in the upper river basin will not be exhausted.	1. GIS data analysis 2. Survey on volume of soil erosion and river flow in the upper stream.	1. Policy concerning forest conservation in Madagascar will not change.
Project Purpose			
With the cooperation of the community, illegal cuttings and distraction of natural forest is strictly regulated and deterred.	1.Biodiversity in the natural forest is maintained beyond 2007. 2. The incidences of illegal cutting in the natural forest are decreased after 2005 compared to the present level.	1. Survey on fauna and flora 2. Report on the regular inspection and interview with the farmers	1. Survey on resources in the natural forest can be conducted without trouble. 2. Report on regular inspection can be reviewed without problems.
Outputs			
1. Natural forest conservation committee is established. 2. Regulation for natural forest conservation is developed. 3. Villagers clearly understand the protection area. 4. Members of the committee carry out the patrolling of the natural forest.	1. Executive members of the committee are selected and their duties clearly defined. 2. Regulations are written by February 2005. 3. Boundary and panel in the conservation area are established by February 2005. 4.Report on the regular inspection is regularly prepared after January 2005.	1. Interview with the committee members, relevant documents 2. Interview with the committee members, relevant documents 3. Field reconnaissance 4. Interview with the committee members, report on the regular inspection	Target villagers will not strongly object or refuse to cooperate towards natural forest conservation activities.
Activities	***Inputs***		
1-1 Workshop to promote establishment of natural forest conservation committee through sensitisation of villagers is conducted. 1-2 Committee members are trained on organisational management. 2. Regulations to conserve natural forest are developed. 3-1 Survey for establishing the conservation area is carried out. 3-2 The boundary and panel are established. 4-1 Committee members carry out regular patrolling of the natural forest. 委員会メンバーによる天然林の定期巡回実施 4-2 Follow up is carried out.	***Japan side*** ***Human resources*** - Watershed management/ participatory forestry - Subcontractor (NGO) - Sensitisation workshops for farmers (FMG) - Establishment of system/ regulations - Establishment of boundary and panel - Implementation of patrolling - Follow up	***Madagascar side*** Human resources - Officer in charge of natural forest conservation - Contribution of labour by the beneficiaries	Implementation of the pilot project in the target commune will not cause significant negative impacts among the villagers.
			Pre conditions Before the launch of the pilot project, natural forest will not become extinct due to the illegal cutting, slash and burn, or forest fire.

Attachment 5-1 PDM for Pilot Projects (7/12)
Pilot Project on prevention of forest fire

Name of Pilot Project: Prevention of forest fire	Implementation period: 2004.10～2007.	Ver. No.: 1
Target area: Antetezantany village Sahadiningana village	Target Group: Villagers in the target area (40 households)	Date: 2004. 10.29

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Natural resources are conserved well and functions of land and water conservation are maintained well.	1. Forest coverage rate in the upper river basin of the pilot project is maintained or slightly improved from the present level in 2014. 2. The level of soil erosion in the target area is reduced in 2014 and water flow is maintained.	1. GIS data analysis 2. Survey on volume of soil erosion and river flow	1. Policy concerning forest conservation in Madagascar will not change.
Project Purpose Forests (natural and man made forests) are not damaged by the forest fire.	1-1 Incidences of forest fire are reduced in 2007. 1-2 Biodiversity in the forest is not damaged by the fire.	1. Report from the responsible forest office 2. Field reconnaissance 3. Analysis of landsat image and reading of aero photo	1. Correct and precise information on the incidences of forest fire is always transferred from the village to the forest office. 2. Field reconnaissance is carried out without problem. 3 Landsat image and air photos are available. 4. Technicians to analyse satellite image and to read aero photos are available. 5. Software and equipments necessary for analysing satellite images are available.
Outputs 1. In the target area, committee for forest fire prevention is established. 2.Forest fire prevention system and regulations are developed by the villagers in the target area. 3. Committee members can use the fire prevention equipments.	1. Executive members of the committee are selected and their duties clearly defined. 2. Regulations on prevention of forest fire are written by February 2005. 3-1 Fire fighting equipments are procured by February 2005. 3-2 Training on fire fighting is carried out at least once a year from 2005.	1. Interview with committee members, relevant documents 2. Interview with committee members, relevant documents 3-1 List of equipments, inspection of maintenance of equipments 3-2 Interview with villagers, record of fire fighting training	1. Villagers in the target area show strong interest in forest fire prevention. 2. Villagers will actively participate in the forest fire prevention activities.
Activities 1-1 Workshop to establish forest fire prevention committee through sensitisation of villagers is conducted. 1-2 Committee members are trained on organisational management. 2-1 Committee members are educated to recognise the latest information and laws concerning forest fire. 2-2 Committee members are encouraged to develop regulations on forest fire prevention. 3-1 Committee members are trained on fire fighting. 3-2 Fire fighting equipments are distributed. 3-3 Training to use fire fighting equipments is implemented. 3-4 Follow up is carried out.	***Inputs*** ***Japan side*** ***Human resources*** - Watershed management/ participatory forestry - Subcontractor (NGO) Project cost - Sensitisation workshop for farmers - Establishment of fire fighting system/ regulations - Procurement of fire extinguishing equipments - Training on fire fighting - Follow up	***Madagascar side*** Human resources - Officer in charge of forest fire prevention - Contribution of labour by the beneficiaries	Fire fighting equipments can be procured. ***Pre conditions*** No farmers will object the participation to the forest fire prevention activities.

Attachment 5-1 PDM for Pilot Projects (8/12)
Pilot Project on development of buffer zone

Name of Project: Development of buffer zone	Implementation Period: 2004.10～2007	Ver. No.: 1
Target Area: Sahadiningana village	Target Group: Villagers in the target village (50 households)	Date: 2004.10.29

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
Natural resources are conserved well and functions of land and water conservation are maintained well.	1. Forest coverage rate in the upper river basin of the pilot project is maintained or slightly improved from the present level in 2014. 2. The level of soil erosion in the target area is reduced in 2014 and water source in the upper river basin will not become extinct.	1. GIS data analysis 2. Survey on volume of soil erosion and river flow	1. Policy concerning forest conservation in Madagascar will not change.
Project Purpose			
1. Natural forest is maintained and conserved by supply of the forest resources from the buffer zone. 2. The vegetation of the degraded area is recovered by buffer zone.	1-1 Incidence of illegal cutting in the natural forest decrease in 2014 compared to the present. 1-2 Forest produces from the man made forests are sustainably used in the target area after 2014. 1.3 Vegetation in the natural forests will begin to recover after 2014. 2. Forest area increased by more than 100 ha in 2014 in the target area.	1-1 Interview with the villagers and field reconnaissance 1-2 Interview with the villagers and field reconnaissance 1-3 Survey on forest resources and ecology 2. Field reconnaissance	Forest survey and interview survey with the villagers can be carried out without problem.
Outputs			
1. Buffer zone development committee is established. 2. Nursery is developed and seedlings can be produced. 3. Buffer zone is developed. 4. Forest is established by RFR. 5. Fire prevention zone is established.	1. Committee members are elected and their duties are clearly defined. 2. Nursery is established by September 2005 for buffer zone development. 3-1 Land for buffer zone development is secured by June 2005. 3-2 60% or more of the planted seedlings survive. 4. Buffer zone is developed under RFR system. 5. Fire prevention zone is established by 2007.	1. Interview with committee members, relevant documents 2. Field reconnaissance 3-1 Interview with villagers、field verification 3-2 field verification, reports 4. Field reconnaissance	1. No natural disaster causes damage upon planted trees. 2. No one will speak rumour of participants and interrupt the implementation. 3.No trouble will arise while implementing the survey.
Activities	***Inputs***		
1-1 Workshop is carried out to establish buffer zone development committee through sensitisation and to promote understanding of RFR system 1-2 Committee members are trained on organisational management. 2-1 Seedling production system is established by procuring the nursery equipments 2-2 Committee members are trained on nursery technology. 3-1 Villagers discusses and select the potential buffer zone area. 3-2 Buffer zone is demarcated and panel is installed. 3-3 Land preparation is carried out for planting trees. 3-4 Trees are planted. 4. Follow up for RFR is carried out. 5. Fire prevention zone is established.	***Japan side*** ***Human resources*** - Community forestry, forest management - Subcontractor (NGO) Project cost - Workshop for sensitising farmers - Equipments for nursery - Training on nursery management - Survey on boundary and installation of the panel - Land preparation, tree planting and fire prevention zone - Follow up	***Madagascar side*** - Officer in charge of RFR - Officer in charge of reforestation - Labour contribution by beneficiaries	Land for buffer zone development can be secured.
			Pre conditions No villagers will object buffer zone development.

Attachment 5-1 PDM for Pilot Projects (9/12)
Pilot Project on development of community and school forests

Name of Project: Development of community and school forests | Implementation Period: 2004.10～2007 | Ver. No.: 1

Target Area: Antetezantany | Target Group: Villagers in the target area (50 households) | Date: 2004.10.29

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
The system to sustainable use forest resources is established by the farmers and their natural and living conditions are improved.	1. Forest area is increased by 50 ha or more in 2010 compared to the present. 2. The loss of soil is decreased in 2010 compared to the present.	1. Forest survey 2. Soil erosion survey	Policy concerning forest conservation in Madagascar will not change.
Project Purpose			
1.Community forest can sufficiently supply construction materials for the communal buildings. 2. Vegetation of degraded land is recovered by reforestation.	1-1 The construction material of communal buildings established after 2015 can be sufficiently harvested from the man made communal forest. 1-2 Communal facilities are improved after 2015. 2. 50 ha of degraded land is covered with the man made forest after 2010.	1-1 Field verification and interview with farmers 1-2 Field verification and interview with farmers 2. Field verification study	1. Field reconnaissance can be carried out without any trouble.
Outputs			
1. Community and school forest committee is established. 2. Community/ school forest management system is established. 3. Nursery is established. 4. Community/ school forests are established. 5. Fire prevention zone is established.	1. Committee members are elected and their duties clearly defined. 2. Management regulations are developed by February 2005. 3-1 Nursery size and design is appropriate to 50 ha of reforestation. 3-2 Nursery size and design is appropriate to 50 ha of reforestation. 4-1 Reforestation area of 50 ha is secured by January 2005. 4-2 60% or more of the planted trees survive after one year. . 5. Fire prevention zone is effectively established.	1. Interview with committee members 2. Relevant documents 3. Field verification study, Report on nursery management 4. Field verification study 5. Field verification study	Villagers are highly motivated to establish community forest and willing to participate and carry out activities without payment.
Activities	***Inputs***		
1-1 Workshop is carried out to establish community/ school forests through sensitisation of the villagers. 1-2 Committee members are trained on organisational management. 2. Community/ school forests development, management, regulations are developed by the committee. 3. Nursery is developed and produces seedlings. 4-1 Potential land to be used for community/ school forests is identified by the discussion of villagers. 4-2 Reforestation area is demarcated and panel installed. 4-3 Land preparation for tree planting is carried out. 4-4 Tree planting is carried out. 5. Fire prevention zone is established.	***Japan side*** ***Human resources*** - Watershed management/ community forestry - Subcontractor (NGO) Project Cost - Workshop to sensitise farmers - Nursery equipments and seeds - Training on nursery - Demarcation of the land and panel - Land preparation, tree planting and fire prevention zone - Follow up	***Madagascar side*** Human resources - Officer in charge of forest extension - Labour contribution by beneficiaries	Land to establish community and school forests is not available in the village.
			Pre conditions Land to establish community and school forests can be secured.

Attachment 5-1 PDM for Pilot Project (10/12)
Pilot project on promotion of agroforestry

Name of the project: Promotion of agroforestry	Implementation period: 2005～2007.8	Ver. No.: 1
Target Area: Sahadiningana	Target Group: Villagers in the target commune (70bhouseholds)	Date: 2004.10.29.

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal			
Soil conservation in the area is promoted and environmental and poverty issues are alleviated.	1. Soil conservation in farm land is improved in 2010 compared to the present. 2. The number of poor farmers is reduced in 2010 compared to the present.	1. Soil survey 2. Village economic survey	Policies of forest conservation and rural development of Madagascar will not change.
Project Purpose			
Poverty among the villagers in the target area is reduced by introducing agro forestry to prevent surface soil erosion in the farm land, and to increase soil fertility which will improve land productivity.	1. Land productivity where agroforestry is introduced is increased by more than 10% in 2010 compared from the present level. 2. Income is increased among more than 80% of the participating farmers in 2010 compared to the present.	1. Crop yield survey, interview with farmers. 2. Village economic survey	No incidence trouble will occur to hinder the implementation of the survey with the target households.
Outputs			
1. Agroforestry committee is established. 2. Demonstration plot of agroforestry is established.	1-1 Members of the committee are elected and their terms of reference are clearly defined. 1-2 Participating farmers understand the objective of agroforestry. 2. More than 2 ha of Demonstration plot is established by February, 2006.	1-1 Interview with the committee members, relevant documents 1-2 Interview with participating farmers 2 Interview with committee members, field visit	No interruption is caused by rumour and jealousy by non-participating villagers.
Activities	***Inputs***		
1-1 Sensitisation is carried out to educate villagers on meaning of agroforestry and workshop is conducted to promote establishment of a committee. 1-2 Technical knowledge on organisation management is transferred through training of committee members. 2-1 Demonstration plots are secured. 2-2 Technical training on fruits tree planting and hedge row planting is given to the participants. 2-3 Seedlings and seeds are distributed to the participants and planted. 2-4 Technical training on bee keeping is conducted and equipments of beekeeping are distributed after the training.. 3. Follow up of each system is conducted.	***Japan side*** ***Human resources*** - Watershed management/ participatory forestry - Subcontractor (NGO) Cost of implementing the project - Sensitisation workshop for farmers - Training - Fruit tree seedlings, seeds and etc. - Bee keeping materials - Follow up	***Madagascar side*** Human resources - Officer in charge of agroforestry - Labour contribution by the beneficiaries	1. Land where agroforestry is introduced can be secured within the commune. 2. No significant damage is caused by the natural disaster on crops. ***Pre conditions*** Farmers understands the meaning of agroforestry, are willing to participate and collaborative.

Attachment 5-1 PDM for pilot project (11/12)
Pilot project on recovery of vegetation in lavaka

Name of the Project: Recovery of vegetation in lavaka | Implementation period: 2004.10～2007. | Ver. No.: 1

Target area:
Manakambahinikely village
Ronoftsy village

Target group: Paddy farmers in the down stream of Lavaka | Date: 2004. 10.29

Summary of Project	Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Farmers in the down stream of Lavaka will be protected from the disaster caused by erosion and increase their productivity.	Production of agriculture produces increase 5 years after the termination the project compared to the present level.	Interview survey with the farmers	There will be no sudden changes in land use, industrial facilities and social conditions of Madagascar.
Project purpose Vegetation of Lavaka is recovered by the model forestry conservation works and the volume of sediment at the down stream is decreased.	1. Over 60% of the planted trees in Lavaka survive by the termination of the project. 2. By the end of project, more than 60% of the forest conservation works which are newly introduced for trial remain effective.	1. Survey on vegetation in the target Lavaka 2. Survey to assess the effectiveness of the works after implementation of the forestry conservation works	1. Lavaka will not be newly created or collapse in a large scale by the unexpected and overwhelmingly large scale natural disaster such as large cyclone or earth quake.
Outputs 1. Direct beneficiaries and villagers in the down stream understands the implication of re-vegetation of Lavaka and participate in the activities. 2. Sustainable and new forestry conservation works are tried out. 3. Forestry conservation works are carried out in the target Lavaka.	1. By the end of the first financial year, beneficiaries and 60%+ of the down stream villagers understand the implication of re-vegetation of Lavaka. 2. By the end of the first financial year, more than 3 new forestry conservation works are carried out on the trial basis. 3. By the end of the first financial year, forestry works are carried out in more than 2 Lavaka.	1. Awareness survey with the beneficiaries and villagers in the down stream 2. Field reconnaissance in the targeted Lavaka 3. Assessment after the forestry conservation works	Model forestry conservation woks will not be terminated by the natural disaster or sudden changes of the social condition.
Activities 1. Meaning of re-vegetation of Lavaka is explained to the direct beneficiaries and villagers in the down stream. 2. Sustainable and new forestry conservation techniques are tried out. 3. Soil conservation is carried out by the direct beneficiaries and villagers in the down stream applying the simple and sustainable re-vegetation techniques in Lavaka.	***Inputs*** ***Japan side*** ***Materials*** ・ Planting of the tree varieties for reforestation ・ Planting of tree cuttings ・ Planting of fruits and fodder trees ・ Sodding works using sandbags ・ Lawn works	***Madagascar side*** - Labour contribution by the beneficiaries	Soil conservation will not be interrupted by the natural disaster such as cyclone.
			Pre Conditions There is no strong objections in the project area against re-vegetation.

Attachment 5-1 PDM for pilot project (12/12)
Pilot project on extension of improved stove

Name of the Project: Extension of improved stove	Implementation period: 2004.10～2007. Ver. No.: 1	
Target area: ANTANIMAFY commune AMBOHIDRONY commune SOALAZAINA commune	Target group: villagers in the targeted communes	Date: 2004. 10. 27

Project Summary	Verifiable Indicators	Means of verification	Important Assumptions
Overall Goal 3 prototypes of improved stoves are used by the reasonable number of villagers in the south western side of Arocha Lake.	5% of the households in the south western side of Arocha Lake use improved stoves by 2012.	Annual report (Amparafabra, Anbatondorazaka Agriculture Bureau, Water conservation and forestry branch office)	
Project Purpose Villagers in the Antanimafy、Ambohidorony、Soalazaina commune use 3 prototypes of improved stoves.	10% of target households use one of the three types of improved stoves by August, 2007.	Annual report of subcontractor (NGO)	Alternative energy of higher efficiency and lower prices will not be widely used.
Outputs 1. Model households in the target area use 3 prototypes of improved stoves. 2. Awareness towards nature and environment conservation especially forest conservation is increased.	1. 80% of 15 model households regularly use improved stove after 4 months of initiation. 2.1 Compare to the early stage of the project, the cost (time and financial cost) of obtaining fuel on average has decreased by 10% on average among the 15 model households after 4 months of initiation. 2.2 With comparison to the early stage of the project, the average marks of awareness survey towards environment increases after 4 months of initiation.	1. Monthly and Annual report of subcontractor (NGO) 2.1 Monthly and Annual report of subcontractor (NGO) 2.2 Monthly and Annual report of subcontractor (NGO)	Alternative energy of higher efficiency and lower prices will not be widely used.
Activities 1.1 15 model households per commune is selected. 1.2 Baseline survey with the selected 15 households is conducted. 1.3 Improved stove is designed. (3 prototype) 1.4 Technical transfer concerning improved stoves(procedure of construction, usage, maintenance) is carried out for the villagers. 1.5 Sensitisation of functions of improved stoves is carried out. (comparison of functions with the conventional and improved stoves; fuel consumption; required time for cooking) 1.6 Technical manual to make improved stoves is developed. 1.7 Sensitisation for promotion is carried out. 1.8 Monitoring and evaluation are carried out. 2.1 Baseline survey on awareness towards natural environemtn is carried out. 2.2 Education and sensitisation towards conservation of nature and environemtn with emphasis on forest is carried out. 2.3 Monitoring and evaluation are carried out.	***Inputs*** ***Japan side*** ***Human resources*** - Crop production/ extension - Community sensitisation - Gender/participatory development II: - Subcontractor (NGO): Funds (Subcontracting fees to the NGO) ***Madagascar side*** Human resources - Officer in charge of community relations Materials - Part of the materials to make stoves（villagers）		More than 80% of the model households will remain in the original settlement. ***Pre-condition*** The target group collectively agrees with the objective of the promotion of improved stoves and expresses willingness to become model households.

EXPLANATION NOTE 5-2

Performance table of Pilot Projects on Watershed management and Rural development

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （1/12）

1. Promotion of Diversification of Agricultural Income Sources（Mahakary Area）

Item	Performance
1. Zone / Area	PC23 Rain-Fed Paddy Area: Mahakary Area
2. Beneficiaries	Small-scale farming households
3. Background	In the eastern part of PC23 area are rain-fed paddies, cultivation field and grazing land, depending on the landscape. This part of the area is a downstream area where the river water (water sources) for agriculture is in shortage. Irrigation water has never reached there even from the time the irrigation facilities started to operate. Paddy rice is cultivated in rain-fed paddies. In non-paddy field, direct sowing of paddy rice to the dry land is practiced. Yield has been decreasing because of a) the delay of the start of the rainy season and b) problems in growth found among the late maturing photo-sensing varieties which is a common paddy rice variety among the farmers. Such delay and problems are due to the recent changes in agricultural weather and environment. To increase household income, diversification of income sources by adopting double cropping of haricot beans, raising poultry, etc is necessary because emergency repair of the irrigation facilities cannot be expected.
4. Goal	To increase household income through diversification of crops grown in the rain-red paddy area and adoption of poultry farming.
5. Activity	1) Double cropping in the agricultural field (non-paddy) Rainy season: upland rice Dry season: haricot beans 2) Fruit cultivation and poultry farming (for edible meat) in vacant lots of the residential area 3) Development of market for haricot beans and poultry farming 4) Establishment of associations for each specific activity such as double-cropping, fruit trees and poultry farming, and autonomous management of the associations
6. Input and Result	1) Input Cost Double-cropping & Fruit trees Phase 1: Agricultural material 4,022,000 MGA (¥221,210) Meeting, training and study cost 2,940,000 MGA (¥161,700) NGO cost 8,565,000 MGA (¥471,075) Double-cropping & Fruit trees Phase 2: Agricultural material 5,656,400 MGA (¥309,431) Agricultural material for the new members 14,452,000 MGA (¥790,591) NGO cost 17,780,000 MGA (¥972,647) Double-cropping & Fruit trees Phase 3: Agricultural material 7,900,000 MGA (¥426,600) NGO cost 30,834,550 MGA (¥1,665,065) Poultry farming Phase 1: Coops and farming materials 3,400,000 MGA (¥187,000) Poultry farming materials 2,318,400 MGA (¥127,512) Meeting, training and study cost 3,340,000 MGA (¥183,700) NGO cost 5,845,000 MGA (¥321,475) Poultry farming Phase 2: Poultry farming materials 2,988,000 MGA (¥172,840) Equipment for coops 4,000,000 MGA (¥232,000) NGO cost 21,755,000 MGA (¥1,261,790) 2)Result Activity by the Study Team Provision of materials for two seasons of double cropping, Provision of fruit trees and technical guidance, Provision of coops for poultry raising and

Item	Performance
	farming equipments, Provision of poultry farming materials (twice) and technical guidance Activity by the participants Establishment of double-cropping/fruit tree association by 10 participants and recruitment of additional members to reinforce the management basis, Establishment of poultry farming association by 16 participants and sales activities of broilers (alive and meat) Achievement The first cultivation of upland rice of was carried out in a 5.0 ha field, using B-22 variety which has resistance to dryness. Due to pests and high humidity, the total harvest was 900kg with 2.13 ha of harvested area. The first cultivation of haricot beans of Lingot Blanc variety resulted in the total harvest of 1,954 kg with 5.98 ha of harvested area. The average yield, 326 kg/ha is near the amount of the rainy-season yield of haricot beans. For the fruit trees, 107 seedlings of mango, litchee and avocado survived. The second cultivation of upland rice was carried out by 8 original members and 20 new members of the association in 14.0 ha field, using SEBOTA-41 which has resistance to both dryness and wetness. Yield of rainy season upland rice was 0.64 ton/ha. Yield of haricot beans of the variety used in the previous year was 0.46 ton/ha. From the third poultry farming, the farming was managed autonomously by the association. Cumulative sale of the 6 batches of farming was 12.28 million MGA, cumulative direct cost was 10.52 million MGA, and gross profit was 1.76 million MGA. After balancing the 2.22 million MGA provided by the Study Team (assistances on poultry raising cost: 2 times) and 2.53 million MGA of dividends for the association members, 1.45 million MGA was left. This money was used as a capital to shift the business voluntarily to goose/gander farming. The overall performance of the poultry farming is as follows:

No.	Input (chickens)	Dead (chickens)	Sold (chickens)	Sales*	Direct cost*	Gross profit*	Gross margin rate
1	600	197	403	2.947	2.512	+0.435	+14.8%
2	440	110	330	2.345	1.802	+0.543	+23.2%
3	560	169	391	2.345	1.465	+0.880	+37.5%
4	490	32	458	2.784	2.022	+0.762	+27.4%
5	440	54	356	1.281	1.813	–0.532	–41.5%
6	220	125	95	0.579	0.911	–0.332	–57.3%
Total	2,750	687	2,063	12.281	10.525	+1.756	+14.3%

*: million MGA
(note: sold chickens include those who were sold alive, and killed to be sold)

7. Evaluation at the Project Completion	1) <u>Relevance of Technology Applied</u> Analysis In the pilot activity of double-cropping in the rain-fed field, upland rice and haricot beans were cultivated in rainy season and dry season, respectively in the selected field where no flooding takes place in the rainy season due to its micro-landscape condition. Broiler farming was carried out as a means to diversify income sources. The broiler farming was shifted to farming of goose/gander which is a special local product. This shift took place in order to solve the problem of access to markets and problem of shipment methods. Evaluation Expectation was raised among the farmers that upland rice of SEBOTA-41 variety which has resistance to both dryness and wetness was more flexible to

Item	Performance
	a) the fluctuation of time of the first rain, b) amount of rainfall and c) amount of water content in soil than B-22 variety which has resistance to dryness. For this reason seeds collected by farmers themselves went into circulation before the setting of the characteristics of the varieties, making it difficult to obtain the pure variety. In PC23 non-irrigated area, where no flooding occurs in the rainy season, water content of the soil fluctuates from field to field due to a big difference in altitude and amount of rainfall. In order to set up an area favorable for cultivation of upland or paddy rice, a hardware approach is needed that a) verifies the altitude of earth surface, b) includes a measure to recover the function of the drainage facility, and c) minimizes the fluctuation of water content of soil or depth of flood water. In the extension of haricot bean cultivation, factors to determine the relevance of techniques are deemed to be a) selection of the adapting variety, b) input of superior variety, and c) adequate timing of sowing. As for the poultry farming, the total number of poultry rose in the poultry farms near Amparafabra, Anbatondorazaka (assumed to be the local markets of poultries) reached nearly 3,000. These poultry farms were established with farmers' own money or loans from agricultural banking facilities. Farmers started poultry farming because they were inspired by this pilot project. Techniques employed in this pilot project are proved to be relevant because broiler farming spread and became established in the areas around the Alaotra Lake. Location of the poultry farms and market research are extremely important in selling products, such as chicken meat whose freshness is difficult to maintain, to local markets of limited size. Considering the facts that a) a small-scale farm of about 400 poultries requires only two people to manage the farm and b) a gross profit rate of 20% needs to be secured to purchase neonatal chicks and feed for the next batch, it is difficult for people to get incentive for participation in group activity. 2) Relevant Organization and Support System Analysis For each component of the pilot project, participating residents organized an association and registered it as a legal body. After the completion of primary assistance by the external agencies, associations are to be self-managed with the money from the product sales. As for the double-cropping association, securing a place to obtain pure varieties at the time of renewal of upland rice seed is the key to self-management sustainability. Evaluation To overcome weak market competitiveness due to its location, the poultry farming association decided to shift the business to goose/gander farming by using a part of the proceeds from the broiler sales. This shift has been carried out autonomously by the association. Self-collection of haricot bean seeds by farmers is going on smoothly, but upland rice needs securement of pure variety before the seed collection. 3) Capacity of the Residents Analysis A household who owns more than 3 ha of agricultural land cultivate and manage crops with its own labor power in non-busy agricultural season. For this reason, household members can spend only a limited time to learn new technique and participate in activities. Evaluation Even if farmers recognize the duty and responsibility to take part in activities as association members, they have limited capacity for participation due to their time limitation. This hinders wider implementation of association activities.

