Société d'Aménagement et d'Exploitation des Terres du Delta du fleuve Sénégal et des Vallées du fleuve Sénégal et de la Falémé (SAED)

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project in Republic of Senegal

Final Report (Prior Release Version)

December 2019

Japan International Cooperation Agency (JICA)

Nippon Koei Co., Ltd.

6R
JR(P)
19-029

Société d'Aménagement et d'Exploitation des Terres du Delta du fleuve Sénégal et des Vallées du fleuve Sénégal et de la Falémé (SAED)

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project in Republic of Senegal

Final Report (Prior Release Version)

December 2019

Japan International Cooperation Agency (JICA)

Nippon Koei Co., Ltd.

Project Location Map

Photographs of the Survey (1)

Irrigation pumping station in Rosso irrigation scheme
11th June 2019

Farm road constructed by UNION in Rosso irrigation scheme
11th June 2019

Existing crossing work for livestock on the main canal in Rosso irrigation scheme
11th June 2019

Main canal with weeds in Rosso irrigation scheme
11th September 2019

Intake of model scheme in Podor department
18th June 2019

Protection walls for structure in model scheme in Podor department
19th June 2019

Source: JICA Survey Team

Photographs of the Survey (2)

Flowering stage of dry season paddy, variety: Sahel 108 (mixed with other varieties), planted in mid-March in Rosso Irrigation Scheme
13th June 2019

Inundated paddy field due to poor drainage facilities in Rosso Irrigation Scheme
13th June 2019

Existing wheel type large combine harvester (broken) in Kassack Nord Union (managed by CEMA)
28th May 2019

100HP Tractor procured by Indian loan project, at SAED Dagana delegation
29th May 2019

Interview on farm management and institutional development at PAPRIZ2 Pilot field in Kassack Nord
15th May 2019

Workshop with Rosso Union
Presentation of implementation plan
29th August 2019

Source: JICA Survey Team

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

General Features of the Project

- Objective of the Project:
  - To improve the efficiency and the productivity of irrigated rice farming practices through the extension and/or rehabilitation of irrigation and agricultural related facilities and the procurement of agricultural machineries.
  - It is expected to contribute to improve self-sufficiency in rice in Senegal and to lessen the trade deficit through the reduction of rice imports by achieving the above objective.
- Outline of the Project:
  - Rehabilitation/extension of existing irrigation and drainage facilities;
  - Development/rehabilitation of agricultural related infrastructures (rural roads and storage);
  - Procurement of agricultural machineries (tractors, combine harvesters, and milling machines); and
  - Consulting services (detailed design, bidding assistance, and construction supervision).
- Target Area of the Project:
  - Dagana and Podor departments in Saint Louis Province.
- Concerned Agency:
  - Ministry of Agriculture and Rural Equipment (MAER) and
  - National Company for the Development and Exploitation of the Senegal River Delta, Senegal River and Faleme Valley (SAED).

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Necessity and Justification of the Project

General Features of the Project	Necessity and Justification
Objective of the Project: **1) To contribute to improve the self-sufficiency in rice,** **2) To contribute to reduce the trade deficit through the reduction of rice imports,** **3) To improve the efficiency and the productivity of irrigated rice farming practices.**	In one of the policies under PSE, the agriculture sector is expected to contribute: to strengthen food security and nutrition security, and to reduce the trade deficit due to the imports of food. To increase the rice production, a key issue is the "improvement of cropping intensity", which can be realized through the improvement of efficiency and productivity of irrigated rice farming activities. Therefore, the objective of the Project is appropriate and conforming to the National Policy.
Outline of the Project: **1) Rehabilitation/extension of the existing irrigation and drainage facilities,** **2) Development/rehabilitation of the agricultural related infrastructures,** **3) Procurement of agricultural machineries, and** **4) Consulting services (detailed design, bidding assistance, construction supervision, etc.).**	1) The main constraints on low cropping intensity are the deterioration of irrigation canal networks and lack of drainage systems. Therefore, rehabilitation/extension of the existing irrigation and drainage facilities is required to achieve the objective of the Project, 2) Deterioration and/or lack of the agricultural related facilities disturb the efficient rice farming activities especially for the agricultural mechanization and post-harvest activities. Therefore, development/rehabilitation of the agricultural related infrastructures is required to achieve the objective of the Project, 3) The number of agricultural machineries especially of combine harvesters is not sufficient in the Senegal River Valley. Therefore, procurement of agricultural machineries is required to achieve the objective of the Project, and 4) SAED requires a technical assistance from the external consultant for the proper and effective implementation of the Project. Therefore, consulting services are required to achieve the objective of the Project.
Target Area of the Project: **Dagana and Podor departments in Saint Louis Province**	- Dagana and Podor departments are located in the Senegal River Valley, - 57% of the total target paddy production amount in Senegal set forth in PRACAS is allocated to the Senegal River Valley, and - Therefore, the target area of the Project is appropriate to achieve the objective of the Project.
Concerned Agencies: **1) MAER** **2) SAED**	- Generally, SAED has a capacity to implement and manage the irrigation development projects in the Senegal River Valley, according to other donor agencies, - One program under AfDB support was cancelled mainly due to the less involvement of SAED, - Therefore, the concerned agencies are appropriate to achieve the objective of the Project.

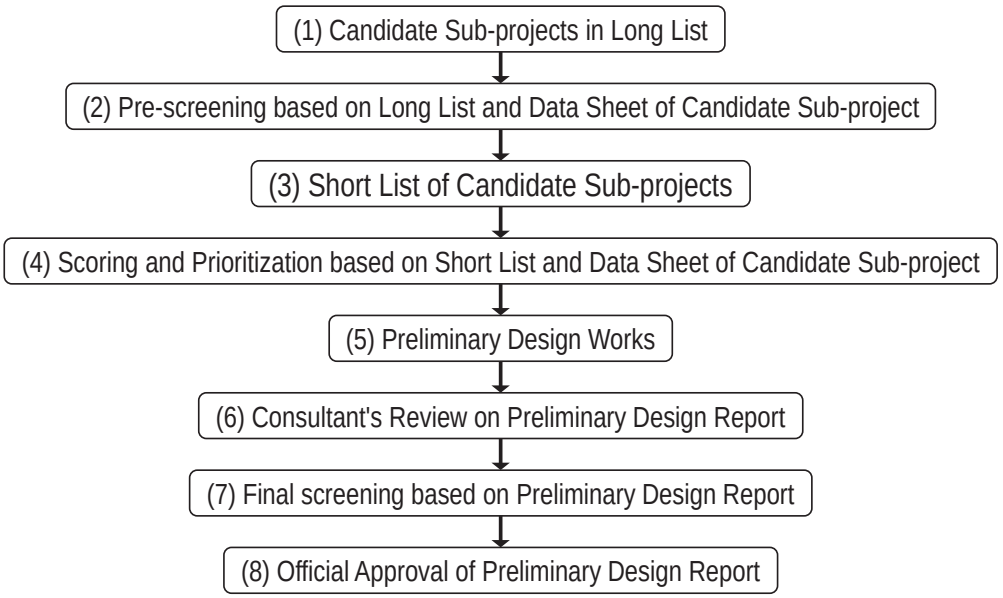
Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Long List for Candidate Sub-projects

	Description	Dagana	Podor	Total
1)	Number of Candidate Subprojects	44	77	121
	- less than 100 ha	17	68	85
	- 100 ha to 500 ha	20	4	24
	- More than 500 ha	6	5	11
	- No data	1	0	1
2)	Irrigation Service Area (ha)			
	- Irrigable area (ha)	9,623	7,142	16,765
	- Actual irrigated area (ha)	6,639	4,421	11,060
	- Ratio (%)	72%	63%	68%

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Draft Flow Chart of Selection of Sub-projects



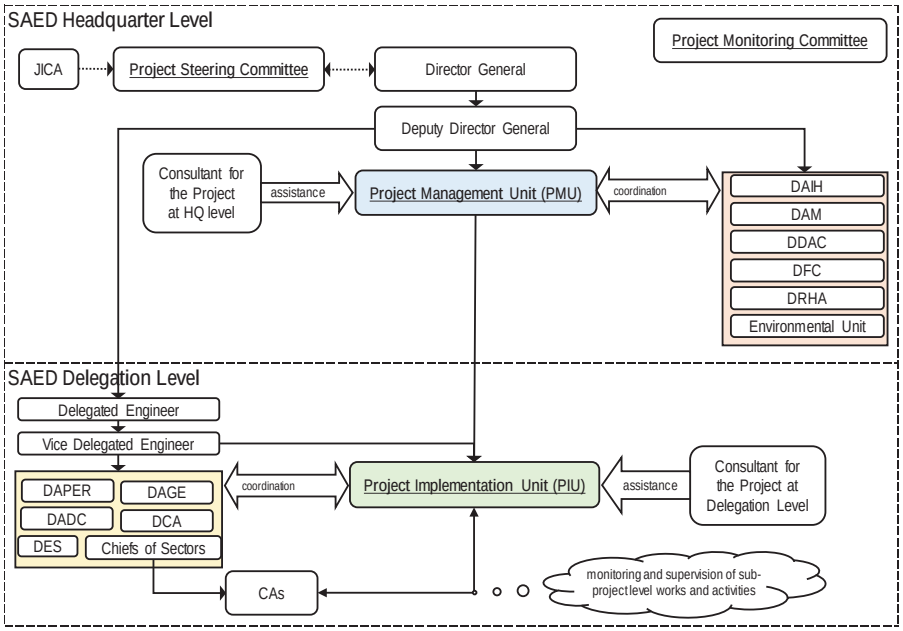
Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Project Scope

No.	Scope of Work
Component-1: Rehabilitation and Improvement of Irrigation Schemes	
1.1	Rehabilitation and Improvement of Irrigation and Drainage Facilities
1.2	Improvement of Agricultural Related Facilities
Component-2: Enhancement of Agricultural Mechanization	
2.1	Introduction of Reapers with Threshers
2.2	Introduction of Medium-size Combine Harvesters
Component-3: Soft Component Activities	
3.1	Consensus Buildings with Beneficiaries
3.2	Capacity Enhancement of Farmers' Organizations
3.3	Agriculture Support Activities
3.4	Capacity Enhancement of Operation and Maintenance (O&M)
Component-4: Enhancement of Project Management and Monitoring	
4.1	Establishment of Project Management Unit (PMU) and Project Implementation Units (PIUs)
4.2	Strengthening of PMU and PIUs for Proper Project Management and Monitoring
4.3	Monitoring and Evaluation (M&E)
Component-5: Consulting Services for Technical Assistance	
5.1	Technical Assistance for the Project Implementation
5.2	Formulation of the Future Development Plans in the SRV

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Project Implementation Structure



Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Implementation Schedule and Procurement Plan for the Project

Non-disclosure Information

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Cost Estimation

Non-disclosure Information

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Project Evaluation

- Operation Indicators

	Indicators	Current (2019)	Target (2030)
1.	Project beneficiary area (ha)	Non-disclosure Information	
2.	Developed length of the farm road (km)		
3.	Developed length of the access road (km)		
4.	Developed area of the warehouses (m2)		
5.	Number of the introduced agricultural machinery (Nos)		
6.	Annual operation hour of pump (hour/year)		
7.	Volume of storage in the warehouse (kg/year)		
8.	Operating hour of the agricultural machinery (hour/year)		

- Effect Indicators

	Indicators	Current (2019)	Target (2030)
1.	Annual crop intensity (%/year)	Non-disclosure Information	
2.	Seasonal cultivation area of rice (ha/season)		
3.	Unit yield of rice (ton/ha)		
4.	Annual production volume of rice (ton/year)		
5.	Increase in rice production by the project (ton/year)		

Preparatory Survey on Senegal River Valley Irrigated Rice Farming Improvement Project (Summary)

Environmental and Social Considerations

- Each sub-project to be implemented in this Project is classified as Category 1 and requires IEE.
- Considering the following, it is proposed that the Project should not implement IEE for each sub-project but instead a sub-project group with a certain degree and implement IEE for the group.
  - It takes about 4 to 5 months from the implementation of the environmental impact survey to the acquisition of the environmental certificate.
  - More than 30 sub-projects will be implemented at multiple sites in this Project.
  - The DEEC suggested that it is not realistic to implement an IEE for each sub-project, and it would be better to implement an IEE for the sub-projects group.
- The sub-project is based on the rehabilitation project of the existing irrigation scheme, and the donation of part of the land is subject to adjustment within the residents after discussions. Therefore, involuntary resettlement is not expected.

Preparatory Survey
on
Senegal River Valley Irrigated Rice Farming Improvement Project
in
Republic of Senegal

Final Report

Table of Contents

CHAPTER 3 PREPARATION OF LONG LIST FOR CANDIDATE SUBPROJECTS

CHAPTER 4 PREPARATION OF THE DRAFT CRITERIA FOR SELECTION OF SUBPROJECTS

CHAPTER 5 PRELIMINARY DESIGN FOR PILOT SITE SUBPROJECT

List of Table A

List of Table B

List of Figure A

List of Figure B

List of Appendices

List of Abbreviations and Local Terms

3PRD	(Fr) Programme de Promotion du Partenariat Rizicole dans Ie Delta du fleuve Sénégal
AFD	(Fr) Agence Française de Développement
AfDB	African Development Bank
AI	(Fr) Aménagement Intermdiaire
AIDEP	(Fr) Agriculture Irriguée et Développent Economique de territoire rural du département de Podor
AIU	Autonomous Irrigation Unit
ANCAR	(Fr) Agence Nationale du Conseil Agricole et Rural
B/C	Benefit Cost Ratio
BNDE	(Fr) Banque Nationale Pour Le Développement Economique
BOAD	(Fr) Banque Ouest Africaine de Développement
BOQ	Bill of Quantity
C/S	Consulting Services
CA	(Fr) Conseil Agricole
CEDAW	Convention on the Elimination of all Forms of Discrimination against Women
CEMA	(Fr) Centre de services mécanisés
CGER	(Fr) Centres de Gestion et d'Économie Rurale
CIF	Cost Insurance and Freight
CIFA	(Fr) Centre Interprofessionnel pour la Formation aux Métiers de l'Agriculture
CIH	(Fr) Centre d'initiation à l'Horticulture
CMS	(Fr) Crédit Mutuel du Sénégal
CNCAS	(Fr) Caisse Nationale de Crédit Agricole du Sénégal
CUMA	(Fr) Coopératives d'Utilisation de Matériels Agricoles
CWR	Crop Water Requirement
DAGE	(Fr) Division de l'Aménagement et de la Gestion de l'Eau, SAED
DAM	(Fr) Direction Autonome de Maintenance
DEEC	(Fr) Direction de l'Environnement et des Établissements Classés
DEFCCS	(Fr) Direction des Eaux et Forêts, Chasse et de la Conservation des Sols
DGEF	(Fr) Division Genre et Entreprenariat Féminin
DIAH	(Fr) Direction des Aménagements et des Infrastructures Hydro-agricoles, SAED
DPN	(Fr) Direction des Parcs Nationaux
DPPD	(Fr) Document de Programmation Pluriannuelle des Dépenses
DRDR	(Fr) Direction Régionale du Développement Rural
ECOWAS	Economic Community of West African States
EI	(Fr) Entreprise Individuelle
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FC	Foreign Currency (Portion)
FCFA	Franc CFA
FEF	Front End Fee
FIDIC	(Fr) Fédération Internationale des Ingénieurs-Conseils
FIRR	Financial Internal Rate of Return
FOMPI	(Fr) Fonds de Maintenance des Périmètres Irrigués
GA	(Fr) Grand Aménagement
GDP	Gross Domestic Products
GIE	(Fr) Groupement d'intérêt Économique
GoJ	Government of Japan
GoS	Government of Senegal
HIV	(Fr) Hivernage
ICB	International Competitive Bidding
ICPE	(Fr) Installations Classées pour la Protection de l'Environnement
IEE	Initial Environmental Examination

ISRA	(Fr) Institut Sénégalais de Recherches Agricoles
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
KOICA	Korea International Cooperation Agency
LBA	(Fr) La Banque Agricole
LC	Local Currency (Portion)
LCB	Local Competitive Bidding
M&E	Monitoring and Evaluation
MAER	(Fr) Ministère de l'Agriculture et de l'Equipement Rural
MAFF	Ministry of Agriculture, Forestry and Fishery (of Japan)
MC	Main Canal
MCA	Millennium Challenge Account
MEC FEPRODES	(Fr) Mutuelle d'Epargne et de Crédit de la Fédération des Groupements et Associations des Femmes Pro-ductrices de Saint-Louis
MEDD	(Fr) Ministère de l'Environnement e du Développement Durable
MEF	(Fr) Ministère de l'Economie et du Finance
MM	(En) Man-Month
MOU	Memorandum of Understanding
NGO	Non-governmental Organization
O&M	Operation & Maintenance
ODA	Official Development Assistance
OMVS	(Fr) Organisation pour la Mise en Valeur du fleuve Sénégal
OPF	(Fr) Organisations Paysannes Fédératives
PADEN	(Fr) Programme d'Aménagement et de Développement économique des Niayes
PAPRIZ	(Fr) Projet d'Amélioration de la Productivité du Riz dans les Aménagements Hydro-Agricoles de la Vallée du Fleuve Sénégal
PARIIS	(Fr) Projet d'appui régional à l'Initiative pour l'irrigation au Sahel
PCGES	(Fr) Plan Cadre de Gestion Environnementale et Sociale
PDCVR	(Fr) Projet de Développement de la Chaîne de Valeur du Riz dans la vallée du fleuve Sénégal
PDIDAS	(Fr) Projet de Développement Inclusif et Durable de l'Agrobusiness au Sénégal
PGIRE	(Fr) Projet de Gestion Intégrée des Ressources en Eau et de développement des usages à buts multiples du bassin du fleuve Sénégal
PIP	(Fr) Périmètres Irrigués Privés
PIU	Project Implementation Unit
PIV	(Fr) Périmètres Irrigués Villageois
PMU	Project Management Unit
PQ	Pre-Qualification
PRACAS	(Fr) Programme de Relance et d'Accélération de la Cadence de l'Agriculture Sénégalaise
PSE	(Fr) Plan Sénégal Émergent
PVC	Polyvinyl Chloride
QBS	Quality Based Selection
QCBS	Quality, Cost Based Selection
SA	(Fr) Société anonyme
SAED	(Fr) Société d'Aménagement et d'Exploitation des Terres du Delta du fleuve Sénégal et des Vallées du fleuve Sénégal et de la Falémé
SARL	(Fr) Société à responsabilité limitée
SC	Secondary Canal
SCF	Standard Conversion Factor
SDDR	(Fr) Service Départemental du Développement Rural
SFSA	Syngenta Foundation for Sustainable Agriculture
SSC	(Fr) Saison Sèche Chaude
SSF	(Fr) Saison Sèche Froide
SUMA	(Fr) Sections d'Utilisation de Matériels Agricoles
SV	(Fr) Section villageoise
TOR	Term of Reference
UEMOA	(Fr) Union Economique et Monétaire Ouest Africaine

USAID	United States Agency for International Development
USDA	United States Department of Agriculture
VAT	Value Added Tax
VFS	(Fr) Vallée du Fleuve Sénégal
WARDA	West Africa Rice Development Association or Africa Rice Center
WB	World Bank

Measurement Unit and Currency

Length
- mm = Millimeter(s)
- cm = Centimeter(s)
- m = Meter(s)
- km = Kilometer (s)

Area
- cm^2 = Square centimeter(s)
- m^2 = sqm = Square meter(s)
- km^2 = Square-kilometer(s)
- ha = Hectare(s) (10,000 m^2)

Volume
- cm^3 = Cubic centimeter(s)
- m^3 = cum = Cubic meter(s)
- L = lit = Liter (1,000 cm^3)

Power
- kW = kilo Watt

Weight
- g = Gram (s)
- kg = Kilogram(s)
- ton = Metric ton(s)

Time
- sec = Second(s)
- min = Minute(s)
- hr = Hour(s)

Temperature
- °C = Degrees Celsius
- % = Percent

Currency
- EUR = Euro
- FCFA = Franc(s) CFA
- EUR 1.0 = 656 Franc(s) CFA
- (As of 30 September 2019)

CHAPTER 1 INTRODUCTION

1.1 General

This is the Final Report prepared by the Japan International Cooperation Agency (JICA) Survey Team for the Senegal River Valley Irrigated Rice Farming Improvement Project, hereinafter referred to as "the Project".

1.2 Background of the Project

The Republic of Senegal, hereinafter referred to as "Senegal", is located in the northwestern part of Africa's Sahel Region. Its land area is 196,722 km^2 with a population of 15.4 million as of 2016[1]. Senegal has maintained more than 6% growth rate of gross domestic product (GDP) since 2015 and it is expected to achieve around 7% growth rate of GDP after 2018[2] under the Emerging Senegal Plan (PSE, 2014).

The structural reform of the economy and growth policy is one of the three main policies in the PSE. In this policy, the agriculture sector is expected to make great contributions to improve food security and reduce the trade deficit. The Program for Stimulus and Acceleration of the Senegalese Agriculture Productivity (PRACAS, 2014-2017), which is the basic program for the agriculture sector in Senegal under the PSE, indicates that paddy should be the key crop as the staple food in Senegal and 1.6 million tons of paddy production should be achieved by the target year of 2017. The paddy production may increase to 2.1 million tons towards the PRACAS2 target year of 2023. However, the actual paddy production amount was 0.9 million ton and 1.0 million ton of milled rice was imported in 2016. Therefore, further efforts to increase the paddy production amount are required to achieve the targets and goals declared in the above policies and programs.

The Senegal River Valley (SRV), located in the northern part of Senegal, has a high potential for irrigation development and around 57% of the total target paddy production amount in Senegal set forth in PRACAS was allocated to the SRV. The National Company for the Development and Exploitation of the Senegal River Delta, Senegal River and Faleme Valley (SAED) is the responsible agency for irrigation development and maintenance of irrigation facilities in the SRV. In order to achieve the above target paddy production amount, SAED has already developed more than 60% of the potential paddy cultivation area in the SRV. However, the following constraints and issues have been observed especially in Dagana and Podor departments, located in the downstream of the Senegal River, where most of the irrigation schemes were developed more than 30 years ago:

- Deterioration of irrigation schemes,
- Abandoned paddy fields, and
- Degradation of paddy quality due to lack of storage facilities.

Therefore, in order to improve the productivity and quality of paddy cultivation in Dagana and Podor departments, it is essential to realize the efficient paddy cultivation through the improvement of irrigation and drainage facilities and agricultural related infrastructures.

[1] World Bank 2016
[2] International Monetary Fund 2018

Under these circumstances, the Government of Senegal (GoS) requested for the JICA official development assistance (ODA) loan for the implementation of the Project.

1.3 General Features of the Project

General features of the Project are summarized below.

Objective of the Project:
To improve the efficiency and the productivity of irrigated rice farming practices through the extension and/or rehabilitation of irrigation and agricultural related facilities and the procurement of agricultural machineries.

It is expected to contribute to improve self-sufficiency in rice in Senegal and to lessen the trade deficit through the reduction of rice imports by achieving the above objective.

Outline of the Project:
1) Rehabilitation/extension of existing irrigation and drainage facilities;
2) Development/rehabilitation of agricultural related infrastructures (rural roads and storage);
3) Procurement of agricultural machineries (tractors, combine harvesters, and milling machines); and
4) Consulting services (detailed design, bidding assistance, construction supervision, etc.).

Target Area of the Project:
Dagana and Podor departments in Saint Louis Province.

Concerned Agency:
Ministry of Agriculture and Rural Equipment (MAER) and
National Company for the Development and Exploitation of the Senegal River Delta, Senegal River and Faleme Valley (SAED).

1.4 Objective of the Survey

The objectives of the survey are i) to collect and analyze the necessary data and information for the project formulation, ii) to examine the technical and financial feasibility of the Project, and iii) to carry out the necessary studies to formulate the Project including the scope, implementation plan, implementation structure, cost estimation, operation and maintenance, and environmental and social consideration for the smooth appraisal of the ODA loan to be funded by JICA.

1.5 Scope of the Survey

In order to accomplish the above objectives, the JICA Survey Team has carried out the survey taking into account the following considerations: i) the survey results would be utilized for the yen loan appraisal; ii) the survey results should cover the required items specifically for the JICA appraisal process; and iii) the environmental and social considerations should be examined carefully. The survey has been compiled into reports and finalized through the discussion with MAER, SAED, and other agencies concerned.

CHAPTER 2 CONFIRMATION OF BACKGROUND, OBJECTIVE AND NECESSITY OF THE PROJECT

2.1 Review of National Policy for Agriculture and Irrigation Development

2.1.1 Emerging Senegal Plan (PSE)

Senegal has implemented the Emerging Senegal Plan (PSE) since 2014, with an aim to boost its strong economic growth. PSE incorporates the social and economic development strategy of the country for the period from 2014 to 2035 and there are 27 priority projects to be implemented under PSE for achieving the 7-8% growth rate of GDP from 2014 to 2018.

The basic policies of PSE for the first ten years and their target sectors are shown in Table A2.1.1.

Table A2.1.1 Policies and Target Sectors of PSE

Policy	Target Sector
Structural reform of the economy and the growth	1) Agriculture, cattle breeding, fisheries and aquaculture, and agriculture processing, 2) Social, economy, and solidarity, 3) Social housing and construction eco-system, 4) Logistic and industrial hub, 5) Tourism and multi-services hub, 6) Mining and fertilizers, 7) Culture, 8) Sport.
Human capital, social protection and sustainable development	1) Population and sustainable human development, 2) Education and training, 3) Health and nutrition, 4) Social protection, 5) Water and sanitation, 6) Housing and living environment, 7) Disasters and catastrophes risk prevention and management, 8) Environment and sustainable development.
Governance, institution, peace and security	1) Peace and security consolidation, 2) Promotion of state law, human rights and justice, 3) Promotion of gender equality and equity, 4) Reform of the state and reinforcement of public administration, 5) Land use planning, local development and territoriality, 6) Strategic, economic and financial governance.

Source: Prepared by the JICA Survey Team based on PSE

In the policy of "structural reform of the economy and the growth", the agriculture sector is expected to make great contributions to achieve the following visions:

- Improvement of food security and reduction of the trade deficit due to the import of foods;
- Development of competitive and high value-added agricultural industries; and
- Preservation of socio-economic balances and revitalization of the rural economy.

In order to achieve these visions, the above priority projects under the PSE are to be implemented in the framework of the PRACAS.

2.1.2 Program for Stimulus and Acceleration of the Senegalese Agriculture Productivity (PRACAS)

The Program for Stimulus and Acceleration of the Senegalese Agriculture Productivity (PRACAS, 2014-2017), is the basic program for the agriculture sector in Senegal under the PSE. Although the PRACAS2 (2019-2027) has not been finalized yet, the PRACAS was reviewed in this sub-chapter.

In the framework of the PRACAS, the Government of Senegal (GoS) specifies the strategic crops including rice, onion, peanut and off-season fruits and vegetables and intends to concentrate its investments on the above crops from the following points of view:

- Promotion of production and consumption of the above crops throughout Senegal;
- Reduction of the degree of import dependency (rice and onion);

- Promotion of exports (vegetables and fruits); and
- Creation of new job opportunities and increase in incomes.

The framework of the PRACAS is shown in Table A2.1.2.

Table A2.1.2 Framework of PRACAS

Crop	Target	Output
Rice	To achieve self-sufficiency in rice by 2017 (1.60 million tons of paddy production and 1.08 million tons of milled rice production).	- Yields for rainfed and irrigated rice cultivation are increased. - System for production and supply of paddy seeds is re-established.
Onion	To achieve self-sufficiency in onion by 2016/17 (265,000 tons production).	- System for production and supply of Violet de Galmi seeds is re-established. - Market access by the producers is improved.
Peanut	To achieve the production of 1.0 million ton by 2017.	- System for production and supply of peanuts seeds is re-established. - Public and private partnerships are developed. - Mechanization of peanut cultivation is promoted.
Off-season fruits and vegetables	To achieve 157,000 tons export to Europe by 2017.	- Horticulture production is increased. - Fruits and vegetables are processed and sold at national and international markets. - Public and private partnerships are strengthened.

Source: Prepared by the JICA Survey Team based on PRACAS

The increase of paddy production is ranked as a priority component of the PRACAS. The target production amount and target cultivated area of paddy are presented in Table A2.1.3 and Table A2.1.4, respectively. The PRACAS indicates that appropriate inputs supply (seeds and fertilizers); sufficient investments for development of irrigation facilities and introduction of agricultural machineries; and technical capacity building are required to achieve these targets.

Table A2.1.3 Target Production Amount of Paddy in PRACAS (ton)

Year	Senegal River Valley	Anambé Basin	Rainfed
2014	585,000	23,400	360,000
2015	780,000	36,000	420,000
2016	845,000	42,000	560,000
2017	912,000	48,000	640,500

Source: prepared by the JICA Survey Team based on PRACAS

Table A2.1.4 Target Cultivated Area of Paddy in PRACAS (ha)

Year	Senegal River Valley	Anambé Basin	Rainfed
2014	90,000	3,900	120,000
2015	120,000	6,000	140,000
2016	130,000	7,000	160,000
2017	140,000	8,000	183,000

Source: Prepared by the JICA Survey Team based on PRACAS

2.1.3 The 12th SAED Mission Letter (ML12)

The mission of SAED is defined in the three-year mission letters with an aim to contribute to the achievement of the goals set by the GoS and MAER. Since 1981, SAED has prepared and issued 12 mission letters and, from 2018, they have implemented their duties and activities based on the 12th SAED mission letter (ML 12) which has been prepared for the period of 2018 to 2020.

ML12 was prepared in accordance with the sector goals and the document for multi-year expenditure program (DPPD) of MAER, and defines the following seven domains of activities for SAED to contribute to the achievement of the goals of the PSE and the PRACAS:

Table A2.1.5 Domains of Activities for SAED under 12th Mission Letter

Sector Goal (SG)	DPPD Program (P)	SAED Domains of Activities (DA)
SG 1: Increase of agriculture production and improvement of productivity.	P 1: Establishment of the production system and development of rural infrastructures.	DA1: Development of irrigation and drainage facilities; DA2: Maintenance of irrigation and drainage facilities; DA3: Water and environment management; and DA4: Support to the management and security of land resources in the rural area.
	P 2: Increase and promotion of agriculture products.	DA5: Support to the promotion and commercialization of agriculture products.
SG 2: Enhancement of support program for agriculture production.	P 3: Strengthening the production system through funding, research, training, and technical support.	DA6: Agricultural technical support and entrepreneurship promotion.
SG 3: Improvement of the agriculture sector governance.	P 4: Management and administrative coordination by MAER.	DA7: Management and coordination.

Source: Prepared by the JICA Survey Team based on the 12th SAED Mission Letter

The following targets are set forth in the ML 12:

- Paddy production amount increases from 455,000 tons (2017) to 875,000 tons (2020) and production amount of milled rice reaches 590,000 tons by 2020;
- Production amount of tomato reaches 136,500 tons by 2020;
- Production amount of onion reaches 254,000 tons with 7,000 ha of cultivated area by 2020;
- Production amount of okra and peanuts increases to contribute to the attainment of the self-sufficiency in these products set forth in the PRACAS;
- 140 km of access roads and protection dykes are rehabilitated; and
- 386 km of irrigation and drainage canals are maintained.

The expected outputs under the ML 12 are as follows:

- The rates of development of potential lands for irrigated farming and utilization of cultivated lands are improved and the number of irrigation and drainage facilities is increased, so as to accomplish the following outputs:
  - To realize the sustainable improvement of agriculture productivity and production;
  - To contribute to self-sufficiency in rice;
  - To enhance the production of the existing diversified crops; and
  - To improve the accessibility to basic social services such as access roads, rural electrification, clean water supply, and pastoral facilities through the supporting activities under the concerned projects.
- The sustainable management and optimal use of natural resources are realized through:
  - The enhancement of the availability and quality of water in and around irrigation schemes through the adequate maintenance, monitoring, and control activities;
  - The establishment of tools and models for the management of irrigation systems; and
  - The promotion of optimal water management techniques for the irrigation schemes.
- The solutions against problems on water and soil degradation are suggested;

- Management and coordination capacity of communes is strengthened through i) establishment of land management standards, ii) support from micro-projects and/or private initiative funding, and iii) activities on raising the awareness of local people to incorporate irrigation development projects and programs into local development plans;
- Needs of rural stakeholders are addressed through i) establishment and improvement of supporting system, ii) adoption and promotion of technical accomplishments and outcomes obtained from research activities, iii) mechanization, iv) improvement of storage capacity, and v) enhancement of agriculture products processing;
- Skills and expertise of producers and their organizations are strengthened through the well-organized technical and management capacity building programs and improvement of supporting system;
- Number of successful entrepreneurs for each stage of agriculture value chain increases; and
- SAED's performances are significantly enhanced through i) technical capacity building through on-demand training programs, ii) improvement of professional ethics, iii) improvement of working conditions, and iv) improvement of staff management including salary increase, reviewing establishment agreement, and reinforcing and/or modernizing of working tools.

2.2 Present Conditions, Constraints and Issues for Agriculture and Irrigation Development in the Senegal River Valley

2.2.1 General

Current situation and problems on agriculture and irrigation development in Dagana and Podor departments are summarized in Table A2.2.1.

Table A2.2.1 Current Situation and Problem in Dagana and Podor Departments

Target Area / Item	Dagana Department	Podor Department
Developed area for paddy cultivation	50,024 ha as of year 2015	16,416 ha as of year 2015
Characteristic of irrigation scheme	- A number of large-scale irrigation schemes have been developed; - Farmland per household is relatively large (e.g., 3.0 ha per household in Débi-Tiguet irrigation scheme); - Cultivated area in the dry season (30,028 ha) was larger than that in the rainy season (12,355 ha) in year 2015; and - Cropping intensity per year in 2015 was only 85%.	- Village irrigation schemes (PIV) and private irrigation schemes (PIP) are the main irrigation schemes; - Farmland per household is around 0.5 ha to 1.0 ha; - Cultivated area in the dry season (5,759 ha) was almost same as that in the rainy season (5,793 ha) in year 2015; and - Cropping intensity per year in 2015 was only 70%.
Potential area for irrigation development	- More than 90% of the potential area for irrigated rice farming has been already developed; and - Most of the existing irrigation schemes were developed more than 30 years ago and require rehabilitation works.	- Millennium Challenge Account (MCA) has already prepared the development plan for the remaining potential area; and - Quality of most of the existing irrigation schemes is low and they require rehabilitation and improvement works.

Target Area / Item	Dagana Department	Podor Department
Industries related to the rice sector	- Many large-scale rice mills are being operated in Ross-Béthio and Richard-Toll; and - Paddy storages are insufficient.	- Many small-scale rice mills are scattered; - Paddy storages are insufficient.
Market for paddy	- Commercial paddy cultivation has been completed; and - Excess harvested paddy has been sold in the market of Senegal.	- Most of the producers cultivate paddy for their home consumption; and - It is currently at the transition period to rice supply area to other markets.
Problems on irrigation facilities, farm management, and producers' organization	- Improper land leveling for paddy plots; - Low quality of irrigation and drainage facilities; - Lack of drainage system, access roads, and farm roads; - Damaged and deteriorated facilities including pumps; - Improper operation and maintenance for irrigation facilities including water management; - Non-compliance with a recommended cropping calendar and block irrigation; - Difficulties in access to certified seeds; - Overdue debt of the loan for paddy cultivation from the bank; and - Lack of information sharing and teamwork among producers.	
Problems on agricultural machinery	- Lack of access roads and farm roads; - Lack of qualified service providers for operation of agricultural machinery; - Usage of inappropriate or poorly maintained agricultural machinery and attachments; - Lack of harvesting machinery such as combine harvester and reaper; and - Problems on large-scale machines (difficulties in transportation and operation in paddy plots due to poor drainage and lack of access and farm roads).	

Source: Prepared by the JICA Survey Team based on the master plan prepared by PAPRIZ2

The problems shown in Table A2.2.1 have caused the increase of abandoned paddy plots as well as inefficient paddy cultivation. As a result, cropping intensity of rice in Dagana and Podor departments continues to be low despite the suitable climate conditions for double cropping of rice. This low cropping intensity has caused low profitability of paddy cultivation and, finally, it may result in further increase of abandoned paddy plots since producers may abandon paddy plots due to such low profitability of paddy cultivation.

Thus, the low cropping intensity may be one of the main causes of the various problems on rice farming in the target area. The inefficiency and low productivity of paddy cultivation, typified by low cropping intensity, have been mainly caused by the following:

i) Problems on irrigation facilities;
   - Deterioration of irrigation facilities,
   - Low quality of irrigation facilities, and
   - Lack of drainage system.

ii) Agricultural related infrastructures; and
   - Lack of access roads and farm roads for smooth operation of agricultural machineries and marketing, and
   - Lack of paddy storages.

iii) Farm management and producers' organization
   - Less compliance with the recommended cropping calendar,
   - Difficulties in access to certified seeds,
   - Installation of improper agricultural machineries for the actual site conditions,

- Inappropriate operation and maintenance of irrigation facility including water management, and
- Delay in the repayment of loan.

Therefore, the low cropping intensity has been caused by various problems, which are intricately interrelated, and is difficult to be improved by solving each problem individually and separately. Since most of the projects/programs implemented in the target area aim to solve the above-listed problems individually and separately, the low cropping intensity, which is the fundamental issue in the target area, has still not been improved through these projects/programs.

2.2.2 Irrigation and Drainage Facilities Including Hydrology

(1) Meteorology

Rainfall data, temperature, humidity and evaporation amount observed at Saint Louis, Podor, Matam and Bakel weather recording stations are summarized in the tables below.

Table A2.2.2 Rainfall Data (Average in 2011 – 2016)

(Unit: mm)

Station	Jan.	Fév.	Mars	Avril	Mai	Juin	Juil.	Août	Sept.	Oct.	Nov.	Déc.	Total
Saint Louis	0.00	0.05	0.00	0.00	0.00	0.47	44.62	100.32	116.97	8.08	0.22	1.30	272.02
Podor	0.00	0.18	3.13	0.08	0.00	1.92	45.55	102.15	72.73	5.02	1.07	0.38	232.22
Matam	0.00	0.00	0.27	0.02	5.55	22.58	86.90	139.42	105.65	6.73	0.14	0.10	367.36
Bakel	0.00	0.00	0.00	0.00	2.48	44.33	134.05	254.07	161.18	48.90	0.00	0.00	645.02
Moyenne	0.00	0.06	0.85	0.02	2.01	17.33	77.78	148.99	114.13	17.18	0.36	0.45	379.15

Source: Ministere du tourisme et des transports aeriens

Table A2.2.3 Maximum Temperature (Average in 2011 – 2016)

(Unit: degree C)

Station	Jan.	Fév.	Mars	Avril	Mai	Juin	Juil.	Août	Sept.	Oct.	Nov.	Déc.	Avr.
Saint Louis	32.02	32.35	31.80	30.85	29.97	29.62	31.03	31.97	32.77	34.28	34.35	32.53	31.96
Podor	32.33	33.48	37.17	40.50	41.93	41.47	37.92	36.62	37.25	39.47	36.72	33.03	37.32
Matam	34.52	36.13	39.52	42.88	43.83	42.33	38.13	35.52	36.35	39.97	39.28	34.60	38.59
Bakel	34.47	36.37	40.65	43.65	43.90	41.53	36.85	34.08	34.92	38.50	38.77	34.17	38.15
Moyenne	33.33	34.58	37.28	39.47	39.91	38.74	35.98	34.55	35.32	38.05	37.28	33.58	36.51

Source: Ministere du tourisme et des transports aeriens

Table A2.2.4 Minimum Temperature (Average in 2011 – 2016)

(Unit: degree C)

Station	Jan.	Fév.	Mars	Avril	Mai	Juin	Juil.	Août	Sept.	Oct.	Nov.	Déc.	Avr.
Saint Louis	16.27	16.57	17.57	18.48	19.88	22.48	24.77	25.27	25.28	24.60	20.65	17.30	20.76
Podor	17.62	17.13	19.42	22.60	24.07	24.55	25.20	25.60	25.77	25.50	21.47	17.45	22.20
Matam	16.85	17.80	21.10	25.60	28.07	28.45	26.57	25.10	25.33	25.83	21.78	17.62	23.34
Bakel	18.07	18.97	22.42	25.85	29.70	28.07	25.37	24.17	24.55	24.33	20.87	18.48	23.40
Average	17.20	17.62	20.13	23.13	25.43	25.89	25.48	25.03	25.23	25.07	21.19	17.71	22.43

Source: Ministere du tourisme et des transports aeriens

Table A2.2.5 Maximum Humidity (Average in 2011 – 2016)

(Unit: %)

Station	Jan.	Fév.	Mars	Avril	Mai	Juin	Juil.	Août	Sept.	Oct.	Nov.	Déc.	Avr.
Saint Louis	76.00	80.17	87.33	90.50	93.33	93.83	91.83	94.00	95.67	95.33	88.33	74.17	88.38
Podor	42.83	41.17	52.50	55.33	60.17	70.83	82.33	87.83	89.33	74.00	57.17	51.50	63.75
Matam	50.83	45.17	45.33	44.83	48.67	57.50	77.67	85.67	90.17	78.50	61.83	52.17	61.53
Bakel	50.17	44.67	47.67	44.67	50.33	62.50	83.67	94.83	96.33	92.33	73.17	51.00	65.94
Moyenne	54.96	52.79	58.21	58.83	63.13	71.17	83.88	90.58	92.88	85.04	70.13	57.21	69.90

Source: Ministere du tourisme et des transports aeriens

Table A2.2.6 Minimum Humidity (Average in 2011 – 2016)

(Unit: %)

Station	Jan.	Fév.	Mars	Avril	Mai	Juin	Juil.	Août	Sept.	Oct.	Nov.	Déc.	Avr.
Saint Louis	26.83	26.33	38.67	47.17	56.83	64.83	66.50	68.17	66.83	53.83	35.67	25.33	48.08
Podor	15.00	14.00	15.00	14.50	16.33	22.83	36.50	46.33	44.33	28.33	21.67	18.50	24.44
Matam	22.33	20.50	22.00	21.67	22.50	29.33	44.33	52.67	56.00	38.33	25.00	22.33	31.42
Bakel	22.00	19.17	19.50	19.33	23.67	32.00	43.50	56.00	61.00	43.00	25.67	22.00	32.24
Moyenne	21.54	20.00	23.79	25.67	29.83	37.25	47.71	55.79	57.04	40.88	27.00	22.04	34.05

Source: Ministere du tourisme et des transports aeriens

Table A2.2.7 Evaporation Amount (Average in 2011 – 2016)

(Unit: mm)

Station	Jan.	Fév.	Mars	Avril	Mai	Juin	Juil.	Août	Sept.	Oct.	Nov.	Déc.	Avr.
Saint Louis	5.40	5.58	4.83	4.37	3.80	3.77	3.23	3.08	2.28	2.80	4.23	5.47	4.07
Podor	5.55	6.33	6.00	6.53	6.83	7.03	5.13	3.28	3.40	5.08	5.70	5.58	5.54
Matam	5.94	7.12	8.00	9.24	9.89	9.15	5.52	3.32	3.85	4.86	5.76	5.58	6.52
Bakel	8.15	9.97	10.92	10.93	11.77	9.83	5.40	2.97	2.83	4.50	6.80	8.10	7.68
Moyenne	6.26	7.25	7.44	7.77	8.07	7.45	4.82	3.16	3.09	4.31	5.62	6.18	5.95

Source: Ministere du tourisme et des transports aeriens

Based on the above Tables A2.2.2 – A2.2.7, the seasonal and location/area-wise meteorological characteristics in the Senegal River Valley are summarized as follows:

Table A2.2.8 Seasonal Meteorological Characteristics in the Target Area

Season	Period		Rainfall	Temperature		Humidity	Evaporation
	from	to		degree	fluctuation	%	
Rainy Season	end. Jun.	beg. Oct.	> 95% of total	mid.	low	high	low
Cold Dry Season	mid. Nov.	end. Feb.	negligible	low	high	low	mid.
Hot Dry Season	beg. Mar	mid. Jun.	negligible	high	high	low	high

Source: Master Plan Final Report, PAPRIZ2

Station	Location	Rainfall	Temperature	Humidity	Evaporation
Saint Louis	Downstream	MORE	HIGHER	HIGHER	MORE
Podor	↓				
Matam	↓				
Bakel	Upstream				

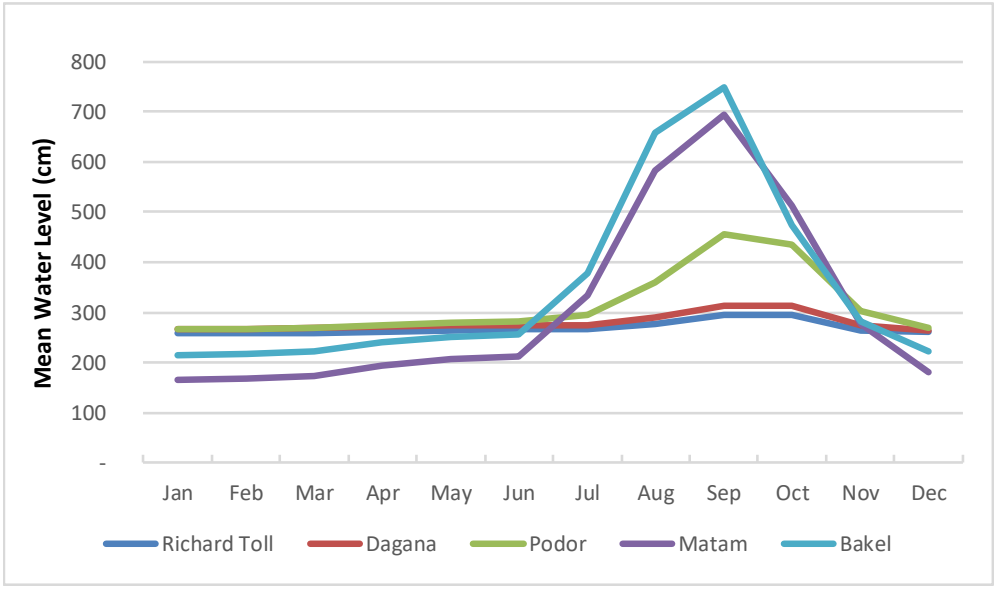
Note: *High humidity is observed in Saint Louis due to its "sea front" location.*
Source: *Master Plan Final Report, PAPRIZ2*

Figure A2.2.1 Area-wise Meteorological Characteristics in the Target Area

(2) Hydrology

Regarding the hydrological data, only the Senegal River water level data at six gauging stations are observed by SAED, while other data required for proper water resources management such as data at the major branch rivers and river discharge data have not been observed and managed. Considering the potential irrigation area for paddy and other crops of 240,000 ha (125,825 ha for paddy and 114,175 ha for other crops) identified by the Organization for the Development of the Senegal River (OMVS) and the current developed area of 128,052 ha (79,373 ha for paddy and 48,679 ha for other crops) in the Senegal River Valley, no serious shortage of water resources is assumed in the near future. Meanwhile, from a long-term point of view, tight water balance may be assumed due to rapid increase of domestic and industrial water demand and the proper water resources management in the Senegal River Valley including all major branch rivers will be essential to avoid unnecessary conflict among agricultural, industrial, and domestic water demands.

