1. INTRODUCTION

History of the Study

01. The alluvial plain around Alaotra lake is one of the granary areas of the Republic of Madagascar with about 100,000 ha of paddy fields contributing to 10 % of the annual rice demand for the country. The upstream areas of this plain have been, however, eroded particularly in the rainy season due to devastation through destructive lumbering in 1950s and erodible soil textual and topographic conditions. Various adverse impacts are recently observed such as flooding, inflow of sandy soil to the paddy field, deterioration of irrigation facilities and decrease of inland fishery yield due to the contraction of Alaotra lake.

Basic Concept of Study Implementation

02. In order to tackle such problems to attain rice self-sufficiency and to improve the livelihood of the communities for poverty alleviation, the Government of the Republic of Madagascar (hereinafter referred to as "the Government") commenced the Study on Rural Development and Watershed Management in the South-West Region of Alaotra with the technical assistance of the Japan International Cooperation Agency (JICA) from August 2003 to January of 2008 for 53 months. This Final Report deals with the Study output: (i) analysis of problems through the identification of present situation, (ii) examination of problem solution measures through the implementation of pilot projects, (iii) formulation of watershed management and agriculture development master plan (M/P) in collaboration with the Ministry of Environment, Water and Forest (MINENVEF) and the Ministry of Agriculture, Livestock and Fisheries (MAEP) on the basis of the lessons learnt from the pilot project, and (iv) preparation of an action plan for priority projects in the M/P.

03. Poverty alleviation and livelihood improvements based on increases in agricultural productivity would materialize by the development of the PC23 irrigation area as well as the stabilization of irrigation water supply toward existing paddy fields in the upstream and the mid-stream of Sahamilahy River, Sahabe River and other small streams. In addition, amelioration of devastated grassland occupying 60 % of the watershed in the upstream water source to recover the function of water and soil conservation so as to stabilize river discharge for irrigation use will be of necessity if the Study Area will continuously contribute to 25 % of rice production around Alotra lake region. In this context, the basic concept of the Plan is set on formulation of a comprehensive plan integrating watershed management in the upstream part and rural development in the PC23 irrigation area in the Study Area.

2. DEVELOPMENT POLICY OF THE GOVERNMENT

Development Policy

04. The Government has been implementing a Madagascar Action Plan (MAP) since 2007 targeting the acceleration of economic growth and poverty alleviation via cooperation with the public, private and international donor agencies based on the lessons learnt from preceding policies such as the Poverty Reduction Strategy Paper. In the MAP, the target of respective sectors has been established to be 2012 and, to achieve such targets, 416 projects are proposed up to 2012. Major numerical indexes set in MAP are shown as follows:

Major Numerical Indexes of MAP

Main indicators	Numerical target		Main indicators	Numerical target	
	2007	2012		2007	2012
UN Human Development Index (ranking)	146	100	Economic growth	4.6%	8~10%
Poverty rate			GDP (billion USD)	50	120
(% of population living below 2 USD/day)	85%	50%	GDP per capita (USD)	309	476
Family size (fertility rate)	5.4	3~4	Foreign direct investment		
Life expectancy	55.6	58~61	(million USD)	84	500
Literacy	63.5	80%	WB Business Climate Ranking	131	80
Percentage of children (Lower)	19%	56%	Corruption Perception Index	2.8	5.2
completing secondary school (Upper)	7%	40%	Households having land title	10%	75%

Source: JICA Study Team

05. In the agricultural sector, it is targeted to increase rice production from 3.42 million tons (2005) to 7 million tons (2012) to satisfy rice self-sufficiency and export the surplus. In order to achieve this policy target, improvement of land productivity by 50 % in paddy fields and 100 % in upland fields and expansion of paddy and upland field in the hilly and mountainous areas are expected as tabulated as follows:

Rice Production Doubling Plan under MAP

Farm land	Farm land area (ha)	Current condition in 2005			Target in 2012			
		Cropped area (ha)	Yield (ton/ha)	Production (ton)	Counter-measure	Cropped area (ha)	Yield (ton/ha)	Production (ton)
Irrigated paddy field	1,100,000	1,118,400		2,870,000		1,185,000		4,212,000
GPI*	86,000	230,000	3.5	805,000	Rehabilitation	150,000	5.0	750,000
PPI**	144,000	(18,400)	3.5	(64,400)	Consolidation	(75,000)	5.0	(375,000)
					-	80,000	3.8	304,000
MPI***	500,000	870,000	2.3	2,001,000	Rehab./Conso.	150,000	4.5	675,000
PP****	370,000				-	720,000	2.9	2,088,000
					Drainage	(10,000)	2.0	(20,000)
Rainfed field	265,000	265,000		546,000		415,000		1,046,000
Shifting cultivation	160,000	160,000	2.1	336,000		160,000	2.1	336,000
					Intensification	50,000	3.0	150,000
Upland field	105,000	105,000	2.0	210,000	-	55,000	2.0	110,000
					Expansion	150,000	3.0	450,000
New reclaimed area	0	0		0	RRI*****	500,000	3.5	1,750,000
Grand Total	1,365,000			3,416,400		2,100,000		7,008,000

Note : * : Large scale irrigation project ** : Middle scale irrigation project *** : Small scale irrigation project **** : Simple irrigation project ***** : Rapid Result Initiative

Source : Program National Bassins Versants - Périmètres Irrigués, MAEP

06. MAEP is the main agency to follow-up these objectives set in the agriculture sector. The Government issued irrigation and watershed management policy in June of 2006 describing that irrigation facilities rehabilitation and development will be promoted for existing paddy fields with an area of approximately 1 million ha in conjunction with sustainable water resource conservation in the upstream of such irrigated areas by the restoration of vegetation through afforestation. On the basis of a basic strategy of rehabilitating irrigation facilities as well as recovering vegetation in the watershed to be implemented, with a total cost of US$ 9.40 million by 2022, the Government plans to carry out the development of facilities covering 280 thousand ha within the framework of irrigation and watershed management policy. The Government has already negotiated with various donor agencies for financial and technical assistance, out of which aid proposals have been sent to the Government of Japan for revitalization of the PC 23 irrigation area located in the south-west of Alaotra Lake.

Foreign Donors' Assistant Activities in the Surrounding Areas of Lake Alaotra

07. In line with decentralization policy, Alaotra Mangoro Region takes responsibility for development administration with the technical assistance by a regional-level office under MAEP and MINENVEF. Alaotra Mangoro has been implementing Alaotra Mangoro regional development and, in addition, preparing to commence four-year development plan expected to be taken-off from 2009.

08. Development of Alaotra Lake and its surroundings has been supported by the World

Bank, International Organizations, France, USA and so forth in the various sectors as summarized in the following table. Furthermore, the Government and private sectors are also taking the initiative in some development fields.

Development Assistant Activities in Surrounding Area of Lake Alaotra

Sector	World Bank	UNDP	AFD	USA	Japan	Public sector	Private sector
Rural road						XXX	
Water supply		XX					
Rural electrification		X		X			
Rural credit		XXX			XXX*		
Agricultural production			XXX		XXX**		
Agricultural infrastructure	XXX						
Rice mill							XXX
Inland fisheries							
Watershed management	XX			XX			
Environment conservation	XXX						

Note: XXX; Under implementation or completed XX; Under preparation
X; Under formulation *; Micro credit project based on collateral funds of Japanese grant aid
**; Dispatching of Indonesian experts under Asia-Africa cooperation program of Japan
Source: JICA Study Team

3. PRESENT CONDITION OF THE STUDY AREA

Present Socio-Economic Conditions

09. The Study Area administratively covers two districts, Amparafaravola and Ambatondrazaka in Alaotra Mangoro Region administratively categorized into 71 villages in nine communes.

Natural Conditions

10. The Area consists of watersheds under the two main Rivers: (i) Sahabe and (ii) Sahamilahy, and four medium and small streams: (i) Asahamena, (ii) Ampasimena, (iii) Behengitra, and (iv) Bemarenina. PC 23 area is provided with irrigation water from those Rivers. The highest points of the Study Area are, 1,373 m a.s.l. at Ambatondorazana Mountain located in the most upstream of Sahamilahy River while the lowest point, 750 to 760 m a.s.l, is found near the boundary between PC 23 irrigation area and the swamp of Alaotra Lake.

11. Average annual rainfall of the Study Area calculated based on the previous 14 years is 1,078 mm, 90 % of which is concentrated in the period from December and March, therefore, the remaining period is severe dry season. In addition, annual gap is also high showing that there were four hydrological years having less than 800 mm of rainfall while four years have more than 1,300 mm of annual rainfall.

Land Use

12. Present land use is summarized in the following tables. As is evident, the land use is categorized into forest (natural forest and artificial forest), grassland/shrubs, agricultural land (upland field and paddy field), swamp, water body and so on. According to the analysis of aerial photographs shot in 1957, natural forest cover has reduced in the last half century to only 3 % of the total due to illegal deforestation, forest fires, conversion to agricultural field and grazing land. In particular, the ratio of forest cover in the watershed of Sahamilahy River and mid and small streams is shown to be lower. Areas of grassland and shrubs occupy 55 % of total area. Although they are utilized for grazing, vegetation cover is damaged by fire and dry season evaporation thereby causing serious erosion. Paddy fields are generally located along the valley bottom of each watershed and downstream of alluvial plains. Upland fields are particularly scattered in the plain near villages and river terrace downstream.

