Appendices

Appendix-1 Member List of the Study Team

1-1 Study Team of Basic Design Study

Name	Responsibility	Position
1. Mr. Kyojin MIMA	Leader	Group Director, Project Management Group III, Grant Aid Management Department, Japan International Cooperation Agency (JICA)
2. Mr. Kazumitsu TSUMURA	Chief Consultant /Irrigation Facility Planning	Manager, Project Operation Division, International Department, Sanyu Consultants Inc. (SCI)
3. Mr. Fumihiko KOMADA	Farming /Water Management /Operation and Management Planning	Technical Advisor, Project Operation Division, International Department, SCI
4. Mr. Masanori MARUKAWA	Cost Estimation /Procurement /Construction Planning	Technical Advisor, Project Operation Division, International Department, SCI
5. Mr. Yusuke MARUNO	Coordinator /Strengthening Water Users Association (WUA)	Project Operation Division, International Department, SCI

1-2 Study Team for Explanation of Draft Basic Design Report

Name	Responsibility	Position
1. Mr. Tetsuya KAMIJO	Leader	Resident Representative of JICA Timor-Leste Office
2. Mr. Takeyuki OYA	Project Coordination	Rural Development Team, Project Management Group III, Grant Aid Management Department, JICA
3. Mr. Kazumitsu TSUMURA	Chief Consultant /Irrigation Facility Planning	Manager, Project Operation Division, International Department, Sanyu Consultants Inc.

1-3 Study Team for Implementation Review Study

Name	Responsibility	Position
1. Mr. Teruyuki INOUE	Leader	Resident Representative of JICA Timor-Leste Office
2. Mr. Kazumitsu TSUMURA	Chief Consultant /Irrigation Facility Planning	General Manager, Project Operation Division No.2, International Department, Sanyu Consultants Inc. (SCI)
3. Mr. Yasusi FUKUDA	Cost Estimation /Procurement /Construction Planning	Project Operation Division No.2, International Department, Sanyu Consultants Inc. (SCI)

Appendix-2 Study Schedule

2-1 Basic Design Study

Date	day	Kyojin Mima: Leader（JICA）		Kazumitsu Tsumura: Chief Consultant /Irrigation Facility Planning	Fumihiko Komada: Farming /Water Management, O/M Planning	Yusuke Maruno: Coordinator /Strengthening WUA		Masanori Narukawa: Cost estimation /Procurement /Construction planning
1-Mar	Tue		1.	Departure at Narita(16:00)(JL729) →Arrive at Denpasaal(22:25)	Departure at Kanku(14:40)(JL713)→Arive at Denpasaal(20:35)	Departure at Narita(JL729)→ Arrive at Denpasaal		
2-Mar	Wed		2.	Departure at Denpasaal (09:10)(MZ848)→Arrive at Dili (12:00) JICA Office in Timor Leste, courtesy call to Embassyof Japan				
3-Mar	Thu		3.	Visit to Irrigation Water Management Division (IWMD) for preliminary explanation of Ic/Report etc.		Preparation of entrust cotract surveys, staff arrangement for workshop, baseline survey		
4-Mar	Fri		4.	Confirmation of background and project purpose, preparation of site survey	O/M survey, preparation of staff arrangement for workshop, baseline survey	Preparation of entrust cotract surveys, staff arrangement for workshop, baseline survey		
5-Mar	Sat		5.	Confirmation on contents of request, Trend of other donors, Preparation of entrust cotract surveys	Survey for O/M preparation of staff arrangement for workshop, baseline survey	Preparation of entrust cotract surveys, staff arrangement for workshop, baseline survey		
6-Mar	Sun		6.	Analysis of collected data			1.	Departure at Narita(16:00)(JL729)→Arrive at Denpasaal(22:25)
7-Mar	Mon		7.	Tender for entrust contract surveys, Preparation for workshop, baseline survey			2.	Departure at Denpasaal(MZ848) →arrive at Dili
8-Mar	Tue		8.	Identification on content of request, Trend of other donors, Signing of entrust contract survey	Survey for farming plan, Preperation for Baseline survey	Preparation of baseline survey, Presence of signing of entrust contract survey	3.	Data and information collection on estimation and procurement
9-Mar	Wed	1. Departure at Narita(JL729)→Arrive at Denpasaal	9.	Identification on content of request, Trend of other donors,	Move（from Dili to Maliana） Reconnaissance survey at Maliana I		4.	Move（from Dili to Maliana） Reconnaissance survey at site
10-Mar	Thu	2. Departure at Denpasaal(MZ848)→ Arrive at Dili, Meeting with JICA Expert Mr. Tanabe, coutesy call to Embassy of Japan (Ambassador)	10.	Meeting with JICA Expert Mr. Tanabe, coutesy call to Embassy of Japan (Ambassador)	Reconnaissance survey at Maliana I	Baseline survey at Maliana I	5.	Reconnaissance survey at site
11-Mar	Fri	3. Courtesy call to MAFF(Vice Minister) explanation and discussion on Ic/Report at IWMD, courtesy call to Ministry of Finace	11.	Courtesy call to MAFF(Vice Minister) explanation and discussion on Ic/Report at IWMD, courtesy call to Ministry of Finace	Reconnaissance survey at Maliana I	Baseline survey at Maliana I	6.	Survey for Construction planning
12-Mar	Sat	4. Move（from Dili to Maliana） Reconnaissance survey at Maliana I	12.	Move（from Dili to Maliana） Reconnaissance survey at Maliana I	Reconnaissance survey at Maliana I	Baseline survey at Maliana I	7.	Survey for Construction planning
13-Mar	Sun	5. Internal Meeting Move（from Maliana to Dili）	13.	Internal Meeting Move（from Maliana to Dili）		Internal Meeting	8.	Internal Meeting Move（from Maliana to Dili）
14-Mar	Mon	6. Discussion on Minutes	14.	Discussion on Minutes		Baseline survey at Maliana I	9.	Discussion on Minutes
15-Mar	Tue	7. Signing on Minutes（MAFF Vice Minister), Report to JICA office and Embassy of Japan	15.	Signing on Minutes（MAFF Vice Minister), Report to JICA office and Embassy of Japan		Baseline survey at Maliana I	10.	Signing on minutes（MAFF Vice Minister), Report to JICA office and Embassy of Japan
16-Mar	Wed	8. Departure at Dili (12:45)(MZ849)→ Arrival at Denpasaal(13:40), Leaving Denpasaal（23:55） （JL720）	16.	Move（from Dili to Maliana） Reconnaissance survey at Maliana I		Preparation for workshop	11.	Move（from Dili to Maliana） Reconnaissance survey at Maliana I
17-Mar	Thu	9. →Arrival at Narita（07:35）	17.	Holding workshop			12.	Holding workshop
18-Mar	Fri		18.	Survey for irrigation facility	Survey for farming plan	Baseline survey at Maliana I	13.	Identification on land acquisition and temporary construction site
19-Mar	Sat		19.	Survey for irrigation facility	Survey for farming plan	Baseline survey at Maliana I	14.	Identification on land acquisition and temporary construction site
20-Mar	Sun		20.	Analysis of collected data and documentation			15.	Move （from Maliana to Dili）
21-Mar	Mon		21.	Environmental Impat Assessment study etc., Facility plan survey	Survey on farming plan, water management, strengthening WUA	Survey on strengthening WUA	16.	Survey for Cost estimation and procurement
22-Mar	Tue		22.	Environmental Impat Assessment study etc, Facility plan survey	O/M and maintenance plan survey	Survey on strengthening WUA	17.	Survey for Cost estimation and procurement
23-Mar	Wed		23.	Survey on irrigation facility plan	Move（from Maliana to Dili） Drafting of site survey report	Survey on strengthening WUA	18.	Survey for Cost estimation and procurement
24-Mar	Thu		24.	Move（from Maliana to Dili） Preparation of site survey report	Survey for O/M plan	Shift（from Maliana to Dili） Preparation of site survey report	19.	Survey for Cost estimation and procurement
25-Mar	Fri		25.	Preparation of report on the result of site survey			20.	Preparation of report on the result of site survey
26-Mar	Sat		26.	Preparation of report on the result of site survey			21.	Preparation of report on the result of site survey
27-Mar	Sun		27.	Preparation of report on the result of site survey			22.	Preparation of report on the result of site survey
28-Mar	Mon		28.	Discussion with IWMD, report to JICA office, Embassy of Japan and related agencies			23.	Discussion with IWMD, report to JICA office, EOJ and related agencies, departure at Dili (MZ849)→arrival at Denpasaal, departure at Denpasaal
29-Mar	Tue		29.	Departure at Dili (12:45)(MZ849)→Arrival at Denpasaal(13:40), Departure at Denpasaal （23:55） （JL720）			24.	→Arrival at Narita
30-Mar	Wed		30.	→Arrival at Narita（07:35）				

2-2 At Explanation on Draft B/D Report

Date	day	Tetsuya Kamijo: Leader, Resident Representative of JICA Timor-Leste Office	Takeyuki Oya: Project Coordination（JICA)	Kazumitsu Tsumura: Chief Consultant /Irrigation Facility Plannning
8-Jan	Sun		1. Departure at Narita(15:55)(JL729) →Arrival at Denpasaal(22:25)	1. Departure at Narita(15:55)(JL729) →Arrival at Denpasaal(22:25)
9-Jan	Mon	1. Meeting at JICA office, courtesy call to Embassy of Japan	2. Departure at Denpasaal (09:10)(MZ8480)→ Arrival at Dili(12:00), Meeting at JICA office, courtesy call to Embassy of Japan in Timor Leste	2. Departure at Denpasaal (09:10)(MZ8480)→ Arrival at Dili(12:00), Meeting at JICA office, courtesy call to Embassy of Japan in Timor Leste
10-Jan	Tue	2. Meeting director of IWMD, Move（Dili→Maliana） Site survey, Move(Maliana→Dili)	3. Meeting director of IWMD, Move（Dili→Maliana） Site survey, Move(Maliana→Dili)	3. Meeting director of IWMD, Move（Dili→Maliana） Site survey, Move(Maliana→Dili)
11-Jan	Wed	3. Meeting director of Irrigation and Water Management Division (IWMD) for explanation and discussion of DBD and Minutes etc., Meeting SSECTOPD regarding on Environmental procedure	4. Meeting director of Irrigation and Water Management Division (IWMD) for explanation and discussion of DBD and minutes etc., Meeting SSECTOPD regarding on Environmental procedure	4. Meeting director of Irrigation and Water Management Division (IWMD) for explanation and discussion of DBD and minutes etc., Meeting SSECTOPD regarding on Environmental procedure
12-Jan	Thu	4. Coutesy call to Ministry of Finance Planning to explain minutes,courtesy call to MAFF (Minister and experts), explanation of Minutes	5. Coutesy call to Ministry of Finance Planning to explain minutes,courtesy call to MAFF (Minister and experts), explanation of Minutes	5. Coutesy call to Ministry of Finance Planning to explain minutes,courtesy call to MAFF (Minister and experts), explanation of minutes
13-Jan	Fri	5. Discussion on the minutes and signing, Report to JICA office and to Embassy of Japan in Timor-Leste	6. Discussion on the minutes and signing, Report to JICA office and to Embassy of Japan in Timor-Leste	6. Discussion on the Minutes and signing, Report to JICA office and to Embassy of Japan in Timor-Leste, Move (Dili to Maliana)
14-Jan	Sat		7. Departure atDili(12:45)(MZ8490)→arrival at Denpasaal(13:40), departure at Denpasaal （23:25） (JL726)	7. Holding workshop Move （Maliana→Dili）
15-Jan	Sun		8. →Arrival at Narita（07:05）	8. Depaerture at Dili(12:45)(MZ8490)→Arrival at Denpasaal(13:40), departure at Denpasaal （23:25） (JL726)
16-Jan	月			9. →Arrival at Narita（07:05）

2-3 At Implementation Review Study

Date	day	Teruyuki INOUE: Leader (JICA)	Kazumitsu TSUMURA: Cheief consultant /Facility planning	Yasushi FUKUDA: Construction planning /Cost estimation
Feb. 18	S		1. Tokyo→Denpasaal (JL729, 15:55/22:25)	
Feb. 19	M		2. Denpasaal→Dili (MZ8480, 10:05/12:55) JICA Timor-Leste Office, C/C to IWMD	1. Tokyo→Jakarta (JL725, 11:20/17:20)
Feb. 20	T		3. Meeting at IWMD, (Schedule, O/M, Workshop, Project component, etc.) SSECTOPD (EMP procedure), Local NGO	2. Survey and data collection on gate cost estimate
Feb. 21	W		4. Meeting at IWMD (Schedule, O/M, Workshop, Project component, etc.)	3. Meeting at Gate makers
Feb. 22	T		5. Meeting at IWMD (O/M, Workshop, Minutes, etc.) World Vision NGO	4. Survey and data collection on gate cost estimate Jakarta→Denpasaal
Feb. 23	F		6. Meeting at Manatuto Team Manatuto site survey Local NGO	5. Denpasaal→Dili (MZ8480, 10:05/12:55)
Feb. 24	S		7. Dili→Maliana, Site Survey Meeting at DIO (Workshop, etc.)	6. Dili→Maliana, Site Survey Survey on construction planning
Feb. 25	S	1. Tokyo→Denpasaal (JL729, 15:55/22:25)	8. Site Survey, Meeting at DIO (Workshop, etc.), Maliana→Dili	7. Site Survey, Survey on construction planning, Maliana→Dili
Feb. 26	M	2. Denpassal→Dili(MZ8480, 10:05/12:55) JICA Timor-Leste Office C/C to Embassy of Japan SSECTOPD (EMP approved), C/C to IWMD	9. Meeting at NGO (Workshop) JICA Timor-Leste Office C/C to Embassy of Japan SSECTOPD (EMP approved), C/C to IWMD	8. Survey on cost estimation
Feb. 27	T	3. Disucssion of Minutes at IWMD C/C to MAFF	10. Disucssion of Minutes at IWMD C/C to MAFF	9. Disucssion of Minutes at IWMD C/C to MAFF, Survey and data collection on cost estimate
Feb. 28	W	4. Disucssion of Minutes at MFP	11. Disucssion of Minutes at MFP	10. Survey and data collection on cost estimate
Mar. 01	T	5. Dili→Maliana, Site Survey Meeting at DIO, Maliana→Dili	12. Dili→Maliana, Site Survey Meeting at DIO, Maliana→Dili	11. Dili→Maliana, Site Survey Meeting at DIO, Maliana→Dili
Mar. 02	F	6. Report to JICA Office Embassy of Japan Signing of Minutes at MAFF and MFP	13. Report to JICA Office Embassy of Japan (AM10:00) Signing of Minutes at MAFF and MFP Meeting at CRS (NGO)	12. Report to JICA Office, Embassy of Japan Signing of Minutes at MAFF and MFP Survey on cost estimate
Mar. 03	S	7. Dili→Denpasaal (MZ8490, 13:25/14:20) Denpasaal→Tokyo (JL720, 23:55→)	14. Dili→Denpasaal (MZ8490, 13:25/14:20) Denpasaal→Tokyo (JL720, 23:55→)	13. Dili→Denpasaal (MZ8490, 13:25/14:20) Denpasaal→Tokyo (JL720, 23:55→)
Mar. 04	S	8. →Arrive Tokyo (07:50)	15. →Arrive Tokyo (07:50)	14. →Arrive Tokyo (07:50)

MAFF: Ministry of Agriculture, Forestry and Fisherie
IWMD: Irrigation and Water Management Divisio
MPF: Ministry of Planning and Financ
SSECTOPD: Secretary of State for Environmental Coordination, Territorial Ordering and Phisical Developme
CC: Courtecy call
O/M: Operation and Maintenance
DIO: Bobonaro District Irrigation Offic

Appendix-3 List of Parties Concerned in Timor-Leste

3.1 At Basic Design Study

No.	Name	Position
Ministry of Agriculture, Forestry and Fisheries (MAFF)		
1.	Mr. Francisco de Sa Benevides	Vice-Minister
2.	Mr. Cesar Jose da Cruz	Secretario Permanente（General director）
3.	Mr. Ir. Deolindo da Silva	Director of Agriculture and Livestock
4.	Mr. Sinobu Sakai	Expert (Irrigation and WUA advisor)
5.	Mr. Adrelfredo	District Irrigation Officer of Region III
6.	Mr. Arcanjo da Silva	Agriculture Policy Planning
Ministry of Planning and Finance		
1.	Ms.AichaBassarewan	Vice-Minister
2.	Mr. Eusebio Jeronimo	Director of Planning and External Assistance Management Division
3.	Mr. Takashi Watanabe	Advisor, National Directorate for Planning and External Assistance Coordination Division
Irrigation and Water Management Division(IWMD)		
1.	Mr. Florindo Barreto	Director of Irrigation and Water Management Division
2.	Mr. Martinho L. Soares	Head of Irrigation Planning
3.	Mr. Agostinho S. Guterres	Sector Beans and Root Crop, Crop Production, RDTL
4.	Mr. Pedro Vital	District Irrigation Officer, Manatuto
5.	Mr. James Oliver Oduic	Irrigation Adviser
6.	Mr. Tatsumi Tanabe	Advisor for Irrigation and Water User Association
7.	Ms. Joki Van Brick	Water User's Association Advisor
Secretary of State for Environment Coordination, Territorial Ordering and Physical Development （SSECTOPD）		
1.	Mr. Carlos Ximenes	Director of National Directorate Environment
2.	Mr. Vasco Leitao	Advisor of EIA and Pollution Control
Bobonaro Office of MAFF		
1.	Mr. Eugenio Borges	District Agriculture Coordinator (DAC), Bobonaro
2.	Mr. Alfredo Soares	District Irrigation Officer (DIO), Bobonaro
3.	Mr. Celestino Henrigue	District Irrigation Officer (DIO), Bobonaro
4.	Mr. Rui Manuel Lasi	Local Consultant for WUA Bobonaro
5.	Mr. Carlos Soares Araujo	Guard Forestry
6.	Mr. Guilherme Da Costa	District Livestock Officer

Bobonaro District Administration Office		
1.	Mr. Leonel de Jesus Carvalho	District Administrator (DA), Bobonaro
2.	Mr. Arcanjo R. Tilman	District Development Officer (DDO), Bobonaro
3.	Mr. Semedu Lacu Costa	In charge of Infrastructure
Maliana Sub-District Administration Office		
1.	Mr. Domingos Martins	Administrator Sub-District Maliana
2.	Mr. Alcino Pires	Government Local Officer
3.	Mr. Aligio Moniz	Community Development Officer (CDO)
Bobonaro District Hygiene Service Office		
1.	Mr. Guilhormino da Cruz	Manager, Water and Sanitation Services
2.	Mr. Alcino Pires	Government Local Officer
NGO, World Vision		
1.	Mr. Chris Walsh	Food Security Officer
2.	Mr. Ceasar Bautista	Operation Manager
3.	Mr. Venacio Ximenes	Agriculture Coordinator
4.	Mr. Nuno Tolentio	Fish Program Coordinator
5.	Mr. Fernando Cardoso	ANCP (Australian NGO Corporation program) Supervisor
6.	Mr. Helder Dos Santos	ADP (Area Development Program)
7.	Mr. Olga Sacdanha	ANCP Staff
8.	Mr. Dos Santos	Maliana Office
Embassy of Japan in Timor-Leste		
1.	Mr. Hideaki Asahi	Ambassador
2.	Mr. Akinori Wada	Councilor （at the Basic Design Study）
3.	Mr. Akira Koizumi	Councilor （at the explanation of the DBD）
4.	Mr. Kanako Nozawa	Second Secretary
JICA Timor-Leste Office		
1.	Mr. Toshiaki Tanaka	Resident representative（at the Basic Design Study）
2.	Mr. Tetsuya Kamijo	Resident representative（at the explanation of the DBD）
3.	Mr. Masayoshi Kimura	Staff (in charge of agricultural development)
4.	Ms. Yuki Kuraoka	Staff
5.	Mr. Jong Robin	Program Officer
Irrigation and Rice Cultivation Project in Manatuto（IRCP）		
1.	Mr. Michihiko Sakaki	Chief advisor
2.	Mr. Naoto Watanabe	Expert

3.2 At Implementation Review Study

No.	Name	Position
Ministry of Planning and Finance		
1.	Ms. Aicha Bassarewan	Vice-Minister
2.	Mr. Eusebio Jeronimo	Director of National Directorate for Planning and External Assistance Coordination
3.	Mr. Arlindo Monteiro	Program Officer for Bilateral Aid
4.	Ms. Miki Morimitsu	Advisor, National Directorate for Planning and External Assistance Coordination
Ministry of Agriculture, Forestry and Fisheries (MAFF)		
1.	Mr. Francisco de Sa Benevides	Vice-Minister
2.	Ms. Maria Odete do Ceu Guterres	Secretary
3.	Mr. Ir. Deolindo da Silva	Director of Agriculture and Livestock Department
Irrigation and Water Management Division (IWMD)		
1.	Mr. Florindo Barreto	Director of Irrigation and Water Management Division
2.	Mr. Martinho L. Soares	Head of Engineering Section
3.	Mr. James Oliver Oduic	Irrigation Adviser
MAFF Agricultural Office Region III		
1.	Mr. Alfredo Soares	District Irrigation Officer (DIO), Bobonaro
Maliana I Water Users' Association（WUA）		
1.	Mr. Manuel Simao Barreto	WUA President
Secretary of State for Environment Coordination, Territorial Ordering and Physical Development （SSECTOPD）		
1.	Mr. Carlos Ximenes	Director, National Directrate of Environmental Services
2.	Mr. Antonio Lelo Taci	EIA Coordinator, National Directrate of Environmental Services
Embassy of Japan in Timor-Leste		
1.	Mr. Kenji Shimizu	Ambassador
2.	Ms. Kanako Nozawa	Second Secretary
JICA Timor-Leste Office		
1.	Mr. Tetsuya Kamijo	Resident Representative
2.	Mr. Yoshikazu Wada	Assistant Resident Representative
3.	Mr. Jong Robin	Program Officer
4.	Mr. Isidra JGA Tilman	Security consultant
Irrigation and Rice Cultivation Project in Manatuto （IRCP）		
1.	Mr. Hikaru Niki	Chief Advisor
2.	Mr. Kiyomi Endo	Farmer's Organization
Local NGO		
1.	Ms. Marsaulina Pasaribu	Program Effectiveness Section, World Vision (WV) Timor Leste
2.	Mr. Afonso De Oliveira	Agriculture Program Manager Catholic Relief Services (CRS) East Timor Program
3.	Mr. Pedro L. da Silva	Freelance Consultant
4.	Mr. Jose Jaquelino	HASATIL (Agricultural sustainability), Local NGO
Local Contractor (Jakarta)		
1.	Mr. Mirwadi	PT. Bambu Jenar Prima
Local Contractor (Timor-leste)		
1.	Mr. Richard Sippel	Chief Representive, JJ McDonald & Sons Group
2.	Mr. Lope Evangelista	Material / Laboratory Technician, JJ McDonald & Sons Group
3.	Mr. Damien K Som	Somedina Construction and Services Pty.Ltd
4.	Mr. Syed Abbas Murtaza	Managing Director, Geotechnik Pty.Ltd.
5.	Mr. Antonio Magno	Sales Executive, SDV Logistics
UN Police		
1.	Mr. Romeo de Gurman	UN Police Bobonaro district

Appendix-4 Minutes of Discussions

MINUTES OF DISCUSSION
ON
THE BASIC DESIGN STUDY
ON
THE PROJECT FOR REHABILITATION AND IMPROVEMENT
OF
MALIANA I IRRIGATION SYSTEM
IN
THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

Based on the requests by the Government of the Democratic Republic of Timor-Leste (hereinafter referred to as "Timor-Leste"), the Government of Japan decided to conduct a Basic Design Study on the Project for Rehabilitation and Improvement of Maliana I Irrigation System (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA")

JICA sent to Timor-Leste the Basic Design Study Team (hereinafter referred to as "the Team"), which is headed by Mr. Kyojin MIMA, Group Director of Project Management Group II, Grant Aid Management Department, JICA and is scheduled to stay in the country from March 2 to March 29, 2005.

The Team held a series of discussion with the officials concerned of the Government of Timor-Leste and conducted a field survey at the study area. In the course of discussion and field survey, both sides confirmed the main items as described on the attached sheets. The Team will proceed to further works and report the findings to the Government of Japan.

Dili, March 15, 2005

Mr. Kyojin MIMA
Leader
Basic Design Study Team
Japan International Cooperation agency

Mr. Francisco de Sá Benevides
Vice-Minister
Ministry of Agriculture, Forestry and Fisheries
Democratic Republic of Timor-Leste

Witness

Ms. Aicha Bassarewan
Vice-Minister
Ministry of Planning and Finance
Democratic Republic of Timor-Leste

ATTACHMENT

1. Objective

The objective of the Project is to distribute stable irrigation water to the Maliana I Irrigation area through rehabilitating Maliana I intake weir and irrigation canals and constructing related facilities.

2. Project Site

The Project site is located about 150 km western from Dili in Maliana sub-district of Bobonaro district as shown in Annex-1.

3. Responsible and Implementation Agency

Irrigation and Water Management Division (hereinafter referred to as "IWMD") of Agriculture and Livestock Department (hereinafter referred to as "ALD") of Ministry of Agriculture, Forestry and Fisheries (hereinafter referred to as "MAFF") is responsible for the administration and implementation of the Project. The organization charts of MAFF and IWMD are shown in Annex-2 and Annex-3 respectively

4. Components requested by Timor-Leste side

After discussion with the Team, Timor-Leste side explained the revised requested components (including technical supports) described in Annex-4. Main items of the Japan's Grant Aid requested by Timor-Leste side were confirmed as follows. JICA will assess the appropriateness of the request and will report the finding to the Government of Japan. The final components of the Project will be decided after the Basic Design Study (hereinafter referred to as "the Study").

(1) Rehabilitation

1) Raising the existing weir crest by appropriate height and attaching sand sluiceway, if necessary,

2) Grouting of the foundation of the existing weir,

3) Raising of the abutments training walls upstream of the crest with reinforced concrete,

4) Repairs on the concrete of the existing intake and sedimentation basin,

5) De-silting of the existing canals,

6) Repair canal lining and structure,

7) Rehabilitation of retaining walls for aqueduct bridge.

(2) New construction

1) Installation of new gates for intake, sluice outlet of sediment basin and canal intake,

2) Installation of steel slide gates at the division structure of Maliana I main canal and other offtake structures,

3) Construction and extension of the Ramaskora secondary canal,

4) Extension of the Ritabou secondary canal,

5) Construction of meeting place for the Water Users' Association (WUA),

6) Construction of the water guards house,

7) Construction of a storage shed,

8) Construction of a drying floor.

(3) Others

Strengthening of the WUA.

5. Japan's Grant Aid System

(1) The government of Timor-Leste has understood the system of Japan's Grant Aid explained by the Team as described in Annex-5.

(2) The Timor-Leste side will take necessary measures described in Annex-6 for smooth implementation of the Project on condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

(1) The Team will proceed to further studies in Timor-Leste until March 29, 2005.

(2) JICA will prepare a draft report in English and dispatch a mission in order to explain its contents around June 2005. The draft report will be sent to the Timor-Leste side one(1) week before the mission is dispatched.

(3) In the case that the contents of the report are accepted in principle by the Timor-Leste side, JICA will complete the final report and send it to Timor-Leste by the end of August 2005.

7. Other Relevant Issues

(1) Both sides confirmed the title of the Project such as "the Project for Rehabilitation and Improvement of Maliana I Irrigation System" instead of "the Project for Maliana I Irrigation Rehabilitation".

(2) Both sides confirmed the Project was identified for one of the priority projects described as *"Improve cropping efficiency under irrigation"* in the "Table 1: Priority Ranking of Proposed New Programs for the Agricultural and Livestock Sector" of the clause, namely; Program Priorities and Intersectoral Linkages of the Chapter IV "KEY PROGRAMS FOR THE MEDIEM TERM" of Part A of "AGRICULTURE, FORESTRY AND FISHERIES PRIORITIES AND PROPOSED SECTOR INVESTMENT PROGRAM" issued in 2005.

(3) The Team explained the importance of security for the persons concerned with the Project in order to implement the Basic Design Study and the Project. The Timor-Leste side understood that and expressed to take necessary measures for the subsequent studies.

(4) The Timor-Leste side requested to involve additional area with about 150 ha for target irrigation area under the Project, located at downstream of Ritabaou secondary canal with length of about 1.7 km by extending the said secondary canal and also Ramaskora irrigation canal with length of about 1.6 km.

The Team expressed that the target irrigation area should be decided by analyzing relevant data and information through the Study, such as availability of water source in the Bulobo river and present cropping pattern, and by examining the alternatives of height and material of raising Maliana I intake weir with attaching sand sluice gate and so on.

And the Timor-Leste side understood the above situations.

(5) Both sides confirmed benefits under the Project as follows;

- To distribute stable irrigation water to the Maliana I Irrigation area in rainy season,
- To extend the Maliana I Irrigation area in dry season.

And both sides identified the tentative irrigation areas and target beneficiaries as follows;

Name of Village	Irrigation Area (ha)	Number of Household (HH)
1) Lahomea	35	18
2) Raifun	230	115
3) Ritabou	290	145
4) Odomau	325	162
5) Holsa	20	10
Total	**900**	**450**

Remarks: Numbers of HH are estimated by average land landholding of 2 ha/HH.

Both sides, furthermore, agreed that actual benefits and target beneficiaries in rainy season and dry season respectively would be examined by the Study in consideration with the above Clause (4).

(6) MAFF agreed to confirm present status on activation of the Environmental laws in Timor-Leste and necessary procedure of conducting the Environmental Impact Assessment (EIA), and also to have responsibility to conduct EIA by December 2005, if necessary.

(7) Both sides confirmed the necessary lands for acquisition for expanding width of main canal and extending secondary canals and so on in the Project area, would be identified by the end of the Study. And the Timor-Leste side agreed to hand basic agreement of land acquisition with beneficiaries to the Team by the end of May 2005.

(8) The Team emphasized that the importance of constructing tertiary canals and field canals to assure more effective use of irrigation water under the Project which were not included in the components of the request by the Timor-Leste side. The Timor-Leste side agreed to undertake to construct the said canals.

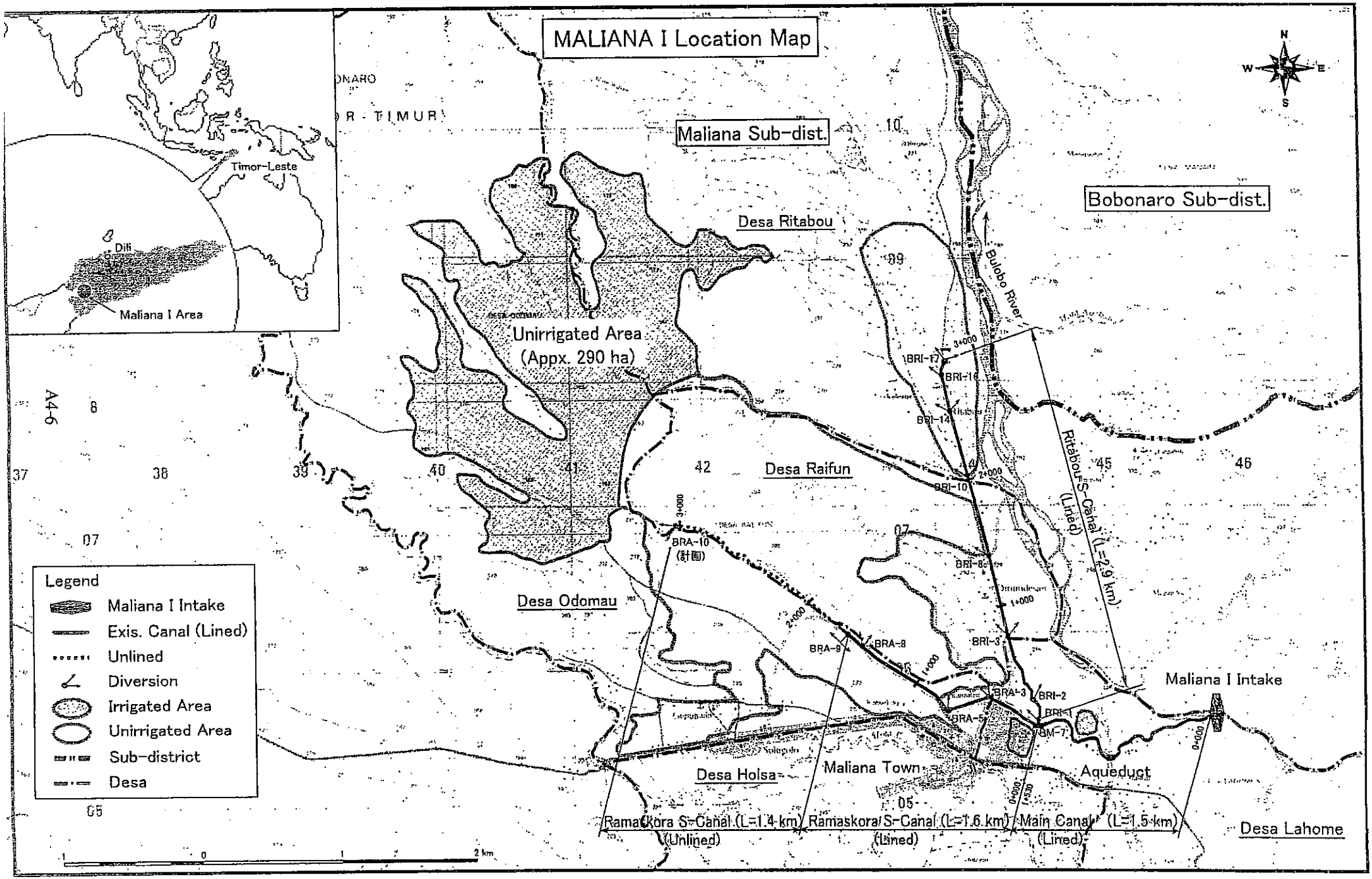
(9) The both sides confirmed that soft component for establishing and strengthening water users' association for sustainability of the Project would be proposed during the Study, if necessary. And the Timor-Leste side agreed to make efforts for providing their staff for necessary arrangements, if the soft component would be proposed.

(10) After discussing at the Project site, the both sides confirmed beneficiaries from intake located at right bank of Maliana I weir are not under the Project.

(11) After discussing at the Project site, the Timor-Leste side agreed to confirm schedule of rehabilitation and its proposed capacity of water supply facility, taking water from main canal of the Project with Ministry of Transport, Communication and Public Works (MTCPW) by the end of March.

(12) After discussing at the Project site, the Timor-Leste side agreed to take necessary actions to reduce water leakage from the aqueduct bridge by temporary measure during water closure.

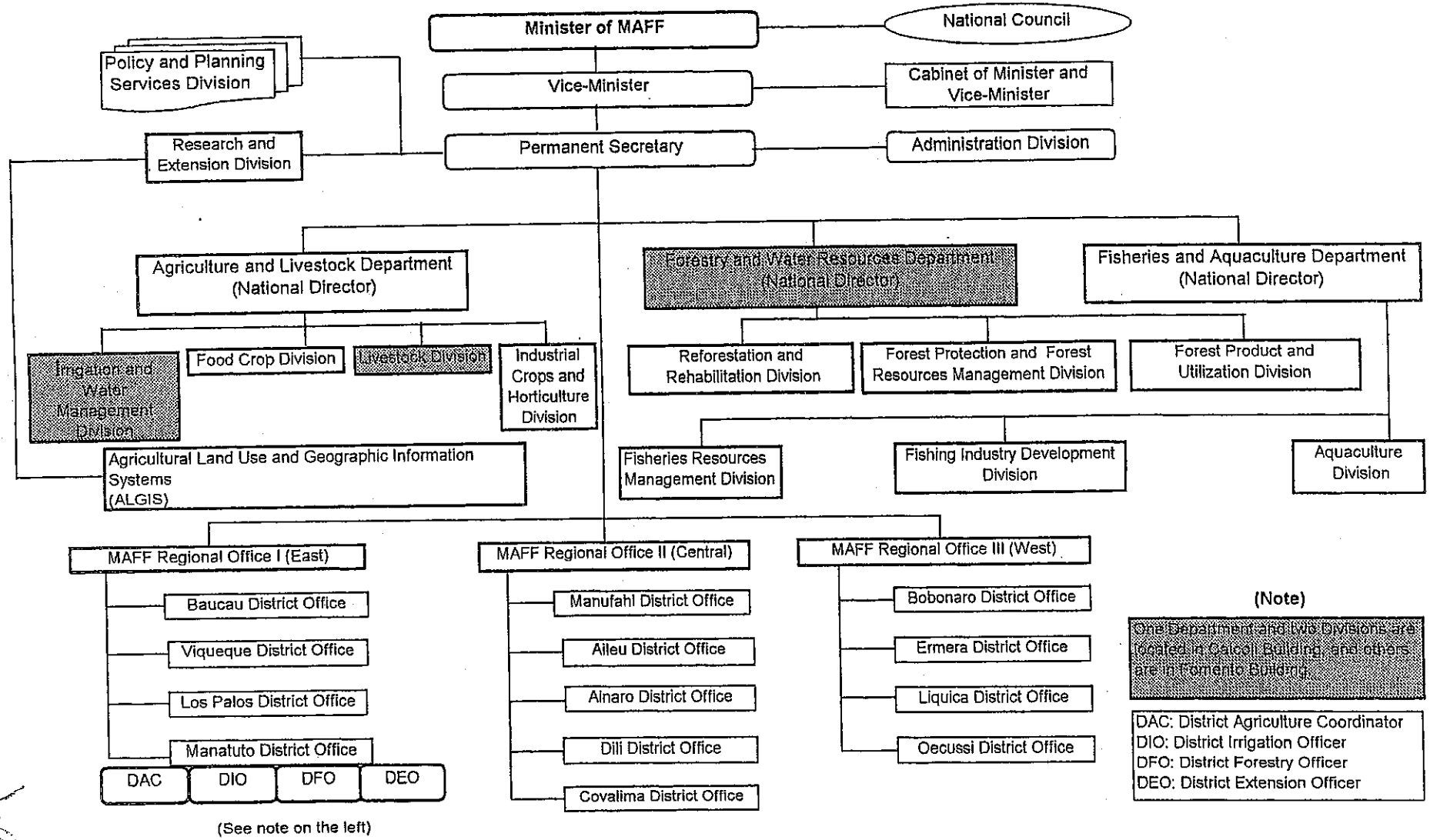
(13) Both sides confirmed that the approval of the Project would be depended on the decision by the Government of Japan.


MALIANA I Location Map
Timor-Leste
Dili
Maliana I Area
Maliana Sub-dist.
Bobonaro Sub-dist.
Desa Ritabou
Desa Raifun
Desa Odomau
Desa Holsa
Maliana Town
Desa Lahome
Unirrigated Area
(Appx. 290 ha)
Bulobo River
Ritabou S-Canal (L=2.9 km)
(Lined)
Maliana I Intake
Aqueduct
Ramaskora S-Canal (L=1.4 km)
(Unlined)
Ramaskora S-Canal (L=1.6 km)
(Lined)
Main Canal (L=1.5 km)
(Lined)
BRA-10
(計画)
BRI-17
BRI-16
BRI-14
BRI-10
BRI-8
BRI-3
BRI-2
BRI-1
BRA-9
BRA-8
BRA-5
BM-7
Legend
Maliana I Intake
Exis. Canal (Lined)
Unlined
Diversion
Irrigated Area
Unirrigated Area
Sub-district
Desa
2 km

Annex-1

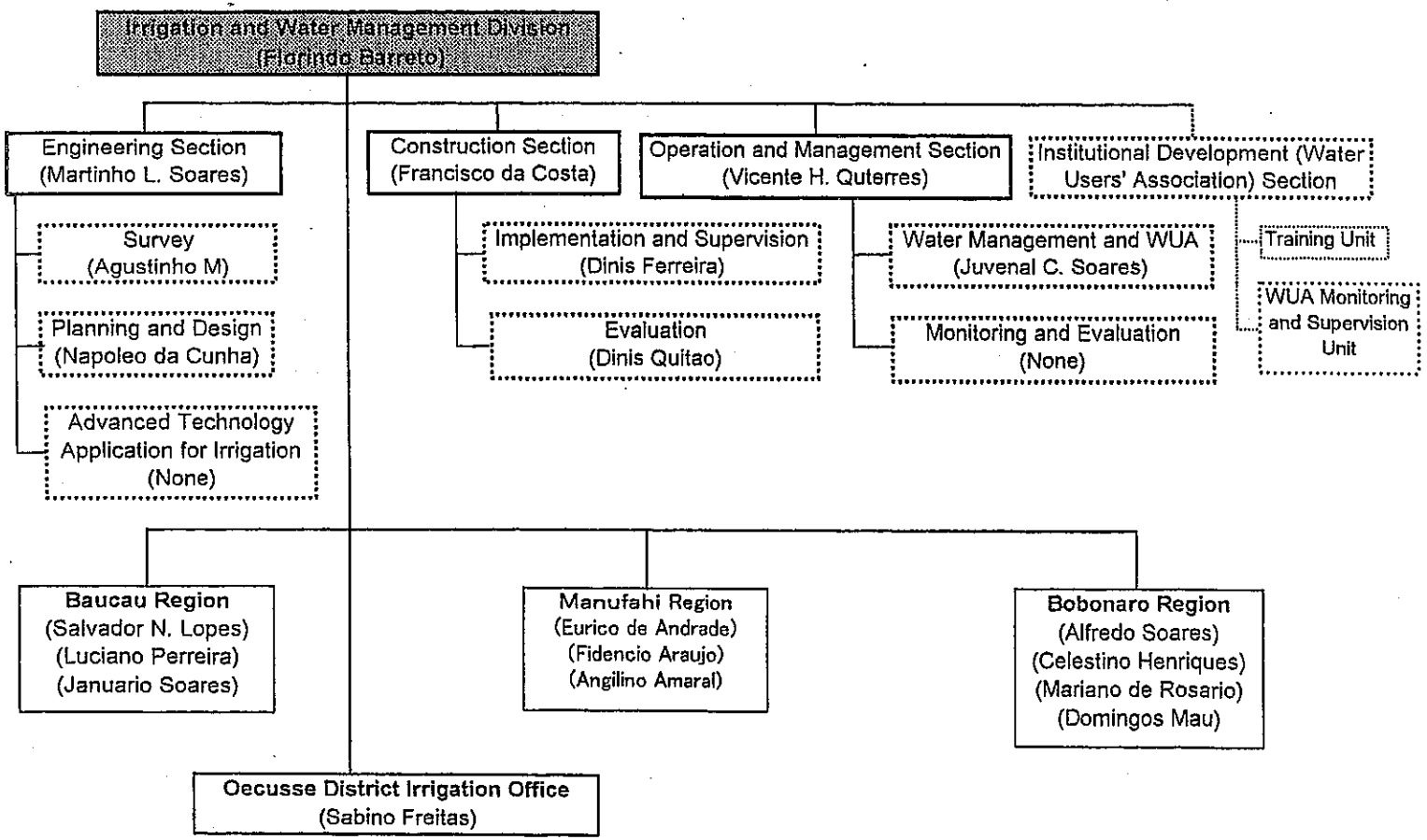
Annex-2 Present Organization Structure of Ministry of Agriculture, Forestry and Fisheries

(As of January 2005)



Annex-3 Organization Structure of Irrigation and Water Management Division, MAFF

(As of January 2005)



Note: The functions and deployment of the staff of the section and sub-sections shown with dot lines may subject to change.