The water level data observed at five gauging stations, namely: Richard-toll, Dagana, Podor, Matam and Bakel stations, are summarized in the figure below.



Source: Master Plan Final Report, PAPRIZ2

Figure A2.2.2 Monthly Mean Water Level at Senegal River (Average in 2011 – 2016)

As shown in the above figure, high water level was recorded from July to October, i.e., in the rainy season, and low water level was recorded from November to June, i.e., in the cold and hot dry seasons, at all the gauging stations.

Additionally, high seasonal fluctuation of water level was observed at the gauging stations in the upstream area and low seasonal fluctuation of water level was observed in the downstream area as summarized in the table below.

Table A2.2.9 Seasonal Fluctuation of Water Level in Senegal River (Average in 2011-2016)

Station	Maximum Water Level		Minimum Water Level		Fluctuation
	(cm)	Month	(cm)	Month	(cm)
Richard-toll	294.82	September	257.78	March	37.04
Dagana	311.98	September	264.28	December	47.70
Podor	456.29	September	266.49	January	189.80
Matam	694.50	September	164.62	January	529.88
Bakel	749.01	September	213.48	January	535.53

Source: Master Plan Final Report, PAPRIZ2

The low seasonal fluctuation is realized in Dagana department because the Senegal River water level at the downstream area is regulated by Diama Dam, which is located at the estuary of the Senegal River, throughout the year. Such low seasonal fluctuation is also observed at Podor station although the fluctuation observed at Podor station is relatively large compared to that observed at Danaga station.

As described above, there are no official records of the discharge data of the Senegal River. Based on "Irrigation Potential in Africa, A Basin Approach: FAO Land and Water Bulletin 4, 1997" (FAO paper), the annual discharge of the Senegal River is roughly estimated at about 27 billion cum as follows:

Senegal River basin area: 483,181 km^2
Mean annual rainfall: 550 mm
Runoff percentage (assumed): 10%
Annual discharge: 483.181 x 0.55 x 10% = about 27 billion m^3

In the above FAO paper, the potential irrigation area in the overall Senegal River basin which includes the area for Guinea, Mali, Mauritania, and Senegal was also estimated and 57% of such potential irrigation area belongs to Senegal.

Meanwhile, the maximum water requirements for irrigated rice farming in the Senegal River Valley are also roughly estimated with the following assumption:

- Cropping intensity is 200% (maximum cropping intensity),
- Potential irrigation area for paddy is 125,825 ha (as described above), and
- The following standard water requirements for rice cultivation are applied:

Table A2.2.10 SAED's Standard Water Requirements

Department / Item	Rice	Mixed Farming
Podor	16,900 to 22,500 cum/ha	8,450 to 10,650 cum/ha
Matam	15,800 to 22,000 cum/ha	7,900 to 10,100 cum/ha
Bakel	14,000 to 24,500 cum/ha	8,600 to 10,800 cum/ha
Design Water Requirement	3.5 L/sec/ha	2.0 L/sec/ha

Source: Document De Referentiel De Normes D'Amenagement Dans La Vallee Rive Gauche Du Fleuve Senegal, SAED, Octobre 2005

With the above assumption, the maximum water requirements for irrigated rice farming in the Senegal River Valley are roughly estimated at about 5 billion cum as follows:

Average water requirements for rice in wet season rice: 16,000 m^3/ha
Average water requirements for rice in dry season rice: 23,000 m^3/ha

Potential rice irrigation area (maximum): 125,825 ha
Maximum cropping intensity: 200%
Annual water requirements: 125,825 x (16,000 + 23,000) = about 5 billion m^3

Based on the above rough estimation for the expected annual discharge of the Senegal River and the maximum water requirements required for overall potential rice irrigation area with 200% cropping intensity, it is tentatively concluded that, as a main water source for irrigation development, the Senegal River may have sufficient potential for the full development of irrigated rice farming in the Senegal River Valley.

(3) Irrigation and Drainage Facilities

The chronology of the development of irrigation schemes in the Senegal River Valley is summarized as follows:

1) Period from 1945 to 1972: The incipient irrigation schemes equipped with control gates were developed in the delta area and operated under the state control. 30,000 ha of irrigation development was realized during this period through the construction of pumping stations and flood dikes. However, the agricultural production was still low despite these efforts.
2) Period from 1972 to 1982: During this period, the irrigation efficiency of the irrigation schemes developed during the former period was improved through the rehabilitation and improvement works. SAED commenced to develop village irrigation schemes as an emergency countermeasure against the drought experienced in the 1970s. SAED also commenced and expanded the irrigation development works not only in the delta area but also in the whole Senegal River Valley.
3) Period from 1982 to 1987: During this period, the irrigation schemes developed during the former periods were rehabilitated and the development works were expanded in the whole Senegal River Valley. At the end of this period, SAED commenced to develop the new type of irrigation schemes, namely, medium-scale irrigation schemes (AIs).

The irrigation schemes in the Senegal River Valley are classified into the following four types:

Table A2.2.11 Irrigation Schemes in the Senegal River Valley

Type	Description/Features
Large-scale irrigation scheme (GA)	GAs have been developed in the area where the irrigation potential as well as the development priority were high. GAs have been equipped with pump station, irrigation networks, and drainage networks.
Medium-scale irrigation scheme (AI)	AIs have been designed considering the respective merits of GAs and PIVs. AIs have been composed of several autonomous irrigation units (AIUs) and rotational irrigation has been applied. AIs have been equipped with the same facilities as those for GAs.
Village irrigation scheme (PIV)	Initially, PIVs equipped with the minimum facilities including pumps and excavated canals have been developed along the Senegal River with the farmers' participation. However, most of these schemes have been abandoned due to the poor quality of the works. Currently, such PIVs have been rehabilitated and upgraded using the design standards applied to AIs.
Private irrigation scheme (PIP)	PIPs have been developed mainly in the delta area where SAED has suspended the development works. Most PIPs have been equipped with similar facilities as those for PIVs and these lack proper drainage system. Due to salinity problems and/or operational problems, most of such PIPs were abandoned soon after the development works.

Source: Document De Referentiel De Normes D'Amenagement Dans La Vallee Rive Gauche Du Fleuve Senegal, SAED, Octobre 2005

The current status of irrigation development in the Senegal River Valley is shown in Table A2.2.12.

Table A2.2.12 Irrigation Development Area in the Senegal River Valley (as of 2015)

Department	Potential Irrigation Area (ha)		Developed Area (ha)		Undeveloped Area (ha)	
	Paddy	Others	Paddy	Others	Paddy	Others
Dagana	55,871	59,329	50,224	35,975	5,647	23,354
Podor	35,687	21,913	16,416	9,425	19.271	12,488
Matamu	27,284	15,916	10,383	1,450	16.901	14,466
Bakel	6,983	17,017	2,350	1,829	4,633	15,188
Total	**125,825**	**114,175**	**79,373**	**48,679**	**46,452**	**65,496**

Source: SAED

Despite the admirable efforts of irrigation development in the Senegal River Valley, there is still large potential to improve the productivity of rice cultivation not only through upgrading and modernizing the existing irrigation schemes but also through the improvement of farming and post-harvest activities.

As described in Sub-chapter 2.2.1, one of the main issues on the rice production in the Senegal River Valley is the improvement of the cropping intensity. As described above (2), the Senegal River, which is the main water source for irrigation in the Senegal River Valley, has the potential to sufficiently supply the irrigation water to the whole potential rice irrigation area in the Senegal River Valley with the cropping intensity of 200%. However, the current cropping intensity in the Senegal River Valley is less than 100% as shown in Table A2.2.1.

The main constraints for such low cropping intensity in most of the irrigation schemes are the deterioration of irrigation facilities and lack of drainage facilities. Additionally, proper farming activities based on the programmed cropping calendar have not been realized due to lack of farm machineries, farm and access road networks, and post-harvest facilities.

2.2.3 Agricultural Related Facilities

(1) Farm and Access Roads

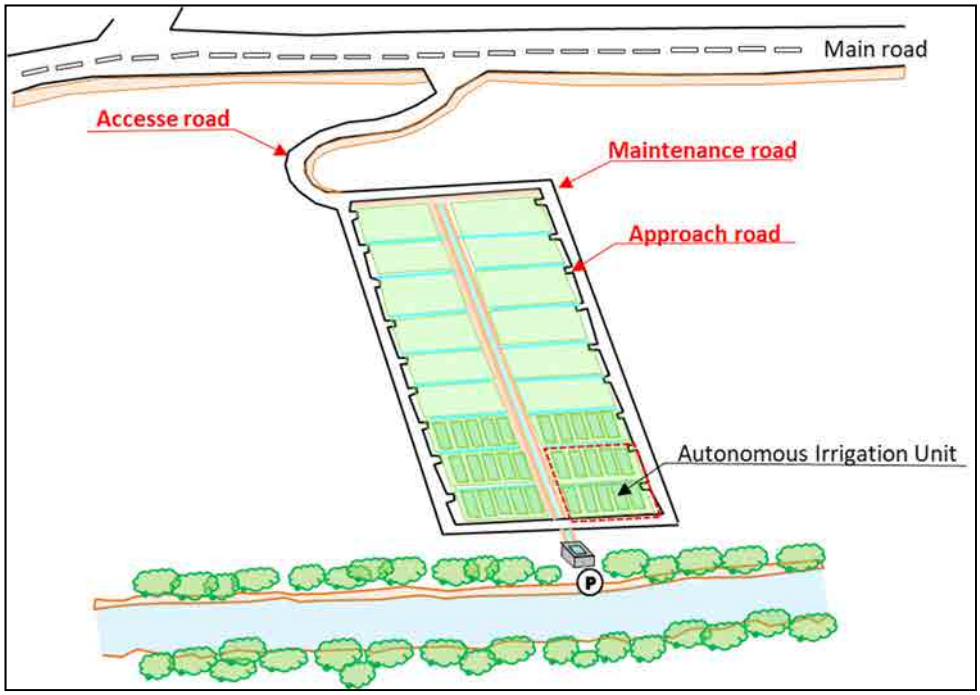
Generally, the following types of farm and access roads are required for proper farming activities:

Table A2.2.13 Farm and Access Roads Required for Farming Activities

Type of Road	Main Function	Current Conditions
Access Road	- to connect schemes with main roads for smooth transportation and marketing, - to connect paddy fields, warehouses, residential area and main roads, and - to be used as community roads connecting villages with main roads.	- with laterite pavement, and - 6 - 8 m width including shoulder.
Maintenance Road	- to connect irrigation units to each other, - to be used for the smooth access to paddy fields mainly for agricultural machineries required for plowing and harvesting activities, and - to be used as operation and maintenance roads (e.g., for daily inspection activities).	- 3 - 5 m width including shoulder, - constructed in some of the irrigation schemes but rarely connected to each paddy plot.
Approach Road	- To be used as approach from maintenance roads to paddy fields mainly for agricultural machineries such as tractors and combine harvesters.	- rarely constructed in the existing irrigation schemes.
Livestock Road	- to allow livestock to cross the irrigation schemes during non-irrigation period, and - canal crossing structures such as bridges and box culverts are required to avoid damages to canals.	- rarely constructed in the existing irrigation schemes.

Source: JICA Survey Team

The following figure shows the image of the farm and access roads in the irrigation schemes:



Source: JICA Survey Team

Figure A2.2.3 Image of the Farm and Access Roads in the Irrigation Schemes

As shown in the above table, especially, the approach roads for the access from maintenance roads to paddy fields are not constructed in most of the irrigation schemes and the absence of the approach roads causes the following constraints:

- delay in the farming activities due to inefficient use or difficulties in introduction of agricultural machineries, and
- difficulties in timely inputs, proper water management, and harvesting due to poor access to paddy fields.

Additionally, site inspections by the JICA Survey Team have revealed that the access and maintenance roads in most of the existing irrigation schemes have been deteriorated as shown in the photographs below.

Maintenance road in Mbagan_Dagana

Maintenance road in Rosso, Dagana

Eroded maintenance road in Ndiwara, Podor

(2) Warehouse

The amount of paddy production and the storage capacity of paddy in each department are shown in the table below.

Table A2.2.14 Paddy Production and Storage Capacity of Paddy in the Senegal River Valley

Category / Department		Dagana	Podor	Matam / Kanel	Bakel	Total
1	Paddy production（2014/15）					
	Rainy season (ton)	121,052	46,317	38,038	2,660	208,067
	Hot dry season (ton)	187,587	34,722	597	0	222,906
	Total (ton)	308,639	81,039	38,635	2,660	430,973
	Proportion of paddy production amount in each department	71.6%	18.8%	9.0%	0.6%	
2	Capacity of paddy storage（2017）					
	Number of storage facilities	146	149	67	27	389
	Total storage capacity (ton)	68,416	29,130	9,897	3,765	111,208
3	Excess or shortage amount of storage capacity in each season (The mark ▲ indicates shortage of capacity)					
	Rainy season (ton)	▲52,636	▲17,187	▲28,141	1,105	▲96,859
	Proportion of storage capacity to paddy production amount	56.5%	62.9%	26.0%	141.5%	**53.4%**
	Hot Dry Season (ton)	▲119,171	▲5,592	9,300	3,765	▲111,698
	Proportion of storage capacity to paddy production amount	36.5%	83.9%	25.6%	-	**49.9%**

Source: Master Plan Final Report, PAPRIZ2

In recent years, the construction of paddy storage facilities has been accelerated and the storage capacity has increased rapidly. However, as shown in Table A2.2.14, in all departments, the storage capacity reaches only about 53% of the production amount in the rainy season and only about 50% of the production amount in the hot dry season. Therefore, around half of the paddy is stored under inadequate circumstances, except for some paddy which are transported to the rice mills immediately after harvesting and drying. In Dagana department, where 70% of the total paddy production amount in the Senegal River Valley is produced, the storage capacity is only about 37% of the production amount in the hot dry season. The paddy storage capacity in Podor department is also about 60-80% of the production amount both for the hot dry season and the rainy season.

The following table shows the current constraints on the farming practices caused by the above insufficient paddy storage capacity and the expected improvements with the sufficient paddy storage capacity:

Table A2.2.15 Impact of Storage Capacity on Rice Millers and Producers

Stakeholder	Paddy Storage Capacity is NOT sufficient: Present Condition	Paddy Storage Capacity is sufficient: Expected Condition
Rice millers	- At a peak period of collection of paddy for milling, milling capacity may not be sufficient to mill whole collected paddy at once and certain amount of paddy shall be stored in the paddy storage. - If the paddy storage capacity is not sufficient, such paddy may be stored under the poor circumstances and the quality of rice may be degraded. - Year-round operation of rice mills cannot be realized due to insufficient storage capacity.	- If the paddy storage capacity is sufficient, the collected paddy can be stored properly to keep its quality. - If the paddy storage capacity is sufficient, year-round operation of rice mills can be realized.
Producers	- The producers store paddy at home and consume paddy for self-consumption. This causes delay in the refund to LBA. - The producers leave the paddy in the open air for a long time. This causes degradation in the quality of paddy.	- The producers can store the paddy in the warehouse with the adequate conditions and can be refunded to the LBA in a timely manner.

Source: JICA Survey Team

(3) Garage for Agricultural Machineries

When the agricultural machineries are introduced, it is suggested that the garage for agricultural machineries, which should be equipped with the necessary tools and crane, be also provided for proper operation and maintenance of the machineries including regular maintenance works, cleaning of machineries, preventive measures, and repair works. However, such garage for agricultural machineries has not been provided in most of the existing irrigation schemes.

2.2.4 Crop Production and Rice Farming Practice

(1) Soils

The target area of the Project is the Dagana and Podor departments, extending over the alluvial plains in the middle to lower reaches of the Senegal River Valley.

From the viewpoint of agricultural value, the soils of the target area are broadly classified into two groups, mainly depending on the availability of water. They are: (i) upland soils in which crops are grown under rainfed conditions (Dieri or jeeri, in local language); and (ii) lowland soils in which crops could be grown with the direct or indirect use of flood water (Walo, in local language).

Upland soils are located at topographically higher land, where there is no risk of inundation even when large flood occurs. However, upland is usually far from the water source and it is prone to drought when the rainfall is minimal. On the other hand, lowland soils are subject to inundation caused by flood. Local people classify the lowland soils into several soil types including “Falo”, “Fondé”, “Hollaldé”, and “Faux Hollaldé” based on their agricultural value which is determined by the degree of inundation period and topographic conditions.

Table A2.2.16 shows the main soil types observed in the lower and middle reaches of the Senegal River Valley with their characteristics and main cultivated crops. Normally, village irrigation schemes are developed along the Senegal River, where “Fondé” soil develops. “Fondé” soil has a moderate clay content and a moderate water holding capacity. “Falo” soil is observed along the Senegal River bank and used for vegetable gardening, which is taking advantage of easy access to water. Sorghum, millet, beans, and melons are planted on “Hollaldé” soil using receding flood water. “Hollaldé” soil has a high clay content and a high water holding capacity.

Table A2.2.16 Main Soil Types of the Lower and Middle Senegal River Valley

Soil type	Characteristics	Cultivated crops
Falo	Silty alluvial and deep soils of high fertility since they are flooded every year and fertile sediments deposited.	Vegetable gardens.
Fondé	Texture is silty to sandy with 70% sand, 30% clay and a moderate water holding capacity. The sandy surface is easy erodible but easy to cultivate with high infiltration rates from 10-15 cm/hour.	Feasible for irrigated agricultural development often cultivating rice and onions when the soils occur along the river.
Hollaldé	Usually a dark brown soil with large amounts of clay 60% (vertisols in USDA Soil Taxonomy). It consist of alluvial sediments that are deposited by receding waters and have a high water holding capacity. It is flooded for a longer period in most years.	Flood recession agriculture is practised on the Hollaldé soils cultivating mainly sorghum, millet, beans, and melons.
Faux Hollaldé	Soils with a variable clay content, between 30-60%.	Used for flood recession agriculture. The soil is of marginal importance in years of low flood.

Source: Nina Larsen Saarnak (2003): Flood recession agriculture in the Senegal River Valley. Geografisk Tidsskrift, Danish Journal of Geography 103(1): 99-113

In the delta area, there are a lot of abandoned irrigation fields, where salt accumulation is observed on the soil surface. There is a small amount of vegetation except halophilic plants in the surrounding area.

Most of the abandoned fields have been developed by private sectors as PIPs. Such private sectors have invested on irrigation system expecting a large profit. However, most of the irrigation schemes were developed without proper drainage system since the private sectors were not aware of the risk of salinization.

Soils in the delta area are naturally saline due to the Atlantic Ocean, and have a high risk of salinization due to the shallow saline water table which induces salt accumulation on the soil surface by capillary action unless proper countermeasure is taken.

In general, soils in large irrigation schemes with drainage system are less saline, while those in small irrigation schemes without drainage system have high salinity.

Salinization process has been studied progressively and the following measures are recommended to cope with the salinity problems (Wopereis, M.C.S. et al., 1998):

- construction of surface drainage facilities,
- introduction of double cropping of irrigated rice which reduces level of saline water, and
- use of salt-tolerant varieties.

In the middle reach of the Senegal River Valley, soil degradation cases have not been reported so far. However, the poor permeability of soils in the irrigation schemes, lack of adequate drainage facilities, and high evaporation may cause concentration of irrigation water in the soil profile. Given the positive residual alkalinity with low carbonate content of the Senegal River water, it is predicted that in the long term, concentration of irrigation water may lead to soil alkalinization and sodication, which is irreversible soil degradation. It is, therefore, strongly recommended to provide all the irrigation schemes with the proper drainage system.

(2) Agriculture and Rice Production

Under the rainfed condition, main cultivated crops are cereals like millet, sorghum and maize, beans and, root crops like sweet potatoes. Those crops are cultivated mostly in the floodplain after the peak

rainy season utilizing residual moisture in the soils derived from the receding flood water. According to the Master Plan Report, the harvested area of the above traditional rainfed cultivation largely fluctuates ranging from 70,000 ha to 130,000 ha depending on the unstable rainfall under the arid to semi-arid conditions and the unit yields are generally low. The area under rainfed cultivation is decreasing from more than 100,000 ha in early 2000s to less than 80,000 ha in middle 2010s, mainly due to the decline of rainfall and flooding area.

Annual total cultivated area of rice was 25,000 ha in 2006/07, and increased to more than 60,000 ha in 2015/16. Production of rice also increased drastically from about 150,000 tons in 2006/07 to more than 450,000 tons in 2014/2015. Average yield of rice in the past ten years has fluctuated, ranging from 5.0 to 6.0 ton/ha in the rainy season and from 6.5 to 7.5 ton/ha in the dry season.

The above increase of rice cultivated area was largely attributed to the expansion of the dry season cultivated area, which was increased from 4,000 ha in 2006/07 to 44,000 ha in 2014/15.

The above tendency is pronounced in the delta area in Dagana department. Rice farmers in this area have realized that (1) there is a higher rice productivity in the dry seasons than in the rainy seasons; (2) better workability in the rice field in dry conditions; and (3) easy access to irrigation water even in the dry seasons because of the stable Senegal River water level maintained by the Diama Dam.

It should be noted, however, that the increase in the rice cultivation area in the dry season has accompanied the decrease in the rice cultivation area in the rainy season especially in the delta area in the Dagana department. The main causes of the decrease in the rainy season rice cultivation are as follows:

- Rapid increase in the rice cultivation area in the dry season has resulted in the prolonged harvest period due to the shortage of labor force and harvest machinery during the harvest time;
- As a consequence, land preparation for the rainy season cultivation was delayed and the rainy season has started before land preparation. Because of rain, the soils in paddy field became too soft for tractors to enter the paddy field for land preparation. Finally, many rice farmers have to abandon the rainy season cultivation; and
- Another reason for the decrease in the cultivation area in the rainy season is the long process to obtain production loan from financial institutions after repaying the previous season's loan. Due to shorter period between the harvest of dry season crop and the start of the rainy season cropping, many rice farmers are faced with difficulty in obtaining the production loan, at the appropriate time, for the rainy season cropping.

Therefore, the increase of the rice cultivation area in the rainy season is one of the important issues especially in Dagana department to improve the cropping intensity in the target area.

(3) Farming Practice

During the course of the preparation of the Master Plan, the baseline survey was carried out to grasp the present situation on the irrigated rice farming. The number of samples was 342 farmers for Dagana department and 285 famers in Podor department. Table A2.2.17 shows the summary of the mentioned baseline survey.

Table A2.2.17 Results of Baseline Survey Conducted During the Master Plan Study

Survey Item	Results
Cropping intensity of rice	Dagana: 96% in the dry season, 38% in the rainy season Podor: 79% in the dry season, 59% in the rainy season
Average yield of rice	Dagana: 6.5 ton/ha in the dry season, 4.5 ton/ha in the rainy season Podor: 5.6 ton/ha in the dry season, 5.1 ton/ha in the rainy season
Levelling of plots during land preparation	Dagana: 30% of farmers practice Podor: 50% of farmers practice
Water depth at sowing (less than ankle-deep)	Dagana: 66% much more than ankle-deep Podor: 56% much more than ankle-deep
Manual weeding after herbicide application	Dagana: 70% of farmers practice, among them 36% of farmers practice only once Podor: 79% of farmers practice, among them 53% of farmers practice only once
Cropping calendar	Majority practices sowing after the recommended latest date (March 15th for the dry season paddy, August 15th for the rainy season paddy)
Popular variety	Sahel 108 for both dry and rainy seasons in Dagana and Podor (Sahel 108: old type short duration variety)
Use of certified seeds	Dagana: 81%: using the certified seeds, 19%: not using Podor: 80%: using the certified seeds, 20%: not using
Reason for not using certified seeds	Dagana: 37%: expensive, 32%: not available, 27%: low quality Podor: 40%: expensive, 35%: not available, 10%: not known
Disease: abnormal symptom on rice plant	Dagana: 30%: yes Podor: 40%: yes
Specific pest symptom identified by SAED staff	Dagana: 48%: brown spots, 40%: yellow leaves, 37%: empty grains Podor: 56%: empty grains, 51%: yellow leaves, 25%: brown spots
Insect plague affecting rice growth and yield	Dagana: 58%: yes Podor: 39%: yes
Specific insect plague	Dagana: 100%: grains sucked, 60%: leaves eaten, 50%: grains empty Podor: 48%: grains sucked, 35%: leaves eaten, 45%: grains empty

Source: Prepared by the JICA Survey Team, referring to the Master Plan Final Report, PAPRIZ 2, April 2018.

The table above shows that the basic rice cultivation techniques have not been sufficiently disseminated to rice farmers and the dissemination of the cultivation techniques is one of the main issues in the target area.

2.2.5 Agricultural Mechanization

(1) Current Situation of Agricultural Mechanization

The major agricultural machines used in the Senegal River Valley are tractors with attachment such as disk hollows and plows, combine harvesters, and threshers. These machines mainly belong to private service providers and farmers' organizations (providers).

The private service providers supply the plowing and harvesting services to farmers in the target area using their own machines. Meanwhile, the farmers' organizations provide plowing and harvesting services mainly to their organization members as their primary clients.

Table A2.2.18 shows the rice cultivated area and the required and actual number of agricultural machines in Dagana and Podor departments as of year 2018.

Table A2.2.18 Rice Cultivated Area and the Required and Actual Number of Agricultural Machines in the Target Area

Department	Rice Cultivated Area in 2018	Machine	Actual Number in 2018	Required Number	Coverage Rate
Dagana	Dry Season: 34,366ha Rain Season: 11,235ha	Tractor	152	112	135%
				36	422%
		Combine harvester	85	206	41%
				67	126%
Podor	Dry Season: 8,416ha Rain Season: 4,772ha	Tractor	52	27	192%
				15	433%
		Combine harvester	7	50	14%
				28	25%

Source: JICA Survey Team

The farmers in the target area indicated that the their demands for machinery services have often exceeded the supply of such services from the private service providers and farmers have often faced difficulties in receiving the machinery services timely as scheduled in their cropping calendar. As shown in the above Table A2.2.18, one of the main reasons for the above supply-demand issue on the machinery services is the shortage of combine harvesters. For tractors, although the number of machines is sufficient in the target area, the lack of management and technical capacity of private service providers, such as the preparation of proper working schedule for the efficient operation and movement of machineries, may cause the above supply-demand issue. However, private service providers have not been aware of the above supply-demand issue and understood that they have provided the sufficient supply to satisfy the farmers' demands. This perception gap between farmers and private service providers may be mainly caused by the following misinterpretation of the actual situations by private service providers:

- Private service providers deem that they have provided the sufficient services to satisfy all farmers' demands since they have completed all the services ordered by farmers,
- However, they have not recognized that there were remaining demands for which they could not receive orders due to a shortage of machineries and/or management problems, and
- Additionally, they have not recognized that they could not provide the machinery services as scheduled in the farmers' cropping calendar.

The farmers' organizations provide their services giving top priority to their organization members. Therefore, there are few organizations who provide the services to other farmers. In case farmers' organization cannot satisfy their members' demands timely and properly, such farmers may order the required services from private service providers.

(2) Maintenance and Repair

In the target area, there are few repair shops which are well-equipped with the necessary tools and equipment for the proper maintenance and repair works. The mechanics in providers and private local mechanics play an important role for the maintenance and repair of agricultural machineries. However, most of these mechanics have not learned the mechanism and the repair method of agricultural machineries systematically and their skills are not competent enough. They carry out the maintenance and repair works based on their own experience and knowledge and are often not capable to maintain or repair the machineries properly.

One of the main issues on the agricultural mechanization in the target area is to obtain the required spare parts for the machineries. It takes time to obtain the required spare parts since it is hard to find

them in the local markets and required to be ordered from dealers in Dakar or manufacturers outside Senegal directly. During such waiting period, the agricultural machineries would be idle or seriously damaged due to the forced operation without the proper repair. Even for the well-managed private service providers in the target area, it is not common to always keep the spare parts required for the proper maintenance and repair works in stock.

Generally, providers do not have serious financial issues on the daily maintenance activities such as oil changes. Meanwhile, they sometimes face difficulties in arranging the budget to carry out the major maintenance and repair works which require expensive spare parts.

There is no association for agricultural machineries and communication among the stakeholders including private service providers, farmers' organizations, repair shops, and mechanics is limited in the target area, although few private service providers sometimes introduce their clients to another provider when they are not able to receive an order from such clients by themselves.

2.2.6 Institutional Development

(1) Farmers' Organization

1) Overview of Farmers' Organizations

Farmers' organizations involved in the irrigation development activities include union, groupement d'intérêt économique (GIE) and section villageoise (SV). The number of other farmers' organizations is small and decreasing recently, and SAED encourages them to register as GIEs. The characteristics of these organizations are shown in the table below.

Table A2.2.19 Characteristics of Farmers' Organization

Type	Characteristics	Member	Fiscal Aspect	Responsible Ministry
Union	Initiated since 1990, and Established for water management and O&M for irrigation facilities.	Farmers' organization	Term deposit, rural tax, income tax: not applicable. VAT: applicable.	MAER
GIE	Initiated since 2002, Corporate status, and Allowed to obtain a bank credit for economic activities.	Farmers	Rural tax: not applicable. VAT: applicable.	Ministry of Trade
SV	Several SVs in each village, Transformed from associations to SVs, and Encouraged to register as GIE.	Farmers from one or several villages	Rural tax: not applicable. VAT: applicable.	MAER
Association	Not Corporate status, and Not allowed to obtain a bank credit for economic activities.	Farmers or Farmers' organizations	Rural tax: not applicable. VAT: applicable.	Ministry of the Interior

Source: Prepared by the JICA Survey Team based on Master Plan Final Report, PAPRIZ2

As shown in the above table, only the GIE has the cooperative status and is allowed to obtain a bank credit for economic activities. The GIE is neither an organization which is specific to the agricultural and rural development sector nor one of the legal corporate status such as individually-owned company, limited liability company, and company limited.

Based on the inventory survey carried out by SAED in August 2016, the number of each type of farmers' organizations in the target area is summarized in Table A2.2.20.

Table A2.2.20 Number of Farmers' Organizations in the Project Target Area

Type	Dagana Department	Podor Department	Total (Saint Louis Region)
Union	25	40	65
GIE*	1,575 (32)	1,036 (99)	2,611 (131)
SV	251	44	295
Others**	1,139 (35)	344 (36)	1,483 (71)
Unknown	93	19	112
Total (except union)	3,058 (67)	1,443 (135)	4,501 (202)

Note: ( ) : number of women's groups

** not including the number of unions who register as GIEs.*

*** private company, women group, youth group, etc.*

Source: Prepared by the JICA Survey Team based on Master Plan Final Report, PAPRIZ2

As shown in the table above, the numbers of farmers' organizations in Dagana department, Podor department, and Saint Louis Region are 3,058, 1,443, and 4,501, respectively. The proportions of the number of GIEs to the total number of farmers' organizations in Dagana department, Podor department, and Saint Louis Region are 51.5%, 71.8%, and 58.0%, respectively, and those of women's groups in Dagana department, Podor department, and Saint Louis Region are only 2.2%, 9.3%, and 4.5%, respectively.

For unions, a new union may be established during the course of the Project activities and the details of unions including the members, regulations, and main tasks are shown in Appendix 2.1.

2) Organizations for Management of Agricultural Machineries

From 1965 to 1986, the agricultural mechanization was implemented and managed under the responsibility of SAED. Thereafter, Coopératives d'Utilisation de Matériels Agricoles (CUMA) and Sections d'Utilisation de Matériels Agricoles (SUMA) were established and SAED was no longer responsible for the agricultural mechanization activities. CUMA and SUMA employed the joint management system with farmers for the management of agricultural machineries. However, this system did not function effectively and CUMA and SUMA failed to achieve the expected goals and targets. According to the inventory survey carried out by SAED in August 2016, there are 22 SUMAs in Podor department and no CUMAs and SUMAs in Dagana department.

Since 2015, Syngenta Foundation for Sustainable Agriculture (SFSA) has provided the agricultural mechanization services for farmers through Centre de Services Mécanisés (CEMA). Basic concept of CEMA is as follows:

- To connect demands and supply for the agricultural machinery services,
- To reduce the transaction costs required for the agricultural machinery services, and
- To improve the profitability of use of the services especially for the introduction of large-scale agricultural machineries that require a large initial investment cost.

As of 2019, seven CEMAs have been established in the Senegal River Valley and SAED intends to disseminate CEMAs throughout the Senegal River Valley.

3) Supporting Organizations for Farmers

a) Centres de Gestion et d'Économie Rurale (CGER)

CGER was established as an extra-governmental organization of SAED in 2004 with the assistance of AFD (Agence Frangaise de Developpement) and SAED, aiming to develop the financial and accounting capacity of farmers. CGER has a headquarters in Saint Louis and three branch offices in Dagana department (Richard Toll), Podor department (Ndioum) and Matam department. As of 2019,

the total number of staffs is 36, including 14 accounting specialists. The source of funds includes contributions from members, service fees, and support from the Senegalese government and AFD.

CGER provides various trainings for farmers and supports them in the preparation of their budget plan. To receive these services, farmers' organizations such as unions and GIEs should register at CGER and make a contract with them for the provision of services for development of accounting capacity and financial audit. Each union and GIE should pay the registration fee of FCFA 100,000 and the annual service fee (about 0.75% of profit and FCFA 700,000 at a maximum) to register at CGER and receive the services. Currently, 1,085 GIEs and 43 unions have registered at CGER and 316 GIEs and 43 unions receive their services. Other types of organizations such as individual farmers and rice millers can also register at CGER and receive the services.

CGER provides the different packaged services for union and GIE individually, which include the training and support programs for calculation of pump operation costs, accounting, preparation of balance sheets, and preparation of annual report.

CGER has carried out various trainings in collaboration with PAPRIZ 2 and therefore, is also expected to collaborate in the implementation of various trainings for the Project.

b) Centre Interprofessionnel pour la Formation aux Métiers de l'Agriculture (CIFA)

CIFA was established in 1995 with the assistance of AFD and SAED as an extra-governmental research institute in the field of agricultural development. Members of CIFA include 26 professional parties as summarized below.

- 14 federations of farmers' organizations,
- 5 private supporting agencies (NGOs, etc.),
- 5 public supporting agencies, and
- 2 private companies which supply inputs, equipment, and services.

The objectives of CIFA are i) to strengthen the expertise of stakeholders and ii) to promote the training programs concerning the agricultural development. The main tasks of CIFA include the following:

- Provide trainings to representatives of organizations, local assembly members, and other agricultural experts/specialists concerned, including institutional development, agricultural techniques, and administrative management;
- Provide trainings to development officers; and
- Training of trainers and facilitators: capacity building of SAED staff for the communication and facilitation skills with farmers.

CIFA employs six permanent trainers and 15 part-time trainers and has a main conference room with a capacity of 200 people, three training rooms, an accommodation facility, and a restaurant.

4) Issues on Farmers' Organizations

Based on the PAPRIZ 2 reports and interviews with PAPRIZ2 staff and concerned parties, the issues on farmers' organizations are summarized in Table A2.2.21.

Table A2.2.21 Issues on Farmers' Organizations

Item	Issues	Details
Organization	Dysfunction	The representatives/leaders of organizations are not replaced for a long period or may not even belong to union/GIE.
Management	Management skills	Lack of management skills

Item	Issues	Details
	Financial aspect	- Shortage of budget, and - Lack of financial management skills.
	Internal communication and coordination	- Lack of cooperative activities such as collection of paddy for loan repayment, purchase of inputs, and block water management.
External factor	External support	- Lack of institutional and management support, - Lack of trainings (e.g., training on pump operation), and - Insufficient monitoring of the fund operation.

Source: Prepared by the JICA Survey Team based on Master Plan Final Report, PAPRIZ2

(2) Operation and Maintenance (O&M)

According to the Master Plan Final Report prepared under PAPRIZ2, the current situation and issues on the operation and maintenance of irrigation schemes and water management are as follows:

1) Current Situation of O&M and Water Management

- Maintenance works are mostly carried out through outsourcing such as a service provider during the off-season in the target area. Major work items of maintenance works are repair of canal leakage and weeding. Land leveling and maintenance of pumps are also carried out.
- Although the block rotation water management system is employed in the target area, irrigation water is supplied to each farm plot not in accordance with the rotation plan prepared based on the cropping calendar but in accordance with the farmer's demand only.
- Water fee is used mainly for electricity/fuel cost for pump operation. Less than 40% of union/GIE keeps the accounting book in the target area.
- Pump and gates are operated by the operator from outside the Podor department and by the operator in-charge from the union/GIE in Dagana department, in most cases.
- Generally, the maintenance of main and secondary canals is carried out using "Fonds de Maintenance des Périmètres Irrigués (FOMPI)" fund and that of tertiary canals (on-farm canals) is carried out by the farmers themselves.
- Main source of budget for maintenance activities is "own budget" in Dagana department and "own budget and FOMPI fund (50% and 50%)" in Podor department.

2) Issues on O&M and Water Management

a) Improper O&M and Water Management

- Main problems at the site are leakage of canal, weed, land leveling, drainage, high cost of electricity for operation of pump, and pump/gate operators' skill.
- High pump operation costs may be caused by the demand-driven water management since the farmers can supply the irrigation water freely and even excessively to their plots without the proper control under such water management method.
- Main constraints for implementation of maintenance works are funds and skills.
- Future maintenance plan has not been prepared, so far, by most of the farmers' organizations.

b) Insufficient Capacity of Unions/GIEs for O&M

- Most of the unions/GIEs are not sufficiently capable for the proper management of irrigation schemes in terms of financial management, water management, and O&M activities.
- One of the causes of these constraints may be that, during the development projects/programs, SAED/donor concentrated only on the construction of irrigation facilities

and did not provide the proper support such as the capacity building of unions/GIEs for the proper management of irrigation schemes before handing over.

(3) Agricultural Financing

The agricultural financing services for rice cultivation in the Senegal River Valley include production loan, marketing loan, and procurement loan for equipment and materials. The Agricultural Bank (LBA) is the major agricultural financial institution mainly for production and marketing loans in the Senegal River Valley. Other agricultural financing institutions for production and marketing loans operating in the Senegal River Valley are the Crédit Mutuel du Sénégal (CMS), MEC FEPRODES, and the Banque Nationale Pour Le Développement Economique (BNDE). Procurement loans are provided by banks and the LOCAFRIQUE provides leasing services.

1) Agricultural Bank (LBA)

In August 2019, the Caisse Nationale de Crédit Agricole du Sénégal (CNCAS) was renamed the Agricultural Bank (LBA).

LBA provides loans for the primary sector including agriculture and plays an important role in agricultural financing in the Senegal River Valley. LBA provides production loan, marketing loan, and procurement loan for equipment and materials required for rice cultivation.

LBA has 37 offices in Senegal and five offices in Saint Louis Region (two offices in Saint Louis and one office each in Ross Béthio, Richard-Toll, and Ndioum). The branch office in Richard-Toll is in charge of three sectors in Dagana department and two site staffs carry out the site inspections to confirm the actual conditions of rice farming in the area two or three times per cropping season.

A production loan from LBA covers the required funds for the irrigated rice farming from land preparation to harvesting. This loan also covers the required costs for inputs such as seeds and fertilizer, pump operation costs, O&M costs, and administrative expenses.