Present land use

Land use categories	Sahamilahy river basin		4-small and medium river basin		Sahabe river basin		PC23area		Study area	
	area (ha)	(%)	Area (ha)	(%)	area (ha)	(%)	area (ha)	(%)	area (ha)	(%)
(1) forest										
- natural forest	1,076	5.2	118	0.5	4,140	4.2	0	0.0	5,334	3.4
- manmade forest (pine)	157	0.8	0	0.0	9,117	9.3	0	0.0	9,274	5.9
- Manmade forest (Eucalyptus)	441	2.1	1,086	4.8	4,871	5.0	0	0.0	6,398	4.0
(2) grass and shrub land	15,925	77.3	16,649	74.0	53,787	55.1	1,020	5.8	87,381	55.2
(3) river	1,609	7.8	2,556	11.4	11,552	11.8	172	1.0	15,889	10.0
(4) farm land										
- paddy field	942	4.6	1,401	6.2	7,459	7.6	15,591	88.8	25,393	16.0
- upland	381	1.9	602	2.7	4,790	4.9	710	4.1	6,483	4.1
(5) wet land	0	0.0	0	0.0	784	0.8	0	0.0	784	0.5
(6) water bodies	65	0.3	81	0.4	1,217	1.3	60	0.3	1,423	0.9
Total	20,596	100.0	22,493	100.0	97,717	100.0	17,553	100.0	158,359	100.0

Source: JICA Study team

Agriculture, Livestock, Post-harvesting and Marketing

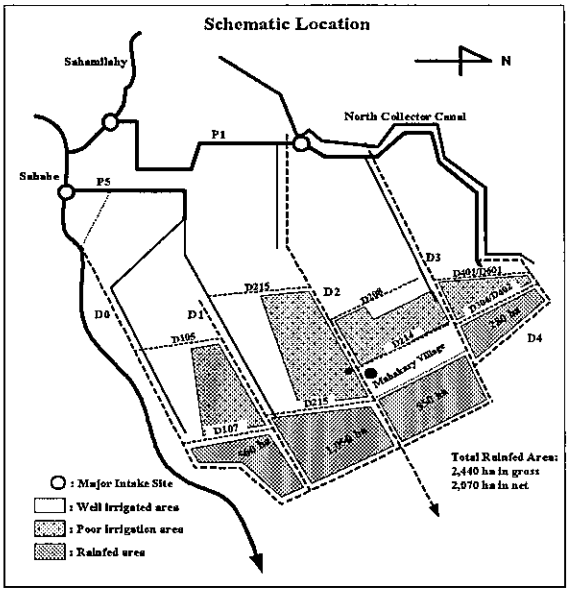
13. Paddy cultivation is the main income source of farmers in the Study area. In the PC 23 irrigation area, MK 34 variety with a growth period of 180 days is predominantly planted. Agricultural field per household is approximately 3 ha. Shortage of workforce for agriculture in the rush farming season is generally supplemented by employment from outside of the PC 23 irrigation areas. Mango, citrus, litchee and pineapple are planted near the villages. Zebu variety cows, as one of the important properties of farmers, are mainly raised with multi-purpose: (i) provision of cow dung for fertilizer,

(ii) workforce for plowing, and (iii) transportation of agricultural input and output, however, those number is insufficient. Main income source of farmers in Sahamilahy and Sahabe River watershed is rice cultivation followed by large and medium livestock breeding, upland crop production, fruit planting and fisheries using available resources. In addition, production of fuelwood by eucalyptus is a source of supplemental income. In the paddy field of PC23 of the watershed of the PC23 irrigation area, Tsemaka variety is cultivated with a growth period of 170 days. Cultivation of upland paddy, maize, cassava, sweet potato, beans, sugarcane and tomatoes is common in the upland field. Since per-capita field is small, less than 2 ha, cassava is the farmers' substitute foodstuff in the late dry season when rice production is lower than the annual average.

As for the livestock in the Study Area, the infant mortality ratio of cows is quite high since nutritious grass and feed tree are insufficient. In addition, livestock is not necessarily a direct income source in the Study Area, it is of necessity to diversify income sources of farmers particularly where farmers have only limited fields and/or optimum land use is difficult.

In total, there are 56 rice mills in the Study Area as of 2007. Milling capacity of the Study Area is judged to be sufficient. Previously, some remote areas of Sahabe watershed faced shortages of rice mills. A large scale milling factory under the private food stuffs company, TIKO, started paddy collection services in 2007, therefore, farmers now are able to easily access to marketing opportunities. The main constraints of marketing aspects in the Study Area are as follows: (i) It is difficult for farmers to sell their agricultural products with a fair price since agricultural markets accessible by farmers are insufficient; and (ii) Farmers cannot obtain high benefit from paddy marketing because the shortage of credit for agricultural input hampers farmers in selling paddy in the off-cropping-season.

14. Seasonal variations of irrigation water supply for PC23 irrigated area is significant. Additionally, function of irrigation and drainage facilities are becoming deteriorated, particularly due to lowering conveyance capacity by



Source JICA Study Team

Condition of Water Supply in PC23

sedimentation in the canals. Shortage of irrigation water is, therefore, widely observed in the command area. Net PC23 irrigated area is 9,870 ha, however, 2,070 ha equivalent to 20 % of the total area remain rain-fed fields. Although another 80 % of the areas are under irrigation, water supply is insufficient and timely water distribution is not carried out. Condition of the water supply in the PC 23 irrigated area is illustrated on the right.

The causes of sedimentation in the canals are as follows: (i) large quantity of sand flows into the canals from Sahabe, Sahamilahy and Asahamena Rivers, and (ii) there are no suspended load control facilities such as sand sluice, settling basin and AVIO gate at the intake. Temporal intake facilities at the Sahabe River is a free-intake type with no gate equipped, therefore, suspended load instantaneously flows into P5 main irrigation canal. Another reason of sedimentation is malfunction of irrigation facilities due to their deterioration. An AVIO gate is installed for automatic discharge regulation at the intake located near Andranotsimihoatra village, it does not function well for preventing suspended load from Asahamena River. In the case of the P1 main irrigation canal with the water source from Sahamilahy River, an AVIO gate is installed at the intake of Sahamilahy River to prevent suspended load from the River. However, the gate is malfunctioning, therefore, suspended load is protected using manual slide gates.

In the upper and middle stream of PC23 irrigated area, there extend 3,500 ha of net irrigation areas. Since the area of watershed is small, irrigation water supply is not stabilized more than that of PC 23 areas. The irrigation area generally consists of small plots with an area of 100m2 . Main facilities in those areas are makeshift structures constructed by locally available materials such as wood, fern, soil, rock and so on, therefore, they are frequently flushed away by floods.

Watershed Management and Soil Conservation

15. Forest management is the main activity for watershed management in the Study Area currently carried out by the staff of DREEF. However, it is impossible to manage such an extensive area with the limited number of staff. In addition, there are no forest management associations presently established. Forest fires has been repeatedly occurring in deteriorating natural forest as well as hampering recovery of vegetation cover in the grassland and shrub areas. Annual erosion is quantitatively estimated, as summarized in the following table. Soil loss from lavaka shows only 5 % of that from grassland/forest, therefore, soil loss from the sloped areas on the mountain would be the most serious issues for water and soil conservation in the watershed.

Estimate of Soil Loss from Respective Watershed

Watershed	Area (ha) Ⓐ	Quantity (ton/year)			Unit Erosion (ton/ha) Ⓑ/Ⓐ	Devastation Category
		Lavaka	Sloped Area	Total Ⓑ		
Sahamilahy	20,596	4,974	250,557	255,531	12.4	Serious
Asahamena	12,433	4,526	148,779	153,305	12.3	
Ranomainty	9,739	805	101,935	102,740	10.5	Moderate
Sahabe	49,066	6,150	489,291	495,441	10.1	
Behengitra	2,648	1,339	24,874	26,231	9.9	
Andranomainty	8,664	2,134	82,058	84,192	9.7	
Ampasimena	2,912	1,068	26,260	27,328	9.4	Minor
Mavolava	24,414	6,312	221,125	227,437	9.3	
Ampondra	5,834	1,446	47,926	49,372	8.5	
Grand Total	136,306	28,754	1,392,805	1,421,559	10.4	

Source: JICA Study Team

16. Population of the Study Area is 118,000 with 20,600 households (5.7 persons per household in 2006). There are major tribes such as the Sihanaka, Merina, Betsimisaraka and Betsileo in the Study area. Educationally, about a half the people had a school career higher than a primary school graduate and the literacy rate is about 69%.According to the result of village survey carried out for 500 selected households in the Study Area, the income of 52.4 % of sample households is lower than the poverty standard defined in the Poverty Reduction Strategy Paper. By comparing income and cropping areas, it is observed as a tendency that farmers with only small fields have a lower income. Although there are complex factors, the size of paddy areas is an important dimension affecting income levels.