Item	Performance
8. Sustainability and Implementation System	1) Sustainability Double cropping of haricot beans is sustainable in areas where the dry-season field conditions are adequate. Poultry farming is sustainable after the shift to goose/gander farming managed by small number of farmers. 2) Implementation System for Sustainability Association reorganized by farmers who are willing to continue goose/gander farming
9. Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied: Increase of agricultural income in the non-irrigated section of PC23 area Double Cropping 1) Relevance The measure to adopt cultivation of good variety of haricot bean as the secondary crop for the dry season in the non-irrigated section of PC23 area is effective. As for the rainy season rice cultivation, the crop situation fluctuates every year, depending on the rainfall and unevenness/roughness of the cultivation field. For this reason, the factor to determine the measure's effectiveness is in the selection of wide range of varieties including the ones with resistance to wetness and drought. 2) Effectiveness Effectiveness of double cropping is greater if the measure, in addition to the improvement of cultivation technology, includes a) land classification by each crop based on topographic survey and b) needed improvement of drainage. 3) Efficiency Efficiency of the double cropping measure becomes larger if land classification by each crop is carried out first. 4) Impact The measure to diversify agricultural income through haricot bean cultivation has more impact if cultivation area is selected based on land classification by the crop. 5) Sustainability Cultivation of haricot bean is sustained if farmers' groups carry out self-selection of seeds and renew the seed regularly. Poultry Farming 1) Relevance The poultry farming measure is more effective if its location is closer to the local markets because the difference in the transport cost of materials and products determines the level of competitiveness. 2) Effectiveness Adoption of broiler farming contributed to diversification of agricultural income sources. However, its effectiveness is high in only certain areas because the size of effectiveness depends much on the scale of the local market. 3) Efficiency Poultry farming for egg collection and farming of local poultry for edible meat did not become alternative measures of diversification of agricultural income sources due to their low a) sufficiency level of the market needs and b) farming efficiency. The measure was shifted to farming of goose/gander which is a special local product. The goose/gander farming makes use of the local water/wet area and grass land as feed sources. 4) Impact Though limited in certain areas, the broiler farming became well established as agri-business 5) Sustainability Broiler farming as agri-business is sustainable if epidemic such as bird flu is absent.

Item	Performance
10. Matters to be Considered in Development Planning (as Feedback)	① Market for the products can be secured ② Effect of the increase of unit yield directly leads to the producers' take-home earnings. The measure to decrease production cost leads to profit generation. ③ Cultivation, breeding and feeding techniques are easily mastered by the producers ④ Production input materials such as good seeds, fertilizer, feed, and fries can be easily secured with low cost. The farmers maintain the seed quality, renew the seeds regularly, and practice a measure to maintain the soil fertility. ⑤ Access to loan service for the initial investment fund is improved.
11. Remark	Techniques that were likely to be adopted in agricultural land other than irrigated paddy land in PC 23 area were tried in this pilot project to diversify agricultural income sources other than rice cultivation. Success and failure of double cropping or mixed non-tilled cropping of bean family of grass species and field crop depend on drainage condition of the cultivation area. Because of this, effects of the measure are limited if assistance is given only on crop cultivation. In addition to such assistance, civil work to improve water drainage should be carried out. In area like the Study area where the annual difference of temperature is great, broiler farming must adopt measures against coldness in winter and heat in summer, and hence, requires technological assistance on a) selection of land to build coops and b) designing of coops. If the area has agricultural products that are acknowledged in the domestic market as local specialty, such products should be included in diversification of income sources. Planning and implementation of activities that make use of such products are likely to be more efficient, and motivate the participating farmers more strongly. The measure to raise goose/grander which is widely acknowledged as the local brand, "Alaotra Geese", by a small group is expected to contribute to the diversification of income sources in the Study area as a way of small domestic animal raising.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （2/12）

2. Promotion of Diversification of Agricultural Income Sources（Maheriara area）

Item		Performance
1.	Zone / Area	Sahamilahy River Basin: Maheriara area
2.	Beneficiaries	Small-scale farming households
3.	Background	Paddies in the mid-mountain section of the upstream region are irrigated by small rivers and reservoirs. Water shortage and water conflicts are common due to silting, inadequate O&M, illegal water intake, and declining capacity of water intake facilities. Agricultural activities remain static because of degradation of seeds, delay in adoption and extension of improved varieties, small number of farmers producing the promising crops, not enough access to the market, etc. In order to increase household income, not only improvement of rice production, but also increased cultivation of secondary crop as well as fish and poultry farming with the development of market need to be done.
4.	Goal	Improvement of income through diversification of agricultural products in the paddy area of the mid-mountain section in the upstream region
5.	Activity	1) Adoption of the new paddy rice varieties 2) Double cropping by cultivation of haricot beans in dry season as an off-season secondary crop 3) Poultry farming in vacant lot of the residential areas (meat for eating) 4) Construction of fish pond whose water sources are natural lakes. Farming of freshwater fish 5) Development of market for haricot beans, poultry and freshwater fish from the farms 6) Establishment of associations for double-cropping, poultry farming and fish farming, and their autonomous management
6.	Input and Result	1) Input Cost Double Cropping Phase 1: Agricultural material 7,923,400 MGA (¥435,787) Meeting, training and study cost 2,500,000 MGA (¥137,500) NGO cost 13,252,340 MGA (¥728,879) Double Cropping Phase 2: Agricultural material 5,100,000 MGA (¥295,800) Material for new association members 12,450,000 MGA (¥722,100) NGO cost 15,542,000 MGA (¥901,436) Double Cropping Phase 3: Agricultural material 5,410,000 MGA (¥292,140) NGO cost 21,524,340 MGA (¥1,162,314) Poultry Farming Phase 1: Chicken coops, farming equipment 5,478,000 MGA (¥301,2900) Poultry equipment 2,980,000 MGA (¥162,800) Meeting, training and study cost 2,800,000 MGA (¥154,000) NGO cost 8,471,300 MGA (¥450,521) Poultry Farming Phase 2: farming equipment 2,988,000 MGA (¥173,304) Material for coops, maintenance of repair cost 1,308,000 MGA (¥75,864) NGO cost 20,595,000 MGA (¥1,194,510) Freshwater Fish Farming Phase 1: Fish pond 4,558,000 MGA (¥250,723) Farming material 2,441,400 MGA (¥134,2772) Meeting, training and study cost 2,550,000 MGA (¥140,250) NGO cost 4,570,000 MGA (¥251.350) Freshwater Fish Farming Phase 2: Farming material 4,896,552 MGA (¥284,000) Maintenance and repair cost 4,000,000 MGA (¥218,818) NGO cost 13,710,000 MGA (¥795,180) Poultry Farming Phase 3: Farming material 9,168,400 MGA (¥495,093)

<table>
<tr><td colspan="2">Item</td><td>Performance</td></tr>
<tr><td></td><td></td><td>NGO cost 32,286,510 MGA (¥1,743,472)</td></tr>
<tr><td></td><td></td><td>2) Result
Activity by the Study Team
Provision of materials for two seasons of double cropping cultivation and technical guidance, Provision of coops for poultry and farming equipments, Provision of materials for poultry farming (twice) and technical guidance, Construction of fish pond, Provision of materials for fish farming (three times) and technical guidance
Activity by the participants
Establishment of double-cropping association by 10 participants and recruitment of additional members, Establishment of poultry association by 16 participants and sales activities of broilers (alive and meat), Establishment of fish farming association by 15 participants and raising of 1,320 royal carps
Achievement
As for the double cropping, the 1st year yields of rainy season paddy rice of the existing variety, Tsemaka and haricot beans of Lingot Blanc variety were 2.61 ton/ha and 0.18 ton/ha, respectively. 2nd year yield of rainy season paddy rice of the existing variety was 3.04 ton/ha.
As for the poultry, cumulative sale of the 6 batches of farming was 15.73 million MGA, cumulative direct cost was 15.48 million MGA, and gross profit was 0.25 million MGA, After balancing the 3.59 million MGA provided by the Study Team and 2.35 million MGA of dividends for the association members, 1.49 million MGA was left. This money was used as a capital to shift the business voluntarily to goose/gander farming.
<table>
<tr><th>No.</th><th>Input (chickens)</th><th>Dead (chickens)</th><th>Sold (chickens)</th><th>Sales*</th><th>Direct cost*</th><th>Gross profit*</th><th>Gross margin rate</th></tr>
<tr><td>1</td><td>550</td><td>137</td><td>413</td><td>3.130</td><td>2.700</td><td>+0.430</td><td>+13.7%</td></tr>
<tr><td>2</td><td>494</td><td>131</td><td>363</td><td>2.372</td><td>1.967</td><td>+0.405</td><td>+17.1%</td></tr>
<tr><td>3</td><td>538</td><td>107</td><td>431</td><td>3.146</td><td>3.080</td><td>+0.066</td><td>+2.1%</td></tr>
<tr><td>4</td><td>499</td><td>20</td><td>479</td><td>3.270</td><td>3.233</td><td>+0.037</td><td>+1.1%</td></tr>
<tr><td>5</td><td>417</td><td>17</td><td>400</td><td>2.645</td><td>3.008</td><td>-0.363</td><td>-13.7%</td></tr>
<tr><td>6</td><td>223</td><td>13</td><td>210</td><td>1.172</td><td>1.493</td><td>-0.321</td><td>-27.4%</td></tr>
<tr><td>Total</td><td>2,721</td><td>425</td><td>2,296</td><td>15.735</td><td>15.481</td><td>+0.254</td><td>+1.6%</td></tr>
</table>
* million MGA
(note: sold chickens include those who were sold alive, and killed to be sold)
As for the fish farming, harvest of the first farming of 1,200 royal carps (10 months) was 140 kg, harvest of second farming of 1,200 royal carps (6 months) was 99kg, harvest of the 1st farming of 626 tilapias (2.5 months) was 39 kg. From these, average growth of fish per day was calculated as 0.39g for the 1st farming royal carp, 0.45g for the 2nd farming royal carp and 0.83g for the 1st farming tilapia.</td></tr>
<tr><td>7.</td><td>Evaluation at the Project Completion</td><td>1) <u>Relevance of Technology Applied</u>
Analysis
In the double cropping of paddy rice and haricot beans in the rice paddy of the mid-mountain section in the upstream region, techniques of rainy season cultivation such as transplanting of young seedling, regular planting in main paddy, weeding, and application of forcing manure were well established among the farmers. Similar results to those of Mahakary area were obtained in poultry farming. As availability of feed was limited in the villages, fish meal and corn were obtained from markets outside the villages and for this reason, farming/breeding cost became high. For the breeding of royal carp, the maximum of the fry/fingerling investment was set to 1.5 fish per 1m²; in general one fish. For six months from January to June, the fish was bred, and feeding started before setting the fish into a fish pond. For feeding, powdery</td></tr>
</table>

Item		Performance
		feed (amount that fish could eat) was supplied on a fixed feeding tray twice a day Evaluation Due to the technology introduced, production cost was reduced and profit increased. Adaptability of haricot beans as a dry season crop in ill-drained paddy field was found to be low. Dry season cultivation of paddy rice or secondary crop with high moisture resistance is deemed to be effective in improving the agricultural productivity. Evaluation of broiler breeding is the same as that obtained in Mahakary area. Obtaining high nutritional values of the feed is raising the cost. Body weight of the mature royal carp which was bred for six months from fry/fingerling was around 150g. Based on this result, tilapia fry/fingerling was invested with one fish per one m² and bred for 2.5 months. The weight of the mature tilapia became about 120g with less feed cost while fry/fingering was produced by self-breeding. It was confirmed that breeding of tilapia is more easily adopted by the farmers than that of royal carp in terms of the ratio of cost-profit and ease of technology. 2) Relevant Organization and Support Systtem Analysis To overcome the weak marketability resulting from inferior location, the association decided to use a part of the proceeds from the sales of broilers to change its business to goose/gander farming. This change is being implemented by the association itself. For double cropping, in order to cut the cost of agricultural input material, technique to create forcing manure was adopted from a team of Indonesian experts of JICA's south-south cooperation through a technical trainer of an NGO. In order to obtain superior paddy rice variety, farmers are practicing by themselves the selection techniques for self-collected seed, which they learned through the technical guidance by the NGO. Self-management of the fish farming association became possible by changing to tilapia farming. A fish farming manager was employed to feed the fish and clean the area. As for capturing and sales of fish, association members sell the fish directly at the market which opens periodically in Morarano Chrome. Evaluation In addition to the technical training by the NGO, some farmers are enthusiastic about mastering agricultural activities and techniques which directly relates to increased take-home income. Some of the farmers have good leadership capacity as well. 3) Capacity of the Residents Analysis Farming households own small cultivation areas and their paddies are located far from their homes, requiring long time for commuting. Farmers, thus, have limited time that they can spend on mastering new technique and participating in activities. Evaluation Even if farmers recognize the duty and responsibility to take part in activities as association members, they have limited capacity for participation due to their time limitation. This hinders wider implementation of association activities.
8.	Sustainability and Implementation System	1) Sustainability Technique of double cropping will not be sustained as it does not fit the field condition in the dry season. Goose/gander farming by small number of people is sustainable. Fish farming is sustainable through self-breeding of tilapia. The size of fish farming was enlarged as proceeds from sales after the start of self management were used as capital to construct 3 more fish ponds in

Item		Performance
		the neighboring areas. 2) Implementation System for Sustainability : Associations reorganized by farmers who are willing to continue goose/gander farming and tilapia farming.
9.	Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied: Increase of agricultural income in irrigation paddy area of the mid-mountain section in the upstream region Double cropping 1) Relevance The measure to grow haricot beans as a secondary crop to existing light sensitive conventional paddy variety cultivation in rainy season becomes useful if drainage improvement work is included in the measure. This is because time of sowing and time of growing of the secondary crop depend on the drainage condition of the paddies in the mid-mountain section. Improvement of current cultivation method of paddy rice is a useful measure that satisfies the need of the farmers. 2) Effectiveness It was confirmed that production of existing rice variety in paddies in the mid-mountain section was increased through the improvement of current rice cultivation method. 3) Efficiency In areas where it is possible to secure water in the dry season, the efficiency of the measure was increased by double cropping of paddy rice. This is because double cropping of paddy rice requires less input than a secondary field crop that entails drainage improvement work. 4) Impact Forcing manure cultivation which had been adopted to improve the current rice cultivation method brought remarkable spillover effect to farmers who had given up using compost due to increasing transport cost. Such effect was brought because forcing manure cultivation can be practiced around the cultivation field. 5) Sustainability The measure to improve current paddy cultivation method, which increases production uniformly can be sustained by the farmers. For further increase in production or improvement of profitability, adoption of early and mid maturing photo-sensitive varieties for double cropping of rice paddy needs to be included in the measure. Poultry: The results of the study are the same as those obtained in Mahakary area Fish farming 1) Relevance In areas where water sources, whose water quality is good for fish rearing, can be secured throughout the year, freshwater fish farming meets the needs of both producers and consumers. 2) Effectiveness Marketing condition of the production market depends on total weight of fish, rather than total number of fish or kind (species) of fish. For this reason, the measure to diversify agricultural income sources become highly effective by selecting the kind (species) of fish which has short growing period, requires small amount of feed, and is easy to feed. 3) Efficiency As the selection of fish species determines the efficiency of the measure, tilapia farming should be carried out as it meets the needs of both its producers and consumers. 4) Impact Spillover effect to the existing fish ponds will take place if adequate breeding method for each fish species is established.

Item		Performance
		5) Sustainability Under a condition where system of fry/fingerling supply is not established, tilapia farming is sustained if it uses self propagated fish fries.
10.	Matters to be Considered in Development Planning (as Feedback)	① Market for the products can be secured ② Effect of the increase of unit yield directly leads to the producers' take-home earnings. The measure to decrease production cost leads to profit generation. ③ Cultivation, breeding and feeding techniques are easily mastered by the producers ④ Production input materials such as good seeds, fertilizer, feed, and fries can be easily secured with low cost. The farmers maintain the seed quality, renew the seeds regularly, and practice a measure to maintain the soil fertility. ⑤ Access to loan service for the initial investment fund is improved.
11.	Remark	Techniques that were likely to be adopted in small-scale irrigation paddies in the mid-mountain section were tried in this pilot project to diversify agricultural income sources other than rice cultivation. Among the techniques, forcing manure making technique, which can be carried out around the cultivation areas is useful as an cheap alternative resource of manure whose transport cost to the cultivation fields is increasing rapidly these days. In terms of fertilizer effect ingredient content, 3 times as high nitrogen content (compared to the content of manure) can be secured through this technology. This technique, thus, should be promoted widely to the farmers to greatly reduce the production costl and to expand organic farming. As in Mahakary area, goose/gander farming is recommended as an effective measure to diverse income sources through small animal rearing. Tilapia farming in the areas, where water sources can be constantly secured and the water quality is fit to raise fish, is also recommended. This is because tilapia farming is a measure to diversify agricultural income sources that meets the domestic marketing condition of freshwater fish in the production areas.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （3/12）

3. Re-Use of Drainage Water

Item		Performance
1.	Zone / Area	PC23 Area
2.	Beneficiaries	Farm households that cultivate Lot 5 and Lot 6 of C5.5.2 field area of the tertiary canal of Sahabe River water channel
3.	Background	In the irrigation paddy area in PC23 area of the P5 main water way whose water comes from the Sahabe River, supply of irrigation water is not adequately due to the functional decline of its irrigation facilities. Despite such water shortage, cultivation of paddy rice by transplanting is done in the whole area. This pilot project aims for efficient use of the water resources by improving the current irrigation system which covers 3,800 ha of the paddy field in the area. This is a short-term hardware measure that improves infrastructure necessary to increase agricultural production. To fulfill the aims, 1) optimum time of cultivation of rainy season paddy rice and 2) possibilities of adoption of dry-season paddy rice or field crops need to be examined. This examination is done through a trial of re-use of paddy drainage water, using the facilities in PC23 area where irrigation and drainage canals are separated.
4.	Goal	1) Clarification of activities of farmers' organization and their procedures which are necessary for operation and maintenance (O&M) of the facilities 2) Maintenance of adequately configured facility to re-use drainage water 3) Clarification and application of irrigation water allocation method for re-use of drainage water 4) Training of farmers' organization on facility O&M
5.	Activity	1) Rehabilitation and construction of irrigation drainage facilities in Lot 5 and Lot 6 field areas 2) Improvement of farm roads 3) Establishment of Water Users Association (WUA) through organizing farmers of Lot 5 and Lot 6 fields 4) Training of WUA on O&M of the irrigation drainage facilities
6.	Input and Result	1) Input Cost Phase 2: Facility repair 121,477,939 MGA (¥7,045,720) Construction management & training 20,523,690 MGA (¥1,190,374) Meeting/Workshop cost381,448 MGA (¥22,124) Monitoring equipment 6,370,309 MGA (¥350,367) Phase 3: Supplementary repair of facility: 21,622,886 MGA (¥1,167,635) Construction management & training 25,435,130 MGA (¥1,373,497) 2) Result Activity by the Study Team Repair of the existing irrigation drainage facilities in Lot 5 and Lot 6 in PC23 area, O&M training of newly established WUA in the two lots by local engineers on commission Activity by the Participants Organizing 69 farmers of Lot 5 and Lot 6 to establish WUA and registering as a legal body, Cleaning of the tertiary canals and earthwork of the quatric (4^{th}/terminal) canals Achievement 2 repairs of diversions of C.5.5.2 tertiary canal, Repair of a dam for re-use of drainage water of D102 tertiary drainage canal, Construction of a dam for re-use of drainage water of D102 drainage canal, 500m bank raising and culvert installation of D1 major drainage canal, Improvement of 1,500m farm roads, Date of completion of the main work: Nov 2005, Date of completion of

Item		Performance
		the supplementary work: Sept 2006, Because of the main and supplementary work, 20 ha of paddy with defective drainage at the end of Lot 5 became well-drained paddy field and 50 ha of rain-fed paddy at the downstream area of Lot 6 became irrigation paddy
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis In order to secure an irrigation water supply source for the end/terminal paddies of the tertiary canal, the project was designed to set up a water intake facility that re-uses the paddy drainage water in the drainage canal. This design makes full use of the condition of PC23 area where irrigation and drainage canals are separated and run parallel to each other. Evaluation If enough water is secured for the secondary canal, it is possible to supply the needed amount of irrigation water from the tertiary canal to paddies at the end of the tertiary canal at the optimum time. The water from the tertiary canal flows through cultivation fields, the tertiary drainage canal, and then, the facility to re-use drainage water. This technology to re-use the drainage water was confirmed to be relevant. 2) Relevant Organizations and Support System Analysis All the farmers who cultivate the fields in the pilot project area assembled together to look at the current condition of the irrigation drainage facility and share one another's problems. In this meeting, a farmers' organization which functions as WUA was established. The WUA assessed the needs for facility repair and confirmed its commitment to the O&M work. As a result, all the WUA members agreed to the implementation of the pilot project. In the WUA meeting, the chief of the Morarano Chrome Commune and an officer of the PC23 area management office participated to sign the meeting minutes and to share information and problems. Evaluation The process of this project is helpful in carrying out a measure for effective use of water resources through re-use of the drainage water in PC23 area. 3) Capacity of the Residents Analysis Farmers discussed the O&M work-sharing between the new WUA for the tertiary canal and the existing Federation of Water Users. WUA members have enough capacity to follow and implement the rules and methods of O&M of the repaired facility. The rules and methods were decided by the members. Evaluation Through the initiation by the farmers, WUA was established for each of the tertiary canal throughout the irrigation area of the P5 main canal of the Sahabe River water system. As an upper organization of the WUAs, the existing Vohibola-Mandroso Water Users Federation and Tsaratanibary Water Users Federation were combined and became Tsaravohi Water Users Federation. Actual implementation of O&M work for the facilities depends much on the leadership of the WUA executives.
8.	Sustainability and Implementation System	1) Sustainability : The project and its activities are sustainable. 2) Implementation System for Sustainability : WUA for each tertiary canal
9.	Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied: Effective use of limited water resource 1) Relevance This measure, which solves the irrigation water shortage for paddies by re-using the limited water resource, meets the need of the residents. The

Item		Performance
		measure's effect, increased production, contributes to the national policy. 2) Effectiveness This is an effective measure because the objectives to stabilize rice cultivation and increase the yield are achieved through the change from rain-fed to irrigation cultivation. 3) Efficiency This measure is effective in dealing with the short-term irrigation water shortage. Efficiency of this measure increases by including a mid- and long-term measure for continuous use of water. 4) Impact Rationalization of water management, which was done by matching the units of implementation measure and water management, gives impacts on a) efficient use of limited water resource, b) rebuilding of WUA, and c) increased capacity of WUA. 5) Sustainability Re-organized WUAs carry out water allocation and facility O&M on their own initiative.
10.	Matters to be Considered in Development Planning (as Feedback)	① Farmers have a need for effective use of limited water resource. The project is based on such need as well as farmers' consensus. The farmers are willing to organize a group and divide the organization work and responsibilities among the members. ② Tasks and responsibilities of the facility managers and users are clearly defined. In carrying out the tasks, capacities for facility O&M held by the managers and users should be even. ③ Water management process based on the needs and consensus of the water users is clearly defined. ④ O&M activities are evenly divided between the managers and users. Amount of the water fee paid by the users is comparable to the necessary cost. ⑤ PR activities, which promotes farmers' participation in every process of the project, are thorough.
11.	Remark	In the irrigated area of PC23, irrigation water is taken from various rivers. Because the upstream areas of the rivers are mostly degraded grass land, PC 23 area has low capacity for water resource recharge and water retention while the amount of the river water vary greatly from season to season. As a result, only the western half of the PC23 area can have irrigated paddy field, and this limits the amount of rice production. Under such conditions, this pilot project to re-use the drainage water was implemented to examine the techniques to increase/expand the irrigation area through the effective use of the limited water resource. This system of re-use of paddy drainage water, which makes the best of the area with separated irrigation and drainage canals, is effective as it overcomes the irrigation water shortage (short-term effect). The system can be included in the repair plan of the key irrigation system as mid- and long-term measures. By doing so, supplementary water resource function which can handle variable conditions of the river flow is expected to emerge. Furthermore, rice productivity is likely to increase up to the average yield of the grain-growing region of the central highland if the project includes software measures such as a) streamlining of water management and b) adoption of new paddy rice varieties that accommodate the recent changes in agricultural climate.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （4/12）

4. Research and Extension of New Varieties and High Potential Crops

Item		Performance
1.	Zone / Area	PC23 Area: Paddy rice cropping test Sahamilahy River Basin: NERICA rice adaptability test
2.	Beneficiaries	Rice-farming households in the study area
3.	Background	In order to accommodate the noticeable changes of agricultural weather and environment in recent years in the areas along the Lake Alaotra, 1) selection of late maturing photo-sensitive paddy rice varieties which have a long growing period, and mid and early maturing thermo-sensing varieties that can replace MK34 and Tsemaka, 2) breeding of promising new paddy rice variety and 3) production of seeds for multiplication are needed.
4.	Goal	1) Adoption of paddy rice varieties with short growing period and low photo-sensitivity as a countermeasure to the changes in the rice cultivation environment 2) Selection of second crops that are adapted to cold winter climate 3) Selection of upland rice that is adapted to the land with low soil fertility
5.	Activity	1) Paddy rice cropping tests on mid maturing varieties, second crop selection test, and local review session on cropping test in PC 23 area 2) Demonstration cultivation (demonstration plot) of promising mid maturing varieties 3) NERICA rice adaptability test 4) Compilation of crop cultivation manual for extension activities
6.	Input and Result	1) Input Cost Phase 1: Cropping test materials 165,500 MGA (¥394,103) Exhibition cost 337,200 MGA (¥18,546) Test management cost (on commission) 3,372,000 MGA (¥185,460) Phase 2: Cropping test materials 2,948,512 MGA (¥161,297) Exhibition cost 778,800 MGA (¥42,604) Test management cost (on commission) 9,430,316 MGA (¥515,882) Phase 3: Cropping test materials 5,510,400 MGA (¥297,540) Exhibition cost 613,600 MGA (¥33,134) Test management cost (on commission) 50,344,234 MGA (¥2,718,588) 2) Result Activity by the Study Team Provision of farming materials and management cost for the 3-year cropping test under a unified design Activity by the Assignees/Trustees (FOFIFA area agricultural research center in CALA) Paddy rice cropping test, 2nd crop selection test, Local review session on cropping test in PC23 area, NERICA rice adaptability test in Anusiboriry and Antanimafy areas Achievement 3 paddy rice cropping tests, 3 local review sessions on cropping test, 1 second crop selection test, 1 early maturing paddy rice variety cropping test, and 1 selection test for paddy rice variety for demonstration cultivation (demonstration plot) were conducted in the test paddy plot in the 4th field of irrigation area of P5 main water way of the Sahabe River in PC 23. Rainy season and dry season cropping tests of early maturing paddy rice variety were conducted in an agricultural field owned by a farming household in PC23 area. NERICA adaptability test was conducted in both test areas. Demonstration

Item		Performance
		cultivation (in a farming household field) of promising mid maturing variety was carried out in Ambodirano village which is along the national road 3a. In paddy rice cropping test, transplant culturing of 7 mid maturing varieties was continuously done for 3 years under a unified design. Direct sowed cropping test of 6 other mid maturing varieties were done once, and out of those 6 varieties the most promising variety was selected for another cropping test. After the transplant culturing cropping test, 3 varieties were deemed to be promising. Together with the 3rd paddy rice cropping test, these 3 promising varieties were cultivated as a demonstration in the field owned by a household where the previous test was conducted. In this demonstration plot, comparison of the common cultivation method practiced by farmers in paddy fields near the plot and a water-saving cultivation method practiced in demonstration plot was also done.
7.	Evaluation at the Project Completion	1) Relevance of the Technology Applied Analysis Yields of 7 varieties of the paddy rice transplant culturing cropping test are as follows: Variety Tested / 2004/05 / 2005/06 / 2006/07 MR10684-45-1-1-1: 3.88/4.18/3.23 / 3.42/2.87/2.30 / 0.80/3.18/3.71 MR10890-92-3-1-1: 4.47/4.13/3.60 / 2.76/2.48/2.58 / 1.31/2.76/4.09 MR10890-209-3-2-3: 4.48/3.83/4.14 / 2.37/2/18/2.05 / 0.53/2.78/4.03 MR10892-36-2-1-2: 4.13/4.05/4.30 / 3.18/2.82/2.58 / 0.65/2.29/3.95 MR10892-174-3-2-3: 4.96/3.97/4.16 / 2.24/2.42/2.21 / 0.63/2.81/4.13 MR10985-61-1-2-2: 4.06/4.13/3.78 / 3.36/3.16/2.52 / 1.03/3.22/3.66 MR10985-76-2-1-2: 4.31/4.40/4.49 / 3.70/2.93/2.27 / 0.59/2.81/3.23 MK Malady (Reference): 5.15/4.78/3.56 / 4.14/3.58/2.88 / 2.58/2.14/2.97 (Note: Yield from the test plot converted to ton/ha. Yield of 1st transplanting /2nd transplanting, 3rd transplanting. Dates of transplanting are (generally) 1 December/1 January/1 February) Direct sowed cultivation cropping test was conducted while sowing on the same day of the transplanting cultivation test. AT77-1 variety whose yield was assumed to reach the level of 3.0 ton/ha was selected for the second cropping test. Although the numbers varied from plot to plot, the average yield of the 2nd test was 3.27 ton/ha, higher than that of the 1st test. Yield of rainy season cultivation of X1649, a paddy rice early maturing variety, was higher if the transplanting was done later. Transplanting done on the first day of February resulted in a yield of 4.31 ton/ha. Yields of cropping tests done in a field owned by a farming household were 2.14 ton/ha for the dry season cultivation and 2.33 ton/ha for the rainy season cultivation. Yields of demonstration cropping test in 2006/07 and demonstration cropping variety selection test conducted in the test paddy in PC23 area in 2005/06 were as follows: Variety tested / Jan. transplanting / Variety tested / March transplanting MR10684-45-1-1-1: 5.28 ton/ha / MR10890-92-3-1-1: 3.75/2.92/3/71 MR10985-61-1-2-2: 5.10 ton/ha / MR10892-174-3-2-3: 3.29/2.37/2.79 MR10985-76-2-1-2: 6.62 ton/ha / MR10985-76-2-1-2: 3.23/2.80/2.64 Evaluation Promising varieties have not been determined yet. This is because at least 3 results of the field cropping tests under the same weather condition and the same test design are needed for the selection of a promising variety. The above 3 mid maturing varieties with a combination of water-saving irrigation method and forcing manure input method are expected to contribute a great deal in improving rice productivity. 2) Relevant Organizations and Support System

Item		Performance
		Analysis FOFIFA area agricultural research center in CALA, which was commissioned for this pilot project, is in charge of breeding of new paddy rice varieties in Madagascar. This center can conduct a series of cropping test including the field adaptability test. Evaluation How (under what kind of system) to breed seeds after promising varieties were determined has been discussed by relevant agencies in Madagascar. 3) Capacity of the Residents Analysis Cultivation and management of the test varieties in the demonstration plot in Ambodirano village are done by the farmer who owns the plot and receives guidance by researchers from the FOFIA area agricultural research center. Evaluation Farmers in PC23 area have strong obsession for MK34, which is a local variety. At the same time, they are greatly interested in new paddy rice variety which produces high yield and high quality rice. For this reason, they seemed to have a capacity for water-saving cultivation technique used for mid maturity varieties.
8.	Sustainability and Implementation System	1) Sustainability: Monetary input to continue the cropping test are needed 2) Implementation system for Sustainability : CALA
9.	Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied: Improvement of rice productivity 1) Relevance The measure to increase rice productivity through development of (promising) mid maturing thermo-sensing rice variety meets the needs of the farmers and conforms to the state policy as well 2) Effectiveness Through setting up and operating a system of multiplication and provision of promising varieties, the measure becomes effective 3) Efficiency Cultivation, selection, determination, stabilization of characteristics and development activities of promising varieties need to be carried out continuously over a long period of time. For this, coordination with a research institute specializing in cultivation increases the efficiency of the measure. 4) Impact Demonstration cultivation in the field owned by a farming household contributes toward having immediate impact 5) Sustainability In making a start of breeding of certified seeds for farming households, coordination with a research institute is important as it leads to continuity of the measure and brings positive effects
10.	Matters to be Considered in Development Planning (as Feedback)	① Farmers are willing to increase agricultural productivity. Follow-up measures to radically change the common cultivation method are well established ② System for multiplication and supply of seeds necessary to stabilize double cropping is established ③ Access to the seed supply source is simplified for the farmers ④ Researchers and engineers of research institute for testing and seed multiplication are adequately supplied and assigned ⑤ Demands for seeds are expected in the area surrounding the Lake Alaotra
11.	Remark	The third adaptability test of the early and mid maturing varieties bred by the FOFIFA area agricultural research center in CALA has just been completed in the field.