The loan conditions are as follows:

- 10% of the loan amount should be contributed by the borrower,
- Interest rate: 7% per year, and
- Duration of the loan: 9-12 months. An annual loan is under trial operation.

The loan conditions for the procurement of agricultural machineries such as tractor and combine harvester are as follows:

- Interest rate: 7.5%, and
- Duration of the loan: 3-5 years.

The process to receive the above loans and repay them is summarized as follows:

- SAED staff confirms if the rice farming activities including inputs, machinery and manpower, and repayment are properly planned by farmers' organizations and the application forms for loans are properly prepared, before submission of the application forms to LBA;
- After validation and approval by LBA, farmers' organizations receive a loan certificate and start the land preparation works; and
- After harvesting, farmers' organizations store the harvested paddy in the paddy storage and then, loans are deemed to be repaid by them.

From the dry season cropping in 2018, LBA in collaboration with SAED and PAPRIZ2 has commenced the annual loan which covers both loans for the dry season cropping and rainy season cropping so as to omit the process to apply and receive the loan for the rainy season cropping which is one of the causes of low cropping intensity in the target area as described in Sub-section 2.2.4.

2) Other Financial Institutions

CMS has 209 offices in Senegal, three offices in Dagana department and six offices in Podor department. CMS provides production loan, marketing loan, and procurement loan for equipment and materials required for rice cultivation. Among these loans, procurement loan is the main one. However, the budget allocated for irrigated rice farming is limited and, therefore, the operations in the Senegal River Valley have also been limited so far.

MEC FEPRODES was established to facilitate the women's access to credit and is active for agricultural financing especially for the irrigated rice cultivation in the Senegal River Valley. However, MEC FEPRODES had the financial difficulties due to a large amount of outstanding loans and the Ministry of Economic and Finance supported it in 2015. MEC FEPRODES had 23,000 members as of 2014.

3) Issues on Agricultural Financing

Based on the PAPRIZ2 reports and interviews with PAPRIZ2 staff and concerned parties, the issues on agricultural financing are summarized as follows:

- Delayed repayment of loans due to: 1) low productivity and income, 2) less motivation for repayment, and 3) less function of repayment committee in farmers' organization;
- Difficulties in access to loans: many farmers do not have access to loans; and
- For the above problems, in some cases, banks allow to extend the loan period from 9 to 12 months. However, some farmers do not understand that the repayment amount would increase due to the additional interests during the extended period.

The difficulties in the rainy season cropping may be caused by the following:

- The farmers cannot repay loans for the dry season cropping and receive loans for the rainy season cropping unless the dry season harvesting is timely and properly carried out, since the period between the dry season harvesting and the land preparation for the rainy season cropping is short as described in Sub-section 2.2.4; and
- The farmers cannot carry out the land preparation works for the rainy season cropping timely since it takes time to prepare an application form for loans and receive a loan certificate from LBA for the rainy season cropping.

2.2.7 Environmental and Social Consideration Including Gender Issues

(1) Environmental and Social Conditions

1) Administrative Location of the Project for Irrigated Rice Production in Senegal River Valley

The Project site is administratively located in the Saint Louis Region, precisely in the departments of Podor and Dagana, as shown in the Location Map in the beginning of this report. The region which covers an area of 879 km² includes the departments of Saint Louis, Dagana, and Podor, and has a total population of 908,942, as estimated in 2013.

2) Biophysical Conditions of the Project Area

At the ecosystem level, the Project is located between the delta and the Senegal River Valley which are two eco-geographical zones influenced by the presence of the Senegal River.

a) Geology and Geomorphology

The Project area is located in the delta of the Senegal River which belongs to the Senegal-Mauritanian sedimentary basin whose establishment is dated Trias-Lias following the opening of the Atlantic Ocean. From a geomorphological point of view, the delta occupies the site of an ancient gulf filled with fluvio-deltaic deposits and shaped into a system of alluvial levees and settling ponds. The gradual establishment of the Senegal River Valley and the evolution of the hydrographic network have formed the following two large morpho-pedological sets individualized and spatially intertwined:

- The alluvial plain called "Waalo" which is regularly flooded
- The dune part called "Diéri" which is hardly affected by the flood of the river.

b) Climate Conditions

The Project site belongs to Sahelian zone and characterized by a rainy season between July and October, a cool dry season from November to February, and a hot dry season from March to June.

The annual rainfall in the delta of the Senegal River lies between 200 and 400 mm. It is one of the least rainy areas of Senegal. The alternation of trade winds and West African monsoon flows is at the origin of two distinct seasons: a dry season (November to May) and a wet season (June to October). The monsoon, hot, and humid flow that can stay in the delta from June to October is not regular, which often causes the early start of the rainy season. The months of August and September are the rainiest of the year, accounting for nearly 70% of the rains in the region. Detailed climatic condition of the Project site is described in Section 2.2.2 (1).

c) Hydrography and Hydrology

With a length of 1,790 km, the Senegal River covers a catchment area of 335,000 km^2. It crosses environments with varied characteristics that can be grouped into three large areas:

- The upper basin, which is located upstream of Bakel and which represents nearly 2/3 of the entire basin. The terrain is rugged with altitudes up to 1000 m. Rainfall is up to 2000 mm/year (Andersen *et al*., 2001).
- The valley itself, which from Bakel to Richard Toll forms a large 600 km-long arc with a major bed covering more than 500,000 ha of arable alluvial land (SAED, 1997). The relief is flat and can be interrupted by fluvio-deltaic discharge systems. Rainfall varies between 400 and 700 mm/year.
- The river delta from Richard Toll to the mouth 35 km upstream of the city of Saint Louis. At the level of the delta, the river has a weak slope gradient with the order of 0.01‰.

The numerous tributaries of the river in the delta constitute a complex network (Figure A2.2.4), the most important of which is the Gorom/Lampsar axis. The Gorom includes two branches called Gorom Amont (Gorom upstream) and Gorom Aval (Gorom downstream).

The Gorom Amont has its source on the Senegal River; it is composed of a single 24.8 km long stretch from Ronq on the Senegal River to the village of Boundoum-Barrage. It is much invaded by aquatic plants (Typha in particular) which strongly reduce its potential. The Gorom Aval stretches 31 km

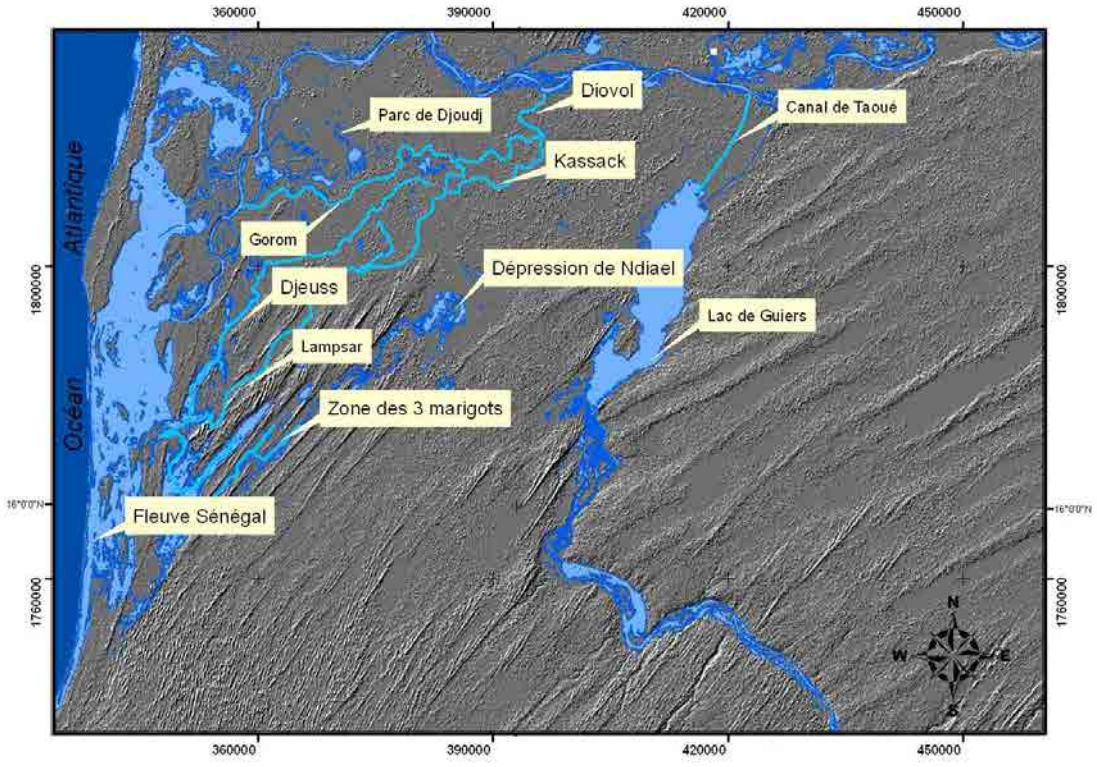
between the Senegal River and the village of Boundoum Barrage where it joins the Gorom Amont crossing the Djoudji National Parks to form the flow of Lampsar in the downstream.

The Lampsar, 70 km in length, flows into the Senegal River downstream from the village of Bango. Currently, the Lampsar is directly connected by the Gorom Aval through the Krankaye Canal developed within the framework of the PDMAS (Development Program of Senegal Agricultural Markets). Consequently, the increased volume of water for the Lampsar allows water sourcing for supplying domestic water to the city of Saint Louis.

The Djeuss is a natural side-stream fed by the Lampsar and in which, under the effect of the river water works, the water goes up towards the Gorom Aval (the natural direction of flow is from Gorom Aval towards the Lampsar). It flows parallel to the Lampsar with which it enters the confluence north of the city of Saint Louis.

The flow of Kassack is jointed by the Gorom Amont at the Diambar Bridge. It runs from east to west parallel to the Gorom Amont and enters the confluence with the Lampsar's river flow at the Demba Bridge with a flow distance of 20 km.

The Guiers Lake is a 50 km long lake fed by the Senegal River via the Taouey Canal. Covering an area of 300 km^2 (Cogels, 1994), the lake is intensively sourced for potable water supply in Dakar and several major cities through the purified water factories of Ngnith and Keur Momar Sarr. It is also used for irrigations in private farms and in villages located around the lake.



Source: OMVS-PGIRE (2018)

Figure A2.2.4 Map of the Senegal River Delta Hydrographic Network

d) Vegetation and Flora

The Project area is located in the Sahelian zone characterized by open tree vegetation dominated by thorny shrubs and combretaceae (white mangrove family). Annual grasses form a continuous carpet made up of species such as *Cenchrus biflorus, Aristida stipoides,* and *Schoenefeldia gracilis*.

Depending on the ecological subzones, the vegetation is classified as shrub steppe or shrub savanna type.

The vegetation is denser along the watercourses, particularly in the Waalo zone (part of the floodplain submerged during floods) characterized by the formation of Gonaki stands (*Acacia nilotica*). Among the species encountered in the Project area, some are protected by the Forest Code. These include *Faidherbia albida, Sclerocarya birrea*, *Acacia senegal, Ziziphus mauritiana, Acacia raddiana*.

In general, vegetation has declined due to the associated several factors including drought, overgrazing, and overexploitation (firewood, service wood). Despite a natural regeneration dynamic in the Waalo area featured by *Prosopis juliflora*, they remain degraded by certain human activities.

e) Aquatic Invasive Plants

In recent decades, invasive plants have developed dramatically in the river valley and the delta. The species concerned are mainly reeds (Typha and Phragmites), water lettuce (*Salvinia molesta*), and water fern *(Pistia stratiotes*). The total area invaded by plants was estimated at over 100,000 ha as was in 2001. In less than ten years, most of the major rivers have been invaded by harmful aquatic plants. The dramatic increase of harmful aquatic plants is one of the most serious environmental issues in the Senegal River basin and the delta, not only because of the scale of the phenomenon but also its "ecological impacts" (ecosystem imbalance, degradation of water quality), "socio-economic impacts" (discomfort for agriculture, fishing, influences for waterborne diseases), and "technical impacts" (difficulty in its eradication).

f) Fauna

The fauna has experienced a decline due to droughts and artificially degraded or deformed earth surface and land environments, and consequently most of the wild animals have migrated further south while some species are still identifiable in the Project area and the most common are: warthog (*Phacochoerus aethiopicus*), jackal (*Canis aureus*), red-fronted gazelle (*Gazella rufifrons*), *Redunca redunca*, red monkey (*Erytrocebus patas*), and zorilla (*Ictonyx striatus*). Warthogs and monkeys are seen in the delta. Due to the wetlands environment, many of the above are now protected, and the delta is "home" to large populations of migratory wild birds. Among these birds are; flamingos, white pelicans, great cormorants, plovers, African ducks, armed lapwing, Gambian goose or armed duck, tawny whistling duck, great egret, little egret, gray heron, tantalum, African shag, African darter, heron, teal summer, stork, black-tailed godwit, harrier, sylvan knight, redshank, and purple heron.

g) Protected Areas

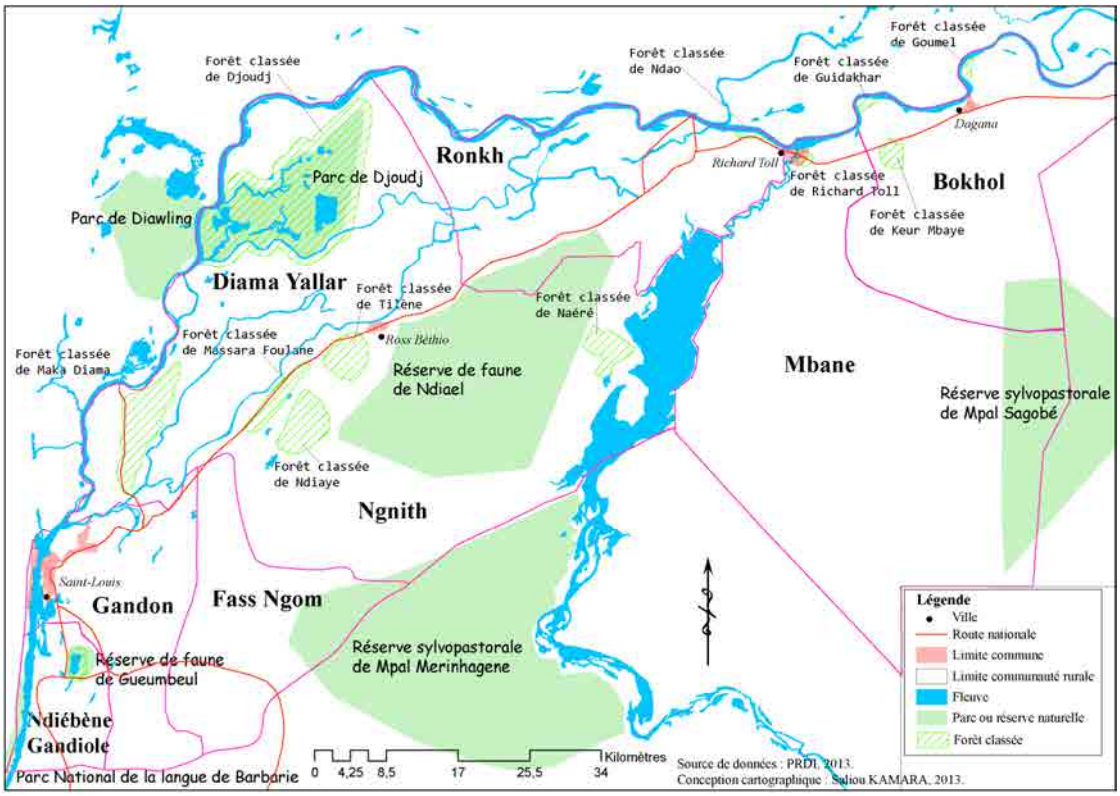
Located in the Sahelo - Saharan zone, the Project area concentrates several forest formations because of particular eco-climatic conditions. These natural formations, according to their legal status, are grouped into two areas: the classified forest and the protected area.

The classified forest is made up of about ten classified massifs (classified forests, parks, natural reserves, and other areas of interest for hunting (ZIC)). The following are included for the classified forest (Figure A2.2.5):

- Djoudj National Parks, Senegal, (16,000 ha)
- Diawling National Park, Mauritania, (16,000 ha)
- Tboul Cat Nature Reserve, Mauritania, (15,500 ha)
- Ndiaël wildlife reserves in Senegal (46,500 ha)

- ZIC Djeuss, Senegal, (62,000 ha)
- Maka Diama Classified Forest, Senegal
- Tilène Classified Forest, Senegal
- Foulane Massata Classified Forest

In addition, it is important to note that all these protected areas are grouped together to form the Transboundary Nature Reserve of the Senegal River Delta. The protected area is the unclassified forest estate whose management is entirely under the control of the local authorities. Due to repeated droughts, hydro-agricultural developments and the uncontrolled exploitation of its woody formations, the protected areas no longer have significant plant potential.



Source: SAED (2016)

Figure A2.2.5 Location of Protected Areas in the Delta and Senegal River Valley

3) Characterization of the Socio-economic Conditions

The economy of the area is marked by a strong agricultural and pastoral potential. However, the decline in soil-based ecosystem services beneath the plant growth and the related climatic hazards greatly influence the socio-economic development of the local communities.

a) Agriculture

The Project site has a huge agricultural development potential based on vast water and land resources. Thus, with the presence of the Senegal River, its water resources allow different types of agriculture practices ranging from irrigation to rainfed cultivation using residual soil water during flood recession and rainfalls (e.g., the Dièri area). However, caution needs to be taken as these agricultural practices largely depend on environments prone to climatic hazards. In addition to water resources, the region has a large area of land resources with nearly half of the potential irrigable land including nearly 80,000 ha already developed by SAED and private sectors.

In addition, the agricultural sector occupies up to 70% of the active population; this is an important source of job creation and economic activities and, at the same time, gives it a vital role in the fight against poverty. Out of agriculture and irrigation development lead by SAED, the associated institutions such as ISRA, WARDA (Africa Rice Centre) and DRDR are working for technical services in cultural techniques and farm management for farmers. The delta and the middle valley, represented by Waalo, have been centred for enhancement of productivity and expansion of production for the cereals in the region. Rice farming, with a long history of cultivation in the region, cohabits more and more with industrial crops (e.g., sugarcane), horticultural crop (e.g., tomatoes) productions, and arboriculture.

b) Livestock Breeding

Current productions of livestock are far below its potential and major causes are derived from both climatic and socio-cultural aspects. Adding to this, there are long movements of animals due to the very nature of the extensive livestock breed and the use of grazing system that remains by far the most common breeding mode especially in the Dièri and more particularly in the Ferlo.

In spite of this, livestock remains the second pillar of the traditional economy of the region since it is practiced by almost all the rural populations, in the extensive form, with the help of the narrow pastures especially in Waalo as well as the abundance of agricultural and agro-industrial byproducts available for feeding. The ruminants are reared on pastures rich in herbaceous forage species (*Andropogon gayanus*, *Penisetum pediculatum*, *Panicum afisila*, and *Cassia tora*) and woody (*Pteraocarpus lucens*, *Balanites aegyptiaca*, and *Ziziphus mauritiana*). However, these pastures are subjected each year to significant influences by bush fires and herds growing in colonies.

4) Main Uses on the Senegal River and Impacts on the Quality of the Water Body

The use of the river water source is vital and its usage varies with economic and social to cultural aspects. Land use on the shores, economic vocations, and socio-anthropological relations in the area are dictated by the Senegal River. The main economic benefits derived from the Senegal River by local communities are mainly:

- Irrigation of land from hydraulic works carried out by OMVS or SAED, which allows the development of important arable lands. In addition, many flood-recession farm practices are observed on the banks of the Senegal River,
- Livestock watering on both banks,
- Development of a major inland fishing activity in the Senegal River basin, particularly at the delta,
- Water supply of human communities with the installation of water intake on the river and water treatment plants.

In terms of culture and socio-anthropology, several utilities are drawn from the Senegal River, including: recreational bathing activities on the river basin, daily laundry activities and the cleaning of certain condiments (indigenous spices) by women in the river basin; livestock cleaning with river water especially during periods of major religious holidays.

5) Impacts of Agricultural Schemes Drainage Activities

In the Senegal River Delta, the drainage water is directly discharged into closed or seasonal water body (land "depression" nearby the river bank) thus constituting major risks of pollution of the water body and exposure of riparian communities to different forms of waterborne pathologies. The application of agrochemicals, particularly pesticides, and the discharge of drainage water into the Senegal River or its depressions present a risk of contamination of aquatic and terrestrial fauna and for the latter category of fauna, it is by watering that it can be contaminated. Indeed, agricultural and rice activities in particular involve the use of chemical inputs such as propanyl, bensulfiron-methyl, carbofuran, cypermethrin for fertilization, and crop protection against pests.

These agrochemicals have a recognized eco-toxicity for aquatic and avian fauna. The assessment of the impact of drainage water on surface water at the delta has shown that only two pesticides, bensulfiron-methyl and propanyl, generally have higher concentrations than the guidelines. It should be noted, however, that these risks are perceptible in areas where agribusiness is developed with the application of large quantities of pests and pesticides.

These drainage waters are often characterized by a pollutant load induced in most cases by the leaching of salty soils, residues of pesticides, and chemical fertilizers used in farm soils. The long-term potential contamination of the water body by the pollutants contained in the drainage water can be induced by excessive concentrations of nitrates and phosphates, the suspended matter being able to accumulate high quantities of toxic substances (metals, pesticides, mineral oils, and polycyclic aromatic hydrocarbons) by adsorption to incur high pH. For water analysis in this study, the team relied on a benchmark state realized in the Senegal River Delta as part of the Millennium Challenge Account (MCA) in 2016 to measure the potential impact of drainage water on aquatic life and livestock.

For the water analysis, sampling areas were categorized into three groups including: 1) the area of existing irrigation facilities (adductors, irrigation canals, and drainage from irrigated plots), 2) natural water bodies, 3) rainfed rice farming area (non-developed channels for main, secondary, and up to tertiary). A total of 61 samples were collected and analyzed for physicochemical parameters, heavy metals, bacteria and parasites, and pesticides. From the laboratory analysis, the following observations were made:

- The geochemical composition gives hyper-chlorinated calcium and hyper-sulphated calcium waters,
- Phosphate pollution is noticeably present in the drains with a threshold exceeding 50 µg/L with an average concentration of 4.25 mg/L,
- At the conductivity level, exceptional salt concentrations in the drains are recorded with an average greater than 20,000 µS/cm,
- At the level of pesticides, two pesticides out of the seven sought gave higher than normal levels. These are bensulfiron methyl and propanil,
- Pesticide analysis revealed the presence of organochlorine products in drainage waters of Natchié drains (endosulfan 1.357 µg, lindane 0.658 µg), Ndiael (endosulfan 0.788 µg, lindane 0.649 µg), and delta (endosulfan: 1.349 µg, lindane: 0.747 µg) and low levels of heavy metals.

From the above, it appears that drainage water is a minor risk in the short term because of its low concentrations of pollutants, especially pesticides. Although they are low, the pollutants can remain for a long time in the environment cumulatively with concentration and diffusion, becoming very harmful to the aquatic ecosystem of the Senegal River and human and animal health.

(2) Gender Issues

The gender aspects in this part of the Senegal River Valley, as everywhere in Senegal, are rather complex and often related to the power relations (economic and political aspects) between men and women. Inequalities and gender disparities are observed in all areas of the economic and social life of the study area.

In addition to community activities, where they also play an important part, especially in self-help work and community investments, women participate in agricultural production activities. Traditionally, in the context of subsistence farming, women play a vital role in family farming. Cereal production is carried out by all members of the family (men, women, and young people). At the same time, they produce vegetables in their individual plots that serve as a supplement to the family's diet. They also undertake income-generating activities such as forest products gathering, small livestock, handicrafts production, and vegetable growing. Women are also involved in all activities of the rice sector, from production to consumption, although some tasks such as irrigation, chemical treatment, mechanical husking, and marketing at the milling point are generally the responsibility of men.

On the other hand, women face enormous difficulties in accessing productive capital "land" thus constituting a major constraint in the promotion of irrigated agriculture. They usually work in the family fields owned by a man. The Senegalese government, at the legislative, legal and institutional level applicable to gender and through the National Gender Policy, has put in place institutional mechanisms for taking gender into account; in this context, it has ratified international conventions and regional agreements. The Ministry of Agriculture and Rural Equipment has defined a number of orientations for a better integration of the "gender" aspects in its projects and programs in Senegal. SAED, through its Gender Unit, has defined an action plan that aims the following:

- Integration of women and youth in irrigated agriculture through partnerships with support structures,
- Promotion of women's entrepreneurship through implementation of different projects within the specific gender programs, and
- Distribution of program/project resources for the benefit of women and youth.

Moreover, Circular No. 0989 / MAER / CT / SMD of 6 June 2018 has defined precise indicators to be observed in the projects of the Ministry of Agriculture and Rural Equipment to reduce gender inequalities. These indicators, specifying benefits for women, are as follows:

- Allocate a quota of at least 15% of surface water development and 20% of groundwater development to women,
- Allocate at least 20% of subsidized fertilizer to women,
- Provide at least 20% of R1 certified seeds of rice and groundnut seeds to women,
- Allocate at least 10% of subsidized tractors to women,
- Allocate at least 40% of funding to women,
- Allocate at least 20% of funded agricultural research projects to women,
- Increase the rate of women as representatives in decision-making bodies to 20%.

2.2.8 Planning, Design, Procurement and Construction Supervision

(1) Planning and Design of Irrigation Development Works

For the detailed design of irrigation development works, SAED employs external consultants through a competitive bidding process. The main tasks of the consultant include the following:

- topographic survey and geological and geotechnical investigations,
- detailed design of irrigation facilities, drainage facilities, pumping and drainage pump stations, and roads, and
- environmental survey.

The construction cost is estimated by the consultant during the detailed design stage. For the detailed design works stated above, the brief criteria for design of pump irrigation system have been prepared and issued by SAED in 2005. However, there is no standard for construction cost estimate, and the standard price of construction materials in the market is also not announced.

(2) Construction Supervision

For the construction supervision of irrigation development works, SAED also employs external consultants through a competitive bidding process. The contract with such external consultant is often made as a contract including detailed design and construction supervision works.

SAED does not have its own standards and/or guidelines for construction supervision works. Standardized guidelines/manuals/standards/criteria for each development stage including planning, design and cost estimate, procurement, and construction supervision should be prepared and issued aiming at the efficient implementation and management of irrigation development works.

(3) Procurement of the Consultant and Contractor

For the biddings under SAED, the eligible countries for consultants and construction companies are as follows:

Table A2.2.22 Eligible Countries for Bidding under SAED

Type of Budget	Type of Bidding	Eligible Countries
Senegal domestic budget	Local Competitive Bidding (LCB)	Member countries of the West African and Monetary Union (UEMOA)
Foreign aided budget	International Competitive Bidding (ICB) *1	No limitation

*Note*1: LCB may be applied depending on the intention of a donor agency.*
Source: JICA Survey Team

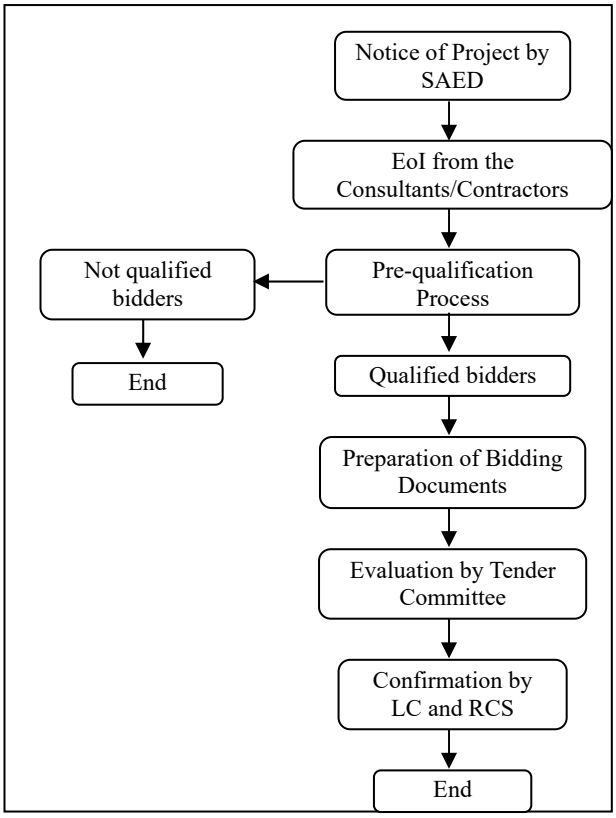
Figure A2.2.6 summarizes the bidding procedure employed by SAED.

For the procurement of consultants, SAED announces a notice of the project in major domestic newspapers and the eligible consultants express their interests to participate in the bidding to SAED. SAED distributes the pre-qualification documents to the bidders who have expressed their interest and commences the pre-qualification process. SAED distributes bidding documents to the bidders who have been evaluated as qualified through the pre-qualification process.

The period for preparation of bidding documents by bidders is 45 days for ICB and 30 days for LCB. The bidding documents are evaluated by the Tender Committee in SAED by means of the two-envelope method. If the bid price of the highest scored bidder in the technical evaluation is higher than the SAED's estimated price, i.e., reference price for bid evaluation, the Tender Committee evaluates the second scored bidder in the technical evaluation and provisionally determine the

successful bidder. The Tender Committee completes its bid evaluation within 15 days, and the evaluation results are sent to the Local Committee (LC) for its confirmation. The results confirmed by the LC are further confirmed at the Regional Control Services (RCS), and the successful bidder is finally concluded and announced.

For the procurement of contractors, SAED announces a notice of the project in major domestic newspapers, and the eligible contractors express their interests to participate in the bidding to SAED. SAED distributes the pre-qualification documents to the bidders who have expressed their interest and commences the pre-qualification process. SAED distributes the bidding documents to the bidders who have been evaluated as qualified through the pre-qualification process.



Source: JICA Survey Team

Figure A2.2.6 Bidding Procedure for SAED's Project

The period for the preparation of the bidding documents by the bidders is 45 days for ICB and 30 days for LCB. The bidding documents are evaluated by the Tender Committee in SAED by means of the quality cost based selection (QCBS) method. The Tender Committee completes its bid evaluation within 15 days and the evaluation results are sent to the LC for its confirmation. The results confirmed by the LC are further confirmed at the RCS, and the successful bidder is finally concluded and announced.

In July 2017, SAED prepared and issued the standard documents for pre-qualification (PQ), procurement of large-scale construction works, procurement of medium-scale construction works, equipment procurement, and consultant procurement (see Appendix 2.2 for the cover and summary of the documents). These documents have been prepared referring to the World Bank standard bidding documents and conforming to the conditions of contract issued by the Federation Internationale des Ingenieurs-Conseils (FIDIC). Additionally, these documents have been confirmed to be valid under the laws of Senegal.

The standard bidding documents for the procurement of large-scale construction works, procurement of medium-scale construction works, and equipment procurement are composed of the General Conditions of Contract and the Special Conditions of Contract, as is the case with the JICA standard bidding documents. The standard bidding documents prepared and issued by foreign aid agencies can also be applied to SAED's projects in the case of projects implemented using foreign aided budget (loan or grant).

The applicable SAED standard bidding documents for each size and type of construction works are shown in the table below.

Table A2.2.23 Applicable SAED Standard Bidding Documents

Name	Estimated contract amount	Remarks
Standard prequalification document	Not specified	-
Standard bidding documents (large-scale construction)	FCFA 300 million or more	Applied with/without PQ.
Standard bidding documents (medium-scale construction)	FCFA 1 to 300 million	Applied without PQ or for designated bidding.
Standard bidding documents (equipment)	Not specified	There is a simplified version for the contract amount less than CFA 25 million.
Standard bid books (consulting services)	Not specified	-
Small-scale contract bidding documents	FCFA 50 million or less	-

Source: JICA Survey Team

Although both QCBS and quality based selection (QBS) can be applied to the procurement of consultants, QBS is applied to the procurement process under SAED pursuant to its regulations for procurement works.

2.2.9 Implementing Agency (SAED)

(1) Organization Structure of SAED

The organization charts of SAED headquarters, Dagana department, and Podor department as of December 2018 are shown in Figures B2.2.1, B2.2.2, and B2.2.3, respectively. The lists of staff in SAED headquarter, Dagana department, and Podor department are shown in Tables B2.2.1, B2.2.2, and B2.2.3, respectively.

Irrigation and drainage development works under SAED are implemented mainly by "Direction des Amennagements et des Infrastructures Hydro-agricoles (DAIH)". DAIH is composed of three divisions, namely: planning division, study and implementation division, and hydrology and water management division, with the following demarcation of works:

1) Planning division who is responsible for preparation of work plan and compilation of proposal of the projects to be submitted to the central government;
2) Study and implementation division who is responsible for the works from needs assessment to implementation of new construction and rehabilitation works; and
3) Hydrology and water management division who is responsible for collection and management of hydrological, meteorological, and water quality data.

For new development projects, SAED employs a consultant for the study, design and construction supervision works, and irrigation engineers (DAGE) in each department who is in charge of the preliminary study.

(2) Technical Management System under SAED

For the implementation of irrigation and drainage projects, guidelines, manuals or criteria for each development stage such as planning and study, basic and detailed design, and construction supervision have not been drawn up by SAED or concerned agencies, except for the standard bidding documents for procurement works and brief criteria for the design of pump irrigation (Refer to Appendix 2.3).

Additionally, the following issues should be considered so as to improve the management and implementation capacity of SAED and to supervise the consultants' works including study, design, and construction supervision works properly:

- shortage of the irrigation engineers in SAED and each delegation, and
- no systematic training programs or courses have been established in SAED.

(3) Budget Managed by SAED

The budget documents of SAED are generally not disclosed to the public. According to interviews with SAED, the annual budget for 2018 was FCFA 22.3 billion. The breakdown of the budget in 2017 is available. The annual budget for 2017 was about FCFA 53.7 billion. The investment budget was FCFA 48.7 billion and the operating budget was FCFA 5 billion. The details of this breakdown are shown in Table A2.2.24.

Table A2.2.24 Budget Allocation of SAED in 2017

(unit: mil. FCFA)

Item	Budget Estimates	SOURCES	
		Government	Donors
Completed developments	7,258	0	7,258
Ongoing developments	21,299	3,563	17,736
Creation of AHA (Hydro Agricultural Developments)	446	0	446
Civil engineering	290	0	290
Drinking water supply	98	0	98
Rehabilitation	7,480	685	6,795
Farm roads	2,500	0	2,500
Electromechanical equipment	1,029	501	528
Pump station equipment	7,847	0	7,847
Agricultural buildings	140	0	140
Administrative buildings	100	0	100
Diverse facilities	10	10	0
Office furniture and equipment	12	3	9
Computer equipment	80	1	7
Farm machines	150	0	150
Light vehicles	24	0	24
Total Investment Budget	**48,691**	**4,763**	**43,928**
Purchase/stock changes	418	364	54
Transports	13	13	0
External Services A	1,010	943	67
External Services B	411	397	14
Burdon of taxes	330	202	128
Other expenses	38	38	0
Staff expenses	2,781	2,766	15
Financial expenses and related costs	2	2	0
Total Operating Budget	**5,003**	**4,725**	**278**
TOTAL	**53,694**	**9,488**	**44,206**

Source: Programme d'activités et Budget SAED – 2017

According to the table above, the contribution in the budget of the Government of Senegal was about 18%. The proportion of funds sourced from donors including AFD and WB exceeded 80%. In the 2017 budget, funds from AFD were about FCFA 16.3 billion and funds from WB were FCFA 12.5 billion. As a result, the annual budget of SAED fluctuates greatly depending on the existence of donor-funded projects. This is the reason why there was a big difference in the budget between 2017 and 2018.

2.3 Review of Other Projects and Programs Implemented in the Senegal River Valley

2.3.1 Projects and Programs Implemented in the Target Area

(1) Irrigation and Infrastructure Development Projects/Programs

Table A2.3.1 shows the outline of the ongoing projects/programs for irrigation and infrastructure development in the target area.

Table A2.3.1 Outline of Ongoing Projects for Irrigation and Infrastructure Development in the Target Area

Name of the Project	Outline of the Project
Projet de Promotion du Partenariat Rizicole dans le Delta (3PRD)	(1) Target area: Dagana department (2) Duration of the project: 2014 to 2019 (3) Donors: - AFD - Central Bank of West African States (BOAD) - European Union (EU) (4) Project cost: - Donors: FCFA 20,724 million - GoS: FCFA 684 million (5) Main project component: - Development of 1,975 ha of new PIP, and - Support for relevant stakeholders of the rice sector.
Agriculture Irriguée et Développement Economique des territoires ruraux du Département de Podor (AIDEP)	(1) Target area: Podor department (2) Duration of the project: 2014 to 2019 (3) Donors: - AFD (4) Project cost: - AFD: FCFA 20,007 million - GoS: FCFA 984 million (5) Main project component: - Rehabilitation and/or expansion of 2,600 ha for 80 PIVs, - Improvement of paddy and horticulture plots for women's groups, - Development of floodplain areas, - Construction of public infrastructures utilizing the intercommunity support fund, and - Strengthening of producers' organizations.
Projet de gestion intégrée des ressources en eau et de développement des usages à buts multiples du bassin du fleuve Sénégal phase 2 (PGIRE 2)	(1) Target area: Dagana and Matam departments (2) Duration of the project: 2014 to 2021 (3) Donors: - WB (4) Project cost: - WB: FCFA 15,430 million (5) Main project component: - Rehabilitation of 630 ha of Ndombo Thiago Irrigation Scheme, - Development of 100 ha of horticulture plots for women's groups, - Construction of management facilities in floodplain areas, - Rehabilitation of 9 km of farm roads, - Rehabilitation of pump stations, and - Strengthening of women's groups.
Projet de développement inclusif et durable de l'agribusiness au Sénégal (PDIDAS)	(1) Target area: Saint Louis and Louga departments (2) Duration of the project: 2014 to 2019 (3) Donors: - WB (4) Project cost: - WB: FCFA 3,418 million (5) Main project component: - Development of irrigation facilities, - Management of natural resources, and - Provision of technical assistance to rural communities.

Name of the Project	Outline of the Project
Projet d'appui régional à l'Initiative pour l'irrigation au Sahel (PARIIS)	(1) Target area: Western Africa Target areas in Senegal are the SRV, Sedhiou Region, Kolda Region, Kaffrine Region, Kaolack Region, Fatick Region, Diourbel Region, and Thies Region. (2) Duration of the project: 2017 to 2024 (3) Donors: - WB (4) Project Cost: - WB: FCFA 13,513 million *1 for each country (5) Main project component: - Modernization of the institutional framework, - Financing for investments on development of irrigation facilities, and - Information and knowledge management and coordination.
Projet de développement de la chaine de valeur du riz dans la vallée de fleuve de Sénégal (PDCVR)*1	(1) Target area: Podor department (2) Duration of the project: Cancellation of the project (3) Donors: - AfDB (4) Main project component: - Development of irrigation and agricultural related facilities, - Support for formulation of rice value chain, and - Strengthening of producers' organizations.

*Note: *1: USD 23 million will be provided in each county in West Africa. Total project cost is converted into FCFA using the JICA rate in June 2019.*
Source: JICA Survey Team

(2) Agricultural Mechanization Program

Table A2.3.2 shows the outline of the programs on agricultural mechanization in the target area.

Table A2.3.2 Outline of Programs on Procurement of Agricultural Machinery

Donor	Procured Agricultural Machinery	Outline of Program
Government of Brazil	Brazilian agricultural machineries including the following: - Tractors (400 units), - Attachment of tractors (Disk harrow and plow), - Trailers, - Plowing machines (80 units), - Combine harvesters (10 units), - Threshing machines, and - Equipment for rice milling.	- Project cost: FCFA 42.5 billion (loan), - Procured in three phases, - The GoS's subsidy is 60% of the sales price of each machine, and - The GoS subsidizes producers or producers' organizations only.
Government of Belgium	- Tractors (400 units), - Attachment of tractors, - Combine harvesters (7 units, 175 horsepower), and - Combine harvesters (10 units, trailed by a tractor).	- Loan program, - The GoS's subsidy is 60% of the sales price of each machine, and - The GoS subsidizes producers or producers' organizations only.
Government of India	- Tractors (90 units, 100 horsepower), - Hallowing machines (90 units, 24 disk harrows, offset type), - Trailers (max. 5 tons capacity), - Combine harvesters (3 units, reaping width: 3.5 m), and - Milling machines (3 units, capacity: 5 tons/hr).	- Loan program, - The GoS's subsidy is 60% of the sales price of each machine, and - The GoS subsidizes producers or producers' organizations only.

Source: JICA Survey Team

2.3.2 Lessons Learnt from Other Projects and Programs

Based on the field visits and the interview survey with SAED, other donors, and the agencies concerned, the lessons learned from other projects and programs are summarized as described below.

(1) Implementation and Management of the Project

The lessons learned from the other donors' projects concerning the implementation and management of the Project are summarized in the table below.

Table A2.3.3 Lessons Learnt from Other Donors' Project (Implementation and Management)

Donor	Lessons Learned	Suggestions for the Project
AFD	3PRD - Design and cost estimate of the irrigation facilities were carried out by the consultant employed by SAED using AFD budget, - During the procurement process, all bidders submitted their bid with the higher price than the employer's estimated price, - Re-bidding was called and it caused the delay in the project activities, and - During the re-bidding process, SAED omitted some important works to reduce the project costs.	- Generally, SAED has a capacity to implement and manage the irrigation development projects, - However, the technical support to assure the quality and progress of the project activities is essential, and - In AFD's project, technical advisors from a French contractor were employed to support SAED especially for the technical issues.
AfDB	PDCVR - The project has been cancelled due to several implementation and management issues.	- One of the key issues was less involvement of SAED to the project; and - It is suggested that SAED be sufficiently involved in the irrigation development works in the SRV.
WB	PDIDAS - Project Management Unit (PIU) was established by WB under a contract with MAER for the management of the project, - PIU was established independently and outside SAED and composed of the experts and engineers for the required fields, and - PIU closely coordinated with SAED.	- Generally, SAED has a capacity to implement and manage the irrigation development projects, and - However, the technical support to assure the quality and progress of the project activities is essential.

Source: JICA Survey Team

There are two types of disbursement procedure applied for foreign donor projects implemented under SAED. The disbursement procedures differ depending on the donors. AFD generally applies the disbursement procedure in which SAED has the authority to make a disbursement based on the progress of projects. On the other hand, WB generally applies the procedure in which SAED makes a disbursement under the approval of MAER. For both procedures, DAIH in SAED continuously monitors the progress of projects and controls the disbursement procedure.

(2) On-farm Development Works

The general requirements for on-farm development works are summarized in the table below referring to the SAED's design standards (Document De Referentiel De Normes D'Amenagement Dans La Vallee Rive Gauche Du Fleuve Senegal, Saed, Octobre 2005).