Revised Items from the Original Components Request by the Government of Timor-Leste

(Remarks: Underlines are showing the revised items)

Original Requested Components	Revised Requested Components
1. Rehabilitation	
1) To raise the existing weir crest by 0.7 m by anchoring a capping of concrete with steel plates armoured to the downstream face of the weir,	1) Raising the existing weir crest by <u>appropriate height and attaching sand sluiceway, if necessary.</u>
2) Grouting of the foundation of the existing weir,	2) Grouting of the foundation of the existing weir,
3) Raising of the abutments training walls upstream of the crest with reinforced concrete,	3) Raising of the abutments training walls upstream of the crest with reinforced concrete,
4) Repairs on the concrete of the existing intake and sedimentation basin,	4) Repairs on the concrete of the existing intake and sedimentation basin,
5) De-silting of the existing canals,	5) De-silting of the existing canals,
6) Repair canal lining and structure.	6) Repair canal lining and structure,
7) -	7) <u>Rehabilitation of retaining walls for aqueduct bridge.</u>
2. New Construction	
1) Instillation of new gates for the sluice outlet and canal intake,	1) Installation of new gates for <u>intake</u>, sluice outlet of sediment basin and canal intake,
2) Instillation of steel slide gates at the division structure of Maliana I main canal and other offtake structures,	2) Installation of steel slide gates at the division structure of Maliana I main canal and other offtake structures,
3) Construction of the Ramaskora secondary canal,	3) Construction <u>and extension</u> of the Ramaskora secondary canal,
4) -	4) <u>Extension of the Ritabou secondary canal,</u>
5) Construction of meeting place for the water users association (WUA),	5) Construction of meeting place for the water users association (WUA),
6) Construction of the water guards house,	6) Construction of the water guards house,
7) Construction of a storage shed,	7) Construction of a storage shed,
8) Construction of a drying floor.	8) Construction of a drying floor.
3. Others	
1) Strengthening of the WUA.	1) Strengthening of the WUA.

Japan's Grant Aid

The Grant Aid scheme provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

1. Grant Aid Procedures

Japan's Grant Aid Scheme is executed through the following procedures:

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the recipient country)

Firstly, the application or request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for the Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.

Secondly, JICA conducts the study (Basic Design Study), using a Japanese consulting firm.

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Scheme, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and recipient country.

Finally, for the smooth implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

(1) Contents of the Study

The aim of the Basic Design Study (hereafter referred to as "the Study"), conducted by JICA on a requested project (hereafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Study are as follows:

- Confirmation of the background, objectives, and benefits of the requested Project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation,
- Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view,
- Confirmation of items agreed upon by both parties concerning the basic concept of the Project,
- Preparation of a Basic Design of the Project,
- Estimation of cost of the Project.

The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Study, JICA uses registered consulting firms. JICA selects firms based on proposals submitted by interested firms. The firms selected carry out a Basic Design Study and writes reports, based upon terms of reference set by JICA.

The consulting firm used for the Study is recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency.

3. Japan's Grant Aid Scheme

(1) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanged by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

(2) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with consulting firm and (a) contractor(s) and final payment to them must be completed.

However, in case of delays in delivery, installation or construction due to unforeseen factors such as natural disaster, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

(3) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However, the prime contractors, namely, consulting constructing and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means persons of Japanese nationality or Japanese corporations controlled by persons of Japanese nationality.)

(4) Necessary of "Verification"

The Government of recipient country or its designated authority will concluded contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

(5) Undertakings required to the Government of the Recipient Country

In the implementation of the Grant Aid project, the recipient country is required to undertake such necessary measures as the following:

a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction,

b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,

c) To secure buildings prior to the procurement in case the installation of the equipment,

d) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,

e) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts,

f) To accord Japanese nationals, whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

(6) "Proper Use"

The recipient country is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

(7) "Re-export"

The products purchased under the Grant Aid should not be re-exported from the recipient country.

(8) Banking Arrangements (B/A)

a) The Government of the recipient country or its designated authority should open an account in the name of the Government of the recipient country in a bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to Pay (A/P) issued by the Government of the recipient country or its designated authority.

(9) Authorization to Pay (A/P)

The Government of the recipient country should bear an advising commission of an Authorization to Pay and payment commissions to the Bank.

Annex-6

Major Undertakings to be taken by Each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure land		●
2	To clear, level and reclaim the side when needed		●
3	To construct gates and fences in and around the site		●
4	To construct the parking lot		●
5	To construct roads		
	1) Within the site	●	
	2) Outside the site		●
6	To construct the building	●	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. The distributing line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (from storm sewer and other to the site)		●
	b. The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	●	
	4) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	5) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
8	To bear the following commissions to the Japanese bank for banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
9	To ensure unloading and customs clearance at port disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan the recipient	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
10	To accord Japanese nationals, whose service may be required in connection with the supply of the products and the services under the verified contract, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work		●
11	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contract		●
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant		●
13	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well as for the transportation and installation of the equipment		●

(B/A: Banking Arrangement, A/P: Authorization to pay)

MINUTES OF DISCUSSION
ON
THE BASIC DESIGN STUDY
ON
PROJECT FOR THE REHABILITATION AND IMPROVEMENT OF MALIANA I IRRIGATION SYSTEM
IN
THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE
(EXPLANATION ON DRAFT REPORT)

In March 2005, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a Basic Design Study Team on Project for the Rehabilitation and Improvement of Maliana I Irrigation System (hereinafter referred to as "the Project") to the Democratic Republic of Timor-Leste (hereinafter referred to as "Timor-Leste"), and through discussion, field survey, and technical examination of the results in Japan, JICA prepared a draft report of the study.

In order to explain and to consult Timor-Leste on the components of the draft report, JICA sent to Timor-Leste the Draft Report Explanation Team (hereinafter referred to as "the Team"), which was headed by Mr. Tetsuya KAMIJO, Resident Representative, JICA Timor-Leste Office and was scheduled to stay in the country from 9th to 14th January, 2006.

As a result of discussion, both parties confirmed the main items described on the attached sheets.

Dili, January 13, 2006

Mr. Tetsuya KAMIJO
Resident Representative
Japan International Cooperation Agency
Timor-Leste Office

Mr. Francisco de Sa Benevides
Vice Minister
Ministry of Agriculture, Forestry and Fisheries
Democratic Republic of Timor-Leste

Witness

Mrs. Aicha Bassarewan
Vice-Minister
Ministry of Planning and Finance
Democratic Republic of Timor-Leste

ATTACHMENT

1. Explanation of the Draft Final Report

The Team explained the draft final report to Ministry of Agriculture, Forestry and Fisheries (hereinafter referred to as "MAFF"), and MAFF agreed and accepted them in principle. However, MAFF commented that the Team would reconsider a possibility of construction of a storage shed and a drying floor to include in the basic design of the Project. The Team told MAFF to convey their comments to concerned Ministries after return to Japan.

2. Japan's Grant Aid Scheme

The Government of Timor-Leste understood the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of Timor-Leste as explained by the Basic Design Study Team and described in Annex-5 and Annex-6 of Minutes of Discussion, dated on 15th of March, 2005.

3. Project Site

The Project site is located in about 150km west of Dili, Maliana sub-district of Bobonaro district, as shown in Annex- I .

4. Further Schedule of the Study

(1) The consultant will proceed with further studies in Timor-Leste until January 15, 2006.

(2) JICA will complete the final report taking a result of the last study in account and send it to the Government of Timor-Leste by the end of March 2006.

5. OTHER RELEVANT ISSUES

5-1. Launch of Water Users' Association

Water Users' Association (hereinafter referred to as "WUA") for Maliana I has not been established yet, and at the present, MAFF is conducting the identification and confirmation of beneficiary farmers. The Team emphasized that the establishment of WUA was very crucial for the launch of the Project, because WUA would be responsible for operation and maintenance (O/M) of Maliana I facilities. MAFF explained that WUA for Maliana I would be established by the end of March 2006 with their responsibility.

5-2. Operation and Maintenance

MAFF explained that MAFF would assist 70% of O/M cost of the irrigation facilities for the first five years (1^{st} – 5^{th}) after the establishment of WUA, and 30% for the second five years, (6^{th} – 10^{th}). After 10 years, WUA will take full responsibility for O/M, but MAFF will assist WUA by conducting periodical monitoring and taking care of major repairs, such as severe damage to intake facility.

5-3. Technical Assistance

The Team explained that technical assistance was included as soft component of the Project, to strengthen WUA to properly conduct water management and O/M.

5-4. Obligations of Timor-Leste Side

Both sides confirmed that the items mentioned below were conducted by the Government of Timor-Leste with its own expenses before and during the implementation of the Project. They are:

(1) Construction of Tertiary canals;
(2) Land for widening canal section and necessary working space for construction of canals;
(3) Land for temporary access road to Maliana I headworks, and to Aqueduct;
(4) Land for concrete batcher plant, stock yard, and diversion canal at Maliana I headworks;
(5) Land for WUA O/M facilities;
(6) Tax exemption; and
(7) Items for implementation of soft component listed as Annex-II.

5-5. Process of Environmental Assessment

MAFF submitted the Development Proposal Application of the Project to Secretary of State for Environment Coordination, Territorial Ordering and Physical Development (hereinafter referred to as "SSECTOPD") and the proposal is under the process of screening. SSECTOPD told the Team that they would inform a result of review in screening to MAFF by 18^{th} January and MAFF is requested to prepare Environmental Management Plan and submit it to SSECTOPD for their approval.

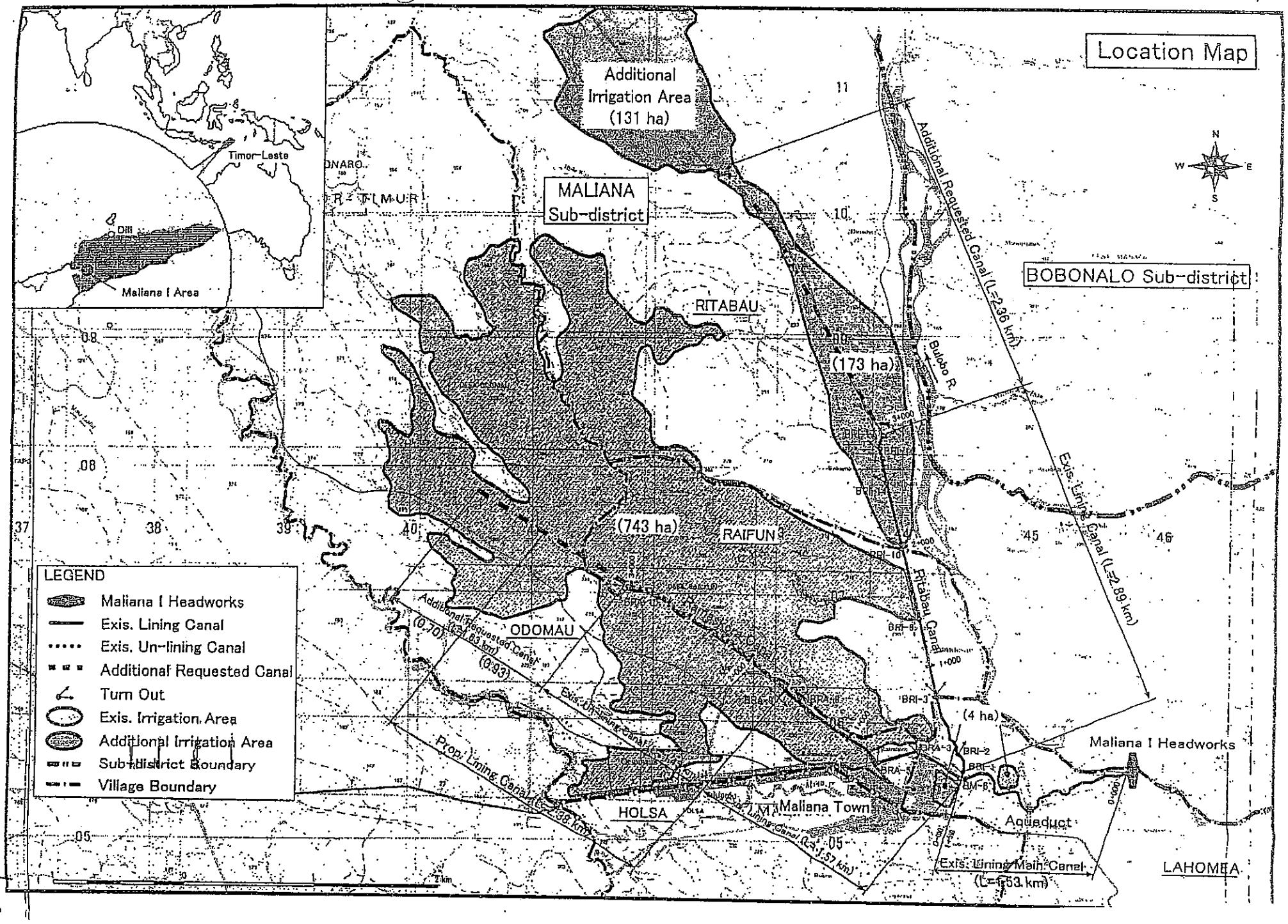
5-6. Security Issues

The Team explained the importance of security for the persons concerned during

implementation of the Project. MAFF agreed to take necessary measures for the security of the persons concerned.

Annex- I Project Site Map

Annex- II Items undertaken by MAFF for implementation of soft component


Location Map
Additional Irrigation Area (131 ha)
MALIANA Sub-district
BOBONALO Sub-district
RITABAU
(173 ha)
RAIFUN
(743 ha)
ODOMAU
HOLSA
Maliana Town
LAHOMEA
Timor-Leste
Dili
Maliana I Area
Additional Requested Canal (L=2.36 km)
Exis. Lining Canal (L=2.89 km)
Bulobo R.
Ritabau Canal
Additional Requested Canal (L=1.83 km)
(0.70)
(0.93)
Exis. Un-lining Canal
Prop. Lining Canal (L=2.38 km)
Exis. Lining Canal (L=1.57 km)
(4 ha)
Maliana I Headworks
Aqueduct
Exis. Lining Main Canal (L=1.53 km)
LEGEND
Maliana I Headworks
Exis. Lining Canal
Exis. Un-lining Canal
Additional Requested Canal
Turn Out
Exis. Irrigation Area
Additional Irrigation Area
Sub-district Boundary
Village Boundary
N
S
W
E

Items to be undertaken by MAFF/Irrigation and Water Management Division (IWMD) for executing Soft Component Plan

(1) Items to be undertaken immediately are:

1) To prepare a list of beneficiaries;

2) To launch Working Group for WUA election, which consists of village chairmen, District Agricultural Coordinator, District Irrigation Officer, local consultant, staff of Maliana sub-district office, and representative of ASC, and other necessary persons;

3) To elect WUA Board members (President, Vice-president, Accountant and Secretary); and

4) To identify 22 Group leaders from beneficiaries.

(2) Items to be undertaken by the detailed design stage are:

1) To appoint a gate keeper other than an existing Marino; and

2) To allocate WUA advisor of IWMD during executing soft component plan when necessary.

(3) Items to be undertaken by and during the construction stage are:

1) To ensure beneficiaries to provide land for tertiary canals and O/M facilities building, including WUA meeting room;

2) To ensure beneficiaries to construct tertiary canals of 12 km length;

3) To supply necessary equipment such as white board, chair, table, rack and so on for the O/M facility building; and

4) To allocate budget for necessary expense of the above.

MINUTES OF DISCUSSION ON THE IMPLEMENTATION REVIEW STUDY ON THE PROJECT FOR REHABILITATION AND IMPROVEMENT OF MALIANA I IRRIGATION SYSTEM IN THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

In March 2007, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched an Implementation Review Study Team (hereinafter referred to as "the Team") on the Project for Rehabilitation and Improvement of Maliana I Irrigation System (hereinafter referred to as "the Project") to the Democratic Republic of Timor-Leste (hereinafter referred to as "Timor-Leste"). The Team is headed by Mr. Teruyuki INOUE, Administration Team, Tsukuba International Center, JICA and is scheduled to stay in the country from February 19th to March 3rd 2007.

The Team held a series of discussion with the officials concerned of the Government of Timor-Leste and conducted a field survey at the study area. In the course of discussion and field survey, both sides confirmed the main items as described on the attached sheets. The Team will proceed to further works and report the findings to the Government of Japan.

Dili, March 2nd, 2007

Mr. Teruyuki INOUE
Leader
Implementation Review Study Team
Japan International Cooperation Agency

Mr. Francisco de Sa Benevides
Vice Minister
Ministry of Agriculture, Forestry and Fisheries
Democratic Republic of Timor-Leste

Witness

Ms. Aicha Bassarewan
Vice-Minister
Ministry of Planning and Finance
Democratic Republic of Timor-Leste

ATTACHMENT

1. Objective of the Project

The objective of the Project is "To distribute irrigation water stably to Maliana I irrigation area".

2. Japan's Grant Aid Scheme

The Government of Timor-Leste understood the Japan's Grant Aid Scheme and the necessary measures to be taken by the Government of Timor-Leste as explained by the Basic Design Study Team and described in Annex-5 and Annex-6 of Minutes of Discussion, dated on 15th of March, 2005.

3. Basic Design Component

Both sides confirmed that the final Basic Design component is as shown in Annex-1.

4. Further Schedule of the Study

JICA will complete the final report taking a result of the last study in account and send it to the Government of Timor-Leste by the end of June 2007.

5. OTHER RELEVANT ISSUES

5-1. Environmental Management Plan (EMP)

Both sides confirmed that EMP has been submitted and approved by Secretary State for Environment Coordination, Territorial Ordering and Physical Development (SSECTOPD), as shown in Annex-2.

5-2. Operation and Maintenance (O/M)

The Team explained to the Timor-Leste side that Ministry of Agriculture, Forestry and Fisheries (hereinafter referred to as "MAFF") should be responsible for all O/M cost for the major facilities such as intake with gates, aqueduct protection works and main canal, and severe damage to facilities by flood, considering the sustainability of WUA activities.

The Timor-Leste side explained that O/M cost of the irrigation facilities in the country consists of the two components; cash expenditure and labor work, its ratio is generally 70% and 30% of the total O/M cost. MAFF will subsidize 70% of the total O/M cost of the irrigation facilities in the first five years after the establishment of Water Users Association (WUA), and 30% for the second

five years, and after 10 years WUA will take full responsibility for O/M in conformity with "the Policy for WUA and O/M of irrigation facilities (draft)".

However, in the emergent case, such as severe damages to retaining wall of intake including gates and aqueduct protection works, and canals with gates washed away by flood, MAFF could take care of necessary repairing, even if the cost exceeds 70% of the total O/M cost in the first five years. Furthermore, MAFF will consider provision of extra support to the WUA, whenever they need.

5-3. Water Users Association

WUA has been established on March 2006 and its organizational chart is shown as Annex -3.

5-4. Obligations of Timor-Leste Side

Both sides confirmed that the items mentioned below, were conducted by the Government of Timor-Leste with its own expenses before and during the implementation of the Project:

(1) Construction of Tertiary canals;
(2) Land for widening canal section and necessary working space for construction of canals;
(3) Land for temporary access road to Maliana I headworks, and to Aqueduct;
(4) Land for concrete batcher plant, stock yard, and temporary diversion canal at Maliana I headworks;
(5) Land for a storage for O/M equipment;
(6) Tax exemption; and
(7) Necessary budget and staff allocation for implementation of Soft component plan.

5-5. Request to the Government of Japan

The Timor-Leste side expressed that the Project was one of the most important irrigation scheme for food security in the country, which had been programmed to start construction in fiscal year 2007/08. In this regard, the Timor-Leste side strongly requested to the Team to convey to the government of Japan that the Project should be started at latest in 2008.

The Team promised to convey the above mentioned matter to the government of Japan.

END

Basic design components under the Japan's Grant Aid Scheme

1. Rehabilitation works

Facilities	Basic design components under the Japan's Grant Aid Scheme
1 Existing weir crest	1) Raising existing weir crest by 0.7 m with high-strength concrete. 2) Constructing 10 m length of downstream apron with max.2.1 m thickness. 3) Attaching 12 m length of riverbed protection by crossing type concrete blocks to the apron 4) Attaching (sand) scouring sluice to the weir in the Bulobo River
2 Abutments retaining walls upstream of the crest	1) Placing concrete blocks at the front of upstream retaining walls of the right bank 2) Rehabilitating upstream retaining wall of the right bank by wet masonry after removing cracked part 3) Repairing mid and downstream retaining wall of the right and left bank by applying new mortar joint to existing wet masonry 4) Repairing downstream retaining wall of the right bank by filling wet masonry to the eroded part
3 Existing intake and sedimentation basin	1) Partly rehabilitating protection wall to meet the necessity of newly installing gates at the existing intake 2) Using existing sidewall on the right side as it is, while constructing a new one on the left side of sediment settling basin
4 Canal lining and structure	1) Main canal: Widening 42 m length of canal sections at insufficient area of flow, and rehabilitating 90% of canal lining out of 1,530 m total length depending on the existing condition 2) Ramaskora secondary canal: Rehabilitating 70% of canal lining out of 1,570 m total length depending on the existing conditions and attached structures. And lining 1,450 m length of existing earth canal with wet masonry 3) Ritabau secondary canal: Rehabilitating 100% of canal lining of 2,890 m total length depending on the existing conditions and attached structures
5 Retaining walls for aqueduct bridge	At right bank retaining wall: 1) Rehabilitating 8 m section of upstream retaining wall after removing existing part of wet masonry with 5m of corner cut 2) Leaving midstream retaining wall, section unaffected by flood as it is 3) Rehabilitating 7 m section of downstream retaining wall after removing existing part of wet masonry 4) Newly placing crossing type concrete blocks as riverbed protection 5) Covering backside on the top of retaining protection wall with wet masonry At left bank retaining wall: 6) Constructing new retaining protection wall by wet masonry 7) Placing crossing type concrete blocks as riverbed protection 8) Stopping water leaking from the Aqueduct by flexible material 9) Rehabilitating wooden cover of the Aqueduct new material

2. New facilities

Facilities	Outline of the Project under the Japan's Grant Aid
1 Intake, sluice outlet of sediment basin and canal intake	1) Constructing a new scouring sluice with control gates. 2) Installing new intake gates by replacing the existing intake screen. 3) Installing a new scouring gate with rehabilitating the existing sediment settling basin. 4) Installing new gates by replacing existing Main canal intake gate and canal scouring gates
2 Division structures of canals and other offtake structures	Installing steel slide gates by manual at turnouts (off-take structures) of the Main and Secondary canals with rehabilitating canal structures by RCC
3 Ramaskora secondary canal	Lining 930 m length of canal
4 Ritabau secondary canal	Lining 2,360 m length of canal
5 Building facilities	1) A storage for O/M equipment with meeting place of WUA 2) A gate keeper's hut
6 Strengthening of the WUA	Implementing soft component plan (Strengthening institutional capacity of WUA and instruction of water management for irrigation facilities)

REPÚBLICA DEMOCRÁTICA DE TIMOR-LESTE
Gabinete do Secretário de Estado para a Coordenação Ambiental, Ordenamento do Território e Desenvolvimento Físico
Direcção Nacional dos Serviços do Meio Ambiente - DNSMA

To : **Eng. Maria Odete do Ceu G.**
Permanent secretary – MAFF

Cc. - **Eng. João B. F Alves,**
Secretary of State for Environmental Coordination, Territorial Ordinance and Physical Development

- **Mr. Kamijo Tetsuya**
Resident Representative of JICA – Dili, Timor Leste

Num. Reff. : 70 /DNSMA.SECAOTDF/ II / 2007

Date : 26 de Fevereiro de 2007

Subject : **Decision of approval of Environmental Management Plan – EMP for Maliana I Irrigation Rehabilitation Project**

Dear Madam/Sir,

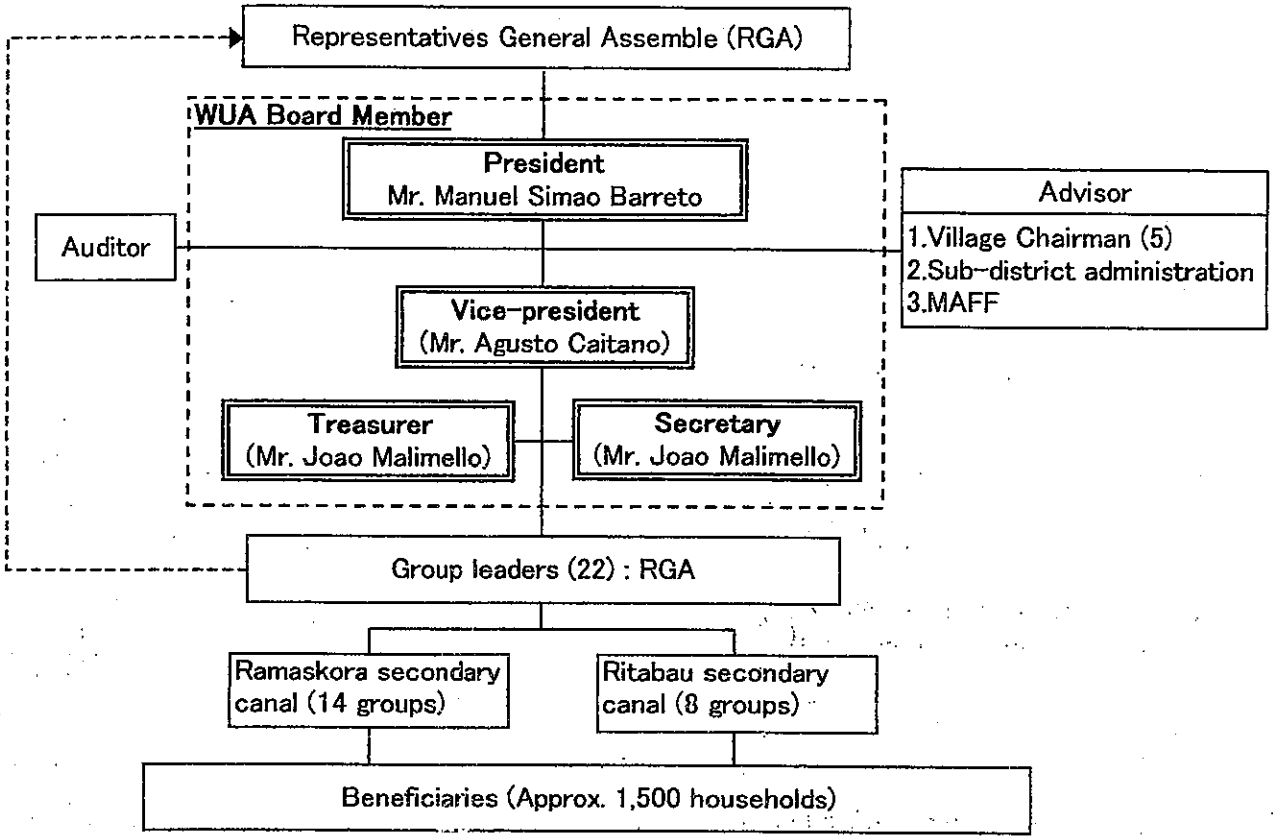
I am pleased to inform that the National Directorate for Environmental Services (NDES), has evaluated the documents received for Maliana I Irrigation Rehabilitation Project and it has approved by the National Directorate of Environmental Services (NDES), under the Secretary of State for Environmental Coordination, Territorial Ordinance and Physical Development SECAOTDF for the Rehabilitation of the Irrigation Project to be operated.

This decision is made, according to the DNSMA Guidelines No. 1 - Environmental Requirements for Development Proposals and Guideline No. 7 – Preparation of an Environmental Management Plan (EMP). When the project is in operation the proponent should contact the NDES for monitoring and evaluation.

Thank you for the Immense Coordination.

Eng. Carlos Ximenes, MTEM
National Director

Maliana I WUA Organizational Chart



IRRIGATION AND WATER MANAGEMENT DIVISION
AGURICULTURE AND LIVESTOCK DEPARTMENT
MINISTRY OF AGRICULTURE, FORESTRY AND FISHERIES

IMPLEMENTATION REVIEW STUDY REPORT
ON
THE PROJECT
FOR
REHABILITATION AND IMPROVEMENT
OF
MALIANA I IRRIGATION SYSTEM
IN
THE DEMOCRATIC REPUBLIC OF TIMOR-LESTE

SOFT COMPONENT PLAN

May 2007

SANYU CONSULTANTS INC.

CONTENTS

1. Background of Soft Component Plan

(1) Policy of Timor-Leste on operation and maintenance of irrigation facilities

Agricultural Rehabilitation Project 1 (ARP 1) funded by the World Bank implemented emergency-oriented improvement of small-scale irrigation infrastructure for food production increase from 2000 to 2002. ARP 2 from 2002 to 2003 supported policy-making for operation and maintenance (O/M) of irrigation facilities, in addition to implementation feasibility studies (F/S) for medium- and large-scale irrigation projects.

MAFF, the implementation organization of this project, made a proposed policy on maintenance of irrigation infrastructure in ARP 2. The proposed policy states that the government transfers operation and management (O&M) of irrigation systems newly-constructed, improved or rehabilitated. Also, the proposed policy obligates water users to establish water users associations (WUAs) and asset the 10-year transition period to foster and strengthen WUAs after their establishments. As for the maintenance cost, the proposed policy states that MAFF pays 70 % of it for the first five years, WUAs pay 70 % for the next five years and the transfer is completed at the beginning of the eleventh year.

WUA strengthening is the urgent need nationwide in East Timor, because of the necessity that beneficiaries themselves carry out O&M of irrigation projects after/during improvement or rehabilitation. Therefore, WUA strengthening is very important to attain the project overall goal in the Maliana I irrigation scheme.

(2) Process to organize/strengthen WUAs

ARP 3 (from 2004) not only keeps financing for irrigation infrastructure improvement but also focuses on system formulation and human resources development. Figure-1 shows the process to establish or strengthen WUAs in ARP 3. MAFF has been Following this process to establish and strengthen WUAs in the Maliana I irrigation scheme. Currently the progress is in the middle of the second stage.

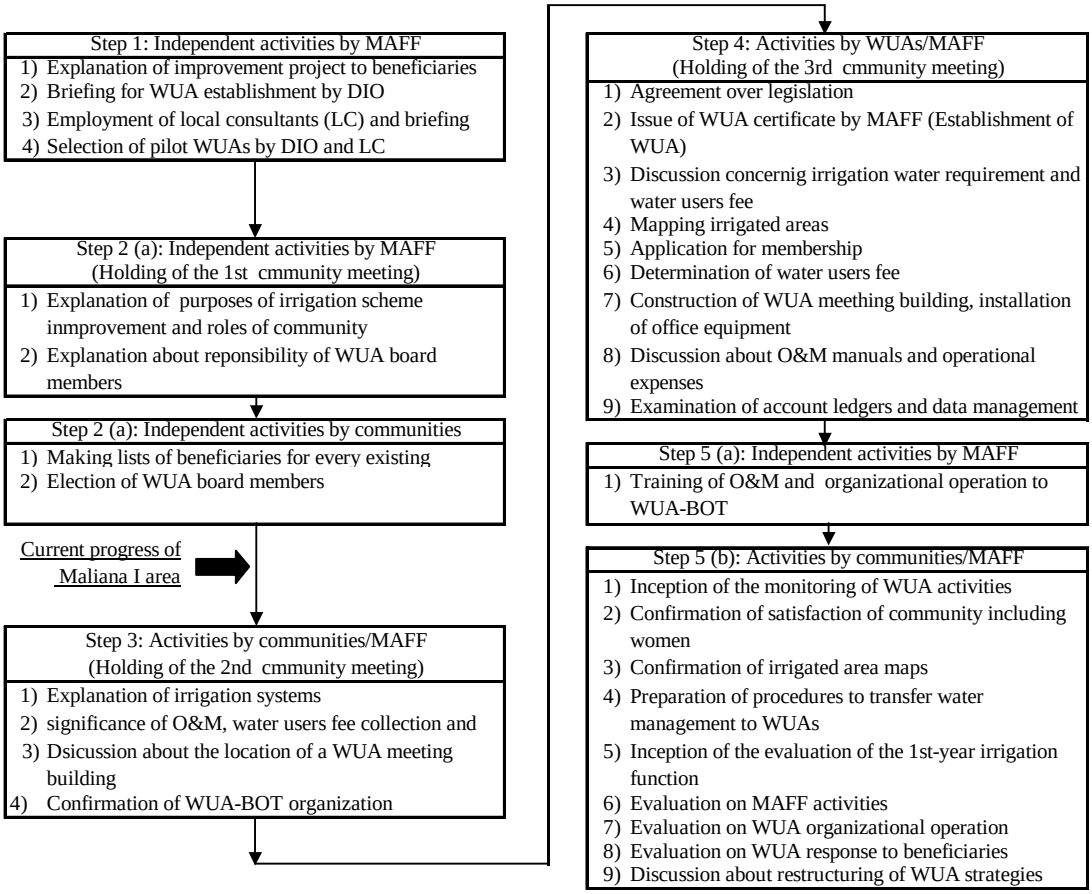


Figure-1 Process of WUA establishments and strengthening in Timor-Leste (WB, ARP3)

(3) Progress of WUA Establishments in Timor-Leste

(a) Current situation of WUA establishments

Fifteen irrigation schemes have been improved by Japan's funding or APR in East Timor, and thirteen out of them have already established WUAs shown in Table-1. The initial stage of schemes has budget for WUA strengthening, and it is used to implement consensus building for WUA establishment among beneficiaries, election of board members, and support for to make guidelines for WUA bylaws.

However, it is supposed that the willingness of beneficiaries to perform O/M of irrigation infrastructure is low, because governments had paid most of O/M cost under the rule of Indonesia in the past. Accordingly, enlightenment activities seem to be indispensable from the beginning of the project for building consensus among water users on benefits from irrigation systems they own and WUAs.

Table-1 Current situation of WUA establishment and water users fee collection

Name of District	Name of Irrigation Scheme	Area of Irrigation	Year of Improvement	WUA Establishment (Yes or No)	Scheduled Water Users fee (US$/ha)	Example of Actual Collected Amount
Bobonaro	1. Halicou	345 ha	2002	Yes	20～25	Not collected
	2. Maliana II	1,000 ha	2004	Yes	20～25	Not collected
	3. Atabae Loes	223 ha	2005	No	－	Not collected
	4. Batugade	80 ha	2003	Yes	20～25	Not collected yet
	5. Belimau	350 ha	2002	Yes	20～25	Rough Rice: 5 kg/ha (equivalent to 0.6 US$/ha)
	6. Maitalo	120 ha	2003	Yes	20～25	Rough Rice3 kg/ha (equivalent to 0.36 US$/ha)
	7. Marco	235 ha	2003	Yes	20～25	2 US$ /ha
Manatuto	8. Laclo	660 ha	2003	Yes	20～25	Not collected
Viqueque	9. Utabati	220 ha	2004	Yes	20～25	Not collected
	10.Baidubu	350 ha	2004	Yes	20～25	Not collected
Oecussi	11.Nitibe	170 ha	2003	Yes	20～25	Rough Rice: 10 kg/ha (equivalent to 1.2 US$/ha)
	12.Tono	245 ha	2003	Yes	20～25	Rough Rice: 10 kg/ha
	13.Oemathitu	360 ha	2003	Yes	20～25	Rough Rice: 10 kg/ha
Manufahi	14.Caraulun	1,030 ha	In progress	Yes	20～25	Not collected
Baucau	15.Seical up	800 ha	Partly	No	－	Not collected

Source: Director of Irrigation and Water Management Department, IWMD, MAFF
Remarks: Equivalent amount of Water users fee was calculated at rough rice 0.12US$ /kg.

(b) Situation of water users fee collection

Water users fee collection amount shall be calculated by IWMD derived from necessary O/M cost depends on irrigated area, sizes of every improved schemes, submitted to MAFF Council and approved by it. Result of the calculation of the water users fee for each schemes are reported 20-25 US$/ha/yr as shown in Table-1. Water users fee collection has started in the 6 irrigation schemes that are already improved. However, the fee is 2 US$/ha/yr at most.

It is practically reasonable to set water users fee as 2 US$/ha/year at the initial stage because the irrigation facility transfer to WUA are in progress in Eat Timor. MAFF and IWMD have intention to modify the proposed policy for WUA and O/M of irrigation facilities after a 10-year trial period during which the amount of water uses fee beneficiaries pay is tested using lessons learned and subsidies when necessary.

(4) Movement towards WUA establishment in Maliana I irrigation scheme

The water management system in which traditional gate operator operates intake gates has been functional since the Indonesian period of rule. It is informal, but tertiary-unit groups periodically hold meeting for deciding the starting date of irrigation, arrangement for irrigation water diversion, settling conflicts over water even today, under guidance by IWMD staff of MAFF Agricultural Regional Office III, five(5) village chairmen in Maliana I area, and Maliana sub-district office.

In March 2006, Maliana I WUA has established after MAFF identified beneficiaries of each tertiary canal in order to have election through the discussions among staff of MAFF Agricultural Regional Office III,

Bobonaro district administrator and village chairmen, of which organizational chart is show in Figure-2.

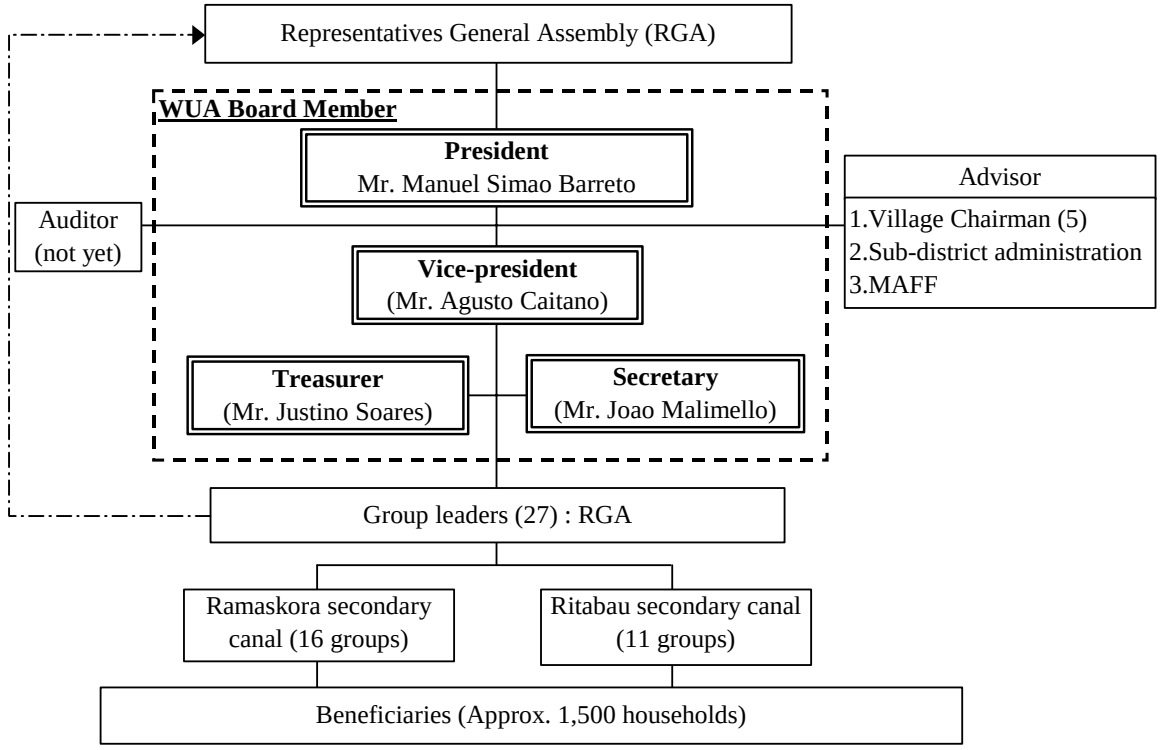


Figure-2 Organizational Chart of Maliana I WUA

And the Agricultural Regional Office III has decided total 27 groups in WUA to 16 groups in the Ramaskora secondary canal and 11 groups in the Ritabau secondary group shown in Table-2.

Table-2 Basic unit names of water management groups

16 groups in Ramaskora 2ndary canal (4 villages)		11 groups in Ritabau 2ndary group (1 village)	
1. Tasi Telu	9. Pue Talin	1. Lelo Koe	7. Banegot
2. Guma Anan	10.Pue Bouk	2. Sama Klot	8. Holi hooq
3. Pas Anan	11.Rae Boe Dasna	3. Bea bubu	9. Sulabbio
4. Rea Bou Orokna	12.Pue Ulus Laran &	4. Kampo aviasio	10.Haglai
5. Robuk Anan	Nua Anan Laran	5. Aikiar	11.Utuluk
6. Blae Buti	13.Raigeren	6. Banegoa	
7. Utedai	14.Ramas Cora		
8. Dakatai Anan Laran	15.Loibane		
	16.Mehen		

Source: Interview at Maliana sub-district office and DIO of MAFF Agricultural Regional Office III

(5) Lessons learned from the Urgent Rehabilitation Project of Laclo Irrigation System

The Urgent Rehabilitation Project of Laclo Irrigation System, which was lead by UNOPS funded by Japan, started before the independence of Timor-Leste and ended in December 2003. The project organized WUAs, strengthened the management capability and implemented trainings for gate operation by a WUA organization expert and an O/M expert.

However, it is pointed out that proper water management has not been executed because of 1) lack of consensus with beneficiaries and 2) lack of practical training after rehabilitation. It seems that the former

was caused by lack of explanation on the policy of WUA establishment, details of facilities, O/M policy, accounting methods, and so forth, at the beginning of project.

2. Necessity of Soft Component Plan

(1) Position of the Project in the policy concerning O/M of irrigation facilities in Timor-Leste

Based on the proposed policy on maintenance of irrigation infrastructure, WUA is established in the Maliana I project and O/M of its irrigation systems are transferred to the WUA in the eleventh year. Since the WUA has to collect water users fee and manage O/M by itself, consensus among users on collection method, the amount of charge, organizational aspects and bylaws will be important.

Consequently, WUA establishment and strengthening is the key for project success and attaining the overall goal, that is, income increase by rice production increase and poverty alleviation, in the Maliana I project the 11th year and later. Therefore, the project goal, i.e. delivery of water to users with reliability in the project area, is significant, which is completed by strengthening WUA organization, enhancing WUA's gate-operation capacity of improved/upgraded facilities and proper water management.

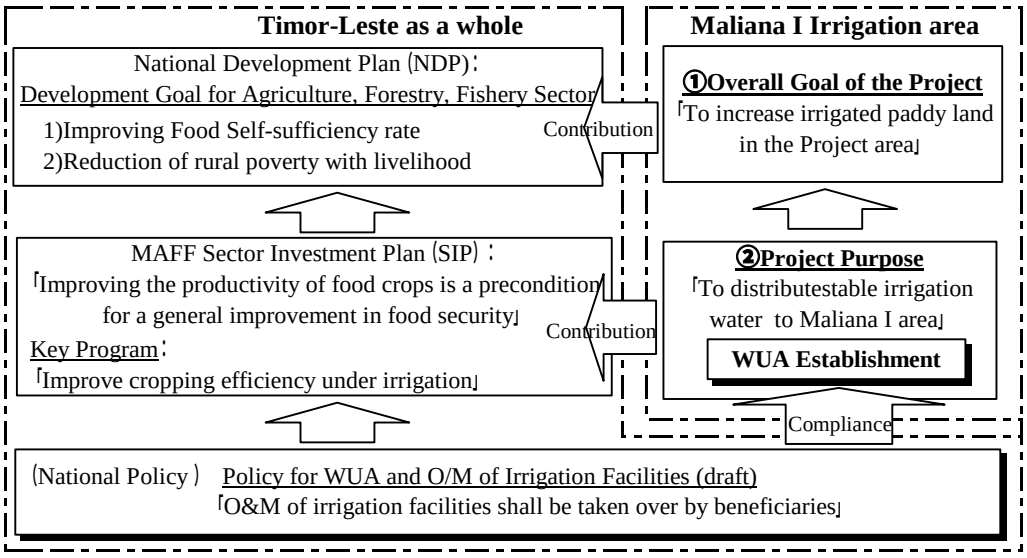


Figure-3 Position of WUA establishments in the Project

(2) Necessity of enlightenment on O/M

Water uses have low willingness to organize WUAs and perform O&M of their own irrigation systems, even though their systems are improved/rehabilitated, because the Indonesian government had paid O&M cost before the independence of Timor-Leste. Therefore, it is significant to explain functions of irrigation facilities and O/M policy, meaning of management by WUA and water users' benefits from their irrigation projects.