Item		Performance
		Although recommended varieties have not been selected yet, promising varieties, which can adapt to cultivation environment of the paddy areas around the Lake Alaotra, are in sight. For the selection of recommended varieties, on-going paddy rice cropping test and demonstration site cropping test need to be carried out continuously for two more cropping seasons. From the results of the 1st and 2nd cropping of the paddy rice transplant culturing cropping test of 7 mid maturing varieties, promising varieties, whose yields of husks and straws are expected to be more than those of the existing varieties, were selected and cultivated in the demonstration plot. As the local farmers showed good reactions in the explanatory meeting open to the public, stabilization of characteristics of the varieties and multiplication of certified seeds are urgently needed to be done. Height of the plant of the promising varieties is long because of a large husk-straw ratio. Thus, establishing and operating a cultivation method which replaces the heavy manure cultivation method is essential for extension of mid maturing thermo-sensing varieties.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （5/12）

5. Establishment of Forest Management Association and Capacity Development

Item		Performance
1.	Zone / Area	Sahamilahy River Basin: Antetezantany Area (forest) Sahabe River Basin: Sahanidingana Area (grass land and shrubs)
2.	Beneficiaries	Residents who are interested in natural resource conservation and forest management
3.	Background	In order to a) conserve natural resource, b) carry out forestation activities, and c) prevent forest fire (3 major components of the watershed conservation activities), an organization to carry out such activities are needed. The residents are organized to establish forest management association which carries out activities for natural forest conservation, forest fire prevention, etc.
4.	Goal	1) Establishing an organization to carry out watershed management activities for forest conservation, sustainable use of resources, etc. 2) Promotion of autonomous activities run by the residents 3) Raising the residents' awareness on forest management and natural resource conservation
5.	Activity	1) Workshop to form consensus on establishment of forest management association 2) Establishment and registration of forest management association 3) Practical training of organization management 4) Practical training to formulate activity plan 5) Implementation of activities to strengthen the organization
6.	Input and Result	1) Input Cost Forest Area Phase 1: Meeting/Workshop cost 120,000 MGA (¥6,600) NGO cost 6,700,000 MGA (¥368,500) Forest Area Phase 2: Meeting/Workshop cost 127,500 MGA (¥6,975) NGO cost 6,215,200 MGA (¥340,000) Forest Area Phase3: NGO cost 1,146,000 MGA (¥61,679) Grass and Shrub Area Phase 1: Meeting/Workshop cost 120,000 MGA (¥6,600) NGO cost 6,700,000 MGA (¥368,560) Grass and Shrub Area Phase 2: Meeting/Workshop cost 127,500 MGA (¥6,975) NGO cost 6,215,200 MGA (¥340,000) Grass and Shrub Area Phase 3: NGO cost 1,146,000 MGA (¥61,769) 2) Result Assistance by the Study Team Support to the association through NGO on organization management Activity by the Forest Management Association Organizing (arrangement) of meeting records, Accounting, Records of activities and their results, Activities for equipment maintenance/management Achievement Registration as a legal body: Antetezantany area on 31 Jan, 2005, Sahanidingana area on 18 Jan, 2005, All the members participated in association activities, Autonomous management of the organization Number of members: Antetezantany area 81members (including 26 women), Sahanidingana area 42 members (including 16 women)
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis Watershed management is a way of rehabilitation of integrated land use that satisfies the condition of the watershed. For this, establishment of an organization and its training are necessary to carry out and sustain various activities in the watershed.

Item		Performance
		Evaluation The people in the project areas have traditional rules called DINA which dictate their customs and participation in communal work. The people, thus, have adaptability to organized activities. 2) Relevant Organization and Support System Analysis It is necessary to register the association as a legal body in order to assure the association's sustainability and to be qualified to apply for new activities to the relevant agencies. If the residents do not have experience in organization management, they need a certain period of time to master how to manage an organization by themselves. For this, assistance by an NGO, which has ample experience of developing potentiality/capacity of the residents, is essential. Evaluation Through a series of routine guidance by an NGO, the people have more understanding of organization activities. Furthermore, organizational autonomy is becoming stronger. Commune's positive attitude on cooperation is raising the moral of its residents. 3) Capacity of the Residents Analysis People in the area have a tradition of DINA, thus they have adaptability to group work. Association activities are not the main livelihood activities of the people. If people do not get incentives from the association activities that are comparable to the incentives livelihood activities offer them, they would not participate in the association so actively. Evaluation Capacity of the residents can be increased by their deeper understanding of the scheme and a series of routine guidance by an NGO. However, it is impossible to improve quality and quantity of participation, if the needs of the area are not met, i.e. people do not receive any incentives.
8.	Sustainability and Implementation System	1) Sustainability Organization activities such as natural forest conservation, prevention of forest and wilderness fire, etc. that do not require new equipment or materials are likely to be sustained. 2) Implementation System for Sustainability Activities can be sustained to a certain extent within the current organization system. In order to increase autonomous organizational activities, regular coordination with the communes, the lowest local government administration body, is necessary.
9.	Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied: Increasing capacity for watershed management 1) Relevance The measure is needed to form a basis of autonomous watershed management activities by the residents. 2) Effectiveness By registering the association as a legal body, the forest management association gained the qualifications to apply and participate in various programs run by the government. For this reason, the measure is effective in enhancing autonomous watershed management activities. 3) Efficiency Efficiency of the measure depends on the work of the NGO which assists the residents to establish the organization and enhance their management capacity. 4) Impact The measure has a full impact if autonomous watershed management activities provide incentives to the residents, thus fulfilling their needs.

Item		Performance
		5) Sustainability The measure is sustained by organization activities by the members if they have adequate capacity.
10.	Matters to be Considered in Development Planning (as Feedback)	The following matters, that aim to increase the willingness of the residents to participate, are to be feedbacked for the formulation of a plan to establish an organization for watershed management and increase its capacity ① In terms of autonomous organization and autonomous management, the association is easy to manage ② Through organization activities (combination of forestry and agricultural activities), people's willingness to participate is increased ③ Technique that fulfills the needs of the residents is easy to master ④ Regular coordination with the communes are established and maintained
11.	Remark	Watershed conservation is likely to generate multiple effects if its activities are implemented in a comprehensive manner. If this pilot project does not end as a one-time-only scheme, but sustains even after the project completion, this proves its reproducibility. For the sustainability, establishment of an organization and its training are essential in setting up a body to carry out various activities for watershed management. The people in the project areas have traditional rules called DINA which dictate their customs and participation in communal work. The people, thus, have adaptability to organization activities. Association activities on watershed management are not the main livelihood activities of the people, and can be quite burdensome to them. To master organization management people need a) a certain period of time for practical experience, and b) incentives that meet their needs. It was found that participatory watershed management activities are likely to be fully implemented if such incentives are provided.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （6/12）

6. Natural Forest Conservation

Item		Performance
1.	Zone / Area	Sahamilahy River Basin: Antetezantany Area (forest)
2.	Beneficiaries	Area residents who use natural resources
3.	Background	Destruction of natural forest is giving a large negative impact on environment in the surrounding areas such as decreasing capacity of soil and water conservation. Natural forest conservation aims to regain the conservation capacity and to increase land productivity.
4..	Goal	1) Improvement of natural environment through natural forest conservation 2) Improvement of soil and water conservation capacity of the natural forest 3) Conservation of natural resources including animals and plants through natural forest protection 4) Maintaining the overall balance of the natural environment
5.	Activity	1) Workshop on importance/significance of natural forest 2) Reinforcement of natural forest conservation activities by natural resource conservation committee 3) Training/Workshop of the committee to set up natural forest conservation system 4) Establishment of natural forest conservation area, its boundaries and panel 5) Well establishment of natural forest conservation activities led by the committee
6.	Input and Result	1) Input Cost Phase 1: Input material 5,359,000 MGA (¥294,745) Meeting/Workshop cost 120,000 MGA (¥6,600) NGO cost 6,700,000 MGA (¥368,500) Phase 2: Input material 529,000 MGA (¥28,939) Meeting/Workshop cost 127,500 MGA (¥6,975) NGO cost 6,215,200 MGA (¥340,000) Phase 3: Input material 40,000 MGA (¥2,156) NGO cost 2,676,000 MGA (¥144,236) 2)Result Assistance by the Study Team Provision of materials (picket for conservation area boundaries, erection of notice board, set of paints, surveying tape, saw, hammer, bush knife, cap/hat, binoculars, white board, uniform, bicycle, recording note, etc), Guidance on formulation of conservation plan Activity by the Forest Committee Establishment of conservation area boundaries, Organizing conservation area patrol team, Carrying out patrol, Formulation of conservation plan proposal, Establishment of Dina, Additional erection of signs Achievement Establishment of boundary lines (length: 10.16 km, conservation area: 600 ha), Formulation of conservation plan, Carrying out patrol, Report on illegal logging
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis Although the residents have strong awareness of the project, they do not accept the project so easily if it consists only of conservation activities. Evaluation The residents are likely to accept the project if the project includes, together with the forest conservation, a system for sustainable use of the forest.

Item		Performance
		2) Relevant Organization and Support System Analysis Natural forest conservation activities tend to create conflicts of interests among the residents. For this reason, a system of assistance by the commune, which is the lowest local government administration body, is required. Evaluation Natural forest conservation regulates traditional use of the forest. In order to have organized activities go smoothly, the project needs to deal with this regulatory aspect and coordinate with the relevant agencies. 3) Capacity of the Residents Analysis Conservation activities only for the sake of conservation do not increase the people's capacity for forest management because their willingness to participation does not increase. Evaluation If natural forest conservation is a part of an integrated package of activities, people's willingness for participation will increase. This will increase their capacity as well.
8.	Sustainability and Implementation System	1) Sustainability The project is likely to be sustained if natural forest conservation is carried out together with other activities. 2) Implementation System for Sustainability Project can be sustained within the current organization system. For further sustainability, establishment of an on-demand technical training system at DREEF is necessary.
9.	Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied: Increasing capacity for watershed management 1) Relevance Natural forest conservation is absolutely necessary to maintain the capacity for soil and water conservation in the watershed, and thus conforms to the national forest policy. 2) Effectiveness Illegal entrance and logging are prevented by establishing and announcing the conservation area and by enhancing the patrol system. In order to secure internal effects, either appropriate compensation to those who lost their rights to use the forest or alternative plan needs to be included in the measure. 3) Efficiency The measure tries to maintain the capacity for the natural forest conservation in the area with the least amount of inputs. 4) Impact Negative impact of the measure is avoided by verifying non-timber products and their owners (those who have the rights to the products), and incorporating appropriate schemes to the owners. 5) Sustainability Conservation activities are sustained if the committee combines other watershed management activities, that are included in their bylaws, and agricultural production activities, that can offer incentives to the committee members.
10.	Matters to be Considered in Development Planning (as Feedback)	① In the process of natural forest conservation plan formulation, approval by the government administration can be obtained. ② Countermeasures to the problems likely to occur in the local area are included. ③ Activities are accepted by the participating residents and are easy to implement. ④ Training and allocation/assignment of those who are responsible for coordination with the government agencies are assured

Item		Performance
		⑤ Mechanism of extension activities of watershed management is established in the government administration
11.	Remark	For watershed conservation, existence of forest is essential. Natural forest conservation requires regulations on forest usage and prevention of people coming in from other areas. Conservation activities by the residents are recognized by people in the surrounding areas if the natural forest conservation plan was formulated and, then, accepted by the DREEF. The residents in villages have different degrees of interests to the forest, which tends to create conflicts among them. Such conflicts are very difficult to solve only by the residents themselves. The government administration such as commune and DREEF needs to be involved in settling the conflicts. For this reason, natural forest conservation should not be done solely by the residents, and the government needs to work together with the residents on this matter.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （7/12）

7. Prevention of Forest Fire

Item		Performance
1.	Zone / Area	Sahamilahy River Basin: Antetezantany area (forest) Sahabe River Basin: Sahanidingana area (grass land and shrubs)
2.	Beneficiaries	Area residents
3.	Background	Forest fire has great impact on natural environment and resources as it leads to soil erosion and increasing sedimentation in downstream areas. Forest fire prevention reduces soil erosion which improves land productivity.
4.	Goal	1) Reduction of forest fire and grass fire 2) Protection of vegetation (forest, shrubs, and grasses) from fire 3) Protection of people's properties such as houses in villages
5.	Activity	1) Workshop on environmental impact of forest fire conducted to increase the residents' understanding of forest fire and to offer the latest information on forest fire regulations 2) Forest fire prevention activities by the residents 3) Training of the committee to establish a system of forest fire countermeasures 4) Maintenance/Improvement of equipments to put out fire in villages 5) Practical training on fire fighting
6.	Input and Result	1) Input Cost Forest Area Phase 1: Input material 3,036,000 MGA (¥166,980) Meeting/Workshop cost 120,000 MGA (¥6,600) NGO cost 6,700,000 MGA (¥368,500) Forest Area Phase 2: Input material 1,100,500 MGA (¥60,202) Meeting/Workshop cost 127,500 MGA (¥6,975) NGO cost 6,215,200 MGA (¥340,000) Forest Area Phase 3: Input material 504,000 MGA (¥27,166) NGO cost 11,460,000 MGA (¥61,769) Grass-Shrub Area Phase 1: Input Material 3,036,000 MGA (¥166,980) Meeting/Workshop cost 120,000 MGA (¥6,600) NGO cost 6,700,000 MGA (¥368,500) Grass-Shrub Area Phase 2: Input Material 1,100,500 MGA (¥60,202) Meeting/Workshop cost 127,500 MGA (¥6,975) NGO cost 6,215,200 MGA (¥340,000) Grass-Shrub Area Phase 3: Input Material 342,000 MGA (¥18,434) NGO cost 7,640,000 MGA (¥411,796) 2) Result Assistance by the Study Team Preparation of equipment and materials (fire beater bar, bush knife, pump for putting out fire, bucket, shovel, fire alarm, cap/hat, water storage tank, bicycle, set of materials for equipment warehouse), Guidance of practical training on fire fighting (fire drills) Activity by the Forest Association Workshop (including audio-visual education), Guidance on committee management (technical training), Practical training with actual use of equipment and materials (twice in each area), Establishment of fire prevention system, Maintenance and management of equipment and materials Performance Fire extinction (total of 5 times in all the areas), Establishment of Dina, Construction of equipment warehouse (completed in Feb. 2006 in forest area, August 2006 in grass area)

Item		Performance
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis Fire prevention activities have been led by the government administration. They are traditional communal activities as well. Through the extension of ideas of fire prevention and technical training, people can master the activities. Evaluation This is an urgent technical matter because administrative guidance on fire prevention needs to have specific actions. 2) Relevant Organizations and Support System Analysis External assistance is necessary to have systematic technical guidance and maintain/improve equipment. Awareness of the residents becomes stronger if coordination with the communes, the lowest local government administration body, is good. Evaluation People's awareness of fire prevention increases by PR activities by the government administration. The awareness increases also by repeated practical training of the residents by NGO with the actual use of the equipment. 3) Capacity of the Residents Analysis: Activities will take place again if the residents have enough capacity, and fire extinction takes place within the scope of self-defense Evaluation Fire extinction in remote areas that is beyond the scope of self-defense will be a challenge as it imposes a burden to the residents. Special measures such as provision of lunch, assistance on mobility/transport, etc. are needed
8.	Sustainability and Implementation System	1) Sustainability Project's sustainability is high because continuation of forest and wilderness fire prevention activities does not require new equipment. 2) Implementation System for Sustainability Project can be sustained within the current organization system. For further sustainability, coordination with the communes and establishment of an on-demand technical training system at DREEF are necessary.
9.	Effectiveness of Measures to Reduce Negative Impacts	Measures to be studied: Measures for forest and wilderness fire damage 1) Relevance The measures to prevent forest fire, which is the primary cause of degradation of water and soil conservation in the watershed, conform to the national policy of forest and protection of people's properties. 2) Effectiveness Forest fire prevention measures are effective as they raise people's awareness of fire prevention. Such awareness leads to reduction of human-caused forest fire due to mismanagement of fire. Fire prevention awareness also improves the system of fire extinction. As a result, more fire extinction activities will take place, and spreading of fire will be reduced. 3) Efficiency Raising people's awareness of fire prevention and capacity building on fire extinction by the people are efficient measures if the local government cannot maintain the fire extinction system that includes mobility/transport. 4) Impact The measures have a small impact on prevention of fire spreading from outside of the watershed. For such fire, regional measures by the government administration are needed. 5) Sustainability

Item		Performance
		Fire prevention system will be sustained if activity areas are limited to those around the houses of the association members.
10.	Matters to be Considered in Development Planning (as Feedback)	The following matters need to be feedbacked if a fire prevention plan is to be formulated to further develop forest fire prevention of self-defense nature. ① Enough sensitization on fire prevention is included in the training of the residents ② Procedures for coordination with the government administrations are included ③ Plan focuses on fire prevention and extinctions measures and identifies objects for fire prevention ④ Training and allocation/assignment of those who are responsible for coordination with the government agencies are assured ⑤ Necessary equipment and practical training plans are included
11.	Remark	Forest and wilderness fire prevention is an important issue in terms of natural resource protection and soil conservation through recovery of vegetation. Such fire prevention is likely to be easily adopted by the residents. Forest and wilderness fire prevention has been already taking place because a) people carry out prevention activities as a traditional way of self-defense, and b) awareness on fire prevention was created by the government administration. The aims of this pilot project include motivating people so that their awareness on fire prevention is developed into concrete actions. Fire prevention activities extend to those who are not committee members, which is found to have large impact on fire prevention. Such impact, however, is only limited to the villages in the pilot project areas. Fire spreading from other areas made the residents work extremely hard on fire extinction. Fire prevention has its limit if it is done by people from only one village. This is because such one-village activity carries a risk of cutting down the awareness and motivation of those people in the village with too much work that is beyond the amount they could handle. Fire prevention is most effective when done in the whole watershed. Results of this pilot project suggest that fire prevention should be handled by the relevant government agencies for the entire area.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （8/12）

8. Development of Buffer Zone

Item		Performance
1.	Zone / Area	Sahamilahy River Basin: Antetezantany Area (Forest)
2.	Beneficiaries	Residents who participate in the project activities and downstream area residents
3.	Background	Conservation of natural forest is assured through the development a buffer zone that meets the need of the residents. In addition to the natural forest conservation, vested interests of the residents, who experienced the restriction to use the forest, are to be assured.
4.	Goal	1) Pressure to use natural forest is reduced 2) Alternative use of natural forest is increased by development of a buffer zone 3) Contribution to the regeneration of natural forest 4) Improvement of livelihood through the development of a buffer zone that meets the needs of the area
5.	Activity	1) Workshop on functions and necessity of the buffer zone 2) Promotion of improvement of the function of the buffer zone committee 3) Training of committee members on development and management of the buffer zone 4) Joint appointment/authorization of buffer zone development area with DREEF 5) Establishment of a fire control belt (area) around the buffer zone 6) Maintenance/Improvement of equipment and materials for buffer zone development
6.	Input and Result	1) Input Cost Area Phase 1: Meeting/Workshop cost 120,000 MGA (¥6,600) NGO cost 580,000 MGA (¥31,900) Phase 2: Input material 4,211,000 MGA (¥230,361) Meeting/Workshop cost 127,500 MGA (¥6,975) NGO cost 6,215,200 MGA (¥340,000) Phase 3: Input material 4,585,000 MGA (¥247,132) 2) Result Assistance by the Study Team Guidance on overall framework of the buffer, Maintenance/Improvement of materials for nursery, Preparation of fruit tree seedlings, Preparation of materials for apiculture, Technical guidance on apiculture, Guidance on raising seedlings and tree planting Activity by the Forest Committee Selection of forestation area, Management of nursery by the committee, Apiculture activities, Tree planting activities, Raising of fruit tree seedlings Achievement Forestation for resource development; 56 ha (including privately-owned forest), Forestation of native species; 0.2 ha, Planting of fruit trees; 480 trees, Honey collection; 3.5 litters (As of Feb 2007)
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis Development of a buffer zone and natural forest protection are two sides of the same program. Buffer zone development can be considered as an aggregation of different activities including existing forestation and fruit tree cultivation, etc. It is technically relevant as development of alternative resources under the government regulation of natural forest usage. Evaluation

Item		Performance
		Buffer zone development is a new concept for the residents. With more understanding of the combination of different techniques, the residents will accept the activities more easily. 2) Relevant Organization and Support System Analysis Thorough guidance by the external agencies in the form of development assistance is needed to gain understanding of the residents on buffer zone development Evaluation As the residents understand the project more, it will be accepted as one and the same as natural forest protection 3) Capacity of the Residents Analysis Support to fruit tree cultivation and apiculture techniques cannot be provided without external assistance Evaluation It is difficult to master new techniques through one-time technical guidance. Gradual follow ups are needed.
8.	Sustainability and Implementation System	1) Sustainability In terms of incentives, fruit tree cultivation and apiculture activities have strong potential for project sustainability 2) Implementation System for Sustainability Activities can be sustained within the current organization system. Technical guidance by external agencies is necessary.
9.	Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied: soil erosion from the watershed 1) Relevance By combining with the natural forest protection activities, the measure meets the needs of the residents 2) Effectiveness Having a measure to develop forest resources that generate forest products with economic/monetary values is more effective than relying solely on natural forest in the protection areas. 3) Efficiency Achievement of the measure becomes greater if inputs that meet the residents' need to create income sources are provided. 4) Impact Impact of the measure will appear quickly through diversification of alternative resources 5) Sustainability The measure will be sustained by adding incentives to the residents
10.	Matters to be Considered in Development Planning (as Feedback)	① Buffer zone is likely to produce diverse effects that can become alternatives to the natural forest ② Establishment of a system of coordination with the government agencies is included in the project ③ The project meets the needs of the residents while techniques introduced can be adopted easily ④Training and allocation/assignment of those who are responsible for coordination with the government agencies are assured
11.	Remark	This project and the natural forest protection project are two sides of the same thing. The main focus of this project is on development of alternative resources under the regulations on natural forest usage. The project also functions as a breakwater of the natural forest. In terms of alternative resources, the project is likely to be

Item		Performance
		accepted by the residents if the activities are not rigid, but meet the needs of the residents. As the natural forest has abundant resources for honey, awareness on natural forest protection becomes stronger if apiculture is included in the project. Adding apiculture is found to make it easier for the resident to accept the project. In reality, the breakwater function of the natural forest is rather weak due to the difficulty in selecting geographically appropriate areas. For this reason, the buffer zone is deemed to be accommodated as a fire protection line.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （9/12）

9. Development of Community and School Forests

Item		Performance
1.	Area	Sahabe River Basin: Sahanidingana area (grass land and shrubs)
2.	Beneficiaries	Residents who participate in the projects and residents of the area
3.	Background	By the development of forests as communal property a) wood and timber for construction of public facilities are secured, b) people's awareness of forestation is increased, c) natural environment of the area is improved and d) land productivity is increased.
4.	Goal	1) Establishment of community and school forests to meet the demand for public facilities 2) Establishment of self-sufficient system of wood and timber among the residents 3) Expansion of forest area to reduce soil erosion
5.	Activity	1) Sensitization of the residents on significance and effects of establishment of community and school forests 2) Practical training to improve the functions of community forest committees and school forest committee 3) On-the-job training of the committees on the establishment of community and school forests 4) Development of community and school forests through participation of the residents 5) Setting up a system to control and manage the forest areas
6.	Input and Result	1) Input Cost Phase 1: Input material 8,264,000 MGA (¥454,520) Meeting/Workshop cost 120,000 MGA (¥6,600) NGO cost 6,700,000 MGA (¥368,500) Phase 2: Input material 4,995,000 MGA (¥273,249) Meeting/Workshop cost 127,500 MGA (¥6,975) NGO cost 6,215,200 MGA (¥340,000) Phase 3: Input material 2,762,500 MGA (¥148,899) 2) Result Assistance by the Study Team Preparation of materials for nursery, Training on raising seedling, Training on tree planting technique Activity by Forest Committees Selection of forestation areas, Management of nurseries, Tree planting activities, Care and management of forestation areas Outputs Community forest area: 22.2 ha, School forest area: 2.0 ha (as of Feb. 2006)
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis Forestation activities in community area offer limited participation of the residents. Development of school forests has large relevance in terms of environmental education of children who build the future. Evaluation Relevance of the activities improves by combining the activities with other projects with high incentives or tree planting in privately-owned land. School forest draws much attention and interest from people including the parents and siblings of the school children due to its curriculum on environmental education.