Table A2.3.4 General Requirements for On-farm Development Works

Work Item	Requirement
Autonomous Irrigation Units (AIUs): - The irrigation scheme is divided into AIUs for the rotational irrigation system.	- Recommended optimal size of AIUs: 20 ~25 ha.
Farming Plots: - AIU is further divided into farm plots.	- Recommended minimum size (rice cropping): 0.25 - 1.00 ha (depend on type of scheme and number of farmers). - Recommended size (mixed farming): around 0.10 ha.
Levelling of Farm Plots	- For rice farm plots: with tolerance of ± 5 cm. - For mixed farm plots: with slope of 0.1 - 1.5 %. - Leveling works shall be periodically carried out as the operation and maintenance activities.
Intakes to Farm Plots	- Using 50 mm diameter pipes (syphon method). *Note: see suggestion made below.*
Outlets from Farm Plots to Drainage	- Using 200 mm diameter pipes placed at low points.

Source: Prepared by JICA Survey Team referring to Document De Referentiel De Normes D'Amenagement Dans La Vallee Rive Gauche Du Fleuve Senegal, Saed, Octobre 2005

According to the field inspection by the JICA Survey Team, however, the current conditions of AIUs and farm plots developed under the other projects/programs are not conforming to the above requirements in many cases. It is suggested that the following measures be employed during the Project implementation:

- Dissemination of practical experiences and outputs obtained through the PAPRIZ2 activities especially for the operation and maintenance of irrigation facilities and water management;
- Realization of high quality on-farm development works conforming to the above requirements; and
- Introduction of improved irrigation system including on-farm canals and concrete division boxes to distribute irrigation water to each plot properly.

(3) Process for Consensus Building and Capacity Development

1) 3PRD, AFD

Large-scale land acquisition and/or resettlement are not scheduled in the ongoing five AFD projects since it will take time to build a consensus with each land owner and it may cause the difficulties in the implementation of the projects.

The target area of 3PRD is 1,975 ha and five GIEs composed of 152 private companies or farmers participated in the project activities. About 30% of the beneficiaries are women. A management committee including a general assembly and a secretariat was established. The commune, farmers' representatives, and SAED made a contract for land use. A management committee was established smoothly. The public and private partnership (PPP) system which requires the beneficiaries' contributions was employed for preparation of the required funds for the project implementation. However, it was very hard to collect the contributions from the beneficiaries. To accelerate the collection of the contributions from the beneficiaries, the project employs the following measures:

- Basically, the project works should be implemented in accordance with the priority list,
- However, if the priority group or farmer does not pay their contribution to the project within one month after receiving the letter of certificate for the project implementation, the implementation of the works for such group or farmer should be suspended and the priority should be given to the next priority group or farmer.

2) PGIRE2, World Bank

The construction works which required the resettlement were not implemented in the PGIRE2 project. However, the construction works implemented under PGIRE2 required land acquisition and it took time to complete the process of such land acquisition. The required lands were valued by WB and compensated by the Senegalese government.

PGIRE2 focused on the capacity development of the existing women's groups. The target groups are the existing women's groups and the new women's groups have not been established under the project. The project provided the following support programs:

- Procurement of equipment required for processing the agricultural and daily products,
- Introduction of the revolving funds, and
- Training for agricultural techniques.

The project did not provide the trainings for operation and maintenance of irrigation facilities.

3) Ngalenka Irrigation Scheme, MCA

For the development of Ngallenka MCA irrigation scheme in Podor department, several PIVs consisting of 53 GIEs have been integrated into one large irrigation scheme and the union was established to manage the pumping station. However, the scheme has not been operated well after handing over the facilities to the farmers' organization mainly due to the following issues:

- Different ethnic groups have been merged into one organization without sufficient consensus building, and
- Farm plots of each GIE have been scattered in the scheme.

4) Other Lessons

Generally, the land acquisition process takes time to build the consensus with farmers and complete the required administrative procedures.

The land owners may not agree with the result of land valuation and it takes time to complete the process in the Senegalese government.

Most of the projects include not only the hard components such as irrigation development works but also the soft components such as institutional development and capacity building for the parties concerned in the agricultural sector. Several projects include components to support women's groups or youth groups.

In addition, when the integration of several PIVs into a medium or large-scale irrigation scheme is planned, special attention should be paid to the following:

- Ethnicity and custom of farmers in different PIVs;
- Institutional characteristics of different GIEs, and
- Location of farm plots for the farmers in the different GIEs.

(4) Agricultural Related Facilities

The design criteria or standard design drawings have not been prepared and issued yet for the agricultural related facilities including farm and access roads, warehouses, and garages for agricultural machineries. Based on the review of the design reports for other projects and field investigations on the existing facilities, the lessons learned from the other projects and programs were studied and reviewed as described below.

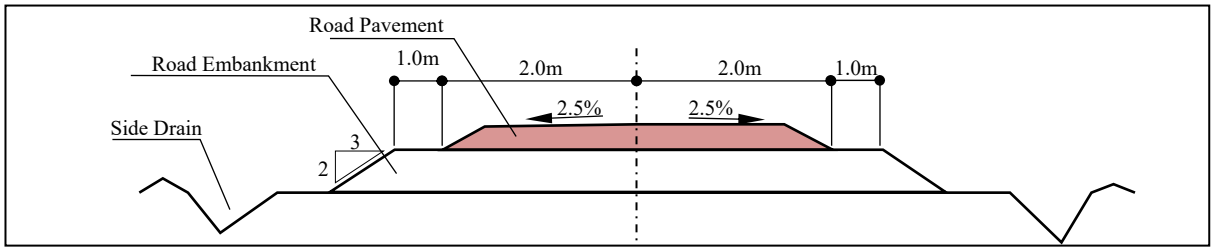
1) Farm and Access Roads

The current conditions and specifications for each type of farm and access road are confirmed through the review of the design reports for the other projects and field investigations on the existing facilities constructed under the other projects and summarized as follows:

Access Roads:

According a design report for rural road project implemented in Matam department, the specifications and a typical cross section of access road are as follows:

- Total width of road: 6.0 m,
- Width of carriageway: 4.0 m,
- Water slope: 2.5%,
- Side slope of road embankment: 2:3,
- Road pavement: Laterite pavement (15 cm), and
- Road facilities: side drains, crossing structures (box culverts and bridges), etc.



Source: Prepared by the JICA Survey Team referring to RAPPORT D'ETUDE DE REHABILITATION DES PISTES RURALES DE GASSAMBERI-BALEL ET DE GANGUEL - OUNARE, Décembre 2015

Figure A2.3.1 Sample Typical Cross Section of Access Road

Maintenance Roads:

According to the field investigations by the JICA Survey Team, the existing maintenance roads have the following features:

- Total width of road: 5.0 m,
- Water slope: not clear (3.0% is recommended),
- Road pavement: non, and
- Road facilities: side drains, etc.

However, the maintenance roads have not been constructed in most of the irrigation schemes developed under the other projects. Additionally, most of the existing maintenance roads are inundated during the rainy season since the road surface level is lower than the water level in paddy fields.

Approach Roads:

According to the field and interview surveys by the JICA Survey Team, approach roads are not available in most of the existing irrigation schemes developed under the other projects.

Ridge damaged by combine harvester

Canal damaged by combine harvester

Based on the above review of the specifications and current conditions of the existing farm and access roads, the suggestions and recommendations shown in the table below shall be taken into account for the Project formulation and implementation.

Table A2.3.5 Suggestions and Recommendations on Farm and Access Road Works

Type of Road	Item and Lessons	Suggestions and Recommendation
Access Road	Carriageway: - Width is 6.0 m.	Width should be determined based on the type of agricultural machinery to be introduced in each irrigation scheme.
Maintenance Road	Road Width: - Width is 5.0 m.	Width should be determined based on the type of agricultural machinery to be introduced in each irrigation scheme.
	Road Pavement: - None.	Laterite pavement should be considered depending on the type of agricultural machinery to be introduced.
	Not available in most of the existing irrigation schemes.	Should be provided for smooth farming activities.
	Inundated during the rainy season.	The height of the farm roads from the paddy fields should be 50 cm or more. *1
Approach Road	Not available in most of the existing irrigation schemes	Should be provided for efficient farming practices. The width and specifications of the road should be determined based on the type of agricultural machinery to be introduced in each irrigation scheme. The slope should be 12 degrees or less. *2

*Note: *1: Refer to the Ministry of Agriculture, Forestry and Fisheries "On-farm Development (paddy field)". The height of the farm road from paddy fields should be 30 cm or more. A 20 cm allowance is considered for rainfall.*
**2: Refer to the guideline for assessment of agricultural machinery introduction plan, Government of Hokkaido, Japan, 2016)*

Source: JICA Survey Team

2) Warehouse

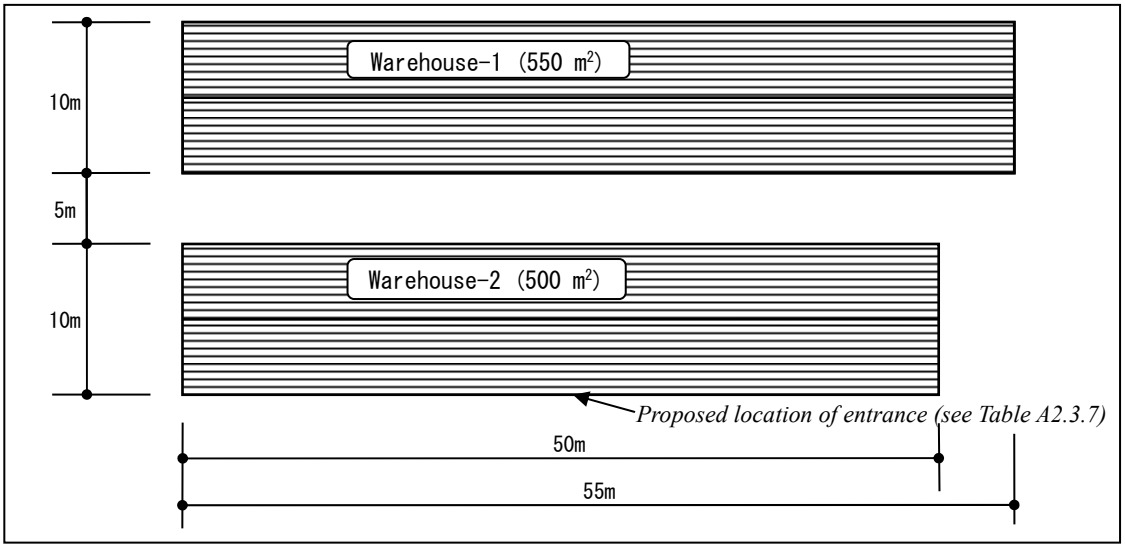
In order to confirm the typical features of warehouses in the target area, the JICA Survey Team carried out the field survey to check the details of the warehouse constructed in Mbagam irrigation scheme in Dagana department. The general features of the warehouse in Mbagam irrigation scheme are summarized in the table below.

Table A2.3.6 General Features of Warehouse in Mbagam Irrigation Scheme

Item	Features
General	The warehouse was constructed in 2011 with the assistance of the Spanish Development Agency.

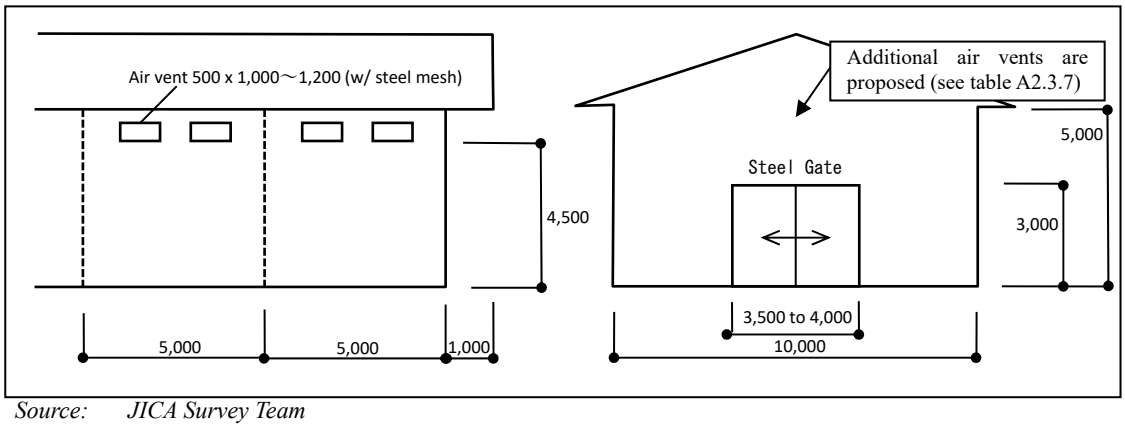
Item	Features
Layout and Size	The warehouse consists of two main buildings and total size of warehouse is around 1,050 m^2 as shown in Figure A2.3.2.
Ridge and Eave Height	6.66 m and 4.60 m, respectively.
Columns	5.00 m pitch surrounding the warehouse and no columns are provided inside the warehouse for taking paddy bags in and out smoothly.
Entrance and Air Vent	As shown in Figure A2.3.3.

Source: JICA Survey Team



Source: JICA Survey Team

Figure A2.3.2 Typical Layout of Warehouse in Mbagam Irrigation Scheme



Source: JICA Survey Team

Figure A2.3.3 Typical Elevation of Warehouse in Mbagam Irrigation Scheme

Based on the field and interview surveys carried out by the JICA Survey Team, the suggestions and recommendations for the warehouse development works under the Project are summarized as shown in Table A2.3.7:

Table A2.3.7 Suggestions and Recommendations on the Warehouse Development Works

Item and Lessons	Suggestions and Recommendation
Entrance: - The entrance is provided only at the gable section - This disturbs famers to take paddy bags in and out smoothly.	It should be considered to provide the entrance at the center of the walls (see Figure A2.3.2 for the proposed location).
Air Vent: - Air vents are not provided at the gable section for most of the existing warehouses.	It is suggested to provide air vents at the gable sections also.
Dry yard: - No dry yard was provided.	It is suggested to provide dry yards in front of warehouses.
Facilities and equipment for operation and management: - Not sufficiently provided.	It is suggested to provide the facilities and equipment such as management room, scale, moisture meter, and pallets.

Source: JICA Survey Team

(5) Agricultural Machinery

Among the programs presented in Table A2.3.2, the program by the Government of India is ongoing as of June 2019 and the following table shows its distribution plan for the procured machineries:

Table A2.3.8 Number of Agricultural Machinery by Department in the Senegal River Valley

Department / Agricultural Machinery	Saint Louis	Dagana	Podor	Matam	Kanel	Ranér-ou	Bakel	Total
Tractors	10	25	15	14	20	6	-	90
Attachment for tractors	10	25	15				-	90
Trailers	5	12	8	20				45
Combine harvesters	-	1	1	1				3
Milling machines	-	1	1	1				3

Source: JICA Survey Team

For the distribution of the procured machineries to the beneficiaries, MAER informs the governor of the i) type of the machineries, ii) quantity of the machineries, and iii) price of the machineries. Based on this information, the committees at the region and department levels are established and the beneficiaries are determined by the committees. Table A2.3.9 shows the members and roles of these committees.

Table A2.3.9 Members and Roles of Committees for Selection of Producers or Producers' Organization for Provision of Agricultural Machinery

Committee	Member	Role
Regional committee	- Chairperson: Governor; - Vice chairperson: Regional Department of Rural Development (DRDR); - Secretariat: National Agriculture and Rural Advisory Agency (ANCAR); - Members of a department council; - Members of the Parliament; - Department of Rural Development (SDDR); - Representatives of producers; - Representatives of women's groups; and - Representatives of youth groups.	- Distribution of agricultural machineries to departments; - Fair selection of beneficiaries; and - Monitoring of the contract performance by beneficiaries.

Committee	Member	Role
Department committee	- Chairperson: Prefectural governor; - Vice chairperson: SDDR; - Secretariat: ANCAR; - Members of a department council; - Members of the Parliament; - Department of Rural Development (SDDR); - Representatives of producers; - Representatives of women's groups; and - Representatives of youth groups.	- Handing over of agricultural machineries; - Decision about the loan repayment method of the purchaser; - Decision about beneficiaries for provision of agricultural machineries; and - Monitoring and supervision of the beneficiaries.
Other organizations	SAED	- SAED attends the committee as an observer.
	LBA	- Bank account of the loan repayment is opened in LBA.

Source: JICA Survey Team

However, according to the interview survey with the relevant agencies, it has been hard to find the appropriate beneficiaries based on the above distribution plan shown in Table A2.3.8 since the procured machineries did not suit the beneficiaries' demand.

Based on the lessons learned above from the programs implemented by other donors, the following issues or constraints shall be considered for the Project formulation and implementation:

- Type and specifications of agricultural machineries including attachments should be selected, taking into consideration the field conditions and the actual demands of the producers;
- Although many large wheel-type combine harvesters have been installed in the Senegal River Valley, it is difficult to enter into a wet paddy plot as the harvester sinks down. Therefore, producers will have to wait to harvest until the plot is dry, which has caused the delay in harvesting; and
- The service providers and producers do not have the sufficient knowledge and skills for proper operation and maintenance of the agricultural machinery. For example, the following misunderstanding of the intended use of disk harrow was observed at the site:
    - The producers intend to carry out the deep plowing using tractors for effective weeding before paddy cultivation,
    - The producers require the large horsepower tractors with disk harrows (offset type) due to the dry hard soils in paddy fields, and
    - The intended use of disk harrow is mainly "crushing soils and levelling ground" rather than "deep plowing".

2.4 Necessity and Justification of the Project

Through the above study and review of national policies, present conditions in the target area, and the lessons learned from other projects, the necessity and justification of the Project have been confirmed as summarized in the table below.

Table A2.4.1 Necessity and Justification of the Project

General Features of the Project	Necessity and Justification
Objective of the Project: 1) To contribute to improve the self-sufficiency in rice, and 2) To contribute to reduce the trade deficit through the reduction of rice imports, through 3) the improvement of the efficiency and the productivity of irrigated rice farming practices.	In one of the policies under PSE, the agriculture sector is expected to contribute (see 2.1.1 for details): 1) To strengthen food security and nutrition security, and 2) To reduce the trade deficit due to the imports of food. To increase the rice production, a key issue is the "improvement of cropping intensity" as mainly shown in Section 2.2.1, which can be realized through the improvement of efficiency and productivity of irrigated rice farming activities. Therefore, it has been confirmed that the objective of the Project is appropriate and conforming to the National Policy.
Outline of the Project: 1) Rehabilitation/extension of the existing irrigation and drainage facilities, 2) Development/rehabilitation of the agricultural related infrastructures, 3) Procurement of agricultural machineries, and 4) Consulting services (detailed design, bidding assistance, construction supervision, etc.).	1) As shown in Section 2.2.2 (3), the main constraints on low cropping intensity are the deterioration of irrigation canal networks and lack of drainage systems. Therefore, rehabilitation/extension of the existing irrigation and drainage facilities is required to achieve the objective of the Project, 2) As shown in Section 2.2.3, deterioration and/or lack of the agricultural related facilities disturb the efficient rice farming activities especially for the agricultural mechanization and post-harvest activities. Therefore, development/rehabilitation of the agricultural related infrastructures is required to achieve the objective of the Project, 3) As shown in Section 2.2.5, the number of agricultural machineries especially of combine harvesters is not sufficient in the Senegal River Valley. Therefore, procurement of agricultural machineries is required to achieve the objective of the Project, and 4) As shown in Sections 2.2.9 and 2.3.2 (1), SAED requires a technical assistance from the external consultant for the proper and effective implementation of the Project. Therefore, consulting services are required to achieve the objective of the Project.
Target Area of the Project: Dagana and Podor departments in Saint Louis Province	- Dagana and Podor departments are located in the Senegal River Valley, - As shown in Section 2.1.2, 57% of the total target paddy production amount in Senegal set forth in PRACAS is allocated to the Senegal River Valley, and - Therefore, the target area of the Project is appropriate to achieve the objective of the Project.
Concerned Agencies: 1) Ministry of Agriculture and Rural Equipment (MAER) 2) National Company for the Development and Exploitation of the Senegal River Delta, Senegal River and Faleme Valley (SAED)	- As shown in Section 2.3.2 (1), generally, SAED has a capacity to implement and manage the irrigation development projects in the Senegal River Valley, according to other donor agencies, - As also shown in Section 2.3.2 (1), one program under AfDB support was cancelled mainly because of the less involvement of SAED, and - Therefore, the concerned agencies of the Project are appropriate to achieve the objective of the Project.

Source: JICA Survey Team

CHAPTER 3 PREPARATION OF LONG LIST FOR CANDIDATE SUBPROJECTS

3.1 Inventory Data for Irrigation Schemes in the Target Area

Appendices 3.1 and 3.2 show the list of irrigation schemes in the target area as of 2015, and Appendices 3.3 and 3.4 show the locations of those irrigation schemes. Based on Appendices 3.1 and 3.2, the irrigation schemes in the target area are summarized as shown in Table A3.1.1.

Table A3.1.1 Summary of Irrigation Schemes in the Target Area (as of 2015)

Department	Type of Irrigation Schemes	Number	Conditions					
			Developed area (ha)	Extension area (ha)	Abandoned Area		Cultivated Area	
					(ha)	%	(ha)	/scheme
Dagana	Large-scale Irrigation Scheme (not transferred)	4	2,785	645	293	8.53	3,138	784.44
	Large-scale Irrigation Scheme (transferred)	27	15,067	1,645	1,508	9.02	15,204	563.12
	Medium-scale Irrigation Scheme	13	620	11	2	0.34	629	48.35
	Village Irrigation Scheme	70	4,568	1,131	311	5.45	5,389	76.98
	Private Irrigation Scheme	1,827	45,197	13,070	1,992	3.42	56,274	30.80
	Others	3	854	606	0	0.00	1,460	486.67
	Sub-total	1,944	69,091	17,108	4,106	4.76	82,094	42.23
Podor	Large-scale Irrigation Scheme (not transferred)	0	0	0	0	-	0	-
	Large-scale Irrigation Scheme (transferred)	4	2,210	143	61	2.59	2,293	573.17
	Medium-scale Irrigation Scheme	9	4,650	38	491	10.47	4,198	466.40
	Village Irrigation Scheme	362	8,483	1,078	801	8.38	8,760	24.20
	Private Irrigation Scheme	796	7,470	1,768	624	6.75	8,615	10.82
	Others	0	0	0	0	-	0	-
	Sub-total	1,171	22,814	3,028	1,976	7.65	23,865	20.38
TOTAL	**Large-scale Irrigation Scheme (not transferred)**	**4**	**2,785**	**645**	**293**	**8.53**	**3,138**	**784.44**
	Large-scale Irrigation Scheme (transferred)	**31**	**17,277**	**1,789**	**1,569**	**8.23**	**17,497**	**564.41**
	Medium-scale Irrigation Scheme	**22**	**5,270**	**49**	**493**	**9.27**	**4,826**	**219.37**
	Village Irrigation Scheme	**432**	**13,051**	**2,210**	**1,111**	**7.28**	**14,149**	**32.75**
	Private Irrigation Scheme	**2,623**	**52,667**	**14,838**	**2,616**	**3.87**	**64,889**	**24.74**
	Others	**3**	**854**	**606**	**0**	**0.00**	**1,460**	**486.67**
	Sub-total	**3,115**	**91,905**	**20,136**	**6,082**	**5.43**	**105,959**	**34.02**

Source: SAED

The list of irrigation schemes shown in Appendices 3.1 and 3.2 was considered as the primary data for the study and preparation of the long list of candidate subprojects for the Project.

3.2 Candidate Subprojects Proposed by SAED

The candidate subprojects proposed by SAED to JICA are summarized in the table below.

Table A3.2.1 Candidates Subprojects Proposed by SAED to JICA

Department	No	Name of Subproject	Irrigation Schemes		Area (ha)
			Type	No.	
Dagana	D1	Rehabilitation and Extension of Mbagam Scheme	PIP	1	660
Dagana	D2	Rehabilitation and Extension of Rosso Scheme	PIV	1	300
Dagana	D3	Rehabilitation of Noar Drain	-	-	1,053
Dagana	D4	Development of Diawel Area	PIV	100	3,000
Dagana			Subtotal	102	5,013
Podor	P1	Rehabilitation of Medina Pete Schemes	PIV	39	1,200
Podor	P2	Rehabilitation and Extension of Doue PIVs	PIV	91	1,300

Department	No	Name of Subproject	Irrigation Schemes		Area (ha)
			Type	No.	
Podor	P3	Rehabilitation and Extension of Ndiawara Scheme	GA	1	500
Podor			Subtotal	131	3,000
			TOTAL	**233**	**8,013**

Source: JICA Survey Team

The proposed activities for each subproject were confirmed with SAED as summarized in Table A3.2.2.

Table A3.2.2 Proposed Activities for Candidate Subprojects Proposed by SAED to JICA

Department	No	Name of Subproject	Proposed Activities
Dagana	D1	Rehabilitation and Extension of Mbagam Scheme	- Rehabilitation and extension of irrigation scheme - Construction of two pumping stations - Construction of warehouse (rice and onion) - Improvement of access road (5 km) - Procurement of agriculture machineries - Procurement of small-scale rice mills - Capacity building for the producers
Dagana	D2	Rehabilitation and Extension of Rosso Scheme	- Rehabilitation and extension of irrigation scheme - Construction of two pumping stations - Construction of warehouse (rice and onion) - Improvement of Rosso farm road - Procurement of agriculture machineries - Procurement of small-scale rice mills - Capacity building for the producers
Dagana	D3	Rehabilitation of Noar Drain	- Improvement of drainage canal (35 km) - Upgrading and construction of crossing structures - Installation of electrical instruments - Capacity building for the producers and operators
Dagana	D4	Development of Diawel Area	- Construction of collecting drains - Construction of drainage pumping station - Installation of electrical instruments - Rehabilitation of existing channels - Construction of access roads - Construction of warehouse - Capacity building for the operators
Podor	P1	Rehabilitation of Medina Pete Schemes	- Rehabilitation of irrigation schemes - Construction of warehouses - Procurement of agriculture machineries - Procurement of small-scale rice mills - Capacity building for the producers
Podor	P2	Rehabilitation and Extension of Doue PIVs	- Rehabilitation and extension of irrigation schemes - Replacement of diesel pumps with electric pumps - Construction of warehouses - Procurement of agriculture machineries - Procurement of small-scale rice mills - Establishment of CEMA - Capacity building for the producers
Podor	P3	Rehabilitation and Extension of Ndiawara Scheme	- Rehabilitation and extension of irrigation schemes - Construction of warehouses - Procurement of agriculture machineries - Procurement of small-scale rice mills - Capacity building for the producers

Source: JICA Survey Team

As shown in Table A3.2.2, the main activities proposed for "D3: Rehabilitation of Noar Drain" subproject and "Development of Diawel Area" subproject, which were the improvement and/or construction of drainage canals and the rehabilitation of irrigation schemes, were not included in the proposed activities for those subprojects. Additionally, these subprojects may be implemented under PARIIS program with support from the World Bank.

Considering the above situations, SAED and the JICA Survey Team have agreed to exclude these subprojects from the long list of candidate subprojects for the Project and to propose other subprojects to compensate for this exclusion.

3.3 General Features of Candidate Subprojects Proposed by SAED

3.3.1 Questionnaire Survey for Candidate Subprojects

The basic data and information of candidate subprojects are essential 1) to prepare the realistic and proper long list of candidate subprojects for the Project, 2) to confirm the consistency between the long list and the draft selection criteria, and 3) to formulate the realistic and concrete concept and plan of the Project.

To obtain the basic data and information for the candidate subprojects, the JICA Survey Team in collaboration with SAED carried out the questionnaire survey, and the details are discussed below.

(1) Workshops at Dagana and Podor Departments

Prior to the questionnaire survey, one-day workshops at the Dagana and Podor departments were organized for the following purposes:

- To explain the outline of the Project and the necessity of the long list of candidate subprojects; and
- To discuss and finalize the questionnaire forms.

A representative from DIAH of the SAED headquarters also participated in the above workshops. During the workshops, the following minimum criteria were explained so that unrealistic or inappropriate subprojects would not be included in the long list:

- PIPs are not selected unless the irrigation schemes will be declared as government property after the rehabilitation works;
- Proposed activities shall include the rehabilitation of the irrigation scheme;
- The project components include not only the rehabilitation/expansion of the irrigation schemes but also the construction of agricultural related facilities (farm roads, warehouses and dryer) and the procurement of agricultural machineries; and
- Farmers' organization, such as the Union and *Groupement D'intérêt Economique* (GIE), shall be functioning and willing to cooperate with the project activities.

At the end of the workshops, the finalized questionnaire forms (see Appendix 3.5) were distributed to design and construction supervision works as well as irrigation engineers, DAGE and C/As in each department. DAGE and C/As in each department committed to fill and submit the questionnaires for all candidate subprojects, including 102 schemes in the Dagana department and 136 schemes in the Podor department.

(2) Results of the Questionnaire Survey

Questionnaires for 121 candidate subprojects were submitted to the JICA Survey Team, and the data and information provided in the submitted questionnaires are summarized in Table B3.3.1. General features of the candidate subprojects are summarized and described below.

Table A3.3.1 General Features of the Candidate Subprojects

	Description	Dagana	Podor	Total
1)	Number of Candidate Subprojects	44	77	121
	- less than 100 ha	17	68	85
	- 100 ha to 500 ha	20	4	24
	- More than 500 ha	6	5	11
	- No data	1	0	1
2)	Irrigation Service Area (ha)			
	- Irrigable area (ha)	9,623	7,142	16,765
	- Actual irrigated area (ha)	6,639	4,421	11,060
	- Ratio (%)	72%	63%	68%
3)	Major Constraints (number of subprojects)			
	- Low productivity	27	42	69
	- Small production area	37	57	94
	- Insufficient market accessibility	14	18	32
	- Insufficient farm labour	4	4	8
	- Salinity	25	0	25
4)	Number of Subprojects which Require Replacement and/or Rehabilitation of Pumps	21	51	72
5)	Length of Irrigation Canals (km)			
	- Total length of existing canals	272	201	473
	- Length of canals for rehabilitation works	219	168	387
	- (No data)	(17 SPs)	(13 SPs)	(30 SPs)
6)	Length of Drainage Canals (km)			
	- Total length of existing canals	139	50	189
	- Length of canals for rehabilitation/construction works	131	26	157
	- (No data)	(22 SPs)	(48 SPs)	(70 SPs)
7)	Farm Road Improvement (km)			
	- Total length of existing roads	373	225	598
	- Length of roads for rehabilitation/construction works	371	223	594
	- (No data)	(17 SPs)	(37 SPs)	(54 SPs)
8)	Post-harvest Facilities (number of subprojects)			
	- Necessary	33	40	73
	- (No data)	(11 SPs)	(22 SPs)	(33 SPs)
9)	Agricultural Machines (requested number)			
	- Tractor	34	43	77
	- Combine harvester	19	9	28
	- Thresher	24	105	129
10)	Present Farming Practice			
	- Average farm size	0.66 ha/farmer	0.31 ha/farmer	0.45 ha/farmer
	- Rice cropping intensity (dry/rainy seasons)	63%/26%	68%/22%	63%/23%
	- Vegetable cropping intensity (onion/okra)	8%	8%	8%
	- Total cropping intensity	96%	92%	91%
	- Rice yield (dry/wet seasons)	6.3/5.6 ton/ha	6.2/4.9 ton/ha	6.3/5.3 ton/ha
	- Market access: difficult	9 schemes	10 schemes	19 schemes
	- New market: necessary	26 schemes	18 schemes	44 schemes
11)	Institutional Development			
	- Average nos. of group (union/GIE, etc.)	275	216	237
	- Average nos. of women member	143	11	82
	- Office building requested (number of SPs)	40	37	77

Note: SP: Subproject

Source: JICA Survey Team

1) General

The number of candidate subprojects and the total and average irrigation area of the candidate subprojects proposed in each sector are summarized in Table A3.3.2 below.

Table A3.3.2 Summary of Candidate Subprojects for Each Sector

Dagana Department/ Sector	Number of SPs	Irrigation Area (ha)	Average Area (ha)	Podor Department/ Sector	Number of SPs	Irrigation Area (ha)	Average Area (ha)
Dagana				**Podor**			
- Bas Delta	24 (55%)	3,711 (39%)	155	- Guede	11 (14%)	1,203 (17%)	109
- Delta Central	4 (9%)	1,843 (19%)	461	- Doue	34 (45%)	3,027 (42%)	89
- OPB	1 (2%)	45 (0.5%)	45	- Ngallenka	31 (40%)	2,832 (40%)	91
- Haul Delta	7 (16%)	1,622 (17%)	232	- Ide a Morphil	1 (1%)	80 (1%)	80
- Dagana	8 (18%)	2,403 (25%)	300				
Total	**44**	**9,623**	**219**	**Total**	**77**	**7,142**	**93**

Note: SP: Subproject
Source: JICA Survey Team

Candidate subprojects proposed from the Dagana department include small-scale, medium-scale, and large-scale irrigation schemes, whereas most of those proposed from the Podor department are small-scale irrigation schemes.

Note that 70% of the candidate subprojects in the Podor department have an irrigation area of less than 100 ha. This is why major constraints in the candidate subprojects in the Podor department are “small production area” as shown in Table A3.3.1.

Also, a large number of subprojects in the Dagana department have salinity problems, whereas none of those in the Podor department indicate such problems.

2) Irrigation and Drainage Improvement Works

Basic data and information for irrigation and drainage improvement works provided in the questionnaires are summarized in the Table A3.3.3.

Table A3.3.3 Basic Data and Information on Irrigation and Drainage Improvement Works

Items	Unit	Dagana		Podor		Total	
Construction Year							
- 2009 to 2018 (less than 10 years)	SPs	3	7%	7	9%	10	8%
- 1999 to 2008 (10 to 20 years)	SPs	7	16%	11	14%	18	15%
- Before 1998 (more than 20 years)	SPs	24	55%	54	70%	78	65%
- No data or new construction works	SPs	10	22%	5	7%	15	12%
Pump Stations							
- SPs with data of pump capacity	SPs	20	45%	36	47%	56	46%
- SPs require improvement works	SPs	21	48%	51	66%	72	60%
Irrigation Canals							
- SPs with data of the existing canal length	SPs	27	61%	64	83%	91	75%
- Total length of the existing canals	km	272		201		473	
- Length of the existing canals per hectare	m/ha	34		30		32	
- Length of canals required for improvement works	km	219		168		387	
Drainage Canals							
- SPs with data of the existing canal length	SPs	22	50%	29	41%	51	42%
- Total length of the existing canals	km	139		50		189	
- Length of the existing canals per hectare	m/ha	19		15		18	
- SPs with data of the required improvement works	SPs	20	45%	16	21%	36	30%
- Length of canals required for improvement works	km	131		26		157	

Note: SP: Subproject
Source: JICA Survey Team

As shown in Table A3.3.3, about 65% of the candidate subprojects were constructed more than 20 years ago. Although some subprojects have not provided sufficient data and information on the irrigation and drainage facilities, most of the candidate subprojects which provide data and information require improvement works for the existing irrigation facilities.

Replacement and/or improvement of pumps are proposed in the 72 subprojects. However, some of the subprojects have not provided data on the discharge capacities of the existing pumps. For the formulation of the improvement plans of pumps, the required discharge capacities of pumps shall be estimated based on the designed irrigation water requirements and the irrigation service area.

As described in Chapter 2 and Sub-chapter 3.3.2, the drainage facilities have not been provided in most of the irrigation schemes in the target area. This is why data and information on the drainage facilities are not sufficiently provided in the questionnaires filled by the C/As in each department. Especially in the Dagana department, the lack of drainage facilities is one of the main causes of the salinity problem and, therefore, the provision of a proper drainage system shall be considered and studied during the planning and design stages, even if the improvement of the drainage canals is not proposed in a questionnaire.

3) Agricultural Related Facilities

Basic data and information for agricultural related facilities provided in the questionnaires are summarized in Table A3.3.4.

Table A3.3.4 Basic Data and Information on Farm/Access Road Improvement Works

Item	Unit	Dagana		Podor		Total	
Farm Road							
- SPs with data of the existing road length	SPs	27	61%	40	52%	67	55%
- Total length of the existing roads	km	150		69		219	
- Length of the existing roads per ha	m/ha	22		20		21	
- Length of roads required for improvement works	km	148		67		215	
Access Road							
- SPs with data of the existing road length	SPs	6	14%	13	17%	19	16%
- Total length of the existing roads	km	223		156		379	
Length of roads required for improvement works	km	223		156		379	

Note: SP: Subproject
Source: JICA Survey Team

As described in Chapter 2, the farm road networks within the irrigation schemes in the target area are not properly and sufficiently provided to assure the smooth farming practices. However, the improvement works of farm roads have not been proposed in several candidate subprojects. This is mainly because i) most of the irrigation schemes, especially for small-scale irrigation schemes, were developed in a vast plain and farmers can access their farm plots from their residential areas easily and ii) C/As or farmers' organizations do not fully understand the necessity of farm roads.

As shown in Table A3.3.1, the construction of paddy storage is proposed in about 60% of candidate subprojects. According to the interview survey with the farmers' organizations, most of them have proposed to construct a solar dryer (dry yard) and a union office together with the paddy storage. Therefore, it is suggested that the provision of a solar dryer and a union office be considered and studied during planning and design stages, even if such works is not proposed in the questionnaire.

4) Agricultural Machineries

A total of 77 tractors have been proposed in the candidate subprojects. The proposed tractors have large capacities that range mostly between 125 HP and 160 HP. However, the intended use of the tractors is not clear because the required attachments, such as disk harrow and plow, are not explicitly mentioned in the submitted questionnaires.

Meanwhile, a total of 28 combine harvesters have been proposed in the candidate subprojects, and the number of proposed combine harvesters are much less than that of tractors. According to the field inspections by the JICA Survey Team, this is because it is difficult to utilize the large-capacity combine harvesters, which are commonly used in the target area due to the current soil and drainage conditions observed in the target area (see Chapter 2 for details). However, a medium-capacity crawler combine harvester has been proposed in one subproject. It seems that the producers/providers have become aware of the importance of the introduction of the agricultural machineries which suit the actual field conditions, and this tendency shall be carefully studied during the planning and design stages.

In the candidate subprojects in the Podor department, a large number of the candidate subprojects require the threshers. Harvesting using "medium-capacity crawler combine harvesters" or "reapers with threshers" will be considered for those candidate subprojects.

5) Farming Practice

The average farm size is 0.66 ha per farmer for candidate subprojects in the Dagana department and 0.31 ha per farmer for those in Podor department as shown in the table below.

Table A3.3.5 Cultivated Area and Average Farm Size

Departments	Cultivated Area	Number of Farmers	Average Farm Size (Range)
Dagana	6,640 ha	10,100	0.66 ha/farmer (0.12～1.58 ha)
Podor	4,320 ha	14,100	0.31 ha/farmer (0.04～1.13 ha)
Total	10,960 ha	24,200	0.45 ha/farmer (0.04～1.58 ha)

Source: JICA Survey Team

Farm lands with above average size of about 0.5 ha/farmer are often further divided into smaller plots due to insufficient leveling works. This small farm size may be taken into account for the study on improvement of farming practices, especially for farm mechanization.

The total cropping intensity for candidate subprojects is estimated at 95%. This low cropping intensity may be mainly caused by inefficient farming practices due to deterioration of irrigation and drainage facilities, lack of agricultural related facilities, and lack of proper agricultural machineries. It is noticed that some questionnaires indicate unrealistically high cropping intensity, and it should be carefully confirmed during the planning and design stages.

Table A3.3.6 Cropped Area and Cropping Intensity

Item	Cultivated Area	Dry Hot Season (Rice)	Rainy Season (Rice)	Dry Cold Season (Vegetable)	Total
Dagan	6,640 ha	4,190 ha	1,700 ha	500 ha	6,390 ha
Intensity	-	63%	26%	8%	96%
Podor	4,320 ha	2,740 ha	880 ha	350 ha	3,970 ha
Intensity	-	63%	20%	8%	92%
Total	10,960 ha	6,930 ha	2,580 ha	850 ha	10,360 ha
Intensity	-	63%	23%	8%	95%

Source: JICA Survey Team

Cultivation area, unit yields, and rice production in candidate subprojects are summarized in Table A3.3.7.

Table A3.3.7 Rice Production in Candidate Subprojects

Departments	Cultivation Area	Unit Yield	Production
Dagana			
Dry hot season	4,190 ha	6.3 ton/ha	26,500 ton
Rainy season	1,700 ha	5.6 ton/ha	9,500 ton
Subtotal	5,890 ha	6.1 ton/ha	36,000 ton
Podor			
Dry hot season	2,740 ha	6.2 ton/ha	17,100 ton
Rainy season	880 ha	4.9 ton/ha	4,300 ton
Subtotal	3,620 ha	5.9 ton/ha	21,400 ton
Total			
Dry hot season	6,930 ha	6.3 ton/ha	43,600 ton
Rainy season	2,580 ha	5.3 ton/ha	13,800 ton
Subtotal	9,510 ha	6.0 ton/ha	57,400 ton

Source: JICA Survey Team

The farming practices currently applied in candidate subprojects are summarized in the Table A3.3.8.

Table A3.3.8 Present Farming Practices for Rice Farming

Department	Major Variety	Rice Seed Volume	Fertilizer Application	Herbicide Application	Pesticide Application
Dagana 44 SPs	Sahel 108 etc. 22 SPs	120 kg/ha 15 SPs	20 SPs (45%)	18 SPs (41%)	10 SPs (23%)
Podor 77 SPs	Sahel 177 etc. 15 SPs	120 kg/ha 8 SPs	11 SPs (15%)	10 SPs (14%)	3 SPs (4%)
Total 121 SPs	Sahel 108/177 etc. 37 SPs	120 kg/ha 23 SPs	33 SPs (29%)	28 SPs (24%)	13 SPs (11%)

Note: SP: Subproject
Source: JICA Survey Team

New markets are requested in 44 candidate subprojects. The average distance from the markets is about 10.8 km, ranging from 0 km to 40 km, as shown in Table A3.3.9.

Table A3.3.9 Accessibility to Market

Department	Average distance to market	Difficult access to market	Regular market information	New market required	Site available for new market
Dagana 44 SPs	13.3 km (0 - 40 km)	9 SPs (20%)	35 SPs (82%)	26 SPs (59%)	24 SPs (55%)
Podor 77 SPs	6.7 km (0 - 25 km)	10 SPs (14%)	35 SPs (49%)	18 SPs (25%)	16 SPs (23%)
Total 121 SPs	10.8 km (0 - 40 km)	19 SPs (17%)	70 SPs (61%)	44 SPs (38%)	40 SPs (35%)

Note: SP: Subproject
Source: JICA Survey Team

6) Institutional Development

The following table shows the summary of results of the questionnaire survey for the institutional development aspects.