(3) Staffing, management and O/M capacity of implementation organizations

The IWMD headquarters under MAFF has 1 water management advisor. Also, as shown in Figure-3, MAFF Agricultural Regional Office III has three fulltime officers for O/M of the Maliana I irrigation system, i.e. a district agriculture Coordinator Officer (AC), a district irrigation officer (DIO), an officer in charge of WUA strengthening. It is possible to utilize these human resources efficiently. In addition, the above advisor and the officer in charge of WUA strengthening. Have been employed by ARP3 of the World Bank, and they are extending their contracts by 6 months. Their contract will be extended when necessary if the World Bank budget can afford.

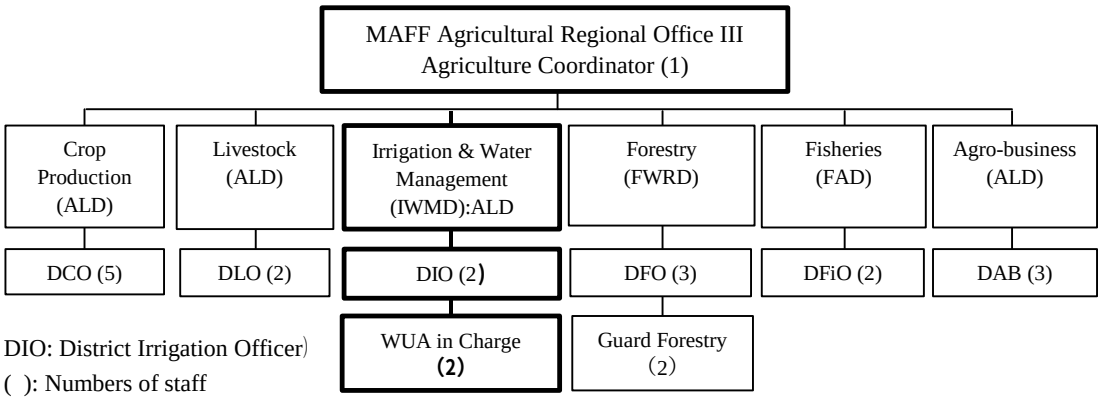


Figure-4 Organization of MAFF Agricultural Regional Office III

(4) Maintenance of facilities newly-constructed and procured

1) Adequate gate operation instruction for headworks and scouring sluice shall be required to lessen the burden of the O/M of WUAs. The purposes of introduction of new scouring sluice gate, intake gate are i)to remove the sediments in front of intake effectively, ii)to reduce sediment inflow into sediment setting basin, iii)to prevent sedimentation by excessive intake, iv)to control the sedimentation inflow as flooding.
2) Sediment settling basin gates and turnout gates to be improved are not operational due to inadequate maintenance, which cause by lack of knowledge and information about O/M. therefore, it is essential of instructing operation purposes of each facility.
3) In order to assure the effective water distribution of a limited amount of Bulobo river water to beneficiaries' lands, it is necessary to instruct proper water management conformed to irrigation rotation, which is going to be planned from now on, using new slide gates installed in main and secondary canals.

3. Goal of the Soft Component Plan

MAFF decided to reduce the disbursement of the subsidy to WUA to 30% of the required amount for O/M from the 6th year of facility management. In this regard, it is indispensable to verify the adequacy of the amount of water fee collected in the past and that of subsidy by MAFF by evaluating the state of activities of WUA after its establishment and of O/M performances. If the new water fee's collection system begins

to be applied from the 6th year, it may be necessary to agree with WUA on this application within the 5th year. It follows that evaluation for the previous 3 years must be carried out in the 4th year. By this reason, the target year is set at the 3rd year to attain the goal of soft component in compliance with the evaluation period described above. The contents of the goal to be fulfilled during three years after the completion of this Grant Aid scheme are as follows:

a) By soundly strengthened WUA, b) by means of sustained collection of water fee and properly manage and maintain the irrigation facilities, c) efficient water intake / management is implemented.

Besides, understanding on WUA's organizational management and water management as well as capacity of instructing WUA will be improved provided that the contents of the activities are explained to the implementing organizations (MAFF, IWMD and MAFF Agricultural Regional Office III) during the process of technically assisting for soft component plan and instruction towards beneficiary people can be conducted through the leading role of the government implementing organizations.

4. Results of Soft Component Plan (Direct Effects)

To conduct Soft component plan under the Japan's Grant Aid Scheme, following direct effects on two(2) field; 1)organizational management and 2)water management are expected.

(1) Organizational management

(a) Necessity of proper use and O/M of irrigation facilities is recognized and accepted by WUA members and beneficiaries
(b) Affordable amount of water (user's) fee and method of collection are established with consensus among beneficiaries

(2) Water management

(a) Gates installed at sediment scouring sluice, water intake, sediment settling basin and canal diversion are properly operated in a linkage
(b) Irrigation water is distributed to tertiary canals
(c) Pragmatic water management manual is provided to WUA members

5. Validation of Achievement

Necessity of adequately managing, operating and maintaining irrigation facilities by WUA are recognized through the implementation of the soft component plan, thus acceptable amount and method of collecting water fee from the users in the first year are determined. Furthermore, gates installed at sediment scouring sluice, water intake, sediment settling basin and gates installed at turnouts are properly operated in a linkage and irrigation water is distributed to tertiary canals. In addition, it is expected that WUA members can avail the practical manual on water management. The direct achievement and what should be identified as the degree of achievement and means of identification are tabulated in Table-3. In this

context, questionnaire surveys will be made towards the same WUA members (beneficiary households) with the same contents of inquiry sheets before and after the implementation of soft component plan, in order to identify the degree of the achieved performances through questionnaire survey.

Table-3 Purpose and effects of the Soft component plan

Purpose of the soft component(3 years after the expiry of the Project)	Performances of the soft component (at the completion of soft component activities)	Factor of identifying degree of performances	Measures to identify them (period and frequency)
(1) Disciplinary in terms of organizational management			
a) WUA is active and soundly functioning	① Necessity of proper management and O/M of irrigation facilities is recognized and accepted	• Degree of understanding of WUA members	Questionnaire: (twice, before and after soft component plan)
b) Water fee is regularly collected	② Affordable amount and method of water fee collection are established	• Degree of acceptance of WUA members	Questionnaire: (once, after soft component plan)
(2) Disciplinary in terms of water management			
c) Efficient water intake and water management are practiced	① Gates installed at sediment scouring sluice, water intake, sediment settling basin, canal intake turnouts are properly operated in a linkage	• Maturity of skill in operating gates by gate keepers / members	Operational identification: (before and after soft component plan)
	② Irrigation water is distributed up to the tertiary canals	• About 12km of the conveyance distance of new tertiary canals	Site confirmation (twice, just after constructing tertiary and after on-the-site training)
	③ Practical water management manual available to WUA members is provided	• Extent of satisfaction of WUA members	Questionnaire: (once, after soft component plan)

6. Activities in Soft Component (Input Plan)

(1) Input strategy of soft component plan

1) Soft component is performed along with 'flow on organizing and strengthening WUAs' proposed by MAFF in World Bank Program, APR 3.
2) The soft component plan is introduced after the election of board members. The necessary conditions of the introduction are (a) compliance with the proposed policy on maintenance of irrigation infrastructure of Timor-Leste aiming at establishment of WUAs for all irrigation systems rehabilitated, improved or newly-constructed and (2) MAFF takes responsibility for implementation of WUA establishment and board-member election.
3) The main target of the soft component plan is WUA board and general members. To improve guidance capability of MAFF, the soft component plan promotes MAFF to explain activities of MAFF and IWMD to beneficiaries at every step.
4) Considering lessons learned from the Laclo project, the project promotes that MAFF and IWMD request participation of group leaders and beneficiary farmers of existing tertiary units from the beginning of the project, and further the project attempts to get a consensus on WUA establishment, election of board members and the amount and collection method of water charge between beneficiaries.
5) Considering the above lessons learned, the project also implements adequate field training on water management and gate operation in the irrigation system. Trainees visit the above Laclo project

about the middle of improvement construction term and have field training using the Lacro irrigation system. Moreover, trainees have exchange with the Laclo WUA so that they develop the ownership over their irrigation system

(2) Contents of required activities

The activities required for achieving the effects (Direct Effects) of the soft component are planned in Table-4.

Table-4 Effects and activities of the Soft component

Effect of the soft component (Direct Effects)	Contents of required activities
(1) Disciplinary in terms of organizational management	
① Necessity of proper use and O/M of irrigation facilities is recognized and accepted	1) Interviewing on current state of existing organizations with workshops to elucidate methods of O/M, water management, problems of water rotation and social conditions, 2) Definition and responsibility of WUA, significance of organizational management are explained to the beneficiaries through orientation and 3) WUA manual (draft) is provided.
② Affordable amount of water (user's) fee and method of collection are established	1) An inquiry survey on the necessary amount of water fee to be collected is conducted, 2) Managing organization is grouped for tertiary canal construction, 3) PCM workshop for discussing method of collection and amount of water fee is held and 4) Workshop for instructing financial balance, data management and method of accounting.
(2) Disciplinary in terms of water management	
① Gates installed at sediment scouring sluice, water intake, sediment settling basin and canal intake turnouts are properly operated in a linkage	1) Study tour is organized to visit Laclo irrigation scheme (4 WUA board members, 2 gate operators and other volunteers are assumed), 2) Operational field training on water management is conducted.
② Irrigation water is distributed to tertiary canals	1) Maps covering the entire irrigation perimeter and command under tertiary canals are drawn, 2) Problems on cropping and water rotation are extracted through workshop and water distribution plan is formulated, 3) Operational field training on water management is conducted.
③ Pragmatic water management manual is provided to WUA members	1) Water management manual (draft) is provided, 2) Utilizing the manual (draft), adding revision by extracting problems on the said manual (draft) through the outcome of field training to complete water management manual.

(3) Outline of soft component inputs and implementation schedule

The process from the establishment to monitoring of WUAs is composed with the following steps.

A. Preparation and basic agreement for WUA establishment (done),
B. Setting working groups (WG) for WUA establishment (done),
C. Election of WUA board members (done March 2006),
D. Enlightenment to strengthen organizational management and of necessity of O/M (at D/D),
E. Establishment of WUAs, completion of WUA bylaw manuals (at the beginning of rehabilitation works),
F. Water management, understanding operation of gates and facilities, strengthening organization, developing ownership (during rehabilitation works),
G. Field training (immediately after rehabilitation works), and
H. Collection of water (user's) fee, monitoring, organizational improvement step of WUAs, according to

the World Bank program.

The soft component plan of this project intends to include D (partly), F and G of the above steps. In this connection, a water management expert (Japanese consultant) for 2.3 MM and an organizational management expert (Local resource) for 2.0 MM, in total 4.3 MM are planned for the input.

Table-5 shows activities of the soft component plan. The DIO and the officer in charge of WUA strengthening of MAFF Agricultural Regional Office III are also trained as well as WUA members so that WUA activities are sustainable even after the completion of the soft component plan.

Table-5 Inputs and activities of the soft component plan

	Steps and work contents (implementation time assumed)	Chief implementation organizations	Chief targets	Goals and results expected
D.	Enlightenment to strengthen organizational management and of necessity of O/M (at Detailed design stage)	MAFF, IWMD, advisors, ASC and NGOs (local resources)	WGs, WUA board members, group leaders and beneficiaries	1) Problems of existing organizations and groups are shared,
1.	Holding workshop to grasp existing organizations and O/M demarcation and social conditions	Inputs from Japan's side NGO: 0.5 MM		1) The demarcation of O/M is confirmed by both MAFF and beneficiaries,
2.	Orientation on organizational management of WUAs, and			2) WUA organizational systems are agreed by beneficiaries, and
3.	Making proposals for guideline of WUA bylaws and O/M manuals.			3) Proposals for guideline of WUA bylaws and O/M manuals are made.
F.	Water management, understanding operation of gates and facilities, strengthening organization, developing ownership (at Construction stage)	MAFF, IWMD, advisors, ASC, Japanese consultant and NGOs	WGs, WUA board members, group leaders and beneficiaries	1) Area irrigated by every branch canal group is confirmed,
1.	Making maps of irrigated areas and access to tertiary units,			2) WUA board members recognize the necessity of fee collection,
2.	Survey concerning water users fee collection,			3) The willingness to join WUAs is developed,
3.	Study tours to the Laclo project, (Using Laclo Irrigation facilities and exchanging Laclo WUA)			4) The ownership of beneficiaries over irrigation infrastructure is developed,
4.	Grouping management organizations for tertiary unit construction	Inputs from Japan's side Consultants: 0.8 MM NGO : 1.0MM		5) Problems on firming and water management are shared and an equitable water delivery schedules are determined,
5.	Cropping schedule and water management workshop			
6.	Workshop on the amount and collection methods of water users fee, and			6) Income & expenditure and living conditions of agricultural households are grasped, and
7.	Determination of the amount and collection methods of water users fee			7) The amount and collection methods of water user fee is determined.
G.	. Field training (at Completion of construction)	MAFF, IWMD, advisors, Japanese consultant and NGOs	WGs, WUA board members, group leaders and beneficiaries	1) Cropping schedule are determined and capability to operate gates and manage water is enhanced,
1.	Field training on water management and headwork operation, Workshop on finance,	Inputs from Japan's side Consultants: 1.5 MM NGO : 0.5 MM		2) Finance and data management is learned, and
2.	Data management and accounting			3) Beneficiaries understand manuals of water management and headwork operation
3.	Completion of manuals of water management and headwork operation, and holding explanatory meeting			

Note) 1. WG (working group): village chairmen (5), MAFF Agricultural Regional Office III (AC, DIO, DCD, LC), and Maliana sub-district office are supposed.
2. ASC: agricultural Support Center

(4) Implementation schedule and input plan

Figure-5 shows implementation schedule and input plan. Soft component activities are planned 1) at detailed design (D/D), 2) when multipurpose meeting buildings of WUA are built and 3) when farmers begin irrigation immediately after the completion of improvement of the Maliana 1 Irrigation system.. According to the plan, the amount of inputs from Japan and Timor-Leste are 4.3M/M and 108.5 M/M, respectively.

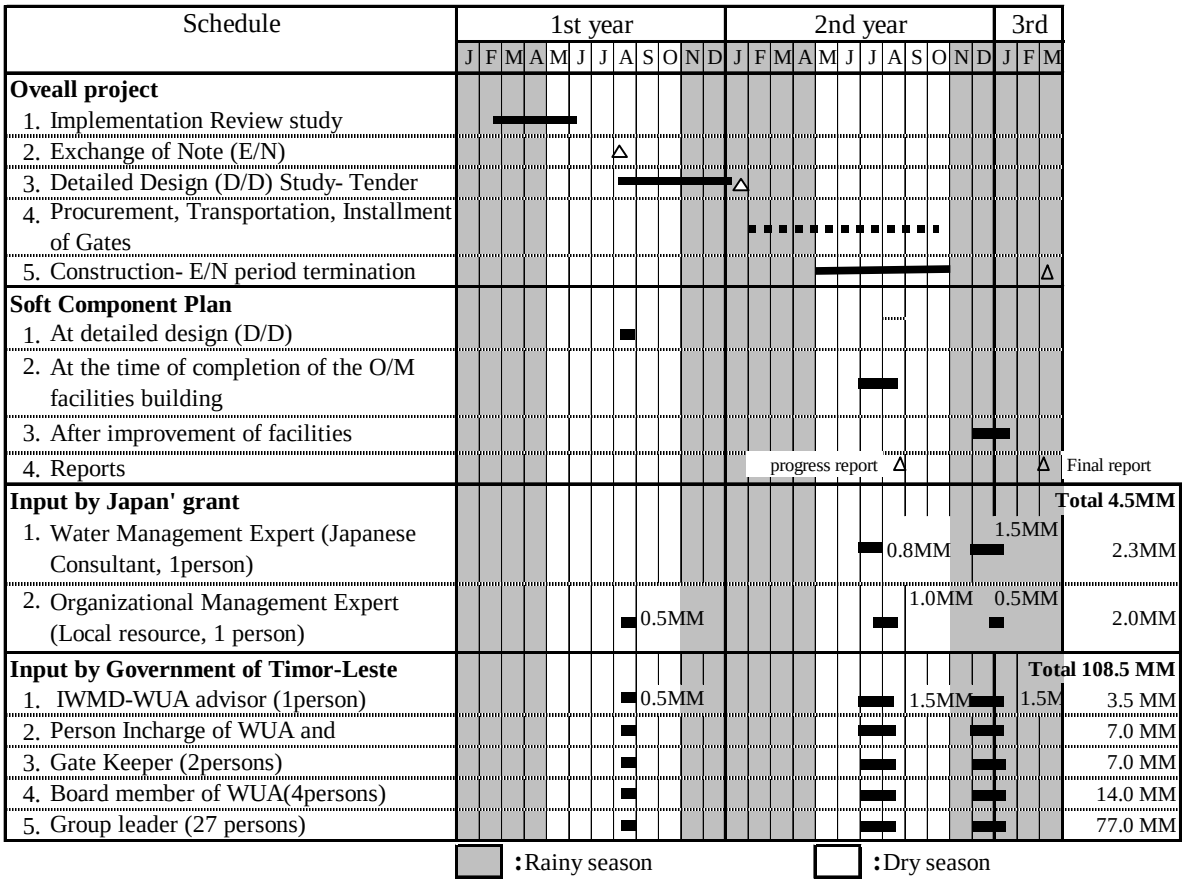


Figure-5 Implementation schedule and input plan of Soft Component

(5) Implementation structure and target beneficiary

Assumed implementation arrangement and target beneficiary are shown in Figure-6. MAFF and IWMD are leading implementation organization and Japanese consultant (one person) and NGO (one person) shall support the implementation of the project.

Direct target beneficiary shall be board members of WUA (4 persons); president of WUA, vice-president, treasurer, secretary, gatekeepers, group leader of Ramaskora Secondary Canal (16 persons), Ritabau Secondary Canal (11 persons), 33 persons totally.

Also, Village chairmen(5), MAFF Agricultural regional Office III (AC, DIO, and person in charge of WUA strengthening), and Maliana sub-district office staff and so on will supports WUA activities.

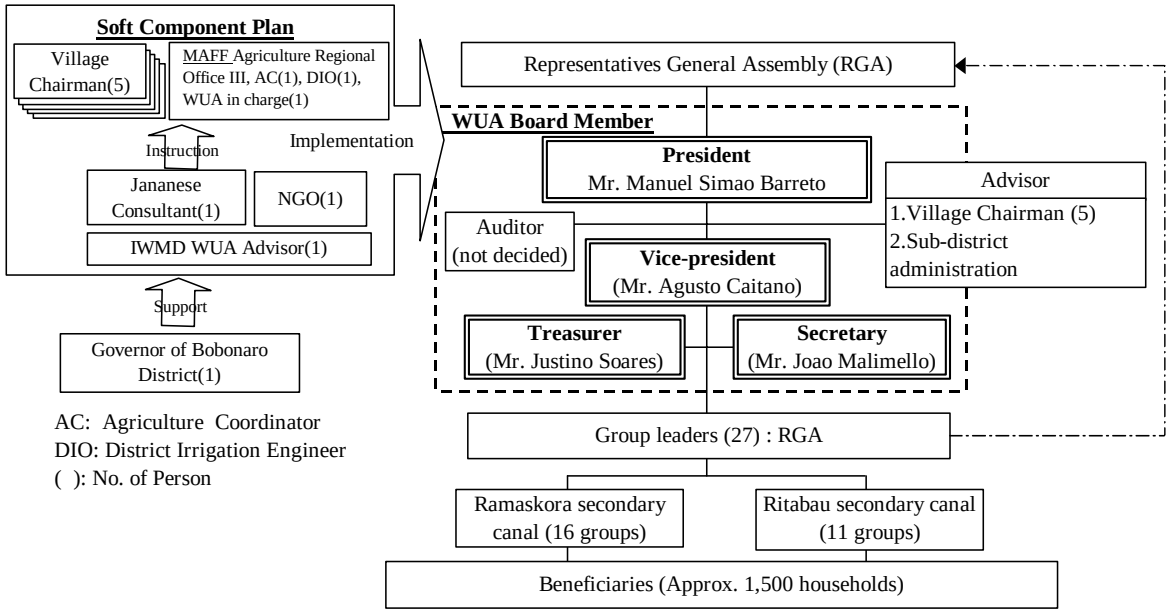


Figure-6 Implementation system of Soft Component

7. Procurement of Local Resources

A Japanese consultant is dispatched for training of water management and headwork operation. Local resources are input for organizational strengthening of WUA, that is, a person is hired from an international NGO that is in action at project areas and has familiarity with social condition and customs of Timor-Leste. The person will be a World Vision employee who has experience of baseline survey and workshop facilitation at the B/D field investigation of this project, because World Vision has carried out enlightenment for water supply project, program of food production increase and social survey around Bobonaro district.

8. Achievements of Soft Component Plan

The following are expected as achievements of the soft component:

1) Final report,
2) Manual of WUA bylaws in English and local language,
3) Water management manuals in English and local language,
4) Facility operation manuals in English and local language, and
5) Results of questionnaire survey for the above manuals and soft component activities

9. Cost Estimation

About 7.8 million J.Yen.

Appendix-6 Other Relevant Data

Memorandum of the Workshop

On the Basic Design Study

On the Rehabilitation and Improvement of Maliana I Irrigation System

Date : March 17 2005

Location : District Administration Office, Bobonaro

Participants : Attached List

1. Opening by District Administrator, Leonel De Jesus Carvalho

He liked to thank everyone for attending. He liked to thank the government of Japan for thinking and caring about the people of Maliana I.

The Maliana I area has not yet reached its maximum potential production. This project will help the families live a better life with full production. At present, families work very hard in the fields and carrying water. It is hoped that this project will assist in relieving this burden.

If we think 3 years into the future, what work and productivity could we be achieving. How can we change our practices from relying solely on rainfall?

We need to create a community that can continue to develop into a strong and developed country. This will take time and many phases of development.

The Portuguese began building the irrigation system and the Indonesians continued to rehabilitate the system, and still the water did not reach all farmers. This project aims at providing an efficient and complete irrigation system, so we can grow crops all year round.

Today, we need to talk about how we are going to distribute the water equally. The project will need people, materials and money, if it is to succeed.

This is not a project to help *individuals*, to make money out of the construction phase --→ this project is to repair the irrigation system and extend the system so that *all* people can benefit -→ YOUR lives, not anyone else.

So I ask: → are you ready to participate? → are you, the community leaders, ready to contribute?

When development begins, we need to make the most of our opportunities.

2. Director of Irrigation, Martinho Soares (IWMD)

If we are going to build a 2-meter wide canal through government and individual people's land, Who is responsible?

If we are the people who benefit from the irrigation water, shouldn't we be the people who contribute to the construction? We CAN do this, we WANT to do this, this is our life. The fields need water to produce, so when will we start?

3. Questions from the Village Chiefs of the 5 villages

1) If a 2 meter canal is going to be built wider than the existing canal close to houses and roads, we will need to consult the communities → how will we do this process?

2) One Chefe Suco offered his village for expansion of the irrigation system

3) Can we really make a irrigation system that will help dryland farmers in the dry season? → Will there be enough water in the river?

→ How will the water be shared / distributed equally?

4) If you use workers in the construction phase, please use people from within the communities, not outside.

If all resources are being put in to the Maliana 1 how will this effect other irrigation development in other areas like downstream or Maliana 2

5) After the new construction, who has the maintenance responsibilities?

We need to involve the community in the design process.

4. Response to Questions by Martinho Soares (IWMD) and Alfredo Soares(DIO, Bobonaro)

If the water is not reaching you yet, we need to analyze why? The consultants have the data on the water load in the river, their design will share out only the available water in the river.

Regarding : work on the construction, the village chiefs will be consulted first, but jobs will be allocated according to skill levels required.

5. Mr. Kazumitsu Tsumura (JICA Team)

The water levels allocated to farmers will possibly increase, and the system can be expanded → but we can not make any promises.

We need to develop a system of agriculture to meet the water supply in the dry season, we may not ALL be able to have fully irrigated rice paddies in the dry season, so we will need a system of rotation that has different crops being allocated different amounts of water.

During construction, the project will be asking for a contribution of assistance of work from the communities. Japan's contribution will be the contracted engineers and managers (they may need manpower with paid work, but no promises).

It is important to explain that it will be the responsibility of the WUA and the community to construct the secondary and tertiary canals; this project is about the primary canals.

6. Martinho Soares (IWMD) adds,

A Water Storage dam is not part of this program, and will need to be considered in a separate program. It will be difficult to build water storage here in Maliana I due to geography and soil types.

Japan has worked in other areas of Timor-Leste like Manatutu. This is high quality work requiring highly skilled workers. They still did use some local workers.

Question to the audience : if the internationals assist by extending the canal ➔ Can you use the water?

There are 3 components to the project

1) Rehabilitation of the Indonesian built canal
2) Construction of new extension of canals
3) Formation of WUA

7. Questions from the Audience

Q: Regarding the 2km extension of the Ramaskora canal, we believe that there is enough water, but there needs to be a very good strategy for distributing the water through tertiary canals. Now, the water does not reach these farmers at all.

Q: Many people have tried to repair the canal to his 20ha area at Dirou – but they still do not get water. States that he needs more secondary channels if the potential paddy is to be established.

Q: We need to form strong WUA to control water use but importantly, we need people to follow the regulations.

Asked if the government had plans to extend the irrigation to all of the Maliana I floodplain.

8. Response from Alfredo Soares (DIO, Bobonaro)

The most important point is that there is a need for the 'WHOLE' community to participate in WUA, and not to be greedy with water.

There will be an assessment of the current infrastructure and water supply before the design is started. The community and government will be asked to participate in the design process.

Strict need to control the irrigation canal gates so that the distribution of water is fair for all. If we are wasting water or losing water we need to discuss solutions quickly. This is because people at the ends of the tertiary canals will be effected the most. This is why it is so important that representatives of all of the areas are members of the WUA.

There may be scope for assistance in rehabilitating secondary canals, but importantly it is the responsibility of the communities to build the tertiary canals.

9. Questions from the Audience

Q: A point was raised about workers and who pays them to construct or rehabilitate tertiary canals.

Q: From Raifun, Before you start anything you should see how much water is here in the dry season, you need to make your assessments based on the least stream flow.

You will need to discuss the project with all the community in its design, particularly the timing of the rehabilitation and construction so that we can minimize the effect on agricultural calendar and production losses.

Q: From Ritabou, water is not reaching everyone now. Will all the water in the river 'really' meet our needs, even with a new rehabilitated system.

10. Response from Alfredo Soares (DIO, Bobonaro)

The potential of the river 'can' irrigate all the area, it just needs rehabilitation. This project will rehabilitate the main and secondary canals but we will need the government to rehabilitate the tertiary canals if we are all to benefit from the irrigation water.

11. Questions from the Audience

Q : There is a need for water daily (washing, drinking, cooking…), so when the construction is taking place, are you planning to open the canal at night time for us to collect water for domestic use.

12. Response from Alfredo Soares (DIO, Bobonaro)

The distribution system is not good now. The main canal needs to be wider, it needs to be kept clean and it needs to be better. It is up to YOU, THE COMMUNITY to make the tertiary canals a success so that all can get irrigation water.

Regarding the maintenance and operation of secondary and tertiary canals, we need to make good plans for their locations; we need to resolve problems by talking with the community leaders, the government and the WUA.

We need to listen and respect each other. We need to work together ➔ do not lose this opportunity.

Water will stop when Rehabilitation/ construction takes place. We need to plan around this in the implementation. The community, government and Japan need to discuss how we will resolve the no domestic water issue.

13. Mr. Kazumitsu Tsumura (JICA Team)

Regarding, the amount of water people will be able to access: there will not be enough water for everyone to be dry season fully irrigated rice farmers. Instead, their needs to be a 'controlled' system of agriculture the uses the water to its maximum potential. There will need to be a rotation of crops and of areas to control the water requirements.

If we can 'share' the water, all farmers will be able to rotate rice/maize/ vegetables/ cassava then we will all get the benefit of the dry season irrigation.

14. Questions from the Audience

Q: You must take in to account 'culture' if this project is to succeed. For instance animal farmers, dryland farmers, fruit growers have different needs but can still affect the project's success. The chief of Odomau stated that past irrigation projects did not succeed because the engineers did not consult with the 'culture'. To succeed the project needs to hold a ceremony to request the 'water god's' permission to use the irrigation water. This will ensure all community members understand that the water is now in the 'water god's' control (this will be more powerful than the regulations in the government or WUA), and should be respected.

15. Closing from District Administrator

- Respects paid.
- We need to listen and learn from people with much more knowledge and experience than us. They will make this project work, they will make the system high quality → this will be all to help you → you need to comprehend this, you will be asked to participate and contribute. DO NOT CAUSE PROBLEMS, such as 'that is my sand or rocks!'
- In 2007 you will get the benefits, be patient
- Many investors have come to help Timor-Leste but the community must open its heart and gratefully receive the assistance → then you will be able to develop yourselves. Do not lie to or deceive donors, have some self respect and develop yourselves, you don't need to wait for donors. The DA says he has some self respect and could not lie or beg to donors.
- Thank you very much for today and the opportunity you are giving. Thanks to all attending the workshop and safe journeys home. Now let's go to work and with God's help we will succeed.

LIST OF PARTICIPANT FOR WORKSOP
THURDAY,DATE 17 MARCH 2005

NO	DATE	NAME	ADDRES	POSITION	SIGN
1	17/3/2005	Luis de Oliveira	Ritaqbou	Chefe Aldeia	
2		Jacinto Dau Bere	Holsa	Chefe Aldeia	
3		Alberto A.Fernandes	Raifun	Chefe Suco	
4		Domingos Lopes	Raifun	Concelho suco	
5		Manuel Lacasuri	Raifun	Farmer	
6		Vasco P.M.Soares	Raifun	Farmer	
7		Baltasar Fernandes	Raifun	Farmer	
8		Hilario Lopes	Raifun	Farmer	
9		Bento Pereira Maya	Raifun	Farmer	
10		Alfredo Lelobere	Raifun	Farmer	
11		Venancia da Cruz	Odomau	Concelho suco	
12		Ines de Jesus	Odomau	Concelho suco	
13		Agustinha Soi Loe	Ritabou	Farmer	
14		Antonio da Cruz	Odomau	Farmer	
15		Ano	Odomau	Farmer	
16		Alexandrino Timotiu Soares	Ritabou	Farmer	
17		Guilhermino da Cruz	Ritabou	Farmer	
18		Domingos Moniz	Ritabou	Chefe Aldeia	
19		ijac Martins	Ritabou	Farmer	
20		Carlito da Cunha	Ritabou	Farmer	
21		Joaquim Maubere	Ritabou	Farmer	
22		Adriano Moniz	Ritabou	Farmer	
23		Martinho Moniz	Ritabou	Farmer	
24		Domingos Soares	Ritabou	Farmer	
25		Josa Soares	Lahomea	Chefe Aldeia	
26		Sipriano da Cruz	Lahomea	Farmer	
27		Apolinario Barros	Lahomea	Concelho suco	
28		Alcino Pires	Lahomea	Farmer	
29		Baptista Pires	Lahomea	Chefe Aldeia	
30		Domingos Lopes	Raifun	Concelho suco	
31		Cosme Soares	Raifun	Chefe Aldeia	
32		Antonio Santa Cruz	Holsa	Chefe Suco	
33		Camilio Gomes	Holsa	Concelho suco	
34		Fernando Pires	Raifun	Farmer	
35		Martinho Bilimau	Lahomea	Chefe Suco	
36		Tohmas C.Lopes	Raifun	Farmer	
37		Alfredo Miniz da Costa	Cailaco	Adm.Sub.Dist	
38		Domingos Martins	Maliana	Adm.Sub.Dist	
39		Carlos Credos	Bobonaro	Adm.Sub.Dist	
40		Alfredo Soares	Maliana	DAO	
41		Agusto Soares	Ritabou	Farmer	
42		Mateus Gomes	Ritabou	Farmer	
43		Fernando Credos	Maliana	Staf WVI	
44		Fernando santos	Maliana	Staf WVI	
45		Moises Lopes	Odomau	Farmer	

LIST OF PARTICIPANT FOR WORKSOP
THURDAY,DATE 17 MARCH 2005

NO	DATE	NAME	ADDRES	POSITION	SIGN
46	17/3/2005	Abel Pereira	Ritabou	Chefe Suco	
47		Carlito da Cunha	Ritabou	Farmer	
48		Tohmas C.Lopes	Raifun	Farmer	
49		Maubili	Lahomea	Farmer	
50		Aniceto Maubuti	Lahomea	Chefe Aldeia	
51		Carla Credos	Maliana	Farmer	
52		Salomao da Cruz	Maliana	Chefe Suco	
53		Jose Soares	Lahomea	DLO	
54		Semedu da Costa	Maliana	Infrastructure	
55		Aleixo Soares	Lahomea	DLO	
56		Natalino Lelobili	Raifun	Farmer	
57		Artur Soares	Raifun	Farmer	
58		Celestinho Henrique	Maliana	District Irg.Ofc.	
59		Fonciano de Fatima	Odomau	Farmer	
60		Justinho Guteres	Holsa	Farmer	
61		Tohmas Laculoi	Lahomea	P3A	
62		Dinis da Costa	Lahomea	RCM	
63		Victor Pires Sousa	Odomau	Manager ASC	
64		Tome dos Santos	Ritabou	Concelho suco	
65		Jose Mali	Ritabou	Farmer	
66		Marcal Amaral	Lahomea	Farmer	
67		Nuno Tolentinho	Maliana	WVI Staf	
68		Mario Amaral	Lahomea	Farmer	
69		Paulo da Costa	Holsa	Farmer	
70		Jose da Costa	Raifun	Farmer	
71		Fumihiko Komada	SCI	Staff	
72		Masanari Narukawa	SCI	Staff	
73		Yusuke Maruno	SCI	Staff	
74		Kazumitsu Tsumura	SCI	Staff	
75		Chris Walsh	Maliana	WVI Staf	
76		Leonel Jesus Carvalho	Maliana	Adm.District	
77		Martinho Soares	Dili	Irigation	
78					
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REPÚBLICA DEMOCRÁTICA DE TIMOR LESTE
ADMINISTRAÇÃO PÚBLICA DISTRITO DE
BOBONARO

ACORDO UZA RAI HO BUAT SELUK-SELUK TAN BA PROJETO REHABILITASAUN, HO HADIA SISTEMA IRIGASAUN MALIANA I

Ohin dia 17 de Marco 2005, ami lori Comunidade/ Benefisiaris ba natar uza be sistema irigasaun Maliana I,Sub-Distrito Maliana Distrito Bobonaro tomak,hodi koncorda/ oferece uza rai ho asset seluk tan ba projecto Rehabilitasaun ho hadia sistema irigasaun Maliana I.

1) Administrador Distrito Bobonaro:Leonel de Jesus Carvalho
2) Administrador Sub Distrito Maliana: Domingos Martins
3) Chefe Dezenvolvimento Distrito Bobonaro: Arcanjo R. Tilman
4) Chefe Rai e Propriedade Distrito Bobonaro: Carlos A. Cardoso
5) Chefe Sucu Lahomea: Martinho Bili Mau
6) Chefe Sucu Odomau: Salamão da Cruz
7) Chefe Sucu Holsa: Antonio Santa Cruz
8) Chefe Sucu Raifun: Alberto Fernandes
9) Chefe Sucu Ritabou: Abel P. Maureso

Acordo nee ami halo ho laran Kaman,no aban bain rua ami la husu Compensasaun ba rai ho asset seluk-seluk tan nebe mak projeto Rehabilitasaun ho hadia sistema Irigasaun Maliana I ne'e kona ba.

Maka nee deit Obrigado.

(LETTER HEAD OF BOBONARO DISTRICT ADMINISTRATION)

Memorandum of Understanding
for
Maliana I Irrigation Rehabilitation

Today, March the 17th 2005, the beneficiaries/ community for Maliana I Irrigation Scheme accept to allow their land and other facilities to be used for Maliana I Rehabilitation

1)	District Administrator, Bobonaro:	Leonel de Jesus Carvalho
2)	Sub-district Administrator of Maliana:	Domingos Matins
3)	District Development Officer, Bobonaro:	Arcanjo R. Tilman
4)	District Land Property, Bibonaro:	Carlos A. Cardoso
5)	Chief of Village, Lahomea:	Matinho Bili Mau
6)	Chief of Village, Odomau:	Salamao da Cruz
7)	Chief of Village, Holsa:	Antonio Santa Cruz
8)	Chief of Village, Raifun:	Alberto Fernandes
9)	Chief of Village, Ritabou:	Abel P. Maureso

This agreement is done by the community who has agree that there will be no objection for land and any other facilities in the future.

Thanks.

Minutes of the Maliana 1 Irrigation System Workshop for the Project Explanation

January14, 2006
Location : District Administration building

9.30am (Alfredo Soares, MAFF Maliana District Irrigation Officer) gives thanks to Government of Japan, Government of Timor Leste, District Administrator, M.A.F.F., Irrigation Division, and ALL farmers.
Introduces the participants of the front table
Mr. Sakai, Pedro, Mr. Tsumura, Vicente, Sub District Administrator
Then Introduces participants; the Chief of villages, Marino's and WUA leaders
9.39 Opening by Sub District Administrator Domingos Martins
Welcomes All, Explains goals of doing a Basic Design and Plan of Implementation, and explains there will be responsibilities of the water users. = INPUTS. This will prevent problems during implementation.
WHO's project is this → YOURS (community) → :. Need to Manage YOURSELF. Workshop here will describe HOW, but opens the project to ideas and questions from YOU.
9.44 OPEN
9.45 Background by Vicente (Chief of Div. Irrigation)
Gives respects to ALL

- Notes that this project is very important for the development of Maliana, important to respect the opportunity that is being given. Support is provided for the project from JICA and Sanyu Consultants in designing the irrigation system. Project hasn't started yet but the process is in place.
- During Indonesian occupation, the farmers of Maliana realized the potential of the Maliana flood plain. Irrigation land is a valuable resource that must be given care.

Explains you are the beneficiaries of a <u>new</u>, big project → so that development stages of the past such as buildings, and fruit trees need to be removed for this project implementation.
Started understanding the potential of irrigation in Portuguese time, Maliana expanded substantially in Indonesian time, when the intake gates were built, this allowed the development of Primary canals. This project will aim to rehabilitate these intake and canals.
Secondary canals were developed in Indonesian time, this project will rehabilitate these.

- JICA aim to "support' this irrigation project, not just by providing a short term INPUT of money, providing paid employment, but this is about long term productivity of Maliana.
- The need to construct a meeting house as a goal of this project is because there will require many decision making processes and problem solving events. The project will require the contribution of some land for this meeting house and this will need to be clarified during this meeting.
- We will ALL benefit a lot from this project so we need to understand that there will be contribution & sacrifices. With this contribution confirmed today the project could then go ahead to the next stage.
- MAFF Maliana Irrigation currently only has 1 staff, Alfredo and there is a proposed 2nd staff from Liquisa, who are responsible for such a large resource → so how are we going to maintain such a large resource? → In Indonesian time, we maintained the system, so can we maintain it now, I believe so, there will be many problems that we will need to resolve.

- If we increase PRODUCTION and increase FOOD Availability → then WHO benefits → those who benefit should maintain the resource → this is YOU, do you want this responsibility, if so you will need to form an association, such as the associations formed in Indonesian times called PPPA or what we will call in this project, WUA (Water Users Association).

Why do we need a WUA? Because there are many beneficiaries → if the water flows ALL will benefit but also ALL need to contribute → so we need 'representatives of each WUA and a board to manage these. (President, Vice President, Treasurer, Secretary). The functioning of the irrigation is important and sustainability will rely on the system being maintained constantly.

- <u>Problem Solving process</u>

Farmer → uses WUA first, → then Board → then Irrigation Division / District Administration → MAFF → other GoTL Ministry will have representatives at WUA meetings → but this is your resource, the WUA needs to control.

There is no need to solve problems with arguments and fighting or police → need to sit together with 1 representative of each household and the WUA can resolve, not MAFF or police first, so we need a stable working environment.

Big decisions, particularly about the water sharing amounts, will be made at WUA meetings. 1 person will be responsible for actually opening the gates but the decisions / plan and schedule will be made by all members of the WUA. → so there will need to be COORDINATION between each of the WUA's → we will need to improve our capacity to manage the irrigation system and to coordinate the activities of each WUA. → there will be a need for 'LEADERS' who will need to decide their own 'Job Descriptions and Responsibilities'

10.13 (Alfredo) Asks for confirmation of - land area, Number of people → outlined the importance of clarifying ALL the members of the WUA beneficiaries. (participants were shy). Alfredo reads out ALL group names and asks for a show of hands from the participants who are representing each group attending this meeting. Alfredo confirms that it will be the DIO responsibility to provide a current list of group names, numbers and members.

10.21 (Alfredo) Outlines the workshop here is a process of feedback, flexibility, and participation starts now. No complaints later once the project has started.

- Components of the project

What does rehabilitation mean, difference between construction? Then there is the New area of construction / lengthening the canal.

- Asks about confirmation of the cropping pattern.
- Explains the importance of strengthening the WUA management capacity.
- Outlines the need to identify all the lengths of canal by group, then WHO is responsible for the repair, construction and maintenance.
- This is why it is important for accurately identifying All the People / households / areas of paddy and fields.
- Problem solving / Decision making → there is a need for protocol → system of allocating decision-making responsibilities → 1 household – 1 representative in problem solving.

Preparation of Non-Physical (or soft) component of the project, which will include training and monitoring. Will need to form a Board of WUA, including a President, Vice President, Treasurer, and Secretary. A manual of regulations will be prepared.

- Will need to have an election → so we need candidates for leaders of WUA groups and the Board of representatives → needs to be a democratic process, including photos of the candidates and an election date for choosing the best people.

There will be problems and benefits with a change to the current irrigation system → it will mean a change in cropping pattern.

- Alfredo asks the Question *Question:* 'during the Construction phase it will be the dry season – Can you tell us if are you are willing to receive this project and do the necessary work required to complete the construction?' Crowd replies "We will work and receive the project".

Feedback from Chief of Odomau village (Salomau) " NO group or Nobody in the community will complain or make problems"

Alfredo talks about increasing the volume of water intake from 1 $m^{3/s}$ to 1.37$m^{3/s}$. Need to know when is the best time for construction, and when is timing of maintenance procedures, this will allow us for earlier cropping seasons.

Question: (Jose de Jesus, Lahomean) "What happens if there is not enough water to reach the end users of the canal system, particularly if we intend to extend the system to new areas? Why is one system longer than the other "

Q: (Manuel,) "in Portuguese times we, at the end of the canal system, had rice paddies and irrigated cropping, then after the occupation until now, there was no water → now we can only grow rain-fed maize and root crops because the irrigation water does not come down the canals → there is not enough water. So if you want us, at the end of the canals, to contribute to this project what happens if we don't get enough water → what will be our return on investment? Why should we contribute before we get any result? How will we survive in the meantime? There are no roads at the proposed extension of the canals, what to do about this?

Q: (Estavoa Lopez, Namduras) "regarding the New Construction of Ramaskora and Ritabou canals; how can we expand if the irrigation water comes from the same one source as now, how do you know there will be enough water? Also, the 2 areas are not the same size! Will water be shared equally between the 2 canals 50% Ramaskora, 50% Ritabou? Will this mean 1 system gets more per hectare on average? With the new extension there will be even more demand for water → will there be enough? And will there be enough water for irrigation all year round?