Item		Performance
		2) Relevant Organizations and Support System Analysis External assistance is needed until the activities are implemented as planned and efficiently Evaluation Trainings on a) activity plan formulation that includes both agricultural and forestry and b) management of planned activities are needed 3) Capacity of the Participants Analysis Capacity for forestation technique increases through practical technical training. Participation only in community forest activities limits the willingness of the residents to participate. Evaluation Assisting the development of not only communal forest, but also privately-owned forest increases the willingness of the residents to participate in activities
8.	Sustainability and Implementation System	1) Sustainability: Sustainability of forestation activities depends on availability of materials such as seeds and agrochemical Sustainability is likely to be high because seeds of trees such as eucalyptus and pine can be collected by individual households 2) Implementation System for Sustainability Activities can be sustained within the current organization system. Sustainability is further assured through early establishment of an on-demand technical guidance system at DREEF.
9.	Effectiveness of Measures to Reduce Negative Impacts	Measures to be studied: soil erosion from the watershed 1) Relevance Measures to recover vegetation of degraded land are implemented first in the areas around the residences. The measures also incorporate the activities into the environmental education program. For these reasons the measures conform to the national forestry policy. 2) Effectiveness Effectiveness of development of community land through people's participation is fully achieved by including, in the measure, incentives such as provision of seedlings for their own land 3) Efficiency A community's owning forest resources, which can provide materials for construction and maintenance of communal and public facilities, is more efficient than a pay-as-you-go/pay-when-needed financing plan, if middle and long-term futures are considered. 4) Impact Incorporation of school forest development into the environmental education program has an impact to make the next generation of pupils recognize the importance of environmental conservation 5) Sustainability Community and school forests are to be sustained by including, in the measure, activities to promote ownership among the participants
10.	Matters to be Considered in Development Planning (as Feedback)	① Forestation activities that meet the needs of the residents are included ② Project plan includes land use guarantees under the coordination with the relevant government agencies ③ Activities meet the needs of the residents who can easily adopt the technology introduced ④ Training and allocation/assignment of those who are responsible for coordination with the government administration are assured

Item		Performance
		⑤ System of extension activities on watershed management by the government agencies is established
11.	Remark	Reinforcement of forestation is an important task in terms of water and soil conservation in the grass land and the shrub areas. Willingness to participate in the development of community forest is not uniform among the residents. Such willingness may have its limit due to the lack of personal interest and to the fact that long time is needed to see the actual benefits of forestation. In order to increase participatory forestation, such activities that offer incentives as development of privately owned forest and apiculture, should be incorporated into the project.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （10/12）

10. Promotion of Agroforestry

Item		Performance
1.	Zone / Area	Sahabe River Basin: Sahanidingana area
2.	Beneficiaries	Activity participants and residents of the area
3.	Background	Agroforestry is an integrated system of land use which aims to reduce soil erosion, improve land productivity and increase household income through production of cash crop.
4.	Goal	1) Prevention of soil erosion from agricultural land on hill slopes 2) Adoption of land use measures for improved land productivity 3) Improved livelihood of the residents
5.	Activity	1) Production of hedgerow and agricultural crops 2) Production of fruits and feed crops 3) Apiculture and cultivation of flowering trees 4) Workshop on extension of agroforestry activities 5) On-the-job training on activities of agroforestry committee 6) Selection of implementation areas of agroforestry 7) On-the-job training on agroforestry 8) Maintenance/Improvement of materials needed to carry out activities 9) Monitoring and follow up of activities
6.	Input and Result	1) Input Cost Phase 2: Input material 8,465,000 MGA (equivalent of ¥463,074) Meeting/Workshop cost127,500 MGA (equivalent of ¥6,975) NGO cost 6,215,200 MGA (equivalent of ¥340,000) Phase 3: Input material 6,504,000 MGA (equivalent of ¥351,216) 2) Result Activity by Study Team Guidance on formulation of overall framework, Technical guidance, Preparation of material and equipment, Preparation of fruit tree seedlings Activity by the Forestry Committee Selection of project areas including exhibition areas, Implementation of planting activities. Outputs Exhibition area 2,100 m², Extension areas (1) 600 m², (2) 1,000 m², (3) 500 m², (4) 800 m² <total of 5 areas: 5,000 m²> Planting of, legume shrubs, fruit trees, etc. in the extension areas
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis As this project combines existing technologies, these technologies can spread easily with increased understanding of the residents. Hence, the technology is relevant. Evaluation As the residents understand more, technological standstill is changing to technological penetration. 2) Relevant Organization and Support System Analysis Since this is a new concept, thorough guidance is needed to be given as external assistance Evaluation

Item		Performance
		To increase understanding of the residents, external assistance on practical guidance (learning by doing) for a set period of time is necessary 3) Capacity of the Local Residents Analysis Activities focus on intensification of the farming activity. Capacity of the residents is increased by having activities that directly contribute to their livelihood and having practical guidance (learning by doing). Such activities and guidance increase the possibility to expand the measures (extension of activities). Evaluation As the residents understand the contents of the project more, they are more interested in the activities. Evaluation by the residents on the project benefits after the completion of activities is likely to influence the level of activity expansion.
8.	Sustainability and Implementation System	1) Sustainability : Befits of agroforestry activities determines the level of sustainability of the activities 2) Implementation System for Sustainability Although activities can be implemented within the current system, timely assistance by outsiders when a problem just emerges is realistically impossible. For this reason, only the activities that do not cause problems are likely to be selected by the residents, and thus, be sustained.
9.	Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied: soil erosion from the watershed 1) Relevance The measure meets the needs of the residents because they prevent soil erosion from forest and agricultural lands on hill slopes. The measure gives the residents strong incentives for participation 2) Effectiveness The measure is effective because the households have limited area for agricultural cultivation. Through the measure, they gain agricultural fields as a new source of income, although such fields have less land productivity than paddies. 3) Efficiency Efficiency of the measure increases by combining the effectiveness of the soil erosion prevention measures and selection of agricultural crops with high economic return 4) Impact Success and failure held by those who participated in the measure lead to the positive and negative impacts to those who have not yet participated. 5) Sustainability : The measure is sustained by participants who receive incentives.
10.	Matters to be Considered in Development Planning (as Feedback)	① The scope of the project is on soil conservation that is expected to give various impacts to improve people's livelihood ② Techniques introduced to the people help to increase land productivity and are sustainable ③ Techniques introduced are welcomed by the people and are easy to master ④ Actions introduced such as securing seeds are easy for the people to expand
11.	Remark	This project gives benefits directly to the residents as it improves their livelihood and land productivity through soil conservation. The result attained in the exhibition area determines the level of ease to expand the new techniques to individual residents. Technical extension is done by collecting seeds from the preceding areas where activities have been already taking place. It (the technical extension) does not need equipments or materials. Although some residents are

Item		Performance
		already using the techniques, effectiveness of the techniques is not yet known because it has not been long since the people started using them. Technical extension will be possible as more and more residents in the exhibition and extension areas come to understand the effectiveness.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （11/12）

11. Recovery of Vegetation in Lavaka

Item		Performance
1.	Zone / Area	Sahamilahy River Basin: Ranofotsy area (Middle-Style Lavaka) Asahamena River Basin: Manakambahinikely area (Active-Style Lavaka)
2.	Beneficiaries	Residents of farming villages and other farmers
3.	Background	Lavaka is a potential source of soil erosion, and civil work for Lavaka recovery requires a large amount of money. This pilot project aims to establish and promote Lavaka recovery techniques using local materials so that the recovery work will not be a large burden to the local residents. Although recovery of vegetation takes a long time, technique of Lavaka recovery can be sustainable
4.	Goal	1) Stabilization of soil disruption through recovery of vegetation 2) Securement of land for agriculture, pasture and grazing 3) Promotion to the local residents of soil conservation techniques on vegetation recovery
5.	Activity	1) Stabilization of soil disruption in Lavaka through recovery of vegetation 2) Reduction of the amount of slope face flow by forestation of areas surrounding Lavaka 3) Soil stabilization in the alluvial fan. 4) Effective use of the alluvial fan (fruit production, feed crop production, grazing)
6.	Input and Result	1) Input Cost Phase 1：Input material 2,851,000 MGA (equivalent of ¥156,806) NGO cost 6,000,000 MGA (equivalent of ¥330,000) Phase 2：Input material 1,769,000 MGA (equivalent of ¥96,772) NGO cost10,758,650 MGA (equivalent of ¥588,548) Phase 2：Input material 2,104,980 MGA (equivalent of ¥113,5458) NGO cost14,135,290 MGA (equivalent of ¥761,892) 2) Result Activity by Study Team Technical guidance on nursery garden making, seedling production, establishment of earth retaining works., etc. and guidance on significance of monitoring and its methodologies Activity by Participants Production of seedlings, Planting the seedlings in hilly areas around Lavaka and downstream alluvial fan, Establishment of earth retaining works. Outputs Establishment of committee by the participants, Committee members' understanding of Lavaka restoration techniques, Learning of techniques through participation in activities as specified in the project plan, Awareness raising on project continuation/sustainability Achievement (Middle-style Lavaka) Afforestation of 9,300 trees, Sandbags/barriers 20 places, Restoration of 1 place, Planting of 130 fruit trees, Sowing of feed crop in 800 m² area (Active-style Lavaka) Afforestation of 4,400 trees, Sandbags/barriers of 7 places, Restoration of 4 places, Planting of 100 fruit trees
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis As for the intermediate Lavaka, technological relevance to the residents is high

Item		Performance
		in terms of efficiently use the land in alluvial fan. Relevance is low foractive Lavaka. Evaluation Residents are very much interested in cultivation of fruit tree and feed crops on the land in alluvial fan. They are highly motivated to participate. 2) Relevant Organization and Support System Analysis Layout design for the whole Lavaka is necessary. This cannot be implemented without any external assistance. Evaluation External assistance by an experienced NGO gives the residents strong interest and motivation for participation 3) Capacity of the Local Residents Analysis It is possible to increase the capacity of the residents by technical practice and guidance which include minor civil works Evaluation The residents have good potentials and are producing good results.
8.	Sustainability and Implementation System	1) Sustainability : Between the 2 types of Lavaka, managing and maintenance activities of fruit trees, feed crop trees and pasture, that were planted in the land in alluvial fan intermediate Lavaka, are likely to be sustained. The participating residents are likely to consider those trees and pasture as their property. 2) Implementation System for Sustainability Intermediate Lavaka, activities by the committees, that were organized by the residents themselves, can be sustained. In active-style Lavaka, on the other hand, it is likely to be very difficult to sustain the activities.
9.	Effectiveness of Measures to Reduce Negative Impacts	Measure to be studied : soil erosion from the watershed area 1) Relevance This is an effective measure for intermediate Lavaka where soil stabilization of the collapsed surface is taking place. However, this effectiveness is limited to stakeholders around the Lavaka. In active-style Lavaka where the collapsed surface is unstable and the amount of soil run-off is large, effectiveness of the measures is weak. 2) Effectiveness Stabilization of soil and agricultural land use in the land in alluvial fan increases the effectiveness of the measure 3) Efficiency Measures for forestation around Lavaka, and agricultural land usage of the alluvial fan in the down stream are more efficient than those for civil works on drainage canals from Lavaka 4) Impact The measures have multiple effects by including activities to spread the information of the project to stakeholders around the Lavaka 5) Sustainability The measures are sustainable if usage of the land in alluvial fan become functional as incentive.
10.	Matters to be Considered in Development Planning (as Feedback)	① The project is centered around stakeholders of Lavaka ② The project scope is on Lavaka and its surrounding areas including the land in alluvial fan where communal usage of land is possible ③ The measures can become incentive for the participating residents, and the techniques introduced are easy to adopt

Item		Performance
		④ Training and allocation/assignment of those who are responsible for coordination with the government administration are assured
11.	Remark	From the point of view of the whole watershed area, effects of Lavaka on the downstream area are small, but if Lavaka is seen as a point, it has a potential for a great risk of. soil erosion Although this pilot project was aimed to be implemented as a model, its activities are difficult to sustain without external pressure to expand to other areas. The residents know very well what benefits will be brought by the utilization of the land in alluvial fan. For this reason, the measures/activities for Lavaka can be technically reproduced 技術的再現性 if they cover an adequate size of the land in alluvial fan that can be communally used. Activities start with utilization of the land in alluvial fan. , and as the utilization continues, such activities are expected to continue to the areas around Lavaka through forestation to reduce soil erosion from the upper stream.

PERFORMANCE TABLE OF PILOT PROJECTS ON WATERSHED MANAGEMENT AND RURAL DEVELOPMENT （12/12）

12. Extension of Improved Stove

Item		Performance
1.	Area	Sahamilahy River Basin: Antanimafy Area (Upstream Mountain Area) Sahabe River Basin: Soalazaina Area (Upstream Grass Land) PC23 Area: Ambohidorony Area (Downstream Paddy Area)
2.	Beneficiaries	Farmers (especially women)
3.	Background	Farmers in the Study Area use wood charcoal as domestic fuel and traditional three-stone stoves for indoor and outdoor cooking. In the upstream area, men make wood charcoal to generate income while women and children collect wood near their residences. In the downstream area, people purchase wood charcoal with cash, which is a large part of the household expenditure. Improvement of living condition, through reduction of A) work by women and children, B) household cash expenditure on wood charcoal in the downstream area, and C) time spent on collecting wood, requires streamlining of domestic work through the adoption of improved stoves with high fuel efficiency
4	Goal	1) Reduction of domestic fuel consumption 2) Reduction of time spent on cooking 3) Reduction of time spent on wood collection 4) Improvement of domestic living conditions 5) Awareness raising on conservation and effective use of forest resources
5.	Activity	1) Designing of improved stove made of locally available materials 2) Production and demonstration of improved stove prototypes 3) Adoption of improved stoves by model households and introduction of improved stoves to regular (non-model) households 4) Promotion activities led by the residents for wider use of improved stove
6.	Input and Result	1) Input Cost Phase 1: Input material 310,000 MGA (equivalent of ¥17,050) NGO cost 4,722,000 MGA (equivalent of ¥259,710) Phase 2: Input material 889,600 MGA (equivalent of ¥48,663) NGO cost 5,255,000 MGA (equivalent of ¥287,472) Phase 3: Input material 1,535,000 MGA (equivalent of ¥82,890) NGO cost 13,579,600 MGA (equivalent of ¥733,298) 2) Result Activity by Study Team: Designing of 3 prototypes of improved stove, Provision of materials and guidance on production to 15 model households in Antanimafy area, Pprovision of (partial) materials to 175 households in Ambohidorony area (=50% of all the households) Activity by Participants: Giving suggestion on improvement of the 3 prototypes based on the trial use by the model households in Antanimafy area, Organizing village committees to promote improved stoves in Ambohidorony area, Guidance by committee members on improved stove production, Promotion/Sensitization activity to the Ambohidorony residents by users of improved stoves in Antanimafy area (voluntary activity) Outputs: In addition to 15 model households, 25 households adopted the stove in Antanimafy area. Seventy-six (76) households in Ambohidorony, 119 households in Soalazaina area, 112 households in Antetezantany area adopted the stove. Except for 5 model households in Antanimafy area, no one wanted

		to have wood-burning stove made of clay. Adoption ratio of brick stove to portable cooking stove with metal-sheet coating around the middle body is 7 to 3. (70%-30%)
7.	Evaluation at the Project Completion	1) Relevance of Technology Applied Analysis: 3 prototypes (1-wood stove made of clay, 2-wood/charcoal (dual input) stove made of bricks, 3-portable charcoal stove made of clay) were tried out. User friendliness of the brick stove increased by having production materials such as metal sheets, iron bars, and commercially available mat to place pans over brick stove. The middle body part of the portable stove made of clay was coated with a metal sheet. Size/Capacity of the portable stove was enlarged within the range of portability for increased fire power. Evaluation: Stoves made of clay ceased to be a prototype option as they cracked during usage, requiring time and labor for repair. Such crack occurred because they were made of soil with low clay content. Despite its higher production cost, wood/charcoal (dual input) stove made of bricks received the highest recognition by the residents due to the flexibility in its design to fit the kitchen layout. 2) Relevant Organizations and Support System Analysis: Activities of Antanimafy residents that took place in Ambohidorony villages confirmed that it is possible to set up voluntary support system by selecting those residents of the preceding area who recognize the effectiveness of the improved stove and are interested in promotion activities. In Ambohidorony and Soalazaina villages, people took initiative to establish village-based improved stove promotion committees whose responsibility includes giving guidance on stove production. Evaluation: To secure sustainability of the pilot project activities, it is essential to create a support system for improved stove promotion based on the people's will for voluntary and positive action. Sense of ownership needs to be developed by carrying out the initial meeting with a participator approach. Technical guidance by outsiders at the early stage of the project is also needed to teach the production methods of the improved stoves to the stove committees 3) Capacity of the Local Residents Analysis: The level of production technique of improved stove is appropriate for the people to master. Capacity building of the people should focus more on organizing and managing a group for stove promotion than on learning production techniques. Evaluation: If measures are taken to promote interest and will of the residents, the stove promotion activities can be carried out rather easily. These measures may include introduction of effectiveness of the improved stoves and provision of some portion of production materials. With these measures, the pilot project is deemed to be duplicated in the future.
8.	Sustainability and Implementation System	1) Sustainability: Activities can be sustained by activities on their own will by the village residents inspired by the earlier adoption of the improved stove by preceding households 2) Implementation System for Sustainability: Guidance by preceding (already-adopted) households in the village
9.	Effectiveness of	Measure to be studied: Reduction of negative impacts to the environment

	Measures to Reduce Negative Impacts	1) Relevance: This is an appropriate measure to meet the needs of the residents to streamline domestic work and reduce household expenses through the reduction of the amount of wood charcoal used for cooking. 2) Effectiveness: This is an effective measure to regain productivity of the limited forest resources 3) Efficiency: This measure is highly efficient, considering the amount of input; The production materials are locally and easily available and the design of the stove can be easily modified to meet the needs of the residents 4) Impact: The measure gives positive impact on health and sanitation; Heat retained by the improved stove can be used to boil water for drinking. This safe drinking water reduces the rate of infectious diseases among infants. 5) Sustainability: The measure is highly sustainable because the activities by the improved stove users lead to voluntary adoption of the stoves by other residents (non-users)
10.	Matters to Be Considered in Development Planning (as Feedback)	① Multiple effects can be expected due to the reduction of wood charcoal consumption ② Materials for stove production are locally and easily available ③ The stove design can be easily modified to meet the residents' needs ④ Maintenance and repair are easy for the users ⑤ Stove users promote activities to non (not-yet)-users
11.	Remarks	Comparative testing on efficiency of traditional three stone cooking stove and brick stoves was carried out. Although time needed to boil water was about the same, there was a clear difference in heat retention by the embers and in fuel consumption. Compared to the traditional three stone cooking stove stoves, fuel consumption of the brick stove is much smaller. Those who adopted the brick stoves estimate the amount of household expense saved by their stoves in a year to be equivalent of the price of a virgin heifer. Women make use of the retained heat of the improved stove to boil bad-quality water. Drinking such boiled water leads to reduction of the rate of infectious disease among infants as well as improvement of health and household sanitation. Benefits of the improved stoves are confirmed as the living condition of the stove users improved due to the lessening of time to collect wood and produce wood charcoal among the upstream residents, and reduction of household cash spending on wood charcoal among the downstream residents. Despite the positive effects of the improved stoves, awareness of the effectiveness of the improved stoves has not increased much. This is because the four areas selected for this pilot project is off the traffic route that many people in the study area take. For effective extension to a wider area, improved stoves should be set up in various public facilities at the centers of the communes along National Routes 3a and 33. Such stoves should not be only for exhibition, but for the actual use by facility visitors so that the visitors themselves can experience the convenience and effectiveness of the improved stoves.

CHAPTER 6 WATERSHED MANAGEMENT AND RURAL DEVELOPMENT PROJECTS

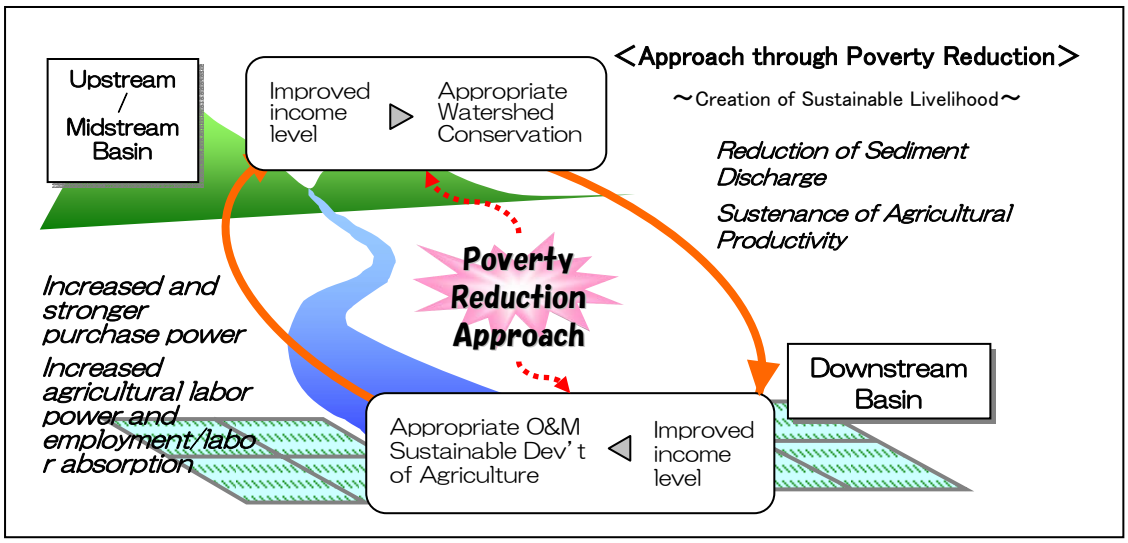
6.1 Basic Concept

6.1.1 Background on Study Area and Basic Development Concept

This study aims to formulate a set of watershed management and rural development projects for poverty reduction and improvement of living conditions. Specifically, it includes measures to a) improve watershed conservation such as forest and soil conservation, b) improve farming technique and infrastructure for agricultural production, c) improve farmers' organizations, d) improve living environment, and d) introduce small-scale business enterprise. These countermeasures are adopted to solve the existing problems in the Study area.

The river basins, consisting of the Sahabe River, the Sahamilahy River and 4 other small and mid-sized rivers, are the water source for the PC23 irrigated area. The local peoples who live in the upper/mid basins of the river basins in the PC23 irrigated area (downstream) are closely connected/intertwined in terms of their economy and societies. As shown by the diagram below, poverty in the PC23 irrigated area and poverty in the upper/med basins of the rivers constitute a cyclic system. In the watershed conservation projects in the upper/mid basins of the Study area, the people of the upper/mid basins receive direct benefits from the downstream area (PC23 irrigated area) through a circulation of a) man power to satisfy the demand of labor, and b) material things as food supply.

Currently, poverty and deterioration of living environment in the upper/mid and downstream areas are causing a vicious cycle, giving negative impacts to each other. For cutting off this vicious cycle of poverty, measures with approaches such as improvement of household income level, improvement of living environment, and improvement watershed conservation (natural resource conservation) are likely to be most effective as they bring sustainable livelihood to the people in the Study area.



6.1.2 Development Objectives

Based on the regional situations and the national policies of Madagascar, development objectives for the Study area for the next 15 years are set to be a) increase of rice production by at least 50%, b) reduction of poverty by 50%, and c) reduction of the amount of soil loss by 20%. Specific objectives are listed below and their indicators are presented in Table 6.1.1.

(1) For the next 15 years by 2023, rice production in the Study area is increased by at least 50% by targeting a) the rice yield in the PC23 irrigated area at 5ton/ha and b) the paddy rice yield in the upper/mid basins of each river at 3ton/ha. The number of households below the poverty line is reduced by half through improved rice production, diversification of agricultural income sources, etc.

(2) For the next 15 years by 2023, infrastructure for water and soil conservation is improved through a) vegetation recovery by planting leguminous seeds on 75% of the 87,000 ha of the grass/shrub area and b) forestation of 25% of the areas whose vegetation is recovered.

(3) For the next 3 years by 2012, the balance between conservation of forest resource and production-usage of fire wood charcoal is maintained by reducing the household consumption of wood energy by half.

Table 6.1.1 Development Indicators

Target Areas	Present (2008)			Future (2023)			
	Area	Annual Soil Loss	Annual Rice Production (in husk)	Area	Annual Soil Loss	Annual Rice Production (in husk)	Rice Production Increase (in husk)
	(ha)	(1,000 ton/yr)	(ton/yr)	(ha)	(1,000 ton/yr)	(ton/yr)	(ton)
(1) PC23 Area							
Irrigated area commanded by P1 main irrigation canal	4,600	-	13,800	4,600	-	27,600	13,800
Irrigated area commanded by P5 main irrigation canal	2,000	-	6,000	2,000	-	12,000	6,000
Subtotal		-	19,800	7,800		39,600	19,800
(2) Sahabe River Basin	97,700			97,700		-	
Existing forest	18,100		-	18,100		-	
Existing grass/shrub area	53,800		-	13,400		-	
Forest by forestation	0		-	10,100		-	
Vegetation area	0		-	40,400		-	
Paddy field	1,900		3.800	1,900		5,700	1,900
Subtotal		910	3,800		628	5,700	1,900
(3) Sahamilahy River Basin	20,600			20,600			
Existing forest	1,700		-	1,700		-	
Existing grass/shrub area	15,900		-	4,000		-	
Forest by forestation	0		-	3,000		-	
Vegetation area	0		-	11,900		-	
Paddy field	360		700	360		1,100	400
Subtotal		255	700		189	1,100	400
(4) Basins of 4 small and medium rivers	22,500			22,500			
Existing forest	1,200		-	1,200		-	
Existing grass/shrub area	16,600		-	4,100		-	
Forest by forestation	0		-	3,100		-	
Vegetation area	0			12,500		-	
Paddy field	1,200		2,400	1,200		3,600	1,200
Subtotal		256			205	3,600	1,200
Total annual rice production (in husk)			26,700			50,000	23,300
Total annual soil discharge		1,421			1,076		-348

Note 1: Rice yield in PC23 irrigated area is set at 3ton/ha for the present and 5ton/ha for the future while the annual cropping index of paddy rice is set at 120%

Note 2: Rice yield in upper/mid basins of each river is set at 2ton/ha for the present and 3ton/ha for the future while the annual cropping index of paddy rice is set at 100%

Note 3: Leguminous plants are to be planted on 75% of the degraded grass/shrub area

Note 4: Forestation is to be carried out in 25% of the area where leguminous plants are planted.

Source: JICA Study Team

6.2 Master Plan for Watershed Management and Rural Development Projects

6.2.1 Principles in formulation of watershed management and rural development projects

Watershed management and rural development projects are based on the basic development concepts of the Study area. The projects are formulated with the following principles: a) the analysis of the present condition, b) the action study to solve the existing problems, and c) applying the lessons learned from implementation of pilot projects.

(1) Watershed Management

Watershed management projects are formulated based on the characteristics of each development area by selecting and combining items on "countermeasures for problems solving" proposed in Section 4.3. The items include establishment of forest management association and capacity development, conservation of natural forest, recovery of degraded natural forest, development of community and school forests, promotion of greening of degraded grass area, development of buffer zone, promotion of agroforestry, introduction of the silvopastoral system, recovery of vegetation in Lavaka, basin environment monitoring by GIS, creation of forest resources, promotion of forestation activities, soil conservation through vegetation recovery, and prevention of forest fire.

(2) Rural Development

In order to increase household income, agricultural production must be increased because agriculture is the major income source of the people in the Study area. Based on the characteristics of each development area, agriculture rural development projects are formulated to a) increase the yield and the total production of rice as the major crop and b) diversify agriculture income sources. This formulation is done by selecting and combining the items on "the counter measures for problems solving" proposed in Section 4.3. The items include improvement of paddy productivity, promotion of diversification of agriculture income sources, repair of the existing intake structures, re-use of drainage water, rehabilitation of irrigation and drainage canal system, rehabilitation of irrigation drainage facilities, and enhancement of O&M of irrigation system, etc.

(3) Development of upper/mid basins area of Sahabe, Sahamilahy and 4 small/medium rivers,

Watershed conservation projects for the upper/mid basins of the rivers are formulated for each river basin in order to carry out watershed conservation systematically. In other words, each of (i) the Sahabe River basin, (ii) the Sahamilahy River basin and (iii) the basin of the four small and mid- rivers is to be covered by its own watershed conservation project.