Table A3.3.10 Summary of Questionnaire Survey for Institutional Development

Number of Candidate Subprojects		Dagana Department		Podor Department		Total (Ratio)	
		44		77		121	
Item	**Answer**	**Results**	**Number of answers**	**Results**	**Number of answers**	**Results**	**Number of answers**
Type of organization	Union	16	*44*	6	*77*	22 *(18%)*	*121*
	GIE	7		24		31 *(26%)*	
	SV	9		0		9 *(7%)*	
	Others/unknown	12		47		59 *(49%)*	
Number of members	Current members	256	*43*	216	*40*	243	*83*
	Women's members *(ratio)*	143 *(41%)*	*42*	11 *(8%)*	*40*	72 *(26%)*	*82*
	Potential members	311	*33*	70	*33*	218	*66*
Office	Yes	17	*40*	10	*37*	27 *(35%)*	*77*
	No	23		27		50 *(65%)*	
Office space	Enough	14	*23*	12	*19*	26 *(62%)*	*42*
	Not enough	9		7		16 *(38%)*	
Furniture and equipment *	Necessary	11	*11*	8	*10*	19 *(90%)*	*21*
	Not necessary	0		2		2 *(10%)*	
Organization structure	General assembly	23	*24*	15	*23*	38 *(88%)*	*47*
	Secretariat	10		0		10 *(20%)*	
	Ave. number of staff	5.6		5.0		5.3	
	Other committees	4		3		7 *(15%)*	
Major activities	Agriculture	34	*34*	29	*29*	63 *(100%)*	*63*
	Trade	9		19		28 *(44%)*	
	Agri-business	4		0		4 *(6%)*	
	Others	7		6		13 *(21%)*	
Current funds	Average ('000 FCFA)	10,055	*24*	1,134	*6*	7,935	*30*
Bank account	LBA	29	*40*	9	*27*	38 *(57%)*	*67*
	CMS	3		5		8 *(14%)*	
	Others/unknown	6		1		7 *(13%)*	
	No account	2		12		14 *(17%)*	

*Note: * Chair, table, meeting table, wardrobe, photocopier, computer, printer and other office supply.*
Source: JICA Survey Team

The table above includes data and information on the answers and the number of answers for each item. The questionnaire survey results for items with only a few responses should be carefully examined if they properly indicate the actual situation, especially for the Podor department. The above table does not include items with extremely few numbers of answers, such as membership fees and annual income and expenses of each of the farmers' organization. The findings from the questionnaire survey are summarized as follows:

- The types of farmers' organizations confirmed based on their names of organizations are unions (18%), GIEs except unions (26%), SVs (7%) and others/unknown (49%). It is noted that some of the organizations may be GIEs, even if they are not named as "GIE".
- The average number of farmers' organizations is 256 for those in the Dagana department and 216 for those in the Podor department. The farmers' organization in the Dagana department have more members than in the Podor department.
- The ratio of women members to all members is 41% in the Dagana department, 8% in the Podor department, and 26% in the target area. That ranges between 2.8% and 100% for each farmers' organization (100%: "women's group") and between 15% and 50% for most of them.

- The ratio of farmers' organizations with an office is 43% in the Dagana department, 27% in the Podor department, and 35 % in the target area. The ratio of farmers' organizations, which satisfies the office space requirements, is 61% in the Dagana department and 63% in the Podor department. The need for construction of offices may be high in the target area since about 65% of the farmers' organization do not have their own offices.
- Most of the farmers' organizations have established a "general assembly" and a "secretariat". However, only a few farmers' organizations have established other committees. The average number of staffs for a secretariat office is about 5.3.
- All the farmers' organizations practice farming activities and 44% and 6% of them do trade activities and agri-business activities, respectively.
- The average funds of the farmers' organizations are FCFA 10 million for those in the Dagana department and FCFA 1 million for those in the Podor department. This is because of the difference of the size of irrigation schemes in two departments.
- Note that 88% of farmers' organizations in the Dagana department and 56% of those in the Podor department have bank accounts in LBA and other entities, such as CMS.

3.3.2 Preliminary Survey and Study for Model Sites

In parallel with the above questionnaire survey, the JICA Survey Team carried out field reconnaissance for several typical candidate subprojects (hereinafter called as "model sites"). Through field reconnaissance for the model sites, the JICA Survey Team confirmed the actual site conditions and requirements of the model sites for the purpose of confirmation of the adequacy of data and information provided in the submitted questionnaires. Table A3.3.11 shows the general features of the model sites confirmed through the field reconnaissance.

Table A3.3.11 General Features of Model Sites

No.	Name of Irrigation Scheme	Department/ Sector	Type	Year of Construction	Irrigation Area (ha)	Farmers Nos.	Necessity of the following Components		
							Road	Ware-house	Farm Mach.
		Dagana							
1	Rosso	Upper Delta	PIV	1985	300	500	Need	Need	Need
2	Mbagan	Upper Delta	PIP	1965	650	1,200	Need	Need	Need
3	Kassack Nord	Delta Central	PIV	1990	432	511	Need	Need	Need
4	Kassack Sud	Delta Central	PIV	1973	513	503	Need	Need	Need
5	Ndiawdoune	Lower Delta	PIV	1987	206	200	Need	Need	Need
6	Mberay	Lower Delta	PIV	2014	30	30	Need	Need	Need
7	De Taaba	Lower Delta	PIV	2014	50	74	Need	Need	Need
		Podor							
8	Ndiawara	Ngallenka	GA	2013	350	795	Need	No	Need
9	Ndiawara 2	Ngallenka	PIV	N/A	12	100	Need	Need	Need
10	14 Donaya	Ngallenka	PIV	2001	29	511	Need	No	Need
11	Cuvette Guede Chantier	Guede	GA	1994	595	1675	Need	Need	Need
12	Nanodiral Golere	Doue	AI	1998	40	140	Need	Need	Need
13	Madina-Soubalo	Doue	PIV	1980	20	100	No	No	Need
14	Wassetake-Torobe	ile a Morphil	AI	1986	80	400	Need	No	Need

Note: Farm Mach.: Farm Machines
Source: JICA Survey Team

The locations of the above model sites are shown in Figure B3.3.1 and Figure B3.3.2.

The major findings obtained through the filed reconnaissance for the model sites are summarized as follows:

- The top priority issue in all model sites is the rehabilitation/improvement of the irrigation main canals. Sufficient irrigation water has not been supplied to the downstream area in most of the irrigation schemes due to leakage of irrigation water from such deteriorated main canals;
- Pumps in most of the model sites, except for two model sites, have functioned well, although most of the pumps are old. In the Ndiawhoune Irrigation Scheme, farmers have used a temporary small pump because the original pump broke down;
- The model sites in the Dagana department have been frequently suffering from the difficulties in drainage of surplus water from paddy fields and flooding in the rainy seasons compared with those in the Podor department. This is one of the reasons why the farmers in the Dagana department practice the irrigated rice farming mainly in the dry seasons;
- On the other hand, in some of the model sites in the Podor department, irrigated rice farming is mainly practiced in the rainy seasons. This is because irrigation using pumps in the dry season may be difficult or not economical compared with that in the rainy seasons. This is because the water levels of main water sources, such as the Senegal, Doue, and Ngallenka Rivers, in the dry season are lower than those in the rainy season. This is shown in Figure A2.2.2 and Table A2.2.9; and
- Most of the model sites require the rehabilitation and/or construction of farm roads and warehouses and the procurement of agricultural machineries, such as tractors and combine harvesters.

Based on the results of the field reconnaissance for the model sites and the review of the submitted questionnaires, data and information provided in the submitted questionnaires should be carefully examined considering the following:

- The questionnaires were filled by C/As whose main tasks are agricultural extension services for the union/GIE; hence, their specialties are not in the engineering fields. This means that the data and information related to the engineering fields, such as irrigation, drainage, and agricultural related facilities, may not be precise. For example, although the appropriate farm road networks are essential for proper and efficient farming practices using the agricultural machineries, C/As and union/GIE members were not able to provide the required farm road network plans. The proposed length of farm roads to be rehabilitated or constructed in the submitted questionnaires should be reviewed and examined based on the sample or standard farm road networks, such as those planned in the pilot site;
- A general layout showing the canal, drainage, and farm road networks, design/as-built drawings, and construction cost related documents which should be prepared during the planning, design, and construction stages, are not available for most of the existing irrigation schemes. Therefore, the data and information mainly related to the irrigation and drainage facilities may be estimated and not precise;
- Next to the rehabilitation/improvement of irrigation main canals, the second priority issue in most of the irrigation schemes is the improvement of drainage networks. For the drainage networks, a drainage pump station may be required to drain out the collected drainage water from paddy fields considering the flat topographic conditions commonly observed at the

lower reaches of the Senegal River. When the construction/rehabilitation of drainage canals are proposed, the construction of a drainage pump station should also be considered in the improvement plans; and

- In most of the existing irrigation schemes, warehouses were constructed without drying facilities, such as a solar dryer. According to the interview survey with union/GIE members for the necessity of post-harvest facilities, most of them required a solar dryer. Provision of a solar dryer should be considered in the development plans when the construction of paddy storage is proposed.

3.4 Long List of Candidate Subprojects

The long list of candidate subprojects for the Project is one of the key documents for project formulation. Basic data and information, such as the subproject name, the irrigation service area, and general features, should be shown in the long list so as to formulate a realistic project, to estimate the overall project costs, and to ensure consistency with the draft selection criteria described in Chapter 4. Based on the results of the questionnaire survey, the long list of candidate subprojects is prepared considering the following:

a) General: All subprojects, for which the questionnaires were submitted by SAED, have been included in the long list even if the submitted questionnaire did not include the important data and information, such as irrigation area and canal length;

b) Pump Station: If the "necessity of pump rehabilitation/improvement works" is indicated in the questionnaire for a candidate subproject, rehabilitation/improvement works of a pump station for such subproject have been included in the long list. If the pump discharge capacity which should be the basic data for planning and design works was not provided in the questionnaire for such subprojects, the capacity was estimated based on the potential irrigation area and the design irrigation water requirement (2.88 liters/sec/ha, see Chapter 5 for details);

c) Irrigation Canals: Most of the irrigation schemes in the target area have irrigation canal networks composed of a main canal and secondary canals and those, except for the large-scale irrigation schemes with the irrigation area of more than 500 ha, do not have tertiary canals. The canal length shown in the long list is the total length of the main and secondary canals. The rehabilitation and improvement of irrigation canals have been proposed for all candidate subprojects, and the costs required for these works will be a major part of the total project costs. In case the canal length was not provided in the questionnaire for a candidate subproject, the canal length for a particular subproject was estimated based on the potential irrigation area and the assumed irrigation canal length per ha (34 m/ha for subprojects in the Dagana department and 30 m/ha for those in the Podor department) shown in Table A3.3.3.

d) Drainage Canals: As described above, sufficient data and information were not provided in the questionnaires for candidate subprojects, although the improvement of drainage system is also one of the major activities in the Project. The drainage canal length for each subproject was also estimated using the assumed drainage canal length per ha (19 m/ha for subprojects in the Dagana department and 15 m/ha for those in the Podor department) shown in Table A3.3.3.

e) Farm and Access Roads: As described above, sufficient data and information were not provided in the questionnaires for the candidate subprojects. The farm road length for each subproject was

also estimated using the assumed farm road length per ha (22 m/ha for subprojects in the Dagana department and 20 m/ha for those in the Podor department) shown in Table A3.3.4. For access roads, lengths for the improvement works proposed in the questionnaires are shown in the long list.

f) Post-harvest Facilities: If the "necessity of warehouse" is indicated in the questionnaire for a candidate subproject, the requirement of construction of a paddy storage with a union/GIE office and a solar dryer for such subproject has been included in the long list. The size and capacity of those facilities will be studied and determined through the preliminary design works.

g) Agricultural Machineries: The procurement plan for agricultural machineries will be formulated separately during the preliminary design works based on the proposed farming plans and the recommended type and specifications of machineries. Therefore, the required agricultural machineries provided in the questionnaires have not been included in the long list.

The long list of candidate subproject is shown in Table B3.4.1. It is recommended that the long list be continuously updated by SAED to include the proposed 238 subprojects by the commencement of the Project.

CHAPTER 4 PREPARATION OF THE DRAFT CRITERIA FOR SELECTION OF SUBPROJECTS

4.1 Basic Concept and Approach for the Preparation of Draft Criteria and Flow Chart for the Selection of Subprojects

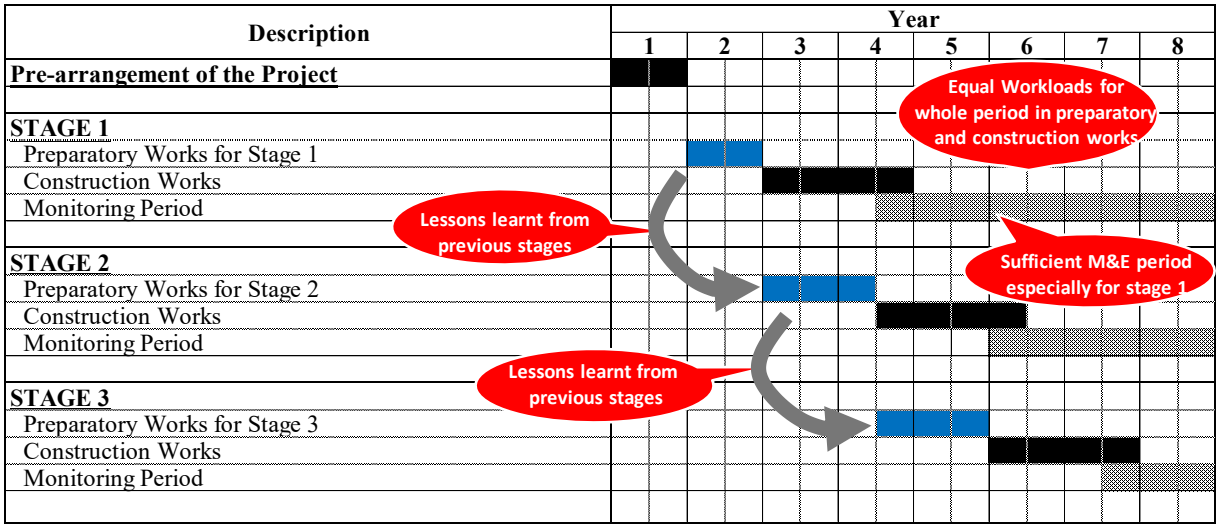
For the preparation of draft criteria for selection of subprojects and a flow chart of selection of subprojects to be implemented under the Project, the JICA Survey Team focused on the following issues:

1. Quick realization of the Project impacts and outcomes, and
2. Realization of high-quality development works.

In order to realize the above issues, the JICA Survey Team considered the following points in the preparation of the draft criteria for the selection of subprojects and a flow chart of the selection of the subprojects:

(1) Stage-wise Implementation of the Project:

The Project is a sector loan type project including a number of subprojects. As such, the JICA Survey Team proposes to adopt a stage-wise implementation for the Project. In case of a stage-wise implementation, the number of subprojects for each stage will be reduced and equal workload throughout the implementation period is expected in comparison to one-stage implementation as shown in Figure A4.1.1.



Source: JICA Survey Team

Figure A4.1.1 Image and Merits of Stage-wise Implementation of the Project

The following merits are expected through the adoption of a stage-wise implementation of the Project:

- Early and smooth commencement of the construction works through smooth pre-construction works including preliminary design, detailed design, and bidding process due to equal workload throughout the implementation period;
- Improvement of the quality and progress of the works through proper construction management and supervision due to equal workload throughout the implementation period;
- Lessons learned from the previous stage activities can be reflected in the next stage of activities even during the Project period; and

- Long-term monitoring period after completion of the construction works especially for the Stage 1 works will contribute to a variety of soft component activities.

(2) Optimum duration and cost of each subproject to maximize the Project benefit:

Duration and cost of each subproject shall be examined considering the following:

- Limitation of period and budget of the Project,
- Quick realization of the Project benefit,
- Capacity of the implementing agency for the management and supervision of the works, and
- Regional balance of the benefitted irrigation schemes (implementation of as many subprojects as possible to maintain a regional balance of development in the target area).

(3) Feasibility and sustainability of each subproject:

The feasibility and sustainability of each subproject shall be assured so as to achieve the Project objectives and goals.

(4) Impact on environmental and social conditions:

Any significant impacts on the environmental and social conditions shall not be anticipated in each subproject implementation so that the subproject activities will be approved and commenced smoothly without a long process of environmental impact assessment and/or land acquisition which are the common causes of delay in the project activities.

(5) Government policy and priority:

Government policies and priorities should be considered for selection of subprojects to be implemented under the Project so as to contribute to achieve the goals set forth in the national policies.

(6) Fundamental requirements including the necessity and justification of each subproject towards the Project objectives shall be assured.

(7) Integrated development:

Integrated development including both hard and soft component approaches is required to maximize the Project benefit and assure the sustainability of the Project.

4.2 Draft Criteria for the Selection of Subprojects and Flow Chart of the Selection of Subprojects

The draft criteria for the selection of subprojects and flow chart of the selection of subprojects to be implemented under the Project are shown in Figure B4.2.1 and described as follows:

(1) Candidate Subprojects in the Long List

Preparation of the long list for candidate sub-projects:
Timing: at the end of this survey period
Prepared by: the JICA Survey Team in collaboration with the SAED departments
Approved by: JICA and SAED headquarters

Subprojects to be implemented under the Project shall be selected from the candidate subprojects listed in the long list of candidate Subprojects for the Project shown in Table B3.4.1. The long list includes basic data and information of each candidate subproject for the pre-screening, which will be obtained through the questionnaire survey described in Sub-chapter 3.3.1.

(2) Pre-screening based on the Long List and Data Sheet of Candidate Subproject

1. Preparation of the draft criteria for pre-screening:
   Timing: at the end of this survey period, Prepared by: the JICA Survey Team
2. Finalization of criteria for pre-screening:
   Timing: during the appraisal process of the Project, Finalized by: JICA and SAED
3. Pre-screening of candidate sub-projects:
   Timing: after conclusion of the loan agreement, Done by: SAED (with JICA support, if necessary)

Pre-screening for candidate subprojects listed in the long list will be carried out using the data and information provided in the long list and data sheets of candidate subprojects to confirm if each candidate subproject satisfies the basic and fundamental requirements for the Project.

The proposed draft criteria for the pre-screening are as follows:

1) The main crop to be cultivated in the target irrigation scheme should be paddy;
2) Proposed works should include irrigation development works, and the type of irrigation development works should be rehabilitation works;
3) Facilities and/or goods improved, constructed and/or provided through the subproject implementation should be government property;
4) Proposed works/activities should not require any land acquisition and/or resettlement (unless the union/GIE can settle such issues by themselves without government financial support);
5) The irrigation service area after the subproject implementation/rehabilitation works shall be in the range from 10 ha to 1,000 ha;
6) The water source for irrigation development should be sufficiently available even in the dry season;
7) Any programs/projects of other donors or the Government of Senegal (GoS) should not be ongoing in the target irrigation scheme;
8) Union/GIEs in the target irrigation scheme should be functioning and willing to cooperate with the proposed subproject activities;
9) Any significant environmental and social impacts due to subproject activities should not be anticipated;
10) Cropping intensity should be improved by more than 50% and to more than 130% by the subproject implementation; and
11) Proposed works should not include large-scale flood prevention works.

The above draft criteria have been proposed considering the following basic concept and approach described in Sub-chapter 4.1:

Table A4.2.1 Proposed Draft Criteria and Basic Concept (Pre-screening Stage)

Draft Criteria	Basic Concept
1) Main crop should be paddy	(6) Fundamental requirements including necessity and justification
2) Proposed works should include irrigation development works, the type of which should be rehabilitation works	(4) Impact on environmental and social conditions
3) Facilities and/or goods improved and/or provided by the subproject should be government property	(6) Fundamental requirements including necessity and justification

Draft Criteria	Basic Concept
4) Proposed works/activities should not require any land acquisition and/or resettlement	(4) Impact on environmental and social conditions
5) Irrigation service area after the subproject implementation should be in the range from 10 ha to 1,000 ha	(1) Stage-wise implementation of the Project (2) Optimum duration and cost
6) Water source for irrigation development should be sufficiently available even in the dry season	(3) Feasibility and sustainability
7) Any programs/projects of other donors or GoS should not be ongoing in the target irrigation scheme	(6) Fundamental requirements including necessity and justification
8) Union/GIEs should be functioning and willing to cooperate with the proposed subproject activities	(3) Feasibility and sustainability
9) Any significant environmental and social impact due to subproject activities should not be anticipated	(4) Impact on environmental and social conditions
10) Crop intensity should be improved by more than 50% and to more than 130% by the subproject implementation	(3) Feasibility and sustainability
11) Proposed works should not include large-scale flood prevention works	(2) Optimum duration and cost

Source: JICA Survey Team

Pre-screening will be carried out using the basic data and information obtained mainly from the long list and data sheet (questionnaire) of each candidate subproject. Whenever necessity arises, the basic data and information should be supported by additional interview surveys with C/As and union/GIEs and field reconnaissance.

(3) Short List of Candidate Subprojects

The candidate subprojects that fail in the above criteria for pre-screening should not be selected as the subprojects to be implemented under the Project. The candidate subprojects that pass all the above criteria for pre-screening will be listed in the short list of candidate subprojects and proceed to the next step, i.e., scoring and prioritization process.

(4) Scoring and Prioritization based on the Short List and Data Sheet of Candidate Subprojects

1. Preparation of the draft criteria for scoring and prioritization:
   Timing: at the end of this survey period, Prepared by: the JICA Survey Team
2. Finalization of criteria for scoring and prioritization:
   Timing: during the appraisal process of the Project, Finalized by: JICA and SAED
3. Scoring and prioritization of candidate sub-projects:
   Timing: after conclusion of loan agreement, Done by: SAED (with JICA support, if necessary)

Since the long list of candidate subprojects has been prepared considering the consistency with the draft criteria for the selection of subprojects, most of the candidate subprojects may pass the criteria for pre-screening and be listed in the short list of candidate subprojects. As a result, the required costs for implementation of all subprojects listed in the short list may be higher than the ceiling budget for the Project to be agreed between JICA and GoS.

Considering the above ceiling of the Project budget and its effective use, it is proposed to score the candidate subprojects to be listed in the short list and prioritize them for the preliminary design works.

The draft criteria for scoring and prioritization of candidate subprojects are shown in Table A4.2.2.

Table A4.2.2 Proposed Draft Criteria for Scoring and Prioritization of Candidate Subprojects

Draft Criteria	Score	Description	Weight	Weighted Score
1) Priority in the SAED policy	1	Very low	x 8	8
	2	Low	x 8	16
	3	Medium	x 8	24
	4	High	x 8	32
	5	Very high	x 8	40
2) Expected improvement of cropping intensity: "Expected crop intensity after the subproject implementation (%)" - "Current crop intensity (%)"	1	Less than 50%	x 3	3
	2	Equal to or more than 50% and less than 60%	x 3	6
	3	Equal to or more than 60% and less than 70%	x 3	9
	4	Equal to or more than 70% and less than 80%	x 3	12
	5	Equal to or more than 80%	x 3	15
3) Year after latest rehabilitation or construction	1	Less than 10 years (yrs)	x 3	3
	2	Equal to or more than 10 yrs and less than 20 yrs	x 3	6
	3	Equal to or more than 20 yrs and less than 30 yrs	x 3	9
	4	Equal to or more than 30 yrs and less than 40 yrs	x 3	12
	5	Equal to or more than 40 yrs	x 3	15
4) Availability of data and information for preliminary design works (for "fast track")	1	Only data and information in the questionnaire	x 2	2
	3	General layout map or equivalent	x 2	6
	5	Feasibility study report or equivalent	x 2	10
5) Access to site (exhibition effects to public as a model case)	1	Bad	x 2	2
	3	Moderate	x 2	6
	5	Good	x 2	10
6) Potential for synergy effects among components *[1]	1	Activities for one component are proposed	x 1	1
	2	Activities for two components are proposed	x 1	2
	3	Activities for three components are proposed	x 1	3
	4	Activities for four components are proposed	x 1	4
	5	Activities for five components are proposed	x 1	5
7) Potential of gender related activities	1	Low potential	x 1	1
	3	Women groups are functioning in the target area	x 1	3
	5	Gender related activities are proposed	x 1	5
TOTAL				**100**

*Note *[1]: Number of components proposed in the subproject, including irrigation development, agricultural machinery, post-harvest facilities, farming practice and institutional development*

Source: JICA Survey Team

The above draft criteria have been proposed considering the following basic concepts and approach described in Sub-chapter 4.1:

Table A4.2.3 Proposed Draft Criteria and Basic Concepts (Scoring Stage)

Draft Criteria	Basic Concept
1) Priority in the SAED policy	(5) Government policy and priority
2) Expected improvement of cropping intensity	(3) Feasibility and sustainability of each subproject (6) Fundamental requirements including necessity and justification
3) Year after latest rehabilitation or construction	(6) Fundamental requirements including necessity and justification
4) Availability of data and information for preliminary design works	(1) Stage-wise implementation of the Project (2) Optimum duration and cost of each subproject
5) Access to site	(1) Stage-wise implementation of the Project
6) Potential for synergy effects among components	(3) Feasibility and sustainability of each subproject (7) Integrated development
7) Potential of gender related activities	(4) Impact on environmental and social conditions

Source: JICA Survey Team

Scoring of each candidate subprojects will be carried out using the basic data and information obtained mainly from short list and data sheet (questionnaire) of each candidate subproject. Whenever necessity arises, the basic data and information should be supported by additional interview surveys with C/As and union/GIEs and field reconnaissance.

(5) Preliminary Design Works for Prioritized Candidate Subprojects (by SAED)

1. Preliminary design works for pilot site:
   Timing: at the end of this survey period, Carried out by: the JICA Survey Team
2. Preliminary design works for prioritized candidate sub-projects:
   Timing: after conclusion of loan agreement, Carried out by: SAED

Based on the score of each candidate subproject, the candidate subprojects listed in the short list will be prioritized for the preliminary design works. It is suggested that SAED commence the preliminary design works for the top ten scored candidate subprojects as the top priority subprojects group considering the merits of the stage-wise implementation of the Project as described in the above Sub-chapter 4.1 (1). From the viewpoint of regional balance between two departments, it is also suggested that these top priority subprojects be selected considering the following:

- At least three subprojects are allocated to each department, and
- At least 30% of total irrigation area is allocated to each department.

After completion of the preliminary design works for the top priority subprojects group, SAED may proceed with the preliminary design works for a second priority subprojects group consisting of "11 - 20 ranked subprojects". Based on the required cost for implementation of each priority subproject which will be estimated during the preliminary design works, SAED will confirm a balance of the Project budget from time to time and determine if further preliminary design works are required. Thus, the preliminary design works will be continuously carried out by SAED until the total required costs for implementation of priority subprojects accumulate up to the ceiling of the Project budget. The results of each preliminary design works will be compiled as a preliminary design report for each priority subproject.

(6) Consultant's Review on the Preliminary Design Report

Consultant's Review on the Preliminary Design Report:
Timing: after the mobilization of the Yen-loan Consultant, Done by: the Yen-loan Consultant

The preliminary design reports prepared by SAED will be reviewed by the Yen-loan Consultant to be employed using the yen-loan budget after the conclusion of the loan agreement. Based on the comments made by the Yen-loan Consultant, the preliminary design reports will be revised and finalized for the final screening process. It is suggested that the Consultant's review works also be carried out according to the priority of each subproject as the detailed procedure described in the above (5).

(7) Final Screening based on the Preliminary Design Report

1. Preparation of the draft criteria for final screening:
   Timing: at the end of this survey period, Prepared by: the JICA Survey Team
2. Finalization of criteria for the final screening:
   Timing: during the appraisal process of the Project, Finalized by: JICA and SAED
3. Final screening of the priority sub-projects based on the preliminary design reports:
   Timing: after the mobilization of the Yen-loan Consultant
   Done by: SAED with the Yen-loan Consultant's assistance

Based on the preliminary design reports accepted by the Yen-loan Consultant, the final screening for the priority subprojects will be carried out by SAED with the assistance of the Yen-loan Consultant. It is proposed to carry out this final screening process with the following two steps:

1) Final screening (1st Step)

Since the pre-screening as described in number (2) above will be carried out using the basic data and information obtained mainly from the long list and data sheet of each candidate subproject, the data and information for the pre-screening would be limited or not accurate and the accuracy of such screening might be low. Therefore, the final screening (1st step) is done to confirm if the priority subprojects conform to the criteria set during the pre-screening, and if it should be carried out based on the data and information provided in the preliminary design reports, which have a far more accurate data and information compared with those provided in the long list and data sheets.

2) Final screening (2nd Step)

The JICA Survey Team proposes the following draft criteria for the final screening (2nd step) of the priority subprojects:

a) Economic internal rate of return (EIRR) of the priority subproject shall not be less than 10%.
b) The subproject shall not be categorized as Category A pursuant to the JICA Guidelines for Environmental and Social Consideration;
c) Memorandum of Understanding (MOU) including the following shall be signed by the concerned parties:
   - Statement of agreement/consensus among affected farmers, union, GIE leaders and SAED (for required lands for the proposed works/activities); and
   - Statement of understanding among union/GIE and SAED which should include the following:
     - Facilities and/or goods improved and/or provided through the subproject implementation shall be government property;
     - Understanding and agreement on the proposed works and activities to be implemented under the subproject; and
     - Commitment to fulfill duties and obligations required for the implementation of the subproject including the future operation and maintenance; and
     - Understanding and agreement on the required intermission of cultivation during the construction and rehabilitation works.

d) Duration of construction works shall not be more than three years (if the duration of construction works is scheduled for more than three years, packaging of the works or stage-wise development may be considered); and
e) Cost of subproject shall not be more than FCFA 2.5 billion (if the required cost for implementation of the subproject is estimated at more than FCFA 2.5 billion, packaging of the works or stage-wise development may be considered).

The above draft criteria have been proposed considering the following basic concepts and approach described in Sub-chapter 4.1:

Table A4.2.4 Proposed Draft Criteria and Basic Concepts (Final Screening Stage)

Draft Criteria	Basic Concept
a) EIRR shall not be less than 10%	(3) Feasibility and sustainability of each subproject
b) Subproject shall not be categorized as Category A	(4) Impact on environmental and social conditions
c) MOU shall be signed by the concerned parties	(3) Feasibility and sustainability of each subproject
d) Duration of construction works should not be more than three years	(1) Stage-wise Implementation of the Project (2) Optimum duration and cost of each subproject
e) Cost of subproject shall not be more than FCFA 2.5 billion	(1) Stage-wise Implementation of the Project (2) Optimum duration and cost of each subproject

Source: JICA Survey Team

It is suggested that the final screening of the priority subprojects be carried out according to the priority of each subproject as detailed in the procedure described in the above number (5).

The priority subprojects that fail the above final screening criteria will not be selected as the subprojects to be implemented under the Project. The priority subprojects which pass all the above criteria for final screening will proceed to the "official approval of the preliminary design report" stage.

(8) Official Approval of the Preliminary Design Report

Official approval of the preliminary design report:
Timing: after the mobilization of the Yen-loan Consultant
Approved by: SAED and concerned agencies with the Yen-loan Consultant's assistance
Concurred by: JICA

The preliminary design reports including the above final screening results for the priority subprojects that pass all the criteria for final screening will be submitted to SAED and concerned agencies for their official approval. After approval of SAED and the concerned agencies, the preliminary design reports including the final screening results will be submitted to JICA for concurrence.

Upon the JICA concurrence of the preliminary design reports including the final screening results for the candidate subprojects, the subprojects will be authorized to be implemented under the Project and SAED with the Yen-loan Consultant's assistance and will proceed to the detailed design works.

It is suggested that this official approval process also be carried out according to the priority of each subproject as detailed in the procedure as described in the above number (5).

CHAPTER 5 PRELIMINARY DESIGN FOR PILOT SITE SUBPROJECT

5.1 Selection of Pilot Site for Preliminary Design Works

The main purposes of survey and study in the pilot site are:

a) To allow the SAED staff to recognize the methodologies of the planning/design works and all procedures of the project implementation through the preliminary design activities,
b) To allow the SAED staff to effectively apply the methodologies and procedures for the proper implementation of the other subprojects, and
c) To obtain the necessary data for the formulation of development plans on the Project.

One pilot irrigation scheme is selected through the preparation of a draft long list and through the site inspection of selected irrigation schemes based on the preliminary criteria proposed in Chapter 4 and the following conditions:

a) Subproject for pilot scheme is required for rehabilitation and/or extension,
b) Subproject for pilot scheme has suitable development scale (assuming 300 to 600 ha),
c) Subproject for pilot scheme has good accessibility,
d) Subproject for pilot scheme shall be high priority in the SAED's rehabilitation program,
e) Subproject for pilot scheme has all development components for the estimation of overall project costs,
f) Subproject for pilot scheme shall be selected among PIV, AI, and GI, and
g) Survey, study, and design works shall be executed with utilization of the available and easily accessible data, such as satellite data, as much as possible.

Through the discussion with SAED based on the data and information obtained by the preparation of a draft long list and site inspection, the Rosso scheme in Dagana Delegation, which is satisfied with all the above conditions, is selected as the pilot site among the seven initial priority subprojects.

Table A5.1.1 Selection of Pilot Scheme for Preliminary Design

Conditions for Selection	Rosso Scheme
a) Required rehabilitation and extension	Scheme requires rehabilitation and extension
b) Development scale	Irrigation service area is 300 ha
c) Accessibility	One and half hours from Saint Louis by car
d) SAED's priority	One of SAED's initial priority 7 subprojects
e) Required components	Scheme requires irrigation and drainage rehabilitation/improvement, farm roads improvement, post-harvest facility development, introduction of farm machines, agricultural practices improvement, and institutional improvement
f) Type of scheme	Scheme is PIV
g) Data availability	Satellite data is available

Source: JICA Survey Team

5.2 Present Conditions, Constraints, and Issues in Pilot Site

5.2.1 General

The Rosso scheme is located in Rosso Senegal, Upper Delta Sector (Secteur Haut Delta), about 100 km northeast from Saint Louis (refer to Figure B3.3.1 for location). The pump station has been constructed along the protection dike with a distance of about 3 km from the town of Rosso. The access road to the pump station is laterite pavement. The total potential irrigation area is about 300 ha, with 250 ha developed area and 50 ha extension area. The scheme was constructed in 1985 by SAED. The actual irrigation area in 2019 dry season paddy is only 136 ha. One of the reasons why the actual irrigation area is about 50% of the developed area is that there are salinity problems in the downstream area.

Based on preliminary field inspection, the general features of the scheme are summarized in Table A5.2.1.

Table A5.2.1 General Information of Rosso Scheme

	Description (Results of Inspection)	Recommendations
1)	Scheme was constructed in 1985 by SAED.	
2)	Irrigation Service Area: Total area = 300 ha, Developed area = 250 ha, Extension area = 50 ha 2019 present dry season cropping area = 136 ha Unit yield of paddy: 7.4 ton/ha	
3)	Farmer: 500 farmers (3-5 persons/household), Farm size: 1.0 ha/farmer or less	
4)	Pump Station Water sources: Senegal River Inlet channel: about 56 m, earth canal presently covered by grass Pump: 3 pumps (A=684 cum/hr, B&C=540 cum/hr), Total capacity = 1,764 cum/hr Pump head: about 2-3 m Outlet channel: about 48m, concrete flume and culvert (Maximum flow capacity: about 1.2 cum/s) Pump operation hour: 6:00-17:00 (11 hrs) Problem: Pump installation year is old.	Rehabilitate Assess capacity
5)	Irrigation Canals Main and secondary, no tertiary Problems: Quality of canal sections is poor, so there is much leakage according to Union members. Therefore, there is only one cropping through the year. Water intake to plot is difficult. Irrigation water does not reach the farthest plot. No existing maintenance road.	Rehabilitate
6)	Drainage Canal No existing drainage canal. Downstream of service area has salinity problem; therefore, there is no irrigation farming.	Construct with drainage pump station
7)	Farm Road Producers set up maintenance road (6 m) by themselves. Union requests effective road network.	Rehabilitate and construct
8)	Warehouse No existing warehouse. After harvesting, the bank collects the products for loan repayment. The remaining products are temporarily stored in existing buildings, such as schools. In general, there is no drying activity.	Construct
9)	Farm Machine Present land preparation done by one tractor. Harvest is done manually with Assye.	Procure

	Description (Results of Inspection)	Recommendations
10)	Union/GIE 1 Union and 8 GIEs	Strengthen
11)	O&M Activities and Cost Inspection committee has been established. Before campaign, there is a walk survey for maintenance. Weeding is done per month. Operation cost (electric bill): 2 million FCFA/crop Irrigation cost (pump operator, maintenance fee): 7 million FCFA/crop	

Source: JICA Survey Team

Further detailed conditions and constraints are presented in the following concerned sub-sections.

5.2.2 Irrigation and Drainage Facilities including Hydrology

(1) Irrigation Service Area

The general layout is prepared based on Google Maps, and the results of site inspection are shown in Figure B5.2.1.

The gross irrigation service area is estimated at 319 ha. The net service area is calculated at 303 ha, excluding the existing right of ways for irrigation canals, farm roads, and farm plot dikes. The right of ways utilizes 5% of the gross area. The Union explained that the extension areas of about 50 ha were scattered between the main irrigation canal and the secondary canal No. 9. The extension areas have constraints for development because these areas are within the depressed land where inundation water cannot be drained. Therefore, as the first stage of the rehabilitation program, it is recommended to improve the existing service area of about 250 ha.

(2) Pump Station

There are installed three pumps, where one is a submersible pump of 684 cum/hour capacity and the other two are propeller pumps with 540 cum/hour capacity each. The total discharge capacity is 1,764 cum/hour, which is equal to 0.49 cum/sec. For 250 ha of the present service area, the capacity is calculated at 1.96 l/sec/ha, which is generally allowed for the design capacity. The pump was installed in 1985. At present, SAED has the standard design capacity of 3.5 l/sec/ha for rice irrigation farming, which is estimated based on the following assumptions. The monthly peak water requirement is estimated at 325 mm, including 175 mm for imbibition (soil saturation) and 150 mm for submersion. This requirement is delivered for a duration of 16 hours per day, six days a week, and with irrigation efficiency of 55%. In case of continuous irrigation of 30 days and 24 hours, 325 mm is converted to 2.28 l/sec/ha. The present pump capacity of the Rosso scheme, which is at 1.96 l/sec/ha, is smaller than these standard rates. Therefore, the design water requirement will be reassessed through the formulation of rehabilitation plans under the Project.

(3) Irrigation Canals

There is one main canal (MC) and 20 secondary canals (SC) identified through the field investigation. The commanding area by one SC is at most 20 ha, and each farm plot is directly irrigated from an SC with PVC pipe. The lengths of these canals are summarized in Table A5.2.2.

Table A5.2.2 Length of Existing Irrigation Canals

	Canal	Length (m)		Canal	Length (m)		Canal	Length (m)
1)	MC	2,650	9)	SC7-2	330	17)	SC9-2	950
2)	SC-1	860	10)	SC7-3	260	18)	SC9-3	565
3)	SC-2	960	11)	SC7-4	218	19)	SC9-4	2,627
4)	SC-3	1,050	12)	SC7-5	123	20)	SC9-5	804
5)	SC-4	1,130	13)	SC7-6	138	21)	SC-10	920
6)	SC-5	1,150	14)	SC-8	847			
7)	SC-6	580	15)	SC-9	2,370	SC Total		17,137
8)	SC-7-1	495	16)	SC9-1	760	**TOTAL**		**19,787**

Source: JICA Survey Team

The average hydraulic gradient of MC is about 1/1,500, which has enough energy head to convey water to end sections. There are many damaged sections along the MC. Damages were caused by the unsuitable embankment materials and by the crossing of houses and farm machines for entering to farm plots. The temporary culvert of small PVC pipes is constructed to cross the MC; thus, the canal banks are destroyed by the crossings. The irrigation water cannot reach the downstream sections due to these damages and seepage, even when there is enough hydraulic gradient. All sections of the MC have to be rehabilitated for the maximization of the irrigation area.

There are concrete turnout structures at the head of SC No. 1 to No. 5, but there is no permanent structure in other heads of SC, only cutting the MC banks to take water to SC. Four concrete box culverts are provided for the crossing of the existing farm roads.

(4) Drainage Canals

No drainage canal is constructed in the service area. Therefore, all excess water is accumulated downstream of the service area thereby causing a salinity problem in such area. It is essential to provide proper drainage canal networks to regenerate productive farm lands. The collected excess water can be drained out by the pump to the existing drainage canal located along the downstream boundary of the service area.

(5) On-farm Development

There is no on-farm canal network; thus, it is very difficult to execute proper water management in the farm plots. Furthermore, irregular farm levels become obstacles for proper water distribution and farming practices in the farm plots due to little farmers' recognition for farm levelling.

5.2.3 Agricultural Related Facilities

(1) Access Road

The existing public road (unpaved roads) connecting the town of Rosso to the pump station is in good condition and can be used as an access road connecting villages, irrigation facilities, and the main road.

It is also easy to access the main canal and the secondary canal No. 9 through the wide spreading plain area from this public road.

(2) Farm Roads

There are five farm roads constructed by the Union. The total width of the roads is approximately 6 m. The total length of five farm roads is roughly estimated at about 2.4 km, which is not sufficient for smooth farm activities. The heights of the roads are low from the farm level, and some sections are inundated due to leakages. Since the farm roads are not enough in quantity and quality, it is not easy to access the farm plot. Thus, effective farm practices are disturbed without proper farm road networks. Furthermore, the maintenance road is also not developed, but access to the main canal and the secondary canal No. 9 is easy as mentioned above. As for other secondary canals, there was .difficulty found with foot paths along the canals.

(3) Warehouse

There is no existing warehouse in the Rosso scheme. The paddy harvested will be charged in the sac, which are stored in the public building rented around the irrigation scheme. The drying facilities, such as solar dryer, is not provided, and drying works of the paddy are generally not carried out at present.

5.2.4 Agricultural Machinery

(1) Agricultural Mechanization

The Rosso Irrigation Scheme was established by the Union in 2016. The Rosso Union procured one tractor and started land preparation. Before 2018, the farmers asked about land preparation to a private service provider in Rosso.

Table A5.2.3 List of Existing Equipment of Rosso Union

Item of Agricultural Machinery	Qty	Manufacturer	Model No.	Delivery Year	Condition
Tractor, 120 HP	1	John Deere	-	2018	Good
Disk Harrow (off-set type)	1	-	-	-	Good

Source: JICA Survey Team

Table A5.2.4 List of Existing Machines of Private Service Providers in Rosso

No	Name of Organization	Commune	Tractor			Combine Harvester			Thresher	
			Qty	Manufacturer	HP	Qty	Manufacturer	HP	Qty	Type
Private Service Provider										
16	GIE Tayene	Rosso Senegal				1	New Holland	125	1	ASI*[1]
50	GIE Mame Oumar Niang	Rosso	1	New Holland	130	1	New Holland	N/A		
			1	Valtra	70					
51	Mboji et Freres	Rosso	3	New Holland	120	2	New Holland	120		
53	GIE Fils Brahima Fall	Rosso	1	New Holland	130	1	New Holland	160		
			3	New Holland	N/A					
55	GIE Amadou Niang	Rosso / Thagar	1	John Deere	120	2	New Holland	160		
			1	New Holland	130					
			1	New Holland	N/A					
56	GIE Ibrahima Mboji	Rosso				2	New Holland	130		
58	GIE Yaye Mareme	Rosso	1	John Deere	120	1	New Holland	50 (To be confirmed)		

No	Name of Organization	Commune	Tractor			Combine Harvester			Thresher	
			Qty	Manufacturer	HP	Qty	Manufacturer	HP	Qty	Type
			1	New Holland	120	1	New Holland	70 (To be confirmed)		
Total			14			11			1	

*Note *1: Above "No." is same as No. in Inventory Survey Results of Farm Machines by PAPRIZ2*
*Note *2: Thresher ASI type is made in Senegal and jointly developed among "Africa Rice", "SAED" and "ISRA"*
Source: JICA Survey Team

Union members ask to use the tractor for land preparation. However, it can only be done using a disk harrow for cultivation of surface soil only in dry condition. The Union made a contract with an operator for each season. The Union does not have a combine harvester, and due to poor drainage in the field, all paddy harvesting is carried out manually.