Q: (Salomoa Da Cruz, Chief Odomau) Gives thanks to all, "what is the target of the 2 secondary canals now → how will we be dividing the water 'within' the WUA areas? Who decides WHO gets water from the tertiary canals, with the new project will more people or hectares be demanding more water. Who makes the new tertiary canals?

Q: (Martinho de Alamau, Chief Lahomean) there is a lot of water that can be used from the river, we don't use 100% of what goes into the canal already, so if we propose that the intake increases to 1.37$m^{3/s}$ can we still guarantee that the water will reach all the identified beneficiaries. Also, there needs to be a plan to use different amounts of water in different seasons because we don't just grow rice all year round but other crops with different water requirements. The contribution from the community farmers needs to take into account not all farmers use the same amount of water because they grow different crops at different times of the year.

The current cropping pattern in his area is December planting rice – March harvest, April plant another different crop, and August can grow another type of crop. (In line with the Cropping pattern outlined in the workshop notes, however rice has a much more 'fixed cropping pattern whereas crops and vegetables are more flexible). At present, the cropping pattern is dependant on rainfall, however with the intake and irrigation system operating, more flexibility and possibly earlier cropping will be possible.

Response: (Mr. Tsumura) the rehabilitation and construction of new intake, sediment basin and rising of the weir height will increase the flow amount of water into the system. Importantly it will be

the maintenance and cleaning of the system that will decide if all beneficiaries receive the water allocation planned. The design will be engineered to meet all targeted beneficiaries water allocation. (Alfredo) it will be the responsibility of the WUA to make decisions and plans on how the water will be allocated so that all proposed beneficiaries receive what is proposed in this project. Decisions need to be based on numbers of farmers and the area they are irrigating. This is why it is important to confirm this data at this stage of the project. Training in this decision making will be provided in the Soft Component of the project. There will need to be strict regulations on how the secondary canals are used to distribute the water so that all requirements are met. These regulations will be compiled into a manual and decided upon by the WUA, Board and MAFF.

11.43am (Vicente Guterres, MAFF Irrigation Division) Vicente outlines the obligations of MAFF /IWMD's from the workshop notes. Importantly, the list of beneficiaries and areas of irrigation are currently being clarified and Alfredo will provide the information to Mr. Tsumura.

Vicente emphasized that there needs to be a process for problem solving and agreed a system such as that below needs to be documented:

Problem → Farmer → presents problem to WUA in a group meeting

→ Group resolve the problem, if not……

→ Group leader resolves the problem, if not……

→ Group leader takes the problem to the Board President,
Vice President, they resolve problem, if not….

→ Board takes the problem to District Irrigation Officer
And D.Administrator, resolve problem, if not…

→ National Irrigation Division MAFF, resolve problem,
if not……

→ Ministry, MAFF, Internal Affairs

Vicente says arguing and fighting and the need for police will not be required in this process.

It is important that the Function of the WUA is established immediately, and then the processes and regulations need to be followed. MAFF will assist in establishing the WUA groups operating procedures and monitor the WUA activities. The WUA needs its own structure to be maintained with their own regulations on how the water will be allocated within the individual WUA group.

MAFF obligations will be to inform the WUA about the timing of Operations and Maintenance of the canals. You the farmers use the water, you will benefit, so...It is the responsibility of the WUA to collect the water fees for O/M. Vicente mentions some of the problems of the Manatutu Irrigation System and says the WUA needs to be strong and follow the regulations that the WUA decides.

Vicente outlines the costs of O/M and how MAFF will subsidize fees for first 5 years by 70%, then next 5 years for 30%, after this the WUA will be fully responsible for costs of O/M. GoTL needs participation and contribution if the nation is to develop, so MAFF will support the WUA groups but must realize that in the future your responsibility will increase. This is your project. The MAFF will be focusing on many areas of agriculture, not just irrigation, so those fortunate enough to be able to irrigate should take most responsibility.

12.02 Vicente outlines the responsibilities of the beneficiaries according to the workshop notes. States that water is free, but the facilities to distribute water are not. The tertiary canals go directly to YOUR padi, so YOU will need to build and control them. The proposal does not include tertiary canals. You will need to contribute the land for canals and the meeting room facilities. Your participation is in building Your canals.

Outlines that After construction the WUA will be making many decisions, like payments to Board, funds for O/M (how much, how to pay) and cleaning of silt and grass from the canals. Outlines

election process to elect WUA leaders, this needs to happen in March. Process will be democratic, including photos of candidates and the reasons for them to be leader. All beneficiaries need to vote.

Q: (Alberto Fernandes, Raifun) "The farmers are clear on their obligations and will need further socialization as the process of the project implementation begins. Can you clarify when the project will start? Will Government help in the election process?
Alberto also says please do not compare other places and projects to Maliana, as they believe that can guarantee success of this project, the community is ready to make contribution and participation. Maliana conditions are well understood by the farmers, this will lead to success and there is no need to bring other people from other areas to do the work in this project.
R: (Mr. Sakai☺) says in his experience that it will take at least a year before the Government of Japan and Government of Timor L. sign any agreements and then a detailed survey, architectural design and concise implementation plan will be developed. This would suggest the project will not start construction phase for 2 years. However, the first step is forming the WUA groups and strengthening the capacity of these to manage the irrigation. If this process happens rapidly and smoothly, with positive feedback from the WUA farmer groups, then maybe the process can be a little faster. Government of Japan will need some evidence that the WUA are formed and operating first.
(Mr. Sakai) he said that he is not the right person who will make the decision on this project. Because he is just an advisor for TL government, so he is on TL side. He is not sure about when the project starts to implement. The process is the government of Japan will make internal agreement first, which will take time about 1-2 years, and then they make agreement with government of Timor Leste. However, the farmers of Maliana I have show that they are committed to contribute to the sustainability of the irrigation system that will be rehabilitated and constructed by establishing an association that will manage the irrigation system.

Q: (Mr. Tsumura) There are estimated O/M costs provided in the workshop notes, do you fully understand that MAFF will only be subsidizing 70% for first 5 years, 30% for next 5 years then no more subsidy. This means that that you will need to collect a water fee, so <u>how</u> will you do this in the WUA and <u>how much</u> are you willing to pay? The project is planned to begin the physical construction phase of the project at the beginning of 2008.
R: (All) We understand the costs involved in O/M!
We will be very happy to contribute to the project and will be grateful for the increase in food production, however, if increased yields and quality are improved and there is still not a good market (price, amounts demanded, imported rice, storage infrastructure), then how will the farmers be able to pay any fees.
Q: Currently, the price for unmilled padi is 12^{c}/kg, which apparently doesn't support the cost of production → this problem needs to be solved. Could pay $1 - $2 but if there is no prices or demand for our product then how can we pay. We have the positive interest in the project, we want to contribute, we also want to increase our yields but WHO will buy our product, the government needs to buy and give a good price (requesting $1/kg). Don't want to talk politics but the Indonesian system that guaranteed that our product is purchased and at a fixed good price made farming possible. Request the Government also assist with improving the quality of our milled rice so that we can compete with the imported rice.
12.52 R: (Vicente) Answers the question with another question 'if the irrigation is operating and some areas need repair and maintenance, WHO will pay for this if the users do not pay". Provides some encouragement and outlines there will much more benefits for the whole community from this

project, not just for rice growers. Your contribution will begin with the formation of the WUA. We need direction, to show the 2 Governments that we are ready to start the project. Then MAFF and WUA can work together to make the decision quicker.
About the price of rice, MAFF cannot control the price of imports and this is what sets the price of the local rice.
Q: (Mr. Tsumura) Repeats his initial direct question "How much can you pay for WUA fee?" asks that we discuss this after lunch.
1.00pm (Alfredo) Outlines the importance of forming the WUA, using the democratic election process to find group leaders, which needs to start now so we can clarify Group name, leader, beneficiaries/ members and areas.

2.00 (Chiefs talking) *Q:* How and when are we going to have an election, based around what groups, what are the criteria to be a group (area, like 30 hectares, or by number of houses/people, water requirement????
Some confusion around this upcoming election.
A W.U.A is What?
R: WUA is:

Has a name
Represents an area / and a group of people farming that area.
Represents a group of water users.
Represents the primary group of people to solve problems

Aim is to determine how much water is required for this group ($m^{3/s}$)

Decided by area and cropping pattern (crop water requirements)
The decisions then allow for a strategy / regulation to be formulated for water allocation → so all WUA will submit a plan for their water use requirements for each WUA → then all WUA leaders and Board make decisions and a plan for the water use for the whole system → then a timetable for m^3 volumes and times for water allocation to each WUA can be formulated.

Q: (Mr. Tsumura) Repeats his initial direct question "How much can you pay for WUA fee?"

Name	$ / Ha / year
Chefe Alberto Fernandes	$1 (even more based on election promises)
Chefe Martinho	$0.50
Chefe Salomao da Cruz	$5.00 (because he knows in the dry season if he has irrigation he will be able to grow cash crops and increase his income).
Chefe Estevao Lopez	$0 (Because he hasn't seen any water yet, not pay until he gets a financial return)
Martinho de Alamau, Chief Lahomean	Can even pay $10, but everyone's cropping reason is different (food or cash) and income is not the same. Suggest fee increases as production and profits increase (like 5% of profit)

Mr. Vicente explained to beneficiaries one example of another WUA namely; Caraulun irrigation scheme, that MAFF is planning to collect 16US$/ha per year for water use.
R: The result of the village Chiefs' discussions is that they expressed US$5/ha for initial stage until profits from farming increase.
R: (Alfredo) Insists that if you want to increase $ from your land, and get irrigation, then you will need to contribute to the maintenance.
R: (Subdistrict Admin Sr Domingos) "He is confident that the design will provide ALL targeted beneficiaries with water, because of the potential volume of water that can be taken from the river. There will be a large workload managing the O/M of the system. Are the farmers ready to do the maintenance and pay for the materials?
It is important that we receive the complete and accurate number of beneficiaries / WUA members, and we need to know that ALL in the WUA are interested in the project. If all members are recorded then the water user's fee can be distributed among all so that each is a small fee. Need accurate numbers, data clarity.
The basic design is ready, the plan is ready → are you farmers??
Q: Some farmers may get to plant crops X 2 per year, whilst others only grow one, so if we all pay the same fee this does not seem fair → suggest that the fee be based on the number and area of crops grown e.g.; $5 for 2 crops, $2.50 for 1 crop. What about people who are in the irrigation area but do not use irrigation, do they have to pay for something they do not use?
If a section of the canals is broken and needs repair we need to discuss WHO will repair and WHO pays.
R: (Vicente) "we understand that people have limited cash. We need to make decisions now, who is responsible for O/M. The proposal is in design phase and is not yet fixed; YOU must make decisions, go to workshops and learn the process of participation.
The capacity of the river has been determined and now we need accurate data about numbers of people in the WUA and the area of the beneficiaries. Then we can calculate the correct maintenance costs and the water user's fee. Also we can start to plan the irrigation water schedule for allocation.
Vicente respects the people of Maliana and is confident that they <u>will</u> come up with a positive response to the responsibilities presented to the new WUA members. There will be responsibilities to utilize the funds wisely and accountability is important.
Q: (elderly farmer) "I have 2 hectare of land but because of labor and cash constraints can only use 1 hectare, what will be my water use fee.
R: (Vicente) This period of the design process is where the WUA must make decisions on how contributions to O/M are collected. Need to resolve, and now is the time to use the WUA process and the regulations YOU set, to decide payment. You will not need, arguing, MAFF or police.
Q: Understand that the community uses the canal, and understand the need to make contributions, but still there are some people who CAN get access to irrigation but chose not to use irrigation, Do they pay?
R: (Vicente) "whoever uses irrigation water must pay for the water, other small water use members will have to be determined by the WUA and the regulations they make on how much water and its cost."
Q: Some people will have a problem paying money, are there alternative methods of payment.
R: (Alfredo) "You can pay in rice or other goods, the WUA needs to make the decisions on how and the value of these products.

Q: (Mr. Tsumura) "There needs to be a President, Vice president, Secretary and Treasurer appointed and a decision made on if these appointments will be volunteers or will there be some form of payment (in cash, water or food).
R: (Chefe Salomao) These positions will be very hard work, and will need strong decision makers. He believes that the Government should play these roles at the beginning of the project. MAFF, Chefe of village and the WUA leaders need to make decisions on who and how much, particularly utilizing the district and sub-district Government officials.
R: (Alfredo) To make decisions on how to pay and how much these positions (and other expenses), we need to begin with strengthening the capacity of the WUA groups and the leaders. An outline of the training that will be provided to the WUA was discussed from the workshop notes.

(Alfredo) Summary of tasks and responsibilities

WUA formed
Board Members (4) chosen.
Survey of beneficiaries numbers, areas, water needs,
Cropping pattern detailed
Water we have, then we needs a detailed plan on how to manage it. Begin the process of setting regulations.
Determine how we will collect the water user fee and its management.
After construction obligations
Manual of regulations for operations and maintenance – workshop to assist

Outline of the Schedule of Project Implementation

The Base Design study is near completion
Now we need the WUA groups formed and trained
Then a M.O.U. between Governments can be drawn up.
Then within next 2 years implementation can begin.

(Sub district Administrator Domingos) This workshop had simple objectives to determine if members of the WUA are positive about implementing this project and if they understand the responsibilities and contributions. There are over 1000 beneficiaries that need to know about these responsibilities.
This project will utilize all of MAFF divisions, not just the Irrigation Division. The benefits of the project will flow on to all community farmers.
Gives thanks to all participants and hopes to see you all soon. The take home message from this workshop is that the community positively wants this project to go ahead and they are willing to contribute to its success.
3.00pm Workshop closed

List of Participants

No	Name	Organization
1	Yuki Kuraoka	Jica Timor Leste
2	Martinho Bili Mau	Chefe suco Lalonca
3	Jasino Araujo Soares	Com.ESQ. Maliana
4	Antonio Marques	Suco Raifun
5	Arcanjo R. Tilman	Dist. Development Officer Bobonaro
6	Juvenal C Soares	MAFP / Central
7	Manuel S. Barreto	Agriculture
8	Estavao Lopes	Agriculture
9	Natalino Araujo	Agriculture
10	Matheus Mau	Agriculture
11	Alberto A. Fernandes	Chief Village Raifun
12	Ponciano de Fatima	Village Council,
13	Paulo Afonso	Agriculture
14	Filomeno G.M.	Youth Representative/ Radio Community. Maliana
15	Domingos Monis	Chief sub-village
16	Domingos Lopes	Agriculture
17	Tome Vicenti	Representative Ritabou
18	Cristavao F.	Chief Sub-village Saunleu
19	Manuel Lopes	Agriculture
20	Jose de Jesus	Agriculture
21	Antonio Santa Cruz	Village Chief
22	Faustino R. Bere	Focal Point Meio Ambiente
23	Maria do Carmo V.Moreiro	Cabinet S.F.R. IV
24	Alipio Moniz	Community Development Officer Sub-district Maliana
25	Salomao Da Cruz	Chief Village Odomau
26	Juvinal Salvador	Agriculture
27	Joaquim M.	Aldeia Maganotu
28	Antonio	Aldeia Ritabou
29	Manuel Henrique	Agriculture
30	Luis de Oliveira	Agriculture
31	Duarte Lelo	ASC. Bobonaro
32	Rui Mamuel Lasi	Irrigation Division MAFF
33	Celestino Henrique	Irrigation Division MAFF
34	Fernando Dos Santos	Ritabou / Samelau
35	Domingos Martins	Administrator Sub-district Maliana
36	Vicente H. Guterres	Chief Irrigation National Office
37	Kazumitsu Tsumura	Sanyu Consultants
38	Pedro Laurentino da Silva	Independent Consultant/ Translator
39	Shinobu SAKAI	Advisor to MAFF
40	Robin Jong	ARO Unit JICA
41	Alcino Mauleto	Group leader
42	Chris Walsh	World Vision Food Security Officer
43	Julio Goncalves	World Vision
44	Moizes Pereira	Group leader Manama
45	Juvenal Salvador	Odamau
46	Alfredo Soares	Maliana
47	Joao justinho	Holsa
48	Dinis A	Holsa
49	Domingos M	Holsa

THE MALIANA I PROJECT WORKSHOP

1. The Workshop Memorandum

28 February 2007

MALIANA WORKSHOP
ON MALIANA I PROJECT

Note taker: Januario Viegas (Lakoda Consultancy)
Facilitator: Pedro da Silva (Lakoda Consultancy)
Alfredo Soares (Bobonaro Irrigation Section)

Agenda :

09:30 – 10:15	Opening – by the State Secretary of Region 4
10:15 – 10:30	Morning Snack
10:30 – 12:30	Project Components – by Pedro
	Confirmation of Target Irrigation Areas and Number of Beneficiaries – by Pedro
	Present Status of Operation and Management (O/M) – by Pedro
	MAFF/IWMD's Obligations to the Beneficiaries to Strengthen WUA – by Mr. Alfredo
	WUA's Obligation – by Mr. Alfredo
	Contents of Soft Component Plan for Strengthening WUA – by Pedro
	Cost of O/M and Irrigation Water Fees – by Pedro
	Further Schedule of Project Implementation – by Pedro
12:30 – 14:00	Lunch
14:00 – 15:00	Questions and Answers – Discussion
15:00 – 16:00	Questionnaire – by Pedro and Alfredo
	Additional Information
16:00 – 16:15	Closing – Pedro and the Sub-district Administrator of Bobonaro
16:15 – 16:30	Afternoon Snack and end of the workshop

Process of the workshop

All participants wrote and signed their names on the attendance lists as they entered the workshop hall. The list of participants is attached. Mr. Alfredo greeted everyone and requested someone to lead the prayer for the start of the workshop.

Opening

Speech from Mr. Jose Orlando Magno, the Director of Agriculture Region-3, mainly saying that the Maliana I Irrigation project as you all know is the agreement between the two governments, Japan and Timor-Leste. We all need to put all efforts to this project from he initial to the end. There will be sacrifices some of you might have to do. For example, let your land to used when the project in the implementation phase. Ready to stop one cropping season for the implementation of the project. This is one-time opportunity for us and it's like a miracle that we are getting this project. I believe in your commitment to realize this dream. Some of you might also think that, why it takes so long. There are steps that are included in the project activities, like study the project, exchanging notes between the governments, or within the government and implementing it. But the main important is for us to have commitment to contribute to it and maintain it in the long run. However the project surely will continue.

Speech from Mr. Lino Torrezao, the State Secretary of the Region-4, technically, I'm not knowledgeable to talk about the project. But it is a part of security development, especially the food security. Many years have passed; Maliana has been having insufficient irrigation water and several times resulted in food shortage. There will be so much improvement in the crop production with proper and improved irrigation with good knowledge of the management. We will have enough food for consumption and surely, there will be enough to sell some products to have some money. It will improve our livelihood and our economic sector. All we need is understanding each other and use the water properly, without conflicts and fights.
There are also other problems in Maliana, like electricity is not sufficiently responding people's necessities. There will be 2 generators brought to Maliana, I've contacted the National Government about it there has been agreement.
But I want to emphasize to all of you that we are very lucky to have this project you're your best to get the best, and officially open this workshop.

After opening the workshop, Pedro da Silva (Lakoda Consultancy), Mr. Domingos Martins (Bobonaro Sub-District Administrator), Mr. Jose Orlando Magno (Director of Agriculture Department Region-3) and Mr. Alfredo Soares (Irrigation Section of Bobonaro) led the workshop to the end. So the workshop started with sequent steps as follows:

Project Components

Pedro read the project components, based on the workshop material on from the paper. He explained that, as we all know from the previous workshop last year, which the project compost of rehabilitation works, some new construction works and strengthening the institutional capacity of the WUA members. It's important to have skills and knowledge to manage and operate the irrigation system by members of association.

Confirmation of Target Irrigation Area and Number of Beneficiaries

Name of Canal	Basic Design Irrigation area (ha)	Clarification, if any Irrigation area (ha)
1)Main canal	4	
2)Ramaskora secondary	743	
3)Ritabau secondary	304	
Sub-Total	**1,051**	
Total	***1384***	

Number of Beneficiaries

Village	Basic design Target area (ha)	Clarification, if any Target area (ha)	Basic design Number of Household*1)	Clarification, if any Number of Household	Number of WUA member
1) Lahomea	214		542		
2) Raifun	307		272		
3) Ritabau	326		336		
4) Odomau	82		169		
5) Holsa	122		105		
Total	**1,051**		**1,424**		

Reference: 1) Bobonaro District Administration Office (Data in 2003)
Names of water management groups

14groups in Ramaskora secondary canal (4 villages)		8 groups in Ritabau secondary group (1 village)
1. Tasi Telu	8. Dakatai Anan Laran	1. Lelo Koe
2. Guma Anan	9. Pue Talin	2. Sama Klot
3. Pas Anan	10.Pue Bouk	3. Bea bubu
4. Rea Bou Orokna	11.Rae Boe Dasna	4. Kampo aviasio
5. Robuk Anan	12.Pue Ulus Laran & Nua	5. Aikiar
6. Blae Buti	Anan Laran	6. Banegoa
7. Utedai	13.Raigeren	7. Banegot
	14.Ramas Cora	8. Holi hooq

Additional water management groups.

2 groups in Ramaskora secondary canal (___ villages)	**3** groups in Ritabau secondary group (___ village)
1. Loibane 2. Mehen	1. Sulabbibo 2. Haglai 3. Utuluk

The present state of Operation and Maintenance (O/M)

In terms of present mechanism of how to maintain the irrigation canal, Pedro threw questions based on the points on the paper about how they manage it. The participants with the president of the WUA responded:

Period	Problems	Materials and costs	Collection methods & Contribution	No. people involved	Duration
Year 2005	Broken canal – 6-8m	▪ 94 sacks of cement @ $3.50/sack ▪ Stones provided by the people ▪ Sand provided by the people ▪ Labor provided by the groups	▪ Farmers: $0.25 - $1.00/household ▪ Businessmen: $5.00 - $10.00/household ▪ Catering provided by the groups ▪ Government – Dept of Ag and Public Works	Up to 100 people – voluntarily provided labor	1 week
Year 2006	Same as above	▪ 38 wire-nets for the stones ▪ 10 truckloads of tones @ $18.00/truckload ▪ 36 sacks of cement @ $4.00/sack ▪ 8 truckloads of sand @ $20.00/truckload	▪ Gov.- Public Works – donated wire-nets ▪ Farmers: $0.25 - $1.00/household ▪ Businessmen: $5.00 - $10.00/household ▪ Catering provided by the groups	Up to 60 people – voluntarily provided labor	9 days
Year 2006	Same as above	▪ 24 sacks of cement @ $4.75/sack ▪ 6 truckloads of sand @ $20.00/truckload ▪ 8 truckloads of	▪ Farmers: $0.25 - $1.00/household ▪ Businessmen: $5.00 - $10.00/household ▪ Catering provided by the groups	Up to 40 people – voluntarily provided labor	3 days

		stones @ $20.00/truckload	▪ Some cement sacks donated by local Agriculture department and Public Works		

The practices of the irrigation canal are:

1. Removal of sedimentation at sediment basin – people are appointed representing each farmer group – duration up to 2 days
2. De-silting main and secondary canals – each groups is responsible to de-silting the canal passing through their areas – duration up to 2 days
3. The method they use to do fees collection, decision making, and notification – the farmers groups hold meeting and decide on writing invitations, the village chief are responsible for distribution of the invitation letters to the stakeholders to contribute to the irrigation canals.
4. The collections are done on the time of distribution the invitation letters by visiting the targets. The contribution can be in-kind and/or money from various people in the community.

MAFF/IWMD's Obligation to the Beneficiaries to Strengthen WUA

Mr. Alfredo read the Policy for WUA and O/M of Irrigation Facilities and WUA's Obligation to the participants and explained as he read along.

He also presented 2 models of the WUA current Structure. Both models are attached. Mr. Alfredo explained the structure to the participants. He said that there are 2 kind models that we prepare. He explained each position of the structure and their tasks. The structure is based on the election by the entire farmers group. We elected them based our mutual trusts.

Contents of Soft Component Plan for Strengthening WUA

Pedro read the stages in from the paper of the workshop about the soft component plan to strengthen the capacity of the WUA to manage the irrigation water. He emphasized that the WUA is like an organization, which the members should have system and regulation to do activities with skills and knowledge of institutional. Therefore it's important for the WUA members to be trained and formulate manual to guide them. A number of workshops will be conducted to the members of WUA for these reasons. Also study tour to the existing and established Irrigation Water Association in Laclo to gain more ideas as inputs to this association.

Cost of O/M and Irrigation Eater Fee

Pedro read and explained about the table from the workshop paper:
The annual average O/M cost
Subsidy from MAFF
Necessary annual water from WUA
Necessary annual water fee collected from WUA/ha
Pedro asked them, if they had different thoughts on this matter, they responded that they are willing to follow the cycle and happy to pay the fee.

And WUA members and group leaders agreed for paying US$5.5/ha for first cycle and told that they hopefully to enable to pay US$15.5/ha for second cycle also if paddy increased after 5 years with better irrigation. However, group leaders said that they must have internal meeting with beneficiaries of his group for finalization, later on.

Further schedule of the project implementation

Explanation by Pedro according to the table from the workshop contents.

Questions and Answers - Discussion

Mr. Alfredo and Pedro facilitated this session by giving 5 people to ask or make suggestion first round. There 3 rounds and each round only 5 people could talk. These 15 people shall represent villages.

First Round:

1. Mr. Ponciano Afonso, sub-village chief – he suggested that there is a need to have canal to the airport area.
   Mr. Alfredo responded saying that the project has been planned and will follow the plan. The sub-district administrator (SDA) Bobonaro also said that we need to stick to current plan. Once this project is done we will have enough resources to expand our irrigation area. I believe we can do it in future. As long we manage this irrigation system properly.
2. About the fee $5.50/ha per year – what about people who don't plant the crop, do they have to pay too?
   Mr. Domingos Martins, the SDA Bobonaro responded – we should only pay the fee if we planting crop based on the size of the paddy. But if we don't plant, you should not pay. Remember that when the irrigation improved, we all will plant. There's no reason why we don't plant the crops. As stated before that when you plant the crop, you pay $5.50/ha. And if you have two hectare, you must pay $11.00. This will be written in the WUA regulation. Because the money will go to the association and for association to manage and maintain the irrigation system of Maliana I.

3. Mr. Martinho, farmer – I do not have water for my paddy. Can you arrange so that the water comes to my paddy from the Hospital.
   Mr. Domingos, Bobonaro SDA responded – the water always flows to relative areas and it's up to us to go and direct the water to our paddy. We can't expect water to flow by itself to our paddies.
4. Mr. Felix Soares, Holsa – why area Mehen is not in the list of the project? I suggested to irrigate also Mehen area
5. The water is enough to reach Mehen area, but there are so many people before that and the amount of water reduces when reach Mehen.
   Mr. Domingos responded – case number 4 and 5 are related. The project is to improve the irrigation canal and management water will be improved. So surely there will be enough water.
   Pedro – Maliana I irrigation canals will be repaired and with additional gates and under proper management will improved the amount of water. So it will last for hundred of years.
   Mr. Jose Orlando Magno, Region-3 Agriculture Director – I want to clarify that this workshop has been done last year and now we all have the ideas about it. I suggest that you should ask questions based on the designed project. If there is a problem please consider as internal issue.
   Mr. Alfredo – we now should focus on this project. If there is more we need we can add after the project is finished and we can approach other donors to support any additional necessities. We need to show our credibility with this project. Do not forget that we have opportunities.

Second Round

1. About lending land with trees for the project voluntarily, I don't mind. But what about graves and houses that are happen to be on the sites where the project is implemented?
   Mr. Domingos Martins, Bobonaro SDA responded – based on the land law in Timor-Leste, that the houses should be 6m from the road and certain meters from the irrigation canal. So if you

houses happen to in the way, they should be demolished without reimbursement. Or this project won't happen?
Lahomean chief of village said – we all have agreed to this project through our meetings. So we do not need ask something that we already know. As a chief of village, who is elected by my people, I believe that there is no problem about sacrificing our lands and anything in order to realize this project.

2. Domingos Lopes, Raifun – if the soil slides and stop the water to flow, what do we do?
   Pedro responded – unless the area is not part of the project, I'm sure the project of rehabilitation and additional of new facilities will improve the irrigation system.
3. Filomeno, Maliana Community Radio – some paddies are cultivated after the rain season, are they paying the irrigation water user fee as well?
   Mr. Domingos responded – as long we use irrigation water for the paddy, we are entitled to pay the fee.
4. Martinho, Lahomean – for those who are not in the list as Maliana I irrigation beneficiaries, are they pay the fee too?
   Mr. Domingos responded – they have to pay too.
5. Holsa Chief village – I suggest that, to avoid the conflict about uneven of irrigation water distribution, we should see the example on Tunu-bibi irrigation system, where people grow crops three times a year. The water of that irrigation system distributed evenly to each turnout.
   Pedro responded – it is good idea to see and learn from other irrigation systems. However, it depends on the condition of land surface. Maliana I irrigation system is different because the land surface is sloping. On the other hand, the Tunu-bibi irrigation system, the land is flat.

Third Round

1. Cristovao Fernandes – giving up one cropping season is quite a sacrifice, how will we have food without growing crops for one season? We might need food support for that
   Mr. Alfredo responded – we need to keep enough food for that time. Also some paddies will be able to grow. We can manage to do that. This is important for our future, and we need to sacrifice once for good.
2. Caetano – study tour to Laclo is not going to help us to learn anything. I suggest going to Bali. Because Balinese have so much experience in organized farming for long time.
   Pedro – I do not make decision about where to go for study tour. But as you all know that it's has been planned in the project. It might affect the plans. But I will put this in the report and hoping JICA to respond.
3. Antonio, Holsa – we need to confirm the location for the O/M facility building.
   All agreed that the location of the building is in **"Raebou Laun"**. After the completion of the building, they request for:
   1) Drinking water pipes installation
   2) Solar panel for the power
   3) A type writer for the administration work of WUA
4. The Lahomean chief of village stressed to the participants that, the land for the building is very essential. If this forum does want to decide the exact location, I will give my land to build the building. I'm very sure we will provide whatever it takes to realize this project. I want to stress out to all my people in Lahomean, that every property on the project area should be demolished without any reimbursement. The law says that the distance of house should be 5 m from the irrigation canal.
5. The workshop forum appointed out 2 Gate Keepers. They are **1) Moises Pereira and 2) Carlito Asabau**.

Questionnaire to WUA/Farmers

There were **57** questionnaires dticked and filled by the participants.

Before rehabilitation of Maliana I Irrigation facilities

1. Do you agree rehabilitating Maliana I Irrigation Scheme?
   57 Yes, 0 No, 0 No Comment
2. How much did you pay for water fee and/or repairing irrigation facilities last year?
   6 nil, **5 US$0–0.25**, **10 US$0.25–0.5**,
   5 US$0.5–0.75, **24 US$0.75–1.0,** **2 US$1.0–1.5**,
   3 US$5.0–7.5
3. Did you provide construction material in free for repairing irrigation facilities last year?
   22 Nil **22** Cement **12** Gravel (stone) **5** Sand
4. Did you participate for maintenance work last year? Not filled =**3**
   5 Nil, **9** Making of masonry wall at Intake, **9** Removing of sedimentation at sediment basin
   33 De-silting of main and/or secondary canals, **13** Removing of weed

If yes,

4.1 How many days did spend for the above works in total last year? (not filled 3)
7=1 day, **17**=2 days, **6**=3–5 days, **12**=5–7 days, **13**=More than 7 days,

During construction

5. Do you agree to construct Tertiary earth canal? Not filled=**3**
   50=Yes **1**=No **3**=No Comment
6. Do you agree to stop cultivation in one dry season? Not filled=3
   49=Yes **2**=No **2**=No Comment
7. Do you lend your land in free for temporary construction road along canal, if necessary?
   54=Yes **2**=No **2**=No Comment
8. Do you provide your land in free for canal expansion, if necessary? Not filled=1
   56=Yes **1**=No **0**=No Comment

After construction

9. Do you pay for irrigation water fee to WUA? Not filled=3
   50=Yes **2**=No **1**=No Comment

If yes,

9.1 How much or rice equivalent to amount of money can you pay? Not filled = 7
2 nil, **5** US$0–0.25, **4** US$0.25–0.5, **1** US$0.5–0.75, **9** US$0.75–1.0,
3 US$1.0–1.5, **3** US$1.5–2.0, **12** US$4.0–5.0, **6** US$5.0–7.5, **1** US$7.5–10.0,
1 US$10–12.5, **1** US$12.5–15.0, **1** US$17.5–20, **2** More than US$25

10. Are you ready to contribute something for maintenance of irrigation facilities? Not filled=4
    51=Yes **0**=No **1**=No Comment

If yes,

12.1 Do you work in free on de-silting of canals before cultivation starts? Not filled=4
42=Yes **8**=No **1**=No Comment

12.2 Can you provide in free material for repairing canals such as cement, gravel, sand, etc, if necessary? Not filled=6
45=Yes **7**=No **2**=No Comment

B. Questionnaire to Agriculture Service Center (ASC)

The following information was provided by Mr. Vitor Pires Sousa, the Manager of ASC of Bobonaro.
ASC can afford to buy 600 tones of rice every year from the farmers. But up to now they could only buy around more than 100 tones/year.
He said that, surely after the improvement of irrigation system of Maliana I, the crop production will increase.

Yield and price

	Unit yield	Selling price by farmers		
		to ASC Price	to Maliana market	to Middleman
Irrigated Paddy	2.5 tones / ha	US$0.13/kg	US$0.25/kg	US$0.25/kg
Rain-fed paddy	1.5-2.0 tones/ ha	US$ 0.13/kg	US$0.25/kg	US$0.25/kg
Maize	tones/ ha	US$0.25/kg	US$0.30/kg	US$0.30/kg

Prepared By:
Pedro Laurentino da Silva
Coordinator:
Lakoda Consultancy-Timor Leste (LCTL)

PARTICIPANTS LIST

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2	Agustu Caitano	Vice Presidente	
3	Justino Soares	Tersoreiro	
4	Filomeno G Mangalesh	R.C.M	
5	Leao monteiro	Exentinits PPN	
6	Faustinho N Bere	Meio Ambiente	
7	Jacinto Daci Bere	Robukanan	
8	Aleixo Soares	Agrikultura	
9	Tome Vicente	Raifun	
10	Dominggos Lopes	Raifun	
11	Natalino	Raifun	
12	Manuel Laka Soru	Raifun	
13	Laurentino Rodafi	Raifun	
14	Fonsiano Mau	Ritabau	
15	Cosme Soares	Raifun	
16	Felis Soares	Holsa	
17	Juvinal Salvador	Odomau	
18	Armando Maia	Raifun	
19	Eusebio Caeiro	Raifun	
20	Jose Cardoso	Lahomea	
21	Oscaar Purificasaun	Batugade	
22	Vicente Bello	Lahomea	
23	Elias Barreto	Odomau	
24	Adriano Tito	Odomau	
25	Martino	Odomau	
26	Cristovao Fernandes	Ritabau	
27	Abel Asa	Ritabau	
28	Duarti Jose	Lahomea	
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30	Albertu Amaral Fernandes	Chefi Suko Raifun	
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32	Aleixo Barreto	Chefi Aldeia	
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37	Carlos A.S Cardoso	Land Propety	
38	Celestino M.L	Pescas	
39	Mateus Monis	Ritabau	
40	Celestino Hendriques	Ofisial Irigasaun	
41	Sabino Araujo Soares	PNTL	

42	Jose Mauloco	Lahomea	
43	Aniseito Maubuti	Lahomea	
44	Eugenio Borges	Agri Bisnis	
45	Alfredo Soares	Ofisial Irigasaun	
46	Rui Manuel Lasi	Agri Bisnis	
47	Isach Martins	Ritabau	
48	Humberto Leto	Ritabau	
49	Llukas Freitas	Ritabau	
50	Lorenso Mangalesh	Ritabau	
51	Victor P Sousa	ASC Bobonaro	
52	Moises Timor Oan	Lahomea	
53	Martinho Vicente	Lahomea	
54	Fransisco CAP	Lokal Konsultan Irigasaun	
55	Maria Gomes Barros	Irigasaun WUA	
56	Armindo Soares	Seguransa Civil	
57	Hernani De Araujo	Seguransa Civil	
58	Olivio Reis Mendonsa	Kamaskora	
59	Armenio Do Monis	Lahomea	
60	Joanita Soares	Lahomea	
61	Juvinal Mau Bau	Lahomea	
62	Santina CBM	Lahomea	
63	Dominggos Armando	Lahomea	
64	Jose Pirres	Lahomea	
65	Minguel Armando	Lahomea	
66	Napoleao Lopes	Lahomea	
67	Dominggos Amaral	Lahomea	
68	Raimundo Martins	Lahomea	
69	Armindo Maumeta	Lahomea	
70	Lino De Jesus Torresao	Secretario Estadu	
71	Pedro Da Silva	Faciltator	
72	Januario Nunes Viegas	Nota taker	
73	Dominggos Martins	Admistrador Sub Distric	
74	Jose Orlando Magno	WAFP	
75	Martinho Bili	Chefi Suko	
76	Salomao Da Crus	Chehfi Suko	

Dimension of Existing Main Canal

Section name	Section (survey point)		Section length	Bottom width	Crest width	Retention wall	Bank gradient	Section gradient		Section shape
	starting point	end point	L (m)	B (m)	W (m)	Heght H (m)	1 : N	I	I	
A	STA.0+030	STA.0+070	40	2.00	2.20	1.00	0.10	0.004000	1/250	trapezoidal open canal
B	STA.0+070	STA.0+340	270	2.40	4.40	1.00	1.00	0.003333	1/300	trapezoidal open canal
C	STA.0+340	STA.0+660	320	2.10	3.80	1.00	0.85	0.000556	1/1,800	trapezoidal open canal
D	STA.0+660	STA.0+690	30	1.20	1.30	1.10	0.05	0.002857	1/350	Flume canal
E	STA.0+690	STA.0+740	50	1.20	1.30	1.10	0.05	0.002857	1/350	Culvert Canal
F	STA.0+740	STA.0+815	75	1.60	1.60	1.80	0.00	0.005000	1/200	Aqueduct
G	STA.0+815	STA.1+175	360	1.10	2.90	1.20	0.75	0.004000	1/250	trapezoidal open canal
H	STA.1+175	STA.1+527	352	1.50	3.30	1.00	0.90	0.002222	1/450	trapezoidal open canal
Total or mean	STA.0+030	STA.1+527	1,497	1.64	2.60	1.15	0.46	0.003103	1/320	

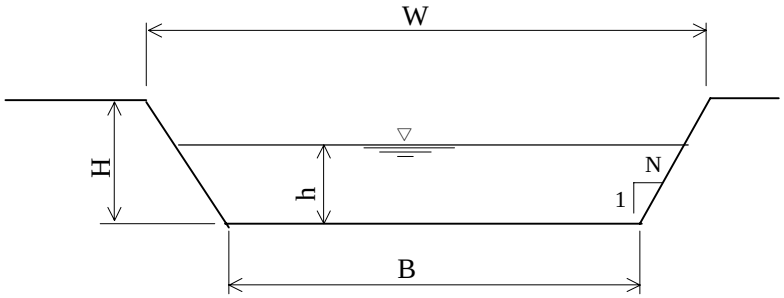
Dimension of Existing Ramaskora Secondary Canal

Section name	Section (survey point)		Section length	Bottom width	Crest width	Retention wall	Bank gradient	Section gradient		Section shape
	starting point	end point	L (m)	B (m)	W (m)	Heght H (m)	1 : N	I	I	
A	STA.0+000	STA.0+355	355	1.80	3.50	0.80	1.06	0.002500	1/400	trapezoidal open canal
B	STA.0+355	STA.0+710	355	1.40	2.70	0.70	0.93	0.003333	1/300	trapezoidal open canal
C	STA.0+710	STA.1+040	330	0.80	0.90	0.85	0.06	0.010000	1/100	Flume canal
D	STA.1+040	STA.1+470	430	1.20	2.50	0.65	1.00	0.005000	1/200	trapezoidal open canal
E	STA.1+470	STA.1+573	103	1.00	2.40	0.55	1.27	0.005556	1/180	trapezoidal open canal
Total or mean	STA.0+000	STA.1+573	1,573	1.24	2.40	0.71	0.86	0.005278	1/190	

Dimension of Existing Ritabau Secondary Canal

Section name	Section (survey point)		Section length	Bottom width	Crest width	Retention wall	Bank gradient	Section gradient		Section shape
	starting point	end point	L (m)	B (m)	W (m)	Heght H (m)	1 : N	I	I	
A	STA.0+000	STA.0+210	210	1.10	2.40	0.60	1.08	0.001429	1/700	trapezoidal open canal
B	STA.0+210	STA.0+760	550	1.00	2.10	0.60	0.92	0.002000	1/500	trapezoidal open canal
C	STA.0+760	STA.1+025	265	1.10	2.20	0.60	0.92	0.005000	1/200	trapezoidal open canal
D	STA.1+025	STA.1+400	375	1.20	2.40	0.60	1.00	0.005000	1/200	trapezoidal open canal
E	STA.1+400	STA.2+000	600	0.80	2.00	0.55	1.09	0.006250	1/160	trapezoidal open canal
F	STA.2+000	STA.2+600	600	0.80	1.90	0.55	1.00	0.005000	1/200	trapezoidal open canal
G	STA.2+600	STA.2+890	290	0.80	1.90	0.55	1.00	0.005000	1/200	trapezoidal open canal
Total or mean	STA.0+000	STA.2+890	2,890	0.97	2.13	0.58	1.00	0.004240	1/240	

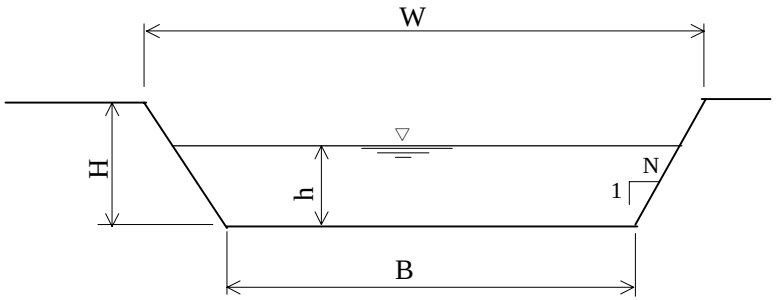
Conveyance Capacity of Existing Main Canal



Item	Sign	Unit	Maliana I Main Canal							
			Section A	Section B	Section C	Section D	Section E	Section F	Section G	Section H
Canal type	–	–	Open Canal			Flume canal	Culvert	Aqueduct	Open Canal	
Cross section	—	—	Trapezoidal				Longutudinal		Trapezoidal	
Section	STA.	m	STA.0+030 ～0+070	STA.0+070 ～0+340	STA.0+340 ～0+660	STA.0+660 ～0+690	STA.0+690 ～0+740	STA.0+740 ～0+815	STA.0+815 ～1+175	STA.1+175 ～1+527
Section Length	L	m	40	270	320	30	50	75	360	352
Bottom width	B	m	2.00	2.40	2.10	1.20	1.20	1.60	1.10	1.50
Crest width	W	m	2.20	4.40	3.80	1.30	1.30	1.60	2.90	3.30
Ret.wall height	H	m	1.00	1.00	1.00	1.10	1.10	1.80	1.20	1.00
Ret.wall slope	N	—	0.10	1.00	0.85	0.05	0.05	0.00	0.75	0.90
Cross sectiongradient	I	—	1/250	1/300	1/1,800	1/350	1/350	1/200	1/250	1/450
			0.004000	0.003333	0.000556	0.002857	0.002857	0.005000	0.004000	0.002222
Roughness coef.	n	—	0.032	0.032	0.032	0.032	0.025	0.015	0.032	0.032
Water depth	h	m	0.70	0.70	0.70	0.80	0.80	0.80	0.90	0.70
Flow section	A	m^2	1.45	2.17	1.89	0.99	0.99	1.28	1.60	1.49
Wetted perimeter	P	m	3.41	4.38	3.94	2.80	2.80	3.20	3.35	3.38
Hydraulic depth	R	m	0.425	0.495	0.479	0.353	0.353	0.400	0.477	0.441
Flow velocity	V	m/s	1.12	1.13	0.45	0.83	1.07	2.56	1.21	0.85
Discharge	Q	m^3/s	1.62	2.45	0.85	0.83	1.06	3.28	1.93	1.27