Watershed conservation projects target local people in the Study area who a) depend on agriculture for their living and b) understand the significance of the watershed management projects well. As short-term benefits of watershed conservation projects cannot be expected,

smooth implementation of watershed management projects requires farmers to receive alternatives to the short-term benefits in the form of incentive. Such incentive is to promote their voluntary participation in watershed management projects. For this reason, an integrated watershed management project is formulated for each river basin, which includes rural development projects that bring short-term benefits to the farmers. Such projects include a) diversification of agricultural income sources (adoption of second crop after harvesting rainy season rice paddy, fruit tree cultivation, goose farming, in land fish farming, development of market, etc.), b) improvement of upland agriculture, and c) improvement of production bases (rehabilitation of existing irrigation facilities, etc.).

(4) Development of PC23 area

The area of the PC23 area commanded by P1 and P5 main irrigation canals is 9,870 ha (net irrigated area) or 11,630 ha (gross area). In the eastern part of the PC23 area (net area of 2,070 ha), irrigation is utterly impossible, and thus the area consists of rain-fed area. As a result, actual irrigated area in the PC23 area is 7,800 ha in total, comprising of 4,600 ha and 3,200 ha commanded by P1 and P5 main irrigation canals, respectively.

If an irrigation project to cover the whole PC23 area is to be set up, it is going to be a large-scale project with a large project cost and a long construction period. Especially, in 2,070 ha of the rain-fed areas mentioned above, new irrigation facilities need to be constructed because the majorities of the existing facilities have been broken or degraded. An irrigation project to construct facilities in the PC 23 rainfed areas requires large construction cost and, thus it is economically inefficient. Instead of irrigation development, PC 23 rainfed areas is formulated as rainfed development project through the diversification of agricultural income sources (adoption of secondary crops, fruit tree cultivation, goose farming, etc).

The area commanded by P1 main irrigation canal is greatly different from that of P5 main irrigation canal in terms of a) its size of irrigated area, b) number of existing irrigation and drainage facilities that require repair, c) activities of the irrigation association, d) size of demand by association members for irrigation project, and association activities. In all respects, the area commanded by P5 main irrigation canal is superior to that of P1. The project in the area commanded by P5 main canal is implemented first because a) concrete benefits of the irrigation are likely to be produced in a short term, b) the project costs are smaller and c) irrigation development in the area is rather easy. Then, based on the lessons learned from the implementation of irrigation project commanded by P5 main irrigation canal, project in P1 irrigated area should be implemented. Hence, the irrigation projects are formulated, keeping such order; P5 first, and then P1.

(5) Improvement of living environment through conservation of existing forest resources and streamlining of household chores

For watershed conservation projects that include tree planting, a long time is needed until people can actually see the projects' effects and benefits. To quickly reduce the consumption of existing forest resources, a project to promote improved stoves is formulated. This project has a large impact on improvement of watershed conservation as well as improvement of living environment including reduction of household expenses on cooking fuel, improvement of household chores, improvement of health and sanitation, reduction of time spent on firewood collection, reduction of hard work by women and children, etc.

(6) Adoption of technical assistance projects

Technical assistance projects are needed for smooth and effective implementation of rural development and watershed conservation projects. In the watershed conservation sector, projects, which a) integrate rural development and watershed management and b) aim to set up organization and to establish technical development methods, are formulated as described in the above (3). In the irrigation sector, projects are formulated to a) develop rice cultivation technique system adaptive to the PC23 irrigated area and b) establish and extend water management technique. In the agricultural sector, projects are formulated to a) establish thermo-sensitive mid and early maturing paddy rice varieties which replace the photo-sensitive varieties and b) study the established varieties for their practical application.

(7) Formulation of projects with immediate effects

Development projects are formulated by giving priorities to those that require small project costs and produce immediate effects/results.

6.2.2 Development Projects

Based on the principles described in the previous section, 8 development projects are formulated as presented in Table 6.2.1. The relationship between "counter measures for problem solving" proposed in Section 4.3 and the development projects are presented in Table 6.2.2. The locations of the projects are shown in Figure 6.2.1. "Project for integrated watershed conservation and rural development of south-western area of the Lake Alaotra" is formulated to reflect the lessons learned from a) the technical assistance projects and b) "Irrigation project in the South-west PC 23 area".

Table 6.2.1 Project List

No.	Name of Project	Implementation Area
1	Irrigation project the south west PC23 area	PC23 irrigated area commanded by PC5 main irrigation canal
2	Training project of water management experts (Technical assistance project)	PC23 irrigated area commanded by PC5 main irrigation canal
3	Experimental project for paddy research (Technical assistance project)	PC23 irrigated area commanded by PC5 main irrigation canal; Ambodirano Village
4	Large scale irrigation farming system research development project (Technical assistance project)	PC23 irrigated area commanded by PC5 main irrigation canal
5	Agricultural diversification project in the Eastern PC23 rain fed area	Eastern PC23 rainfed area
6	Development research project on method for integrated watershed conservation and rural development at Morarano Chrome area (Technical assistance project)	Upper/mid basins of the Sahamilahy River
7	Extension of improved stove project	Study area
8	Integrated watershed conservation and agricultural rural development project in South-West Alaotra lake area	PC23 irrigated area commanded by PC1 main irrigation canal), Basins of Sahabe River, Sahamilahy River, and 4 small and medium rivers
	Sub-Projects	
	(i) Rehabilitation sub-project for irrigation and drainage system in South West PC23 irrigated area	PC23 irrigated area commanded by PC1 main irrigation canal
	(ii) Integrated watershed conservation and agricultural rural development sub-project in upper and mid basin of Sahamilahy river	Upper/mid basin of Sahamilahy River
	(iii) Integrated watershed conservation and agricultural rural development sub-project for upper and mid basins of 4 small/medium rivers	Upper/mid basin of 4 small and medium rivers
	(iv) Integrated watershed conservation and agricultural rural development sub-project for upper and mid basins of Sahabe river	Upper/mid basin of Sahabe River

Source：JICA Study Team

Table 6.2.2 Comparison of countermeasures and development projects

No.	Couuntermeasures	Area/location	Project									
			1	2	3	4	5	6	7	8		
			Irrigation project in the South West PC23 area	Training project of water management experts	Experimental project for paddy research	Large scale irrigation farming system research development project	Agricultural diversification project in the Eastern PC23 rain fed area	Development research project on method for integrated watershed conservation and rural development at Morarano Chrome area	Extension of improved stove project	Integrated watershed conservation and agricultural rural develoment project in South-West Alaotra lake area		
										Rehabilitation sub-project for irrigation and drainage system in South West PC23 irrigated area	Integrated watershed conservarion and agricultural rural development sub-project in upper and mid basins of Sahamilahy river	Intergrated watershed conservation and agricultural rural development sub-project in upper and mid basins of 4 small/medium rivers	Intergrated watershed conservation and agricultural rural development sub-project in upper and mid basins of Sahabe river
1	Improvement of paddy productivity	PC23 irrigated area				★						
2	Promotion of diversification of agriculture income source	PC23 eastern rainf fed area					◎					
3	Promotion of diversificatin of agriculture sources	Irrigated area in upper and mid basin of each river***						★			◎	◎	◎
4	Extension of improved upland crop	Upland area in upper and mid basin of each river						★			◎	◎	◎
5	Strengthening research and extension system for new variety and high potential crops	PC23 irrigated area			★								
6	Research on developing methods of pasture land establishment and fodder production	Grass/shrub area in upper and mid basin of each river						★					
7	Promtion of diversification of agriculture income sources (goose)****	Study area					◎	★			◎	◎	◎
8	Rehabilitation of intake structures	PC23 irrigated area	◎*							◎**			
9	Re-use of drainage water	PC23 irrigated area	◎							◎			
10	Rehabilitation of on-farm irrigation and drainage facilities	PC23 irrigated area	◎							◎			
11	Rehabilitation of irrigation and drainage system	PC23 irrigated area	◎							◎			
12	Extension of appropriate irrigation technology	Irrigated area in PC23 area and in upper and mid basin of		★*		★					◎	◎	◎
13	Enhancement of O&M irrigation system	Irrigated area in PC23 area and in upper and mid basin of		★*							◎	◎	◎
14	Development of appropriate land ue paln for PC23 rainfed area	PC23 each rainf fed area					◎						
15	Rehabilitation of intake structures	Irrigated area in upper and mid basin of each river									◎	◎	◎
16	Establishment of forest management association and capacity development	Forest and grass/shrub areas in upper and mid basin of						★			◎	◎	◎
17	Conservation of natural forest	Forest in Sahabe and Sahamilahy river basins						★			◎		◎
18	Introduction of bee keeping	Forest in Sahabe and Sahamilahy river basins						★			◎	◎	◎
19	Capacity enhancement of local forstry offices	Study area						★					
20	Basin environment monitoring with GIS	Study area						★					
21	Prevention of forest fire	Forest and grass/shrub areas in upper and mid basin of						★			◎	◎	◎
22	Development of buffer zone	Forest of Sahamilahy and Sahabe river basins						★			◎		◎
23	Recovery of degraded natural forest	Forest of Sahamilahy and Sahabe river basins						★			◎		◎
24	Development of community and school forest	Grass/shrub area in upper and mid basin of each river						★			◎	◎	◎
25	Promotion of greenization of degraded grass area	Grass/shrub area in upper and mid basins of each river						★			◎	◎	◎
26	Promotion of agroforesty	Grass/shrub area in upper and mid basins of each river						★			◎	◎	◎
27	Introduction of silvopastral	Grass/shrub area in upper and mid basins of each river						★			◎	◎	◎
28	Recovery of vegetation in lavaka	Grass/shrub area in upper and mid basins of each river						★			◎	◎	◎
29	Road improvement-III	PC23 area	◎*							◎**			
30	Extension of improved stove	Study area							◎				

◎: Counter measure for development ★:Technical supports for development ★*:PC23 irrigated areas commanded by P5main irrigation canal ***:Total basins of Sahamilahy river, Sahabe river and 4 small. Midium rivers above PC23 area

◎*: PC23 irrigated areas commanded by P5 main irrigation canal ◎** : PC23 irrigated area excluding area commanded by P1main irrigation canal ****:Goose cultivation in stead of poultry

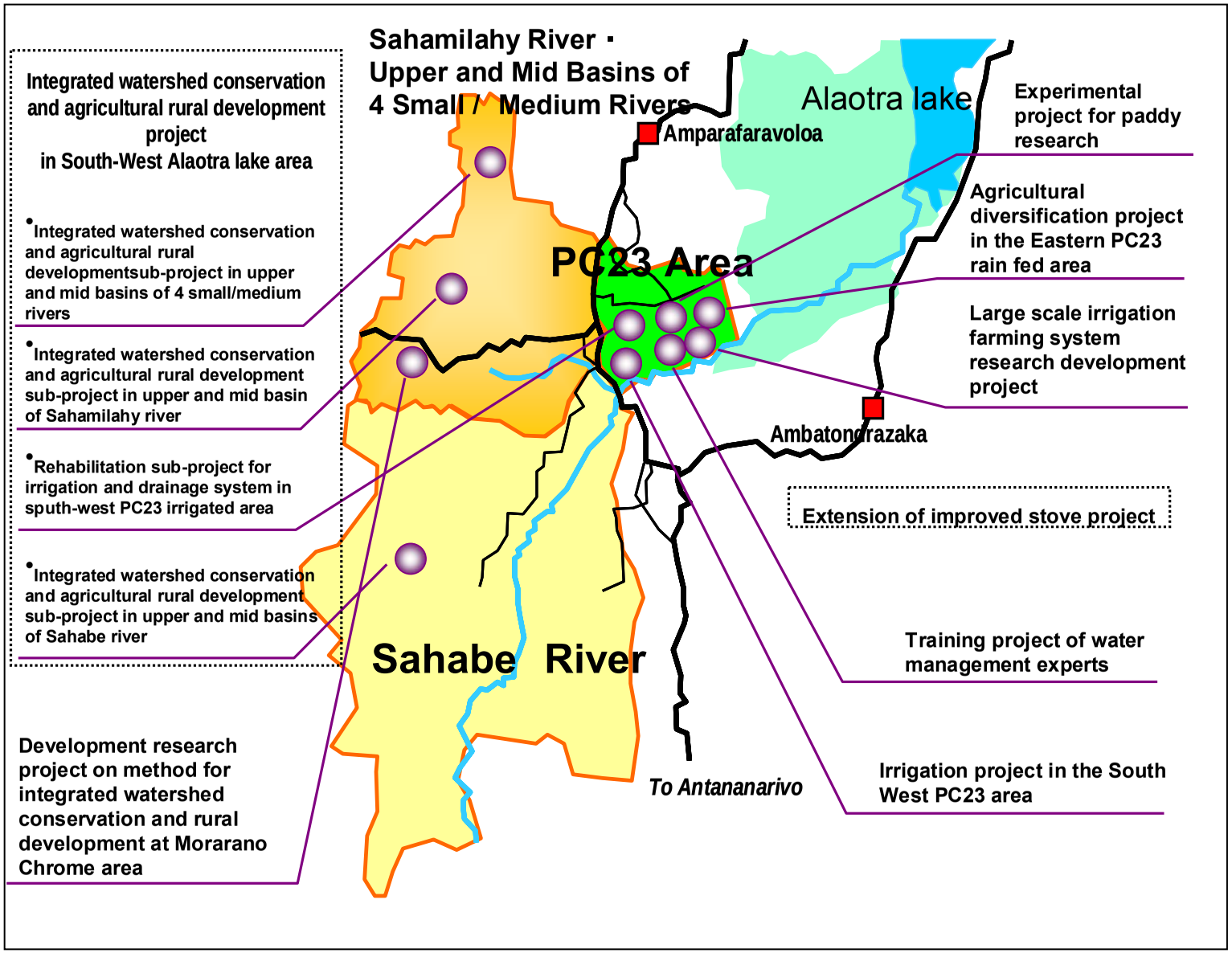


Figure 6.2.1 Location of Development Projects

Source: JICA Study Team

6.2.3 Outline of the Development Projects

(1) Irrigation project in the South west PC23 area

Water source/river head area in the PC23 irrigated area, which occupies the downstream part of the Study area, does not have suitable sites for dam and reservoir construction due to geographical and societal reasons. Because all the irrigation water in this area is drawn from the existing intake structures at the river head using gravity force, quantity of water intake for irrigation depends on the seasonal fluctuation of the river flow rate. Earth and sand discharged from the degraded grass/shrub area, which a) occupies greater part of the mountain and hill areas of the upstream and downstream regions and b) lacks power to recharge water, are deposited at the bottom of the rivers and irrigation canals. Such earth and sand cause floods and reduction of water flow amount. Under such circumstances, the planned amount of water intake (8.0 ton/sec) cannot be secured for the P5 main canal system that draws its water from the temporary head works of the Sahabe River. As a result, irrigation water is currently supplied to only 3,200 ha of the planned net irrigated area of 4,570 ha.

In the PC23 irrigated area, a drainage separation system is operating in which irrigation water distributed from the tertiary irrigation canals to various section of the farm fields (150 ha/section) is discharged into the tertiary drainage canals. Meanwhile, in every section of the farm fields of the P5 main canal system, not enough irrigation water reaches paddies at the tail end of a canal, creating water shortage. Consequently farmers are forced to engage in rain-fed cultivation.

Through the implementation of the pilot projects, re-using the water of the tertiary drainage canals, which run parallel to the tertiary irrigation canals, was found to be an effective and immediate measure to solve the problem of irrigation water shortage. In order to contribute, in terms of agricultural infrastructure, to the policy of double increase of rice production set by MAP, a measure to strengthen the functions of irrigation facilities is implemented. This measure is based on repeated/cyclical use of drainage water and targets the P5 main canal system. This measure is considered as a part of the measure for complete repair of the irrigation drainage system. Dams to re-use drainage water from the tertiary drainage canal, which are to be constructed and repaired through the measure, are to be permanent structures. These dams are to be used in the future as a) supplementary water sources that can accommodate the fluctuation of water flow conditions of the rivers (head water/water source) and b) facilities to adjust the water level of the paddies where the water-saving irrigation cultivation methods can be practiced.

This project consists of i) a measure to strengthen the functions of the key facilities in the irrigated area by the P5 main canal system in the west-southern part of PC 23, ii) a measure to improve facilities to re-use water of the tertiary drainage canals in 13 farm plots (about

2,000ha) whose irrigation water is taken from C5.3, C5.5 and C5.6 secondary irrigation canals of the P5 main canal system, and iii) a countermeasures improve access roads connective the National Road 3a with PC 23 area, and farm roads in the area. An irrigation water users' association was organized by land owners and cultivators in each of the 13 farm plots. Currently, the total number of association members is 803 persons.

After the rehabilitation of irrigation drainage facilities carried out by this project, (combined with Large scale irrigation forming system research development project propose later the present average paddy yield of 3 ton/ha is expected to reach 5 ton/ha while the cropping intensity of dry-season paddy rice cultivation is expected to be at least 20%.

This project is managed by MAEP. Components of the projects are described below. Location of the project and layout of main irrigation facilities are shown in Figure 6.2.2 and 6.2.3, respectively.

a) Strengthening the functions of the main facilities: Reconstruction of Sahabe river division work, Construction of Sahabe intake structure, Construction of setting basin (7,800m²), Improvement of dust/sediment removal bars for P5 main canal water gate for water level adjustment and repair of slope section of the canals (6,400m), Improvement of regulating gate (1 gate) in C5.5 secondary canal and repair of slope section of the canals (7,900m),regulating water gates (4 gates) in C5.6 secondary canal and repair of slope section of the canals (5,500m), Raising banks of main drain(D0, D1 and D2) (total 35,900m), Reinforcement of polder dikes (1,500m)

   Reconstruction of Sahabe river division work, construction of Sahabe intake structure, Construction of setting basin (7,800m^2), improvement of C5.5 secondary canal (6,400m), raising banks of main drain (D0, D1, D2) reinforcement of polder dikes (35,900m).

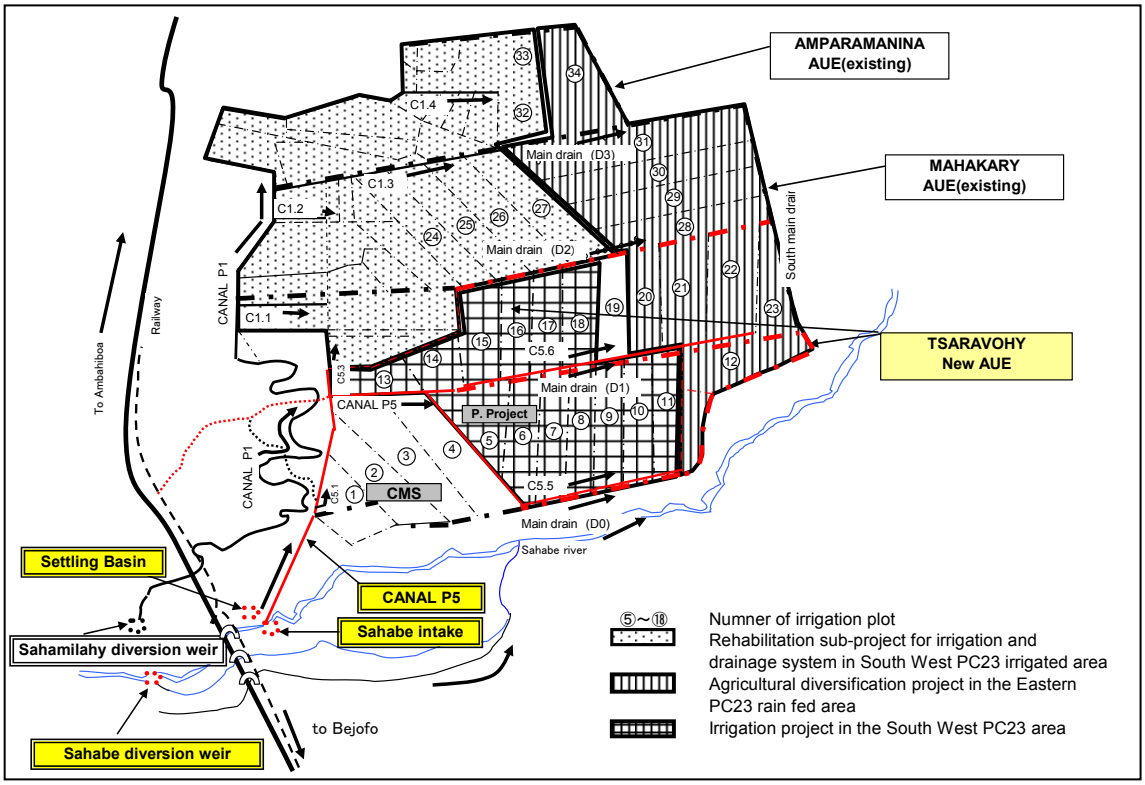


Figure 6.2.2 Locations of 3 development projects in PC23area

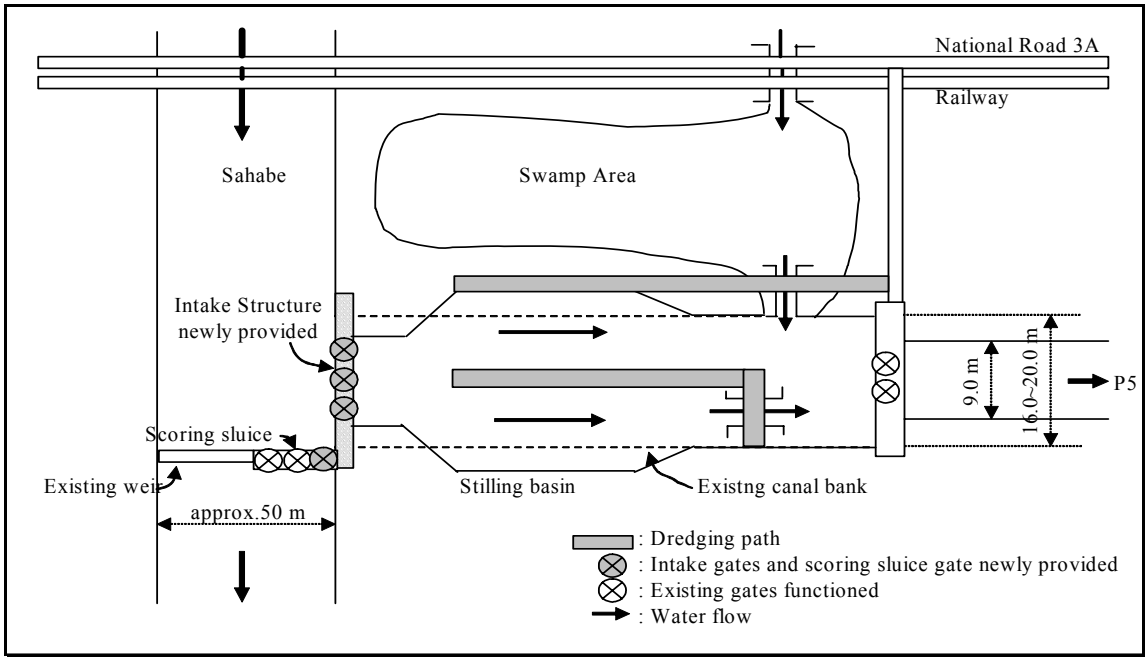


Figure 6.2.3 Layout of main irrigation facilities in PC 23 south west irrigated area

b) Preparation of facilities to reuse drainage water

Improvement of tertiary irrigation canals (reinstallation of 4 gates, repair of 9 gates, constriction of 8 division boxes and repair 20 division boxes, repair of slope section of canals(19,900m)) ; Rehabilitation and more construction of reuse facilities in tertiary drain (reinstallation of 8 division weir works and repair of 20 weir works, repair of slope section of the canal (28,400m)

c) Improvement of farm road network

Rehabilitation of approach roads to PC23 irrigated area (2,900m), Rehabilitation of main farm roads at the center of the PC 23 irrigated area (13,000m), Rehabilitation of main farm roads in the PC23 west-southern area (20,600m), Rehabilitation of tertiary inspection roads (28,400m)

d) Construction of operation and maintenance building

Construction of area administration office building, Construction of administration cabin for intake structures and settling basin

(2) Training project of water management experts

To carry out the countermeasures to rehabilitate the irrigation drainage system of the PC23 area, land owners and cultivators who use the irrigation water need to agree to divide responsibilities for O&M of irrigation/drainage facilitation. This agreement is considered as a precondition for the performance of the countermeasures. To satisfy this precondition, the existing AUE, which is currently inactive, must be re-organized. To divide water among the irrigation users in proportion to the size of their paddy field, irrigation water users' associations comparable to the scale and functions of the facilities need to be organized. By organizing irrigation water users to set up an association for each tertiary canal in PC23 area, appropriate water management can be exercised in each farm plot. Based on such concept of reorganization, water users' associations were organized in the pilot project. The water users' associations of the 5^{th} and 6^{th} farm plots took the leading role in the meeting with DRDR (a government administrative organization), and Morarano Chrome communes, and decided that a) water users' associations were to be organized in 14 farm plots of the P5 main canal irrigated area and b) the existing two AUEs were to be disbanded to organize the federation of the water users' associations. Before the mid-2007, 14 water users' associations were organized and registered as shown in Table 6.2.3.

Table 6.2.3 List of newly organized water users' associations in PC5 main canal irrigated area

2ndary Canal	Water Users' Assoc. (farm plots)	Regis-tered Area (ha)	Land Owners (Pers)	Assoc. Mem-bers (Pers)	2ndary Canal	Water Users' Assoc. (Section)	Regis-tered Area (ha)	Land Owners (Pers)	Assoc. Mem-bers (Pers)
C.5.2	5	166.0	33	62	C.5.5	13	166.0	21	62
	6	170.0	37	74		14	170.0	44	74
	7	169.3	35	68	C.5.3	15	169.3	64	68
	8	170.6	36	73		16	170.6	72	73
	9	162.8	30	62		17	162.8	66	62
	10	184.7	35	64		18	184.7	69	64
	11	167.3	33	57					
	12*	353.0	81	130	Federation of Water Users' Associations		2,558.1	656	993

Note:*: Plot 12 is a rain-fed area and is excluded from this project area

Source：Rapport "Contribution des JICA pour constitutions des associations par maille PC23", 2007

Under the circumstances described above, capacity building of those engaged in irrigation management including government personnel and water users is carried out so that O&M of the facilities and water management in each farm plot are done appropriately when irrigation drainage facilities in the PC23 west-southern irrigated area are repaired. Hence, to develop human resources, this project sets up training courses for water management personal in parallel with the implementation of "Irrigation project in the south west PC23 area".

The capacity building program is managed by MAEP. Project components are as follows. The number of participants for each course is set to be about 35 persons.

a) Preparation of training program
   (i) Preparation of training program made by senior national engineers
   (ii) Preparation of plan of operation of training program

b) Conducting group training course on water management in other countries including the third country training (11 persons)
   (i) Selection of trainees
   (ii) Establishing training course

c) Conducting training course of water users' association members by trainees of the group training course on water management (2 persons from each of the 13 farm plots, total 26 persons)
   (i) Selection of trainees
   (ii) Establishing training course

d) Preparation and operation of follow-up program to trainees
   (i) Monitoring of the activities of trainees after completion
   (ii) Preparation and operation of the follow-up program

The countermeasures to strengthen water management capacity in areas outside south west PC23 irrigated area are implemented as a component of the project.

(3) Experimental project for paddy research

The countermeasures to strengthen rice cultivation trails and studies are implemented for quicker selection of promising thermo-sensitive new varieties which replace photo-sensitive late maturing paddy rice varieties. Such replacement is a prerequisite to the establishment of a cultivation system adaptive to agricultural weather changes which has been noticeable in recent years in the areas around the Lake Alaotra. The countermeasures to select and establish 3 promising mid-maturing varieties (that were preliminary selected in the pilot project) are to be continued. When the project to improve rice productivity in central highland, which is scheduled to be implemented by FOFIFA, actually starts, countermeasures are going to be included as a base activity. The countermeasures to strengthen rice cultivation trials and studies by FOFIFA Regional Agricultural Recearch Center of CALA are implemented within the framework of the above mentioned project. Project components that are carried out in the immediate future are as follows. Implementing agency will be MAEP. Under MAEP, implementation of the continued project is undertaken by the Training Center.

a) Practical and demonstrative cropping at farmers field level will be made in the following 2 sites; 1)A new demonstration plot (5 ha) where is located farm plot No.6 in the south west PC23 irrigated area, 2) The existing demonstration plot in Ambodirano village (5ha)
   (i) Trial cropping of two promised medium matured varieties in the rainy season (2 places)
   (ii) Trial cropping of one promised early matured variety in the rainy season (2 places)
   (iii) Combination cropping of promised early and medium matured variety (2
b) Open to the public the cropping technologies in demonstration farm (once every cultivation season)
   (i) Opening a field day
c) Preparation of cultivation manuals of the new varieties
   (i) Preparation of a cultivation manual for medium matured varieties in the rainy season
   (ii) Preparation of a cultivation manual for early matured varieties in the rainy season
   (iii) Preparation of a cultivation manual for double-cropping of paddy

(4) Large scale irrigation farming system research development project

When thermo-sensitive medium-maturing promising varieties are put into practical

application, the countermeasures to develop rice cultivation technique system adaptive to large-scale irrigation paddies in PC23 and other areas is implemented. This project is in charge of MAEP with assistance from FOFIFA Regional Agricultural Research Center of CALA.