The operator carries out daily maintenance. The lubricant oil can be changed at a petrol station. If the Union has to repair a serious damage in the machine, the Union is requested to have the works done in repair shops in Rosso or Ross Bethio.

There is no storage facility for the farm machine in the Rosso scheme area. The existing machines are kept in the open spaces near private houses. The present security measurements for the machines are not sufficient.

The farming size per household is about 0.5 ha, but the actual size of one farm plot is 0.2 to 0.5 ha. According to the farmers, the reason why the farm plot is so small is that there is no leveling in the plot. Thus, a small plot size is easy to maintain when there is full water ponding in one plot. The farmers are willing to expand the plot to a proper size for mechanical farming if the farm plots are improved by leveling works.

As a first step, the reaper and thresher shall be procured to harvest the paddy in small farm plots. After improvement to a larger size of plots by farmer, a middle-sized combine harvester will be procured.

5.2.5 Farm Management

(1) Soils and Land Conditions

Soil and land conditions in the Rosso scheme are summarized in Table A5.2.5.

Table A5.2.5 Soils and Land Condition of the Rosso Scheme

Items	Features and Characteristics
Topography	Low land situated on the flood plain, along the left bank of the Senegal river in the north and the drainage canal of the sugarcane plantation in the south.
Field drainage	Poor drainage condition in the lower southern part, inundating throughout the year due to excess irrigation water and rain flowing from the higher northern part.
Main soil types	Faux Hollalde and Hollalde, characterized as the heavy clay texture, showing the vertisol-like features shrinking (hard) when dry and swelling (muddy) when wet.
Salinity	Higher salt accumulation observed in the depressed lands sporadically situated in the service area, particularly in the southern part, without cropping rice.

Source: JICA Survey Team

Soils called as Faux Hollalde and Hollalde are the heavy textured clay soils. They have particular features such as i) shrinking with cracks and very hard when dry, and ii) swelling and muddy (too soft) when wet. These features bring difficulty in the working condition of the paddy field. On the other hand, the soils show good soil fertility with higher capacity of holding plant nutrients. They are usually classified into suitable soils for paddies, not for vegetables. Taking this situation into account,

an adequate drainage system to control water in the paddy field is required to maintain appropriate soil moisture, thus enabling the conduct of proper farming practices.

The irrigation service area is situated in the southern part, and the excess water flows into this area because the excess irrigation water and rain water from the surroundings is collected, then the water stagnates to inundate the area because there is no drainage outside. This inundated situation continues in the dry season, and the inundated area is expanding every year according to the farmers.

Inundation results to a higher groundwater level, then the salt content of water and soils becomes higher due to high evaporation with the arid climate condition, so salts are easily accumulated. During the field survey conducted in the middle of June 2019, salt accumulation was observed on the soil surface, and farmers abandoned rice cropping in the paddy fields.

This situation can be improved by introducing a drainage system to remove the excess water with enough supply of irrigation water to leach salts from the soils. It will take some time (1 to 2 years) to leach salts from surface soils, and proper operation of irrigation and drainage facilities will promote the utilization of lands for rice cropping.

(2) Rice Cropping and Production

Farmers cultivating rice in the Rosso irrigation service area said that in the mid-1980s, just after the scheme was established, rice cropping was done twice a year. However, rice is presently cropped once during the dry season mainly due to the following situations:

a) Delay of dry season harvest
   As a result of poor drainage, the muddy field conditions prevent the combine harvester from entering, so only manual harvesting is applicable. The limited available labor force in this season results in the delay of harvesting.

b) Disturbance of land preparation
   Delayed harvesting disturbs routine land preparation by tractor. The rainy season sometimes commences before land preparation starts, and soil becomes too muddy to operate a tractor. In this situation, farmers have to wait until the next dry season for land preparation.

c) Inundation by excess water and high salinity area
   The southern part of the irrigation service area is inundated during the rainy and dry seasons, and rice cropping is not possible. In the area where salt accumulates in the soils, rice plant cannot survive, and farmers abandon rice cropping.

The average cropping intensity is estimated at 78% in the past three years from 2016 to 2018, as shown in Table A5.2.6, with a decreasing tendency from 94% in 2016 to 68% in 2018, which reflects the above situation.

Table A5.2.6 Present Rice Cropped Area, Unit Yield and Production in the Rosso Subproject

	Dry season 2016	Dry season 2017	Dry season 2018	Dry season 2019	Average 2016-2017
Planted area	236 ha	183 ha	170 ha	132 ha	196 ha
Cropping intensity	94%	73%	68%	53%	78%
Average yield	7.7 ton/ha	7.2 ton/ha	7.3 ton/ha	-	7.4 ton/ha
Production	1,820 ton	1,320 ton	1,240 ton	-	1,460 ton

Source: prepared by the JICA Survey Team based on the results of questionnaire survey

Based on the above table, the average rice production is estimated at 1,460 tons based on an average cropped area of 196 ha and an average yield of 7.4 ton/ha.

During the field survey, it is observed that rice plants showed wide growth stages, from panicle initiation to ripening resulting from mixing of varieties. Weeds are dominant in the plots, and the unit yield of 7.4 ton/ha seems to be rather higher than the actual value. In this regard, the average yield of 6.3 ton/ha from the 44 questionnaires obtained from the Dagana Delegation is employed for preliminary design.

(3) Present Cropping Pattern

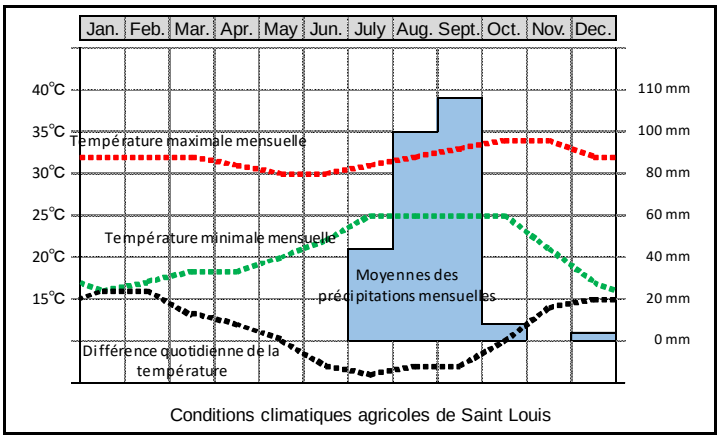
The meteorological data show three seasons in the pilot site, namely rainy season, dry cold season, and dry hot season, as summarized in Table A5.2.7 and Figure A5.2.1.

Table A5.2.7 Seasonal Meteorological Feature

Season	Timing	Rainfall	Minimum Temperature	Daily Difference of Temp.	Humidity
Rainy Season	Late Jul. to late Sep.	250 mm	24 to 25 ℃	6 to 10 ℃	High
Dry Cold Season SSF	Mid Nov. to late Feb.	No rain	16 to 17 ℃	13 to16 ℃	Low
Dry Hot Season SSC	Early Mar to mid Jul.	No rain	18 to 22 ℃	7 to 14 ℃	Low

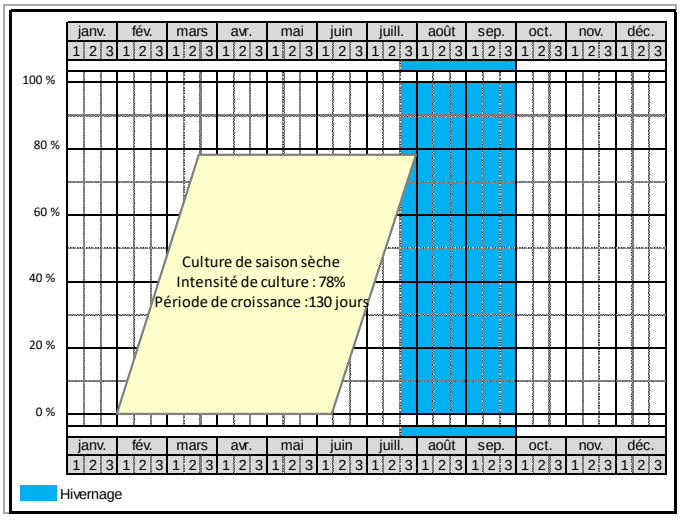
Note: Meteorological data quoted from the Saint Louis station.
Source: Prepared by the JICA Survey Team based on the data of "Ministere du tourisme et des transports aerien"

In the dry cold season, the minimum temperature is frequently recorded to be lower than 17 ℃ from late December to late February, and farmers tend to avoid planting during this period. This behavior causes delay in harvesting and disturbs land preparation for the rainy season crop. The Practical Manual for rice farming in the Senegal River Valley prepared jointly by SAED and WARDA recommends to start planting in the beginning of January. In this regard, a series of demonstrations according to the Practical Manual will be conducted during the project implementation to obtain farmers' understanding.



Source: JICA Survey Team

Figure A5.2.1 Meteorological Data in Saint Louis



Source: JICA Survey Team

Figure A5.2.2 Present Cropping Pattern in Rosso

Based on the above situation as well as climatic data and farmers custom, the present cropping pattern is estimated as shown in Figure A5.2.2. The main rice variety in the Rosso scheme is Sahael 108, which is an early matured variety with growth period ranging from 110 days in

the rainy season to 130 days in the dry season. According to the farmers, planting starts from early February to middle of March, and harvesting can be done from middle of June to late July, or it may start from the rainy season. Since late planting is done in March, higher temperature accelerates vegetative growth, so the growth period will be shortened to 110 to 120 days. In this case, harvesting can be conducted before the rainy season starts.

(4) Farming Practices and Farm Management

Based on the interviews with the farmers conducted in the Rosso scheme, the main features of the present farming practices are consolidated in Table A5.2.8.

Table A5.2.8 Present Farming Practices in the Rosso Subproject

Farming Practices and their Features
Land preparation ・ Although the surface soils are lifted and crushed using "offset harrow" driven by a large-size tractor (125 hp), the soil depth seems to be shallow at less than 10 cm. ・ Dry soils are very hard, and farmers prefer powerful tractors with more power. One-time harrowing is not enough, so second harrowing is done in many cases. In this case, the land preparation cost becomes higher. ・ Pre-irrigation is desirable for easier, deeper, effective, and efficient land preparation, but no practices are carried out because farmers feel that the irrigation cost becomes higher. Difficulty in controlling field moisture may be another reason for this. ・ The plot size is rather small ranging from 0.2 ha to 0.5 ha, which is not suitable for a large-size tractor and combine harvester in terms of efficiency. ・ Under wet conditions, a large-scale tractor is not suitable for heavy muddy conditions. Small- to medium-size tractors may work better because of their light grounding pressure. ・ Manual levelling is the basis of the present condition, but it is not so broadly practiced.
Seeding ・ Broadcasting is the common practice, and bird damage is reported in the broadcasted paddy fields. In order to avoid bird damage, some farmers practice transplanting in the limited area by taking seedlings from the broadcasted fields. Some farmers indicated their willingness to try transplanting of rice. ・ The desirable seed rates are 120 kg/ha for broadcasting, and farmers can reduce the seed rate to 80 kg/ha to use the certified seeds. ・ It is observed in the field survey that varieties are mixed and contaminated in the fields due to self-multiplication of seeds without renewal of the certified seeds. It is recommended to use the certified seeds every three years. ・ Farmers sometimes utilize the seed broadcasting services from the service provider.
Fertilizer application ・ No basal fertilizers are applied before seeding. ・ Top dressing is practically applied twice during rice growing, although it is desirable to conduct top dressing three times. This is because of low availability and high prices of fertilizers. ・ Farmers sometimes utilize the fertilizer application services from the service provider.
Weeding ・ The first weeding is carried out by applying herbicide after seeding. The second weeding is recommended to be conducted manually. ・ Farmers sometimes utilize the herbicide application services and manual weeding services from the service provider.
Harvesting ・ It is recommended by PAPRIZ2 that water should be drained from the field about two weeks before harvesting to accelerate ripening and to improve the soil condition. ・ The present drainage condition does not permit draining of water from the field, and the large-scale combine harvester cannot enter the field. Therefore, all the harvesting work is done manually in the subproject. ・ Farmers hire laborers for harvesting since family laborers are not available in their households.
Funds for farming ・ Farming funds are required for procurement and operation of services and materials, such as mechanical services, labors, seeds, fertilizers, and herbicides. ・ Farmers are usually put in a difficult situation of needing to build their own capital and not having enough funds for rice farming. In this situation, farmers must obtain financial measures, like loans and credits, for farm operation. ・ National Bank for Agricultural Credit in Senegal (CNCAS) is the largest and most popular financial institution to provide

Farming Practices and their Features
credit and loans in favor of farmers. ・ In the process of obtaining loans and credits from CNCAS, farmers require support from SAED extension officers (Conseil Agricole: SAED CA) for the preparation of application documents. Another situation is also reported wherein farmers are sometimes unable to repay due to delay of harvesting or due to damages from natural calamities.

Source: JICA Survey Team

(5) Rice Crop Budget and Farm Household Income

In order to estimate the present crop budget for rice farming, the following basic assumptions are set:

a) The average farm size is estimated at about 0.5 ha/farmer, derived from the total service area of 250 ha and 500 farmers under the scheme,
b) Based on the farmers' interview results, farm family size is estimated at 7 persons/farm family,
c) Home consumption of rice grain is estimated at 735 kg/family per annum (68.3 kg milled rice = 105 kg grain/person per annum, 7 person/family),
d) Home consumption per ha is 1,430 kg/2 families (1 ha), and
e) A unit yield of 6.3 ton/ha is applied for dry season crop, referring to the average unit yield of the subprojects in Dagana.

Based on the above assumptions, the present budget for rice cropping is estimated with the net income of farm family, as shown in Table B5.2.1 and summarized in Table A5.2.9.

Table A5.2.9 Present Rice Crop Budget in the Rosso Subproject

Item	Amount (per ha)	Remarks
A. Gross income		
Production:	6,300 kg	Refer to the average yield of subprojects in Dagana
Marketable surplus	4,830 kg	Deduction of 1,470 kg (2 families/ha)
Gross income	604,000	@125 FCFA/kg
B. Production cost		
1. Land preparation	25,000	1 times of offset harrow by tractor,
2. Seeds	12,000	Renewal of seed every 3 years
3. Input (fertilizer & herbicide)	60,000	No basal fertilizer, 1 times of herbicide
4. Irrigation	85,000	Water fee for Union
5. Labor work	10,000	Seeding, fertilizer application, chemical application, manual weeding
6. Harvesting	75,000	25 man-days/ha by hired labour
7. Others	41,000	Transport, contingency, depreciation
8. Financial expenses	23,000	Interest 7.5% per annum, for 12 months
9. Subtotal	331,000	
C. Net income per ha	273,000	A. Gross income – B. Production cost
D. Net income for cropping intensity 78%	212,000	per 2 farm family
E. Net income per farm family	106,000	about 106,000 FCFA per farm family

Note: Prices are estimated based on crop budget table by SAED and so on, as of June 2019
Source: JICA Survey Team

The net income of the farm family is estimated at about 106,000 FCFA per annum. This amount may not be enough for overall family expenses, and farm families may rely on another supplemental source of income, like off-season labor work or another kind of off-farm income.

In order to increase the income of individual rice farmers, rice farming should be increased in terms of productivity by focusing on the following issues:

1) Increase the cropping intensity by rice double cropping,

2) Minimization of production cost and enlargement of farm size,
3) Reduction of post-harvest loss and improvement of rice quality, and
4) Achievement of appropriate rice unit yield balanced with the production cost.

5.2.6 Institutional Development, Operation and Maintenance

(1) Institutional Development

A cooperative in the Rosso Irrigation Scheme was established in the 1960s and was reformed as the "Rosso Union" in 2016. As of 2019, members of the Union include eight GIE of farmers and two individuals. There is a total of about 500 members (294 farmers practice rice cropping, dry season of 2019), and 11 of them are women. According to the farmers, at the time of the development of the irrigation scheme, women had not shown interest in rice cultivation; therefore, there were not a lot of farm plots allocated for them.

There is no initial charge for the Union; however, each group member pays a water fee of FCFA 85,000 per ha for maintenance and other activities. This water fee was increased in 2019 from a previous value of FCFA 70,000.

Although the internal regulations have not yet been signed, the Union is operated in accordance with the draft internal regulations. According to the draft, the organization of the Union consists of a general meeting, a board of directors, and a secretariat. The functions of each organization is given below:

- The general assembly approves the proposal presented by the secretariat and decides on the general orientation of the Union's activities;
- The board of directors decides on the budget and the plan of activities for each crop season. The board of directors is also able to call an extraordinary general meeting, if necessary; and
- The secretariat carries out activities based on the budget and the plan decided by the board of directors of Union.

A general assembly meeting is held once after the end of each crop season. The board of directors has 16 members from 8 GIEs (i.e., a representative and another member of each GIE). The draft internal regulations state that meetings shall be held every month during the crop season, but, for practicality, the meetings are held twice a season on the average. The secretariat has 11 members, including a president, a vice president, a secretary, an assistant secretary, a treasurer, an assistant treasurer, a manager of development/operations, a manager of the pumping station, a manager of equipment/materials (in charge of agricultural machinery), and two auditors. The frequency of the secretariat meetings is not set in the draft internal regulations; however, it is generally held monthly. Each GIE has a committee for collection of the water fee.

The block management could be relatively easy to introduce for the Rosso Irrigation Scheme since the farmers carry out farming activities in blocks. The block size of each GIE is shown in Table A5.2.10.

Table A5.2.10 Number of GIEs and Their Assigned Blocks

	Number		Block per secondary canal													
	Total	Women	No.1	2	3	4	5	6	7*	8	9-1	9-2	9-3	9-4	9-5	10
GIE Bokk Diom	45	2											27	18		
GIE Bokk Liggey	42	3	16	26												
GIE Diambarou Rosso	42	0					26	16								
GIE Bokk Guiss Guiss	25	1			25											
GIE Yakar Yalla	32	1				32										

	Number		Block per secondary canal													
	Total	Women	No.1	2	3	4	5	6	7*	8	9-1	9-2	9-3	9-4	9-5	10
GIE Khar Yalla	38	1							38							
GIE Mbawar	25	2													7	18
Bokk Tekki	43	1								22	12	9				
Ndonxay (individual)	1	0								1						
Saliou Dieng (individual)	1	0											1	1		
Total	**294**	**11**	**16**	**26**	**25**	**32**	**26**	**16**	**38**	**23**	**12**	**9**	**28**	**19**	**7**	**18**

Note : Groups by 7-1 to 7-6*

Source: JICA Survey Team

(2) Activity Planning and Loan Application

The Union had paid FCFA 50,200 to open an account at the LBA (Ex CNCAS) and a deposit of FCFA 28,000 per ha. The repayment period of the loan for farming operations is set to nine months. This was extended to one year since January 2019, with an interest rate of 7.5%.

The Union has signed a contract with LBA (Ex CNCAS). The Union needs to prepare a budget plan for requesting a loan from LBA for each crop season. The Union prepares the budget plan with the support of CGER and SAED. In case some farmers did not complete the repayment of the loan as scheduled, GIE members need to compensate for this by financing other members. This is one of the conditions of the bank for loans.

The table below shows the budget allocation for the dry season in 2019. The water fee is defined based on to the planed cropping area by each GIE member. The amount required by the GIE is prepared by LBA or by own funds.

Table A5.2.11 Budget Allocation for the Rosso GIE Unions
- Dry Season 2019 –

Unit: FCFA

Member	Planned cropping area (ha)	Water fee	Fund			Balance
			Area (ha)	LBA	Own Funds	
GIE Bokk Diom	29.00	2 465 000	29.00	2 465 000		
GIE Bokk Liggey	29.00	2 465 000	29.00	2 465 000		
GIE Diambarou Rosso	30.00	2 550 000	30.00	2 550 000		
GIE Bokk Guiss Guiss	8.63	733 550	8.63		733 550	733 550
GIE Yakar Yalla	7.59	645 150	7.59		645 150	645 150
GIE Khar Yalla	14.00	1 190 000	14.00		1 190 000	1 190 000
GIE Mbawar	2.00	170 000	2.00		170 000	170 000
Ndonxay (individu)	6.00	510 000	6.00		510 000	510 000
Saliou Dieng (individu)	1.60	136 000	1.60		136 000	
Tota l	**127.82**	**10 864 700**	**127.82**	**7 480 000**	**3 384 700**	**2 173 700**

Unit: FCFA excepted for the area, Hydraulic cost is 85 000 FCFA / ha

Source: Prepared by JICA Survey Team based on the Rosso GIE/ Union document

The following table shows the estimated income and expense for dry season in 2019. It covers the estimate of expenses for six months from February to July. The ratio of expense for each major item is (i) 71% of pump, (ii) 14% of operation and maintenance, (iii) 5% for administration, and (iv) 4% of deposit. The electricity cost of the pump reaches 57%.

Table A5.2.12 Billing Forecast for the Rosso GIE Unions - Dry Season 2019 -

Unit: FCFA

Items		Feb.	Mar.	Apr.	May	Jun.	Jul.	Total
Incomes								
Water Fee		10,864,700						
Expenses								
i) Pump	**71.00%**	42,500	1,695,795	1,540,000	1,440,000	1,430,860	1,564,782	**7,713,937**
Salary for Pump Operator and Security Guard	6.90%		150,000	150,000	150,000	150,000	150,000	750,000
Salary for Mechanic	4.69%		150,000	90,000	90,000	90,000	90,000	510,000
Electricity	57.25%		1,295,795	1,300,000	1,200,000	1,100,000	1,324,782	6,220,577
O&M of Pump	2.15%	42,500	100,000			90,860		233,360
ii) Operation and Maintenance	**14.00%**		385,000	1,100,000		36,058		**1,521,058**
O&M of Canals	14.00%		385,000	1,100,000		36,058		1,521,058
iii) Administration	**5.00%**		33,000	43,000	214,611	18,000	234,624	**543,235**
Equipment	0.23%			25,000				25,000
Communication	0.23%		5,000	5,000	5,000	5,000	5,000	25,000
Transportation	0.37%		8,000	8,000	8,000	8,000	8,000	40,000
Bank Charge	0.41%		15,000		15,000		15,000	45,000
Meeting Expense	0.23%		5,000	5,000	5,000	5,000	5,000	25,000
Payment for CGER	2.61%				181,611		101,624	283,235
Expense for General Assembly Meeting	0.92%						100,000	100,000
iv) Deposit	**10.00%**	1,086,470						**1,086,470**
Deposit	10.00%	1,086,470						1,086,470
Total Expenses	**100.00%**	1,128,970	2,113,795	2,683,000	1,654,611	1,484,918	1,799,406	**10,864,700**
Balance		9,735,730	7,621,935	4,938,935	3,284,324	1,799,406	-	

Source: Prepared by JICA Survey Team based on the Rosso GIE/ Union document

(3) Operation and Maintenance

The Union employs operators who are able to operate and maintain pump facilities for daily operation. When they have problems on the pump facilities, they request DAM and SAED to inspect and repair the pump facilities, as needed.

The Union checks the situation of canals and paddy fields and orders repair and maintenance works to contractors as needed before the start of the cropping season. In case the cost estimate of the work exceeds their budget, they would occasionally carry out maintenance works on their own. Checking of activities in the canal and paddy field is carried out daily. Removal of sediment in the canals is carried out every month.

(4) Issues and Capacity Building

Through the survey, the following problems are identified concerning the organization of the Union:

- The function of the organization is weak, and financial management is difficult;
- Repayment of loan is difficult because of the lack of productivity in some paddy fields; and
- Coordination among organizations is difficult because some members do not fully understand the meaning of unity and leadership.

The activity report of the Union outlines the following points on organizational management:

- Lack of office building and lack of equipment for office; and

- The expenses for electricity costs, spare parts, etc. are high.

According to the interviews with farmers, they request various trainings, such as seed production, pump operation, organizational strengthening, and financial management. One of the pump operators has not yet received any training on the operation and maintenance of pumps.

5.2.7 Gender

In line with the "gender" indicator advocated by the Ministry of Agriculture and Rural Development and the action plan developed by SAED, which has jurisdiction over Dagana and Podol, the Gender Action Plan for the Rosso Irrigation Scheme has been formulated. The plan recognizes that women and young people are not encouraged to participate in the current organization and the GIEs that make up the Rosso Union. In accordance with the SAED Gender Action Plan, the Gender Action Plan for the Rosso Irrigation Scheme includes the following activities:

- Establish a gender office in Rosso Union;
- Appoint women to become at least 20% of the board members and assign two women to the Rosso Union Executive;
- Use an equivalent of 20% or 50 ha of the total plot for the utilization of small-scale rice milling facilities for women;
- Involve women and young people in irrigated agriculture in cooperation with support organizations;
- Promote women's entrepreneurship through the implementation of specific gender programs in different projects; and
- Incorporate perspectives that contribute to women and youth in project and program resource allocation.

In fact, at the decision-making level, there are no women appointed in the Rosso Union office, and only 4% of the 292 union members are women.

5.3 Formation of Development Plan for Pilot Site Subproject

5.3.1 General Approach and Overall Development Plan

(1) Development Concept

The objective of the irrigation development project is generally recognized to improve agricultural productivity by providing irrigation and drainage facilities. However, this understanding sometimes misleads the direction of the irrigation project as part of agricultural development. The improvement of agricultural productivity is only the process to the goals and is not achieved by infrastructure development alone. The ultimate goals of irrigation development shall be the attainment of food self-sufficiency (food security) and the improvement of poverty (poverty alleviation = improvement of farm economy) in the rural area. These goals shall be achieved through integrated approaches composed of institutional development as well as infrastructure development. It is essential to recognize that infrastructure development is important for the fundamental development of the activities of the rice value chain, which include farming practices, farm mechanizations, post-harvest activities, and marketing. In consideration of this role, infrastructure shall be developed to satisfy the requirements and necessity from these components. The Project shall be implemented toward these goals. Therefore, the

development plans for the Rosso Scheme are formulated through collaborative studies on the infrastructure component (hard) and the agricultural and institutional components (soft).

(2) Overall Development Plans

The most important factor for irrigation farming is the availability of water resources to the irrigation service area. As explained in the previous chapter, the water resources of the Senegal River are abundant for the irrigation of double cropping of paddies every year.

On the other hand, as clarified in Sub-chapter 5.2 "Present Conditions, Constraints and Issues in Pilot Site", the main constraint in the Rosso Scheme is low cropping intensity which is the same in the Project target areas as described in Sub-chapter 2.2.1. The rice cropping intensity in the Rosso Scheme is estimated at only 78% in average from 2016 to 2018, as shown in Table A5.2.4. There is an extension area of 50 ha in the Rosso scheme, but it is expensive and takes time to develop this area as mentioned in Sub-chapter 5.2.2 (1). Therefore, as the first phase development in the Rosso Scheme, it is judged that the present irrigation area of 250 ha shall be improved.

In consideration of the above present situations, the development plans in the Rosso Scheme are formulated to focus on the "improvement of cropping intensity for the double cropping of irrigated rice farming in the present irrigable area of 250 ha", and the necessary plans for each component are presented.

To achieve full irrigated rice farming in the Rosso Scheme, the following rehabilitation and improvement works are indispensable.

Table A5.3.1 Overall Development Plans in Rosso Scheme

Component	Present and Constraints (Chapter Reference)	Development Plans
Irrigation and Drainage Facilities	Insufficient pump capacity for standard water requirement (5.2.2 (2))	Installation of additional pump equipment for supplemental water requirements between the proper irrigation water requirements and the present pump capacity
	No water distribution to terminal area due to canal deterioration, seepages, insufficient and low quality canal structures (5.2.2 (3))	Rehabilitation and/or improvement of irrigation canals and related structures for delivery of irrigation water to all service areas/farm lots
	Due to drainage canal network, inundation and salinity problem in the downstream area, and difficulty of farm mechanization with such drainage problems (5.2.2 (4)、5.2.4、5.2.5 (1) (2))	Construction of new drainage canals and pump station to drain excess water and to mitigate salinity issues as well as to improve workability in the farm plots
	Difficulty of proper water management without on-farm facilities and poor farm leveling (5.2.2 (5))	On-farm development composed of on-farm canal networks and land levelling for optimum water distribution and paddy field
Agricultural Related Facilities	Insufficient farm road networks and low quality road surface construction (5.2.3 (1) (2))	Rehabilitation and construction of farm roads for smooth transportation of agricultural inputs and outputs as well as access by farm machines
	No post-harvest facility (5.2.3 (3)、5.2.4、5.2.6 (4))	Construction of post-harvest facilities, such as warehouse, Union's office, motor pool, and solar dryer, for proper marketing of agricultural products and for strengthening cooperative works by the Union
Farm Machines	Delay of wet season farming due to long period harvesting of dry cropping (5.2.5 (2)), and manual harvesting without combine harvester	Improvement of farm mechanization for proper farming practices with programmed cropping pattern to prevent unnecessary time-lag to the

	(5.2.4)	following crop
Institutional Strengthening	Necessity of capability building for the Union (GIE) focusing on O&M management (5.2.6 (4))	Strengthening of farmers' cooperative (Union, GIEs) through trainings for organizational structures, financial management, etc.

Source: JICA Survey Team

The above-mentioned development activities shall be necessary to achieve double cropping of rice in the Rosso Scheme, with consideration of the current situation mentioned in Sub-chapter 5.2. In this sub-chapter, the development plan of the Rosso Scheme for each component is discussed and described.

5.3.2 Necessity of Installation of Hydrological Measurement Instruments

Meteorological and hydrological measurement systems are required for proper irrigation water management. The rainfall and river discharge measurements are basic conditions needed to assess the irrigation water requirements and water source availability. Therefore, irrigation in the area where water resources are critical requires rainfall stations, not only in the irrigation area but also in the water resource river basin (catchment area of the river). The water level at the intake site (pump station) shall also be observed to estimate the river discharge and to control the utilization of water sources for irrigation.

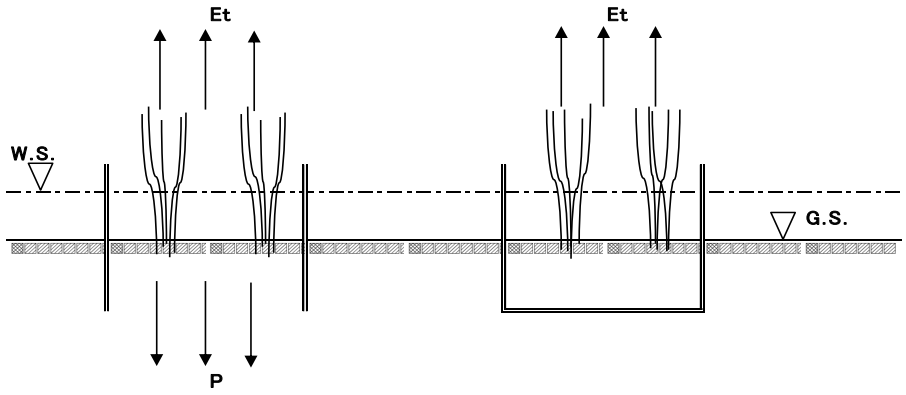
For the Rosso pilot site, however, the water resources of the Senegal River are adequate for the present irrigation area of 250 ha through the year. The pump can be operated relatively easily by the ocular monitoring of rainfall because the pump station is located near the irrigation area. Under these situations, the meteorological and hydrological measurement systems are not necessary for the Rosso pilot site at present. Initially, the basic rehabilitation works shall be carried out to realize the full potential of irrigation farming. The meteorological and hydrological measurement systems will be studied after the realization.

Aside from above meteo-hydro measurement systems, actual irrigation water requirements shall be reassessed based on the field research of crop water requirement. SAED shall also review the standard figures on the irrigation water requirements mentioned in Chapter 2 (2.2.2). The present water requirements are only the total volume per crop during the wet and the dry seasons. At least monthly, the water requirements shall be planned for the proper water distribution and operation of pumps.

Crop water requirement (CWR) may be defined as the total water necessary for crop growth from pre-planting to transplanting to terminal drainage prior to harvesting. It is equal to the amount of water used for evapotranspiration (Et) or consumptive use (CU) (evaporation from the water/soil surface and transpiration through the crop's vegetative parts) and percolation loss (P) through the soil to the groundwater. Using symbols, CWR = Et + P.

Crop water requirement can be determined by conducting a field experiment using lysimeter tanks. It consists of two tanks, one with a bottom and one without a bottom. They are installed side by side, planted with the same number of hills, and the level of water inside and outside the tanks are the same as shown in Figure 5.3.1. The tank without bottom measures evapotranspiration and percolation (Et + P), while the tank with bottom measures evapotranspiration. Measurement is done in each tank at least once a day for the whole growing period of the rice crop. Daily averages are computed in mm/day. Based on the results, monthly or semi-monthly crop water requirements can be estimated for the programmed cropping pattern.

It is recommendable to conduct the above-mentioned field researches before the commencement of the Project to adopt more realistic water requirements in the operation of pump as well as in the planning and design works.



Source: Water and Irrigation Management, National Irrigation Administration Philippines

Figure A5.3.1 Set of Lysimeter Tanks

5.3.3 Irrigation and Drainage Improvement

The Rosso scheme has a developed irrigation area of 250 ha; however, the present irrigation farming area is limited to about 140 ha due to the poor conditions of irrigation canal networks and the salinity problem in the downstream area, which is caused by the absence of a drainage canal network. Thus, it is essential to rehabilitate and construct both canal networks to achieve full production in the 250-ha service area.

The irrigation water requirements serve as basis for the formulation of irrigation development and/or rehabilitation plans. For irrigation development, crop water requirements are roughly estimated based on SAED's standard irrigation water requirements presented in Chapter 2 (2.2.2). The gross water requirements for rice in Podor are 16,900 cum/ha to 22,500 cum/ha for one crop season. These gross requirements are estimated based on an irrigation efficiency of 55% to 45%, depending on soil permeability. The crop water requirements are estimated considering the following assumptions:

a) The gross water requirements for rice are assumed at 16,900 cum/ha in wet season and 22,500 cum/ha in dry season.
b) Irrigation efficiency is assumed at 55% in consideration of clay soil in the scheme.
c) Crop water requirements of rice for one cropping season are estimated at 1,200 mm for dry season and 900 mm for wet season, with the assumption of 55% efficiency.
d) Land preparation water requirement is adopted at 325 mm per month, as mentioned in Sub-chapter 5.2.2.
e) The cropping schedule of rice is 130 days for dry season and 120 days for wet season. The cropping schedule is explained in Sub-chapter 5.3.7.
f) The monthly crop water requirements are proportionally estimated based on the monthly evaporation data shown in Table A5.3.2.

Table A5.3.2 Crop Water Requirements Estimated from Evaporation Data

Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave.
Evaporation (mm/day)													
Podor	5.55	6.33	6.00	6.53	6.83	7.03	5.13	3.28	3.40	5.08	5.70	5.58	5.54
Crop Water Requirement (mm/day)													
Wet (900 mm/sqm)							10.8	4.32	4.48	6.69	7.51		
Dry (1,200 mm/sqm)	10.8	7.84	7.43	8.09	8.46								

Note: Evaporation data is average of 2011 to 2016
Source: SAED and JICA Survey Team

(1) Irrigation Pump Station

The existing three pumps are functional and have a total capacity of 1,764 cum/hour (0.49 cum/sec). This capacity has to be assessed whether it can supply the design water requirement or not. In order to estimate the design water requirement, the overall irrigation efficiencies are estimated at 65% with the rehabilitation/improvement works of the irrigation canal networks and other works planned.

With this overall irrigation efficiency, the design water requirement (DWR) is estimated as follows:

DWR = (Peak CWR) / (IE) = (10.8 mm/day) / (65%) = 16.6 mm/day

Based on this DWR and the pump operation hours per day, the required pump capacities are estimated as follows:

Table A5.3.3 Required Pump Capacity by Operation Hours

Pump Operation Hours	**24**	20	**16**	12	10	8
Design Pump Capacity (lit/sec/ha)	**1.92**	2.30	**2.88**	3.84	4.61	5.76
Irrigation Water Requirement for 250 ha (cum/sec)	**0.48**	0.58	**0.72**	0.96	1.15	1.44

Source: JICA Survey Team

The present pump capacity of 0.49 cum/sec is enough for 24-hour operation during the peak irrigation (land preparation stage). However, in consideration of the SAED standard operation hours (16 hours), the age of the present pumps, and the future extension of the irrigation area, an additional pump shall be provided to supplement the balance between the requirement (0.72 cum/sec) and the present capacity (0.49 cum/sec). Thus, the additional pump is proposed to be installed with a capacity of 0. 23 cum/sec (828 cum/hour). As the secondary effects, it is expected that (1) minimum pump discharge can be assured by 24-hour operation of three pumps when one pump is damaged and (2) the design water discharge can be supplied by 20-hour operation of full pumps in peak time when the extension area of 50 ha is developed.

The existing three pumps are still functional, and the Union does not request to have them replaced yet. The Union plans for the replacement of pumps using the reserve funds. In consideration of these situations, the replacement of the existing pumps is not recommended in the preliminary design.

The inlet and outlet channels will improve with the installation of an additional pump. The suction sump and discharge sump for the additional pump are constructed beside the existing pump, and the discharge sump will be connected to the existing inlet channel. Except for the improvement works, the present outlet channel is well-maintained, and the flume section has enough flow capacity for the design water requirement. Thus, extra rehabilitation work is not planned. The inlet channel requires some improvement works, such as reshaping of canal sections and installation of screen and platform to clean flouting debris.

In addition to the above improvement works, the pump house shall also be constructed considering safety and work efficiency. Based on the size of the pump, a new pump house with about 9.5 sqm floor

area will be constructed.

(2) Irrigation Canal Networks

As for the rehabilitation and/or improvement of irrigation canal network, the present earth canal is proposed to be converted to a concrete type canal, such as concrete flume canal or trapezoidal concrete lining canal. Generally assessing the earth materials for the canal section (not only embankment but also excavation sections), the quality is very poor, and the leakage and erosion of the canals are common problems encountered in so many schemes. For the model of future irrigation development and for proper O&M of canal networks, it is recommendable to introduce modernized canal networks in the existing irrigation schemes whenever these schemes are required to be rehabilitated and/or improved.

A construction schedule is proposed in consideration of not only the workability based on weather conditions but also the suspension of farming practices. The rehabilitation of the scheme benefits the farmers. However, if construction requires suspension of farming, it will be detrimental for the farmers to loss their income sources. Construction works will be executed during the off-farming periods or non-farming activities, as much as possible. Thus, precast concrete flume canal is one of the recommendable types, which can shorten the construction period as opposed to the concrete lining method.

With the above consideration, the following rehabilitation/improvement works are proposed:

a) The main canal (MC) is improved with a concrete flume canal. The canal type for the improvement will be determined through further studies on technical soundness and economic feasibility.
b) All structures along the MC are replaced with new structures (e.g., turnout and culvert). Furthermore, new road crossing structures are also constructed together with the proposed farm road networks.
c) All secondary canals (SC) are rehabilitated with reshaping of the sections with suitable canal bank width.
d) Farm land leveling and on-farm canal development are planned. These works will be carried out with participatory approach by the Union.

Through the above rehabilitation/improvement works, conveyance efficiency is assumed to be 65%. Even SCs are earth canals, and the length of the longest canal (SC-5) is 1,150 m. Therefore, water losses from SCs are not serious. Operation efficiency is also improved with rehabilitation/construction of concrete turnout structures which can control the water distribution more effectively. On-farm efficiency can be improved by the land levelling works. Present and improved efficiencies are compared in Table A5.3.4.

Table A5.3.4 Irrigation Efficiency

Efficiency	Present	Improved	Improvement Works
Conveyance	80 %	85 %	Concrete Lining of MC & SC-9, Re-shaping of all SCs
Operation	85 %	90 %	Provision of all turnout & division boxes
On-Farm	80 %	85 %	Land leveling
Overall	55 %	65 %	

Source: Prepared by JICA Survey Team referring to "FAO Irrigation and Drainage Paper"

(3) Drainage Pump Station

The drainage pump capacity is estimated at 1.00 cum/sec (3,600 cum/hour) based on the total drainage area of 400 ha. Based on this, the preliminary design will be carried out for the following facilities.

Drainage pump station: Pump equipment, inlet and outlet channels, and pump house

Main drainage canal: 3,090 m

Secondary drain: 4,000 m

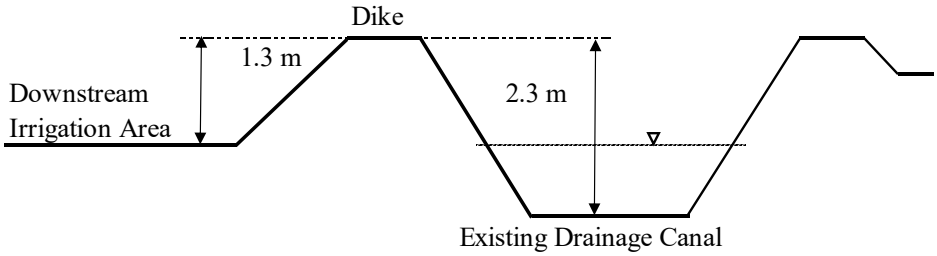
Collector drains: 24 units, 21,740 m

Related structures: Drainage culvert (5 units)

The proposed drainage facilities can contribute to the improvement of not only the salinity and inundation problems in the downstream area but also the farm conditions for farm mechanization.

(4) Drainage Canal Networks

To drain the excess water, collector drains are proposed to be constructed along both sides of the farm roads. The collector drains are connected to the main drainage canal proposed in the downstream boundary of the irrigation area along the existing Nathis Drainage Canal. The excess water collected to the main drainage canal is pumped out to the Nathis Drainage Canal because the bottom elevation of the Nathis Drainage Canal is only 1 meter below the elevation of the downstream irrigation service area (refer to Figure A5.3.2). Therefore, the drainage pump station is indispensable to improve the salinity problem and the poor drainage conditions in the Rosso Scheme.



Source: JICA Survey Team

Figure A5.3.2 Typical Section between Irrigation Area and Existing Drainage Canal

On-farm drainage canal networks, including some of the collector drains, are constructed with participatory approach by the Union.