4. COUNTERMEASURES FOR PROBLEM SOLVING

17. On the basis of problems and their causes identified through the situational analysis in the Study area from the viewpoints of agriculture, livestock, post-harvesting, irrigation, watershed management and living environment, 40 improvement measures are prepared. Then, activities of assistance under donors and international organizations, policy implementation progress by the Madagascan government, private investment and lessons learnt from pilot projects are considered and finally 30 countermeasures for problem solving are selected, as tabulated as follows:

Problems and Approaches to Problem Solving and Countermeasures

Problem	Approaches to problem solving	Countermeasures
Agriculture		
PC23 Irrigated Area Delay of plowing/ puddling 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	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	1. Improvement of paddy productivity
PC23 rain-fed area Shortage of irrigation water source Serious risk for rain fed crops cultivation	Diversification of agriculture income sources through introduction of appropriate variety for rain fed paddy cultivation; of legume for secondary cropping and of poultry farming	2. Promotion of diversification of agricultural income source
Upper and middle stream of each watershed *(irrigated area) Delay of plowing/puddling Difficult access to paddy field Deterioration of quality of paddy seed Difficult access to markets	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.	3. Promotion of diversification of agriculture sources
Upper and middle stream of each watershed (upland) Poor technology for upland crops, vegetables and horticulture, farmer's indifference for soil conservation technology	Increase of agricultural income primarily through the improvement of upland crop production	4. Extension of improved upland crop
PC23 Irrigated Area Delay of practical use of early and middle variety, drought and humidity tolerant variety	Enhancement of research and extension system to select the high potential paddy varieties	5. Strengthening research and extension system for new variety and high potential crops

Problem	Approaches to problem solving	Countermeasures
Livestock		
Insufficient growth of cows (the grass/ shrub area in upper and middle stream of each watershed)	Selection of highly nutritious fodder grass and tree varieties suitable to the given environment Developing methods to establish grassland with the newly selected varieties to provide fodder	6. Research on developing methods of pasture land establishment and fodder production
Low income of farmers (Study area)	Promotion of small livestock or poultry (broiler) to be maintained with low cost Identification and development of market in the surrounding area	7. Promotion of diversification of agriculture income sources (goose)
Irrigation		
PC23 irrigated area		
Decrease of intake discharge for irrigation	Stable irrigation water supply	8. Rehabilitation of intake structures
Insufficient irrigation water distribution to secondary/ tertiary area	Effective utilization of water resources	9. Reuse of drainage water
Shortage of irrigation water distribution to on-farm level	Improvement of irrigation method at the on-farm level	10. Rehabilitation of on-farm level irrigation and drainage facilities
Decreases of conveyance capacity of irrigation canal, deterioration of tertiary level facilities, overtopping of paddy field and O&M road, severed secondary and tertiary road to hamper transportation of products	Implementation of systematic irrigation and drainage operation	11. Rehabilitation of irrigation and drainage system
Ineffective utilization of irrigation water	Extension of appropriate irrigation techniques	12. Extension of appropriate irrigation technology
Insufficient O&M of facilities by farmers at the on-farm level	Restructuring and strengthening of water management	13. Enhancement of O&M system
PC23 area (Rain fed area)		
Rain-fed farming due to no provision of water from upstream, inundation of the field, insufficient leveling of the field, low function of O&M road, field utilization for grazing	Optimum land use	14. Development of appropriate land use plan for PC23 rain-fed area
Irrigated area (upper and middle stream area)		
Unstable water supply, low irrigation efficiency	Stable irrigation water supply	15. Rehabilitation of intake structures in 4 upper/mid basin of small/medium rivers

Problem	Approaches to problem solving	Countermeasures
Insufficient growth and low production of paddy due to delay of planting in the drought year	Extension of appropriate irrigation techniques	12. Extension of appropriate irrigation technology
Insufficient organizational set-up at the watershed level	Strengthening of water management set-up at the watershed level	13. Enhancement of O&M system
Watershed Management		
No watershed management activities	Enhancement of capability in watershed management	16. Establishment of forest management association and capacity development
		17. Conservation of natural forest
		18. Introduction of beekeeping
		19. Capacity enhancement of local forestry office
		20. Basin environment monitoring with GIS
Forest fire	Prevention of forest fire	21. Prevention of forest fire
Erosion from watershed	Recovery of vegetation cover	22. Development of buffer zone
		23. Recovery of degraded natural forest
		24. Development of community and school forest
		25. Promotion of greenization of degraded grasslands
		26. Promotion of agroforestry
		27. Introduction of silvopastoral
		28. Recovery of vegetation in lavaka
Improvement of living environment		
Low income and inactive economic activities	Preparation of foundation for income increase	29. Road improvement III
Excessive burden to forest resources	Mitigation of burden to the environment	30. Extension of improved stove

Remarks: Upper and middle stream of each watershed means the total basin of Sahabe, Sahamilahy and 4 small/ medium rivers above PC23 area.

Source: JICA Study Team

5. Validation of Proposed Counter Measures through Implementation of Pilot Projects

18. It is essential to verify from a technical point of view whether the proposed 30 measures contribute to the improvement of agriculture and watershed management. In this light, 12 pilot projects are selected on the basis of: (i) urgency and (ii) contribution toward

watershed management, so as to clarify the effectiveness and adaptability of the proposed measures. The selected projects are tabulated as follows:

List of Pilot Projects

Subject	Pilot Project	Subject	Pilot Project
Agriculture	Agriculture income diversification (Mahakary)	Watershed Management	Natural forest protection
	Agriculture income diversification (Maheriara)		Buffer zone establishment
	Reuse of drainage water		Promotion of village- and school-managed forest
	Research and extension of new and potential crops		Promotion of agro-forestry
Watershed Management	Establishment of forest management association and capacity development		Recover of vegetation in Lavaka
	Forest fire prevention action	Living Environment	Dissemination of improved stove

Source: JICA Study Team

19. Technologies adopted and their effectiveness was verified by the respective pilot projects as summarized as follows:

Summary of Pilot Projects and the Effectiveness

Pilot Project	Trial Technology, Contents of Pilot Project and Validation Result
Agriculture income diversification (Mahakary)	1. Trial Technology: introduction of double cropping, poultry raising and fruits cultivation 2. Contents of the Pilot Project: Double cropping in the upland field (rainy season: upland paddy, dry season: haricot bean), fruits planting and broiler chicken raising in the blank space of residential area, market development of haricot beans and poultry, establishment and strengthening of cooperatives for double cropping and poultry raising 3. Validation Result: Cultivation of haricot beans in the dry season is an effective measure for both paddy and upland field in the rain-fed areas of PC 23 if quality variety and seed can be obtained. Broiler chicken raising is of use particularly near the market. In the Study Area, goose raising is effective since the market is already available.
Agriculture income diversification (Maheriara)	1. Trial Technology: introduction of double cropping, poultry raising and fishery 2. Contents of the Pilot Project: Double cropping in the paddy field (traditional rice variety and haricot bean), poultry raising near residential areas, construction of fishery pond using natural pond and fish feeding in the fresh water, market development of poultry and fish, establishment and strengthening of cooperatives for double cropping and fishery 3. Validation Result: Second cropping is required to improve field drainage conditions, which would be difficult at present. Therefore, improvement of traditional paddy cultivation is appropriate as a means to increase and stabilize agricultural income. Poultry raising environment is as same as Agriculture income diversification (Mahakary). As for fishery raising, feeding of tilapia alevin would be effective and applicable means to increase income.
Reuse of drainage water (PC23 irrigated area)	1. Trial Technology: Reuse of tertiary drainage water 2. Contents of the Pilot Project: Rehabilitation of drainage facilities in fifth and sixth plot, rehabilitation of rural road and establishment of water users' association, training of water users' association for system O&M, 3. Validation Result: This technology is useful to quickly obtain effects for the

Pilot Project	Trial Technology, Contents of Pilot Project and Validation Result
	mitigation of water shortage. It would be generally effective to improve irrigation systems receiving water from the river with unstable discharge. Rehabilitation of drainage water reuse facilities on a permanent level would ensure supplemental water source.
Research and extension of new and potential crops	1. Trial Technology: Promotion of thermosensitivite variety of paddy application 2. Contents of the Pilot Project: Field experiment using medium variety, Selection experiment for second cropping season, field workshop, medium variety demonstration farm, Field experimentation for NERICA, preparation of extension manual 3. Validation Result: The technology is effective to improve paddy productivity in and around Alaotra Lake.
Establishment of forest management association and capacity development	1. Trial Technology: Establishment of forest management organization 2. Contents of the Pilot Project: Workshop for consensus building among community members for the establishment of forest management organization, establishment and registration of forest management organization, training for organizational management and work scheduling 3. Validation Result: The technology is effective to facilitate coordination between the government and communities through communities' initiative in watershed management.
Natural forest protection	1. Trial Technology: Natural forest protection 2. Contents of the Pilot Project: Awareness raising through workshops, training of forest management organizations for the establishment of natural forest protection committees and protection systems, identification of boundary of natural forest areas, installation of sign board, implementation of natural forest protection activities by the committee 3. Validation Result: The technology is effective measure to protect natural forest.
Forest fire prevention action	1. Trial Technology: Protection of forest fire 2. Contents of the Pilot Project: Workshop for the promotion of the understanding of adverse impacts of forest fires, training of forest management organizations for the establishment of forest fire protection committee and protection system, Dissemination of information of forest fire control to communities, awareness raising for fire protection and fire protection activity promotion, preparation of fire extinguishing equipment 3. Validation Result: The technology is effective to protect water and soil conservation functions inherent in watershed.
Buffer zone establishment	1. Trial Technology: Creation of substitute resource in line with natural forest protection 2. Contents of the Pilot Project: Workshop for the role and the necessity of buffer zone, training of forest management organization for the establishment of buffer zone committee and buffer zone management system, field survey for buffer zone set-up in collaboration with the government, setting-up of fire control area around buffer zone, preparation of equipment for buffer zone creation and management 3. Validation Result: The technology is useful to be carried out in line with natural forest protection.
Promotion of village- and school managed forest	1. Trial Technology: Development of community-managed forest 2. Contents of the Pilot Project: Awareness raising among community members for the purpose and effectiveness of community-managed forest, training of community members for the establishment of village- and school-managed forest committee, Training of forest development and management, participatory forest development, preparation of forest management system 3. Validation Result: The technology is effective for both vegetation recovery in the watershed and nurturing of future generation.
Promotion of agro-forestry	1. Trial Technology: Grassland utilization for soil conservation 2. Contents of the Pilot Project: workshop for the dissemination of agro-forestry