Manning' Formula : $Q = A \times 1/n \times R^{2/3} \times I^{1/2}$

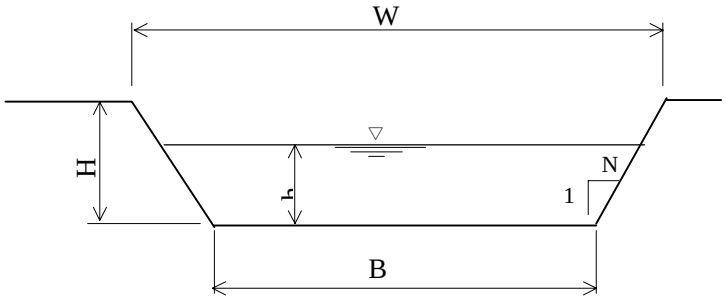
Conveyance Capacity of Existing Ramaskora Secondary Canal



Item	Sign	Unit	Ramaskora Secondary Canal				
			Section A	Section B	Section C	Section D	Section E
Canal type	–	–	Open Canal				
Cross section	—	—	Trapezoidal				
Section	STA.	m	STA.0+000 ～0+355	STA.0+355 ～0+710	STA.0+710 ～1+040	STA.1+040 ～1+470	STA.1+470 ～1+573
Section Length	L	m	355	355	330	430	103
Bottom width	B	m	1.80	1.40	0.80	1.20	1.00
Crest width	W	m	3.50	2.70	0.90	2.50	2.40
Ret.wall height	H	m	0.80	0.70	0.85	0.65	0.55
Ret.wall slope	N	—	1.06	0.93	0.06	1.00	1.27
Cross sectiongradient	I	—	1/400	1/300	1/100	1/200	1/180
			0.002500	0.003333	0.010000	0.005000	0.005556
Roughness coef.	n	—	0.032	0.032	0.032	0.032	0.032
Water depth	h	m	0.55	0.45	0.60	0.40	0.35
Flow section	A	m^2	1.31	0.82	0.50	0.64	0.51
Wetted perimeter	P	m	3.40	2.63	2.00	2.33	2.13
Hydraulic depth	R	m	0.385	0.311	0.250	0.275	0.237
Flow velocity	V	m/s	0.83	0.83	1.24	0.93	0.89
Discharge	Q	m^3/s	1.08	0.68	0.62	0.60	0.45

Manning' Formula : $Q = A \times 1/n \times R^{2/3} \times I^{1/2}$

Conveyance Capacity of Existing Ritabau Secondary Canal



Item	Sign	Unit	Ritabau Secondary Canal						
			Section A	Section B	Section C	Section D	Section E	Section F	Section G
Canal type	–	–	Open Canal						
Cross section	—	—	Trapezoidal						
Section	STA.	m	STA.0+000	STA.0+210	STA.0+760	STA.1+025	STA.1+400	STA.2+000	STA.2+600
			～0+210	～0+760	～1+025	～1+400	～2+000	～2+600	～2+890
Section Length	L	m	210	550	265	375	600	600	290
Bottom width	B	m	1.10	1.00	1.10	1.20	0.80	0.80	0.80
Crest width	W	m	2.40	2.10	2.20	2.40	2.00	1.90	1.90
Ret.wall height	H	m	0.60	0.60	0.60	0.60	0.55	0.55	0.55
Ret.wall slope	N	—	1.08	0.92	0.92	1.00	1.09	1.00	1.00
Cross sectiongradient	I	—	1/700	1/500	1/200	1/200	1/160	1/200	1/200
			0.001429	0.002000	0.005000	0.005000	0.006250	0.005000	0.005000
Roughness coef.	n	—	0.032	0.032	0.032	0.032	0.032	0.032	0.032
Water depth	h	m	0.40	0.40	0.40	0.40	0.35	0.35	0.35
Flow section	A	m^2	0.61	0.55	0.59	0.64	0.41	0.40	0.40
Wetted perimeter	P	m	2.28	2.09	2.19	2.33	1.84	1.79	1.79
Hydraulic depth	R	m	0.269	0.262	0.268	0.275	0.225	0.225	0.225
Flow velocity	V	m/s	0.49	0.57	0.92	0.93	0.91	0.82	0.82
Discharge	Q	m^3/s	0.30	0.31	0.54	0.60	0.38	0.33	0.33

Manning' Formula : $Q = A \times 1/n \times R^{2/3} \times I^{1/2}$

6-7 Record of Proposed Canal Structure

Proposed Main Canal

No.	Name of Structure	No. of Structure	Station	Location	Elements	Remarks
1	Main canal B.P.	—	0 + 030	—	B: 2.1m x H: 1.0m	Trapezoidal canal
2	Side ditch type spillway	—	0 + 050	Right bank	L: 2.5m x ⊿H: 0.3m x 2sets	with stop-log, repairing joint and mortar
3	River protection work	—	0 + 090	Right bank	H: 5.0m x L: 20.0m	new construction：wet masonry work
4	Wooden footbridge (No.1)	—	0 + 150	—	W: 0.5m x L: 4.5m	Overall restoration、
5	Drainage crossing work (No.1)	—	0 + 160	Left bank→ Right bank	corrugated pipe D 1,000mm x 1sets	Partial rehabilitation：outlet wet masonry, H: 3.0m x L: 10.0m
6	Wooden fence(No.1)	—	0 + 165	—	H: 1.0m	Conventional wooden fence, remove
7	Right bank wet masonry work (No.1)	—	0 + 170	Right bank	H: 3.5m x L: 20.0m	New construction：wet masonry work
8	Right bank wet masonry work (No.2)	—	0 + 235	Right bank	H: 3.5m x L: 10.0m	New construction：wet masonry work
9	Small-sized turn out (No.1)	—	0 + 312	Right bank	Hole around D100mm	Rehabilitation：stop-log type
10	Transition	BM-1	0 + 340	—	Partial flume type	Use existing one, removal of broken measuring device
11	Scouring gate	BM-2	0 + 412	Right bank	steel-made slide gate B: 1.5m x H: 1.2m x 2sets	Gate body：Overall rehabilitation, Connective side-wall：partially utilize (repair with mortar) Bottom of scoring sluice：rehabilitation
12	Drainage crossing work (No.2)	—	0 + 425	Left bank→ Right bank	corrugated pipe D 1,000mm x 1sets	Use existing one
13	Concrete footbridge	—	0 + 430	—	W: 0.5m x L: 4.5m	Use existing one
14	Small-sized Turn out (No.2)	—	0 + 430	Right bank	Hole around D100mm	Rehabilitation：stop-log type
15	Wooden fence (No.2)	—	0 + 465	—	H: 0.8m	Small-sized wooden fence, remove
16	Washing basin (No.1)	—	0 + 500	Left bank	L: 1.5m x H: 0.3m x 1step	Overall repairing
17	Wet masonry work	—	0 + 550	Right bank	H: 2.5m x L: 19.0m	New construction：wet masonry work
18	Drainage crossing work (No.3)	—	0 + 575	Left bank→ Right bank	Corrugated pipe D 1,000mm x 2sets	Use existing one, wooden fence remove
19	Small-sized Turn out (No.3)	—	0 + 580	Right bank	Hole around D100mm	rehabilitation：stop-log type
20	Flume canal B.P.	—	0 + 660	—	B: 1.7m x H: 1.3m	Trapezoidal canal, examine section again
21	Covered flume canal B.P.	—	0 + 693	—	B: 1.2m x H: 1.1m	Trapezoidal canal, examine section again
22	Covered flume canal E.P.		0 + 730	—	B: 1.2m x H: 1.1m	Trapezoidal canal, examine section again
23	Aqueduct B.P.	BM-2a	0 + 742	—	B: 1.8m x H: 1.0m	Trapezoidal canal, examine section again
24	Aqueduct E.P.	BM-3	0 + 805	—	B: 1.8m x H: 1.0m	wet masonry work and wooden stepping board rehabilitation
25	Vertical drop work (No.1)	BM-4	0 + 843	—	⊿H: 1.5m x W: 2.0m	50% repairing with mortar
26	Washing basin (No.2)	—	0 + 865	Left bank	L: 2.0m x H: 0.3m x 1step	Overall repairing
27	Transient point of canal section	—	0 + 911	—	W:3.1～1.6m x H: 0.7m x N: 1.0	
28	Corrugated footbridge	—	0 + 915	—	W: 1.0m x L: 2.5m	Use existing one
29	Corrugated footbridge	—	0 + 935	—	W: 1.0m x L: 2.5m	Use existing one
30	Washing basin (No.3)	—	0 + 995	Left bank	L: 1.0m x H: 0.3m x 2steps	Overall repairing
31	Concrete bridge	—	1 + 000	—	W: 2.5m x L: 3.0m	Use existing one
32	Domestic water pipe crossing work	—	1 + 015	—	D30mm x L: 4.m	Use existing one
33	Small-sized Turn out (No.4)	—	1 + 060	Right bank	D300mmpipeturn-out	Rehabilitation：stop-log type
34	Drainage crossing work (No. 4	—	1 + 075	Left bank→ Right bank	corrugated pipe D 1,000mm x 1set	Partial rehabilitation：outlet wet masonry, H: 4.0m x L: 10.0m x 3sites
35	Wooden footbridge (No.2)	—	1 + 100	—	log 2piece	Overall restoration
36	Washing basin (No.4)	—	1 + 125	Left bank	L: 2.0m x H: 0.3m x 2steps	Overall repairing
37	Wooden footbridge (No.3)	—	1 + 130	—	log 2piece	Overall restoration
38	Wooden footbridge (No.4)	—	1 + 140	—	log 2piece	Overall restoration
39	Washing basin (No.5)	—	1 + 145	Left bank	L: 2.0m x H: 0.3m x 1step	Overall repairing
40	Vertical drop work (No.2)	BM-5	1 + 175	—	⊿H: 0.6m x W: 2.0m	Overall rehabilitation
41	Washing basin (No.6)	—	1 + 220	Right bank	L: 2.0m x H: 0.3m x 1step	Overall repairing
42	Washing basin (No.7)	—	1 + 230	Right bank	L: 2.0m x H: 0.3m x 1step	Overall repairing
43	Washing basin (No.8)	—	1 + 238	Right bank	L: 2.0m x H: 0.3m x 2steps	Overall repairing
44	Domestic water pipe crossing work	—	1 + 294	—	D75mm x L: 4.m	Use existing one
45	Washing basin (No.9)	—	1 + 300	Right bank	L: 2.5m x H: 0.45m x 3steps	Overall repairing
46	Washing basin (No.10)	—	1 + 350	Left bank	L: 1.0m x H: 0.3m x 1step	Overall repairing
47	Wooden footbridge (No.5)	—	1 + 375	—	log: 1piece + board: 1pc. x L: 3.0m	Overall restoration
48	Washing basin (No.11)	—	1 + 380	Left bank	L: 1.0m x H: 0.3m x 1step	Overall repairing
49	Lining B.P.	—	1 + 420	—		
50	Washing basin (No.12)	—	1 + 485	Left bank	L: 4.5m x H: 0.4m x 3steps	Overall repairing
51	Drainage inlet work (No.1)	—	1 + 490	Left bank	W: 1.0m x H: 0.7m	Use existing one
52	Turn out (No.5)	BM-6	1 + 527	—		Overall rehabilitation

Note) Use existing one, Overall restoration, Overall repairing and Overall rehabilitation in the column of remarks are based on the site observation. Hence, it will be re-examined in the homework in Japan.

Proposed Ramaskora Secondary Canal

No.	Name of Structure	No. of Structure	Station	Location	Elements	Remarks
1	B.P. of Sec. Canal	—	0 + 000	—	B: 2.4m x H: 1.1m x N: 1.0	Trapezoidal canal, paved with block（W= 1m）
2	Concrete bridge	—	0 + 050	—	W: 3.5m x L: 4.0m	Use existing one, exclusive of concrete block factory
3	Domestic water intake（No.1）	—	0 + 060	Left bank	D38mm pipe	Use existing structure
4	Washing basin（No.1,No.2）	—	0 + 075	Both banks	L: 1.0m x H: 0.4m x 2steps	Overall repairing, same scale for both banks
5	Washing basin （No.3）	—	0 + 080	Left bank	L: 3.5m x H: 0.3m x 3steps	Overall repairing, raised by 0.3m at downstream 5m
6	Wooden footbridge(No.1)	—	0 + 083	—	Divided log 1piece	Overall restoration
7	Wooden footbridge(No.2)	—	0 + 140	—	Divided log 2pieces	Overall restoration
8	Wooden footbridge(No.3)	—	0 + 150	—	Divided log 1piece	Overall restoration
9	Damaged lining B.P.	—	0 + 170	—	slope length：1.4m	Restoration：100%
10	Village road bridge（concrete）	—	0 + 215	—	W: 2.7m x L: 3.7m	Use existing structure
11	Washing basin （No.4）	—	0 + 220	Right bank	L: 1.0m x H: 0.3m x 1step	Overall repairing
12	Washing basin （No.5）	—	0 + 230	Left bank	L: 2.50m x H: 0.25m x 3steps	Overall repairing
13	Washing basin （No.6）	—	0 + 235	Right bank	L: 2.0m x H: 0.4m x 2steps	Overall repairing
14	Village bridge（concrete）	BRa-1	0 + 215	—	W: 2.7m x L: 3.7m	Use existing structure
15	Mun.road bridge（concrete）	BRa-2	0 + 272	—	W: 7.5m x L: 4.0m	Use existing structure
16	Washing basin （No.7）	—	0 + 290	Right bank	L: 1.5m x H: 0.3m x 2steps	Overall repairing
17	Drainage crossing work（No.1）	—	0 + 330	Left→ Right bank	Corrugate pipe D1,000mm x 1series → □ 700x700 traversing canal	Partial repairing：wet masonry around outlet、 H: 3.5m x L: 13.0m x 2sites
18	Washing basin （No.8）	—	0 + 345	Left bank	L: 7.0m x H: 0.3m x 3steps	Overall repairing
19	Turn out （No.1）	BRa-3	0 + 355	Right bank	Tertiary canal W: 0.7m x H: 1.2m	Overall restoration
20	Wooden footbridge(No.4)	—	0 + 400	—	Wooden board 0.3m thick 1 piece	Overall rehabilitation
21	Concrete bridge	—	0 + 410	—	W: 3.5m x L: 2.5m	Use existing one, exclusive by creditors（narrowed section）
22	Concrete bridge	—	0 + 420	—	W: 1.9m x L: 2.8m	Use existing one, exclusive for private use (narrowed section）
23	Bridge-type washing basin(No.1)	—	0 + 425	—	W: 0.7m x L: 2.0m	Overall rehabilitation
24	Aquaculture pond（No.1）	—	0 + 430	Right bank	pond：W: 2.0m x L: 3.5m	Use existing one H: 0.4m (water depth：0.2m)
25	Washing basin （No.9）	—	0 + 450	Left bank	L: 2.0m x H: 0.3m x 3steps	Overall repairing
26	Washing basin （No.10）	—	0 + 452	Right bank	L: 2.0m x H: 0.3m x 3steps	Overall repairing
27	Wooden footbridge(No5)	—	0 + 455	—	W: 2.0m x L: 2.5m	Overall restoration
28	Vertical drop（No.1）	BRa-4	0 + 470	—	⊿H: 1.4m x W: 2.1m	Overall rehabilitation
29	Washing basin （No.11）	—	0 + 540	Left bank	L: 1.5m x H: 0.3m x 2steps	Overall repairing
30	Wooden footbridge(No6)	—	0 + 545	—	W: 2.5m x L: 3.5m x log 12pieces	Overall restoration
31	Wooden footbridge(No7)	—	0 + 555	—	Log 2pieces	Overall restoration
32	Corrugated bridge（No.8）	—	0 + 560	—	W: 1.0m x L: 3.0m	Use existing one, exclusive for private use
33	Washing basin （No.12）	—	0 + 562	Right bank	L: 2.0m x H: 0.3m x 1step	Overall repairing
34	Wooden footbridge(No9)	—	0 + 580	—	W: 2.0m x L: 2.5m, paved by log	Overall restoration
35	Washing basin （No.13）	—	0 + 590	Left bank	L: 1.5m x H: 0.3m x 2steps	Overall repairing
36	Washing basin （No.14）	—	0 + 590	Right bank	L: 0.8m x H: 0.3m x 2steps	Overall repairing
37	Concrete bridge	—	0 + 591	—	W: 2.5m x L: 2.5m	Use existing one, exclusive for private use (narrowed section）
38	Wooden footbridge (No10)	—	0 + 600	—	W: 1.0m x L: 2.5m, some pieces log	Overall restoration
39	Washing basin （No.15）	—	0 + 605	Left bank	L: 1.8m x H: 0.3m x 3steps	Overall repairing
40	Washing basin （No.16）	—	0 + 606	Right bank	L: 1.8m x H: 0.3m x 3steps	Overall repairing
41	Wooden footbridge (No11)	—	0 + 610	—	W: 0.8m x L: 2.5m, log 6pieces	Overall restoration
42	Concrete bridge	—	0 + 615	—	W: 3.0m x L: 2.0m	Use existing one, exclusive for private use (narrowed section）
43	Concrete bridge	—	0 + 660	—	W: 3.0m x L: 3.5m	Use existing one, exclusive for private use
44	Wooden footbridge (No12)	—	0 + 690	—	W: 1.0m x L: 3.0m, log 5 pieces	Overall restoration
45	Wooden footbridge (No13)	—	0 + 700	—	2pieces of log	Overall restoration
46	Washing basin （No.17）	—	0 + 705	Left bank	L: 3.5m x H: 0.2m x 5steps	Overall repairing
47	Turn out（No.2～4）	BRa-5	0 + 710	Both banks	Right bank :2sites, left bank:1site	Overall restoration, right bank drainage inlet: 1 site
48	Flume canal B.P.	—	0 + 727	—	W: 1.0m x H: 0.8m	Use existing structure, longitudinal wet masonry
49	Wooden footbridge (No14)	—	0 + 767	—	W: 2.5m x L: 1.0m	Use existing structure
50	Footbridge by cube pipes	—	0 + 777	—	W: 0.45m x L: 1.0m x 3pieces	Use existing structure
51	Washing basin （No.18）	—	0 + 778	—	L: 0.8m x H: 0.45m x 1step	Use existing structure
52	Washing basin（No.19, 20）	—	0 + 807	Both banks	L: 1.1m x H: 0.25m x 3steps	Use existing structure, same scale for left and right banks
53	Drainage inlet（No.1）	BRa-6	0 + 812	Right bank	W: 0.5m x H: 0.8m x T: 0.3m	Use existing structure
54	Irrigation crossing pipe（No.1）	—	0 + 850	—	D50mm x L: 10m, vinyl-chloride pipe	Use existing structure
55	Vertical drop（No.2）	—	0 + 956	—	⊿H: 1.2m x W: 0.9m	Use existing structure
56	Washing basin （No.21）	—	1 + 041	Left bank	L: 1.5m x H: 0.25m x 3steps	Use existing structure
57	Drainage inlet（No.2）	—	1 + 045	Right bank	W: 0.3m x H: 0.2m	Use existing structure, abundant water quantity
58	Flume canal E.P.	—	1 + 090	—	W: 1.0m x H: 0.8m	Use existing structure, longitudinal wet masonry
59	Concrete bridge for piste	—	1 + 140	—	W: 2.5m x L: 3.5m	Use existing structure, BRa-7b not found
60	Concrete bridge for piste	—	1 + 250	—	W: 3.5m x L: 2.5m	Use existing structure
61	Wooden footbridge (No15)	—	1 + 280	—	4 pieces of log	Overall restoration
62	Wooden footbridge (No16)	—	1 + 295	—	4 pieces of log	Overall restoration
63	Washing basin （No.22）	—	1 + 310	Left bank	L: 1.0m x H: 0.25m x 3steps	Overall repairing
64	Wooden footbridge (No17)	—	1 + 325	—	W: 1.5m x L: 3.5m	Overall restoration
65	Wooden footbridge (No18)	—	1 + 340	—	W: 1.0m x L: 3.5m	Overall restoration
66	Washing basin （No.23）	—	1 + 345	Right bank	L: 1.5m x H: 0.4m x 1step	Use existing structure

No.	Name of Structure	No. of Structure	Station	Location	Elements	Remarks
67	Wooden footbridge (No19)	—	1 + 360	—	W: 1.0m x L: 3.0m	Overall restoration
68	Washing basin （No.24）	—	1 + 365	Right bank	L: 1.0m x H: 0.25m x 2steps	Use existing structure
69	Wooden footbridge (No20)	—	1 + 380	—	W: 1.0m x L: 3.0m	Overall restoration
70	Washing basin （No.25）	—	1 + 385	Right bank	L: 1.5m x H: 0.25m x 2steps	Use existing structure
71	Wooden footbridge (No21)	—	1 + 400	—	1 pieces of cut in half log	Overall restoration
72	Washing basin （No.26）	—	1 + 420	Right bank	L: 1.0m x H: 0.25m x 2steps	Use existing structure
73	Wooden footbridge (No22)	—	1 + 430	—	W: 1.0m x L: 2.5m	Overall restoration
74	Wooden footbridge (No23)	—	1 + 435	—	W: 1.0m x L: 2.5m	Overall restoration
75	Wooden footbridge (No24)	—	1 + 450	—	W: 1.0m x L: 2.5m	Overall restoration
76	Turn out（No.5）	BRa-8	1 + 470	Right bank	Tertiary canal W: 0.4m x H: 1.0m	Overall rehabilitation, secondary canal W: 0.4m x H: 1.0m
77	Wooden footbridge (No25)	—	1 + 480	—	Board W: 0.3m x L:1.5m x 1sheet	Overall restoration
78	Wooden footbridge (No26)	—	1 + 490	—	Board W: 0.2m x L:2.5m x 2sheets	Overall restoration
79	Wooden footbridge (No27)	—	1 + 500	—	W: 1.5m x L: 2.5m	Overall restoration
80	Washing basin （No.27）	—	1 + 502	Right bank	L: 1.5m x H: 0.25m x 1step	Overall repairing
81	Wooden footbridge (No28)	—	1 + 515	—	W: 1.8m x L: 2.5m	Overall restoration
82	Wooden footbridge (No29)	—	1 + 540	—	W: 1.2m x L: 2.5m	Overall restoration
83	Corrugated bridge（No.30）	—	1 + 560	—	W: 3.5m x L: 2.0m	Overall restoration
84	Turn out (6)/vertical drop(3)	BRa-9	1 + 570	Left bank	Tertiary canal W: 0.3m x H: 0.85m	Tertiary canal, secondary canal W: 0.9m x H: 0.85m
85	Piste concrete bridge(No.31)	—	1 + 605	—	W: 5.0m x L: 3.0m	Use existing structure
86	Wooden footbridge (No32)	—	1 + 905	—	Board W: 0.2m x L:2.0m x 2sheets	Overall restoration
87	Turn out（No.7）	—	1 + 915	Right bank	Tertiary canal W: 0.5m x H: 0.3m	Tertiary canal, secondary canal W: 0.9m x H: 0.5m
88	Turn out（No.8）	—	1 + 930	Both banks	Tertiary（right）W: 0.45m x H: 0.3m	Tertiary canal, tertiary (left) W: 0.3m x H: 0.5m
89	Lining B.P.	—	2 + 115	—	W: (0.4～0.8)m x H: 0.6m	Trapezoidal section lining canal
90	Turn out（No.9）	—	2 + 165	Left bank	Tertiary canal W: 1.0m x H: 0.6m	Tertiary canal, use existing road crossing work (L=5m)
91	Turn out（No.10）	—	2 + 415	Right bank	Tertiary canal W: 1.0m x H: 0.3m(earth)	Tertiary canal
92	Paddy field drain inlet（3）	—	2 + 440	Right bank	W: 0.5m x H: 0.4m (earthen canal)	Tertiary canal
93	Lining E.P.	—	2 + 490	—	W: 0.4～0.8m x H: 0.6m	Trapezoidal section lining canal
94	Turn out（No.11）	—	2 + 500	Right bank	Tertiary canal W: 1.0m x H: 0.3m(earth)	Tertiary canal、
95	Turn out（No.12）	—	2 + 660	Left bank	Tertiary canal W: 1.0m x H: 0.6m	Tertiary canal, use existing road crossing work (L=5m)
96	Turn out（No.13）	—	2 + 685	Right bank	Tertiary canal W: 1.0m x H: 0.3m(earth)	Tertiary canal、
97	Piste bridge（No.33）	—	2 + 795	—	W: 5m x L: (0.4～0.8)m x H:0.6m	Use existing structure
98	Turn out（No.14）	—	2 + 815	Left bank	Tertiary canal W: 1.0m x H: 0.6m	Tertiary canal, use existing road crossing work (L=5m)
99	Lining B.P.	—	2 + 925	—	W: 0.4～0.8m x H: 0.6m	Trapezoidal section lining canal
100	Turn out（No.15, 16）	—	2 + 990	Both banks	Tertiary canal W: 1.0m x H: 0.2m(earth)	Tertiary canal, tertiary (left), road crossing work D800mm
101	Lining E.P.	—	3 + 020	—	W: 0.4～0.8m x H: 0.6m	Trapezoidal section lining canal
102	Wooden footbridge (No34)	—	3 + 090	—	4 pieces of log	Overall restoration
103	Lining B.P.	—	3 + 175	—	W: 0.4～0.8m x H: 0.6m	Trapezoidal section lining canal
104	Turn out（No.17）	—	3 + 305	Left bank	Tertiary canal W: 0.7m x H: 0.6m	Tertiary canal, use existing road crossing work (L=5m)
105	Turn out（No.18）	—	3 + 460	Right bank	Tertiary canal W: 1.0m x H: 0.3m(earth)	Tertiary canal
106	Turn out（No.19）	—	3 + 650	Left bank	Tertiary canal W: 0.8m x H: 0.35m	Tertiary canal, use existing road crossing work (L=5m)
107	Turn out（No.20）	—	3 + 945	Left bank	Tertiary canal W: 0.6m x H: 0.3m	Tertiary canal, use existing road crossing work (L=5m)
108	Turn out（No.21）	—	4 + 095	Right bank	Tertiary canal W: 1.0m x H: 0.3m(earth)	Tertiary canal
109	Road crossing work	—	4 + 100	—	W: 0.6m x H: 0.7m x L: 5.0m	Use existing structure
110	Turn out（No.22）	—	4 + 650	Right bank	Tertiary canal W: 0.6m x H: 0.3m	Tertiary canal、Secondary canal W: 0.8m x H: 0.3m

Proposed Ritabau Secondary Canal Structure

No.	Name of Structure	No. of Structure	Station	Location	Elements	Remarks
1	Secondary canal B.P.	—	0 + 000	—	B: 0.95m x H: 0.6m x N: 1.0	Trapezoidal canal
2	Wooden footbridge（No.1）	—	0 + 050	—	Square wood 1pieces x L: 3.0m	Overall restoration
3	Turn out（No.1）	BRi-1	0 + 070	Left bank	Tertiary canal W: 0.3m x H: 0.95m	Overall rehabilitation、secondary canal W: 1.0m x H: 1.0m
4	Turn out(2)/Vertical drop work(1)	BRi-2	0 + 210	Right bank	Tertiary canal W: 0.35m x H: 1m	Overall rehabilitation、Vertical drop work ⊿H: 1.65m
5	Washing basin （No.1）	—	0 + 295	Right bank	L: 2.3m x H: 0.35m x 1steps	Overall repairing、
6	Wooden footbridge（No.2）	—	0 + 296	—	W: 0.2m wooden board 1sheets x L: 2.5m	Overall restoration
7	Wooden footbridge（No.3）	—	0 + 340	—	log 1pieces x L: 2.5m	Overall restoration, bridge for sheep passage：W: 2.0m（requested）
8	Turn out（No.3）	—	0 + 500	Left bank	Tertiary canal pipe D100mm	Overall rehabilitation
9	Wooden footbridge（No.4）	—	0 + 530	—	W: 0.3m wooden board 1sheets x L: 2.5m	Overall restoration
10	Washing basin （No.2, 3）	—	0 + 595	Left & Right bank	(right) L: 1.5m x H: 0.3m x 2steps	Overall repairing, (left) L: 1.4mxH:0.3mx2step
11	Wooden bridge（No.5）	—	0 + 600	—	W: 1.0m x L: 3.5m (high position)	Overall restoration
12	Village road bridge（wooden,No.6）	—	0 + 755	—	W: 2.6m x L: 2.0m	Conversion into concrete bridge
13	Rapid flow work（No.1）	BRi-3	0 + 760	—	W: 1.0m x H: 1.0m x L: 47.5m	Overall rehabilitation, drop height⊿H: 5.4m, gradient 1/8.8
14	Turn out（No.4）	BRi-3	0 + 770	Right bank	Tertiary canal W: 0.5m x H: 0.65m	Overall rehabilitation
15	Turn out（No.5）	BRi-3	0 + 781	Left bank	Tertiary canal W: 0.5m x H: 0.65m	Overall rehabilitation
16	Turn out（No.6）	—	0 + 803	Left bank	Tertiary canal W: 0.6m x H: 0.3m(Drainage crossing work)	Overall rehabilitation
17	Vertical drop work（No.2）	BRi-4	0 + 805	—	⊿H: 1.05m x W: 1.1m	Overall rehabilitation
18	Turn out（No.7）	—	0 + 850	Right bank	Tertiary canal W: 0.7m x H: 0.55m (Drainage crossing work)	Overall rehabilitation
19	Washing basin （No.8）	—	0 + 345	Left bank	L: 7.0m x H: 0.3m x 3step	Overall repairing
20	Vertical drop work（No.3）	BRi-5	0 + 902	—	⊿H: 1.5m x W: 1.1m	Overall rehabilitation
21	Wooden footbridge（No.7）	—	0 + 980	—	W: 0.6m x L: 3.5m（board sheets）	Overall restoration
22	Washing basin （No.4）	—	1 + 020	Left bank	L: 1.5m x H: 0.3m x 2steps	Overall repairing、
23	Vertical drop work（No.4）	BRi-6	1 + 025	—	⊿H: 1.7m x W: 1.0m	Overall rehabilitation, safety fence requested
24	Concrete bridge (No.8)	—	1 + 040	—	W: 2.7m x L: 4.0m	use existing one, exclusive private use
25	Wooden bridge（No.9）	—	1 + 060	—	W: 2.5m x L: 3.0m	Overall restoration, 15 households use it.
26	Wooden bridge（No.10）	—	1 + 070	—	W: 2.5m x L: 3.0m	Overall restoration, grocery shop uses it
27	Washing basin （No.5）	—	1 + 080	Left bank	L: 1.2m x H: 0.3m x 1step	Overall repairing
28	Concretefootbridge(No.11)	—	1 + 085	—	W: 2.3m x L: 2.9m	Use existing one, exclusive private use
29	Domestic water pipe crossing work（No.1）	—	1 + 100	—	D45mm Steel Pipe L: 3.0m	Use existing one
30	Wooden footbridge（No.12）	—	1 + 105	—	W: 1.5m x L: 2.0m	Overall restoration
31	Vertical drop work（No.5）	BRi-7	1 + 170	—	⊿H: 1.5m x W: 0.95m	Overall rehabilitation
32	Wooden footbridge（No.13）	—	1 + 185	—	W: 1.5m x L: 2.0m	Overall restoration
33	Wooden footbridge（No.14）	—	1 + 195	—	log 4 pieces x L: 3.0m	Overall restoration
34	Concrete bridge (No.15)	—	1 + 210	—	W: 2.3m x L: 3.3m	Use existing one, exclusive private use
35	Wooden footbridge（No.16）	—	1 + 225	—	log 3pieces x L: 3.0m	Overall restoration, domestic water pipe D50mm x 3.0m
36	Village road bridge(concreteNo.17)	—	1 + 255	—	W: 2.8m x L: 2.0m	Overall repairing
37	Wooden footbridge（No.18）	—	1 + 285	—	W: 1.3m x L: 2.5m	Overall restoration
38	Wooden footbridge（No.19）	—	1 + 290	—	W: 1.0m x L: 2.5m	Overall restoration
39	Wooden footbridge（No.20）	—	1 + 310	—	log 2pieces x L: 3.0m	Overall restoration
40	Wooden footbridge（No.21）	—	1 + 325	—	W: 2.0m x L: 2.5m、log 13pieces	Overall restoration
41	Wooden footbridge（No.22）	—	1 + 340	—	W: 1.2m x L: 2.0m、log 10pieces	Overall restoration
42	Domestic water pipe crossing work（No.2）	—	1 + 350	—	D25mmSteel Pipe L: 3.0m	Use existing one
43	Washing basin （No.6）	—	1 + 360	Right bank	L: 2.2m x H: 0.3m x 2step	Overall repairing
44	Wooden footbridge（No.23）	—	1 + 370	—	log 5pieces x L: 2.5m	Overall restoration
45	Turn out（No.8）	—	1 + 380	Left bank	Tertiary canal W: 0.55m x H: 0.9m (Drainage crossing work)	Overall rehabilitation
46	Washing basin （No.7）	—	1 + 398	Right bank	L: 1.2m x H: 0.3m x 1step	Overall repairing
47	Vertical drop work（No.6）	BRi-8	1 + 400	—	⊿H: 0.55m x W: 1.0m	Overall rehabilitation
48	Village road bridge(concreteNo.24)	BRi-8	1 + 405	—	W: 6.0m x L: 3.5m	Overall rehabilitation
49	Concrete bridge (No.25)	—	1 + 485	—	W: 2.4m x L: 3.0m	Use existing one, exclusive private use
50	Wooden footbridge（No.26）	—	1 + 535	—	log3pieces x L: 2.0m	Overall restoration
51	Washing basin （No.8）	—	1 + 550	Right bank	L: 1.8m x H: 0.3m x 1step	Overall repairing
52	Wooden footbridge（No.27）	—	1 + 553	—	log3pieces x L: 2.0m	Overall restoration
53	Wooden footbridge（No.28）	—	1 + 570	—	W: 1.0m x L: 2.0m、	Overall restoration
54	Concrete bridge (No.29)	—	1 + 590	—	W: 2.5m x L: 2.5m	use existing one, exclusive private use
55	Washing basin （No.9）	—	1 + 593	Right bank	L: 1.2m x H: 0.23m x 1step	Overall repairing
56	Wooden footbridge（No.30）	—	1 + 600	—	log3pieces x L: 2.0m	Overall restoration
57	Washing basin （No.10）	—	1 + 620	Right bank	L: 1.3m x H: 0.35m x 1step	Overall repairing
58	Wooden footbridge（No.31）	—	1 + 630	—	W: 1.0m x L: 2.0m	Overall restoration
59	Vertical drop work（No.7）	BRi-9	1 + 660	—	⊿H: 0.9m x W: 0.6m	Partial repairing
60	Wooden footbridge（No.32）	—	1 + 670	—	W: 1.0m x L: 2.0m、log 8pieces	Overall restoration
61	Drainage inlet work（No.1）	—	1 + 680	Right bank	D100mm pipe new construction	Overall rehabilitation
62	Wooden footbridge（No.33）	—	1 + 673	—	W: 1.0m x L: 2.0m、board3sheets	Overall restoration
63	Wooden footbridge（No.34）	—	1 + 700	—	W: 1.8m x L: 2.0m, fixed board	Overall restoration
64	Washing basin （No.11）	—	1 + 705	Right bank	L: 1.5m x H: 0.35m x 1step	Overall repairing
65	Washing basin （No.12）	—	1 + 720	Right bank	L: 1.0m x H: 0.3m x 1step	Overall repairing
66	Private house over canal （No.1）	—	1 + 730	—	W: 2.6m x L: 2.6m x H: 2.1m	Overall restoration
67	Concrete bridge (No.35)	—	1 + 740	—	W: 5.0m x L: 2.9m, partial repairing	use existing one, 9 households use it
68	Private house over canal （No.2）	—	1 + 750	—	W: 4.8m x L: 4.5m x H: 2.1m	Overall restoration
69	Washing basin （No.13）	—	1 + 760	Right bank	L: 1.3m x H: 0.3m x 1step	Overall repairing
70	Wooden footbridge（No.35）	—	1 + 765	—	W: 0.1m board x L:2.0m x 6sheets	Overall restoration
71	Wooden footbridge（No.36）	—	1 + 780	—	log 2pieces x L: 2.0m	Overall restoration

No.	Name of Structure	No. of Structure	Station	Location	Elements	Remarks
72	Wooden footbridge（No.37）	—	1 + 790	—	log 9pieces x L: 2.0m	Overall restoration
73	Wooden footbridge（No.38）	—	1 + 840	—	W: 2.0m x L: 2.0m, log 16pieces	Overall restoration
74	Wooden footbridge（No.39）	—	1 + 860	—	W: 1.2m x L: 2.0m, board 7sheets	Overall restoration
75	Wooden footbridge（No.40）	—	1 + 870	—	log 1pieces x L: 2.0m	Overall restoration
76	Washing basin （No.14）	—	1 + 885	Left bank	L: 1.0m x H: 0.3m x 1step	Overall repairing
77	Concrete bridge (No.41)	—	1 + 900	—	W: 3.0m x L: 2.5m	use existing one but partially repairing
78	Washing basin （No.15）	—	1 + 905	Right bank	L: 1.2m x H: 0.2m x 1step	Overall repairing
79	Wooden footbridge（No.42）	—	1 + 920	—	W: 0.8m x L: 1.5m	Overall restoration、board 2sheets+log 1pieces
80	Washing basin （No.16）	—	1 + 950	Right bank	L: 2.0m x H: 0.3m x 1step	Overall repairing
81	Concrete bridge (No.43)	—	1 + 955	—	W: 2.2m x L: 2.1m	use existing one but partially repairing
82	Wooden footbridge（No.44）	—	1 + 970	—	W: 1.2m x L: 2.0m、board 5sheets	Overall restoration
83	Turn out（No.9）	BRi-10	1 + 999	Right bank	tertiary canal W: 0.5m x H: 0.4m	Overall rehabilitation
84	Homestead crossing work（No.1）	BRi-10	2 + 006	—	W: 0.8m x L: 0.6m	use existing one
85	Road crossing work(No.1)	BRi-10	2 + 012	—	W: 0.8m x H: 0.6m x L: 7.5m	use existing one but partially repairing
86	Turn out（No.10）	BRi-10	2 + 020	Left bank	tertiary canal W: 0.3m x H: 0.55m	Overall rehabilitation, secondary canal W: 0.75m x H: 0.65m
87	Wooden footbridge（No.45）	—	2 + 050	—	W: 0.2m board x L:2.5m x 3sheets	Overall restoration
88	Wooden footbridge（No.46）	—	2 + 070	—	W: 1.0m x L: 2.5m、	Overall restoration
89	Wooden footbridge（No.47）	—	2 + 085	—	W: 0.3mΦboard x L:2.5m x 1sheets	Overall restoration
90	Vertical drop work（No.8）	BRi-11	2 + 121	—	⊿H: 1.5m x W: 0.8m	Overall rehabilitation
91	Wooden footbridge（No.48）	—	2 + 200	—	W: 1.5m x L:2.0m、board5sheets	Overall restoration
92	Washing basin （No.17）	—	2 + 201	Right bank	L: 1.0m x H: 0.2m x 2step	Overall repairing
93	Wooden footbridge（No.48）	—	2 + 215	—	log L:2.5m x 3pieces	Overall restoration
94	Wooden footbridge（No.49）	—	2 + 230	—	board L:2.5m x 4sheets	Overall restoration
95	Washing basin （No.18）	—	2 + 231	Left bank	L: 1.0m x H: 0.2m x 1step	Overall repairing
96	Wooden footbridge（No.50）	—	2 + 300	—	W: 2.5m x L:2.0m	Overall restoration
97	Vertical drop work（No.9）	BRi-12	2 + 319	—	⊿H: 0.5m x W: 0.9m	Overall rehabilitation
98	Washing basin （No.19）	—	2 + 370	Left bank	L: 1.2m x H: 0.35m x 2step	Overall repairing
99	Wooden footbridge（No.51）	—	2 + 375	—	W: 2.5m x L:2.5m	Overall restoration
100	Wooden footbridge（No.52）	—	2 + 390	—	log L:2.5m x 3pieces	Overall restoration
101	Village road bridge（wooden,No.53）	—	2 + 400	—	W: 2.0m x L:2.0m、	Overall restoration
102	Washing basin （No.20）	—	2 + 410	Right bank	L: 1.3m x H: 0.25m x 1step	Overall repairing
103	Washing basin （No.21）	—	2 + 450	Left bank	L: 0.8m x H: 0.15m x 1step	Overall repairing
104	Washing basin （No.22）	—	2 + 465	Left bank	L: 1.3m x H: 0.25m x 1step	Overall repairing
105	Wooden footbridge（No.54）	—	2 + 466	—	log L:2.5m x 1pieces	Overall restoration
106	Washing basin （No.23）	—	2 + 475	Right bank	L: 1.0m x H: 0.25m x 1step	Overall repairing
107	Vertical drop work（No.10）	BRi-13	2 + 480	—	⊿H: 1.3m x W: 0.8m	Overall rehabilitation
108	Washing basin （No.24）	—	2 + 560	Left bank	L: 1.0m x H: 0.25m x 1step	Overall repairing
109	Wooden footbridge（No.55）	—	2 + 565	—	W: 2.0m x L:2.0m、	Overall restoration
110	Wooden footbridge（No.56）	—	2 + 590	—	board L:2.0m x 2sheets	Overall restoration
111	Vertical drop work（No.11）	BRi-14	2 + 600	—	⊿H: 1.3m x W: 0.6m	Overall rehabilitation
112	Washing basin （No.25）	—	2 + 650	Left bank	L: 1.4m x H: 0.3m x 1stwp	Overall repairing
113	Wooden footbridge（No.57）	—	2 + 655	—	board L:2.5m x 6sheets	Overall restoration
114	Wooden footbridge（No.58）	—	2 + 685	—	board L:2.5m x 5sheets	Overall restoration
115	Wooden footbridge（No.59）	—	2 + 700	—	half log L: 2.5m x 3pieces	Overall restoration
116	Steel-made footbridge（No.60）	—	2 + 715	—	W: 2.0m x L:2.0m、	Overall restoration
117	Vertical drop work（No.12）	BRi-15	2 + 725	—	⊿H: 0.4m x W: 0.8m	Overall rehabilitation
118	Concretebridge(No.61)	—	2 + 765	—	W: 3.0m x L: 2.0m	Use existing one, exclusive use for school, partial repairing
119	Vertical drop work（No.13）	BRi-15a	2 + 770	—	⊿H: 0.3m x W: 0.8m	Overall rehabilitation
120	Wooden footbridge（No.62）	—	2 + 800	—	Square section log L: 2.0m x 3pieces	Overall restoration
121	Washing basin （No.26）	—	2 + 810	Right bank	L: 1.0m x H: 0.2m x 1step	Overall repairing
122	Concrete bridge (No.63)	—	2 + 820	—	W: 1.5m x L: 3.0m	use existing one, but partial repairing
123	Turn out（No.11）	BRi-16	2 + 831	Left bank	tertiary canal W: 0.25m x H: 0.75m	Overall rehabilitation、secondary canal W: 0.8m x H: 0.9m
124	Washing basin （No.27）	—	2 + 870	Left bank	L: 2.7m x H: 0.3m x 2step	Overall repairing
125	Road crossing work(No.2)	BRi-17	2 + 880	—	W: 1.2m x H: 0.6 x L: 4.5m（half circle section）	Overall repairing
126	Turn out（No.12）	BRi-17	2 + 890	Right bank	tertiary canal W: 0.45m x H: 0.85m	Overall rehabilitation、secondary canal W: 0.5m x H: 1.0m
127	Vertical drop work（No.14）	BRi-17	2 + 892	—	⊿H: 1.3m x W: 0.5m	Overall rehabilitation
128	Wooden footbridge（No.64）	—	2 + 925	—	W: 2.0m x L: 2.0m	Overall restoration
129	Wooden footbridge（No.65）	—	2 + 940	—	W: 1.0m x L: 2.0m、board 5sheets	Overall restoration
130	Vertical drop work（No.15）	—	2 + 955	—	⊿H: 1.0m x W: 0.55m	Overall rehabilitation
131	Wooden footbridge（No.66）	—	2 + 975	—	W: 2.5m x L: 2.0m, log 17pieces	Overall restoration
132	Concrete bridge (No.67)	—	3 + 070	—	W: 2.5m x L: 3.3m	use existing one, partial repairing
133	Wooden footbridge（No.68）	—	3 + 105	—	W: 2.5m x L: 2.0m, log 15pieces	Overall restoration
134	Wooden footbridge（No.69）	—	3 + 155	—	W: 1.0m x L: 2.0m, board 4 sheets	Overall restoration
135	Vertical drop work（No.16）	—	3 + 200	—	⊿H: 0.95m x W: 0.55m	Overall rehabilitation
136	Wooden footbridge（No.70）	—	3 + 340	—	W: 0.8m x L: 2.0m, log 4pieces	Overall restoration
137	Wooden footbridge（No.71）	—	3 + 360	—	Cut in half log L: 2.0m x 2pieces	Overall restoration
138	Wooden footbridge（No.72）	—	3 + 385	—	W: 1.2m x L: 2.0m, board 6sheets	Overall restoration
139	Wooden footbridge（No.73）	—	3 + 400	—	W: 1.8m x L: 2.0m, board 7 sheets	Overall restoration
140	Wooden footbridge（No.74）	—	3 + 455	—	Cut in half log L: 2.0m x 1piece	Overall restoration
141	Wooden footbridge（No.75）	—	3 + 510	—	W: 2.0m x L: 2.0m, log 11pieces	Overall restoration
142	Wooden footbridge（No.76）	—	3 + 565	—	W: 2.0m x L: 2.0m, log 14pieces	Overall restoration
143	Wooden footbridge（No.77）	—	3 + 575	—	log L: 3.0m x 1piece	Overall restoration
144	Wooden footbridge（No.78）	—	3 + 620	—	log L: 1.5m x 2pieces	Overall restoration
145	Drainage inlet work（No.2）	—	3 + 685	Left bank	W: 0.6m x H: 0.6 x L: 5.0m	Inflow box by new construction, road crossing work：partial repairing
146	Wooden footbridge（No.79）	—	3 + 735	—	W: 2.5m x L: 2.0m, log 14 pieces	Overall restoration
147	Wooden footbridge（No.80）	—	3 + 750	—	W: 2.0m x L: 2.0m, log 12 pieces	Overall restoration
148	Turn out（No.13）	—	3 + 760	Right bank	tertiary canal W: 0.4m x H: 0.65m	Overall rehabilitation、secondary canal W: 1.0m x H: 0.6m
149	Wooden footbridge（No.81）	—	3 + 780	—	W: 2.0m x L: 2.5m, log 14 pieces	Overall restoration