The total drainage area is estimated at 400 ha, including the gross irrigation area of 319 ha and a part of the town of Rosso. The secondary drainage canal will also be constructed to drain the excess water in the irrigation area located in the left side of the main canal and the Rosso town area. The secondary drain is constructed along the northern and eastern boundary of the irrigation area. The secondary drain is connected to the main drainage canal just before the proposed pump station. The maximum drainage discharges of both drainage canals are estimated based on SAED's drainage requirement as follows:

Main drainage canal: Drainage area (145 ha) x 2.5 lit/sec/ha = 0.36 cum/sec

Secondary drain: Drainage area (255 ha) x 2.5 lit/sec/ha = 0.64 cum/sec

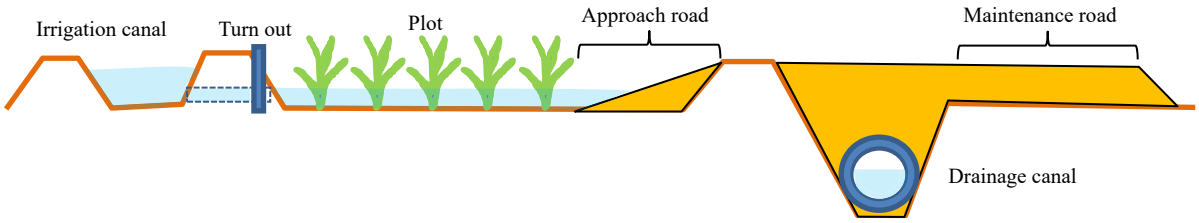
5.3.4 Plan for Agricultural Related Facilities Improvement

(1) Farm Roads

Extension of all the existing farm roads to cover all areas of the irrigation scheme is proposed for effective farming. In addition, construction of new farm roads between secondary canals (SC-1 and SC-2, SC-3 and SC-4, SC-5 and SC-6) are proposed. In other areas, new farm roads are proposed along the secondary canals, except SC-9. The approach roads from farm road to farm plots are also constructed

for the improvement of access to the agricultural machines. The farm roads are partially utilized as maintenance roads.

The cross section of the farm plot, road, and canal is shown in the following figure:



Source: JICA Survey Team

Figure A5.3.3 Typical Cross Section of Farm Plot, Road, and Canal

(2) Access Road

The existing public roads (unpaved roads) can be utilized as access roads from the irrigation area to the main road since the existing road is properly maintained. Therefore, construction of access road is not included in the development plan of the subproject.

(3) Post-harvest Facility

The candidate construction site of the warehouse, with 1,686 sqm area near the existing public road and the irrigation area, is already proposed by the Union (refer to Figure B5.2.1). Any land acquisition is not required for the candidate site since the land will be provided by the Union.

The facilities requested by the Union are as follows:

a) Warehouse: size is determined by calculation from expected paddy storage quantity;
b) Office: for meetings of Union members;
c) Solar dryer: size is 20 m × 30 m; and
d) Garage of agricultural machine: calculated from the number of agricultural machine owned by the Union.

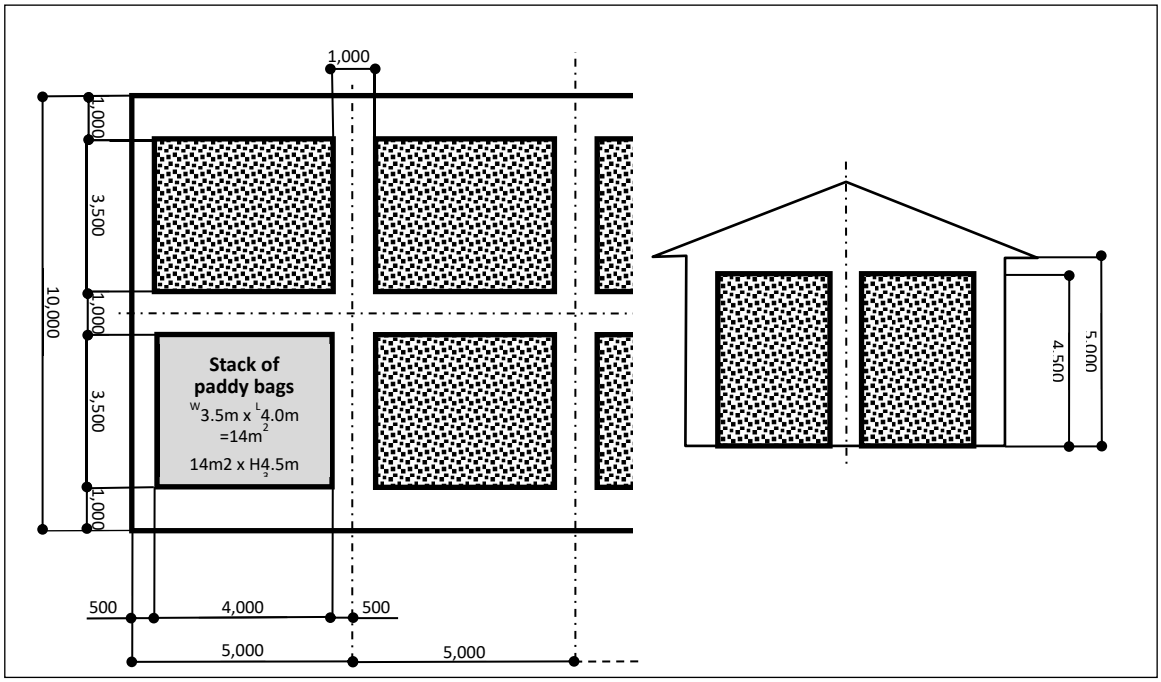
1) Warehouse

Required Storage Capacity

The required storage capacity is determined by assuming the storage condition of the paddy as follows:

a) Paddy bags are stacked in two places in one span (5 m x 10 m).
b) The width of the space between the wall side and the bags of the paddy is 1 m for loading and unloading of the paddy.
c) The area occupied by one span of the stack of paddy bags is 14 m^2 = 3.5 m x 4.0 m.
d) For air circulation in the storage space, the maximum height of the stack of paddy bags shall be up to 4.5 m.
e) Therefore, the volume of paddy bags stacked in one span is 126 m^3 = 14 m^2 x 4.5 m x 2 places.
f) It is assumed that the weight volume ratio of the paddy bags is 0.5 ton/m^3.
g) The weight of the paddy stacked in one span will be 63 ton = 126 m^3 × 0.5 ton m^3.

The outline of the proposed warehouse is shown in Figure A5.3.4.



Source: JICA Survey Team

Figure A5.3.4 Outline of Warehouse

The number of spans in the warehouse will be calculated based on the weight of the paddy stacked in one span (63 ton/one span) and the expected storage volume.

The length of the warehouse shall not exceed 50 m (10 spans) with consideration of work efficiency and ventilation in the warehouse. According to necessary storage volume, a separate warehouse building shall be constructed in case the calculated length of warehouse exceeds 50 m based on the assumptions above.

Paddy Production and Storage Capacity

The expected paddy production volume is determined as follows:

a) Cultivation area: 250 ha and unit yield: 7.5 ton/ha
b) Expected paddy production volume: 1,875 tons = 250 ha x 7.5 ton/ha
c) The storage capacity is calculated by deducting the temporally storage volumes from the total production volume. The temporary storage volumes are composed of paddy equivalent volume for loan repayment (about 50% of total production), early marketable volume (about 25% of total production), and house consumption volume for each farm household (about 5% of total production). In consideration of the temporary storage volumes, it is assumed that about 30% of the total production volume will be stored. The storage capacity is assumed to be 560 tons (1,875 tons x 30%).

Span of Warehouse

a) Storage capacity per span: 63 tons/span
b) Expected paddy storage volume: 560 tons

From this, the required storage capacity is 9 spans (8.9 span = 560 ton/63 ton/span). Therefore, the required storage warehouse will only need one building (450 m^2=width 10 m × length 45 m).

2) Office

The office area is calculated from the number of members and the occupied area per person.

a) Number of persons: 27 persons = Union 11 persons + 8 GIEs×2 persons
b) Occupied area per person: 3 m^2
c) Other required space (lavatory, space for office equipment & furniture): 8 m^2
d) Office area: 100 m^2 > (81 m^2 = 27 persons×3 m^2) + (18 m^2 for lavatory, etc.)

The office building will be constructed as one building together with the warehouse; thus, the total floor area is calculated as 10 m width times 10 m.

3) Solar Dryer

The solar dryer is constructed in front of the warehouse to dry the paddy immediately after harvesting. The area of the solar dryer (20 m x 30 m) is the size of a basketball court so that the area can be used for other purposes. The floor has a slight slope from the center for drainage of rain water. The ditch will be installed at the edges of the solar dryer to collect rain water.

4) Garage of Agricultural Machinery

The size of the garage for agricultural machineries is determined by the size and number of agricultural machines owned by the Union. As explained in Sub-chapter 5.3.5, one combine harvester, three sets of reaper and thresher, and one trailer will be procured. A total of five farm machines (reaper and thresher are considered as one set) and one existing tractor have to be kept. The required width for one machine (one set) is assumed at 3 m, and the total width of the garage is 20 m (>6 nos x 3 m = 18 m). The inner width is decided at 7 m based on the existing garage in the Dagana Delegation. Therefore, the required space of the garage is estimated at 140 m^2 (20 m x 7 m). A roof to secure space for washing of the machines and simple maintenance is also installed. In addition, the agricultural related facilities constructed by the subproject shall be surrounded by the wall for prevention of crime.

5.3.5 Plan for Introduction of Agricultural Machinery

At present, there is a short period of bottleneck of rice double cropping from the end of rice cropping in the dry season to the start of rice cropping in the rainy season. It is necessary to conduct harvesting in the dry season to improve rice double cropping and rice cropping intensity, which are promoted by PAPRIZ2.

In order to overcome this problem, the policy for enhancement of mechanization of harvesting states the following:

a) The basic plan of mechanization is the introduction of reaper and thresher, which is promoted in PAPRIZ2.
b) In addition, for the promotion of mechanization in the future, one unit of a middle size crawler type combine harvester is recommended to be introduced. A middle size combine harvester is suitable for even a small plot field and for soft soil conditions.
c) A trailer for transportation of the above machinery shall be procured.

The introduction of agricultural machinery system will result to scheduled harvesting in the dry season and implementation of rice double cropping. Based on the harvesting capacity of the machines, the necessary number of machines for 250 ha of dry season rice cultivation area in the Rosso Irrigation Scheme is discussed below.

(1) Reaper and Thresher

1) Basic Factor

Harvesting period in dry season for planned rice double cropping: 30 days
Required harvesting area by reaper and thresher: 175 ha (250 ha – 75 ha)

2) Estimation of Necessary Number of Reaper and Thresher

Three units of reapers are necessary for a 175-ha harvesting area. The calculations are shown below:

Table A5.3.5 Capacity Estimation of Reaper

No.	Items	Capacity Estimation	Remarks
1	Harvesting capacity per hour (ha/hour)	0.29 ha/hour	Catalog value from manufacturer of reaper
2	Expected working hour per day (hour/day)	7.0 hour/day	Value comes from PAPRIZ2 report and data of actual working hours
3	Harvesting area par day	2.0 ha/day	0.29 ha/hour x 7.0 hour/day
4	Harvesting area per 30 days	60 ha/unit	2.0 ha/day x 30 days
5	Necessary number	3 units	175 ha ÷ 60 ha/unit

Source: JICA Survey Team

Using the same method of calculation, three units of threshers are necessary to work on a 175-ha paddy in a span of 30 days. The average yield in the dry season is estimated at 7.5 ton per ha.

Table A5.3.6 Capacity Estimation of Thresher

No.	Items	Capacity Estimation	Remarks
1	Threshing capacity per hour (ton/hour)	2.3 ton/hour	Catalog value from manufacturer of thresher
2	Expected working hour per day (hour/day)	7.0 hour/day	Same working hour of reaper
3	Threshing capacity per day	16.1 ton/day	2.3 ton/hour x 7.0 hour/day
4	Threshing capacity per 30 days	483 ton/unit	16.1 ton/day x 30 days
5	Threshing volume in 125 ha	1,312.5 ton	175 ha x 7.5 ton
6	Necessary number	3 units	1,312.5 ton ÷ 483 ton/unit

Source: JICA Survey Team

(2) Middle Size Combine Harvester (Crawler Type)

1) Basic Factor

Harvesting period in dry season for planned rice double cropping: 30 days

2) Harvesting Area by Capacity Estimation of Combine Harvester

Table A5.3.7 Capacity Estimation of Middle Size Combine Harvester

No.	Items	Capacity Estimation per 1 unit	Remarks
1	Harvesting capacity per hour (ha/hour)	0.36 ha/hour	Catalog value from manufacturer of middle size combine harvester
2	Expected working hour per day (hour/day)	7.0 hour/day	Value comes from PAPRIZ2 report and data of actual working hours
3	Harvesting area par day	2.5 ha/day	0.36 ha/hour x 7.0 hour/day
4	Harvesting area per 30 days	75 ha/unit	2.5 ha/day x 30 days

Source: JICA Survey Team

(3) Trailer for Transportation of Combine Harvester (Crawler Type)

A trailer is planned to be procured to transport the combine harvester (crawler type) since tractors cannot be used for self-running for long distances. A ladder or aluminum bridge will also be procured for loading and unloading the machines. One unit of trailer will be procured. The trailer shall be attached to the tractor owned by the Rosso Union.

5.3.6 Plan for Farm Management

(1) Present and Future Rice Cropped Area

The Survey Team obtained the opinion of farmers in the Rosso Scheme on future cropping pattern. The result is that 1) they intend to conduct double cropping after implementation of the subproject, and 2) they currently do not have an idea on how to expand vegetable cultivation. They will discuss among themselves and decide in the future whether they will increase the vegetable cultivation area or not.

Taking this into consideration, the Survey Team proposes rice double cropping for the future target cropping pattern, i.e., the cropping area will be expanded from the current 196 ha with crop intensity of 78% to 250 ha in both dry and rainy seasons with crop intensity of 200%, as shown in Table A5.3.8.

Table A5.3.8 Present and Future Rice Cropping Area in the Rosso Scheme

	Dry season	Rainy season	Total
Present rice cropped area	196 ha[*1] (78%)	0 ha (0%)	196 ha (78%)
Future rice cropped area	250 ha (100%)	250 ha (100%)	500 ha (200%)
Increment	+54 ha (+22%)	+250 ha (+100%)	304 ha (+122%)

*Note: *1 196 ha is the average of cropping area during the period from 2016 to 2018.*
Source: JICA Survey Team

The present unit yield of 6.3 ton/ha is assumed from the average yield of subprojects in Dagana included in the long list. The future anticipated yield is estimated at 7.5 ton/ha in the dry season and 6.5 ton/ha in the rainy season, based on the recent average yields in the master plan according to the SAED data.

Based on the assumptions above, production of rice will increase from the present 1,235 tons to the future 3,500 tons, which is about 2.8 times of the present production volume as shown in Table A5.3.9.

Table A5.3.9 Unit Yield and Production of Rice under the Project

		Dry Season	Rainy Season	Total
Present	rice cropped area	196 ha	0 ha	196 ha
	unit yield	6.3 ton/ha	-	6.3 ton
	rice production	1,235 ton	-	1,235 ton
Future	rice cropped area	250 ha	250 ha	500 ha
	unit yield	7.5 ton/ha	6.5 ton/ha	7.0 ton
	rice production	1,875 ton	1,625 ton	3,500 ton
Increment of rice production		+640 ton	+1,625 ton	+2,265 ton

Source: JICA Survey Team

(2) Proposed Cropping Pattern and Farming Practices

The proposed target cropping pattern is shown in Figure A5.3.5. The Survey Team proposes rice double cropping since the farmers in Rosso do not have an idea on how to expand vegetable cultivation at this time.

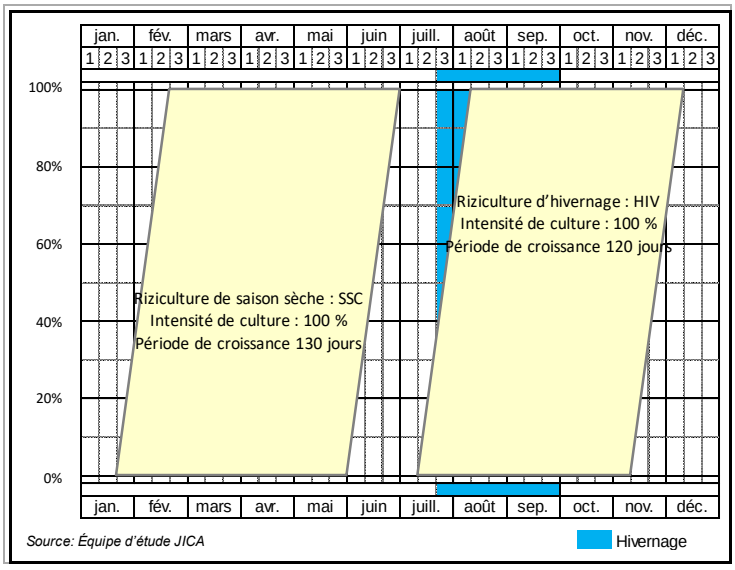


Figure A5.3.5 Proposed Target Cropping Pattern for Rosso Irrigation Scheme

Dry season rice cropping starts from late January to the middle of February with growth duration of 130 days due to lower minimum temperature in this period. The early matured variety is recommended to complete harvesting by the end of June, or one month before the beginning of rainy season, so that land preparation for the rainy season rice cropping can be carried out smoothly.

Land preparation is expected to be completed before the rainy season starts. Rainy season rice cropping starts from the middle of July with growth duration of 110 to 120 days from seeding to maturing.

In order to realize the above cropping pattern and schedule, the Survey Team recommend improving farming practices and farm management as shown in Table A5.3.10.

Table A5.3.10 Major Farming Practice and Farm Management under the Project

Proposed Farming Practices and their Features
Water Management ・ Proper water management will be carried out to maintain the appropriate soil moisture contents and water depth according to the growth stage and farming practices. ・ Particularly, the field condition will be maintained to enable such machinery, like tractors and combine harvester, to enter for land preparation or harvesting. ・ "Block management" will be carried out in each irrigation block.
Land preparation ・ Pre-irrigation is recommended before land preparation to soften the surface soil. ・ It is recommended to have "offset harrowing: 2 times" or "ploughing: 1 time + offset harrowing: 1 time" since offset harrowing: 1 time is not enough. ・ Land levelling under wet conditions is recommended, preferably employing small or medium tractors with cultivator, if available. ・ Since the plots are too small and soils are sometimes too soft, small to medium machinery are generally more efficient than large machinery.
Seeding ・ Broadcasting may continue using the certified seeds to avoid mixing and contamination of varieties. The certified seeds should be used at least every three years. ・ The seed rate of less than 80 kg/ha is enough. ・ Farmers can try seedling transplanting for (1) avoiding bird damage, (2) shortening field duration by 3 to 4 weeks, and (3) easier management of weeding and other practices.
Fertilizer application ・ Application is recommended to be done four times, one basal application and three top dressing, at each growing stage recommended by the rice farming manual. ・ Application can be one basal and two top dressing with minimum dosage to avoid wasting effective contents.

Proposed Farming Practices and their Features
Weeding ・ Ploughing and levelling by cultivator may treat weeds and roots and disturb their growth in the early stage. ・ Herbicide will be applied according to the rice farming manual, and manual weeding will follow sometime after herbicide application.
Plant protection ・ If farmers find the abnormal symptom of disease or insect damage, he or she is to consult with SAED CA. ・ SAED CA will confirm the symptom and advise farmers to apply agro-chemicals. If required, SAED CA will report to research institutes to identify the symptom and treatment.
Harvesting ・ Appropriate harvesting according to the schedule are required for smooth implementation of the next crop, particularly for dry season rice crop. ・ The risk to delay harvesting due to wet soil condition can be reduced by introduction of 1) medium size combine harvesters and 2) reapers and threshers.

Source: JICA Survey Team

(3) Rice Crop Budget and Farm Household Income

In order to estimate the future crop budget for rice farming, the basic assumption is set below:

a) Average farm size: 0.5 ha/farmer
b) Farm family size: 7 persons/farm family,
c) Home consumption: 735 kg/family per annum (105 kg/person, 7 person/family),
d) Home consumption per ha is 1,470 kg/2 families.

Based on the above assumption, the future crop budget of rice cropping is estimated with the net income of farm family, as shown in Table B5.3.1/B5.3.2 and summarized in Table A5.3.11.

Table A5.3.11 Future Rice Crop Budget in the Rosso Subproject

Item	Dry Season (per ha)	Rainy Season (per ha)	Total (per ha)	Remark
Gross income				
Production:	7,500 kg	6,500 kg	14,000 kg	
Marketable surplus	6,765 kg	5,765 kg	12,530 kg	Home consumption 1,470 kg
Gross income	FCFA 845,000	FCFA 721,000	FCFA 1,566,000	@125 FCFA/kg
Production cost				
1. Land preparation	FCFA 117,000	FCFA 52,000	-	Ploughing in dry season
2. Seeds	FCFA 12,000	FCFA 12,000	-	80 kg/ha, newal every 2 years
3. Input	FCFA 93,000	FCFA 87,000	-	
4. Irrigation	FCFA 85,000	FCFA 85,000	-	Water fee for Union
5. Labor work	FCFA 24,000	FCFA 24,000	-	
6. Harvesting	FCFA 94,000	FCFA 81,000	-	harvesting by machine
7. Others	FCFA 35,000	FCFA 27,000	-	
8. Financial expenses	FCFA 30,000	FCFA 26,000	-	
9. Subtotal	FCFA 490,000	FCFA 394,000	FCFA 884,000	
Net income per ha	FCFA 356,000	FCFA 327,000	FCFA 683,000	56% 0f gross income
Net income per family	FCFA 178,000	FCFA 164,000	FCFA 342,000	Farm size: 0.5 ha

Note: Prices are estimated based on crop budget table by SAED and so on, as of June 2019
Source: JICA Survey Team

The net income of the farm family will increase from the present FCFA 106,000 per annum to about FCFA 342,000 in the future, which is equivalent to approximately 3.22 times increase. The substantial farm income from rice will be FCFA 548,000, including the value of home consumption of 735 kg of grain rice per family, equivalent to FCFA 548,0000 (i.e., FCFA 280/kg at retail price).

5.3.7 Plan for Soft Component

(1) Consensus Buildings with Beneficiaries

No large-scale land acquisition for construction works is included in the subproject plan. It is not necessary to establish a new union since the Union already exists in the Rosso subproject.

In the case of the Rosso Scheme, the necessary consensus building is i) agreement for implementation of construction works, ii) consensus on provision of land by farmers or groups necessary for construction works (e.g., for development of farm road, etc.), and iii) consensus on suspension of farming during construction.

1) Agreement for Implementation of Construction Works

Agreement for implementation of construction works between SAED and the representative of beneficiaries (representative of the Union or GIEs and the village chief) shall be prepared and signed by the concerned parties before the final approval of the preliminary design or before the start of construction works, if necessary. The key contents of the agreement involve 1) government ownership of the facilities and equipment under the subproject, 2) details of the subproject component, and 3) role of beneficiaries for implementation of the subproject and responsibilities for operation and maintenance. The agreement also includes terms on the suspension of farming during construction (refer Appendix B5.2). A one-day meeting of stakeholders is planned for consensus building for implementation of construction works.

The Survey Team asked the opinion of farmers in the Rosso scheme on the suspension of farming during construction. Their insights are as follows:

a) Rehabilitation of irrigation facilities is important. With the rehabilitation, the farmers are expecting an increase in income in the future brought by increasing the production of rice. Therefore, the farmers will accept temporary suspension of farming during the construction period.

b) The farmers demand SAED to implement the rehabilitation of facilities as soon as possible since there may be a possibility that the farmers could not carry out rice farming due to water shortage without the rehabilitation.

The farmers in the Rosso Scheme expect more benefit from the rehabilitation than temporary reduction of income due to the suspension of farming during construction.

2) Consensus on Provision of Land for Construction Works

An agreement for the provision of land for construction works (e.g., for development of farm road, etc.) shall be prepared and signed by the concerned parties before the final approval of the preliminary design.

In the case of small-scale provision of land for construction, it is efficient to build a consensus with the initiative of farmers. The key role of SAED for consensus building is to support and facilitate the discussion of farmers. It is also essential to share information to the commune on the changing of land ownership through the provision of land for construction works and to obtain approval from the commune, even with small-scale land provision. Thus, it is necessary to obtain consensus from the farmers, SAED, and commune in written form (refer Appendix B5.2). The Survey Team proposes that one of the conditions for commencement of the subproject is to reach a consensus on the provision of land for construction and have it stated officially in written form.

Table A5.3.12 shows the proposed process for consensus building on the provision of land for construction. A five-day meeting of stakeholders, including confirmation in the field, is planned for consensus building on the provision of land.

Table A5.3.12 Proposed Process for Consensus Building on Provision of Land

Steps	Actions	Stakeholders	Remarks
1. Determination	-Determination of affected land and its decreasing area by construction plan -Evaluation of the affected land value	Project, SAED	
2. Explanation and discussion with farmers leaders	-Explanation of the construction contents and impact in the field -Approval on internal discussion and the countermeasures - Prior consultation on the countermeasures	SAED, Secretariat of Union/GIE, Village chief, commune, etc.	Explanations to the municipality (commune) could possibly be held separately
3. Preparation (in case of necessity)	-Examination of countermeasures	SAED or Secretariat of Union/ GIE	optional
4. Internal consultation	-Explanation of the construction contents and impact in the field - Explanation of countermeasures (judgement on implementation of compensation, method, and amount of compensation if implement)	Main members of Union/ GIE, all affected farmers, SAED	
5. Document preparation	-Preparation and confirmation of the provisional agreement document	SAED, Consultants (confirmation)	
6. Approval	-Confirmation of the contents of agreement -Signature of the agreement document -Presentation and distribution of the document	Main members of Union/ GIE, all affected farmers, SAED, municipality	5 originals

Source: JICA Survey Team

The Survey Team asked the opinion of farmers in the Rosso Scheme on the provision of land of farmers/groups for construction. Their opinions are as follows:

a) Improvement of farm roads will be a common benefit for all members of the Union. Residents along the farm roads will benefit more, so they should agree to provide land even without compensation.

b) When the Union developed the farm roads using their own fund, they did not face major problems even without compensation for provision of the land.

The farmers in the Rosso scheme do not consider compensation for land essential for development in the case of small-scale land provision.

(2) Capacity Enhancement of Farmers' Organizations

The plan of the subproject includes training on capacity enhancement of farmers' organization. The contents of the training include the function and roles of farmers' organization, communication between organizations, preparation of action plan, financial management, block management, and so on. The secretaries of the Union are key participants of the training. The members of the GIEs shall also be participants of the training. As part of the training, gender consideration is planned to be included as a topic to promote active participation of women in activities included in the subproject, such as trainings of farming, O&M, etc.

The outline of the training on capacity enhancement of farmers' organization is summarized in Table A5.3.13.

Table A5.3.13 Outline of the Training on Capacity Enhancement of Farmers' Organization

Participants	Farmers of Rosso scheme
Objectives	- To know how to manage a farmer's organization - To understand the importance of block management
Training	CGER or CIFA
Training contents	- Function and role of farmer's organization - Communication between the Union et GIEs - Preparation of action plan - Financial management - Importance of blocks managements - Gender consideration

Source: JICA Survey Team

(3) Agriculture Support Activities

After the implementation of the Rosso pilot subproject, basic infrastructure development and agricultural machinery distribution will provide farmers with better physical condition to solve the present constraints to limit the rice cropping intensity, namely (1) delay of dry season crop harvest, (2) disturbance of land preparation for rainy season crop, and (3) inundation by excess water and high salinity area. In this situation, when farmers conduct proper farming practices, the cropping intensity is expected to increase from the present 78% to the future 200% by introducing rice double cropping.

In order to ensure that farmers conduct the proper farming practices as explained in Table A5.3.7, the agricultural supporting activities are required to utilize the results and experience obtained in PAPRIZ2 and to extend to the pilot area. Out of the various activities under PAPRIZ2, technical trainings are important, such as (1) trials of rice double cropping in the pilot projects and (2) improvement of rice productivity and grain quality. Based on these results and experience, trainings are prepared for the pilot project of the Rosso Irrigation Scheme.

To promote double cropping of rice in the Rosso scheme, agriculture support activities are proposed. The activities are planned based on the results and experience in activities under PAPRIZ2, such as 1) trials of rice double cropping in the pilot projects and 2) improvement of rice productivity and grain quality. The following trainings are planned for the Rosso scheme:

- Demonstration of the improved farming practices for double cropping of rice
- Training of farmers to extend the improved farming practices

1) Demonstration of the improved farming practices for double cropping of rice

One demonstration farm is to be established in the Rosso Irrigation Scheme for dissemination of the improved farming practices for double cropping of rice. The role of the demonstration farm is to disseminate the farming practices not only for the Rosso scheme but also for several subprojects around the Rosso area.

The Survey Team proposed to establish two demonstration farms for each sector under the jurisdiction of the Dagana and the Podor Delegations of SAED (i.e., 7 sectors, 14 demonstration farms) under the project. The demonstration farm will be operated for one year (i.e., two crop seasons in dry and rainy season). Each demonstration farm will be utilized for trainings and other activities for agriculture support for several neighboring subprojects.

The selection criteria of the demonstration farm are assumed to be 1) commitment of farmer, 2) impact of demonstration (e.g., access to demonstration farm, etc.), and 3) representatives of demonstration farm (e.g., typical soil, irrigation, and drainage condition in the area, etc.). The Survey Team proposes to put high priority on the commitment of the farmer since the demonstration plot will be utilized for trainings for farmers.

After the selection of a demonstration farm, the minutes of understanding (MOU), in which conditions of demonstration farm are mentioned, will be concluded between SAED and the farmer of the demonstration farm (hereinafter called "demo farmer") to prevent troubles in operation of the demonstration farm. Demo farmers shall have incentive to provide demonstration farms since they could receive more advanced technical support from the project.

The outline of demonstration activities for the Rosso scheme is summarized in Table A5.3.14 below.

Table A5.3.14 Outlines of Demonstration Activities of Double Cropping of Rice

Personnel in Charge	Demo farmer in collaboration with Union/GIE staff, key farmers from irrigation blocks, farmers cultivating plots surrounding demonstration plot
Objective of Demonstration	- To provide farmers in the Rosso Irrigation Scheme with training opportunities to solve the constraints of the present rice cropping; done through demonstrating rice double cropping by applying the proper farming practices under the improved agricultural facilities
Stakeholders	PMU, PIU, SAED Conseil Agricoles, ISRA (research), and other stakeholders related with rice cultivation technology
Activities for Demonstration	Preparation of demonstration program - Preparation of plan and cost estimate for establishment and operation of demonstration plot by PMU/PIU, SAED Sector Chief, and Conseil Agricole (CA) in collaboration with ISRA and other stakeholders - Field visits by candidates of demo farmer and key farmers to PAPRITZ2 pilot project sites and advanced farmers' plots where rice double cropping is conducted - Training need assessment of candidates of demo farmers and key farmers - Selection of demonstration plots through preparation of selection criteria - Preparation of training materials, like operation manual of demonstration plot, layout demonstration plot, and other materials Establishment and operation of demonstration plot - Preparation of cropping rice calendar and schedule of farming practice by demo farmers and key farmers under the guidance and support of CA - Execution and recording of a series of farming practices of preparation of cropping, land preparation, basal fertilizer application, sawing, weeding, top dressing of fertilizers, water management, draining water, harvesting, threshing, transporting, drying - Monitoring to check and confirm farming practices execution, production, and yield

Source : JICA Survey Team

2) Training of farmers to extend the improved farming practices to their farm plots

In the Rosso Irrigation Scheme, about 500 farmers will cultivate 250 ha of irrigated paddy fields, consisting of 21 irrigation blocks with an average size of 12 ha. In order to disseminate the improved farming practices to all the farmers covered in the entire scheme, two stages are assumed for farmers training in utilizing the demonstration plot. In the first stage, key farmers are selected as a leader of farmers from each irrigation block, and they participate in trainings at the demonstration plot. Then, in the second stage, the key farmers conduct training for other farmers in each irrigation block, as a "farmers to farmers" training system.

The number of trainees in each stage is assumed as shown below:

- 1st stage training at the demonstration plot : maximum 40 key farmers, 1 to 2 key farmers from each irrigation blocks
- 2nd stage training at the irrigation block : average 24 farmers ranging from 7 to 38 farmers

Before conducting the first and second trainings, the SAED Sector Chief and the Conseil Agricole will prepare the training programs with support from the PMU and PIU. For preparation of training programs, the training needs of farmers will be assessed by holding a workshop at the scheme, as outlined in Table 5.3.15 below.

Table A5.3.15 Preparation of Training Programs for the 1st and 2nd Stage

Personnel in charge	- SAED Conseil Agricole, SAED Sector Chief, PMU/PIU
Participants to prepare training program	- Union/GIE management staff, key farmers from irrigation blocks, and demo farmer - ISRA, LBA (CNCAS), Commune representatives, service providers, input supplier, and other stakeholders
Work items	- Training needs assessment of farmers and stakeholders in the Rosso Irrigation Scheme - Preparation of training action plan, training schedule, and monitoring plan - Estimation of training cost and procurement of goods and materials for training - Preparation of training materials, manuals and guidelines, etc. - Arrangement of training for the 1st and 2nd stages - Monitoring of trainings, particularly for the 2nd stage, and holding of review meetings

Source : JICA Survey Team

Based on the training program prepared in the above, the first stage of training will be conducted for the key farmers at the demonstration plot as outlined in Table A5.3.16

Table A5.3.16 Outline of the 1st Stage Training for Key Farmers

Target trainee	- Key farmers from irrigation blocks, Union/GIE management staff, farmers surrounding the demonstration plot
Objective of training	- To understand the proper farming practices in each growing stage of rice - To obtain awareness on use of herbicides for weed control as well as insecticides/fungicides for disease and pest control - To take consciousness on irrigation block management as the smallest unit of rice cultivation in the double cropping
Trainer	Demo farmer and Union/GIE management staff in collaboration with SAED CA, Sector Chief, PMU/ PIU, ISRA, and personnel from other institutions
Training contents	- Preparation of action plan (cropping calendar and working schedule), procurement of inputs and services, arrangement of finance and crop insurance - Execution of farming practices according to the action plan and monitoring of progress

Source : JICA Survey Team

Based on the training program prepared in the above, the farmers' field days targeting key farmers will be conducted to show and practice the improved farming practices at the demonstration plot in the first stage of training. In the first stage, four trainings are scheduled in one crop season, wherein the first training is for preparation of cropping schedule as farmers' action plan, the second training is for land preparation to seeding, the third training is for weeding and top dressing, and the fourth is for ripening to harvesting. In the first and fourth trainings, resource persons will be invited from research institutions and other organizations appropriate for classroom training. In the second and third trainings, farmers will exchange their experiences from practices.

Immediately after each of the trainings for the first stage at the demonstration plot, the second stage will be carried out. In this training, key farmers trained at the demo plot will extend the similar training to

the farmers in the irrigation blocks at the key farmers' plots. The PMU/PIUs will monitor the trainings and technical transfer by key farmers. If the PMU/PIUs find lack of the technical transfer in each irrigation block, the PMU/PIUs will implement follow-up trainings as shown below:

Table A5.3.17 Outline of the Follow-up Training for Farmers

Target trainee	- Farmers in each irrigation block
Objective of training	- To understand the proper farming practices in each growing stage of rice - To obtain awareness on use of herbicides for weed control as well as insecticides/fungicides for disease and pest control - To take consciousness on irrigation block management as the smallest unit of rice cultivation in the double cropping
Trainer	Key farmers and GIE management staff in collaboration with demo farmer, SAED CA, Sector Chief, PMU/ PIU
Training contents	- Preparation of action plan (cropping calendar and working schedule), procurement of inputs and services, arrangement of finance and crop insurance - Execution of farming practices according to the action plan and monitoring of progress

Source : JICA Survey Team

(4) Capacity Enhancement of Operation and Maintenance (O&M)

1) Operation, Maintenance, and Management of Irrigation and Drainage Facilities

The following table shows a proposal for the operation and maintenance (O&M) plan for the Rosso scheme.

Table A5.3.18 Proposal of Operation and Maintenance Plan

Maintenance Subject	Activities	Responsible	Period/Frequency
Supervision of the pumping station's operation	Daily verification of operation, communication to SAED in case of irregular situation	Responsible of the pumping station	Every day
Supervision of the drainage pump operation	Verification of its operation, communication to SAED in case of irregular situation	Responsible of the pumping station	When drainage pump is operated
Monitoring of irrigation infrastructure	Periodic monitoring	Members of each block	Every day during the irrigation period
Maintenance of farm road	Leveling, restoration of slope	Members of each block	Before start of the crop season
Weeding around the pumping station	Group work for weeding	Selected members (or designed per par order)	Before the crop season
Weeding for earth canal and drainage canal	Periodic Group work for weeding	Members of each block	Before the crop season, every one or two months
Elimination of siltation in the main canal	Group work for elimination	All members	Before the crop season
Elimination of siltation in the secondary canal and drainage canal	Group work for elimination	Members of each block	Before the crop season
Repair of secondary canal	Compaction by hand-guided vibration compactor	Person in charge of each block	Before the crop season
Restoration of defective parts in the canals (leakage, erosion, overflow)	Group work of temporary removal, mixing, tamping and masonry	Members of each block	Before the crop season, in case of necessity
Creation and repair of farm plot dikes and plot leveling	Leveling after construction of farm plot dikes, if unevenness is large	Members of each block	Before the crop season
Repair of earth canal and farm road by machine[*1]	Digging and refilling earth channels, excavating earth channels at repair parts, and leveling work on farmland	Machine operators with direction and supervision of Union/GIE	Before the crop season

*Note: * Backhoe with earth removing plate (crawler type)*
Source : JICA Survey Team

Funds required for the abovementioned O&M activities by the Rosso Union are considered to be basically secured since the Union prepares a financial plan, including the O&M expenses, as a requirement before obtaining the loan from LBA.

A technical training for O&M of the Rosso scheme is planned based on the above O&M plan. The training is proposed based on the results and experience of the PAPRIZ2. The outline of technical training for O&M of the irrigation and drainage facilities and the farm road is shown in Table 5.3.23. A two-day training shall be provided to the farmers at the time of handing over of the facilities. A follow-up training may be considered to be carried out based on the monitoring of O&M conditions by the Union.

Table A5.3.19 Outline of Technical Training for O&M of Irrigation and Drainage Facilities and Farm Road

Participants	Farmers in the Rosso scheme
Objectives	- Enhancement of farmers' capacity on O&M - Make farmers understand the importance of routine monitoring of irrigation infrastructure
Trainer	SAED, consultants
Contents of the training	- Categorization of maintenance work (routine, periodic, urgent, and for improvement) - Inspection of irrigation infrastructure (importance of early findings of defective locations) - Maintenance and management of irrigation infrastructure (leveling, weeding and cleaning of channels, repair work against overflow, water leakage, and erosion) - Maintenance machines and tools (method of use and management) - Contents of the monitoring sheets and registration methods

Source : JICA Survey Team

In order to carry out maintenance activities efficiently, backhoes, vibration compactors, and various tools for maintenance are required. These machines and tools, together with a guide on how to use and manage them, are to be provided to the Union (See 6.4.5 for details on equipment).

The following activities will be carried out at the time of the training for O&M:

1) Agreement on handing over the irrigation and drainage facilities,

2) Establishment of committees for block management, and

3) Agreement on O&M and water management.

The responsibility of stakeholders, including SAED, the Union, and farmers, shall be clarified through the training before signing the agreements. The agreements follows the format generally used by SAED.

2) Water Management

A training for improvement of capacity of water management is planned based on the training conducted in the activities of PAPRIZ2. The plan for the training on water management is shown in the table below.

Table A5.3.20 Outline of the Training on Water Management

Participants	Farmers in the Rosso scheme
Objectives	- Have a basic knowledge of water management - Understand the importance of the block irrigation system for double cropping
Trainer	SAED (DAGE, DAIH), consultants
Contents of the training	- What is water management (plan water distribution and make appropriate distributions through adjustment and management) - Water management according to the growth stage of rice (appropriate water level management at an appropriate time) - Preparation of paddy field (importance of leveling the field before planting) - Importance of complying with water distribution plans - Concept of block irrigation in double cropping activities

	- Outline of recommended cultivation calendar

Source : JICA Survey Team

A two-day training on water management will be carried out at the time of handing over of the facilities. A follow-up training may be considered to be carried out based on the monitoring of water management by the Union.

3) Operation and Maintenance of Warehouses

A training on management of warehouse was organized in PAPRIZ2. For the Rosso scheme, the following training will be conducted by adding the management method of the new warehouse to the PAPRIZ2 training content.

Table A5.3.21 Outline of Training for Operation and Maintenance of Warehouse

Participants	Warehouse manager, members of Rosso's Union's secretariat
Objectives	- To get a basic knowledge in warehouse management - To understand the mission of manager (who would be the marketing manager) - To understand the importance of paddy moisture management
Trainer	SAED, AFRICARICE/ISRA, consultants
Contents of training	- Warehouse management method (accounting, etc.) - Postharvest treatment technique based on the manual developed by PAPRIZ2 - Method of using the portable moisture meter

Source : JICA Survey Team

A two-day training on the O&M of the warehouse will be carried out after completion of construction of the facilities. A follow-up training may be considered to be carried out based on the monitoring of O&M conditions by the Union.

4) Operation, Maintenance, and Management of Agricultural Machinery

The Union/GIE is responsible for the O&M of the agricultural machinery. This will be mentioned in the contract agreement for handing over the agricultural machineries (refer to appendix 5.3). The Union/GIE will implement daily and scheduled maintenance, such as checkup before and after using, cleaning, and maintenance of agricultural machinery, according to the manufacturer's maintenance manual and logbook. SAED will supervise maintenance and repair works done by the Union.

The Survey Team planned the following trainings necessary for strengthening of operation skill and capacity of the O&M of agricultural machineries.

a) Capacity Building for Operators and Mechanics in Union/GIE and Private Service Providers

Almost all operators of agricultural machinery do not have experience that qualify them to take training courses on operation. They learned their operation skills by practicing in the field. The training course for operation of agricultural machinery is planned as one of the soft component activities of the subproject based on "capacity building of necessary for proper operation of agricultural machinery" carried out under PAPRIZ2. Reapers and middle size combine harvesters will be introduced under the subproject. It is necessary to enhance the O&M skill of operators and mechanics since the machines will be newly introduced for farmers in the Rosso scheme.

The outlines of the trainings on enhancement of operation and management skill for the agricultural machines are shown in Table 5.3.22.

Table A5.3.22 Outlines of Training for Operators and Mechanics

Target Trainee	Operators and Mechanics of Union/GIE and Private Service Provider
Objective of Training	Basic Training - To understand structure and maintenance of reaper and middle size combine harvester and importance of logbook - To master good operation of reaper and middle size combine harvester Follow-up Training - To review the basic training
Trainer	SAED, Dealer, Professor from university, Teacher from tech. high school, CEMA
Training Contents	- Operation, checkup, and maintenance of reaper - Operation, checkup, and maintenance of middle size combine harvester - Filling up logbook

Source : JICA Survey Team

A basic training and a follow-up training will be carried out for the enhancement of operation and management skill for the agricultural machines in the Rosso scheme. The basic training will be conducted over three days, and the follow-up training will be done over two days. The trainee will be a member of the Rosso Union and the private service providers around the Rosso area. There will be about 30 participants per training.

b) Capacity Building for Engineers in Private Repair Shops

Capacity building for engineers in private repair shops around the Rosso area is planned for better O&M of agricultural machinery. The outline of this training for engineers is shown in Table 5.3.23.