Pilot Project	Trial Technology, Contents of Pilot Project and Validation Result
	activities including hedgerow, upland crops, fruits, feed crops, beekeeping and flower, training of forest management organization for the establishment of agro-forestry committee, the selection of agro-forestry area and techniques of agro-forestry, monitoring and follow-up of agro-forestry activities 3. Validation Result: This approach would be effective for soil conservation as well as income generation.
Recover of vegetation in Lavaka	1. Trial Technology: Stabilization of erodible portion in Lavaka through vegetation recovery 2. Contents of the Pilot Project: Reduction of run-off in the sloped areas and mitigation of erosion in the alluvial cone by forestation around Lavaka, effective land use of alluvial cone by planting fruit trees, cultivating feed crop and grazing 3. Validation Result: This approach is useful by ensuring material incentive of stakeholders around Lavaka through land use planning downstream of alluvial cone.
Dissemination of improved stove	1. Trial Technology: Improvement of household duties by introduction of improved stove 2. Contents of the Pilot Project: design of improved stove using locally available materials, introduction of improved stove to model households and dissemination to others, promotion of improved stove dissemination by community-initiatives 3. Validation Result: The technology would be one of the effective methods to improve domestic health care and sanitation.

Source: JICA Study Team

20. Effectiveness of measures for problem solving was verified and useful lessons were obtained through the implementation of pilot projects as explained above. The issues to be incorporated into the formulation of watershed management and agriculture development are summarized as follows:

Issues and Lessons Learnt from the Pilot Projects to be Incorporated into the Formulation of Development Plan

Sector	Issues
Agriculture	In order to increase income through the enhancement of agricultural production, the following three issues are inevitable: (i) increase of land use intensity, (ii) increase in crop productivity and (iii) crop diversification. On the other hand, income increase through strengthening of agricultural production facilities, three issues needs to be considered: (i) land use planning adaptable for surrounding conditions, (ii) effective utilization of water resources, and (iii) restructuring of water users' association.
Watershed Management	Mitigation of soil erosion is one of the most important challenging in the Study Area. The following issues need to be considered: (i) maintenance of water conservation function of watersheds, (ii) strengthening of group activities organized by the stakeholders for watershed management, (iii) natural forest protection and development of forest management techniques, (iv) mitigation of damage by forest fire, (v) prevention of forest fire, (vi) mitigation of soil erosion by forest resource recovery, (vii) development of forest resource, and (viii) promotion of forestation. An important point to formulate development plan is to integrate measures of both water and soil conservation and income increase.
Living Environment	Improvement of living environment in the Study Area requires formulation of development plans focusing on: (i) effective usage of household fuel and (ii) health care and sanitation improvement.
Community Participation	Most of the people in the upper to midstream of the Study Area earn income from both agriculture and forestry. Therefore, measures for income generation and soil and water conservation need to be integrated in the development plan in order to ensure practicability, sustainability and replicability of community participatory watershed management.

Source: JICA Study Team

6. WATERSHED MANAGEMENT AND RURAL DEVELOPMENT PROJECTS

21. In accordance with the background of the problems in the Study Area and the policy of the Government, a basic concept of watershed management and agricultural development covering fifteen years is formulated. A poverty of PC 23 irrigation area in the downstream and the areas in the upstream are under one cardiovascular system, therefore, they are mutually correlated. Watershed management programs in the upstream can be expected to contribute to both upstream and downstream through the provision of workforce and food supply. In order to bring an end to the present vicious circle in the Study Area, it is most important to tackle the core problems of low income, living environment deterioration and forest devastation. This approach will make it possible to create sustainable living environment for community members in the Study Area. On this basis, development targets of the Study Area are tabulated as follows:

Development Target

Subject	Numerical Target
Increase of agricultural productivity and poverty alleviation	50 % reduction of poor households by increasing income and paddy production by more than 50 %
Strengthening of water and soil conservation function	Recovery of vegetation in 75 % of degraded area and promotion of forestation in 25 % of vegetated areas to reduct soil loss by 20%
Conservation of forest resources	Achieve an equilibrium in upstream forest resource conservation and fuelwood production through the reduction of household wooden fuel consumption by half

Source: JICA Study Team

22. Basic concept of watershed management and rural development is shown as follows:

Subject	Basic Concept
Watershed Management	Various programs are integrated based on the characteristics of each area, programs of which would consist of: (i) strengthening of forest management association, (ii) conservation of natural forest, (iii) recovery of deteriorated natural forest, and (iv) development of village- and school-managed forest.
Rural Development	Several programs are integrated to formulate projects suitable for the regional characteristics so as to increase agricultural productivity focusing on rice production and promotion of income source diversification.
Upstream and midstream development in each watershed	Watershed management plan is formulated for Sahabe River Watershed, (ii) Sahamilahy River Watershed and (iii) 4 middle and small rivers watershed respectively. Agricultural development plan with materializing benefit in a short-term such as agriculture income diversification (second cropping, fruit planting, goose feeding, fish feeding and market development) are integrated in the Plan in a community participatory approach.
PC23 area development	Irrigation development is not carried out for 2,070 ha currently utilized for rain-fed cultivation. Instead, agriculture income diversification activities (second cropping, fruit planting, goose feeding etc.) are introduced to effectively utilize such areas. On the other hand, command areas under main canal P5 are superior to

Subject	Basic Concept
	P1-command areas from various view points: (i) quick-return, (ii) small-scale with low project cost, (iii) easiness for the development, and (iv) developed water users' group. Therefore, P5-command areas are selected for development in the first stage followed by P1-command areas. In this case, lessons to be learnt from the implementation of P5-command area should be used.
Improvement of living environment through conservation of forest resources and improvement of household duties	In order to conserve forest resources in the watershed, the plans for the introduction and dissemination of improved stoves are formulated: (i) to reduce consumption of wooden fuel, (ii) to improve health and sanitation, (iii) reduce burden of household duties of women and children.
Introduction of technical assistance project	Technical assistance-type projects are required to smoothly carry out watershed management and agriculture development projects. Necessary technical assistance projects are, therefore, formulated for watershed sector, irrigation sector and agriculture sector respectively.
Formulation of quick-return project	Projects with low cost and quick-return are prioritized in the development plan.

Source: JICA Study Team

23. Eight projects are formulated as tabulated as follows based on the development concept. Location of proposed projects is depicted afterward. Integrated Watershed Conservation and Agricultural Rural Development Project in West Alaotra Lake Area is formulated as a comprehensive project according to the lessons to be learnt from technical assistance projects and Irrigation Project in the South West PC23 Area.