"Large scale irrigation farming system research development project" is implemented to succeed "Irrigation project in the south west PC23 area" and "Experimental project for paddy research". The contents of this project are to be determined based on the results of the project to improve rice productivity in central highlands which is scheduled to be implemented shortly. At this moment, "Large scale irrigation farming system research development project" is assumed to establish a sustainable rice cultivation technique system and a paddy rice double-cropping system both of which include plowing with field-level water management, and all the activities from setting up nursery to threshing. To establish such systems, wide-area experimental cultivation trial is done in one farm field plot (150ha) of the C5.5 secondary canal, using the thermo-sensitive medium matured varieties that passed the final selection. This cultivation trial is to go with the progress of complete switch-over to irrigation paddies. Components of the project are as follows.

a) Preparation of one experimental farm plot south west PC 23 area as wide-area demonstration cultivation plot

b) Improvement of farming calendar
   (i) Establishment of farming calendar adaptive to climate changes
   (ii) Establishment of cropping system of non-photosensitive medium matured variety

c) Improvement of farming method
   (i) Establishment of fertilization technology which centers application of manure
   (ii) Establishment of crop control system based on the introduction of regular planting manual type notary weirder

d) Improvement of post-harvest and proceeding
   (i) Adoption of cropping machine (harvester)
   (ii) Improvement of soil fertility

e) Improvement of soil fertility
   (i) High input of compost
   (ii) Adoption of leguminous plants as second crops

f) Establishment of water-saving cultivation
   (i) Practice of SRI/SRA
   (ii) Follow out the water management program

(5) Agricultural diversification project in the eastern PC23 rainfed area

This project extends to the end/edge parts of PC23 area. (Refer to Figure 6.2.2 for project location) The project covers 2,070ha of the PC23 eastern rainfed area, and its activities include preparation of land use plan map to stabilize crops for rain-fed cultivation and to increase the utilization rate of cultivated land. For the preparation of production map, topographical survey and confirmation of flood condition in the rainy season that accommodates minute difference of topographical elevation are conducted. Results of the survey and the study are used to classify the whole area into 1) rain-fed paddy, 2) upland field, and 3) pasture areas. Such classification is done to carry out area-specific countermeasures such as enhancing soil fertility and improvement of cultivation method for rainfed paddies, adoption of double cropping in upland field, improvement of pasture area, and goose farming by utilization of the drainage water. Implementing agency for this project will be MAEP. Under MAEP cooperative agency will be Alaotra Mangoro region area while the technical guidance on rain-fed cultivation such as double cropping is offered by an NGO. Project components are as follows.

a) Undertaking of relative elevation survey

b) Undertaking of interview survey for landforms and cultivation for topographic condition and flood condition

c) Field survey and formulation of land use plan

d) Technical guidance on improvement of rain-fed rice cultivation methods, adoption of double cropping and improvement of grass for pasture area

e) Diversification of agricultural income sources project(4 villages)

(6) Development research project on method for integrated watershed, conservation and rural development at Morarano Chrome area

In upper/medium basins of the Sahamilahy River, the forest coverage rate, including the existing natural forest, is now down to 8%, and the water and soil conservation capacity is extremely weak. To increase household income for better living environment and conserve environment in an integrated manner, a) various participatory watershed management countermeasures and b) countermeasures that give farmers incentives such as improvement of agricultural production and diversification of agricultural income sources are both needed as agriculture is the main occupation of the people in the area.

Because land and water resources are limited also in upper/medium basin, countermeasures to diversify agricultural income sources through effective use of such resources meet the needs of the farmers. These countermeasures must be based on agricultural/irrigation engineering and farming technique. With an aim to increase the effectiveness of the wide-area watershed management activities, the countermeasures also attempt to improve

forest management and leadership capacity (guidance of farmers) of DREEF staff and technical staff of communes. Such capacity building is necessary in switching management methods from the one that relies solely on DREEF of Alaotra Mangoro region, (which has insufficient staff, budget and mobility) to the participatory watershed management method. The project focuses on development of methodologies to take comprehensive actions for the measures, and is jointly administered by DREEF and DRDR of Alaotra Mangoro region. From the local government, DREEF and Morarano Chrome communes participate in the project also.

The implementation agency of their project will be MAEP. Development of methodologies for integrated environment conservation and rural development is carried out with the participation of residents in 3 villages in Morarano Chrome commune (Andoharano, Antetezanntany and Morarano Quest). Project components are as follows.

a) Establishment and training of village organization

- Formation and registration of village organization through agreement of inhabitants
- Practice and guidance of organization management

b) Improvement of agricultural productivity

- Improvement of function of irrigation facilities, and reorganization of AUE
- Extension of appropriate agricultural technology

c) Diversification of income sources of agriculture and forestry

- Technical guidance of secondary crops, fruit growing, fresh water pisciculture, apiculture, breeding poultry
- Demonstration, extension, and guidance of technology of agro forestry

d) Natural resources conservation

- Establishment of natural resources conservation reserve area and setting up of conservation system
- Development of buffer zone and technical guidance as a substitution of conservation area
- Training for sustainable management capacity by organization activity

e) Prevention activity of forest fire and grass land fire

- Enlightenment of inhabitants for prevention of forest fire and grass land fire
- Practice and training for prevention of forest fire and grass land fire

f) Development of community and school forests, and promotion of afforestation by RFR

- Development and technical guidance of school forest by parent and students
- Development and technical guidance of community forest by village organization
- Technical support to afforestation by RFR

g) Effective use of Lavaka alluvial fan

- Technical guidance of effective use of Lavaka alluvial fan such as development of a pasture

h) Establishment of promotion system of watershed management

i) Training of DREEF and commune staff on forest management and leadership (guidance of residents)

j) Assistance to improve the legal system to promote extension of forestation activities by the residents. Explanation to the residents of the legal system including the policy on promotion of forestation

k) Assistance for integrated management of agriculture, irrigation and watershed management, and workshop to build training capacity

(7) Extension of improved stove project

The traditional three-stone stove, which is widely used for household cooking in the Study area, is characterized by extremely low thermal efficiency. In order to solve this problem, a pilot project for 3 prototypes of improved stove was implemented in 4 villages (Soalazaina, Antanimafy, Antetezantaini, and Antetezantany). In this project, an improved stove made of bricks was found to be technically appropriate because it is repeatable, has high thermal efficiency, improves household chores, reduces the amount of labor of women and children, reduces the time for firewood collection, reduces the consumption of fire wood for charcoal making, reduces the annual household cash expenditure on fuel (equivalent of the price of one virgin heifer) and improves health and household sanitation such as lowering the morbidity rate of infectious disease among babies and infants.

This project to promote improved stove is to be implemented in 67 villages (excluding the 4 villages mentioned above), targeting 20,300 households. In the initial stage, demonstration of the improved stove is carried out in 2 villages. To enhance effectiveness of the demonstration and offer people a chance to use a stove, improved stoves are to be set up in public facilities such as markets, schools and patients ward of clinics in Ambaibo village and Morarano Chrome village which are trading centers in the Study area, located along the national road 3a and 33, respectively. After the initial stage, stoves are shown and explained to people in the Study area by an NGO, using a participatory approach. This is done to promote the ownership and to give instruction on how to create a stove to the committees for improved stove promotion which are organized by the local people.

"Extension of improved stove project" targets all the households in the whole Study area and is carried out to promote the NGO and raise awareness on environmental conservation. Parts of the construction materials such as a) iron bars for pots and kettles and b) metal sheets are provided free of charge. The implementation agency of the project will be MAEP. Under MAEP the Alaotra Mangoro regional office will assist the project. Components of the project are as follows.

a) Installation of 60 improved stoves for demonstration

b) Awareness-raising activities to make people understand the effectiveness of the stove and to promote the usage

c) Assistance to a) set up committees for improved stove promotion which were organized by the residents and b) teach the committees stove-making technique

d) Installation of improved stoves (for 20,300 household)

e) Monitoring of project results

(8) Integrated water conservation and agricultural rural development project in south West Alaotra lake area

Countermeasures to increase household income and improve living environment and watershed conservation in the Study area must be carried out in an integrated manner. In the upper/mid basin area where agriculture is the main occupation of the people, countermeasures for water and soil conservation under the integrated framework of agriculture and forestry are needed. These countermeasures are to provide the rocal people with incentives in the forms of agricultural productivity increase and diversification of agricultural income sources. In the downstream area (PC23 area), on the other hand, countermeasures to increase agricultural productivity through a) improvement of agricultural technique and b) functional improvement of the irrigation facilities are needed. These countermeasures in both upper/ mid basin area and downstream area conform to the BVPI policy of the Madagascar government.

This development project consists of 4 sub-projects described below. These sub-projects should be carried out based on the result of the technical assistance projects and the lessons learned from a) the projects which were formulated as quick countermeasures to solve problems and b) countermeasures to solve the situation before a problem arises. This is an integrated project for irrigation and watershed conservation which covers the whole south-west area of the Lake Alaotra. The project is implemented under the responsibility of MAEP within the framework of the BVPI policy while MINENVEF is in charge of technical guidance on forest management as such guidance is necessary as project assistance. "The Lake Alaotra south-west area" BVPI office, which is the implementing agency of the project, will be instituted. 4 sub-projects are shown below.

a) Rehabilitation sub-project for irrigation and drainage system in South West of PC23 irrigated area

This project is located in the northern part of PC23 area. (See Figure 6.2.2 for its location) It covers the irrigated area commanded by P1 main irrigation canals in the PC23 area depending on water sources of the Sahamilahy River and 4 other small and medium rivers. The water and soil conservation function in the upper/ mid basin area is more deteriorated than that in the Sahabe river watershed. Furthermore, the facility for automatic water level adjustment at the intake structure of the Sahamilahy river is out of order/operation. For these reasons, irrigation water is supplied from the 4 small and medium rivers via the north collector canal. Currently, 4,600 ha out of the planned net irrigated area of 5,300 is irrigated. On the other hand, paddy fields with constant water shortage exist in a wide area and the farmers obtain water by themselves by making the weirs in the main drainage canals or by illegally cutting channels.

Under the condition proposed in "Large scale irrigation forming system research development project", rehabilitation of the irrigation drainage facilities done by this sub-project is expected to increase the current rice yield of 3 ton/ha to 5 ton/ha and raise the rate of dry season paddy rice cultivation to more than 20%. The sub-project to repair irrigation drainage system in PC23 is implemented to solve the irrigation water shortage fundamentally, while boosting the area's contribution to the Madagascar policy to increase rice production as an important granary region. The sub-project is managed by DRDR of Alaotra Mangoro regain and the project components are as follows

(i) Rehabilitation of head works in the Sahamilahy river, rehabilitation of 3 automatic water level adjustment gates, dredging of the main canal and the north collector canal (33,700m)

(ii) Rehabilitation of 81 turnouts in of the secondary and tertiary irrigation canals

(iii) Rehabilitation and construction of check structures on the main drainage canal (5 places) , the tertiary irrigation canals (55km)

(iv) Expansion of canal irrigation cum-farm roads (55,000km)

(v) Detailed design and construction supervision

When the design intake discharge for P1 and P5 main canals is secured and water management in each farm plot gets on the right track, it will be possible to supply irrigation the eastern half of the PC23 rain fed area. When such irrigation water supply becomes possible, re-cutting of tertiary irrigation and drainage canals, and improvement of water division facility are carried out.

b) Integrated watershed conservation and agricultural rural development sub-project upper/mid basin of Sahamilahy river

This sub-project is carried out, based on the methodologies and the contents established by "Development research project on method for integrated watershed conservation and rural development in Morarano Chrome area". The sub-project is implemented with the participation of local people while an NGO is commissioned for technical management and (sub-) project management. Rehabilitation of irrigation drainage facilities carried out by this sub-project is be expected to increase the average yield of paddy rice from 2 ton/ha as of now to 3 ton/ha. Paddy rice cultivation in dry season is not planned/included in the sub-project. Components of the sub-project are as follows.

(A) Watershed Conservation

i) Protection of natural forest (about 1,100ha) and recovery of deteriorated natural forest (protection of natural forest, establishment of committee for recovery of deteriorated natural forest, capacity building of the organizations, implementation of enrichment planting, development of forest corridor)

ii) Development of buffer zone (about 1,000ha)

iii) Afforestation in grass/shrub area (3,000ha)

iv) Vegetation cover in grass/shrub area (12,000ha)

v) Introduction of agroforestry and aquiculture (100ha in each of the13 village; total of 1,300ha)

vi) Development of community forest and school forest (50ha in each of the 13 village; total of 650ha; apiculture (13 village))

vii) Establishment of silvopastoral system demonstration site (10ha in each of the 13 village; total of 130ha)

viii) Establishment of demonstration site for alluvial fans downstream Lavaka (total of 5 sites in the whole watershed)

ix) Prevention of forest fire (Establishment of forest fire prevention committee in all the 13 villages, Improvement of forest fire prevention system and its training)

(B) Rural Development

i) Rehabilitation of existing irrigation facilities (total gross area: about 700ha)

ii) Rehabilitation of water management organizations (training in Madagascar: 2 persons/trainees)

iii) Improvement of upland crops farming (about 380ha: Establishment of

research extension committee, implementation of demonstration trials, training of concerned individuals)

iv) Adoption of measures to diversify agricultural income sources (all the 13 villages)

c) Integrated watershed conservation and agricultural development sub-project for upper and mid basin of Sahabe river

This sub-project is carried out, based on the methodologies and contents established by "Development research project on method for integrated watershed conservation and rural development at Morarano Chrome area". The sub-project is implemented with the participation of local people, while an NGO is commissioned for technical management and (sub-) project management. Rehabilitation of irrigation drainage facilities carried out by this sub-project is expected to increase the average yield of paddy rice from 2 ton/ha as of now to 3 ton/ha. Paddy rice cultivation in dry season is not planned/included in the sub-project. Components of the sub-project are described below. Because weirs at the bottom of the flood control basin constructed by various irrigation projects are not functioning adequately, there have been disputes/quarrels over water between farmers in the mid basin of the Sahabe river and farmers in the PC 23 irrigated areas. In order to solve the disputes/quarrels, rehabilitation of check gate structure in the retarding basin is essential.

(A) Watershed Conservation

(i) Protection of natural forest (about 4,100ha) and recovery of deteriorated natural forest (protection of natural forest, establishment of committee for recovery of deteriorated natural forest, capacity building of the organizations, implementation of enrichment planting, development of forest corridor)

(ii) Development Creation of buffer zone (about 4,100ha)

(iii) Afforestation in grass/shrub area (10,100ha)

(iv) Vegetation cover in grass/shrub area (40,000ha)

(v) Introduction of agroforestry and aquiculture (100ha in each of the28 village; total of 2,800ha; apiculture (28 village))

(vi) Development of community forest and school forest (50 ha in each of the 28 villages; total of 1,400ha)

(vii) Establishment of silvopastoral system demonstration site (10ha in each of the 28 village; total of 280ha)

(viii) Establishment of demonstration site for alluvial fans downstream of Lavaka (total of 10 sites in the whole watershed)

(ix) Prevention of forest fire (Establishment of forest fire prevention committee in all the 28 villages, Improvement of forest fire prevention system and its training)

(B) Rural Development

i) Rehabilitation of existing irrigation facilities (total gross area: about 3,900ha)

ii) Rehabilitation of water management organizations (training in Madagascar: 8 persons/trainees)

iii) Improvement of upland crop farming (about 4,800ha: Establishment of research extension committee, implementation of demonstration trials, training of concerned individuals)

iv) Adoption of measures to diversify agricultural income sources (all the 28 villages)

d) Integrated watershed conservation and rural development sub-project for upper/mid basins of 4 small/medium rivers

This sub-project is carried out, using the methodologies and contents established by "Development research project on method for integrated watershed conservation and rural development at Morarano Chrome area". The sub-project is implemented with the participation of local people, while an NGO is commissioned for technical management and (sub-) project management. As for paddy cultivation, rehabilitation of irrigation drainage facilities carried out by this sub-project is planned to increase the average yield of paddy rice from 2 ton/ha as of now to 3 ton/ha. Paddy cultivation in dry season is not planned/included in the sub-project. Components of the sub-project are as follows.

(A) Watershed Conservation

i) Afforestation in grass/shrub area (3,100ha)

ii) Vegetation cover in grass/shrub area (12,500ha)

iii) Introduction of agroforestry and aquiculture (100ha in each of the17 village; total of 1,700ha; apiculture (17 village))

iv) Development of community forest and school forest (50ha in each of the 17 villages; total of 850ha)

v) Establishment of silvopastoral system demonstration site (10ha in each of the 17 village; total of 170ha)

vi) Establishment of demonstration site for alluvial fans downstream of Lavaka (total of 5 sites in the whole watershed)

vii) Prevention of forest fire (Establishment of forest fire prevention committee in

all the 17 villages, Improvement of forest fire prevention system and its training)

(B) Rural Development

i) Repair of existing irrigation facilities (total gross area: about 2,500ha)

ii) Reinforcement of water management organizations (training in Madagascar: 5 persons/trainees)

iii) Improvement of crop farming field (about 600ha: Establishment of research extension committee, implementation of demonstration trials, training of concerned individuals)

iv) Adoption of measures to diversify agricultural income sources (all the 17 villages)

6.2.4 Approximate operation costs and expected benefits/effects of the development projects

Duration, approximate operation costs and expected benefits/effects of each development project are indicated in Table 6.2.4. For details, please refer to the attached documents on projects and profiles.

Table 6.2.4 Implementation Period, Project Cost and Expected Benefits/effects of Development Projects

No.	Name of Project	Implementation Period (year)	Operation Cost (1,000USD)	Expected Benefits/Effects
1	Irrigation project the south west PC23 area	2.5	11,800	By the complete transformation of rice paddy with water shortage (2,000ha) into irrigation paddy, husked rice production is increased by 6,000 ton
2	Training project of water management experts (Technical assistance project)	3	690	By training of 2 individuals from each of the 13 Water Users' Association in PC23 west-southern area, water management technique is improved and appropriate O&M is carried out
3	Experimental project for paddy research (Technical assistance project)	2	60	By setting up thermo-sensitive early and mid maturing promising varieties, the amount of production is increased and agricultural foundations/techniques such as adoption of double cropping are improved
4	Large scale irrigation farming system research development project (Technical assistance project)	3	2,925	By establishing cultivation methods in which large-scale irrigation paddy double cropping technology is adopted through the use of thermo-sensitive early and mid maturing varieties; Dry-season yield is stabilized. Profitability is increased by low production cost. Rice quality is improved. Technical foundations through water-saving cultivation (effective use of limited water resources) is established

5	Agricultural diversification project in the Eastern PC23 rain fed area	3	251	Appropriate land use in the rain-fed area of 2,070ha is established. Agricultural income is increased by diversification of agricultural income sources. Cropping situation of rain-fed crops cultivation is stabilized.
6	Development research project on method for integrated watershed conservation and rural development at Morarano Chrome area (Technical assistance project)	5	5,000	Vegetation recovery of widely degraded area in the upper/mid basin of the Sahabe river, Sahamilahy river and 4 small and mid-size rivers is recovered. Methodologies for integrated promotion of agriculture and forestry are developed. Development projects in the above mentioned area are implemented smoothly and effectively by using the methodologies
7	Extension of improved stove project	3	604	Household chores in all the 20,300 households in the whole Study area excluding the 4 villages where the pilot project was carried out are improved. Works by women and children is reduced. Time to collect firewood is reduced. Firewood and charcoal consumption is reduced. Household expense on fuel is reduced.
8	Integrated watershed conservation and agricultural rural development project in South-West Alaotra lake area	5	94,652	
	(i) Rehabilitation sub-project for irrigation and drainage system in South West PC23 irrigated area	(3)	(40,735)	Production of husked rice is increased by 13,800ton through the complete transformation of 4,600ha of paddy field with water shortage into irrigated area
	(ii) Integrated watershed conservation and agricultural rural development sub-project in upper and mid basin of Sahamilahy river	(5)	(9,535)	By rehabilitation of pairing the existing irrigation; Production of paddy is increased by 700ton. Water management techniques are improved and appropriate O&M is carried out. Agricultural income is increased by the measures to diversify agricultural income sources. Natural forest and deteriorated natural forest are improved. Harmonious coexistence of those who acquired the right to use the natural forest and those who live around the area is promoted by the creation of buffer zones. Soil loss is reduced by tree planting in grass and bush land (3,000ha) and by vegetation recovery (12,000ha). Soil runoff is reduced by development of community and school forest (650ha). Local people awareness is raised by agroforestry, demonstration of silvopastoral system and demonstration of countermeasures for Lavaka. Awareness on forest fire is raised and fire prevention system is improved by the countermeasure to prevent forest fire.

	(iii) Integrated watershed conservation and agricultural rural development sub-project for upper and mid basins of 4 small/medium rivers	(5)	(10,528)	By rehabilitation of the existing irrigation; Production of paddy is increased by 1,200ton. Water management techniques are improved and appropriate O&M is carried out. Yield of upland crops is increased by improved technique for upland field. Agricultural income is increased by the countermeasures to diversify agricultural income sources. Soil loss is reduced by afforestation in grass/shrub area (10,100ha) and by vegetation cover (40,000ha). Soil loss is reduced by development of community and school forest (1,400ha). Local people awareness is raised by agroforestry, demonstration of silvopastoral system and demonstration of countermeasures for Lavaka. Awareness on forest fire is raised and fire prevention system is improved by the countermeasure to prevent forest fire.
	(iv) Integrated watershed conservation and agricultural rural development sub-project for upper and mid basins of Sahabe river	(5)	(33,859)	By repairing the existing irrigation; Production of paddy is increased by 2,000ton. Water management techniques are improved and appropriate O&M is carried out. Yield of upland crops is increased by improved technique for upland field. Agricultural income is increased by the countermeasures to diversify agricultural income sources. Natural forest and deteriorated natural forest are improved. Harmonious coexistence of those who acquired the right to use the natural forest and those who live around the area is promoted by the creation of buffer zones. Soil loss is reduced by afforestation in grass/shrub area (10,100ha) and by vegetation cover (40,000ha). Soil loss is reduced by development of community and school forest (1,400ha). Local people awareness is raised by agroforestry, demonstration of silvopastoral system and demonstration of countermeasures for Lavaka. Awareness on forest fire is raised and fire prevention system is improved by the countermeasure to prevent forest fire.

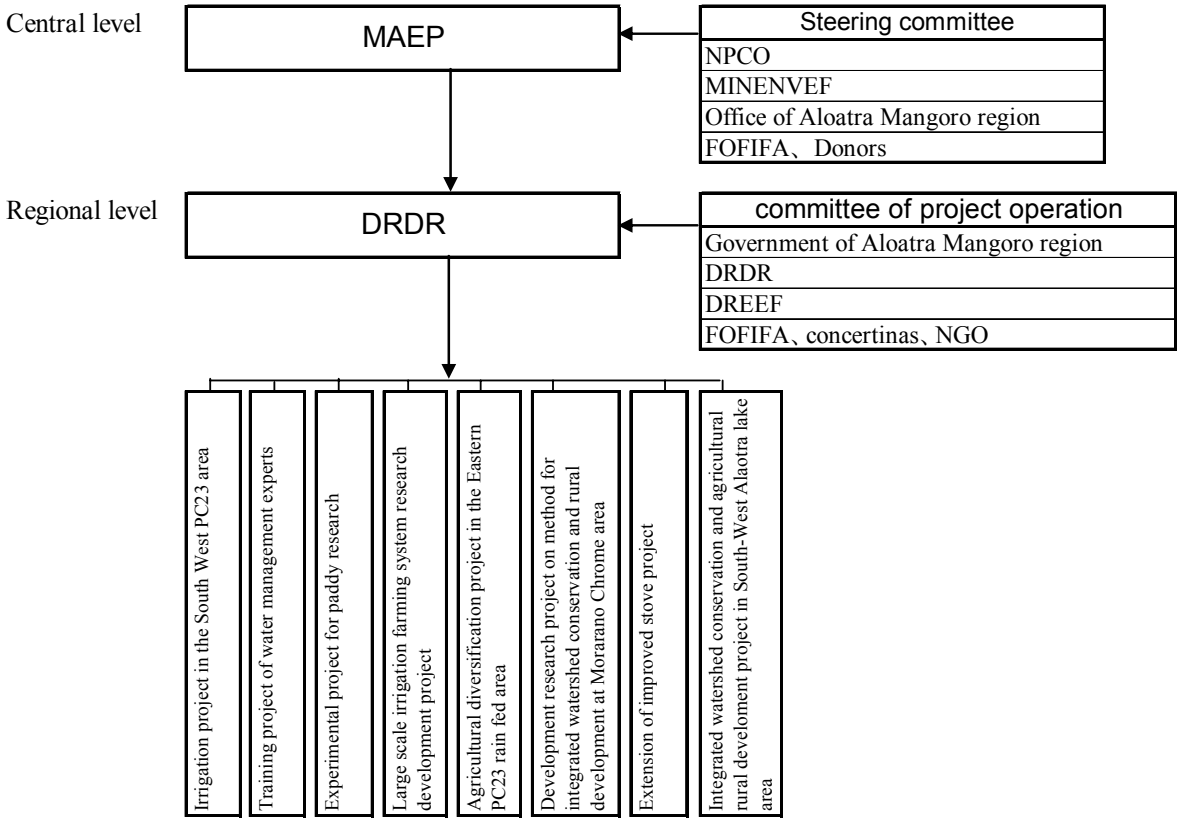
Source: JICA Study Team

6.2.5 Organization of implementation of development projects

The implementation agency for the proposed projects will be MAEP. The smooth and effective implementation a steering committee will be established in the central government. The steering committee is will be chaired by director of National Project Coordination Office (NPCO) in MAEP.

The committee members consist of the representatives of relevant organization MINENVEF, Ministry of finance, the office of Alaotra Mangor region, FOFIFA, donors, concertinas, NGOs, and etc,). The direction of NPCO manages arrangements and monitoring of the projects among the relevant organization actual operation of the project implementation will

be carried out by DRDR under MAEP in cooperation with relevant organization. The project officer for each proposed project will be instituted under DRDR to implement the projects. DRDR will manage arrangement, monitoring of the projects, and supervision of the project. A committee of project operation will be established at regional level and chirred by government of the Aloatra Mangoro region. The member of the committee will consider of DREEF, DRDR, FOFIFA, donors, concertinas, NGOs, and etc. The organization for implementation of the projects is shown in Figure 6.2.4. The organization will be changed basin on the loan condition of financial sauces.



Source: JICA Study Team

Figure 6.2.4 Organization for Implementation of the Projects

6.3 Action Plan

6.3.1 Target years

Eight (8) projects are formulated in this Master Plan which is set up to be a 15year operation from 2008 to 2023. The projects are urged to be implemented effectively by following an appropriate schedule in which each project can relate to one another to increase the overall effectiveness.

6.3.2 Implementation Schedule of the Projects

Based on the following principles, implementation schedule of the projects is set up.

(1) Two kinds of projects have the highest priority for implementation. One is a project a) whose technical relevance was confirmed by the pilot projects, b) whose implementation is technically easy, c) whose operation cost is low, d) for which the local people place high demand and e) which brings quick returns. The other is a technical assistance projects which is an essential part of project of agrilcutural and irrigation development and must be established early. Such technical assistance project is among the technical assistance projects which are needed to carry out the proposed development projects smoothly and effectively.

(2) The second priority is on technical assistance projects necessary for smooth and effective implementation of the proposed development projects.

(3) The third priority is put on the project, a) which can produce results during the implementation of (2), b) whose technical relevance was confirmed by the pilot projects, c) whose implementation is technically easy, d) for which the residents place high demand, e) whose operation cost is low, and f) which brings quick returns.

(4) The fourth priority is on a project for which the people have high demand, but whose operation cost is high and which needs to fully utilize the result of (2) and (3)

Order of project priority is as follows. Implementation schedule of the 8 projects is shown in Figure 6.3.1.