No.	Name of Structure	No. of Structure	Station	Location	Elements	Remarks
150	Drainage inlet work（No.3）	—	3 + 805	Left bank	W: 0.6m x H: 0.7 x L: 5.0m	Inflow box by new construction, road crossing work：partial repairing
151	Wooden footbridge（No.82）	—	3 + 815	—	W: 3.5m x L: 2.5m, J132, log 20pieces	Overall restoration
152	Turn out（No.14）	—	3 + 830	Right bank	tertiary canal W: 0.3m x H: 0.8m	new construction
153	Wooden footbridge（No.83）	—	3 + 845	—	W: 2.0m x L: 1.5m, log 18pieces	Overall restoration
154	Wooden footbridge（No.84）	—	3 + 895	—	W: 2.5m x L: 2.0m, log 14 pieces	Overall restoration
155	Turn out（No.15）	—	3 + 905	Right bank	tertiary canal W: 0.5m x H: 0.2m	new construction
156	Wooden footbridge（No.85）	—	3 + 945	—	W: 2.5m x L: 2.0m, log 12 pieces	Overall restoration
157	dDrainage inlet work（No.4）	—	3 + 980	Left bank	W: 0.6m x H: 0.4 x L: 5.0m	new construction for inlet box, partial repairing for road crossing work
158	Turn out（No.16）	—	4 + 060	Right bank	tertiary canal W: 0.25m x H: 0.7m	Overall rehabilitation、secondary canal W: 0.3m x H: 0.7m
159	Wooden footbridge（No.86）	—	4 + 130	—	log L: 2.0m x 2 pieces	Overall restoration
160	Turn out（No.17）	—	4 + 145	Right bank	tertiary canal W: 0.25m x H: 0.8m	Overall rehabilitation、secondary canal W: 0.3m x H: 0.8m
161	Wooden footbridge（No.87）	—	4 + 170	—	log L: 2.0m x 2pieces	Overall restoration
162	Turn out（No.18）	—	4 + 260	Right bank	tertiary canal W: 0.5m x H: 0.2m(Drainage crossing work)	new construction、secondary canal W: 0.6m x H: 0.3m
163	Turn out（No.19）	—	4 + 295	Right bank	tertiary canal W: 0.3m x H: 0.2m(Drainage crossing work)	new construction、secondary canal W: 0.6m x H: 0.3m
164	Wooden footbridge（No.88）	—	4 + 295	—	board (W:0.3m) x L: 2.5m x 1sheets	Overall restoration
165	Turn out（No.20）	—	4 + 365	Right bank	tertiary canal W: 0.3m x H: 0.2m(Drainage crossing work)	new construction、secondary canal W: 0.6m x H: 0.3m
166	Wooden footbridge（No.89）	—	4 + 385	—	W: 2.0m x L: 1.5m, log 11pieces	Overall restoration
167	Wooden footbridge（No.90）	—	4 + 420	—	W: 2.5m x L: 2.0m	Overall restoration
168	Turn out（No.21）	—	4 + 470	Right bank	tertiary canal W: 0.4m x H: 0.3m(Drainage crossing work)	new construction、secondary canal W: 0.6m x H: 0.3m
169	Wooden footbridge（No.91）	—	4 + 510	—	board (W:0.3m) x L: 2.5m x 1sheets	Overall restoration
170	Wooden footbridge（No.92）	—	4 + 530	—	board (W:0.5m) x L: 2.5m x 1sheets	Overall restoration
171	Wooden footbridge（No.93）	—	4 + 565	—	board (W:0.3m) x L: 2.0m x 1sheets	Overall restoration
172	Turn out（No.22）	—	4 + 580	Right bank	tertiary canal W: 0.5m x H: 0.2m(Drainage crossing work)	new construction、secondary canal W: 0.6m x H: 0.3m
173	Turn out（No.23）	—	4 + 650	Right bank	tertiary canal W: 0.3m x H: 0.2m(Drainage crossing work)	new construction、secondary canal W: 0.6m x H: 0.3m
174	Turn out（No.24）	—	4 + 775	Right bank	tertiary canal W: 0.5m x H: 0.2m(Drainage crossing work)	new construction、secondary canal W: 0.6m x H: 0.3m
175	Turn out（No.25）	—	4 + 835	Left bank	Tertiary: 1.0m x H: 0.6m x L: 4.5m	new construction for inflow box, partial repairing for crossing work
176	Drainage inlet work（No.5）		4 + 875	Left bank		
177	Road crossing work (No.3)		5 + 145			
178	Turn out（No.26）	—	5 + 250	Left bank		

(1) Present Cropping Pattern（Paddy Only）

Pattern 1:
Paddy 105-day variety
Present situation
Irrigation period:105 days

Cropping pattern — season: Rainy / Dry
- Upstream: Main and Ramaskora and Ritabou 2ndary, upstream — 30% / 60%
- Midstream: Ramskora and Ritabau 2ndary, midstream — 30% / 40%
- Downstream: Ramskora and Ritabau 2ndary, downdstream — 40% / 0%

Percolation rate (water requirement rate measurement)
- Up/Midstream: 3.0mm/day
- Downstream: 5.0mm/day

Water requirement for land preparation (including ponding depth 50mm/month)
- land preparation period: 1 month
- beginning of rainy season crop: 300mm
- beginning of dry season crop: 250mm

Water Layer Replacement(WLR):WB F/S report
50mm/15day

Irrigation efficiency（FAO criteria）
- Application efficiency(Ea) Ea=0.80
- Branch canal efficiency(Eb) Eb=0.80
- Farm efficiency(Ef=Ea x Eb) Ef=0.64
- Conveyance efficiency(Ec) Ec=0.65
- **Irrigation(Project) efficiency(Ep=Ef x Ec) Ep=0.416**

		January		February		March		April		May		June		July		August		September		October		November		December		Total/AV
Discharge of Bulobo river Maximum average discharge:		4.60		5.60		4.50		3.70		1.90		1.40		1.10		0.80		0.60		0.50		1.40		3.00		1.70
Average discharge:		**2.00**		**2.50**		**2.20**		**1.70**		**1.10**		**0.90**		**0.60**		**0.40**		**0.30**		**0.20**		**0.70**		**1.20**		**1.20**
Minimum average discharge:		0.40		0.80		0.70		0.60		0.40		0.30		0.20		0.10		0.10		0.10		0.20		0.30		0.50
Low-flow reliability, 1 in 2 years		1.73		2.02		2.30		1.56		1.06		0.84		0.62		0.39		0.26		0.23		0.47		1.05		1.04
Low-flow reliability, 1 in 3 years		1.33		1.67		1.68		1.42		0.99		0.75		0.49		0.31		0.20		0.19		0.30		0.84		0.85
Low-flow reliability, 1 in 5 years: (m3/sec)		**0.94**		**1.37**		**1.37**		**1.30**		**0.95**		**0.73**		**0.46**		**0.28**		**0.18**		**0.16**		**0.29**		**0.71**		**0.90**
1. Cropping pattern, Crop coefficient (kc)																										
1)Upstream	30% 60%	1.05	1.05	1.10	1.10	0.95	0.00	-		L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	-						L.P.	L.P.	
2)Midstream	30% 40%	L.P	1.05	1.05	1.10	1.10	0.95	0.00	-		L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	-						L.P.	
3)Downstream	40% 0%	L.P	L.P	1.05	1.05	1.10	1.10	0.95	0.00	-		L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	-						
2. Evapo-transpiration (ET_0)		**1.4**	**1.4**	**1.2**	**1.2**	**1.3**	**1.3**	**1.8**	**1.8**	**2.2**	**2.2**	**2.9**	**2.9**	**4.1**	**4.1**	**4.2**	**4.2**	**3.9**	**3.9**	**3.7**	**3.7**	**2.4**	**2.4**	**1.5**	**1.5**	
Crop evapo-transpiration rate (ETcrop=kc x ET_0)																										
1)Upstream	30% 60%	0.4	0.4	0.4	0.4	0.4	0.0					1.8	1.8	2.7	2.7	2.4										
2)Midstream	30% 40%		0.4	0.4	0.4	0.4	0.5	0.0					1.2	1.7	1.8	1.8	1.6									
3)Downstream	40% 0%			0.5	0.5	0.6	0.6	0.7	0.0					0.0	0.0	0.0	0.0	0.0								
Total (mm/day)		**0.4**	**0.9**	**1.3**	**1.3**	**1.4**	**1.1**	**0.7**	**0.0**	**0.0**	**0.0**	**1.8**	**3.0**	**4.4**	**4.5**	**4.2**	**1.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
3. Percolation rate																										
1)Upstream	30% 60% 3.0mm/day	0.9	0.9	0.9	0.9	0.9				1.8	1.8	1.8	1.8	1.8	1.8									0.9	0.9	
2)Midstream	30% 40% 3.0mm/day	0.9	0.9	0.9	0.9	0.9	0.9				1.2	1.2	1.2	1.2	1.2	1.2									0.9	
3)Downstream	40% 0% 5.0mm/day	2.0	2.0	2.0	2.0	2.0	2.0	2.0				0.0	0.0	0.0	0.0	0.0	0.0									
Total (mm/day)		**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**2.9**	**2.0**	**0.0**	**1.8**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**1.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.9**	**1.8**	
4. Water requirment rate (2+3) (mm/day)		**4.2**	**4.7**	**5.1**	**5.1**	**5.2**	**4.0**	**2.7**	**0.0**	**1.8**	**3.0**	**4.8**	**6.0**	**7.4**	**7.5** Max.	**5.4**	**1.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.9**	**1.8**	
5. Net water requirement for land preparation (source:WB F/S)																										
1)Upstream	30% 60% Rainy season: 17.3mm/day									7.6	7.6													4.3	4.3	
2)Midstream	30% 40% Dry season: 15.6mm/day	4.3									5.0	5.0													4.3	
3)Downstream	40% 0%	4.9	4.9									0.0	0.0													
Total (mm/day)		**9.2**	**4.9**	**0.0**					**0.0**	**7.6**	**12.6**	**5.0**											**0.0**	**4.3**	**8.6**	
6. Water Layer Replacement: WLR																										
1)Upstream	30% 60% 10.3mm/day			3.1										6.2												
2)Midstream	30% 40%				3.1										4.1											
3)Downstream	40% 0%					4.1										0.0										
Total (mm/day)			**0.0**	**3.1**	**3.1**	**4.1**	**0.0**						**0.0**	**6.2**	**4.1**											
7. Total farm water requirement (4+5+6) (mm/day)		**13.4**	**9.6**	**8.2**	**8.2**	**9.3**	**4.0**	**2.7**	**0.0**	**9.4**	**15.6**	**9.9**	**6.0**	**13.6**	**11.6**	**5.4**	**1.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**5.2**	**10.4**	**144.0**
																									annual water requirement(mm)	**2,160**
8. Effective rainfall (source:WB F/S)																										
1) Agerage rainfall per month		380		362		312		120		100		43		12		12		13		78		208		305		1,945
2) Low-rainfall reliability, 1 in 5 years (reliability more than 80%)		106	117	106	92	76	81	13	13	12	13	0	0	0	0	0	0	0	0	10	11	45	45	95	152	987
3) Effective rainfall (80% of low-rainfall reliability, 1 in 5 years)		85	94	85	74	61	65	10	10	10	10	0	0	0	0	0	0	0	0	8	9	36	36	76	122	790
4) Effective rainfall per day (mm/day)		**5.7**	**6.2**	**5.7**	**4.9**	**4.1**	**4.3**	**0.7**	**0.7**	**0.6**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**0.6**	**2.4**	**2.4**	**5.1**	**8.1**	
																									annual net water requirement(mm)	
9. Net water requirement(7-8) (mm/day)		**7.8**	**3.3**	**2.5**	**3.3**	**5.3**	**0.0**	**2.0**	**0.0**	**8.7**	**14.9**	**9.9**	**6.0**	**13.6**	**11.6**	**5.4**	**1.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**2.2**	**1,475**
unit net water requirement (lit/sec/ha)		**0.90**	**0.39**	**0.29**	**0.38**	**0.61**	**0.00**	**0.23**	**0.00**	**1.01**	**1.72**	**1.14**	**0.70**	**1.58**	**1.35**	**0.63**	**0.18**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.26**	
10. Unit diversion requirement at offtakes from 2ndary canal																										
Farm efficiency: Ef=0.64 (lit/sec/ha)		**1.40**	**0.60**	**0.46**	**0.59**	**0.95**	**0.00**	**0.36**	**0.00**	**1.58**	**2.69**	**1.78**	**1.09**	**2.46**	**2.11**	**0.98**	**0.29**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.41**	
11. Unit diversion requirement at intake		peak								peak																
Conveyance efficiency Ec=0.65 (lit/sec/ha)		**2.16**	**0.93**	**0.70**	**0.92**	**1.46**	**0.00**	**0.55**	**0.00**	**2.42**	**4.14**	**2.74**	**1.68**	**3.79**	**3.24**	**1.51**	**0.44**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.03**	**0.62**	
12. Diversion requirement at intake **100ha** **(m3/sec)**		0.22	0.09	0.07	0.09	0.15	0.00	0.06	0.00	0.24	0.41	0.27	0.17	0.38	0.32	0.15	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	
Irrigation area: **150ha** **(m3/sec)**		0.32	0.14	0.11	0.14	0.22	0.00	0.08	0.00	0.36	0.62	0.41	0.25	0.57	0.49	0.23	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	
200ha (m3/sec)		0.43	0.19	0.14	0.18	0.29	0.00	0.11	0.00	0.48	0.83	0.55	0.34	0.76	0.65	0.30	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.12	
Low-flow reliability, 1 in 5 years **300ha** **(m3/sec)**		0.65	0.28	0.21	0.27	0.44	0.00	0.17	0.00	0.73	1.24	0.82	0.50	1.14	0.97	0.45	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.19	
400ha (m3/sec)		0.86	0.37	0.28	0.37	0.58	0.00	0.22	0.00	0.97	1.66	1.10	0.67	1.52	1.30	0.61	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.25	
Low-flow reliability, 1 in 3 years 500ha (m3/sec)		1.08	0.46	0.35	0.46	0.73	0.00	0.28	0.00	1.21	2.07	1.37	0.84	1.90	1.62	0.76	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.31	
Low-flow reliability, 1 in 3 years 550ha (m3/sec)		1.19	0.51	0.39	0.50	0.80	0.00	0.30	0.00	1.33	2.28	1.51	0.93	2.09	1.78	0.83	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.34	
Low-flow reliability, 1 in 3 years **600ha** **(m3/sec)**		1.30	0.56	0.42	0.55	0.88	0.00	0.33	0.00	1.45	2.49	1.65	1.01	2.27	1.94	0.91	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.37	
650ha (m3/sec)		1.40	0.60	0.46	0.59	0.95	0.00	0.36	0.00	1.58	2.69	1.78	1.09	2.46	2.11	0.98	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.41	
700ha (m3/sec)		1.51	0.65	0.49	0.64	1.02	0.00	0.39	0.00	1.70	2.90	1.92	1.18	2.65	2.27	1.06	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.44	
800ha (m3/sec)		1.73	0.74	0.56	0.73	1.17	0.00	0.44	0.00	1.94	3.31	2.19	1.35	3.03	2.59	1.21	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.50	
850ha (m3/sec)		1.84	0.79	0.60	0.78	1.24	0.00	0.47	0.00	2.06	3.52	2.33	1.43	3.22	2.75	1.29	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.53	

Estimation of water requirement for land preparation

Peak requirement rate	Rainy season	Dry season
Sn:Water requirement rate(mm/day)		
Sn=（D+d x(N-1)）/N	**17.3 mm/day**	**15.6 mm/day**
D:Water requirement fot land preparation(mm)	300 mm	250 mm
d:Water requirement per day(mm)	7.5 mm	7.5 mm
N:Term of puddling(day)	30 days	30 days

Estimation of water layer replacement

Peak requirement rate	Rainy season
Wn:Water requirement rate(mm/day)	
Wn=（D+d x(N-1)）/N	**10.3 mm/day**
D:Water layer replacement(mm)	50 mm
d:Water requirement per day(mm)	7.5 mm
N:Term of water layer replacement(day)	15 day

(2) Present Cropping Pattern (Upland Only)

Pattern 8:
Upland 4-month
Present situation
Irrigation period:105-day

Cropping pattern — season: Rainy / Dry
1)Upstream: Main and Ramaskora and Ritabou 2ndary, upstream — 60% / 60%
2)Downstream: Ramskora and Ritabau 2ndary, downdstream — 40% / 40%

Initial water requirement(15days)
Upstream: 3.0mm/day
Downstream: 5.0mm/day

Irrigation efficiency (FAO criteria)
Application efficiency(Ea) Ea=0.70
Branch canal efficiency(Eb) Eb=0.80
Farm efficiency(Ef=Ea x Eb) Ef=0.56
Conveyance efficiency(Ec) Ec=0.65
Irrigation(Project) efficiency(Ep=Ef x Ec) Ep=0.364

				January		February		March		April		May		June		July		August		September		October		November		December		Total/AV
Discharge of Bulobo river	Maximum average discharge:			4.60		5.60		4.50		3.70		1.90		1.40		1.10		0.80		0.60		0.50		1.40		3.00		1.70
	Average discharge:			**2.00**		**2.50**		**2.20**		**1.70**		**1.10**		**0.90**		**0.60**		**0.40**		**0.30**		**0.20**		**0.70**		**1.20**		**1.20**
	Minimum average discharge:			0.40		0.80		0.70		0.60		0.40		0.30		0.20		0.10		0.10		0.10		0.20		0.30		0.50
	Low-flow reliability, 1 in 2 years			1.73		2.02		2.30		1.56		1.06		0.84		0.62		0.39		0.26		0.23		0.47		1.05		1.04
	Low-flow reliability, 1 in 3 years			1.33		1.67		1.68		1.42		0.99		0.75		0.49		0.31		0.20		0.19		0.30		0.84		0.85
	Low-flow reliability, 1 in 5 years:		**(m3/sec)**	**0.94**		**1.37**		**1.37**		**1.30**		**0.95**		**0.73**		**0.46**		**0.28**		**0.18**		**0.16**		**0.29**		**0.71**		**0.90**
1. Cropping pattern, Crop coefficient (kc)																												
1)Upstream	60%	60%		0.98	0.82	0.35	0.00					0.40	0.54	0.82	0.96	0.98	0.82	0.35	0.00					0.40	0.54	0.82	0.96	
2)Downstream	40%	40%		0.82	0.96	0.98	0.82	0.35	0.00					0.40	0.54	0.82	0.96	0.98	0.82	0.35	0.00					0.40	0.54	
2. Consumptive use (ETcrop=kcxET$_0$)			(ET$_0$)	**1.4**	**1.4**	**1.2**	**1.2**	**1.3**	**1.3**	**1.8**	**1.8**	**2.2**	**2.2**	**2.9**	**2.9**	**4.1**	**4.1**	**4.2**	**4.2**	**3.9**	**3.9**	**3.7**	**3.7**	**2.4**	**2.4**	**1.5**	**1.5**	
1)Upstream	60%	60%		0.8	0.7	0.3						0.5	0.7	1.4	1.7	2.4	2.0	0.9						0.6	0.8	0.7	0.9	
3)Downstream	40%	40%		0.5	0.5	0.5	0.4	0.2						0.5	0.6	1.3	1.6	1.6	1.4	0.5						0.2	0.3	
Total			**(mm/day)**	**1.3**	**1.2**	**0.7**	**0.4**	**0.2**	**0.0**	**0.0**	**0.0**	**0.5**	**0.7**	**1.9**	**2.3**	**3.8**	**3.6**	**2.5**	**1.4**	**0.5**	**0.0**	**0.0**	**0.0**	**0.6**	**0.8**	**1.0**	**1.2**	
3. Initial water requirement																												
1)Upstream	60%	60%	3.0mm/day									1.8												1.8				
2)Downstream	40%	40%	5.0mm/day											2.0												2.0		
Total			**(mm/day)**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**0.0**	**2.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**0.0**	**2.0**	**0.0**	
4. Consumative use rate(2+3)			**(mm/day)**	**1.3**	**1.2**	**0.7**	**0.4**	**0.2**	**0.0**	**0.0**	**0.0**	**2.3**	**0.7**	**3.9**	**2.3**	**3.8**	**3.6**	**2.5**	**1.4**	**0.5**	**0.0**	**0.0**	**0.0**	**2.4**	**0.8**	**3.0**	**1.2**	
5. Total farm water requirement(=4)			(mm/day)	**1.3**	**1.2**	**0.7**	**0.4**	**0.2**	**0.0**	**0.0**	**0.0**	**2.3**	**0.7**	**3.9**	**2.3**	**3.8**	**3.6**	**2.5**	**1.4**	**0.5**	**0.0**	**0.0**	**0.0**	**2.4**	**0.8**	**3.0**	**1.2**	**32.2**
																												annual water requirement(mm)
6. Effective rainfall (source:WB F/S)																												
1) Agerage rainfall per month				380		362		312		120		100		43		12		12		13		78		208		305		1,945
2) Low-rainfall reliability, 1 in 5 years (reliability more than 8**0%**)				106	117	106	92	76	81	13	13	12	13	0	0	0	0	0	0	0	0	10	11	45	45	95	152	987
3) Effective rainfall (80% of low-rainfall reliability, 1 in 5 years				85	94	85	74	61	65	10	10	10	10	0	0	0	0	0	0	0	0	8	9	36	36	76	122	790
4) Effective rainfall per day			(mm/day)	**5.7**	**6.2**	**5.7**	**4.9**	**4.1**	**4.3**	**0.7**	**0.7**	**0.6**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**0.6**	**2.4**	**2.4**	**5.1**	**8.1**	
																												annual net water requirement(mm)
7. Net water requirement(5-6)			(mm/day)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.7**	**0.0**	**3.9**	**2.3**	**3.8**	**3.6**	**2.5**	**1.4**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**295**
unit net water requirement			(lit/sec/ha)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.20**	**0.00**	**0.45**	**0.27**	**0.43**	**0.42**	**0.29**	**0.16**	**0.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
8. Unit diversion requirement at offtakes from 2ndary canal																												
Farm efficiency: Ef=0.56			(lit/sec/ha)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.35**	**0.00**	**0.80**	**0.47**	**0.78**	**0.74**	**0.52**	**0.28**	**0.11**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
9. Unit diversion requirement at intake														peak														
Conveyance efficiency Ec=0.65			(lit/sec/ha)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.54**	**0.01**	**1.24**	**0.73**	**1.19**	**1.14**	**0.80**	**0.44**	**0.17**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
10. Diversion requirement at intake	Dry s.	**100ha**	**(m3/sec)**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.12	0.07	0.12	0.11	0.08	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
		150ha	(m3/sec)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.19	0.11	0.18	0.17	0.12	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Irrigation area:	Rainy s.	**250ha**	(m3/sec)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.31	0.18	0.30	0.29	0.20	0.11	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

(3) Cropping Pattern Proposed by World Bank F/S Report (Paddy+Upland)

Pattern 2:
Paddy 105-day variety
1st crop starts on December
Irrigation Period:105-day

Cropping pattern	season Rainy	Dry
Upstream: Main and Ramaskora and Ritabou 2ndary, upstream	30%	40%
Midstream: Ramskora and Ritabau 2ndary, midstream	30%	60%
Downstream: Ramskora and Ritabau 2ndary, downdstream	40%	0%

Percolation rate (water requirement rate measurement)
Up/Midstream: 2.5mm/day
Downstream: 2.5mm/day

Water requirement for land preparation (including ponding depth 50mm/month)
land preparation period: 1 month
beginning of rainy season cropping: 300mm
beginning of dry season cropping: 250mm
Water Layer Replacement(WLR):WB F/S report 50mm/15day

Irrigation efficiency (FAO criteria)
Application efficiency(Ea) -
Branch canal efficiency(Eb) -
Farm efficiency(Ef=Ea x Eb) Ef=0.80
Conveyance efficiency(Ec) Ec=0.725
Irrigation(Project) efficiency(Ep=Ef x Ec) Ep=0.580

				January		February		March		April		May		June		July		August		September		October		November		December		Total/AV
Discharge of Bulobo river	Maximum average discharge:			4.60		5.60		4.50		3.70		1.90		1.40		1.10		0.80		0.60		0.50		1.40		3.00		1.70
	Average discharge:			**2.00**		**2.50**		**2.20**		**1.70**		**1.10**		**0.90**		**0.60**		**0.40**		**0.30**		**0.20**		**0.70**		**1.20**		**1.20**
	Minimum average discharge:			0.40		0.80		0.70		0.60		0.40		0.30		0.20		0.10		0.10		0.10		0.20		0.30		0.50
	Low-flow reliability, 1 in 2 years			1.73		2.02		2.30		1.56		1.06		0.84		0.62		0.39		0.26		0.23		0.47		1.05		1.04
	Low-flow reliability, 1 in 3 years			1.33		1.67		1.68		1.42		0.99		0.75		0.49		0.31		0.20		0.19		0.30		0.84		0.85
	Low-flow reliability, 1 in 5 years:		**(m3/sec)**	**0.94**		**1.37**		**1.37**		**1.30**		**0.95**		**0.73**		**0.46**		**0.28**		**0.18**		**0.16**		**0.29**		**0.71**		**0.90**
1. Cropping pattern, Crop coefficient (kc)																												
1)Upstream	30%	40%		1.05	1.05	1.10	1.10	0.95	0.00	L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	0.40	0.54	0.96	0.96	0.98	0.82	0.35		L.P.	L.P.	
2)Midstream	30%	60%		1.05	1.05	1.10	1.10	0.95	0.00	L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	0.40	0.54	0.96	0.96	0.98	0.82	0.35		L.P.	L.P.	
3)Downstream	40%	0%		1.05	1.05	1.10	1.10	0.95	0.00	L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	0.40	0.54	0.96	0.96	0.98	0.82	0.35		L.P.	L.P.	
2. Evapo-transpiration (ET_0)			(ET_0)	**1.4**	**1.4**	**1.2**	**1.2**	**1.3**	**1.3**	**1.8**	**1.8**	**2.2**	**2.2**	**2.9**	**2.9**	**4.1**	**4.1**	**4.2**	**4.2**	**3.9**	**3.9**	**3.7**	**3.7**	**2.4**	**2.4**	**1.5**	**1.5**	
Crop evapo-transpiration rate (ETcrop=kc x ET_0)																												
1)Upstream	30%	40%		0.4	0.4	0.4	0.4	0.4	0.0			0.9	0.9	1.3	1.3	1.6	0.0	0.7	0.9	1.5	1.5	1.5	1.2	0.3				
2)Midstream	30%	60%		0.4	0.4	0.4	0.4	0.4	0.0			1.4	1.4	1.9	1.9	2.3	0.0	1.0	1.4	2.2	2.2	2.2	1.8	0.5				
3)Downstream	40%	0%		0.6	0.6	0.5	0.5	0.5	0.0			0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0				
Total			**(mm/day)**	**1.5**	**1.5**	**1.3**	**1.3**	**1.2**	**0.0**	**0.0**	**0.0**	**2.3**	**2.3**	**3.2**	**3.2**	**3.9**	**0.0**	**1.7**	**2.3**	**3.7**	**3.7**	**3.6**	**3.0**	**0.8**	**0.0**	**0.0**	**0.0**	
3. Percolation rate																												
1)Upstream	30%	40%	2.5mm/day	0.8	0.8	0.8	0.8	0.8		1.0	1.0	1.0	1.0	1.0	1.0	1.0		1.0	1.0	1.0	1.0	1.0	1.0	1.0		0.8	0.8	
2)Midstream	30%	60%	2.5mm/day	0.8	0.8	0.8	0.8	0.8		1.5	1.5	1.5	1.5	1.5	1.5	1.5		1.5	1.5	1.5	1.5	1.5	1.5	1.5		0.8	0.8	
3)Downstream	40%	0%	2.5mm/day	1.0	1.0	1.0	1.0	1.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0		1.0	1.0	
Total			**(mm/day)**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**0.0**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**0.0**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**	**0.0**	**2.5**	**2.5**	
4. Water requirment rate (2+3)			**(mm/day)**	**4.0**	**4.0**	**3.8**	**3.8**	**3.7**	**0.0**	**2.5**	**2.5**	**4.8**	**4.8**	**5.7**	**5.7**	**6.4**	**0.0**	**4.2**	**4.8**	**6.2**	**6.2**	**6.1**	**5.5**	**3.3**	**0.0**	**2.5**	**2.5**	
5. Net water requirement for land preparation (source:WB F/S)																												
1)Upstream	30%	40%	Rainy season: 300mm/month							3.3	3.3															3.0	3.0	
2)Midstream	30%	60%	Dry season: 250mm/month							5.0	5.0															3.0	3.0	
3)Downstream	40%	0%								0.0	0.0															4.0	4.0	
Total			**(mm/day)**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**8.3**	**8.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**10.0**	**10.0**	
6. Water Layer Replacement: WLR																												
1)Upstream	30%	40%	50mm/15day		1.0		1.0						1.3		1.3													
2)Midstream	30%	60%			1.0		1.0						2.0		2.0													
3)Downstream	40%	0%			1.3		1.3						0.0		0.0													
Total			**(mm/day)**	**0.0**	**3.3**	**0.0**	**3.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**3.3**	**0.0**	**3.3**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
7. Total farm water requirement (4+5+6)			(mm/day)	**4.0**	**7.3**	**3.8**	**7.2**	**3.7**	**0.0**	**10.8**	**10.8**	**4.8**	**8.1**	**5.7**	**9.0**	**6.4**	**0.0**	**4.2**	**4.8**	**6.2**	**6.2**	**6.1**	**5.5**	**3.3**	**0.0**	**12.5**	**12.5**	**143.1**
																												annual water requirement(mm) **2,147**
8. Effective rainfall (source:WB F/S)																												
1) Agerage rainfall per month				380		362		312		120		100		43		12		12		13		78		208		305		1,945
2) Low-rainfall reliability, 1 in 5 years (reliability more than 80%)				106	117	106	92	76	81	13	13	12	13	0	0	0	0	0	0	0	0	10	11	45	45	95	152	987
3) Effective rainfall (80% of low-rainfall reliability, 1 in 5 years)				85	94	85	74	61	65	10	10	10	10	0	0	0	0	0	0	0	0	8	9	36	36	76	122	790
4) Effective rainfall per day			(mm/day)	**5.7**	**6.2**	**5.7**	**4.9**	**4.1**	**4.3**	**0.7**	**0.7**	**0.6**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**0.6**	**2.4**	**2.4**	**5.1**	**8.1**	
																												annual net water requirement(mm)
9. Net water requirement(7-8)			(mm/day)	**0.0**	**1.1**	**0.0**	**2.2**	**0.0**	**0.0**	**10.1**	**10.1**	**4.2**	**7.5**	**5.7**	**9.0**	**6.4**	**0.0**	**4.2**	**4.8**	**6.2**	**6.2**	**5.6**	**4.9**	**0.9**	**0.0**	**7.4**	**4.4**	**1,516**
unit net water requirement			(lit/sec/ha)	**0.00**	**0.12**	**0.00**	**0.26**	**0.00**	**0.00**	**1.17**	**1.17**	**0.48**	**0.86**	**0.66**	**1.04**	**0.74**	**0.00**	**0.48**	**0.55**	**0.72**	**0.72**	**0.65**	**0.57**	**0.11**	**0.00**	**0.86**	**0.51**	
10. Unit diversion requirement at offtakes from 2ndary canal																												
Farm efficiency: Ef=0.80			(lit/sec/ha)	**0.00**	**0.15**	**0.00**	**0.33**	**0.00**	**0.00**	**1.47**	**1.47**	**0.60**	**1.08**	**0.82**	**1.31**	**0.93**	**0.00**	**0.60**	**0.69**	**0.90**	**0.90**	**0.81**	**0.72**	**0.14**	**0.00**	**1.08**	**0.64**	
11. Unit diversion requirement at intake										peak	peak									peak						peak		
Conveyance efficiency Ec=0.725			(lit/sec/ha)	**0.00**	**0.21**	**0.00**	**0.45**	**0.00**	**0.00**	**2.02**	**2.02**	**0.83**	**1.49**	**1.14**	**1.80**	**1.28**	**0.00**	**0.83**	**0.95**	**1.25**	**1.25**	**1.12**	**0.99**	**0.19**	**0.00**	**1.48**	**0.88**	
12. Diversion requirement at intake		100ha	(m3/sec)	0.00	0.02	0.00	0.04	0.00	0.00	0.20	0.20	0.08	0.15	0.11	0.18	0.13	0.00	0.08	0.10	0.12	0.12	0.11	0.10	0.02	0.00	0.15	0.09	
Irrigation area: **For upland**		150ha	(m3/sec)	0.00	0.03	0.00	0.07	0.00	0.00	0.30	0.30	0.12	0.22	0.17	0.27	0.19	0.00	**0.13**	**0.14**	**0.19**	**0.19**	**0.17**	**0.15**	**0.03**	0.00	0.22	0.13	
		200ha	(m3/sec)	0.00	0.04	0.00	0.09	0.00	0.00	0.40	0.40	0.17	0.30	0.23	0.36	0.26	0.00	0.17	0.19	0.25	0.25	0.22	0.20	0.04	0.00	0.30	0.18	
		250ha	(m3/sec)	0.00	0.05	0.00	0.11	0.00	0.00	0.51	0.51	0.21	0.37	0.28	0.45	0.32	0.00	0.21	0.24	0.31	0.31	0.28	0.25	0.05	0.00	0.37	0.22	
		300ha	(m3/sec)	0.00	0.06	0.00	0.13	0.00	0.00	0.61	0.61	0.25	0.45	0.34	0.54	0.38	0.00	0.25	0.29	0.37	0.37	0.33	0.30	0.06	0.00	0.45	0.26	
For dry season		**400ha**	**(m3/sec)**	0.00	0.08	0.00	0.18	0.00	0.00	**0.81**	**0.81**	**0.33**	**0.59**	**0.45**	**0.72**	**0.51**	0.00	0.33	0.38	0.50	0.50	0.45	0.39	0.08	0.00	0.59	0.35	
For rainy season		**500ha**	**(m3/sec)**	**0.00**	**0.11**	**0.00**	**0.22**	**0.00**	0.00	1.01	1.01	0.42	0.74	0.57	0.90	0.64	0.00	0.42	0.48	0.62	0.62	0.56	0.49	0.09	0.00	**0.74**	**0.44**	
		700ha	(m3/sec)	0.00	0.15	0.00	0.31	0.00	0.00	1.42	1.42	0.58	1.04	0.79	1.26	0.89	0.00	0.58	0.67	0.87	0.87	0.78	0.69	0.13	0.00	1.04	0.61	
		800ha	(m3/sec)	0.00	0.17	0.00	0.36	0.00	0.00	1.62	1.62	0.67	1.19	0.91	1.44	1.02	0.00	0.67	0.76	1.00	1.00	0.89	0.79	0.15	0.00	1.19	0.70	
		900ha	(m3/sec)	0.00	0.19	0.00	0.40	0.00	0.00	1.82	1.82	0.75	1.34	1.02	1.62	1.15	0.00	0.75	0.86	1.12	1.12	1.00	0.89	0.17	0.00	1.34	0.79	

(4) Cropping Pattern Proposed by the BD（Paddy Only）

Pattern 6:
Paddy 105-day variety
2nd crop starts April(2)
Irrigation period:105 days

Cropping pattern — season: Rainy / Dry
Upstream: Main and Ramaskora and Ritabou 2ndary, upstream — 30% / 60%
Midstream: Ramskora and Ritabau 2ndary, midstream — 30% / 40%
Downstream: Ramskora and Ritabau 2ndary, downdstream — 40% / 0%

Percolation rate (water requirement rate measuremen)
Up/Midstream: 3.0mm/day
Downstream: 5.0mm/day

Water requirement for land preparatio (including ponding depth 50mm/mont)
land preparation period: 1 month
beginning of rainy season cropping 300mm
beginning of dry season cropping 250mm
Water Layer Replacement(WLR):WB F/S repor 50mm/15day

Irrigation efficiency（FAO criteria）
Application efficiency(Ea Ea=0.80
Branch canal efficiency(Eb Eb=0.80
Farm efficiency(Ef=Ea x Eb Ef=0.64
Conveyance efficiency(Ec Ec=0.85
Irrigation(Project) efficiency(Ep=Ef x Ec) Ep=0.544