Proposed Projects List

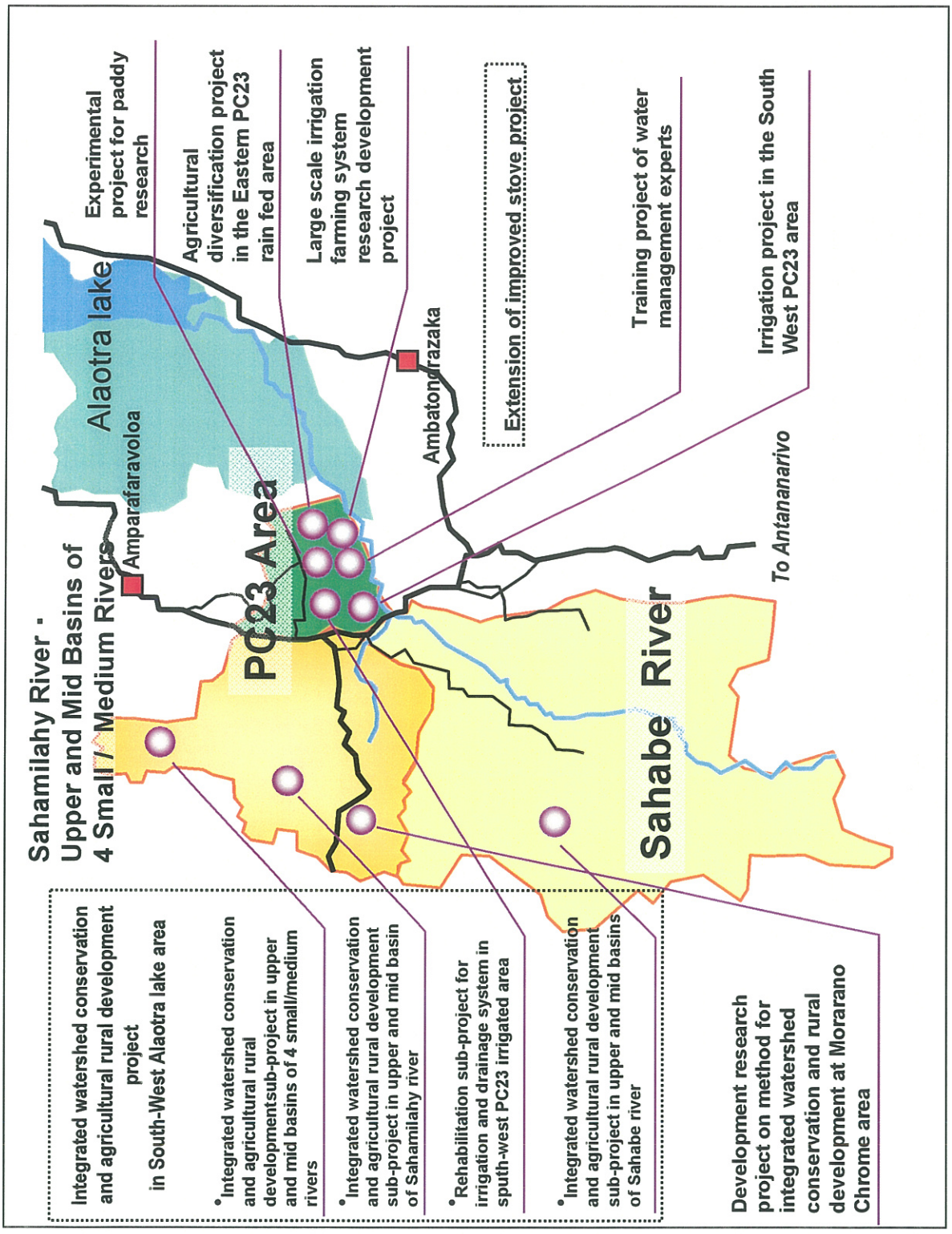
No.	Project Name	Area	Component
1	Irrigation Project in the South West PC23 Area	PC 23 irrigated area (command area of PC5 main canal)	1) Strengthening of main facilities: rehabilitation of diversion works on Sahabe River, construction of intake on Sahabe River, construction of settling basin (7,800 m²), installation of trash rack for regulating weir on P5 main canal, rehabilitation of slope on main canal (6,400 m), rehabilitation of regulating fate on secondary canal 1 no. (C5.5), rehabilitation of slope on secondary canal (5,500 m), heightening of main drainage D0, D1 and D2 embankment (35,900 m), strengthening of polder (1,500 m) 2) Construction and rehabilitation of facilities for drainage water re-use: installation of gate to regulate discharge of tertiary drainage (new gate installation: 4 nos., gate rehabilitation : 9 nos.; replacement of diversion works: 9 nos., rehabilitation: 20 nos.; rehabilitation of canal slope: 19,900m), heightening of drainage embankment (new: 8 nos., rehabilitation: 20 nos.; rehabilitation of slope: 28,400m) 3) Improvement of rural road network: rehabilitation of approach road to PC23 irrigation area: 2,900m, rehabilitation main road in PC23 area: 13,000 m, rehabilitation of main road in west south area of PC23: 20,600 m, rehabilitation of O&M road for tertiary canals: 28,400 m 4) Construction of O&M facilities: construction of project office, construction of O&M house for intake weir and settling basin
2	Training Project of Water Management Experts (Technical assistance project)	PC 23 irrigated area (command area of PC5 main canal)	1) Preparation of group training program for water management of MAEP staff (preparation of training program for senior engineer group and training schedule) 2) Implementation of group training for water management in foreign countries (11 staffs) (selection of trainees and implementation) 3) Implementation of training programs for the members of water users' association by trainees of 2) (2 members from each block, 26 members from 13 blocks) (selection of trainees and implementation) 4) Preparation and implementation of follow-up programs (monitoring of water management activities, preparation of monitoring programs and its implementation)
3	Experimental Project for Paddy Research (Technical assistance project)	PC 23 irrigated area (command area of PC5 main canal) and Ambodirano village	1) Technical extension through new demonstration farm (5 ha) at sixth block of PC23 west south area and existing farm (5ha) in Ambodirano village: adaptability test for 3 varieties of thermosensitivity medium variety at two plots in the rainy season, one variety of early variety adaptability test at two plots in the rainy season, and combination of early variety and medium variety in the rainy season 2) Presentation of cultivation techniques at demonstration farm (arrangement of FIELD DAY) 3) Preparation of manual for new variety (medium variety rainy season cultivation manual, early variety rainy season cultivation manual, and double cropping manual)
4	Large-scale Irrigation Farming System Research Development Project (Technical assistance project)	PC 23 irrigated area (command area of PC5 main canal)	1) Improvement of cropping calendar (establishment of improved cropping calendar based on climatic change, establishment of cropping system of non-photosensitive medium variety) 2) Improvement of cropping method (establishment of fertilization techniques through comparative trials, establishment of cropping techniques through regular planting and manual hoeing machine) 3) Improvement of post harvest activities (introduction of harvester and thresher) 4) Improvement of cultivation techniques (intensive farming, well-matured compost, bean cultivation as a secondary crop) 5) Introduction and dissemination of water-saving farming (SRI/SRA farming practice, implementation of improved water

No.	Project Name	Area	Component
			management)
5	Agricultural Diversification Project in the Eastern PC 23 Rain-fed Area	PC 23 eastern rainfed area (command area of PC5 main canal)	1) Implementation of relative elevation survey 2) Interview survey to land owner and cultivator for water standing condition in the rainy season using the result of relative elevation survey 3) Preparation of land use plan 4) Improvement of rain-fed rice farming, introduction of double cropping, technical assistance for grassland improvement 5) Diversification of agriculture income (4 villages)
6	Development Research Project on Method for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area (Technical assistance project)	Upper and mid basin of Sahamilahy River	1) Assistance in the establishment of community organization, preparation of article and by-laws and group management 2) Implementation of inventory survey for irrigation facilities and water users' association at sub-watershed under respective watershed 3) Assistance of farming techniques: (i) forcing compost preparation, (ii) intensification of farming and increase of paddy productivity through double cropping, (iii) improvement of upland farming through non-tillage farming of bean variety, upland paddy, maize and cassava 4) Technical assistance for selection of suitable areas for fishery in fresh water, needs assessment, hatching pond and fish culture management, marketing etc. 5) Technical assistance for livestock management and feeding cultivation, integration of crop production and livestock management (cow, pig, goat and goose) 6) Awareness promoting for fire prevention, provision of fire prevention equipment and training of those usage, and techniques of forest fire prevention techniques 7) Introduction of demonstration areas for soil conservation through agro-forestry, contour farming, terrace farming, and selection of areas for Lavaka alluvial plains 8) Technical assistance for the selection of natural forest to be conserved and alternative forest resource development 9) Training of DREEF and commune technical staff for forest management and training skills of community members 10) Assistance of the preparation of regulation for community participatory forest management and explanation to community members about forest promotion policy through RFR approach 11) Training for integrated management of agriculture, irrigation and watershed management
7	Extension of Improved Stove Project	Whole Study Area	1) Preparation of 60 improved stoves on a demonstration basis 2) Awareness promoting of community members for the effectiveness of improved stove 3) Assistance of the establishment of improved stoves committed to be organized by community members and training of improved stove preparation 4) Construction of improved stove for approximately 20,300 households in 67 villages 5) Monitoring of the process of activities

No.	Project Name	Area	Component
8	Integrated Watershed Conservation and Agricultural Rural Development Project in South-West Alaotra Lake Area	PC1 main canal-command area under PC 23 area, watershed of Sahabe River, Sahamilahy River and 4 small and medium Rivers	
	Sub-project		
	(1) Rehabilitation sub-project for Irrigation and Drainage System in PC23 Irrigated Area	PC 23 irrigated area (command area of PC1 main canal)	1) Rehabilitation of intake weir on Sahamilahy River, automatic water level regulators (3 nos.), de-silting of main canal and north canal (33,700m) 2) Rehabilitation of diversion works on secondary and tertiary canals (81 nos.) 3) Rehabilitation and new construction of water level regulators on main canals (5 nos.), new construction on tertiary canals 4) Rehabilitation of O&M road (55,000km) 5) Detailed design and construction supervision
	(2) Integrated Watershed Conservation and Agricultural Rural Development sub-project in Upper and Mid-Basin of Sahamilahy River	Upper and Mid-Basin of Sahamilahy River	<u>Watershed Management</u> 1) Conservation of natural forest and recovery of deteriorated natural forest with approximately 1,100ha (establishment of natural forest conservation and deteriorated natural forest recovery committee, capacity building of the committee, implementation of enrichment planting and development of forest corridor) 2) Development of buffer zone (approximately 1,000ha) 3) Forestation in grass and shrub areas (3,000ha) 4) Vegetation cover for grass and shrub areas (12,000ha) 5) Introduction of agro-forestry (about 100 ha per villages covering 13 villages thus 1,300ha in total) and bee keeping (13 villages) 6) Development of village- and school-managed forest (50ha per villages covering 13 villages thus 650ha in total) 7) Development of silvo-pastral demonstration (10ha per villages covering 13 villages thus 130ha in total) 8) Land use demonstration at Lavaka downstream (5 nos. in watershed) 9) Prevention of forest fires (establishment of forest fire prevention committee, preparation and training of forest prevention system for 13 villages) <u>Agriculture Development</u> 1) Rehabilitation of irrigation facilities (gross area: 700ha) 2) Strengthening of water users' association (number of trainees for in-country training: 2 nos.) 3) Improvement of upland farming for 380 ha (establishment of research and extension committee, management of demonstration farm and training) 4) Agriculture income source diversification (13 villages)