Table 6.3.1 Project Priority

Priority Ranking	Project	Remarks
(1)	Extension of Improved Stoves and Improvement of Rural Health and Sanitation (Technical assistant project)	-
	Experimental Project for Paddy Research (Technical assistant project)	-
(2)	Large-scale Irrigation Farming System Research Development Project (Technical assistant project)	This project will commence on the basis of Experimental Project for Paddy Research.
	Development Research Project on Method for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area (Technical assistant project)	-
	Training Project of Water Management Experts (Technical assistant project)	It is required to train staff of the government and water users' association for irrigation water management during the construction period.
(3)	Irrigation Project in the South West PC23 Area	-
	Agricultural Diversification Project in the Eastern PC 23 Rain-fed Area	-
(4)	Integrated Watershed Conservation and Agricultural Rural Development Project in West Alaotra Lake Area	Increase of agricultural productivity and income source diversification particularly in the upper and middle stream of the watershed is inevitable to ensure incentive of the people. This project is, therefore, proposed as a comprehensive project consisting of watershed management and agricultural development. In this implementation, lessons to be learnt from Development Research Project on Method for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area and Irrigation Project in the South West PC23 Area need to be fully utilized.

Source: JICA Study Team

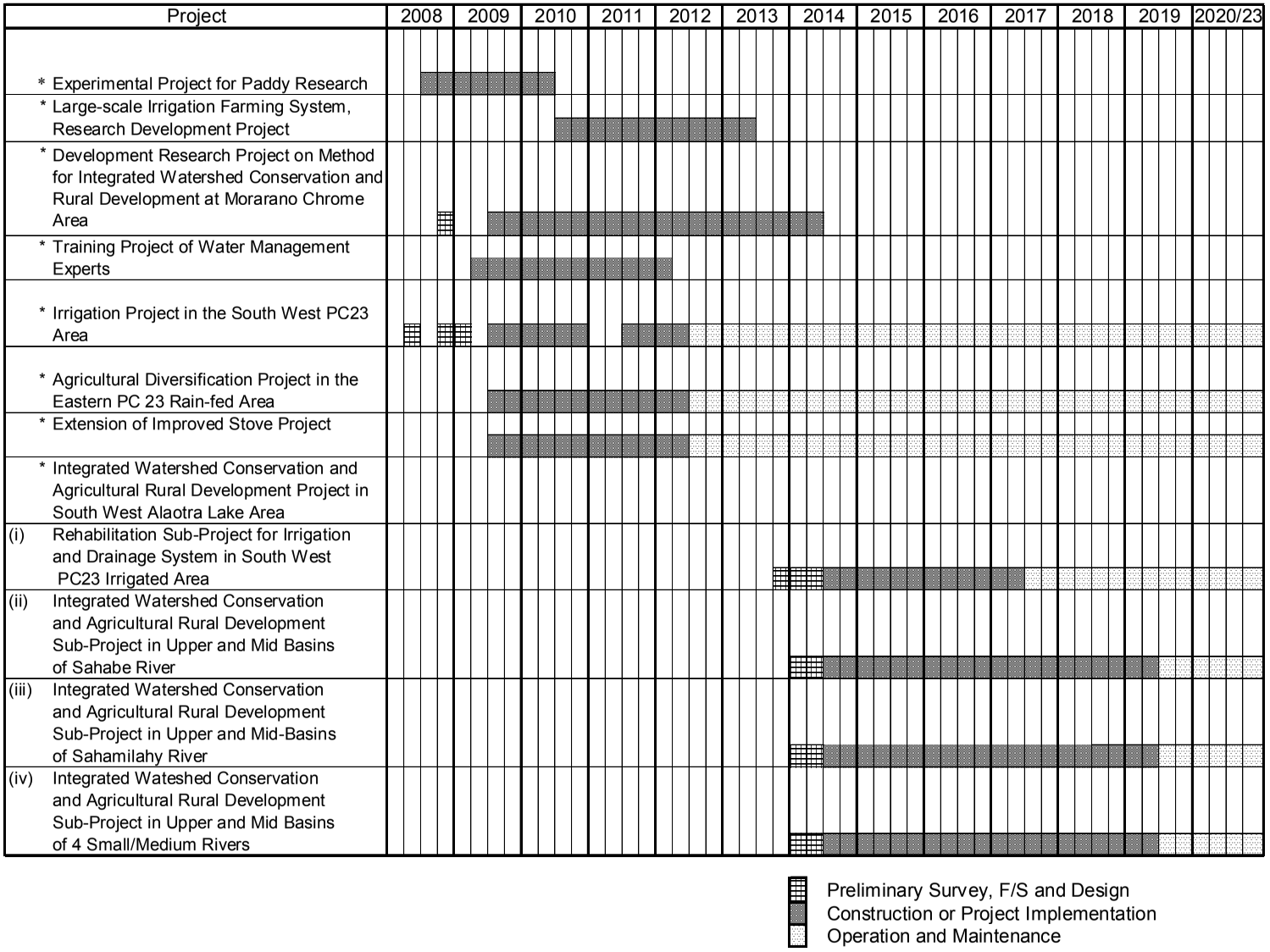


Figure 6.3.1 Implementation Schedule of Development Projects

6.4 Evaluation of Environmental Impact

Both "Irrigation project in the South West PC23 area" and "Development research project on method for integrated watershed conservation and rural development at Morarano Chrome area" require their project owners to take a procedure for evaluation of environmental impacts. This is according to the government decree No. 99-954 on integration of development and environment which was issued in accordance with the section No. 10 of the law No. 90-033 on environment charter.

As for "Irrigation project in the South West PC23 area", the central environment committee of the Madagascar government is currently evaluating the report on evaluation of environmental impact which was compiled based on the above mentioned procedure. The outline of this report is as follows.

(1) Dredging of intake weir and irrigation-drainage canals is expected to have impact on environment around the area when the dredging is conducted during implementation period. In selection of a site to pile up the dredged sediments, the sediments along the P5 main irrigation canal that were dredged from the year 2003 are to be used as construction material. By using a vacant lot along the P5 main irrigation canal for sediments disposal, environmental impact to the surrounding areas by dredged sediments is minimized.

(2) After implementation of the project, operation of scouring sluice gates at intake weir during low flow season is done to release the maintenance flow in the downstream of the Sahabe river. It is consideration that negative impacts of the increase of sediments to the downstream by the sluice gates operation do not take place. Also it is expected that negative impacts of increase of the sediment to the downstream during the high flow season, do not take place.

(3) In agricultural cultivation, overabundance of nutrients and contamination phenomena of the paddy drainage water from paddy field due to chemical fertilizer and herbicide do not take place. This is because low-cost farming methods such as use a lot of manure, low inputs of chemical fertilizer and use of hand-pushed waters.

(4) Suspended sediments from the intake weir of the Sahabe river is deposited in paddy field. For this reason, drainage water to the Lake Alaotra via does not become the supply source of sediments.

(5) By re-organizing water users' associations, which is a prerequisite for the implementation of "Irrigation project in the South West PC23 area", contents of the project were explained to the landowners and cultivators in the area. Through the re-organization, 14 water users' associations were organized voluntarily by the beneficiaries, and Tsarabola water users' federation was established.

“Development research project on method for integrated watershed conservation and rural development at Morarano Chrome area” does not fall under the provision of the government decree. This is because activities of this project include a) inventory study of small-scale irrigation which are scattered in the area (each paddy is about 30 ha), b) deliberation of countermeasures to strengthen the function of the existing facilities, and c) technical assistance if the farmers want the construction.

Components of “Training project of water management experts” and “Agricultural diversification project in the Eastern PC23 rain fed area” do not have physical activities that bring changes to their natural conditions. Therefore, direct and indirect impacts on the environment cannot be expected.

In the areas of “Experimental project for paddy research” and “Large scale irrigation farming system research development project”, crops are cultivated in paddy fields and upland field by organic farming method. In these areas, insecticide and rodenticide are used when needed, but their doses are thought to be below the level that brings negative impact on watershed environment.

In the area of “Extension of improved stove project”, negative impact on environment is not expected to be brought by the project. Instead, improvement of natural and social environment is expected to take place. This is because improved stoves made of clay improve the thermal efficiency, reducing the amount of firewood consumption and time spent on household chores and firewood collection.

“Integrated watershed conservation and agricultural rural development project in South-West Alaotra lake area” is implemented throughout the whole watershed with integrated methodologies of environmental conservation and rural development. Therefore, an evaluation study on environmental impact needs to be carried out in accordance with the government decree when the project framework is determined.

EXPLANATION NOTE 6-1

PROJECT PROFILE

Project No. 1　Irrigation Project in the South West PC23 Area

Name of the Project	Irrigation Project in the South West PC23 Area		
Project Period	2009～2011（2.5 years）		
Target Group	Member of AUE in irrigated area of PC23 Area		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	Alaotra-Mangoro Region

Project Background

Paddy field surrounding Lake Alaotra shares 8% of paddy field in Madagascar, and is the second largest granary in the country. It produces 280,000 tons of rice, which is 20% of the country production. The region exports 75% of the rice, and shoulders the largest rice supply base in the country. The unit yield of rice still remains 3 ton/ha due to shortage of irrigation water and very extensive and traditional farming practice. PC23 Area has a great potential for improvement of productivity of rice. Farmers in the area show high capacity for development. The integrated enhancement of existing irrigation system of P5 main canal which is taking irrigation water from Sahabe River is required to improve agricultural productivity aiming at increase of farmer's income and achievement of sustainable rice supply in the country.

Project Goal

The objective area is about 2,000 ha commanded by P5 main canal. The project aims at increase of farmer's income by improvement of unit yield of rice from 3ton/ha to 5ton/ha, and increase of production of rice through extension of complete irrigation area in the rainy season and introduction of dry season irrigation by reuse of drainage water. The annual paddy cropping intensity will be 120% par year.

Project Output

1. Intrusion of sediment and trash is reduced, and O&M cost of main facilities is curtailed.
2. Irrigation water is supplied from tertiary drain to the lowest field blocks through reuse facility.
3. Farming input is brought smoothly in the area in rainy season, and traffic time of vehicle is shortened in the area in the harvesting time
4. The responsibility of operation and maintenance work is clarified between AUE, FAUE, and government agents. Transparency of water distribution and water management in the field block is assured, and collection of Irrigation Service Fee is guaranteed by beneficiaries.
5. Production of rice increases through improvement of unit yield and increase of cropping area.

Project Activities

1. Enhancement of function of main facilities
   - 1-1 Reconstruction of Sahabe River Diversion Work
   - 1-2 Construction of Sahabe Intake Structure
   - 1-3 Construction of Settling Basin
   - 1-4 Improvement of P5 main canal
   - 1-5 Improvement of C.5.5 secondary canal
   - 1-6 Raising of banks of main drain D0/D1
   - 1-7 Reinforcement of polder dikes
2. Preparation of facilities for reuse of drainage water
   - 2-1 Improvement of tertiary irrigation canals
   - 2-2 Rehabilitation and more construction of reuse facilities in tertiary drains
3. Improvement of farm road network
   - 3-1 Rehabilitation of approach roads to the area
   - 3-2 Rehabilitation of main farm roads
   - 3-3 Rehabilitation of tertiary inspection roads
   - 3-4 Construction of the operation and maintenance building
4. Detailed Design and Construction Supervision

Project Cost

1. Enhancement of function of main facilities	$7,400,000
2. Preparation of facilities for reuse of drainage water	$1,600,000
3. Improvement of farm road network	$1,000,000
4. Detailed Design and Construction Supervision	$1,800,000
Total	$11,800,000

Source: JICA Study Team

Project No. 2　Training Project of Water Management Experts

Name of the Project	Training Project of Water Management Experts		
Project Period	2009～2012 (3 years)		
Target Group	Technical staff in the Government (11 person)・Technical staff in the AUE (26 persons)		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	

Project Background

Responsibility of operation and maintenance (O&M) of PC 23 Area was transferred to the Office of PC23 Area and the existing federation of 4 AUEs after SOMLAC was dissolved in 1992 due to implementation of privatization and reduction of government system. Since then, however, adequate O&M work such as rehabilitation of facility and excavation of sediment material in the canal have been hardly executed because of shortage of necessary personnel, fund and material, so that.

A training project is inevitable to train water management personnel, so that O&M work of facilities is executed properly after the facilities will be rehabilitated and constructed through Irrigation Project in the South West PC23 Area.

Project Goal

A training course is established and personnel are trained in parallel with implementation of the Irrigation Project in the South West PC23 Area.

Project Output

1 A training program of water management, which is suited to actual situation and needs in Madagascar.
2 Transfer of basic technology of water management is made to participants of the training course.
3 An improvement of capacity of participants, and execution of appropriate water management are guaranteed

Project Activities

1. Preparation of training program
   1-1 Preparation of a training program by senior national engineers
   1-2 Preparation of plan of operation of the training program
2. Operation of the training program
   2-1 Selection of trainees
   2-2 Inauguration of the training course
3. Preparation and operation of follow-up program to the trainees
   3-1 Monitoring of activities of trainees after completion
   3-2 Preparation and operation of the follow-up program

Project Cost

1. Training in the donor country (5 persons)	$115,000
2. Training in the third country (6 persons)	$432,000
3. Training in Madagascar (26 persons)	$130,000
4. Other expenditures	$13,000
Total	$690,000

Source: JICA Study Team

Project No. 3　Experimental Project for Paddy Research

Name of the Project	Experimental Project for Paddy Research		
Project Period	2008～2010（2years）		
Target Group	Technical staff in FOFIFA		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	FOFIFA (CALA Regional Research Center)

Project Background

The currently popular varieties in the Alaotra Lake region are MK34 and Tsemaka. Those have photosensitive and late matured characteristics in which long growing period and limited flowering season are predominant, and hardly response recent remarkable change of agricultural climate such as late start of rainy season causing the reach limit of unit yield or decreasing unit yield. The new varieties with non-photosensitive and early to medium matured characteristics are to be developed, be selected and spread through reinforcement of experiment and research system of CALA Regional Research Center in FOFIFA.

Project Goal

Two medium non-photosensitive medium matured varieties and one early matured variety were bred and selected in CALA Regional Research Center, and are multiplied in the demonstration farm in the selected farmers.

Project output

1-1 An difference between the promised medium matured varieties and traditionally farming varieties is cleared in terms of growth and unit yield

1-2 An difference between the promised early matured varieties and traditionally farming varieties is cleared in terms of growth and unit yield

1-3 Possibility of introduction and practice of two rice cropping are confirmed in farmers' field level.

2-1 Characteristics of non-photosensitive varieties are recognized by central and regional government agents, donors, NGO, and farmers.

3-1 A cultivation manual of medium matured variety in the rainy season is used by people concerned with seed multiplication at the first time, and by farmers in future

3-2 A cultivation manual of early matured variety in the rainy season is used by people concerned with seed multiplication at the first time, and by farmers in future

3-3 A two rice cropping manual is used by people concerned with seed multiplication at the first time, and by farmers in future

Project Activities

1. Practical and demonstrative cropping at farmers field level (2 years)
   - 1-1 Trial cropping of two promised medium matured varieties in the rainy season (2 places)
   - 1-2 Trial cropping of one promised early matured variety in the rainy season (2 places)
   - 1-3 Combination cropping of the promised early and medium matured varieties (2 places)
2. Open to the public the cropping technology in the demonstration farm (once in one cropping season)
   - 2-1 Opening a field day
3. Preparation of cultivation manual of the new varieties
   - 3-1 Preparation of a cultivation manual of the medium matured variety in the rainy season
   - 3-2 Preparation of a cultivation manual of the early matured variety in the rainy season
   - 3-3 Preparation of two rice cropping manual

Project Cost

1. Sub-contract for experimental and research of rice cultivation	$32,000
2. Sub-contract for demonstration farming	$28,000
Total	$60,000

Source: JICA Study Team

Project No. 4　Large Scale Irrigation Farming System Research Development Project

Name of the Project	Large Scale Irrigation Farming System Research Development Project		
Project Period	2010～2013（3 years）		
Target Group	Member of AUE in 13 filed blocks of irrigated area of PC23 Area and other farmers out side of 13 field block		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	FOFIFA (CALA Regional Research Center)

Project Background

The currently popular variety in the Alaotra Lake region is MK34 and Tsemaka. Those have photosensitive and late matured characteristics in which long growing period and limited flowering season are predominant, and hardly response recent remarkable change of agriculture climate such as late start of rainy season causing the reach limit of unit yield or decreasing unit yield. A development of irrigation farming technology system in large scale is required in PC23 Area and surrounding Alaotra Lake by using outputs from Project No. 3 Experimental Project for Paddy Research in which new varieties with non-photosensitive and early to medium matured characteristics are to be developed and selected through reinforcement of experiment and research system of CALA Regional Research Center in FOFIFA.

Project goal

Farmers income is improved through improvement of unit yield and quality of rice, and decrease of production cost by development of irrigation farming system which contains farming practice of new varieties and two rice cropping in No.5 to No.13 filed blocks in which irrigation system is rehabilitated and improved by the proposed Project No. 1 Irrigation Project in the South West PC23 Area.

Project output

1. The unit yield of rice increases by introducing new farming practice.
2. The profitability of rice production is improved by introducing low cost farming input.
3. The quality of unhusked rice is improved by practical use of mobile thresher in the process of post harvesting.
4. Practice of organic and livestock farming is accelerated
5. Effective use of limited water resources is achieved by introduction of water saving irrigation farming.
6. Farmers income increases.

Project Activities

1. Improvement of the farming calendar
   1-1 Setting up of a farming calendar which corresponds to recent change of climate
   1-2 Building up of a cropping system of non-photosensitive medium matured variety
2. Improvement of the farming technology
   2-1 Setting up of the fertilization technology which centers application of manure
   2-2 Building up of the crop control system based on the introduction of regular planting manual type rotary weeder
3. Improvement of post harvest work
   3-1 Introduction of harvesting machine
   3-2 Introduction of thresher
4. Improvement of soil fertility
   4-1 High input of forced and fully ripened manure
   4-2 Introduction of leguminous cover crops as a secondary crop
5. Establishment of water saving cultivation
   5-1 Practice of SRI/SRA
   5-2 Follow out the water management program

Project Cost

1. Personnel expenditures	$2,160,000
2. Administration	$420,000
3. Overseas training (5 persons)	$345,000
Total	$2,925,000

Source: JICA Study Team

Project No. 5　Agricultural Diversification Project in the Eastern PC23 Rain fed Area

Name of the Project	Agricultural Diversification Project in the Eastern PC23 Rain fed Area		
Project Period	2009～2012(3 years)		
Target Group	Farmers in the Eastern PC23 Area（Refer to Figure 6.2.3）		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	Alaotra-Mangoro Region

Project Background

The Eastern PC23 Area was a part of irrigation area of PC23, and now, is rainfed area and not appropriately utilized because irrigation facilities are completely damaged and micro relieves are developed　A back a agricultural technology causes low unit yield and low production resulting in low income of farmers.

Project Promise/Goal

Farmers' income in the Eastern PC23 Rainfed Area is improved by the development of appropriate land use plan, the improvement of rainfed agricultural technology, and the promotion of diversification of agriculture income sources.

Project Output

1. Appropriate land use is made possible.
2. Increase of agricultural income is made possible by improvement of unit yield of crops through improvement of cultivation technology of rainfed rice and secondary crops.
3. Improvement of agricultural income is made possible by introduction of agricultural diversification program such as fruit trees, geese breeding.

Project Activities

1. Relative elevation survey
2. Field survey and formulation of land use plan
3. Technical guidance of improvement of rainfed rice farming technology, introduction of secondary crops, improvement of sod culture
4. Implementation of diversification of agricultural income sources in four villages

Project Cost

1. Topographic survey	$30,000
2. Formulation of land use plan	$6,000
3. Technical guidance of rainfed crop cultivation	$95,000
4. Countermeasures for agricultural diversification	$120,000
Total	$251,000

Source: JICA Study Team

Project No. 6 Development Research Project on Method for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area

Name of the Project	Development Research Project on Method for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area		
Project Period	2009～2014(5 years)		
Target Group	Inhabitants and farmers in Andoharano, Antetezanntany, and Morarano Quest villages in Morarano Chrome Commune of Upstream and Middlestream of Sahamilahy Watershed		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	Ambatondrazaka DREEF, Alaotra-Mangoro Region, Morarano Chrome Commune

Project Background

PC23 Area is located in south west of Alaotra Lake, and is one of the important granary in Madagascar. The forest in the upstream mountain region which is source of the river is remarkably degraded due to illegal deforestation and forest fire. The vegetation cover of hills in the middle stream is changed to degraded grass or shrub land because plain fire which has been occurring repeatedly after deforestation in 1950s. These cause damages such as wash away of soils, dry up of river water, sediment inflow to cultivated land, sediment in the irrigation facility, sediment in the river and frequent flood, drought, and are large factors of poverty of inhabitants in the basin.

Project goal

The project goal is to research developing method of improvement of livelihood and natural environment in the upstream and middle stream of the Sahamilahy River through promotion of agricultural production, sustainable control of endangered natural forest in the source of river, and recovery of vegetation in the degraded grass land based on the voluntary unified watershed management and agricultural activity by organized inhabitants.

Project output

1-1 Acquisition of qualification to be an applicant and beneficiary of public supporting services
1-2 Improvement of capacity of inhabitants for self-reliant organization management
2-1 Stabilization of irrigation water supply, and establishment of self-reliant water management activity
2-2 Increase of unit yield of rice and decrease of production cost
3-1 Increase of selling agricultural products
3-2 Improvement of land productivity by mitigating soil erosion
4-1 Awareness and fermentation of consciousness of natural resources conservation of the inhabitants
4-2 Creation of substitutive forest resources
4-3 Acquirement of methodology and technology for natural resources conservation by the inhabitants, and firm establishment of self-reliant control of substitute resources by inhabitants
5-1 Improvement of awareness by inhabitants for protection of forest fire and land fire
5-2 Firm establishment of fire prevention activity by inhabitants
6-1 Improvement of interest to natural environment in juveniles
6-2 Acquirement of technology of nursery trees and afforestation by inhabitants, and safeness of forest resources to the next generation
6-3 Recovery of vegetation in the degraded grass land, and mitigation of soil erosion
7-1 Safeness of grazing land as a supply source of feed for livestock
8-1 Establishment of watershed management control system through implementation of watershed management training

Project Activities

1. Establishment and training of village organization
   1-1 Formation and registration of village organization through agreement of inhabitants
   1-2 Practice and guidance of organization management
2. Improvement of agricultural productivity
   2-1 Improvement of function of irrigation facilities, and reorganization of AUE
   2-2 Extension of appropriate agricultural technology
3. Diversification of income sources of agriculture and forestry
   3-1 Technical guidance of secondary crops, fruit growing , fresh water pisciculture, apiculture, breeding poultry
   3-2 Demonstration, extension, and guidance of technology of agro forestry
4. Natural resources conservation
   4-1 Establishment of natural resources conservation reserve area and setting up of conservation system
   4-2 Development of buffer zone and technical guidance as a substitution of conservation area
   4-3 Training for sustainable management capacity by organization activity
5. Prevention activity of forest fire and grass land fire
   5-1 Enlightenment of inhabitants for prevention of forest fire and grass land fire

5-2 Practice and training for prevention of forest fire and grass land fire 6. Development of community and school forests, and promotion of afforestation by RFR 6-1 Development and technical guidance of school forest by parent and students 6-2 Development and technical guidance of community forest by village organization 6-3 Technical support to afforestation by RFR 7. Effective use of Lavaka alluvial fan 7-1 Technical guidance of effective use of Lavaka alluvial fan such as development of a pasture 8. Establishment of promotion system of watershed management 8-1 Training of watershed management promotion system

Project Cost

1. Personnel expenditure	$3,600,000
2. Administration	$700,000
3. Overseas training (6 persons)	$690,000
4. Training for watershed management promotion system	$10,000
Total	$5,000,000

Source: JICA Study Team

Project No. 7　Extension of Improved Stove and Improvement of Rural Health and Sanitation

Name of the Project	Extension of Improved Stove Project		
Project Period	2009～2012 (3 years)		
Target Group	20,300 households in all the study area except for 4 villages in which the pilot project has been implemented		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	Alaotra-Mangoro Region

Project Background

In the study area, many households use a traditional 3-stones stove of which thermal efficiency is low and causes over-consumption of firewood resulting over-cutting of firewood forest. This also makes issues on overwork of women and children for collection of firewood, increase of firewood expenditure, and high susceptible rate to infection of infants.

Project Goal

Improved stoves are introduced by households in the study area aiming at betterment of housework, alleviation of labor of women and children, reduction of collection time and consumption of firewood, reduction of firewood expenditure, and drop down of susceptible rate to infection of infants.

Project Output

1-1 Improved stoves are smoothly set in the public facility by cooperation of the commune.
1-2 The number of improved stoves is confirmed.
2-1 Quality and durability of improved stove are guaranteed.
2-2 Improved stove attracts attention of users of public facility.
3-1 Opportunity is created so that visitors to public facility use the improved stove and confirm its effects.
3-2 Maintenance of improved stove is well-known.
4-1 Housework is improved, labor of women and children is alleviated, collection time and consumption of firewood are reduced, expenditure of firewood is reduced, susceptible rate to infection of infants drops down.

Project Activities

1. Needs survey
   1-1 Explanation of the purpose of the project to the commune members, and confirmation of wishes to participate to the project
   1-2 Survey of public facilities in which improved stoves will be installed
2. Installation of improved stoves for demonstration
   2-1 Selection of NGOs to participate to the project
   2-2 Installation of improved stoves (60 stoves) at the objective public facilities
3. Technical guidance on the usage of improved stoves
   3-1 Preparation of the pamphlet of the improved stove
   3-2 Transfer of technology on usage and maintenance of improved stove to managers of facility
4. Installation of improved stoves
   4-1 Installation of improved stoves in about 20,300 households

Project Cost

1. Demonstration of improved stove	$10,000
2. Material of the stoves	$102,000
3. Technical supporting for extension of stoves	$492,000
Total	$604,000

Source: JICA Study Team

Project No. 8 Integrated Watershed Conservation and Agricultural Rural Development Project in Southwest Alaotra Lake Area

Name of the Project	Integrated Watershed Conservation and Agricultural Rural Development Project in Southwest Alaotra Lake Area		
Project Period	2014～2019(5 years)		
Target Group	Inhabitants in southwest PC23 irrigated area (irrigated area by P1 main canal) and those in watershed of Sahabe and Sahmilahy Rivers and other four small/medium rivers		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	Ambatondrazaka-Amparafaravola DREEF, Alaotra-Mangoro Region

Project Background

PC23 Area located in southwest of Alaotra Lake is one of the important granary in Madagascar. The forest in the upstream mountain region which is source of a river is remarkably degraded due to illegal deforestation and forest fire. The vegetation cover of hills in the middle stream is changed to degraded grass or shrub land because of plain fire which has been occurring repeatedly after deforestation in 1950s. These cause damages such as wash away of soils, dry up of river water, sediment inflow to cultivated land, sediment in the irrigation facility, sediment in the river and frequent flood, drought, and are large factors of poverty of inhabitants in the basin.

Project Goal

The project goal is to improve livelihood and natural environment in the southwest PC23 Area and watershed area of the Sahabe and Sahamilahy Rivers and other small/medium 4 rivers through promotion of agricultural production, sustainable control of endangered natural forest, and recovery of vegetation in the degraded grass land, based on the voluntary unified watershed management and agricultural activity by organized inhabitants.

Project output

(A) Rehabilitation sub-project for irrigation and drainage system in PC23 irrigated area

1. Stable irrigation water is secured.
2. Stable and appropriate irrigation water distribution is made possible.
3. Irrigation water is supplied from tertiary drain through the reuse facility to lowest field blocks.
4. Operation and maintenance of irrigation and drainage facilities is executed appropriately, farming input can be brought smoothly in the area in the rainy season, and vehicle traffic time in the area is shortened in harvesting time.
5. Production of rice increases through improvement of unit yield and increase of cropping area.