				January		February		March		April		May		June		July		August		September		October		November		December		Total/AV
Discharge of	Maximum average discharge			4.60		5.60		4.50		3.70		1.90		1.40		1.10		0.80		0.60		0.50		1.40		3.00		1.70
Bulobo river	**Average discharge:**			**2.00**		**2.50**		**2.20**		**1.70**		**1.10**		**0.90**		**0.60**		**0.40**		**0.30**		**0.20**		**0.70**		**1.20**		**1.20**
	Minimum average discharge			0.40		0.80		0.70		0.60		0.40		0.30		0.20		0.10		0.10		0.10		0.20		0.30		0.50
	Low-flow reliability, 1 in 2 years			1.73		2.02		2.30		1.56		1.06		0.84		0.62		0.39		0.26		0.23		0.47		1.05		1.04
	Low-flow reliability, 1 in 3 years			1.33		1.67		1.68		1.42		0.99		0.75		0.49		0.31		0.20		0.19		0.30		0.84		0.85
	Low-flow reliability, 1 in 5 years:		**(m3/sec)**	**0.94**		**1.37**		**1.37**		**1.30**		**0.95**		**0.73**		**0.46**		**0.28**		**0.18**		**0.16**		**0.29**		**0.71**		**0.90**
1. Cropping pattern, Crop coefficient (kc)																												
1)Upstream	30%	60%		1.05	1.05	1.10	1.10	0.95	0.00	-	L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	-							L.P.	L.P.	
2)Midstream	30%	40%		L.P	1.05	1.05	1.10	1.10	0.95	0.00	-	L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	-								L.P.	
3)Downstream	40%	0%			L.P	L.P	1.05	1.05	1.10	1.10	0.95	0.00	L.P.	L.P.	1.05	1.05	1.10	1.10	0.95	0.00	-									
2. Evapo-transpiration (ET_0)			(ET_0)	**1.4**	**1.4**	**1.2**	**1.2**	**1.3**	**1.3**	**1.8**	**1.8**	**2.2**	**2.2**	**2.9**	**2.9**	**4.1**	**4.1**	**4.2**	**4.2**	**3.9**	**3.9**	**3.7**	**3.7**	**2.4**	**2.4**	**1.5**	**1.5**	
Crop evapo-transpiration rate (ETcrop=kc x ET_0)																												
1)Upstream	30%	60%		0.4	0.4	0.4	0.4	0.4	0.0				1.4	1.8	1.9	2.7	2.3											
2)Midstream	30%	40%			0.4	0.4	0.4	0.4	0.4	0.0				1.2	1.2	1.8	1.8	1.6										
3)Downstream	40%	0%				0.5	0.5	0.5	0.6	0.8	0.7	0.0			0.0	0.0	0.0	0.0	0.0										
Total			**(mm/day)**	**0.4**	**0.9**	**0.8**	**1.3**	**1.3**	**0.9**	**0.8**	**0.7**	**0.0**	**1.4**	**3.0**	**3.1**	**4.5**	**4.1**	**1.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**		
3. Percolation rate																												
1)Upstream	30%	60%	3.0mm/day	0.9	0.9	0.9	0.9	0.9			1.8	1.8	1.8	1.8	1.8	1.8	1.8									0.9	0.9	
2)Midstream	30%	40%	3.0mm/day	0.9	0.9	0.9	0.9	0.9	0.9			1.2	1.2	1.2	1.2	1.2	1.2	1.2									0.9	
3)Downstream	40%	0%	5.0mm/day		2.0	2.0	2.0	2.0	2.0	2.0	2.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0										
Total			**(mm/day)**	**1.8**	**3.8**	**3.8**	**3.8**	**3.8**	**2.9**	**2.0**	**3.8**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**3.0**	**1.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.9**	**1.8**	
4. Water requirment rate (2+3)			**(mm/day)**	**2.2**	**4.7**	**4.6**	**5.1**	**5.1**	**3.8**	**2.8**	**4.5**	**3.0**	**4.4**	**6.0**	**6.1**	**7.5**	**7.1**	**2.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.9**	**1.8**	
5. Net water requirement for land preparation																												
1)Upstream	30%	60%	Rainy season: 17.3mm/day								7.6	7.6														4.3	4.3	
2)Midstream	30%	40%	Dry season: 15.6mm/day	4.3								5.0	5.0														4.3	
3)Downstream	40%	0%			4.9	4.9							0.0	0.0														
Total			**(mm/day)**	**4.3**	**4.9**	**4.9**				**7.6**		**12.6**	**5.0**	**0.0**											**0.0**	**4.3**	**8.6**	
6. Water Layer Replacement: WLR																												
1)Upstream	30%	60%	10.3mm/day			2.2									4.4													
2)Midstream	30%	40%					2.2									2.9												
3)Downstream	40%	0%							2.1								0.0											
Total			**(mm/day)**		**0.0**	**2.2**	**2.2**	**0.0**	**2.1**						**4.4**	**2.9**	**0.0**											
7. Total farm water requirement (4+5+6)			(mm/day)	**6.5**	**9.6**	**11.7**	**7.3**	**5.1**	**6.0**	**2.8**	**12.0**	**15.6**	**9.4**	**6.0**	**10.5**	**10.4**	**7.1**	**2.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**5.2**	**10.4**	**138.5**
																											annual water requirement(mm)	**2,078**
8. Effective rainfall (source:WB F/S)																												
1) Agerage rainfall per month				380		362		312		120		100		43		12		12		13		78		208		305		1,945
2) Low-rainfall reliability, 1 in 5 years (reliability more than 8**0%**)				106	117	106	92	76	81	13	13	12	13	0	0	0	0	0	0	0	0	10	11	45	45	95	152	987
3) Effective rainfall (80% of low-rainfall reliability, 1 in 5 years				85	94	85	74	61	65	10	10	10	10	0	0	0	0	0	0	0	0	8	9	36	36	76	122	790
4) Effective rainfall per day			(mm/day)	**5.7**	**6.2**	**5.7**	**4.9**	**4.1**	**4.3**	**0.7**	**0.7**	**0.6**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**0.6**	**2.4**	**2.4**	**5.1**	**8.1**	
																											annunal net water requirement(mm	
9. Net water requirement(7-8)			(mm/day)	**0.9**	**3.3**	**6.0**	**2.4**	**1.1**	**1.7**	**2.1**	**11.3**	**14.9**	**8.7**	**6.0**	**10.5**	**10.4**	**7.1**	**2.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**2.2**	**1,377**
unit net water requirement			(lit/sec/ha)	**0.10**	**0.39**	**0.70**	**0.28**	**0.13**	**0.19**	**0.24**	**1.31**	**1.73**	**1.01**	**0.70**	**1.22**	**1.21**	**0.83**	**0.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.26**	
10. Unit diversion requirement at offtakes from 2ndary cana																												
Farm efficiency: Ef=0.64			(lit/sec/ha)	**0.16**	**0.60**	**1.09**	**0.43**	**0.20**	**0.30**	**0.38**	**2.05**	**2.70**	**1.58**	**1.09**	**1.90**	**1.89**	**1.29**	**0.51**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.41**	
11. Diversion requirement at intake						peak						peak																
Conveyance efficiency Ec=0.85			(lit/sec/ha)	**0.18**	**0.71**	**1.29**	**0.51**	**0.23**	**0.35**	**0.45**	**2.41**	**3.18**	**1.86**	**1.29**	**2.24**	**2.22**	**1.52**	**0.59**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.48**	
										Rainy seaso	**0.54**																	
										Dry seaso	**1.87**																	
12. Diversion requirement at intake		100ha	(m3/sec)	0.02	0.07	0.13	0.05	0.02	0.04	0.04	0.19	0.32	0.19	0.13	0.22	0.22	0.15	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	
Dry season		**150ha**	**(m3/sec)**	0.03	0.11	0.19	0.08	0.03	0.05	0.07	0.28	0.48	0.28	0.19	0.34	0.33	0.23	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	
		200ha	**(m3/sec)**	0.04	0.14	0.26	0.10	0.05	0.07	0.09	0.37	0.64	0.37	0.26	0.45	0.44	0.30	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	
Irrigation area:		**250ha**	**(m3/sec)**	0.05	0.18	0.32	0.13	0.06	0.09	0.11	0.47	0.79	0.46	0.32	0.56	0.56	0.38	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.12	
		300ha	**(m3/sec)**	0.06	0.21	0.39	0.15	0.07	0.11	0.13	0.56	0.95	0.56	0.39	0.67	0.67	0.46	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.14	
		600ha	(m3/sec)	0.11	0.43	0.77	0.31	0.14	0.21	0.27	0.32	1.91	1.11	0.77	1.34	1.33	0.91	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.29	
		700ha	(m3/sec)	0.13	0.50	0.90	0.36	0.16	0.25	0.31	0.38	2.23	1.30	0.90	1.57	1.56	1.06	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.33	
		750ha	(m3/sec)	0.14	0.53	0.97	0.38	0.17	0.26	0.33	0.40	2.38	1.39	0.96	1.68	1.67	1.14	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.36	
Rainy season		**800ha**	**(m3/sec)**	0.15	0.57	1.03	0.41	0.19	0.28	0.36	0.43	2.54	1.49	1.03	1.79	1.78	1.22	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.38	
		850ha	**(m3/sec)**	0.16	0.60	1.10	0.43	0.20	0.30	0.38	0.46	2.70	1.58	1.09	1.90	1.89	1.29	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.41	
		900ha	**(m3/sec)**	0.17	0.64	1.16	0.46	0.21	0.32	0.40	0.48	2.86	1.67	1.16	2.02	2.00	1.37	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.43	
		950ha	**(m3/sec)**	0.17	0.68	1.23	0.48	0.22	0.33	0.42	0.51	3.02	1.76	1.22	2.13	2.11	1.44	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.45	
		1,000ha	**(m3/sec)**	0.18	0.71	1.29	0.51	0.23	0.35	0.45	0.54	3.18	1.86	1.29	2.24	2.22	1.52	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.48	
		1,050ha	**(m3/sec)**	0.19	0.75	1.35	0.53	0.24	0.37	0.47	0.57	3.34	1.95	1.35	2.35	2.33	1.60	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.50	
13. Water taken by Water service facilitiy		**15lit/sec**	**(m3/sec)**	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	
14. Total(1,050+200):			**(m3/sec)**	**0.21**	**0.76**	**1.37**	**0.55**	**0.26**	**0.38**	**0.48**	**0.86**	**0.49**	**0.29**	**0.21**	**0.35**	**0.35**	**0.24**	**0.10**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.04**	**0.52**	

Estimation of water requirement for land preparation

Peak requirement per day	Rainy season	Dry season
Sn:Water requirement rate(mm/day)		
Sn=（D+d x(N-1)）/N	**17.3 mm/day**	**15.6 mm/day**
D:Water requirement for land preparation(mm)	300 mm	250 mm
d:Water requirement per day(mm)	7.5 mm	7.5 mm
N:Term of puddling(day)	30 days	30 days

Estimation of water layer replacement

Peak requirement rate	Rainy season
Wn:Water requirement per day(mm/day)	
Wn=（D+d x(N-1)）/N	**10.3 mm/day**
D:Water layer replacement(mm)	50 mm
d:Water requirement per day(mm)	7.5 mm
N:Term of water layer replacement(day)	15 day

(5) Cropping Pattern proposed by the BD（Upland only）

Pattern 8:
Upland 4-month
2nd crop starts on November
Irrigation period:105-day

Cropping pattern
1)Upstream: Main, Ramaskora & Ritabou 2ndary, upstream
2)Downstream: Ramskora & Ritabau 2ndary, downdstream

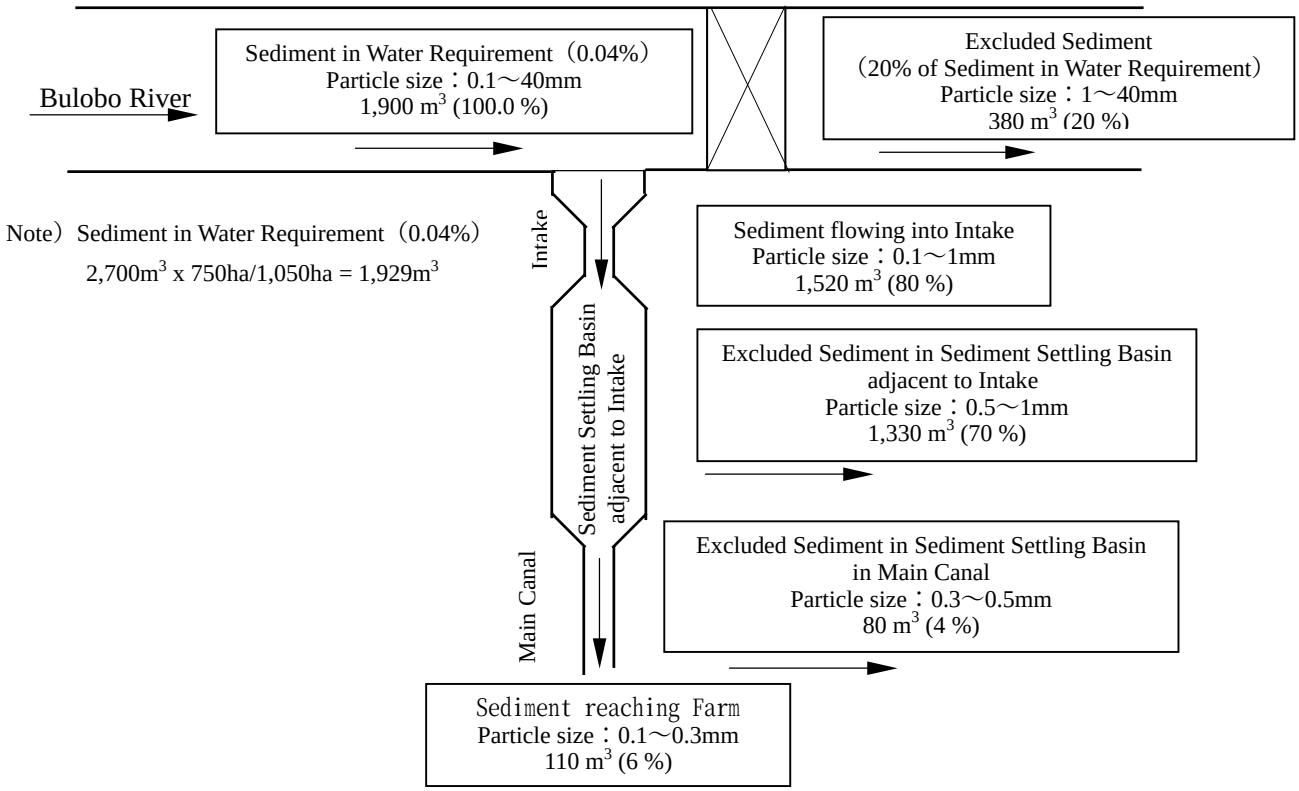
season: Rainy 60% 40% / Dry 60% 40%

Initial water requirement(15days)
Upstream: 3.0mm/day
Downstream: 3.0mm/day

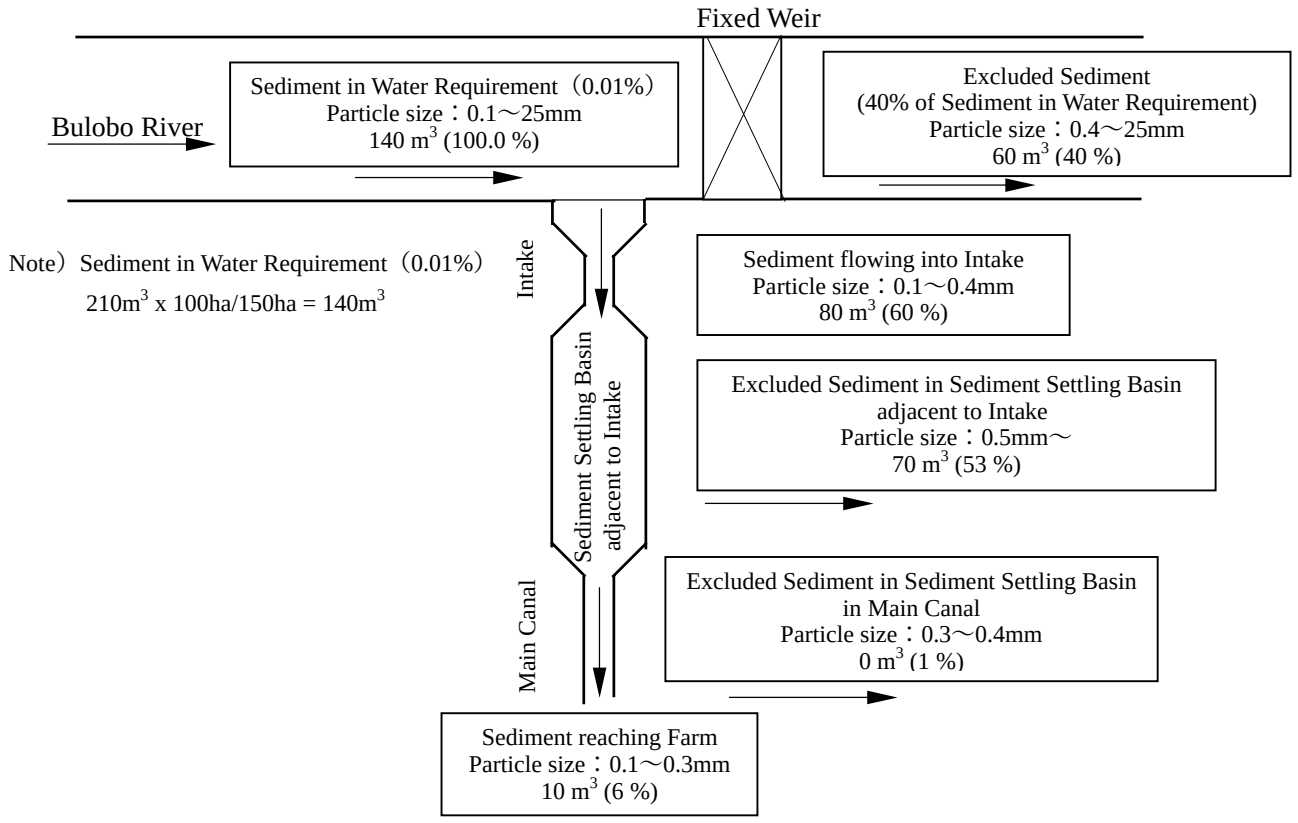
Irrigation efficiency（FAO criteria）
Application efficiency(Ea) Ea=0.70
Branch canal efficiency(Eb) Eb=0.80
Farm efficiency(Ef=Ea x Eb) Ef=0.56
Conveyance efficiency(Ec) Ec=0.85
Irrigation(Project) efficiency(Ep=Ef x Ec) Ep=0.476

		January		February		March		April		May		June		July		August		September		October		November		December		Total/AV
Discharge of Bulobo river Maximum average discharge:		4.60		5.60		4.50		3.70		1.90		1.40		1.10		0.80		0.60		0.50		1.40		3.00		1.70
Average discharge:		**2.00**		**2.50**		**2.20**		**1.70**		**1.10**		**0.90**		**0.60**		**0.40**		**0.30**		**0.20**		**0.70**		**1.20**		**1.20**
Minimum average discharge:		0.40		0.80		0.70		0.60		0.40		0.30		0.20		0.10		0.10		0.10		0.20		0.30		0.50
Low-flow reliability, 1 in 2 years		1.73		2.02		2.30		1.56		1.06		0.84		0.62		0.39		0.26		0.23		0.47		1.05		1.04
Low-flow reliability, 1 in 3 years		1.33		1.67		1.68		1.42		0.99		0.75		0.49		0.31		0.20		0.19		0.30		0.84		0.85
Low-flow reliability, 1 in 5 years:	**(m3/sec)**	**0.94**		**1.37**		**1.37**		**1.30**		**0.95**		**0.73**		**0.46**		**0.28**		**0.18**		**0.16**		**0.29**		**0.71**		**0.90**
1. Cropping pattern, Crop coefficient (kc)																										
1)Upstream 60% 60%		0.98	0.82	0.35	0.00		0.00	0.40	0.54	0.82	0.96	0.98	0.82	0.35	0.00							0.40	0.54	0.82	0.96	
2)Midstream 40% 40%		0.96	0.98	0.82	0.35	0.00		0.00	0.40	0.54	0.82	0.96	0.98	0.82	0.35	0.00							0.40	0.54	0.82	
2. Consumptive use ($ETcrop=kc \times ET_0$)	(ET_0)	**1.4**	**1.4**	**1.2**	**1.2**	**1.3**	**1.3**	**1.8**	**1.8**	**2.2**	**2.2**	**2.9**	**2.9**	**4.1**	**4.1**	**4.2**	**4.2**	**3.9**	**3.9**	**3.7**	**3.7**	**2.4**	**2.4**	**1.5**	**1.5**	
1)Upstream 60% 60%		0.8	0.7	0.3				0.4	0.6	1.1	1.3	1.7	1.4	0.9	0.0											
2)Midstream 40% 40%		0.5	0.5	0.4	0.2				0.3	0.5	0.7	1.1	1.1	1.3	0.6	0.0										
Total	**(mm/day)**	**1.4**	**1.2**	**0.6**	**0.2**	**0.0**	**0.0**	**0.4**	**0.9**	**1.6**	**2.0**	**2.8**	**2.6**	**2.2**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	
3. Initial water requirement																										
1)Upstream 60% 60% 3.0mm/day								1.8														1.8				
2)Midstream 40% 40% 3.0mm/day									1.2														1.2			
Total	**(mm/day)**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**1.2**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**1.2**	**0.0**	**0.0**	
4. Consumative use rate(2+3)	**(mm/day)**	**1.4**	**1.2**	**0.6**	**0.2**	**0.0**	**0.0**	**2.2**	**2.1**	**1.6**	**2.0**	**2.8**	**2.6**	**2.2**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**1.2**	**0.0**	**0.0**	
5. Total farm water requirement(=4)	(mm/day)	**1.4**	**1.2**	**0.6**	**0.2**	**0.0**	**0.0**	**2.2**	**2.1**	**1.6**	**2.0**	**2.8**	**2.6**	**2.2**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**1.2**	**0.0**	**0.0**	**22.4**
																										annual water requirement(mm) **336**
6. Effective rainfall (source:WB F/S)																										
1) Agerage rainfall per month		380		362		312		120		100		43		12		12		13		78		208		305		1,945
2) Low-rainfall reliability, 1 in 5 years (reliability more than 8(%)		106	117	106	92	76	81	13	13	12	13	0	0	0	0	0	0	0	0	10	11	45	45	95	152	987
3) Effective rainfall (80% of low-rainfall reliability, 1 in 5 years		85	94	85	74	61	65	10	10	10	10	0	0	0	0	0	0	0	0	8	9	36	36	76	122	790
4) Effective rainfall per day	(mm/day)	**5.7**	**6.2**	**5.7**	**4.9**	**4.1**	**4.3**	**0.7**	**0.7**	**0.6**	**0.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.5**	**0.6**	**2.4**	**2.4**	**5.1**	**8.1**	
																										annual net water requirement(mm)
7. Net water requirement(5-6)	(mm/day)	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.5**	**1.4**	**0.9**	**1.3**	**2.8**	**2.6**	**2.2**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**199**
unit net water requirement	(lit/sec/ha)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.18**	**0.16**	**0.11**	**0.15**	**0.33**	**0.30**	**0.26**	**0.07**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
8. Unit diversion requirement at offtakes from 2ndary canal																										
Farm efficiency: Ef=0.56	(lit/sec/ha)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.32**	**0.28**	**0.19**	**0.27**	**0.58**	**0.53**	**0.46**	**0.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
9. Unit diversion requirement at intake												peak														
Conveyance efficiency Ec=0.85	(lit/sec/ha)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.37**	**0.34**	**0.22**	**0.31**	**0.69**	**0.62**	**0.54**	**0.14**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	
10. Diersion requirement at intake 100ha	(m3/sec)	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.02	0.03	0.07	0.06	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Irrigation area: 150ha	(m3/sec)	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.05	0.03	0.05	0.10	0.09	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
200ha	(m3/sec)	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.04	0.06	0.14	0.12	0.11	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
250ha	**(m3/sec)**	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.08	0.06	0.08	0.17	0.16	0.13	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
300ha	**(m3/sec)**	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.10	0.07	0.09	0.21	0.19	0.16	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

(1) Fixed Weir

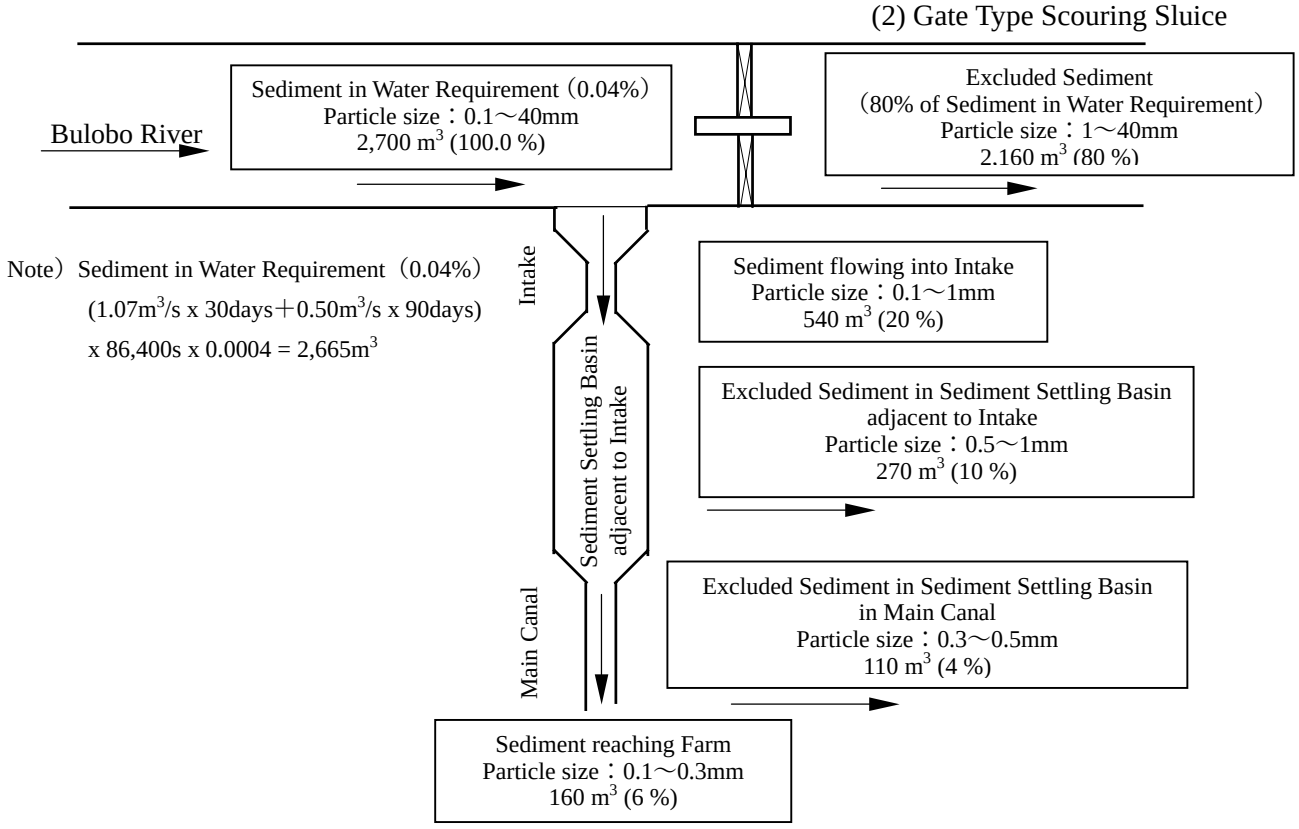


Sediment Control Measure in Rainy Season

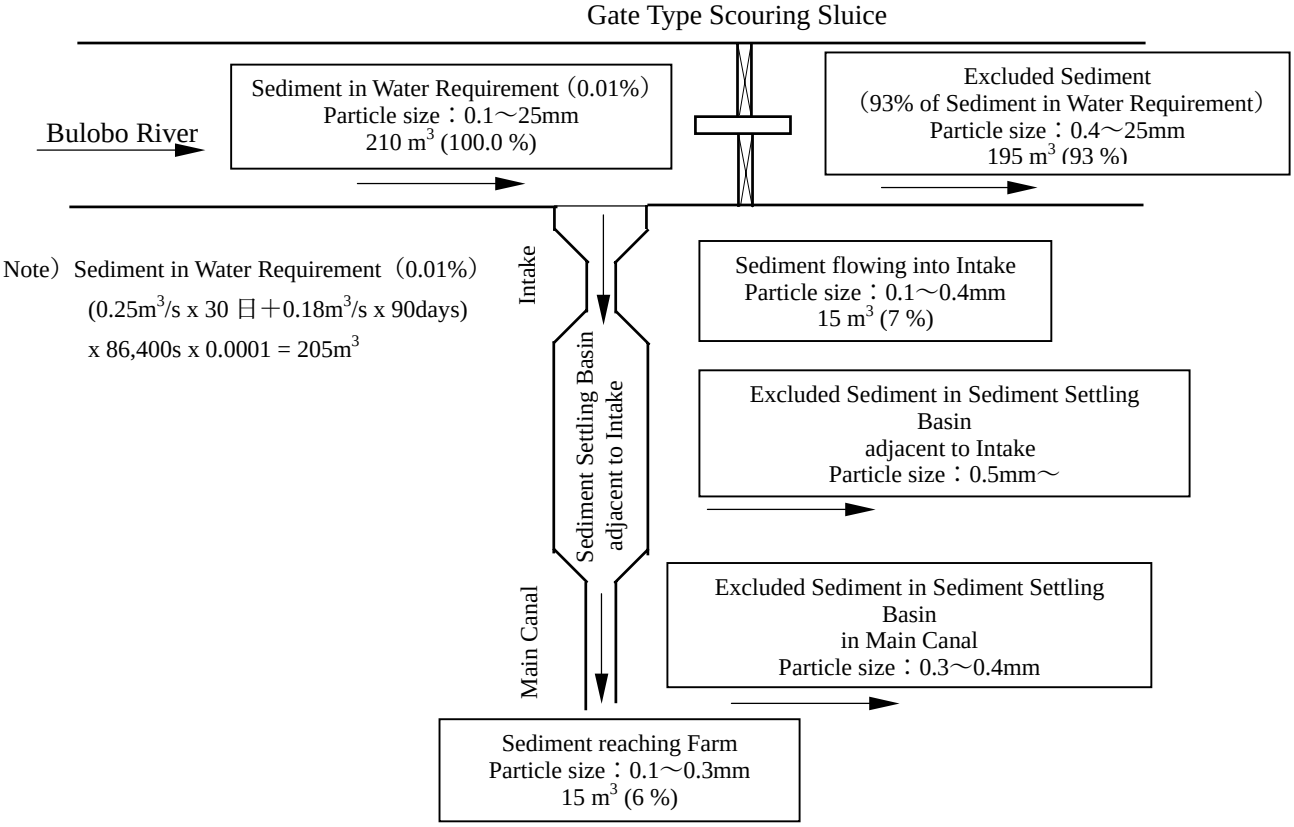


Sediment Control Measure in Dry Season

Figure A 5-8.1 Sediment Control by Proposed Fixed Weir



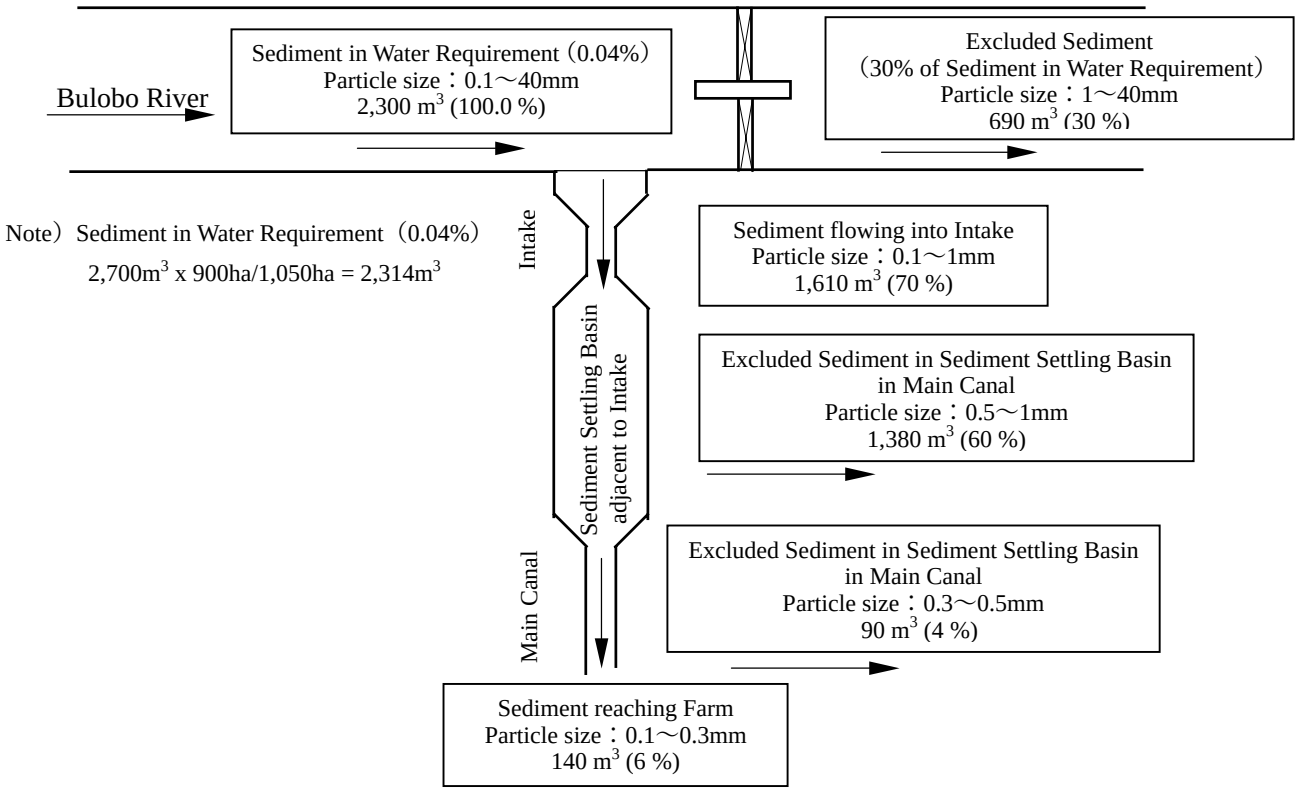
Sediment Control Measure in Rainy Season



Sediment Control Measure in Dry Season

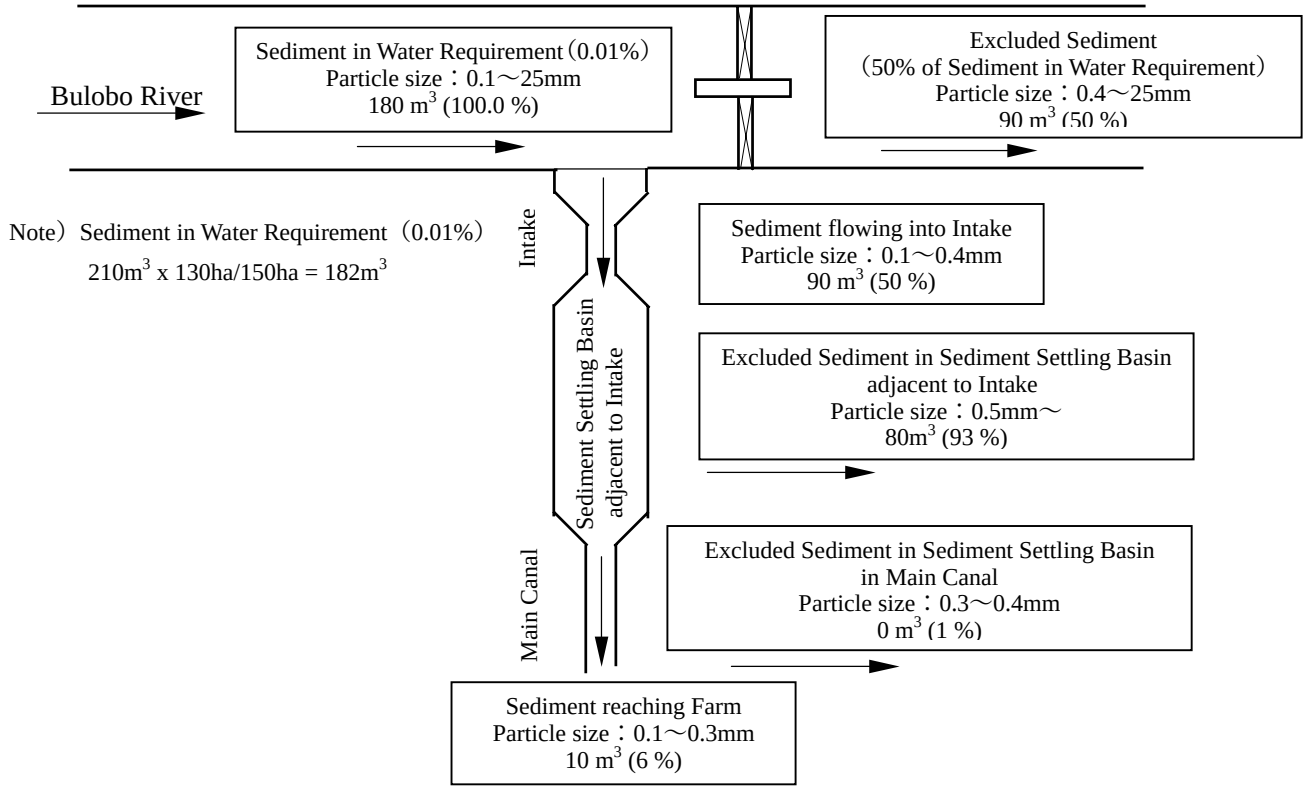
Figure A 5-8.2 Sediment Control by Proposed Gate Type Scouring Sluice

(3) Stop Log Type Scouring Sluice



Sediment Control Measure in Rainy Season

Stop Log Type Scouring Sluice

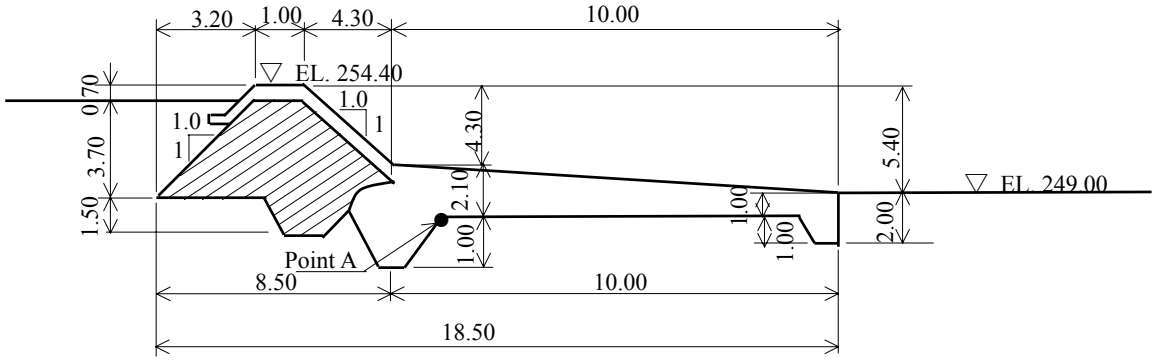


Sediment Control Measure in Dry Season

Figure A 5-8.3 Sediment Control by Proposed Stop Log Type Scouring Sluice

6-10. 1 Design of Fixed Weir

Longitudinal cross section of designed headworks



(1) Downstream apron of fixed weir

① Length of downstream apron

The fixed weir has an apron on the downstream side to avoid possible scouring by water flow over the weir body. The length of the downstream apron is determined as follows (See Headwork Design Standard of MAFF, page 207);

The length of the downstream apron is obtained using the Bligh's formula.

$$l_1 = 0.6 \times C\sqrt{D_1} = 0.6 \times 4 \times \sqrt{5.40} = 5.57 \text{ m}$$

Where;

l_1 = Length of the downstream apron (m)

D_1 = Elevation difference between the weir crown and the top at the apron downstream end (i.e. D_1 = EL 254.40 m − EL 249.00 m = 5.40 m)

C = Bligh's coefficient, which is 4 for boulders, gravel and sand

In conclusion, the length of the downstream apron is determined to be 10.0 m as a combination of creep length (discussed in the following section), downstream apron length of the scouring sluice (discussed in Section 2-4.2 (3)) and 5.57 m obtained above.

② Method of creep length examination

It is essential to secure a creep length along with ground-contact surface of the weir or back face of bank protection retaining walls for prevention of piping. The creep length to prevent piping is calculated using two methods: Bligh's and Lane's methods. After comparing two values to each other, the larger one is adopted as the minimum length of creep length (See Headwork Design Standard of MAFF, page 192).

Assuming the downstream one is zero, to be safer, the maximum water level difference between up- and downstream sides is calculated. Weep holes are installed in the cutoff wall at the downstream end of the downstream apron, to reduce uplift pressure. Therefore, we do not consider the width of cutoff wall as a part of the creep length.

③ Examination of creep length

i) Bligh's method

$$S \geq C \times \Delta H = 4 \times 5.40 = 21.60\ \text{m} \leq 27.20\ \text{m}$$

where

S = Creep length along with ground-contact surface of the weir (m)

(i.e. S = 3.70 + 1.50 × 2 +1.00 × 2 + 18.50 = 27.20 m)

C = Bligh's coefficient, which is 4 for boulders, gravel and sand

ΔH = the maximum water level difference between up- and downstream sides

= 5.40 m

ii) Lane's method

$$L \geq C' \times \Delta H = 2.5 \times 5.40 = 13.50\ \text{m} \leq 14.87\ \text{m}$$

where

L = Weighted creep length (m), $L = \sum l_{\text{V}} + (1/3)\sum l_{\text{h}}$

L = (3.70+1.50×2+1.00×2) + 1/3 ×18.50 = 14.87 m

C' = Lane's weighted coefficient, which is 2.5 for boulders, gravel and stones

ΔH = the maximum water level difference between up- and downstream sides

= 5.40 m

As a result, the downstream apron length of 10.0 m satisfies both inequalities above and is inferred to be safe.

④ Thickness of downstream apron

The thickness of the downstream apron is obtained from the following inequality concerning the uplifting pressure balance (See Headwork Design Standard of MAFF, page 207).

$$t \geq \frac{4}{3} \times \frac{\Delta H - H_{\text{f}}}{\gamma - 1}$$

where

t = Apron thickness at a point of interest (m)

ΔH = the maximum water level difference between up- and downstream sides

= 5.40 m

H_{f} = Head loss of percolating water to the point of interest

γ = Specific gravity of the material of weir and apron, γ = 2.35 tf/m^3

$\frac{4}{3}$ = Safety factor

- Overall creep length

  L_X = 3.70 + 1.50 × 2 +1.00 × 2 + 18.50 = 27.20 m

- Creep length to Point A

$L_A = 3.70 + 1.50 \times 2 + 1.00 \times 2 + 8.50 = 17.20$ m

- Head loss of percolating water to Point A

  $H_f = (L_A/L_x) \times \Delta H = (17.20/27.20) \times 5.40 = 3.41$ m

- Apron thickness

$$t \geq \frac{4}{3} \times \frac{\Delta H - H_f}{\gamma - 1} = \frac{4}{3} \times \frac{5.40 - 3.41}{2.35 - 1} = 1.97 \text{ m}$$

Consequently, the apron thickness at Point A, *t*, is determined to be 2.10 m.

(2) Length of riverbed protection of fixed weir

① Length of riverbed protection

In addition to the downstream apron, riverbed protection is implemented to avoid possible scouring by water flow over the fixed weir. The length of riverbed protection is determined as follows (See Headwork Design Standard of MAFF, page 259);

The length of riverbed protection is obtained using the Bligh's formula.

$$L = L_B - l_a$$

$$L_B = 0.67 \times C\sqrt{H_a \times q} \times f = 0.67 \times 4 \times \sqrt{5.40 \times 11.22} \times 1.0 = 20.86 \text{ m}$$

Where;

L = Length of riverbed protection

L_B = Total of apron length l_a and riverbed protection length L

H_a = Elevation difference between the weir crown and downstream-side water level during drought period

H_a = EL 254.40 m − WL 249.00 m = 5.40 m

q = Design flood discharge per unit width, $q = 11.22$ m^3/sec/m

f = Safety factor of fixed weir, f = 1.0

$L = 20.86 - 10.00 = 10.86$ m

Thus, the length of riverbed protection is determined to be 12.0 m, that is 3 m × 3 rows.

② Riverbed Protection Block

Riverbed protection blocks must be stable against water flow. The approximate weight of a riverbed protection block is determined as follows (See Headwork Design Standard of MAFF, page 259):

$$W \geq 3.77 \times A \times \frac{V^2}{2g} = 3.77 \times 1.35 \times \frac{5.25^2}{2 \times 9.8} = 7.16 \text{ tf}$$

Where;

W = Weight of a riverbed protection block (tf)

A = Area of a block exposed perpendicular to water flow (m^2)

$A = 0.50 \times 2.70 = 1.35$ m^2

V = Velocity of water when it hits blocks, $V = 5.25$ m/sec

g = acceleration of gravity = 9.8 m/sec^2

Thus, riverbed protection blocks are crossing type and made of in-place concrete. The size of a block is 2.70 m in width, 2.70 m in length and1.00 m in height, and the weight is 8.75 of each.

6-10. 2 Design of Scouring Sluice

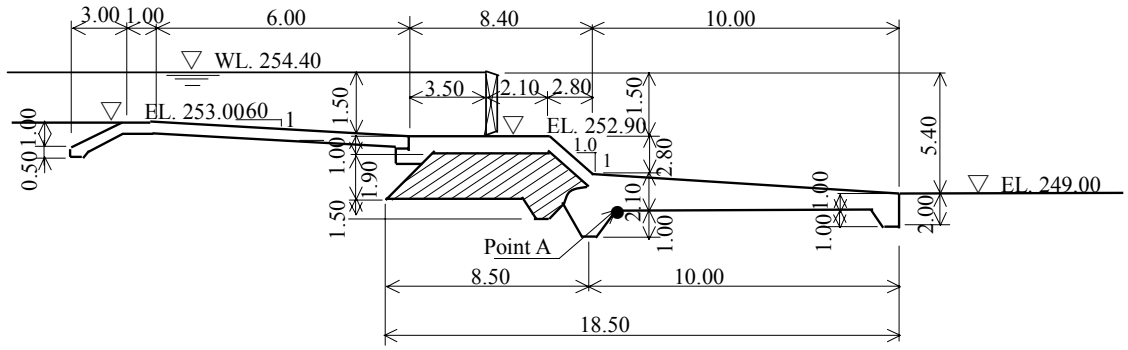
(1) Width of scouring sluice

The width of scouring sluice is determined so that the inside water velocity is approximately 0.4 m/sec for water intake at the normal flow rate during the wet period (approximately 2.0 m^3/sec). Assuming the sedimentation depth is 0.5 m, the effective depth inside the scouring depth is 0.9 m.

Width of scouring sluice, B = 2.0 (m^3/sec) × 0.4 (m/sec) × 0.9 (m) = 5.6 (m) Therefore, the scouring sluice is composed of two sets of sluice gates. The gate size is 3 meter wide and 1.5 meter wide.