No.	Project Name	Area	Component
	(3) Integrated Wateshed Conservation and Agricultural Rural Development sub-project in Upper and Mid Basins of 4 Small/Medium Rivers	Upper and Mid Basins of Sahabe River	Watershed Management 1) Forestation in grass and shrub areas (3,100ha) 2) Vegetation cover (12,500ha) 3) Introduction of agro-forestry (about 100 ha per villages covering 17 villages thus 1,700ha in total) and beekeeping (17 villages) 4) Development of village- and school-managed forest (50ha per villages covering 17 villages thus 850ha in total) 5) Development of silvopastoral demonstration (10ha per villages covering 17 villages thus 170ha in total) 6) Land use demonstration at Lavaka downstream (5 nos. in watershed) 7) Prevention of forest fire (establishment of forest fire prevention committee, preparation and training of forest prevention system) Agriculture Development 1) Rehabilitation of irrigation facilities (gross area: 2,500ha) 2) Strengthening of water users' association (number of trainees for in-country training: 5 nos.) 3) Improvement of upland farming for 600 ha (establishment of research and extension committee, management of demonstration farm and training) 4) Agriculture income diversification (17 villages)
	(4) Integrated Watershed Conservation and Agricultural Rural Development sub-project in Upper and Mid Basins of Sahabe River	Upper and Mid Basins of 4 Small/Medium Rivers	Watershed Management 1) Conservation of natural forest and recovery of deteriorated natural forest with approximately 4,100ha (establishment of natural forest conservation and deteriorated natural forest recovery committee, capacity building of the committee, implementation of enrichment planting and development of forest corridor) 2) Development of buffer zone (approximately 10,100ha) 3) Forestation in grass and shrub areas (40,000ha) 4) Vegetation cover (12,000ha) 5) Introduction of agro-forestry (about 100 ha per villages covering 28 villages thus 2,800ha in total) and beekeeping (28 villages) 6) Development of village- and school-managed forest (50ha per villages covering 28 villages thus 1,400ha in total) 7) Development of silvopastoral demonstration (10ha per villages covering 28 villages thus 280ha in total) 8) Land use demonstration at Lavaka downstream (10 nos. in watershed) 9) Prevention of forest fires (establishment of forest fire prevention committee, preparation and training of forest prevention system) Agriculture Development 1) Rehabilitation of irrigation facilities (gross area: 3,900ha) 2) Strengthening of water users' association (number of trainees for in-country training: 8 nos.) 3) Improvement of upland farming for 4,800 ha (establishment of research and extension committee, management of demonstration farm and training) 5) Agriculture income diversification (28 villages)

Source: JICA Study Team



Source: JICA Study Team

Location Map of Proposed Projects

24. Implementation period cost and expected effects of eight projects including Integrated Watershed Conservation and Agricultural Rural Development Project is summarized in the following table.

Implementation Period, Implementation Cost and Expected Effects of Proposed Projects

No.	Project	Implementation Period (years)	Cost (thousand USD)	Expected Effects
1	Irrigation Project in the South West PC23 Area	2.5	11,800	• Provision of irrigation water to 2,000 ha and increase of paddy production of 4,000 ton
2	Training Project of Water Management Experts (Technical assistance project)	3	690	• Upgrading of staffs' skills (2 nos. per water users' association covering 13 associations) in water management and improvement of water management and O&M
3	Experimental Project for Paddy Research (Technical assistance project)	2	60	• Establishment of production increase though paddy multiplication system by the use of thermosensitive early variety and potential medium variety and double cropping system
4	Large-scale Irrigation Farming System Research Development Project (Technical assistance project)	3	2,925	• Stabilization of agricultural production using thermosensitive early variety and medium variety in double cropping of large-scale irrigation farming system, • Improvement of profitability based on low-cost paddy farming, • Improvement of paddy quality, and • Establishment of effective water use techniques through water-saving agriculture
5	Agricultural Diversification Project in the Eastern PC 23 Rain-fed Area	3	251	• Optimum land use in rain-fed areas, • Diversification of agricultural income source, and • Increase of agricultural income by stabilizing rain-fed farming
6	Development Research Project on Method for Integrated Watershed Conservation and Rural Development at Morarano Chrome Area (Technical assistance project)	5	5,000	• Recovery of vegetation cover in Sahabe, Sahamilahy and medium and small Rivers Watershed, and • Establishment of comprehensive development approach by a combination of agriculture and forestry, and • Smooth implementation of proposed projects using abovementioned newly developed approach
7	Extension of Improved Stove Project	3	604	• Improvement of household duties at 20,300 households excluding 3 villages covered under pilot project, • Mitigation of burden of household duties particularly for women, • Reduction of time spent for fuelwood collection, • Reduction of fuelwood consumption, and • Retrenchment of the cost for fuel
8	Integrated Watershed Conservation and Agricultural Rural	5	94,652	

No.	Project	Implementation Period (years)	Cost (thousand USD)	Expected Effects
	Development Project in South West Alaotra Lake Area			
	(i) Rehabilitation Sub-Project for Irrigation and Drainage System in South West PC23 Irrigated Area	(3)	(40,735)	• Provision of irrigation water to 4,600 ha and increase of paddy production of 9,200 ton
	(ii) Integrated Watershed Conservation and Agricultural Rural Development Sub-Project in Upper and Mid-Basins of Sahamilahy River	(5)	(9,535)	• Increase of paddy production by 700 tons via the rehabilitation of irrigation facilities and improvement of water management and O&M, • Increase of agricultural income based on the diversification of agricultural income source, • Improvement of natural forest and deteriorated natural forest areas, • Promotion of Symbiosis between natural forest consumer and surrounding people by developing buffer zone, • Forestation (3,000 ha) and vegetation cover (12,000 ha) in grass and shrub areas to mitigate soil erosion, • Demonstration of agro-forestry and silvopastoral, • Awareness raising through demonstration of Lavaka protection measures, and • Awareness raising for forest fire protection and forest fire protection system improvement
	(iii) Integrated Wateshed Conservation and Agricultural Rural Development Sub-Project in Upper and Mid Basins of 4 Small/Medium Rivers	(5)	(10,528)	• Increase of paddy production by 1,200 tons through the rehabilitation of irrigation facilities and improvement of water management and O&M, • Increase of upland crop production by improved upland farming techniques, • Increase of agricultural income based on the diversification of agricultural income source, • Forestation (10,100 ha) and vegetation cover (40,000 ha) in grass and shrub areas to mitigate soil erosion, • Mitigation of soil erosion through the development of village- and school-managed forest (1,400 ha) • Demonstration of agro-forestry and silvopastoral, • Awareness raising through demonstration of Lavaka protection measures, and • Awareness raising toward forest fire protection and forest fire protection system improvement

No.	Project	Implementation Period (years)	Cost (thousand USD)	Expected Effects
	(iv) Integrated Watershed Conservation and Agricultural Rural Development Sub-Project in Upper and Mid Basins of Sahabe River	(5)	(33,854)	• Increase of paddy production by 2,000 tons via the rehabilitation of irrigation facilities and improvement of water management and O&M, • Increase of upland crop production by improved upland farming techniques, • Increase of agricultural income based on the diversification of agricultural income source, • Improvement of natural forest and deteriorated natural forest areas, • Promotion of Symbiosis between natural forest consumer and surrounding people by developing buffer zone, • Forestation (10,100 ha) and vegetation cover (40,000 ha) in grass and shrub areas to mitigate soil erosion, • Mitigation of soil erosion through the development of village- and school-managed forest (1,400 ha) • Demonstration of agro-forestry and silvopastoral, • Awareness raising through demonstration of Lavaka protection measures, and • Awareness raising for forest fire protection and forest fire protection system improvement

Source: JICA Study Team

25. The implementation organization for the above-listed proposed projects is DRDR, MAEP. A coordination committee is established at the central level to be in charge of overall coordination so as to comprehensively and effectively implement Projects. The Committee is chaired by the director of National Project Coordination Office (NPCO) of MAEP and the members include the representative from the MINENVEF, Ministry of finance laotra Mangoro Region Office, FOFIFA, Donors, Consultants and NGOs. The director of NPCO is expected to take charge of coordination, monitoring and supervision of projects' implementation from the outset to O&M to their smooth implementation. Under MAEP, DRDR of Alaotra Mangoro Region is responsible for projects' operation at the local level. DRDR is required to have project management offices for each project to be newly established for the management of each project. Overall coordination, monitoring and supervision of the proposed projects are carried out by DRDR of Alaotra Mongoro Region. At the regional level, a coordination council is newly organized headed by the governor of Alaotra Mangoro Region with members from DRDR of Alaotra Mangoro Region, DREEF of Alaotra Mangoro Region, FOFIFA, Donors for each project, consultant and NGOs.