(B) Watershed management and agricultural rural development sub-project in the three basins

(1) Watershed management

1-1 Awareness and fermentation of consciousness of natural resources conservation, restoration and self-reliant management in the inhabitants
1-2 Mitigation of soil erosion
2-1 Creation of substitutive forest resources
3-1 Mitigation of soil erosion and improvement of productivity of land
4-1 Mitigation of soil erosion and improvement of productivity of land, creation of new income source of inhabitants
4-2 Creation of new income source of inhabitations
5-1 Improvement of interest to natural environment in juveniles, acquirement of technology of nursery trees and afforestation by inhabitants, and secureness of forest resources to the next generation, recovery of vegetation in the degraded grass land, and mitigation of soil erosion
6-1 Mitigation of soil erosion and improvement of productivity of land, increase of secureness of good quality feed stuff
7-1 Development of pasture land or fruit trees for effective use of Lavaka alluvial fan
8-1 Reinforcement of village organization to prevent forest fires
8-2 Enablement of quick and systematic response to forest fire, preparation of fire tools

(2) Agricultural Rural Development

1-1 Unit yield of rice increases from 2 ton/ha to 3 ton/ha and is stabilized by irrigation
2-1 Basic technology of water management to participants of training course
3-1 Farming technology is improved and production of upland crops increases
4-1 Agricultural income increase by breeding geese, fresh water pisciculture, and introduction of secondary crops

Project Activities

(A) Rehabilitation sub-project for irrigation and drainage system in PC23 irrigated area

1. Rehabilitation of head works in the Sahamilahy River
2. Rehabilitation of automatic check gates (3 places)

3. Dredging of main canal and north collector canal (33,700 m)
4. Rehabilitation of turnouts in the secondary and tertiary irrigation canals (81 nos.)
5. Rehabilitation and construction of check structures on the main drainage canal (5 places), tertiary irrigation canals (55km)
6. Expansion of canal inspection-cum-farm road (55km)
7. Detailed design and construction supervision

(B) Watershed management and agricultural rural sub-development in the three basins

(1) Watershed conservation

1. Conservation of natural forest and restoration of degraded forest
   1-1 Establishment and capacity building of Committee for Natural Forest and Degraded Forest Committee
   1-2 Conservation and restoration: 5,200 ha
2. Development of buffer zone
   2-1 Development area: 5,100 ha
3. Afforestation of shrub land vegetation of grass land
   3-1 Afforestation: 16,200 ha
   3-2 Vegetation cover: 64,500 ha
4. Introduction of agro forestry in 58 villages (100ha per village)
   4-1 Agro forestry area: 5,800ha
   4-2 Introduction of bee keeping (58 villages)
5. Development of village community and school forests in 58 villages (50 ha per village)
   5-1 Afforestation area: 2,900 ha
6. Demonstration of silvopastral in 58 villages (10ha per village)
   6-1 Demonstration area: 580ha
7. Demonstration filed blocks in the Lavaka alluvial fan
   7-1 Number of demonstration field blocks: 20 places
8. Prevention of forest fire in 58 villages
   8-1 Establishment and capacity building of Committee of Natural Forest
   8-2 Preparation and training of forest fire prevention

(2) Agricultural Rural Development

1. Rehabilitation of existing irrigation facilities
   1-1 Irrigation area: 7,100 ha
2. Reinforcement of water management organization
   2-1 Domestic training in Madagascar 15 persons
3. Improvement of upland crops farming (Establishment of research and extension committee, experiments, training)
   3-1 Area: 5,800 ha
4. Measures of diversification of agricultural income sources (58 villages, one measure per one village)
   4-1 Measures to be introduced: 58

Project Cost

1. Rehabilitation of irrigation and drainage system in south west of PC23 Area	$40,735,000
2. Watershed management and agricultural rural development in the three basins	$53,917,000
Total	$94,652,000

Source: JICA Study Team

Sub-project No. 8(1) Rehabilitation Sub-project for Irrigation and Drainage System in Southwest PC23 Area

Name of the Project	Rehabilitation Sub-project for Irrigation and Drainage System in Southwest PC23 Area		
Project Period	2014～2017（3 years）		
Target Group	Farmers in the irrigated area by main canal P1		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	

Project Background

Paddy field surrounding Lake Alaotra shares 8% of paddy field in Madagascar, and is second largest granary in the country. It produces 280,000 tons of rice, which is 20% of the country production. The region exports 75% of the rice, and shoulders the largest rice supply base in the country. The unit yield of rice still remains 3 tons per hectare due to shortage of irrigation water and very extensive and traditional farming. PC23 Area has a great potential for improvement of productivity of rice. Farmers in the area show high capacity for development. The integrated enhancement of existing irrigation system of 4,600 ha of P1 main canal which takes irrigation water from Sahamilahy River is required to improve agricultural productivity aiming at increase of farmers income and achievement of sustainable rice supply in the country.

Project Goal

The project aims at increase of farmer's income by improvement of unit yield of rice from 3ton/ha to 5 ton/ha, and increase of production of rice through extension of complete irrigation area in the rainy season and introduction of dry season irrigation by reuse of drainage water. The annual paddy cropping intensity will be 120% par year.

Project Output

1. Stable irrigation water is secured.
2. Stable and appropriated irrigation water distribution is made possible.
3. Irrigation water is supplied from tertiary drain through the reuse facility to lowest field blocks.
4. Operation and maintenance of irrigation and drainage facilities is executed appropriately, farming input can be brought smoothly in the area in the rainy season, and vehicle traffic time in the area is shortened in harvesting time
5. Production of rice increases through improvement of unit yield and increase of cropping area.

Project Activities

1. Rehabilitation of head works in the Sahamilahy River
2. Rehabilitation of automatic check gates (3 places)
3. Dredging of main canal and north collector canal (33,700 m)
4. Rehabilitation of turnouts in the secondary and tertiary irrigation canals (81 nos.)
5. Rehabilitation and construction of check structures on the main drainage canal (5 places), tertiary irrigation canals (55km)
6. Expansion of canal inspection-cum-farm road (55km)
7. Detailed design and construction supervision

Project Cost

1. Rehabilitation of head works in the Sahamilahy River, rehabilitation of automatic check gates, and dredging of main canal and north collector canal	$30,845,000
2. Rehabilitation of turnouts in the secondary and tertiary irrigation canals	$1,620,000
3. Rehabilitation and construction of check structures on the main drainage canal, tertiary irrigation canals	$1,550,000
4. Expansion of canal inspection-cum-farm road	$610,000
5. Detailed design and construction supervision	$6,110,000
Total	$40,735,000

Source: JICA Study Team

Sub-project No. 8(2) Integrated Watershed Conservation and Agricultural Rural Development Sub-Project in Upper and Mid Basins of Sahamilahy River

Name of the Project	Integrated Watershed Conservation and Agricultural Rural Development Project in Upper and Mid Basin of Sahamilahy River		
Project Period	2014～2019 (5 years)		
Target Group	Inhabitants in the Sahabe River basin		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	Ambatondrazaka-Amparafaravola DREEF, Alaotra-Mangoro Region

Project Background

The forest in the upstream mountain region which is water source of PC23 irrigation area is remarkably degraded due to illegal deforestation and forest fire. The vegetation cover of hills in the middle stream is changed to degraded grass or shrub land because of plain fire which has been occurring repeatedly after deforestation in 1950s. These cause damages such as wash away of soils, dry up of river water, sediment inflow to cultivated land, sediment in the irrigation facility, sediment in the river and frequent flood, drought, and are large factors of poverty of inhabitants in the basin.

Project Goal

The project goal is to improve livelihood and natural environment in the Sahamilahy River basin through promotion of agricultural production, sustainable control of endangered natural forest, and recovery of vegetation in the degraded grass land, based on the voluntary unified watershed management and agricultural activity by organized inhabitants.

Project output

(1) Watershed management

1-1 Awareness and fermentation of consciousness of natural resources conservation, restoration and self-reliant management in the inhabitants
1-2 Mitigation of soil erosion
2-1 Creation of substitutive forest resources
3-1 Mitigation of soil erosion and improvement of productivity of land
4-1 Creation of new income source of inhabitants resulting from mitigation of soil erosion and improvement of land productivity
4-2 Creation of new income source of inhabitants
5-1 Improvement of interest to natural environment in juveniles, acquirement of technology of nursery trees and afforestation by inhabitants, and secureness of forest resources to the next generation, recovery of vegetation in the degraded grass land, and mitigation of soil erosion
6-1 Improvement of productivity of land and increase of secureness of good quality feed stuff due to the mitigation of soil erosion
7-1 Effective use of Lavaka alluvial fan by the development of pasture land or fruit trees
8-1 Reinforcement of village organization to prevent forest fires
8-2 Enablement of quick and systematic response to forest fire, preparation of fire tools

(2) Agricultural Rural Development

1-1 Unit yield of rice increases from 2 ton/ha to 3 ton/ha and is stabilized by irrigation
2-1 Basic technology of water management to participant of training course
3-1 Farming technology is improved and production of upland crops increases
4-1 Agricultural income increase by breeding geese, fresh water pisciculture, and introduction of secondary crops

Project Activities

(1) Watershed conservation

1. Conservation of natural forest and restoration of degraded forest
   1-1 Establishment and capacity building of Committee for Natural Forest and Degraded Forest Committee
   1-2 Conservation and restoration: 1,100ha
2. Development of buffer zone
   2-1 Development area: 1,000 ha
3. Afforestation of shrub land vegetation of grass land
   3-1 Afforestation: 3,000ha
   3-2 Vegetation cover: 12,000ha
4. Introduction of agro forestry and apiculture in 13 villages (100ha per village)
   4-1 Agro forestry area: 1,300ha
   4-2 Apiculture: 13 villages

5. Development of village community and school forests in 13 villages (50 ha per village)
   5-1 Afforestation area: 650ha
6. Demonstration of silvopastral in 13 villages (10ha per village)
   6-1 Demonstration area: 130 ha
7. Demonstration of filed blocks in the Lavaka alluvial fan
   7-1 Number of demonstration field blocks: 5 places
8. Prevention of forest fire in 13 villages
   8-1 Establishment and capacity building of Committee of Natural Forest
   8-2 Preparation and training of forest fire prevention

(2) Agricultural Rural Development

1. Rehabilitation of existing irrigation facilities
   1-1 Irrigation area: 700ha
2. Reinforcement of water management organization
   2-1 Domestic training in Madagascar: 2 persons
3. Improvement of upland crops farming (Establishment of research and extension committee, experiments, training)
   3-1 Area: 380ha
4. Measures of diversification of agricultural income sources (13 villages, one measure per one village)
   4-1 Measures to be introduced: 13

Project Cost

1. Conservation of natural forest and restoration of degraded forest	$300,000
2. Development of buffer zone	$500,000
3. Afforestation and vegetation cover	$5,400,000
4. Introduction of agro forestry and apiculture	$1,300,000
5. Others watershed conservation activities	$410,000
6. Reinforcement of water management	$10,000
7. Rehabilitation of irrigation facilities	$360,000
8. Improvement of upland crop field	$38,000
9. Measures of diversification of agricultural income sources	$390,000
10.Employment of NGO	$710,000
Total	$9,535,000

Source: JICA Study Team

Sub-project No. 8(3) Integrated Watershed Conservation and Agricultural Rural Development Sub-Project for Upper and Mid Basin of Four Small/medium Rivers

Name of the Project	Integrated Watershed Conservation and Agricultural Rural Development Project in Upper and Mid Basin of Four Small/Medium Rivers		
Project Period	2014～2019 (5 years)		
Target Group	Inhabitants in the four small/medium river basins		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	Ambatondrazaka-Amparafaravola DREEF, Alaotra-Mangoro Region

Project Background

The forest in the upstream mountain region which is water source of PC23 irrigation area is remarkably degraded due to illegal deforestation and forest fire. The vegetation cover of hills in the middle stream is changed to degraded grass or shrub land because plain fire which has been occurring repeatedly after deforestation in 1950s. These cause damages such as wash away of soils, dry up of river water, sediment inflow to cultivated land, sediment in the irrigation facility, sediment in the river and frequent flood, drought, and are large factors of poverty of inhabitants in the basin.

Project Goal

The project goal is to improve livelihood and natural environment in the four small/medium river basins through promotion of agricultural production, sustainable control of endangered natural forest, and recovery of vegetation in the degraded grass land based on the voluntary unified watershed management and agricultural activity by organized inhabitants.

Project output

(1) Watershed management

1-1 Mitigation of soil erosion and improvement of productivity of land

2-1 Creation of new income source of inhabitants resulting from mitigation of soil erosion and improvement of productivity of land

2-2 Creation of new income source of inhabitants

3-1 Improvement of interest to natural environment in juveniles, Acquirement of technology of nursery trees and afforestation by inhabitants, and secureness of forest resources to the next generation, Recovery of vegetation in the degraded grass land, and mitigation of soil erosion

4-1 Improvement of productivity of land and increase of secureness of good quality feed stuff due to the mitigation of soil erosion

5-1 Effective use of Lavaka alluvial fan by the development of pasture land or fruit trees

6-1 Reinforcement of village organization to prevent forest fires

6-2 Enablement of quick and systematic response to forest fire, preparation of fire tools

(2) Agricultural Rural Development

1-1 Unit yield of rice increases from 2 ton/ha to 3 ton/ha and is stabilized by irrigation

2-1 Basic technology of water management to participant of training course

3-1 Farming technology is improved and production of upland crops increases

4-1 Agricultural income increase by breeding geese, fresh water pisciculture, and introduction of secondary crops

Project Activities

(1) Watershed management

1. Afforestation of shrub land vegetation of grass land
   - 1-1 Afforestation: 3,100ha
   - 1-2 Vegetation cover: 12,500ha
2. Introduction of agro forestry and apiculture in 17 villages (100ha per village)
   - 2-1 Agro forestry area: 1,300ha
   - 2-2 Apiculture: 17 villages
3. Development of village community and school forests in 17 villages (50 ha per village)
   - 3-1 Afforestation area: 850ha
4. Demonstration of silvopastral in 17 villages (10ha per village)
   - 4-1 Demonstration area: 170 ha
5. Demonstration of filed blocks in the Lavaka alluvial fan
   - 7-1 Number of demonstration field blocks: 5 places
8. Prevention of forest fire in 13 villages
   - 8-1 Establishment and capacity building of Committee of Natural Forest
   - 8-2 Preparation and training of forest fire prevention

(2) Agricultural Rural Development

1. Rehabilitation of existing irrigation facilities
   1-1 Irrigation area: 2,500ha
2. Reinforcement of water management organization
   2-1 Domestic training in Madagascar 5 persons
3. Improvement of upland crops farming (Establishment of research and extension committee, experiments, training)
   3-1 Area: 600ha
4. Measures of diversification of agricultural income sources (13 villages, one measure per one village)
   4-1 Measures to be introduced: 17

Project Cost

1. Afforestation and vegetation cover	$5,600,000
2. Introduction of agro forestry and apiculture	$1,853,000
3. Others watershed conservation activities	$530,000
4. Reinforcement of water management	$25,000
5. Rehabilitation of irrigation facilities	$1,240,000
6. Improvement of upland crop field	$60,000
9. Measures of diversification of agricultural income sources	$510,000
10. Employment of NGO	$710,000
Total	$10,528,000

Source: JICA Study Team

Sub-project No. 8(4) Integrated Watershed Conservation and Agricultural Rural Development Sub-Project for Upper and Mid Basin of Sahabe River

Name of the Project	Integrated Watershed Conservation and Agricultural Rural Development Project in Upper and Mid Basin of Sahabe River		
Project Period	2014～2019 (5 years)		
Target Group	Inhabitants in the Sahabe river basins		
Implementing Agency	DGDR in MAEP	**Cooperating Agency**	Ambatondrazaka Amparafaravola DREEF, and Alaotra Mangoro Region

Project Background

The forest in the upstream mountain region which is water source of PC23 irrigation area is remarkably degraded due to illegal deforestation and forest fire. The vegetation cover of hills in the middle stream is changed to degraded grass or shrub land because plain fire which has been occurring repeatedly after deforestation in 1950s. These cause damages such as wash away of soils, dry up of river water, sediment inflow to cultivated land, sediment in the irrigation facility, sediment in the river and frequent flood, drought, and are large factors of poverty of inhabitants in the basin.

Project Goal

The project goal is to improve livelihood and natural environment in the Sahabe River basin through promotion of agricultural production, sustainable control of endangered natural forest, and recovery of vegetation in the degraded grass land based on the voluntary unified watershed management and agricultural activity by organized inhabitants

Project output

(1) Watershed management

1-1 Awareness and fermentation of consciousness of natural resources conservation, restoration and self-reliant management in the inhabitants
1-2 Mitigation of soil erosion
2-1 Creation of substitutive forest resources
3-1 Mitigation of soil erosion and improvement of productivity of land
4-1 Creation of new income source of inhabitants resulting from mitigation of soil erosion and improvement of land productivity
4-2 Creation of new income source of inhabitants
5-1 Improvement of interest to natural environment in juveniles, acquirement of technology of nursery trees and afforestation by inhabitants, and secureness of forest resources to the next generation, recovery of vegetation in the degraded grass land, and mitigation of soil erosion
6-1 Improvement of productivity of land and increase of secureness of good quality feed stuff due to the mitigation of soil erosion
7-1 Effective use of Lavaka alluvial fan by the development of pasture land or fruit trees
8-1 Reinforcement of village organization to prevent forest fires
8-2 Enablement of quick and systematic response to forest fire, preparation of fire tools

(2) Agricultural Rural Development

1-1 Unit yield of rice increases from 2 ton/ha to 3 ton/ha and is stabilized by irrigation
2-1 Basic technology of water management to participant of training course
3-1 Farming technology is improved and production of upland crops increases
4-1 Agricultural income increase by breeding geese, fresh water pisciculture, and introduction of secondary crops

Project Activities

(1) Watershed management

1. Conservation of natural forest and restoration of degraded forest
   1-1 Establishment and capacity building of Committee for Natural Forest and Degraded Forest Committee
   1-2 Conservation and restoration: 4,100ha
2. Development of buffer zone
   2-1 Development area: 4,100 ha
3. Afforestation of shrub land vegetation of grass land
   3-1 Afforestation: 10,100ha
   3-2 Vegetation cover: 40,000ha
4. Introduction of agro forestry and apiculture in 28 villages (100ha per village)
   4-1 Agro forestry area: 2,800ha
   4-2 Apiculture: 28 villages

5. Development of village community and school forests in 28 villages (50 ha per village)
   5-1 Afforestation area: 1,400ha
6. Demonstration of silvopastral in 28 villages (10ha per village)
   6-1 Demonstration area: 280 ha
7. Demonstration filed blocks in the Lavaka alluvial fan
   7-1 Number of demonstration field blocks: 10 places
8. Prevention of forest fire in 28 villages
   8-1 Establishment and capacity building of Committee of Natural Forest
   8-2 Preparation and training of forest fire prevention

(2) Agricultural Rural Development

1. Rehabilitation of existing irrigation facilities
   1-1 Irrigation area: 3,900ha
2. Reinforcement of water management organization
   2-1 Domestic training in Madagascar: 8 persons
3. Improvement of upland crops farming (Establishment of research and extension committee, experiments, training)
   3-1 Area: 4,800ha
4. Measures of diversification of agricultural income sources (28 villages, one measure per one village)
   4-1 Measures to be introduces: 28

Cost

1. Conservation of natural forest and restoration of degraded forest	$1,242,000
2. Development of buffer zone	$2,050,000
3. Afforestation and vegetation	$18,100,000
4. Introduction of agro forestry and apiculture	$3,052,000
5. Others watershed conservation activities	$880,000
6. Reinforcement of water management	$40,000
7. Rehabilitation of irrigation facilities	$6,240,000
8. Improvement of upland crop field	$480,000
9. Measures of diversification of agricultural income sources	$840,000
10. Employment of NGO	$930,000
Total	$33,854,000

Source: JICA Study Team

CHAPTER 7 COUNTERMEASURES FOR PROBLEM SOLVING

7.1 Problem Analysis, Countermeasures and Project Proposed

The Study has been carried out with the aim of formulating watershed management and agricultural development in the PC23 irrigation area and its water sources consisting of Sahabe, Sahamilahy and medium and small streams in the Alaotra Region. The target area extends to 158,300 ha and plays an important role in food supply in Madagascar.

On the basis of survey and an analysis of the present situation, the following problems are identified: (i) low agricultural technology, (ii) deteriorated and/or insufficient irrigation facilities, (iii) insufficient market information, (iv) shortage of quality pasture grass, (v) degraded land resources and soil erosion in the upper and the middle watershed, (vi) sluggish agriculture and watershed management activities, (vii) insufficient living environment services and so forth, which are the direct causes of watershed degradation, hampering of sustainable agriculture as well as poverty in the community.

Under the Study, therefore, 30 countermeasures for problem solving were proposed from the viewpoints of agriculture, livestock, post-harvest, marketing, irrigation, watershed management and living environment. The problems and countermeasures are not independent, rather they are mutually correlated. Watershed management activities in the upper and the middle stream of the area largely contribute to sustainable irrigated agriculture in the downstream areas so that people in the upper and the middle stream can obtain benefits such as food supply and working opportunities downstream. Therefore, it is judged that income increases, living environment improvement and watershed improvement will be materialized through the improvement of sequential processes of the living environment. In addition, supporting mechanisms are required to support decision-making and activities in a community participatory way so as to kick-off activities with community initiatives.

On the basis of this concept, eight projects are proposed as follows:

(i) Irrigation Project in the South West PC23 Area

(ii) Training Project of Water Management Experts

(iii) Experimental Project for Paddy Research

(iv) Large-scale Irrigation Farming System Research Development Project

(v) Agricultural Diversification Project in the Eastern PC23 Rain-fed Area

(vi) Development Research Project on Method for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area

(vii) Extension of Improved Stove and Improvement of Rural Health and Sanitation

(viii) Integrated Watershed Conservation and Agricultural Rural Development Project in West Alaotra Lake Area

- Rehabilitation Project for Irrigation and Drainage System in PC23 Irrigated Area
- Integrated Watershed Conservation and Agricultural Rural Development Project in Upper and Mid-Basin of Sahamilahy River
- Integrated Watershed Conservation and Agricultural Rural Development Project for Upper and Mid Basins of 4 Small/Medium Rivers
- Integrated Watershed Conservation and Agricultural Rural Development Project for Upper and Mid Basins of Sahabe River

As is apparent, each element of the problems is tackled by projects for irrigation, paddy research and agricultural diversification. In addition, as a comprehensive approach is emphasized in the Study, Integrated Watershed Conservation and Agriculture Development Project (Integrated Watershed Conservation and Agricultural Rural Development Project in West Alaotra Lake Area) is also proposed.

Eight projects are proposed to be implemented for fifteen years from 2008 to 2023. The schedule and the implementation order needs to be formulated in consideration of priority and correlations so as to maximize the effects and the outcomes. The following criteria are utilized for priority ranking to prepare implementation schedule: (i) First priority is given to the projects necessary for early implementation; (ii) Second priority is for technical assistance projects to support smooth implementation of proposed projects; (iii) Third priority is put on the projects with technical validities already confirmed through pilot projects, easy implementation, high need from the communities, low cost and quick-return; (iv) last priority is given to the projects with high cost which, for the implementation of which, necessitate lessons from (ii) and (iii).

7.2 Early Implementation and Budgetary Arrangement

Since the communities struggle with rural poverty due to the degradation of upper and middle stream watershed and stagnation of agricultural productivity in the Study Area, it is strongly recommended that proposed projects be implemented in accordance with the implementation schedule prepared in the Study. Budgetary arrangements are also an important issue. In order to accelerate implementation, prospective budgetary sources, including the Japanese Government (technical assistance, grant assistance for grass-roots projects, grant aid, a counterpart fund, loan and south-south cooperation), other foreign donors, the World Bank, African Development Bank and other international organizations

need to be considered and arranged depending upon the scale and the type of the project.

7.3 Supporting Projects for Smooth Implementation of Proposed Projects

The proposed eight projects are expected to contribute to watershed conservation and poverty alleviation through a stepwise and comprehensive approach in their implementation. It will be more effective if supporting projects are carried out in line with proposed projects to maximize effects and to raise the sustainability of the proposed projects. The outlines of the supporting projects are tabulated in Table 7.3.1.

(i) Supporting Project for Agricultural Extension

(ii) Micro Credit Promotion Project

(iii) Training of Experts for Freshwater Fisheries

(iv) Quality Seed Multiplication and Dissemination Project

7.4 Set-up Improvement for Basic Data Collection

Monitoring of basic data such as meteorology and hydrology are hardly executed in the Study Area. In order to boost the effects of proposed projects and spread them to other areas, it is essential to improve and strengthen the set-up of such basic data collection and monitoring, the collected data of which will be referred to the projects' implementation. Capacity development of staff for such monitoring is also an important issue in this process.

7.5 Coordination with Relevant Organizations

Coordination with relevant organizations is of high importance to improve watershed management and to increase agricultural productivity. Steering member of this Study, MAEP, MINENVEF, Finance Bureau, DREEF under MINENVEF, and DRDR under MAEP are required to undertake necessary coordination so that maximum effects and outcomes from the projects can be expected.

Table 7.3.1 Supporting Projects to Maximize Effects and Outcomes of Proposed Projects

(1) Supporting Project for Agricultural Extension

In order to increase agricultural productivity through agricultural extension to farmers, extension of improved techniques on traditional paddy cultivation is continued and, also, improved upland crop cultivation techniques are introduced by this activities. The implementing organization is MAEP and practical supervision at the local level is the responsibility of Alaotra Region DRDR under MAEP.

Technical assistance for the extension of improved techniques on traditional paddy cultivation is carried out within the technical assistance framework of instant compost and line-planting under Asia-Africa cooperation having been carried out in the last 3 years. In addition, assistance for the new introduction of upland crops is also a part of the activities. Project components are as follows. Components also include promotion of the traditional variety, Tsemaka through home-grown, seed selection via salt solution for purchased seed, line-planting of young seedlings weeding, manual-type thresher and increased usage of instant compost. Seminars are organized at the village to promote and disseminate instant compost as an alternative organic resource.

1) Organization of seminars and technical assistance of traditional farming improvementd through an on-demand basis

2) Cooperation for a Development Research Project on Methods for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area

3) Preparation of demonstration field and technical assistance for intercropping of bean variety grass planting through non-tillage and upland paddy, maize and cassava, contour cropping, terracing and agro-forestry,

4) Testing of practical applications for improved agricultural equipment such as manual weeding machines and handy-type threshing machine.

(2) Micro Credit Promotion Project

In order to expand and sustain micro credit easily accessible and utilized for farmers, technical assistance for the improvement of fund source arrangement, loan conditions and so forth of rural credit organization. The first target is to provide rural credit institutions with low-interest fund sources for OTIV and CECAM, introduction of short-term agriculture loan to small-holder farmers through joint guaranty and a favorable system of medium-term loans for agricultural machinery, and promotion of saving by farmers together with strengthening of capital adequacy ratio of rural credit institution. The second target is to introduce two-step loans as a countermeasure to ensure the source of low-interest fund. OTIV and CECAM having branch office around Alaotra Lake Region, take charge of the Project. Since the operation of both organizations extends to national-wide, approximately 20 % of the fund is utilized for the Alaotra Lake Region.

1) Provision of low-interest fund sources to rural credit institutions using counterpart funds, improvement of loan conditions for farmers, and assistance of those institutions to promote saving among farmers

2) Introduction of two-step loans using donor funds

(3) Training of Experts for Freshwater Fisheries

A regional technical assistance center is proposed to be established so as to promote fisheries in the freshwater around Alaotra Lake Region. The initial stage of the Project is supervised by DRDR of Alaotra Mangoro Region. In line with the establishment of the center, technical staff and technicians of CMS will be trained through a tilapia feeding extension at north-west Majunga area to be implemented under MAEP within the framework of a rural development plan. Project components are as follows, including utilization of young fish hatching facilities of CVS in separate feeding.

1) Implementation of training program on freshwater fisheries targeting technical staff and technicians of CMS

2) Cooperation for a Development Research Project on Method for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area

3) Assistance in the establishment and the operation of regional technical assistance center utilization of young fish hatching facilities of CVS in separate feeding

(4) ***Quality Seed Multiplication and Dissemination Project***

Certified seed multiplication is carried out at a farm of CMS after early and/or medium thermosensitive variety is selected and fixed under an Experimental Project for Paddy Research, and is provided by the FOFIFA regional agricultural research center. In addition, corresponding to increases in demand in the future, a certified seed cultivation system on a contract basis is introduced at plots number 1 and number 4 adjacent to CMS farm. The organization responsible is CMS. The Project components are listed as follows:

1) Implementation of multiplication of certified early and/or medium thermosensitive variety and assistance in establishing a pay-distribution system

2) Strengthening of coordination with FOFIFA regional agricultural research center at CALA for the promotion of certified seed multiplication

3) Introduction of a certified seed cultivation system on a contract basis at plot numbera 1 and number 4 adjacent to CMS farm