(2) Longitudinal slope of scouring sluice

Longitudinal cross section of new scouring sluice



① Conditions for hydraulic design of scouring sluice

- ✓ Target discharge (normal discharge): $Q_m = 2.00$ m^3/sec
- ✓ Maximum diameter of soil particle scoured: $d_{max} = 40$ mm
- ✓ River bed slope: I_u = 1:100 for upstream side of weir, I_d = 1:60 for downstream side
- ✓ Roughness coefficient of scouring sluice: $n = 0.020$

② Longitudinal slope of scouring sluice

The scouring sluice channel is designed so that it has a supercritical flow at the normal discharge that can flush away stones of d_{max} through fully-opened gates.

- ✓ Critical velocity: $V_c = \sqrt{20 \times d_{max}} = \sqrt{20 \times 0.04} = 0.89$ m/sec

✓ Critical depth: $h_c = \frac{V_c^2}{g} = \frac{0.89^2}{9.8} = 0.08\,\text{m}$

✓ Critical slope: $I_c = \left(0.020 \times \frac{0.89}{0.08^{2/3}} \right) = 0.00919 = 1:109$

Therefore, the longitudinal slope of the scouring sluice can be the same as I_d and is determined to be 1:60.

The longitudinal slope of the scouring sluice = I_d = 1/60.

(3) Downstream apron of scouring sluice

① Length of downstream apron of scouring sluice

A downstream apron is constructed to avoid possible scouring by water flow through the scouring sluice. The length of the downstream apron is determined as follows (See Headwork Design Standard of MAFF, page 207);

The length of the downstream apron is obtained using the Bligh's formula.

$$l_1 = 0.9 \times C\sqrt{D_1} = 0.9 \times 4 \times \sqrt{5.40} = 8.37\,\text{m}$$

Where;

l_1 = Length of the downstream apron (m)

D_1 = Elevation difference between the gate top and the top at the apron downstream end (i.e. D_1 = EL 254.40 m − EL 249.00 m = 5.40 m)

C = Bligh's coefficient, which is 4 for boulders, gravel and sand

Thus, the length of the downstream apron is determined to be 10.0 m to secure creep length.

② Creep length of scouring sluice

1) Method of creep length examination

It is essential to secure a creep length along with ground-contact surface of the weir or back face of bank protection retaining walls for prevention of piping. The creep length to prevent piping is calculated using two methods: Bligh's and Lane's methods. After comparing two values to each other, the larger one is adopted as the minimum length of creep length (See Headwork Design Standard of MAFF, page 192).

Assuming the downstream one is zero, to be safer, the maximum water level difference between up- and downstream sides is calculated. Weep holes are installed in the cutoff wall at the downstream end of the downstream apron, to reduce uplift pressure. Therefore, we do not consider the width of cutoff wall as a part of the creep length.

2) Examination of creep length

i) Bligh's method

$$S \geq C \times \Delta H = 4 \times 5.40 = 21.60\ \text{m} \leq 27.20\ \text{m}$$

where

S = Creep length along with ground-contact surface of the weir (m)

(i.e. S = 1.00 + 1.90 +1.50 × 2 + 1.00×2 +18.50 = 26.40 m)

C = Bligh's coefficient, which is 4 for boulders, gravel and sand

ΔH = the maximum water level difference between up- and downstream sides

= 5.40 m

ii) Lane's method

$$L \geq C' \times \Delta H = 2.5 \times 5.40 = 13.50\ \text{m} \leq 14.07\ \text{m}$$

where

L = Weighted creep length (m), $L = \sum l_{\text{V}} + (1/3)\sum l_{\text{h}}$

L = (1.00 +1.90 + 1.50×2 + 1.00×2) + 1/3 ×18.50 = 14.07 m

C' = Lane's weighted coefficient, which is 2.5 for boulders, gravel and stones

ΔH = the maximum water level difference between up- and downstream sides

= 5.40 m

As a result, the downstream apron length of 10.0 m satisfies both inequalities above and is inferred to be safe.

③ Thickness of downstream apron of scouring sluice

The thickness of the downstream apron is obtained from the following inequality concerning the uplifting pressure balance (See Headwork Design Standard of MAFF, page 207).

$$t \geq \frac{4}{3} \times \frac{\Delta H - H_{\text{f}}}{\gamma - 1}$$

Where;

t = Apron thickness at a point of interest (m)

ΔH = the maximum water level difference between up- and downstream sides

= 5.40 m

H_{f} = Head loss of percolating water to the point of interest

γ = Specific gravity of the material of weir and apron, γ = 2.35 tf/m^3

$\frac{4}{3}$ = Safety factor

- Overall creep length

  L_{X} = 1.00 + 1.90 + 1.50 × 2 +1.00 × 2 + 18.50 = 26.40 m

- Creep length to Point A

  L_{A} = 1.00 + 1.90 + 1.50 × 2 +1.00 × 2 + 8.50 = 16.40 m

- Head loss of percolating water to Point A

  $H_f = (L_A/L_x) \times \Delta H = (16.40/26.40) \times 5.40 = 3.35$ m

- Apron thickness

$$t \geq \frac{4}{3} \times \frac{\Delta H - H_f}{\gamma - 1} = \frac{4}{3} \times \frac{5.40 - 3.35}{2.35 - 1} = 2.10\,\text{m}$$

Consequently, the apron thickness at Point A, t, is determined to be 2.10 m.

(4) Riverbed protection of scouring sluice

① Length of riverbed protection of scouring sluice

In addition to the downstream apron, riverbed protection is implemented to avoid possible scouring by water flow over the fixed weir. The length of riverbed protection is determined as follows (See Headwork Design Standard of MAFF, page 259):

The length of riverbed protection is obtained using the Bligh's formula.

$$L = L_B - l_a$$

$$L_B = 0.67 \times C\sqrt{H_a \times q} \times f = 0.67 \times 4 \times \sqrt{5.40 \times 19.97} \times 1.5 = 41.75\,\text{m}$$

Where;

L = Length of riverbed protection

L_B = Total of apron length l_a and riverbed protection length L

H_a = Elevation difference between the weir crown and downstream-side water level during drought period H_a = EL 254.40 m − WL 249.00 m = 5.40 m

q = Design flood discharge per unit width, q = 19.97 m^3/sec/m

f = Safety factor of sluice-gate weir, f = 1.5

L = 41.75 − 14.90 = 26.85 m

Thus, the length of riverbed protection is determined to be 12.0 m, that is 3 m × 3 rows.

② Riverbed protection block of scouring sluice

Riverbed protection blocks must be stable against water flow. The approximate weight of a riverbed protection block is determined as follows (See Headwork Design Standard of MAFF, page 259);

$$W \geq 3.77 \times A \times \frac{V^2}{2g} = 3.77 \times 1.35 \times \frac{5.25^2}{2 \times 9.8} = 7.16\,\text{tf}$$

Where;

W = Weight of a riverbed protection block (tf)

A = Area of a block exposed perpendicular to water flow (m^2)

A = 0.50 × 2.70 = 1.35 m^2

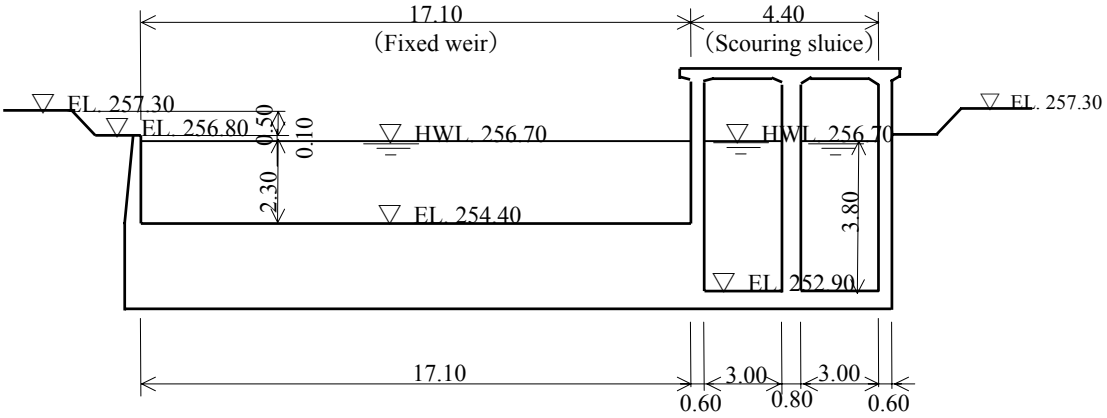
V = Velocity of water when it hits blocks, V = 5.25 m/sec

g = acceleration of gravity = 9.8 m/sec^2

Thus, riverbed protection blocks are crossing type and made of in-place concrete. The size of a block is 2.70 m in width, 2.70 m in length and 1.00 m in height, and the weight is 8.75 of each.

6-10. 3 Flood Water Level on the Upstream Side of Headworks after Rehabilitation

Elevation of Maliana I headworks



We presume the design flood discharge is HWL. 256.70 m.

(1) Fixed weir

Water depth, m	:	hw = HWL. 256.70 m − EL. 254.40 m = 2.30 m
Cross-sectional flow area, m^2	:	Aw = 16.90 × 2.30 = 38.87 m^2
Flow velocity, m/sec	:	Vw = 189.7 / 38.87 = 4.88 m/sec
Velocity head, m	:	Hvw = 4.88^2 / (2×9.8) = 1.22 m
Energy head, m	:	H = 2.30 + 1.22 = 3.52 m
Discharge, m^3/sec	:	Q = 1.70 × 17.10 × $3.52^{3/2}$ = 192.0 m^3/sec

(2) Scouring sluice (Concrete section)

Water depth, m	:	hs = HWL. 256.70 m − EL. 252.90 m = 3.80 m
Cross-sectional flow area, m^2	:	As = 3.00 × 3.80 × 2 = 22.80 m^2
Wetted perimeter, m	:	Ps = (3.00 + 3.80 × 2) × 2 = 21.20 m
Hydraulic radius, m	:	Rs = 22.80 / 21.20 = 1.075 m
Roughness coefficient	:	n_s = 0.020
River bed slope	:	Is = 1 / 100
Flow velocity, m/sec	:	Vs = 1 / 0.020 × $1.075^{2/3}$ × $(1 / 100)^{0.5}$ = 4.88 m/sec
Discharge, m^3/sec	:	Qs = 22.80 × 5.25 = 119.8 m^3/sec
Total discharge, m^3/sec	:	Q = 192.0 ×119.8 = 311.8 ≈ 310 m^3/sec

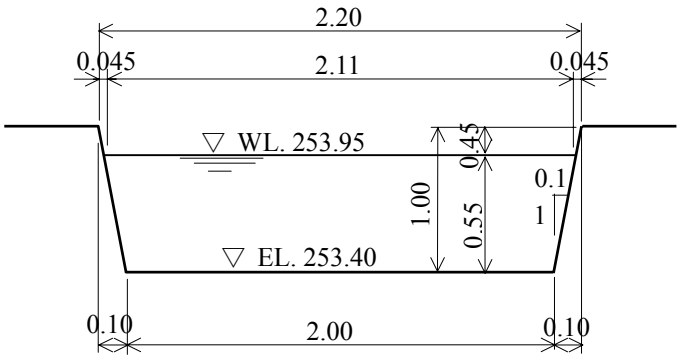
Therefore, the flood water level on the upstream side of headworks after rehabilitation is HWL. 256.70 m.

6-11. 1 Hydraulic Design Conditions and Hydraulic Longitudinal Profile

(1) Hydraulic design conditions

1) Design intake discharge : Q = 1.37 m^3/sec
2) Design intake water level : NWL. 254.30 m
3) Design intake width : W = 1.50 × 2 + 0.60 = 3.60 m
4) Design intake bottom elevation : EL. 253.60 m
5) Boundary hydraulic conditions at the beginning point of main canal :

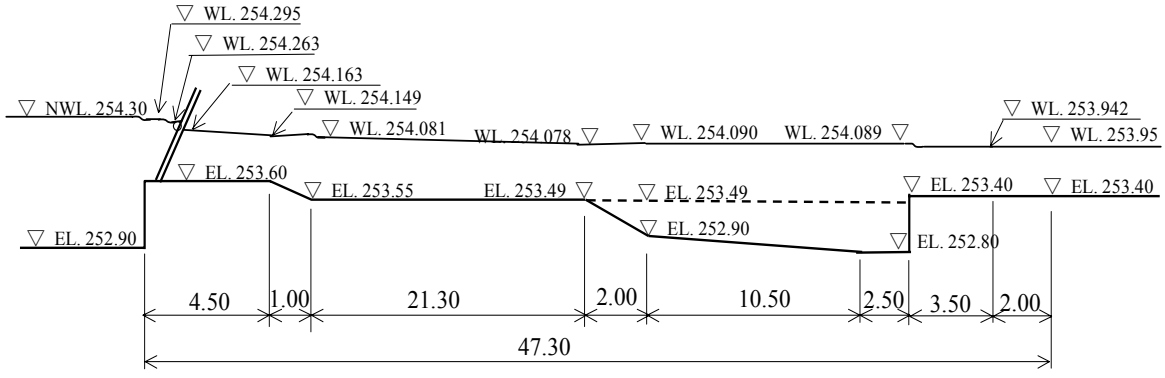
Cross Section of at the Beginning Point of Main Canal



- Design depth : h = 0.55 m
- Cross-sectional flow area : A = 1/2 × (2.00 + 2.11) × 0.55 = 1.13 m^2
- Wetted perimeter : P = 2.00 + 0.55 × 2 = 3.11 m^2
- Hydraulic radius : R = 1.13 / 3.11 = 0.364 m
- Roughness coefficient : n = 0.020
- Bed slope : I = 1 / 400
- Flow velocity : $V = 1 / 0.020 \times 0.364^{2/3} \times (1 / 400)^{0.5} = 1.27$ m/sec
- Discharge : Q = 1.13 × 1.27 = 1.44 > Design Q = 1.37 m^3/sec

(2) Longitudinal profile

Longitudinal profile of intake works and sediment settling basin



6-11. 2 Hydraulic Calculations

(1) Water level decline due to water intake

$$\Delta he = fe \times \frac{V_1^2}{2g} + \frac{V_1^2 - V_0^2}{2g}$$

Where;

Δhe = Water level decline due to water intake, m

fe = Coefficient of loss due to water intake, fe = 0.20 for rectangular shape with rounded corners

V_1 = Flow velocity after water intake, m/sec

V_0 = Flow velocity before water intake, V_0 = 0 m/sec

g = acceleration of gravity = 9.80 m/sec^2

Assuming Δhe = 0.005 m, we have

Depth after water intake	:	h_1 = NWL. 254.30 − 0.005 − EL. 252.90 = 1.395 m
Width of intake opening	:	$B_1 = 1.50 \times 2 + 0.60 = 3.60$ m
Cross-sectional flow area after water intake	:	$A_1 = 3.60 \times 1.395 = 5.022$ m^2
Flow velocity after water intake	:	$V_1 = 1.37 / 5.022 = 0.27$ m/sec

These values result in

$$\Delta he = 0.20 \times \frac{0.27^2}{2 \times 9.80} + \frac{0.27^2 - 0^2}{2 \times 9.80} = 0.001 + 0.004 = 0.005 \text{ m},$$

And Δhe coincides with the above assumed value. Therefore,

Water level after water intake = NWL. 254.30 − 0.005 = WL. 254.295 m.

(2) Water level decline due to step

$$\Delta hc = fc \times \frac{V_2^2}{2g} + \frac{V_2^2 - V_1^2}{2g}$$

Where;

Δhc = Water level decline due to step (i.e. difference in channel bottom elevations), m

fc = Coefficient of loss due to step

V_2 = Flow velocity after passing step, m/sec

V_1 = Flow velocity before passing step, V_1 = 0.27 m/sec

Assuming Δhc = 0.019 m;

Depth after passing step	:	h_2 = WL. 254.295 − 0.019 − EL. 253.60 = 0.676 m
Width of intake opening	:	$B_2 = 1.50 \times 2 + 0.60 = 3.60$ m
Cross-sectional flow area after passing step	:	$A_2 = 3.60 \times 0.676 = 2.434$ m^2
Flow velocity after passing step	:	$V_2 = 1.37 / 2.434 = 0.56$ m/sec

Coefficient of loss due to step : $A_2/A_1 = 2.434 / 5.022 = 0.48$, hereby fc = 0.44

These values result in

$$\Delta hc = 0.44 \times \frac{0.56^2}{2 \times 9.80} + \frac{0.56^2 - 0.27^2}{2 \times 9.80} = 0.007 + 0.016 = 0.019\ \mathrm{m},$$

And Δhc coincides with the above assumed value. Therefore,

Water level after passing step = WL. 254.295 − 0.019 = WL. 254.276 m.

(3) Water level decline due to pier

$$\Delta hp = \frac{Q^2}{2g} \times \left(\frac{1}{C^2 B_3^2 (h_2 - \Delta hp)^2} - \frac{1}{B_2^2 h_2^2} \right)$$

Where;

Δhp = Water level decline due to pier(s), m

Q = Design discharge, that is 1.37 m^3/sec

C = Coefficient of loss due to pier(s), C = 0.92 for round shape

B_3 = Width after passing pier(s), $B_3 = 1.50 \times 2 = 3.00$ m

Assuming Δhp = 0.013 m;

Depth after passing pier(s)	:	h_3 = WL. 254.276 − 0.013 − EL. 253.60 = 0.663 m
Width after passing pier(s)	:	$B_3 = 1.50 \times 2 = 3.00$ m
Cross-sectional flow area after passing pier(s)	:	$A_3 = 3.60 \times 0.663 \times 2 = 1.989\ m^2$
Flow velocity after passing pier(s)	:	$V_3 = 1.37 / 1.989 = 0.69$ m/sec

These values result in

$$\Delta hp = \frac{1.37^2}{2 \times 9.80} \times \left(\frac{1}{0.92^2 \times 3.00^2 \times (0.676 - 0.013)^2} - \frac{1}{3.60^2 \times 0.676^2} \right) = 0.013,$$

And Δhc coincides with the above assumed value. Therefore,

Water level after passing pier(s) = WL. 254.276 − 0.013 = WL. 254.263 m.

(4) Water level decline due to screen

$$\Delta hr = fr \times \frac{V_4^2}{2g} + \frac{V_4^2 - V_3^2}{2g}$$

Where;

Δhr = Water level decline due to screen, m

fr = Coefficient of loss due to screen

$$\text{i.e. } fr = \beta \cdot \sin\theta \cdot \left(\frac{t}{b}\right)^{4/3} = 2.34 \times \sin 76° \times \left(\frac{1.6}{18.4}\right)^{4/3} = 0.09$$

V_4 = Flow velocity after passing screen, m/sec

V_3 = Flow velocity before passing screen, V_3 = 0.69 m/sec

β = Shape coefficient of screen bars, β = 2.34 for rectangular shape

θ = Angle of screen bars to the level, θ = 76°

t = Thickness of screen bars, t = 1.6 mm

b = Opening between screen bars, b = 28.4 mm

Assuming Δhr = 0.002 m;

Depth after passing screen	:	h_4 = WL. 254.263 − 0.002 − EL. 253.60 = 0.661 m
Width of screen	:	$B_4 = 1.50 \times 2 = 3.00$ m
Cross-sectional flow area after passing screen	:	$A_4 = 1.50 \times 0.661 \times 2 = 1.983$ m^2
Wetted perimeter after passing screen	:	$P_4 = (1.50 + 0.661 \times 2) \times 2 = 5.664$ m
Hydraulic radius after passing screen	:	$R_4 = 1.983 / 5.644 = 0.351$ m
Flow velocity after passing pier(s)	:	$V_4 = 1.37 / 1.989 = 0.69$ m/sec
Hydraulic gradient after passing screen	:	$I_4 = (0.015 \times 0.69 / 0.351^{2/3})^2 = 0.000433$

These values result in

$$\Delta hr = 0.09 \times \frac{0.69^2}{2 \times 9.80} + \frac{0.69^2 - 0.69^2}{2 \times 9.80} = 0.002 \text{ m},$$

And Δhr coincides with the above assumed value. However, water level decline greatly depends on condition of clogging due to rubbish. Therefore, considering such conditions, we determine Δhr = 0.100 m.

Water level after passing screen = WL. 254.263 − 0.100 = WL. 254.163 m.

(5) Water level decline due to friction at the intake

$$\Delta h_{fl} = \frac{I_4 + I_5}{2} \times L_4 + \frac{V_5^2 - V_4^2}{2g}$$

Where;

Δh_{fl} = Water level decline due to friction at the intake, m

I_5 = Hydraulic gradient at the downstream end of the intake

L_4 = Distance to the downstream end of the intake, L_4 = 4.50 m

V_5 = Flow velocity at the downstream end of the intake, m/sec

Assuming Δh_{fl} = 0.014 m;

Depth of the intake at its downstream end : h_5 = WL. 254.163 − 0.014 − EL. 253.60 = 0.549 m

Width of the intake at its downstream end	:	$B_5 = 1.50 \times 2 = 3.00$ m
Cross-sectional flow area of the intake at its downstream end	:	$A_5 = 1.50 \times 0.549 \times 2 = 1.647$ m^2
Wetted perimeter of the intake at its downstream end	:	$P_5 = (1.50 + 0.549 \times 2) \times 2 = 5.196$ m
Hydraulic radius of the intake at its downstream end	:	$R_5 = 1.647 / 5.196 = 0.317$ m
Flow velocity at the downstream end of the intake	:	$V_5 = 1.37 / 1.647 = 0.83$ m/sec
Hydraulic gradient at the downstream end of the intake	:	$I_5 = (0.015 \times 0.83 / 0.317^{2/3})^2 = 0.000717$

These values result in

$$\Delta h_{f1} = \frac{0.000433 + 0.000717}{2} \times 4.50 + \frac{0.83^2 - 0.69^2}{2 \times 9.80} = 0.014\,\text{m},$$

And Δh_{f1} coincides with the above assumed value. Therefore,

$$\left(\begin{array}{c}\text{Water level at the downstream - most} \\ \text{point of the intake}\end{array}\right) = \text{WL.}254.163 - 0.014 = \text{WL.}254.149\text{m}$$

(6) Water level decline due to bends

$$\Delta h_b = f_b \times \frac{V_5^2}{2g} + \frac{V_6^2}{2g}$$

Where;

Δh_b = Water level decline due to bends, m

f_b = Coefficient of loss due to bends, $f_b = 1.0$

V_6 = Flow velocity at the upstream end of the connective canal

Assuming $\Delta h_b = 0.068$ m;

Depth of its connective canal at its upstream end	:	h_6 = WL. 254.149 − 0.068 − EL. 253.55 = 0.531 m
Width of the connective canal at its upstream end	:	$B_6 = 3.20$ m
Cross-sectional flow area of the connective canal at its upstream end	:	$A_6 = 3.20 \times 0.531 = 1.699$ m^2
Wetted perimeter of the connective canal at its upstream end	:	$P_6 = 3.20 + 0.531 \times 2 = 4.262$ m
Hydraulic radius of the connective canal at its upstream end	:	$R_6 = 1.699 / 4.262 = 0.399$ m
Flow velocity at the upstream end of the connective canal	:	$V_6 = 1.37 / 1.699 = 0.81$ m/sec
Hydraulic gradient at the upstream end of the connective canal	:	$I_6 = (0.015 \times 0.81 / 0.399^{2/3})^2 = 0.000503$

These values result in

$$\Delta h_b = 1.0 \times \frac{0.83^2}{2 \times 9.80} + \frac{0.81^2}{2 \times 9.80} = 0.068\,\text{m},$$

And Δh_{f1} coincides with the above assumed value. Therefore,

$$\begin{pmatrix}\text{Water level at the upstream - most}\\ \text{point of the branch canal}\end{pmatrix} = \text{WL.}254.149 - 0.068 = \text{WL.}254.081\text{m}$$

(7) Water level decline due to friction in the connective canal

$$\Delta h_{f2} = \frac{I_6 + I_7}{2} \times L_6 + \frac{V_7^2 - V_6^2}{2g}$$

Where;

Δh_{f2} = Water level decline due to friction in the connective canal, m

I_7 = Hydraulic gradient at the downstream end of the connective canal

L_6 = Distance to the downstream end of the connective canal, L_6 = 21.30 m

V_7 = Flow velocity at the downstream end of the connective canal, m/sec

Assuming Δh_{f2} = 0.003 m,

Depth of the connective canal at its downstream end	:	h_7 = WL. 254.081 − 0.003 − EL. 253.49 = 0.588 m
Width of the connective canal at its downstream end	:	B_7 = 3.20 m
Cross-sectional flow area of the connective canal at its downstream end	:	$A_7 = 3.20 \times 0.588 \times 2 = 1.882$ m^2
Wetted perimeter of the connective canal at its downstream end	:	$P_7 = 3.20 + 0.588 \times 2 = 4.376$ m
Hydraulic radius of the connective canal at its downstream end	:	$R_7 = 1.882 / 4.376 = 0.430$ m
Flow velocity at the downstream end of the connective canal	:	$V_7 = 1.37 / 1.882 = 0.73$ m/sec
Hydraulic gradient at the downstream end of the connective canal	:	$I_5 = (0.015 \times 0.73 / 0.430^{2/3})^2 = 0.000369$

These values result in

$$\Delta h_{f2} = \frac{0.000503 + 0.000369}{2} \times 21.30 + \frac{0.73^2 - 0.81^2}{2 \times 9.80} = 0.003\,\text{m},$$

And Δh_{f1} coincides with the above assumed value. Therefore,

$$\begin{pmatrix}\text{Water level at the downstream - most}\\ \text{point of the branch canal}\end{pmatrix} = \text{WL.}254.081 - 0.003 = \text{WL.}254.078\,\text{m}$$

(8) Water level decline at the entrance of the sediment settling basin

$$\Delta h_t = \frac{I_7 + I_8}{2} \times L_7 + (1 - f_t) \times \frac{V_8^2 - V_7^2}{2g}$$

Where;

Δh_t = Water level decline at the entrance of the sediment settling basin, m

I_8 = Hydraulic gradient at the upstream end of the sediment settling basin

L_7 = Distance to the upstream end of the sediment settling basin, L_7 = 2.00 m

f_t = Coefficient of loss due to enlargement of cross section, f_t = 0.50

V_8 = Flow velocity at the upstream end of the sediment settling basin, m/sec

Assuming Δh_t = 0.012 m;

Depth of the sediment settling basin at its upstream end	:	h_8 = WL. 254.078 − 0.012 − EL. 253.49 = 0.600 m
Width of the sediment settling basin at its upstream end	:	B_8 = 8.00 m
Cross-sectional flow area of the sediment settling basin at its upstream end	:	$A_8 = 8.00 \times 0.600 \times 2 = 4.800$ m^2
Wetted perimeter of the sediment settling basin at its upstream end	:	$P_8 = 8.00 + 0.600 \times 2 = 4.800$ m
Hydraulic radius of the sediment settling basin at its upstream end	:	$R_8 = 4.800 / 9.200 = 0.522$ m
Flow velocity at the upstream end of the sediment settling basin	:	$V_8 = 1.37 / 4.800 = 0.29$ m/sec
Hydraulic gradient at the upstream end of the sediment settling basin	:	$I_8 = (0.020 \times 0.29 / 0.522^{2/3})^2 = 0.000080$

These values result in

$$\Delta h_t = \frac{0.000369 + 0.000080}{2} \times 2.00 + (1 - 1.50) \times \frac{0.29^2 - 0.73^2}{2g} = -0.012,$$

and Δh_t coincides with the above assumed value. Therefore,

$$\begin{pmatrix} \text{Water level at the entrance} \\ \text{of the settling basin} \end{pmatrix} = \text{WL.}254.078 + 0.012 = \text{WL.}254.090\,\text{m}$$

(9) Water Level Decline in the Sediment Settling Basin

$$\Delta h_{f3} = \frac{I_8 + I_9}{2} \times L_8 + \frac{V_9^2 - V_8^2}{2g}$$

Where;

Δh_{f3} = Water level decline due to friction in the sediment settling basin, m

I_9 = Hydraulic gradient at the downstream end of the sediment settling basin

L_8 = Distance to the downstream end of the sediment settling basin, L_8 = 13.00 m

V_9 = Flow velocity at the downstream end of the sediment settling basin, m/sec

Assuming Δh_{f3} = 0.001 m, we have

Depth of the sediment settling basin at its downstream end	:	h_9 = WL. 254.090 − 0.001 − EL. 253.45 = 0.639 m
Width of the sediment settling basin at its downstream end	:	B_9 = 8.00 m
Cross-sectional flow area of the sediment settling basin at its downstream end	:	$A_9 = 8.00 \times 0.639 = 5.112$ m^2
Wetted perimeter of the sediment settling basin at its downstream end	:	$P_9 = 8.00 + 0.639 \times 2 = 9.278$ m
Hydraulic radius of the sediment settling	:	$R_9 = 5.112 / 9.278 = 0.551$ m

basin at its downstream end

Flow velocity at the downstream end of the sediment settling basin	:	$V_9 = 1.37 / 5.112 = 0.27$ m/sec
Hydraulic gradient at the downstream end of the sediment settling basin	:	$I_8 = (0.020 \times 0.27 / 0.551^{2/3})^2 = 0.000065$

These values result in

$$\Delta h_{f3} = \frac{0.000080 + 0.000065}{2} \times 13.00 + \frac{0.27 - 0.29}{2 \times 9.80} = 0.001\,\mathrm{m},$$

and Δh_{f3} coincides with the above assumed value. Therefore,

$$\begin{pmatrix}\text{Water level at the downstream end} \\ \text{of the settling basin}\end{pmatrix} = \mathrm{WL.254.090} + 0.001 = \mathrm{WL.254.089\,m}$$

(10) Water Level Decline at the Entrance of the Intake Gate

$$\Delta h_g = (1 + f_g) \times \frac{V_{10}^2 - V_9^2}{2g} + \frac{I_9 + I_{10}}{2} \times L_9$$

Where;

Δh_g = Water level decline at the entrance of the intake gate, m

f_g = Coefficient of loss at the entrance of the intake gate, $f_g = 0.50$ for rectangular shape

V_{10} = Flow velocity at the intake gate, m/sec

L_9 = Distance to the downstream end of the intake gate, $L_9 = 3.50$ m

Assuming $\Delta h_g = 0.147$ m, we have

Depth of the intake gate at its downstream end	:	h_{10} = WL. 254.089 − 0.147 − EL. 253.40 = 0.542 m
Width of the intake gate at its downstream end	:	$B_{10} = 1.80$ m
Cross-sectional flow area of the intake gate at its downstream end	:	$A_{10} = 1.80 \times 0.542 = 0.976$ m^2
Wetted perimeter of the intake gate at its downstream end	:	$P_9 = 1.80 + 0.542 \times 2 = 2.884$ m
Hydraulic radius of the intake gate at its downstream end	:	$R_{10} = 0.976 / 2.884 = 0.339$ m
Flow velocity at the downstream end of the intake gate	:	$V_{10} = 1.37 / 0.976 = 1.40$ m/sec
Hydraulic gradient at the downstream end of the intake gate	:	$I_{10} = (0.015 \times 1.40 / 0.339^{2/3})^2 = 0.001873$

These values result in

$$\Delta h_g = (1 + 1.50) \times \frac{1.40^2 - 0.27^2}{2 \times 9.80} + \frac{0.000065 + 0.001873}{2} \times 3.50 = 0.147\,\mathrm{m},$$

And Δh_g coincides with the above assumed value. Therefore,

$$\begin{pmatrix}\text{Water level at the downstream end} \\ \text{of the intake gate}\end{pmatrix} = \mathrm{WL.254.089} - 0.147 = \mathrm{WL.254.942\,m},$$

And

$$\begin{pmatrix}\text{Invert elevation at the downstream end}\\ \text{of the intake gate}\end{pmatrix} = \text{WL.}254.942 - 0.542 = \text{WL.}254.400\,\text{m}$$

(11) Water level decline at the transition section

$$\Delta h_i = (1 - f_i) \times \frac{V_{11}^2 - V_{10}^2}{2g} + \frac{I_{10} + I_{11}}{2} \times L_{10}$$

where

Δh_g = Water level decline at the transition section, m

f_g = Coefficient of loss due to transition (enlargement), $f_i = 0.20$

V_{11} = Flow velocity at the beginning point (B.P.) of mail canal, $V_{11} = 1.27$ m/sec

L_{10} = Distance of the transition section, $L_{10} = 2.00$ m

I_{11} = Hydraulic gradient at the B.P. of mail canal, $I_{11} = 0.002500$

These values result in

$$\Delta h_i = (1.0 - 0.2) \times \frac{1.27^2 - 1.40^2}{2 \times 9.80} + \frac{0.001873 + 0.002500}{2} \times 2.00 = -0.010\,\text{m},$$

Therefore, if we determine $\Delta h_i = -0.008$ for the bed slope from the intake gate to the B.P. of the main canal not to be inverse,

Water level at the B.P. of the main canal = WL. 253.942 + 0.008 = WL. 253.950 m, and
Invert elevation at the B.P. of the main canal = WL. 253.950 − 0.550 = WL. 253.400 m.

6-12 Balance Sheet for O/M Cost and Water Fee Collecting by Year

	Item	Unit price (US$)	The First Cycle Year 1	2	3	4	5	Average 1-5	The Second Cycle Year 6	7	8	9	10	Average 6-10	Average 1-10	The Third Cycle Year 11	12	13	14	15	Average 11-15	Year 16	17	18	19	20	Average 16-20	Average 11-20	Year 21	22	23	24	25	Average 21-25	Average 11-25	remarks
A. Salary of WUA executive	not estimated																																		for 4 cadres of WUA
B. Personnel cost for instruction	1)DIO adviser	240	240	240	240	240	240	240	240	240	240	240	240	240	240																				
(estimating only allowance	2)O/M coordinator	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800	1,800																				salary for coordinator
for gate keepers up to 10th	3)Gate keeper	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	salary for gate keeper
year)	**Sub total(1)+2)+3)**		2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	2,940	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	
	1)Turnout gate keeper(22perso	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	2,640	salary of turn-out gate keepers
C.Water distribution work	2)Intake gate keeper (1person)	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180	salary of intake gate keeper
	Sub total(1)+2)	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	2,820	
D. Gate maintenance cost																																			
1.Intake gate (8 gates)	1)Oiling	628	0	628	628	628	628	502	628	628	628	628	628	628	565	628	628	628	628	628	628	628	628	628	628	628	628	628	628	628	628	628	628	628	taking place once a year
	2)Re-painting	3,364	0	0	0	0	0	0	1,121	1,121	1,121	0	0	673	336	0	1,121	1,121	1,121	0	673	0	0	0	0	1,121	224	449	1,121	1,121	0	0	0	449	449	once in 7 years, dividing into 3-times
	3)Water seal rubber exchange	9,346	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,115	623	3,115	3,115	0	0	0	1,246	935	0	0	0	0	0	0	623	once in 15 years, dividing into 3-times
	Sub total (1)+2)+3)		0	628	628	628	628	502	1,750	1,750	1,750	628	628	1,301	902	628	1,750	1,750	1,750	3,743	1,924	3,743	3,743	628	628	1,750	2,098	2,011	1,750	1,750	628	628	628	1,077	1,700	
2.Turn out gates (65 gates)	1)Oiling	790	0	790	790	790	790	632	790	790	790	790	790	790	711	790	790	790	790	790	790	790	790	790	790	790	790	790	790	790	790	790	790	790	taking place once a year
	2)Re-painting	5,467	0	0	0	0	0	0	1,822	1,822	1,822	0	0	1,093	547	0	1,822	1,822	1,822	0	1,093	0	0	0	0	1,822	364	729	1,822	1,822	0	0	0	729	729	once in 7 years, dividing into 3-times
	3)Water seal rubber exchange	12,150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,050	810	4,050	4,050	0	0	0	1,620	1,215	0	0	0	0	0	0	810	once in 15 years, dividing into 3-times
	Sub total (1)+2)+3)		0	790	790	790	790	632	2,612	2,612	2,612	790	790	1,883	1,257	790	2,612	2,612	2,612	4,840	2,693	4,840	4,840	790	790	2,612	2,774	2,734	2,612	2,612	790	790	790	1,519	2,329	
E.Facility repairing cost	1)Riverbed protection work	869	0	869	869	869	869	695	869	869	869	869	869	869	782	869	869	869	869	869	869	869	869	869	869	869	869	869	869	869	869	869	869	869	taking place once a year
	2)Bank protection work	2,737	0	2,737	2,737	2,737	2,737	2,190	2,737	2,737	2,737	2,737	2,737	2,737	2,463	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	2,737	
	3)Main canal	1,373	0	1,373	1,373	1,373	1,373	1,099	1,373	1,373	1,373	1,373	1,373	1,373	1,236	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	1,373	
	4)Ramaskorasecondary canal	2,645	0	2,645	2,645	2,645	2,645	2,116	2,645	2,645	2,645	2,645	2,645	2,645	2,380	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	2,645	
	5) Rotabau secondary canal	2,668	0	2,668	2,668	2,668	2,668	2,135	2,668	2,668	2,668	2,668	2,668	2,668	2,401	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	2,668	
	Sub-total (1)+2)+3)+4)+5)	10,293	0	10,293	10,293	10,293	10,293	8,234	10,293	10,293	10,293	10,293	10,293	10,293	9,263	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	10,293	
Total (D+E)			0	11,710	11,710	11,710	11,710	9,368	14,654	14,654	14,654	11,710	11,710	13,477	11,423	11,710	14,654	14,654	14,654	18,875	14,910	18,875	18,875	11,710	11,710	14,654	15,165	15,037	14,654	14,654	11,710	11,710	11,710	12,888	14,321	
F.O/M Routine work																																			
1.Dredging	1)scouring of sediment setting basic of intake facility	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	270x30%=80m3
	2)scouring of sediment setting basin in main canal	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	105x10%=10m3
	3)sediment evacuation from main canal	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	264	(160+15)x50%=88m3
	4)Sediment evacuation from Ramaskora secondary canal	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	186	(160+15)x35%=62m3
	5)Sediment evacuation from Ritabau secondary canal	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	81	(160+15)x15%=27m3
	Sub total(1)+2)+3)+4)+5)	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	801	
2.Weeding in canals	1)Main canal	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	25% of full time
	2)Ramaskora secondary canal	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	593	25% of full time
	3)Ritabau secondary canal	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	788	25% of full time
	Sub total(1)+2)+3)	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	
Total (F=1+2)		2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	2,411	
Total(B+C+D+E+F)	(US$)		8,171	19,881	19,881	19,881	19,881	17,539	22,825	22,825	22,825	19,881	19,881	21,647	19,593	17,841	20,785	20,785	20,785	25,006	21,040	25,006	25,006	17,841	17,841	20,785	21,296	21,168	20,785	20,785	17,841	17,841	17,841	19,018	20,451	
O &M cost/ha	① per ha	1,050 ha	7.8	18.9	18.9	18.9	18.9	16.7	21.7	21.7	21.7	18.9	18.9	20.6	18.7	17.0	19.8	19.8	19.8	23.8	20.0	23.8	23.8	17.0	17.0	19.8	20.3	20.2	19.8	19.8	17.0	17.0	17.0	18.1	19.5	
MAFFSubsidy (US$)		70%	5,719	13,917	13,917	13,917	13,917	12,277							Average																					
		30%							6,847	6,847	6,847	5,964	5,964	6,494	9,386						0						0	0						0		
Cost borne by WUA		Total(US$)	2,451	5,964	5,964	5,964	5,964	5,262	15,977	15,977	15,977	13,917	13,917	15,153	10,207	17,841	20,785	20,785	20,785	25,006	21,040	25,006	25,006	17,841	17,841	20,785	21,296	21,168	20,785	20,785	17,841	17,841	17,841	19,018	20,451	
		Average for 5 years(US$)			5,262						15,153							21,040						21,296						19,018					
A.Water fee collected (necessary)	per member household	1,500member	1.6	4.0	4.0	4.0	4.0	3.5	10.7	10.7	10.7	9.3	9.3	10.1	6.8	11.9	13.9	13.9	13.9	16.7	14.0	16.7	16.7	11.9	11.9	13.9	14.2	14.1	13.9	13.9	11.9	11.9	11.9	12.7	13.6	
	(US$/ha)	Average for 5 years			3.5						10.1							14.0						14.2						12.7					
	① per area (ha)	1,050 ha	2.3	5.7	5.7	5.7	5.7	5.0	15.2	15.2	15.2	13.3	13.3	14.4	9.7	17.0	19.8	19.8	19.8	23.8	20.0	23.8	23.8	17.0	17.0	19.8	20.3	20.2	19.8	19.8	17.0	17.0	17.0	18.1	19.5	
	(US$/ha)	Average for 5 years			5.0						14.4							20.0						20.3						18.1					

B.Amount of collected water fee(US$)

	1-5year	6-10y.	11-25y.		The First Cycle Year 1	2	3	4	5	Average 1-5	The Second Cycle Year 6	7	8	9	10	Average 6-10	Average 1-10	The Third Cycle Year 11	12	13	14	15	Average 11-15	Year 16	17	18	19	20	Average 16-20	Average 11-20	Year 21	22	23	24	25	Average 21-25	Average 11-25	Remarks
② Fixed amount per ha (75% of the total amount)	4.0	12.0	15.0	4$/ha to 5th year 11$/ha for 5th ~ 10th 16$/ha from 11th	4.0	4.0	4.0	4.0	4.0	4.0	12.0	12.0	12.0	12.0	12.0	12.0	8.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	Assuming annual cropping area at 1,400ha(cropping intensity 133%). Out of which, area in rainy season 1,050ha (75%) is taken for the fixed amount
③ collection per piece from 1 ha (25% of the total)	1.5	3.5	5.5	assuming 80% piece once in 5 years	1.5	1.5	1.5	1.5	1.2	1.4	3.5	3.5	3.5	3.5	2.8	3.4	2.4	5.5	5.5	5.5	5.5	4.4	5.3	5.5	5.5	5.5	5.5	4.4	5.3	5.3	5.5	5.5	5.5	5.5	4.4	5.3	5.3	
④ Total amount of collection	**5.5**	**15.5**	**20.5**		**5.5**	**5.5**	**5.5**	**5.5**	**5.2**	5.4	**15.5**	**15.5**	**15.5**	**15.5**	**14.8**	15.4	10.4	**20.5**	**20.5**	**20.5**	**20.5**	**19.4**	20.3	**20.5**	**20.5**	**20.5**	**20.5**	**19.4**	20.3	20.3	**20.5**	**20.5**	**20.5**	**20.5**	**19.4**	20.3	20.3	**Total amount of collection for 25 years**
⑤ rest amount per ha (④－①)					3.2	▲0.2	▲0.2	▲0.2	▲0.5		0.3	0.3	0.3	2.2	1.5			3.5	0.7	0.7	0.7	▲4.4		▲3.3	▲3.3	3.5	3.5	▲0.4			0.7	0.7	3.5	3.5	2.4			**408.2 US$/ha**
⑥ cumulative reserve per ha (⑤+⑧)					3.2	3.0	2.8	2.7	2.3		2.6	2.9	3.2	5.5	7.2			10.8	11.6	12.5	13.4	9.2		6.0	2.8	6.4	10.0	9.7			10.6	11.4	15.1	18.8	21.5			**428,610 US$**
⑦ interest per ha	1.5%	1.5%	1.5%	bank loan interest	-	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.1	0.1			0.2	0.2	0.2	0.2	0.1		0.1	0.0	0.1	0.1	0.1			0.2	0.2	0.2	0.3	0.3			
⑧ after adding interest per ha					3.2	3.0	2.9	2.8	2.3		2.6	3.0	3.3	5.6	7.3			10.9	11.8	12.7	13.6	9.3		6.1	2.8	6.4	10.1	9.9			10.7	11.6	15.3	19.1	21.9			

⑨ Total amount of reserve (treatable amount) : ⑥x1,050 ha	3,324	3,182	3,037	2,891	2,422		2,761	3,104	3,453	5,898	7,635			11,488	12,412	13,350	14,301	9,810		6,424	2,987	6,771	10,612	10,350			11,257	12,177	16,099	20,080	22,948			