Action Plan

26. Master plan is formulated for 15 years from 2008 to 2023. An implementation schedule is

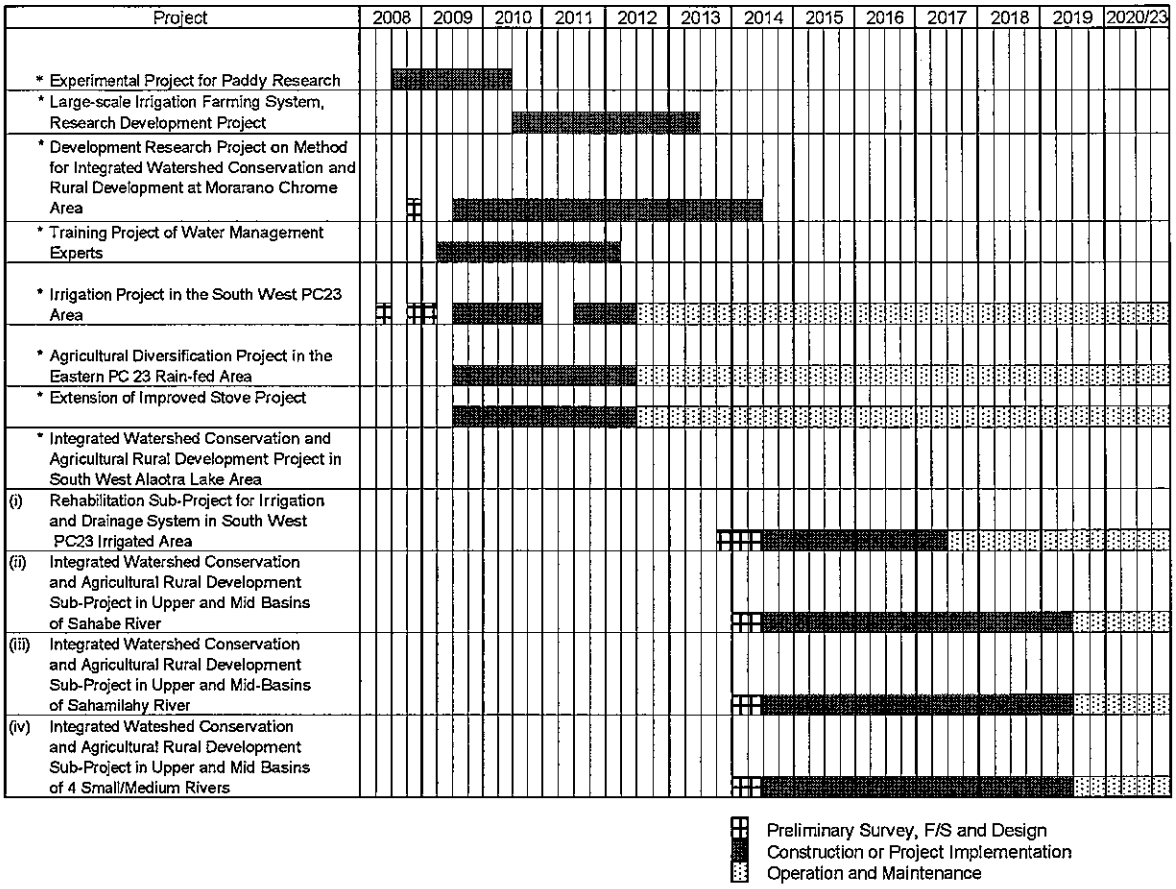
prepared by taking mutual correlation of the projects into consideration so as to raise their effectiveness. The general concept of the implementation schedule is described as follows: (i) First priority is given to the projects necessary for early implementation; (ii) Second priority is for technical assistance projects to support smooth implementation of proposed projects; (iii) Third priority is put on the projects with those technical validities already confirmed through the pilot projects, easy implementation, great need from the communities, low cost and quick-return; (iv) last priority is given to the projects with high cost which, for those implementation, necessitate lessons from (ii) and (iii).

Priority Ranking of the Project

Priority Ranking	Project	Remarks
1	Extension of Improved Stoves and Improvement of Rural Health and Sanitation	-
	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

27. Implementation schedule of eight proposed projects is illustrated as follows:



Implementation Schedule of Proposed Projects

Environmental Impact Assessment

28. Two proposed projects consisting of: (i) Irrigation Project in the South West PC23 Area and (ii) Integrated Watershed Conservation and Agricultural Rural Development Project in West Alaotra Lake Area are required to assess the environmental impact by the Project Owners, in accordance with cabinet order no. 99-954, Harmonization of Development and Environment issued under Article 10 of Law no. 90-33, Charter of the Environment. An environmental impact assessment report was prepared and examination by Madagascar Central Environmental Committee has been already carried out for the Irrigation Project in the South West PC23 Area, a summary of which is as follows: (i) Construction of intake weir and de-silting of canals and drains needs environmental impact assessment. In these works, it is necessary to minimize adverse impact by the disposal of de-silted soils; (ii) There are no adverse environmental impact expected from the operation of flood gate of intake weir; (iii) Since low-cost farming techniques are proposed, eutrophication and pollution in the downstream will not happen; (iv) Inflow of sand through the drain into Alaotra Lake are not expected; (v) 14 s of water user associations have been already established together with Tsarabola Federation of Water Users' Association. In addition, it is judged that other seven projects proposed in the Study will not have adverse impacts from a natural and social environmental point of view.

7. Recommendations

29. The following four points are the recommendations on the basis of the Study.

(i) Since the Study Area is facing serious deterioration of watershed as well as low agricultural productivity, it is recommended that the proposed projects be implemented in accordance with the schedule. In this case, budgetary arrangements including assistance from international donors is required, depending upon the type and scale of the Projects.

(ii) In order to maximize the effects of the proposed Projects, project supporting activities are recommended such as: (i) Technical Assistance for Agricultural Extension, (ii) Micro Credit, (iii) Training of Freshwater Fishery Experts and (iv) Seed Multiplication and Dissemination Project.

(iii) Collection of meteorological and hydrological data is also an important issue to smoothly and effectively implement the proposed projects. In addition, capacity development of such basic data collection is essential in the process of collection activities.

(iv) Coordination among organizations relevant to watershed management and agricultural production needs to be promoted so as to effectively carry out proposed projects.

THE STUDY ON RURAL DEVELOPMENT AND WATERSHED MANAGEMENT IN THE SOUTH-WEST REGION OF ALAOTRA OF THE REPUBLIC OF MADAGASCAR

FINAL REPORT

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Explanation note

Abbreviation

ADF	African Development Fund	African Development Fund
AFD	Agence Francaise de Développement	French Development Agency
AfDB	African Development Bank	African Development Bank
AUE	Association des Usagers de l'Eau	Water Users' Association
BNI-CA	Banque Nationale pour l'Institute - Credit Agricole	National Bank for the Farm Credit - Institute
BOA	Bank of Africa	Bank of Africa
BVPI	Bassins Versants et Périmètres Irrigués	Watershed and Command Areas
CAF	Centre d' Appui et Formation	Support and Training Centre
CALA	Complexe Agronomique du Lac Alaotra	Alaotra Lake Agronomic Complex
CECAM	Caisses d'Epargne et de Crédit Agricole Mutuelles	Agricultural Credit Union
CIRAD	Centre de Coopération Internationale en Rechereche Agronomique pour le Développement	International Cooperation Centre of Agricultural Research for Development
CIREEF	Circonscription de l'Environnment, des Eaux et Forets	Environment, Waters, and Forest Constituency
CMS	Centre Multiplicateur de Semences	Seed Multiplication Centre
CP	Crude Protein	Crude Protein
CRRME	Centre Regional de Recherche du Moyen Est	Mid-east Regional Research Centre
DAC	Development Assistance Committee	Development Assistance Committee
DIRDR	Direction Inter-Régionale Rural de l'Agriculture	Rural Interregional Division for Agriculture
DM	Dry Matter	Dry Matter
DRDR	Direction Régionale du Développement Rural	Regional Division for Rural Development
DREEF	Direction Régionale de l' Envirionment, des Eahx et Forêts	Environment, Waters, and Forest Regional Division
EIA	Environmental Impact Assessment	Environmental Impact Assessment
E/N	Exchange of Notes	Exchange of Notes
EU	European Union	European Union
FAO	Food and Agriculture Organization of the United Nations	Food and Agriculture Organization of the United Nations
FID	Fonds d'Intervention pour Développement	Intervention Fund for Development

FIFAMANOR	Centre de developpemente rural et de recherché appliqué issu d'un project de cooperation bilaterale entre la Norvège et Madagascar	Centre for Rural development and applied Research resulting from a bilateral cooperation project between Norway and Madagascar
FOFIFA	Foibem Momba ny Fiompiana ny Fambolena	Foibem Momba ny Fiompiana ny Fambolena
FS	Feasibility Study	Feasibility Study
GDP	Gross Domestic Product	Gross Domestic Product
GIS	Geographic Information System	Geographic Information System
GNI	Gross National Income	Gross National Income
GPI	Grands Périmètres Irrigués	Large-scale command areas
GTDR	Groupes de Travail de Developpement Rural Regional	Working groups for Rural Regional Development
HIPC	Heavily Indebted Poor Country	Heavily Indebted Poor Country
HIV	Human Immunodeficiency Virus	Human Immunodeficiency Virus
IDA	International Development Association	International Development Association
IEE	Initial Environmental Examination	Initial Environmental Examination
IFAD	International Fund for Agricultural Development	International Fund for Agricultural Development
IMF	International Monetary Fund	International Monetary Fund
JICA	Japan International Cooperation Agency	Japan International Cooperation Agency
JIRAMA	Jiro sy Rano Malagasy	Jiro sy Rano Malagasy
LDC	Least Developed Country	Least Developed Country
MAEP	Ministères de l'Agriculture, de l'Elevage et de la Pêche	Ministry of Agriculture, Livestock and Fisheries
MAP	Madagascar Action Plan	Madagascar Action Plan
MCA	Millennium Challenge Account	Millennium Challenge Account
MECIE	Décret n°99 954 relatif à la Mise en Compatibilité des Investissements avec l'Environnement	Order n°99 954 relating to the compliance of Investments with Environment
MINENVEF	Ministère de l'Environnement, des Eaux et Forêts	Environment, Waters, and Forest Constituency
MGA	Madagascar Ariary	Madagascar Ariary
MPI	Micro Périmètres Irrigués	Micro Command Areas
NGO	Non-governmental Organization	Non-governmental Organization

NPCO	National Project Coordination Office	National Project Coordination Office
OECD	Organization for Economic Co-operation and Development	Organization for Economic Co-operation and Development
OJT	On the Job Training	On the Job Training
OTIV	Ombona Tahiry Ifampisamborana Vola	Ombona Tahiry Ifampisamborana Vola
PADR	Plan d'Action pour le Développement Rural à Madagascar	Action Plan for Madagascar Rural Development
PC	Périmètre de colonisation	Colonization area
PCD	Plan Communal Développement	Commune Development Plan
PDM	Project Design Matrix	Project Design Matrix
PE	Programme Environnemental	Environmental Programme
PF	Périmètres Familiaux	Family farms
PPI	Petits Périmètres Irrigués	Small Command Areas
PRD	Plan Régional de Développement	Regional Development Plan
PREE	Programme d' Engagement Environnemental	Environmental Commitment Programme
PRSP	Poverty Reduction Strategic Paper	Poverty Reduction Strategic Paper
PSDR	Programme de Soutien au Développement Rural	Rural Development Support Programme
RFR	Réserve Foncière pour le Reboisement	Land Reserve for Reafforestation
RRI	Rapid Result Initiative	Rapid Result Initiative
SOMALAC	Société malgache d'aménagement du lac Alaotra	Malagasy Alaotra Lake Development Corporation
SRA	System of Improved Riziculture	System of Improved Riziculture
SRI	System of Rice Intensificaiton	System of Rice Intensificaiton
S/W	Scope of Work	Scope of Work
TAU	Tropical Annual Unit	Tropical Annual Unit
TDN	Total Digestive Nutrients	Total Digestive Nutrients
UNDP	United Nations Development Programme	United Nations Development Programme
UPDR	Unité de Politique de Développement Rural	Rural Development Policy Unit
USAID	United States Agency for International Development	United States Agency for International Development

Exchange Rate

US $1.00 = FMG 1,746 = JP¥ 110

As of December, 2007

CHAPTER 1 INTRODUCTION

1.1 History of the Study

The Government of the Republic of Madagascar (GOM) made a request to donors to support stabilization of agricultural production and the rural community in the surrounding area of Lake Alaotra. The GOM made a request to Japan for the undertaking of a comprehensive rural development study in the surrounding area of Lake Alaotra from the Ministry of Agriculture, Livestock and Fisheries (MAEP) and another study on the recovery of the devastated areas of Lake Alaotra watersheds from the Ministry of Water and Forestry after making a continuous request for three years for the rehabilitation of the PC23 irrigation system.

In response to these requests, the Government of Japan carried out a project formation study in October 2000 aimed at confirming the possibility of technical cooperation in the forestry, rural development and environmental sectors. The result of this study was the formulation of an environmental conservation and rural development plan to integrate upstream hilly areas and downstream rural areas, both of which are complementary to each other. Following such a recommendation, the GOM combined these two requests into one and submitted its request for a development study on "Rural Development and Watershed Management in the Southwestern Area of Lake Alaotra" to the GOJ. Upon this request, the Scope of Work (S/W) and minutes of discussions were signed and exchanged between the preliminary study team of Japan International Cooperation Agency (JICA) and the Ministry of Environment, Water and Forestry (MINENVEF) as the counterpart agency of GOM on January 23, 2002.

1.2 Objectives of the Study

The objectives of the Study are as follows;

a. To formulate a rural development and watershed management plan for the southwestern area of Lake Alaotra to ensure sustainable environment conservation and livelihood activities, to carry out pilot projects in the study area for the purpose of verifying the draft plan formulated, to improve the concreteness of the plan; and

b. To undertake the transfer and guidance of technology to counterpart agencies and rural inhabitants about the process from project planning to implementation stages throughout implementation of the Study.

1.3 Study Area

The Study Area is located in the Alaotra-Mangolo Region and its total coverage is around 158,300 ha comprising PC23 area of 17,600 ha, the Sahamilahy river watershed of 20,600 ha, the Sahabe river watershed of 97,700 ha and four medium and small rivers watersheds of

22,400 ha. These watersheds are functioning as water sources for the PC23 irrigation area.

1.4 Basic Concept of Study Implementation

Aiming at the realization of poverty alleviation and livelihood improvements via the raising of agricultural productivity in the Study area, it is indispensable to increase paddy production by steadily supplying irrigation water to not only the PC23 irrigation area but also small scale paddy fields on valley bottoms among upstream hills. To maintain the Study Area as a granary in the future by attaining this target, it is also inevitable to make river flow less fluctuated and stabilize intake water discharge for irrigation purposes via strengthening water resource fostering and soil conservation capabilities of devastated hills by means of vegetation recovery. In this context, the basic concept of survey implementation is set on the formulation of a comprehensive plan integrating watershed management in the upstream part and rural development in the mid-reach and downstream parts of the Study Area.

1.5 Progress of the Study

The Study was undertaken by the JICA Study Team for 53 months from August 20, 2003 to January 31, 2008. The work period was composed of the following three stages:

a. First stage: Major work items of the preparatory work in Japan, the first and second field works in Madagascar and the first home work in Japan carried out between August 20, 2003 and July 10, 2004 were: 1) preparation, briefing and discussion of the Inception Report; 2) investigation and analysis of the current conditions of natural, socio-economic, and agricultural, forestry, animal husbandry and inland fishery sectors, and 3) village profile survey on the 39 villages in the Study Area. Based on the progress of the Study during this period, Progress Reports (1) to (3) were prepared, and then an Interim Report was made, compiling the investigation and analysis results, basic ideas on rural development and watershed management as well as an execution plan for 12 pilot projects aimed at the verification of efficiency on the basic ideas;

b. Second stage: Major work items of the third to fifth field works in Madagascar and the second home work in Japan conducted for the period of September 11, 2004 to March 27, 2007 were: 1) commencement of five rural development pilot projects and seven watershed management pilot projects based on a mutual agreement among both sides through explanation and discussion of the Interim Report; 2) implementation of the 12 pilot projects by four groups of local non-government organizations (NGO), consultant and government research center under the supervision of JICA Study Team; 3) terminal evaluation on performance of the 12 pilot projects including verification of the basic ideas; 4) supplemental data collection concerning development policies of the MOG and progress of development activities in and around the Study Area; 5) preparation of Progress Reports (4) to (8) followed by

presentation and discussion with the Madagascan side; and .

c. Third stage: Major work items of the third home work in Japan, the fifth field work in Madagascar and the fourth home work in Japan undertaken from July 24, 2007 to January 31, 2008 were: 1) preparation of a Draft Final Report presenting the draft rural development and watershed management plan in the southwestern area of Lake Alaotra; 2) explanation of and discussion about the Draft Final Report with the Madagascan side; 3) execution of seminar for technical transfer to counterparts and stakeholders of the Madagascar side; and 4) preparation of a Final Report in consideration of the comments and suggestions of the Madagascar side.

1.6 Organization for Study Implementation

The counterpart agencies for the Study are MINENVEF and MAEP. In the Study Area, a counterpart team was organized for participation in and support of field activities of the Study in September 2003, which was formed from staff belonging to the Alaotra-Mangoro Environment, Water and Forestry Regional Office (DREEF) under MINENVEF, and the Alaotra-Mangoro Rural Development Regional Office (DRDR) under MAEP.

In performing the Study, a Steering Committee was set up in September 2003 in order to carry out field activities smoothly and exchange opinions actively between the Madagascan side and the Study Team. Members of the Steering Committee are as shown below.

a. Madagascar side: MINENVEF, MAEP, Ministry of Health and Family Planning, Ministry of Interior, Ministry of Defense, Office of Alaotra-Mangoro Regional Chief, and DREEF and DRDR of Alaotra-Mangoro; and

b. Japanese side: JICA Madagascar Office with JICA experts, Embassy of Japan and JICA Study Team.