Table A5.3.23 Outline of Training for Engineers

Target Trainee	Engineers of Private Repair Shops
Objective of Training	- To understand prevention of machine trouble and temporary repair in the field - To master the trouble identification based on proper malfunction diagnosis
Trainer	SAED, Dealer, Professor from Univ., Teacher from tech. high school, CEMA
Training Contents	- Structure and maintenance of reaper and middle size combine harvester - Major failure source and malfunction diagnosis of reaper and middle size combine harvester

Source : JICA Survey Team

The two-day training will be carried out twice for the engineers in private repair shops around the Rosso area after the introduction of agricultural machineries.

c) Follow-up Consultation for Union, Service Providers and Private Repair Shops

A follow-up consultation meeting will be held for the participants of the training courses for the purpose of monitoring and follow-up after trainings. The outline of follow-up consultation is shown in Table 5.3.24.

Table A5.3.24 Outline of Follow-up Consultation

Target Trainee	Participants of a) and b) training course
Objective of Training	- Monitoring and follow-up the participants of capacity building training course
Trainer	SAED, Dealer, professor from University, CEMA
Training Contents	- Advice the improvement of current condition - Consideration of lesson to be solved - Suggestion of new business plan

Source : PAPRIZ2Project Progress Report (Second Phase)

After the trainings, the SAED staff and other concerned technical persons are to visit individual participants of the trainings for monitoring and follow-up.

d) Reaper Exhibition

Reapers will be newly introduced to the Rosso scheme under the subproject. Therefore, a field day as exhibition of the reaper is proposed to be held for the Rosso union members before the delivery of reapers. Four units of reapers procured by PAPRIZ2 shall be used for exhibition in the Rosso scheme. The exhibition will be held during the harvesting time in the dry season (May to June) and in the rainy season (October to November).

e) Reaper Demonstration

After delivery of the reaper under the subproject, a demonstration of the operation of the reaper is proposed to be conducted for other farmers around the Rosso area during the harvesting period as this is a new harvesting method.

f) Enhancement of Operation Management

The Union as the agricultural machinery service provider is not good at preparing an operation plan and fund management. The Union/GIE have an obligation from SAED to conclude a contract with CGER regarding fund and operation management. Operation and fund management of the Union/GIE will be enhanced through training and support from CGER.

(5) Outline of Development Plan of Soft Component

The outline of the development plan of the soft component is summarized in Table A5.3.25.

Table A5.3.25 Outline of Development Plan of Soft Component in Rosso Scheme

Training item	Quantity	Remarks
1 Consensus Buildings with Beneficiaries		
(1) Agreement for Implementation of Construction Works	Once at the beginning of the subproject	One-day meeting
(2) Consensus on Provision of Land for Construction Works	Once at the beginning of the subproject	Five-day meeting
2 Capacity Enhancement of Farmers' Organization		
(1) Capacity Enhancement of Farmers' Organization	Once during construction of the subproject	Two-day training/set
3 Agriculture Support Activities		
(1) Preparation of Demonstration Plot	For one year (two crop seasons, rainy and dry season)	
(2) Preparation of Training Program	For one year (two crop seasons, rainy and dry season)	
(3) Trainings for Key Farmers in Demonstration Plot	For one year (two crop seasons, rainy and dry season) Four times in each season, total eight times	Two-day training/set Lecturer shall be invited for four trainings
(4) Follow trainings for farmers in each irrigation block	As required	One-day training/set
4 Capacity Enhancement of Operation and Maintenance		
4.1 Operation and Maintenance of Facilities		
(1) Operation, Maintenance, and Management of Irrigation and Drainage Facilities	Once after completion of the construction	Two-day training/set
(2) Water Management	Once after completion of the construction	Two-day training/set
(3) Training for Operation and Maintenance of Warehouse	Once after completion of the construction	Two-day training/set
4.2 Operation, Maintenance, and Management of Agricultural Machinery		
(1) Capacity Building for Operators and Mechanics	Basic training one time	Three-day basic training

Training item	Quantity	Remarks
in Union/GIE and Private Service Providers	Follow-up training once time	Two-day follow-up training
(2) Capacity Building for Engineers in Private Repair Shops	Twice after introduction of agricultural machineries	Two days
(3) Follow-up Consultation for Union, Service Providers and Private Repair Shops	Twice after introduction of agricultural machineries	Three-day training/set
(4) Reaper Exhibition	One time in each crop season, rainy and dry season	Two-day training and one-day exhibition
(5) Reaper Demonstration	One time in each crop season, rainy and dry season	One-day training

Source : JICA Survey Team

5.3.8 Gender

In the subproject, only facility rehabilitation will be carried out, and no new land will be redistributed. Therefore, it is difficult to increase the number of women who own and operate land in the Rosso Irrigation Scheme. It is difficult to meet the ratio of women landlords: 15% (the "gender" index). However, the Gender Action Plan for the Rosso Irrigation Scheme focuses on capacity building for the Rosso Union women members and increased opportunities to participate in decision-making, and gender considerations in the Rosso Irrigation Scheme will be in line with this.

Based on the Gender Action Plan for the Rosso Irrigation Scheme established by SAED (see Section 5.2.7), it is proposed to implement activities on gender considerations in the subproject.

Table A5.3.26 Gender Action Plan for the Rosso Irrigation Scheme and Its Proposed Activities

Action Plan	Proposed Activities to be Carried Out in the Subproject
Establish a gender office in Rosso Union.	Secure a room in the organizational training program (See Table 5.3.17) for discussion and consideration of establishment of the gender office in the Rosso Union.
At least 20% of the board members are women, and two women will be assigned to the Rosso Union Executive.	Secure a room in the organizational training program (See Table 5.3.17) for discussion and consideration of setting target values.
Equivalent to 20% or 50ha of the total plot will be used for the utilization of small-scale rice milling facilities for women.	Same as above.
Involve women and young people in irrigated agriculture in cooperation with support organizations.	Secure a room in the organizational training program (See Table 5.3.17) for discussion and consideration about the specific action plan.
Others	Not applicable in this subproject

Source : JICA Survey Team

Because the promotion of understanding among the Union executives is quite important in implementing the Gender Action Plan, it is suggested that the proposed activities for the subproject be implemented within the framework of the capacity enhancement of the farmers' organization.

5.4 Preliminary Design of Pilot Site Subproject

5.4.1 General Approach and Design Concept

The preliminary design work was carried out based on the following general approaches and design concepts, with consideration of the objective of the project and purpose of the preliminary design:

1) The adoption of common and typical facilities is desired for the smooth and simultaneous implementation of subprojects with the same quality, as well as for establishment of easy

O&M system by farmers. Effective utilization of guidelines/manuals on planning, design, and O&M is also important to simultaneously implement many and various subprojects.

2) For sustainable development, the beneficiary participatory approach is the most important strategy. It is easier to adopt this approach in the small-scale development project than in a large-scale project. Major facilities are constructed by the SAED, but minor facilities are constructed by the beneficiaries. The right-of-way compensation is shared by the beneficiaries.
3) Generally speaking, pump irrigation is high-cost farming. In the planning and design works of pump irrigation, it is essential to improve irrigation efficiency to optimize pump operation costs. The water pumped up to the irrigation canal is more valuable than that used in gravity irrigation. Valuable water shall be distributed to the full designed area through irrigation canal networks which shall not be allowed unexpected losses. Based on the site inspection and the results of the survey, most of the irrigation schemes suffer from large seepage losses. It is strongly recommended to rehabilitate at least the main canals with concrete lining type to minimize seepage losses and for proper O&M works of the canals. The final canal type for improvement will be presented through further studies, including economic and financial viabilities.
4) Aside from the above recommendations, the construction materials, such as embankment soils, sand, gravel, and boulder, shall be obtained from the nearest borrow pits of the construction sites. Stone masonry is one of the alternatives to concrete works if the materials are available near the site.
5) After formulation of the preliminary rehabilitation/improvement plans, all plans shall be presented to and discussed with the farmer beneficiary (Union) in the orientation meeting. All advantages and disadvantages of the implementation of the project shall be discussed, and the necessary modification on the plan shall be agreed. Once the project is accepted by the farmer beneficiary (Union), the agreement (No Objection Certificate for the Project) will be prepared and signed by both the SAED and the farmer beneficiary (Union).
6) The procedures for the preliminary design works are compiled as manuals and/or checklists, as much as possible, as guidelines for the implementation of other subprojects. Furthermore, SAED staff are requested to participate in all the procedures.
7) The typical design procedures are adopted for the contribution to the planning/design of the overall Project. The project costs are also summarized as the cost per area (ha) and the cost per length (m) by each development works to be applied for the overall project.

Through the preliminary design works, standard construction costs, construction schedule, and procedures, design standards and so on will be prepared for the future Project.

5.4.2 Applicable Design Standards and Criteria

The preliminary design is prepared based mainly on SAED's standards and criteria, such as "Document of Irrigation Scheme Standards in the Senegal River Left Bank Valley (*Document de Referentiel de Normes D'Normes D'Amenagement Dans la Vallee Rive Gauche du Fleuve Senegal*) October 2005". If some of the proposed improvement works are not definitely presented in the existing standards, the international standards, including Japanese Design Standards, will be adopted for the design works. For example, the concrete lining type canal is proposed, but this type is not common in the present schemes. Therefore, the design of a concrete lining canal will be prepared based on other formal standards. As

mentioned in Sub-chapter 5.4.1, however, majority of the facilities are designed considering the familiarity and utility of the farmers for easy O&M works. The applicable standards for facilities are tentatively considered as follows:

Pump Station: SAED's standards for rehabilitation works, adding international standards for new construction/procurement

Irrigation Facility: SAED's standards adding international standards for lining canal and the related structures

Drainage Facility: SAED's standards adding international standards for pump station

Farm Road: SAED's standards adding common standards for similar type projects (JICA ODA Projects) in other countries

Post-harvest Facility: SAED's standards

5.4.3 Preliminary Design for Proposed Works

As described in the previous sub-chapter, preliminary design is performed for the irrigation facilities such as pump station and irrigation canals, drainage facilities of pump station and drainage canals, farm roads, and post-harvest facilities. The general layout of these facilities is presented in Figure B5.4.1.

(1) Irrigation Pump Station

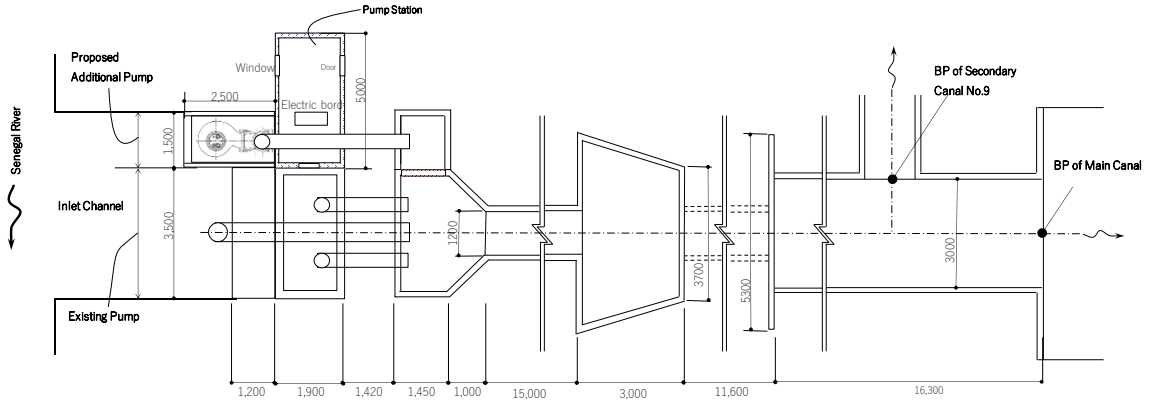
According to the development plan for the pump station, which is explained in Sub-chapter 5.3.3 (1), the required works are preliminarily designed. The general features and work quantities of the proposed works are summarized in the table below.

Table A5.4.1 General Features and Work Quantities of Irrigation Pump Station

	Facility	Proposed Works	Quantity
1	Pump	Installation of New Centrifugal (Volute) Pump (Submergible Type) (Capacity=828 cum/hour, Head=3 m, Diameter=400 mm, 17 kw) - Existing Propeller Pump (Cap.=684 cum/hour, Dia.=400 mm) - Existing Centrifugal Pump (Cap.=540 cum/hour, Dia.=250 mm)	1 unit (1 unit) (2 units)
2	Inlet Channel	Construction of New Suction Sump for New Pump (Concrete works) Reshaping of Existing Earth Canal Sections (Excavation) Installation of Trash Rack (Screen)	20 cum 400 cum 0.5 ton
3	Outlet Channel	Construction of Discharge Sump for New Pump (Concrete Works)	6 cum
4	Pump House	Concrete Building (5.0 m x 1.9 m)	9.5 sqm

Source: JICA Survey Team

The general plan of the pump station and the outlet channel is presented in Figure A5.4.1.



Source: JICA Survey Team

Figure A5.4.1 General Plan of Irrigation Pump Station with Outlet Channel and Proposed Additional Pump

(2) Irrigation Canals and Related Structures

In order to effectively perform the preliminary design of irrigation canals, the irrigation diagram is prepared as shown in Figure B5.4.2. For the main canal (MC), the longitudinal and cross-sectional profiles are also prepared based on the results of topographic survey. Using the data, hydraulic design of the MC is carried out, as shown in Table B5.4.1, for the concrete flume canal. For the comparison study of canal types, the hydraulic designs for the earth canal and the concrete lining canal are also conducted (Refer to Table B5.4.2 and Table B5.4.3).

The comparison of the three types of canal is studied based on the results of the hydraulic designs and other factors, such as construction costs, construction periods, O&M costs, suspension of farming during construction works, etc. The construction of concrete flume canals for the improvement works of the MC can be completed within one dry season for a period of nine months. The improvement of the MC by earth canal or concrete lining canal requires two dry seasons, or four cropping seasons for suspension of cropping. The results are summarized in the table below.

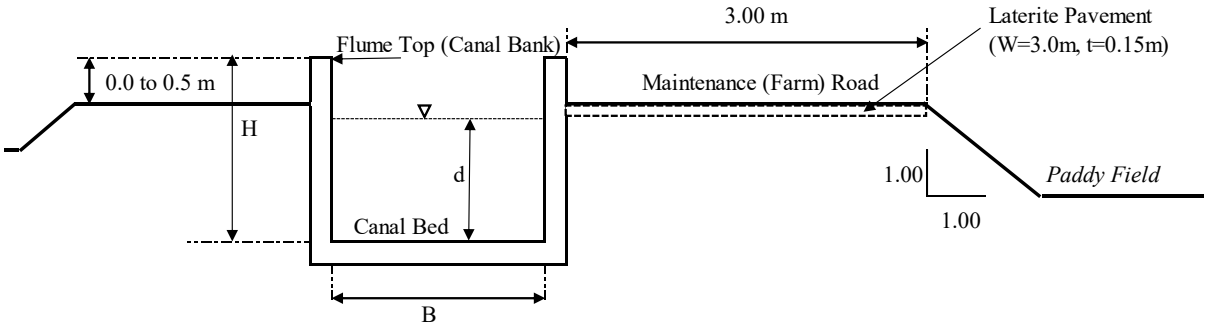
A concrete flume canal is more expensive than an earth canal, but it can be concluded that the concrete flume canal is competitive in a comprehensive manner. The concrete flume canal has a big advantage for the farmers to reduce O&M cost and to minimize the suspension periods of farming. Thus, the concrete flume canal is proposed for the improvement works of the MC. All secondary canals (SC) are reshaped with the optimum designed section size and suitable embankment materials.

Table A5.4.2 Comparison by Canal Types

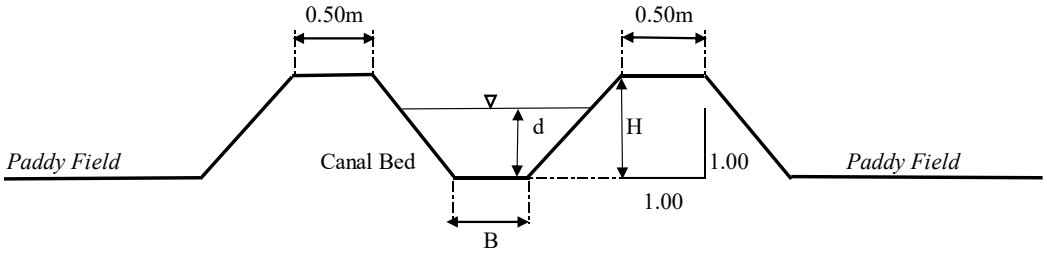
	Items	Earth Canal	Concrete Flume Canal	Concrete Lining Canal
1	Irrigation Efficiency	1	5	5
2	Construction Cost	5	1	2
3	Construction Period	3	5	3
4	O&M Cost	1	3	5
5	Suspension Period of Farming for Construction	3	5	3
	Total	13	19	18

Source: JICA Survey Team

The general features and work quantities of irrigation canals are summarized in the table below.



Main Canal (Concrete Flume Canal)



Secondary Canal (Trapezoidal Earth Canal)

Source: JICA Survey Team

Figure A5.4.2 Typical Sections of Irrigation Canals

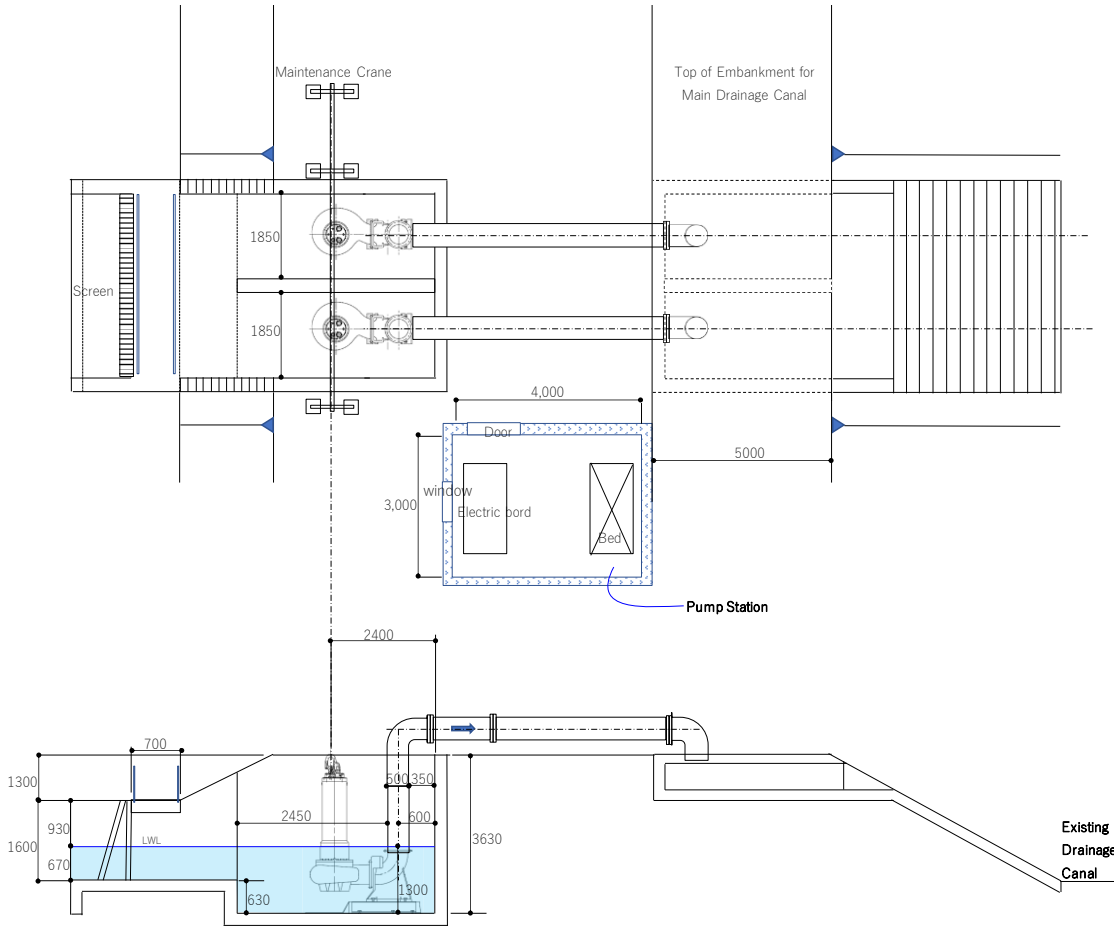
Table A5.4.3 General Features and Work Quantities of Irrigation Canal Works

	Items	Unit	MC	SC	Total
1	Canal Length & (Numbers)	m, (nos)	2,390 (1)	17,564 (20)	19,954 (21)
2	Related Structures				
	- Turnout	nos	19	0	19
	- Box Culvert	nos	8	0	8
	- Box Culvert with Check Gate	nos	3	0	3
3	Work Quantities				
	- Embankment	cum	8,420	15,400	23,820
	- Reinforced Concrete (Flume Canal)	cum	1,100	0	1,100
	- Reinforced Concrete (Structures)	cum	90	4	94
	- Foundation Concrete	cum	3	2	5
	- Sand bedding	cum	400	0	400
	- Concrete Pipe 12" (30 cm)	m	21	0	21
	- Concrete Pipe 18" (46 cm)	m	24	16	40
	- Steel Gate 0.4 m x 0.4 m	nos	7	0	7
	- Steel Gate 0.6 m x 0.6 m	nos	8	0	8
	- Steel Gate 0.8 m x 0.7 m	nos	2	0	2
	- Steel Gate 1.0 m x 0.85 m	nos	1	0	1

Note: Embankment volume for MC is included the volume required for farm road along MC
Source: JICA Survey Team

(3) Drainage Pump Station

All excess water in the Rosso Scheme and the neighboring areas will be conveyed to the proposed drainage pump station by the collector, secondary, and main drains. It is proposed to install two units of submergible pumps, each with a capacity of 1,800 cum/hour, to drain out the designed drainage discharge of 1.0 cum/sec. The layout of the proposed pump station is shown in Figure A5.4.4.



Source: JICA Survey Team

Figure A5.4.3 General Plan of Drainage Pump Station

The general features and work quantities of the proposed works are summarized in the table below.

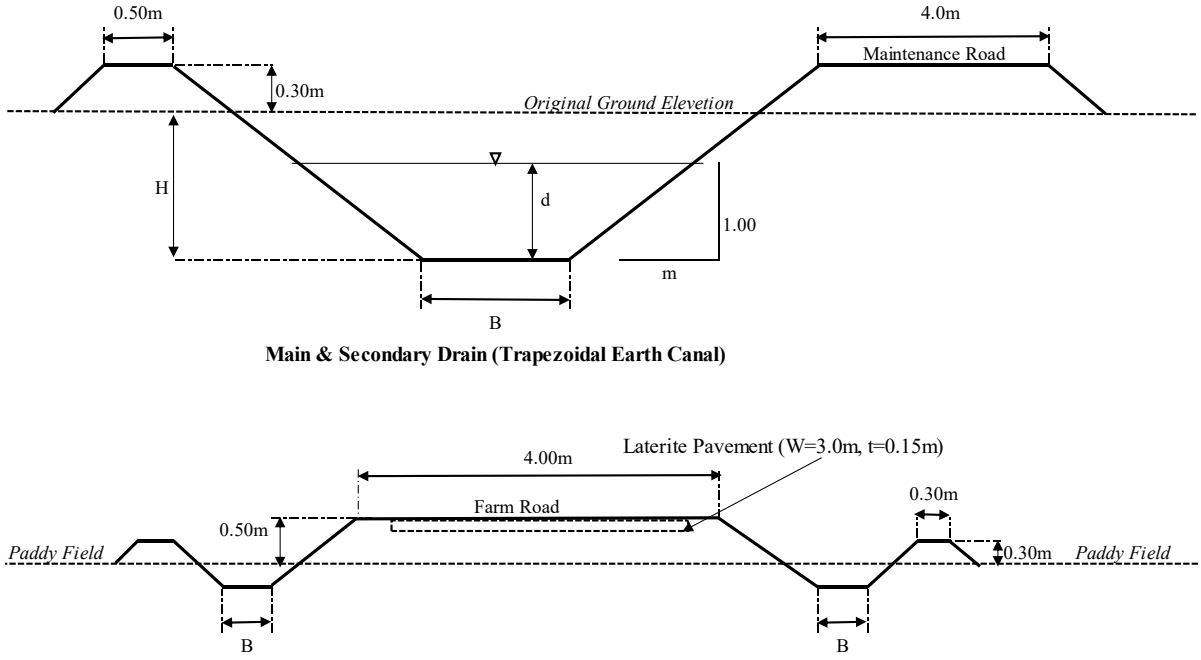
Table A5.4.4 General Features and Work Quantities of Drainage Pump Station

	Facility	Proposed Works	Quantity
1	Pump	Installation of Centrifugal (Volute) Pump (Submergible Type) (Capacity=1,800 cum/hour, Head=3 m, Diameter=500 mm, 26 kw)	2 units
2	Suction Sump	Construction of Suction Sump (Concrete works) Installation of Trash Rack (Screen)	12 cum 0.5 ton
3	Outlet Channel	Construction of Outlet Channel (Concrete Works)	8 cum
4	Pump House	Concrete Building (4.0 m x 3.0 m)	12 sqm

Source: JICA Survey Team

(4) Drainage Canals and Related Structures

For the preliminary design of main drain (MD), a leveling survey of the proposed canal alignment was conducted. Using the survey data, the hydraulic design of the MD is also prepared as shown in Table B5.4.4, and the designed longitudinal profile is attached as Figure B5.4.4. The secondary drain (SD) is designed on the satellite images utilizing the results of the preliminary design for the MD. Typical sections of drainage canals are shown in Figure A5.4.3. The collector drains (CD) are mainly designed along the farm roads to collect excess water from the farm plots and to convey water to the main and secondary drains. Based on these design outputs, the general features and work quantities of drainage canals are summarized in the table below.



Source: JICA Survey Team

Figure A5.4.4 Typical Sections of Drainage Canals

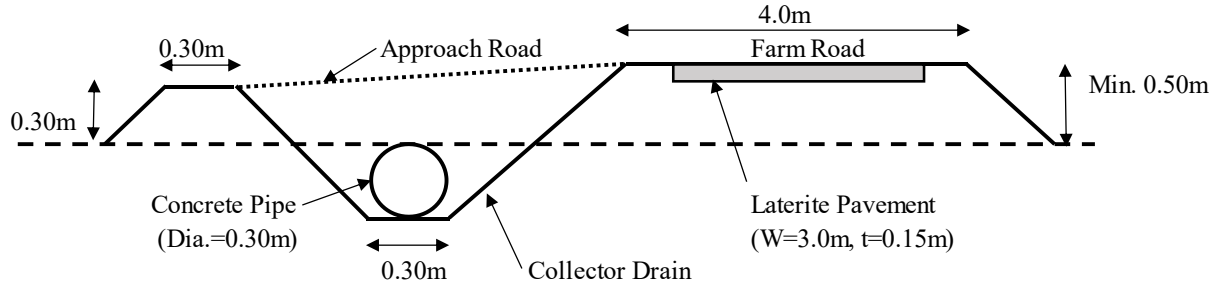
Table A5.4.5 General Features and Work Quantities of Drainage Canal Works

	Items	Unit	MD	SD	CD	Total
1	Drain Length & (Numbers)	m, (nos)	3,090 (1)	4,000 (1)	21,740 (24)	28,830 (26)
2	Related Structures Box Culvert	nos	0	5	0	5
3	Work Quantities - Excavation - Embankment - Reinforced Concrete (Structures)	cum cum cum	13,600 4,600 0	21,000 5,900 35	14,400 3,900 0	49,000 14,400 35

Source: JICA Survey Team

(5) Farm Roads

Two types of farm road (FR) are designed for the Rosso scheme so that farmers can easily operate and maintain farming and water management. One FR is constructed along the proposed concrete flume main canal as shown in Figure A5.4.2. The other is provided inside the farm land area as explained in the previous section. The approach road (AR) is provided at the levee between two farm plots; thus, the farm machine can enter both plots by one AP. The typical section of FR and AR is shown in Figure A5.4.5. The general features and work quantities of FRs are summarized in the table below.



Source: JICA Survey Team

Figure A5.4.5 Typical Section of Farm Road and Approach Road

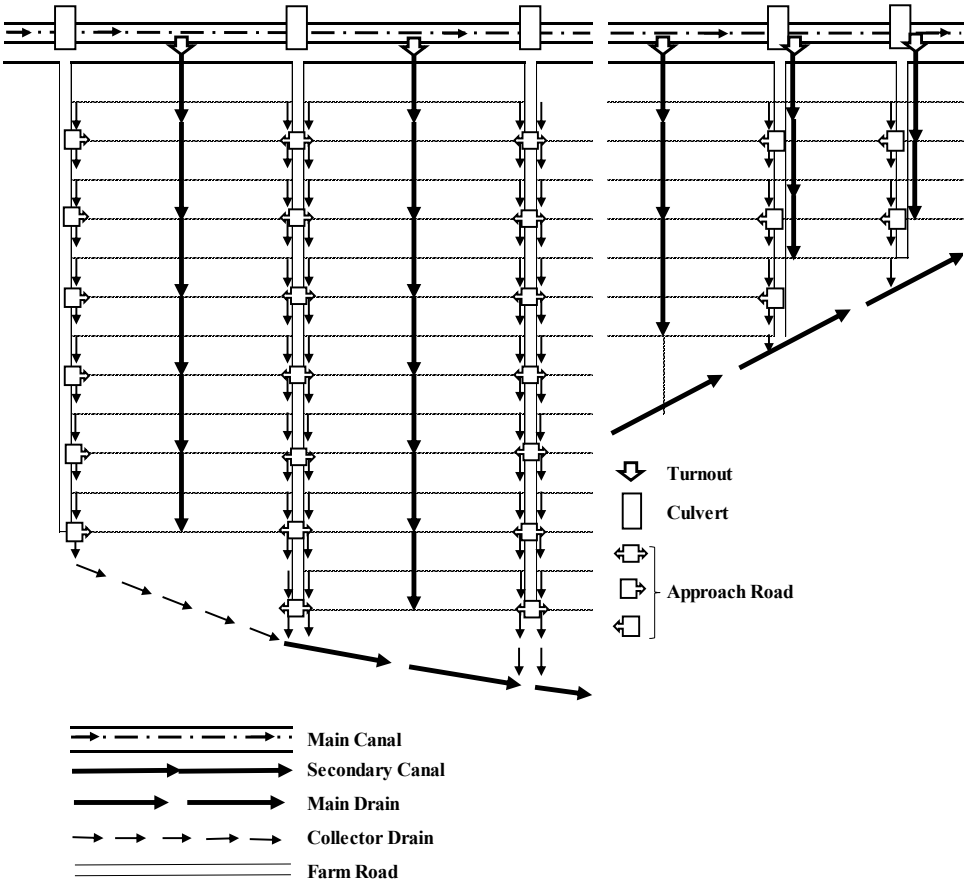
Table A5.4.6 General Features and Work Quantities of Farm Roads

Farm Road	Length (m)			Embankment (cum)	Approach Road Nos.	Concrete Pipe 30 cm dia. (m)	Embankment (cum)
	Existing	Proposed	Total				
FR along MC	0	2,390	2,390	*1	0	0	0
FR-1	520	340	860	1,470	8	48	47
FR-2		960	960	2,400	20	120	117
FR-3		760	760	1,900	8	48	47
FR-4	550	500	1,050	1,910	22	132	129
FR-5		1,130	1,130	2,830	22	132	129
FR-6		950	950	2,380	9	54	52
FR-7	550	600	1,150	2,160	24	144	140
FR-8		1,150	1,150	2,880	24	144	140
FR-9	570	0	570	680	6	36	30
FR-10		500	500	1,250	5	30	25
FR-11		330	330	830	3	18	15
FR-12		2,630	2,630	6,570	27	162	158
FR-13		260	260	650	3	18	15
FR-14		220	220	550	2	12	10
FR-15	180	0	180	270	4	24	20
FR-16		800	800	2,000	9	54	53
FR-17		960	960	2,400	0	0	0
Total	2,370	14,480	16,850	33,130	196	1,176	1,127

*Note *1: This quantity is included in volume for MC embankment (Table A5.4.3)*
Source: JICA Survey Team

(6) On-farm Development Works

The typical on-farm layout is presented in Figure A5.4.6, showing the relations among MC, SC, CD, MD, FR, AR, and the canal-related structures of turnouts and culverts.



Source: JICA Survey Team

Figure A5.4.6 Typical On-farm Layout

Land leveling is essential for the effective irrigated rice farming with proper water management. About 10 cm difference among the heights in one farm plot (about 0.4 ha) is clarified through the field research and observation. Work quantities of land leveling is roughly estimated at 70 cum per 0.4 ha or 175 cum per ha. For the Rosso Scheme of 250 ha, 43,750 cum of leveling works are required. The leveling works will be roughly carried out using a motor grader or bulldozer. The final levelling shall be done by farmers during land preparation for a few years.

(7) Post-harvest Facility

The proposed post-harvest facilities (PHF) are composed of the following buildings and works:

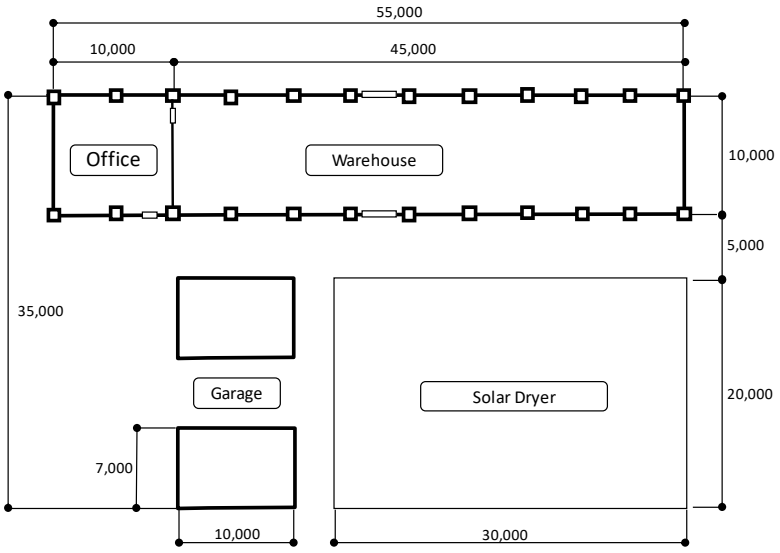
Warehouse: Building width (10 m) x Length (45 m), Total floor area (450 sqm)

Office: Building width (10 m) x Length (10 m), Total floor area (100 sqm)

Garage: Building width (7 m) x Length (20 m), Total floor area (140 sqm)

Solar Dryer: Concrete floor, Width (20 m) x Length (30 m), Total area (600 sqm)

The garage will be provided with two sheds in consideration of the PHF site proposed by the Union. The general layout of the PHF site is shown in the following figure. The present lot site proposed by the Rosso Union is a little bit smaller than the space required for the mentioned PHF facilities. In the workshop on the results of the preliminary design, the Union expressed that they will try to expand the lot to meet the requirements of the improvement project.



Source: JICA Survey Team

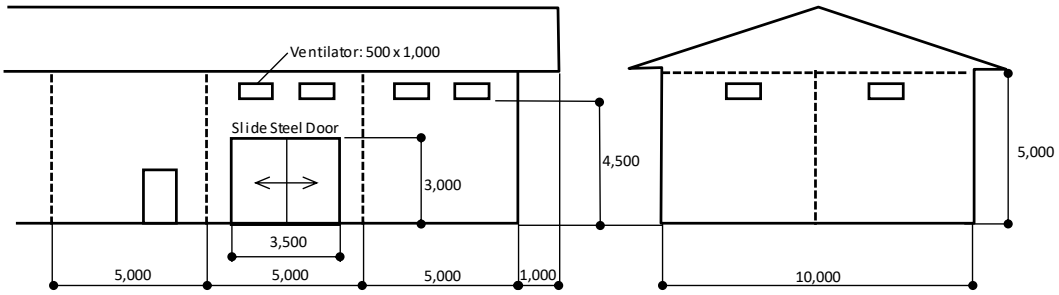
Figure A5.4.7 General Layout of PHF Site

The major structural features of the buildings are summarized in the following table. The front and side elevations of the warehouse are shown in Figure A5.4.8.

Table A5.4.7 Major Structural Features of Buildings

	Items	Works
1	Main Structure	Reinforced Concrete
2	Roof	Steel Truss Corrugated G.I. Roof Sheet Plain G.I. Sheet (Roof ridge)
3	Wall	Concrete Follow Block (CHB, t=150) with Plastering (Plain Cement) for Warehouse and Office No Wall (Opening) for garage
4	Floor	Exposed Concrete Floor
5.	Door	Slide Steel Door for Warehouse Wooden Door for Office
6.	Window	Steel Window with Clear Glass

Source: JICA Survey Team



Source: JICA Survey Team

Figure A5.4.8 Front and Side Views of Warehouse

5.5 Implementation Plan

5.5.1 Implementation Structure

The Rosso subproject will also be implemented under the implementation structure of the project proposed and explained in Chapter 7. At the beginning of the project, the PMU will review the preliminary design and perform necessary works, including detailed topographic survey, preparation of procurement plan of agricultural machinery, detailed design, and bidding. After the selection of the contractor, construction work and procurement of agricultural machinery will be carried out as supervised by the PIUs. Major civil and construction works are carried out by contractors. Small-scale works are proposed to be carried out by the farmers and the Union with participatory approach.

5.5.2 Procurement Plan

[redacted]

5.5.3 Implementation Schedule

The implementation schedule of the Rosso subproject is shown in Figure A5.5.1

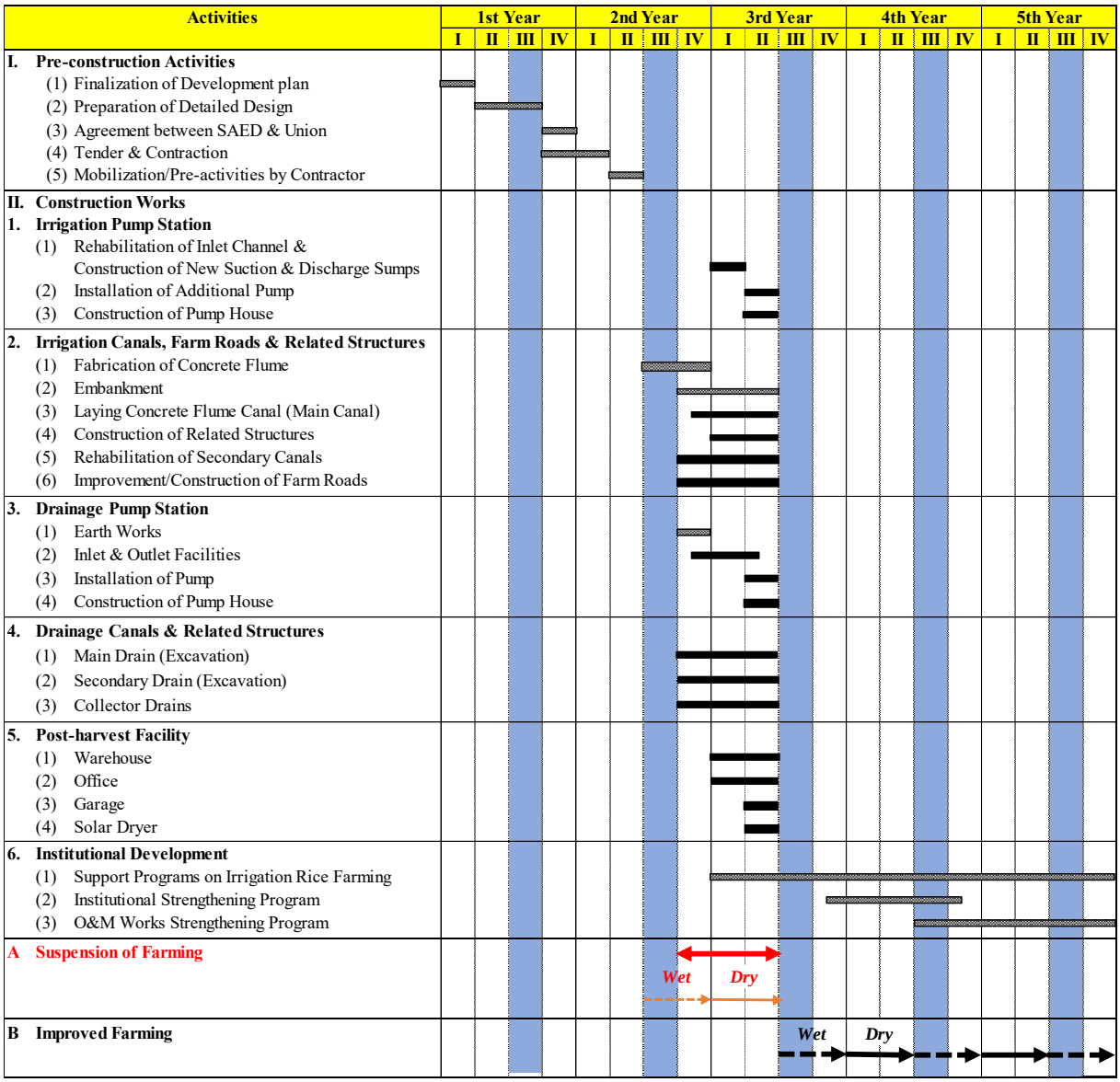


Figure A5.5.1 Implementation Schedule of the Rosso Subproject

5.6 Cost Estimation

5.6.1 Basic Conditions for Cost Estimation

The basic conditions for cost estimation are as follows:

1) Subproject cost is estimated with reference to the "JICA Manual for Design and Cost Estimation for Preparatory Survey, 2009";
2) Base year and month of cost estimation is July 2019;
3) Foreign exchange rate is as follows in June 2019:

   USD 1.00 = JPY 108, USD 1.00 = FCFA 581, FCFA 1.00 = JPY 0.186
4) Fiscal year of the subproject is calendar year (January to December);
5) Construction period, including preparatory works, is three years, and defect liability period is one

year;

6) All cost estimates do not include tax;

7) SAED does not establish guidelines and standard unit prices for cost estimation. Standard unit prices of labor, material, and equipment in Senegal are also not established. Therefore, the unit price for the cost estimation for the Rosso subproject is prepared by the JICA Survey Team based on the following data/materials.

Table A5.6.1 Data and Materials Collected for Cost Estimation

No.	Item	Data/materials collected from	Remarks
1	BOQ estimated by Consultant for SAED projects	BEATICO Mali SCP French SOSETER Senegal	Provided by SAED For preparation of standard unit price of construction works
2	Contractor's BOQ cost proposal for SAED projects	GIE TAIF 2018 SOFICA 2018 RC Construction 2018 EIFFAGE 2016 SAHE 2016 AGRIBAT Seal 2008	Provided by SAED For preparation of standard unit price of construction works
3	Unit price of labor, driver and operator	Contractors of construction works in market 2019	Interview by the Survey Team
4	Unit price of materials	Supplier of construction material in market 2019 Financial proposal of Warehouse development 2019	Interview by the Survey Team
5.	Unit price of operation of construction equipment	Rental company of common construction equipment 2019 in market	Interview by the Survey Team
6	Borrow Area	Borrow area list, national road construction project in Podor, PDIDAS Project in Dagana	Collected from contractor through SAED
7	Unit price of pump facilities	IKAO Senegal, June 2019	Interview by the Survey Team

Source : JICA Survey Team

8) The productivity of construction works is estimated based on the abovementioned data. The standard productivity of the Ministry of Agriculture, Forestry and Fisheries, Japan (MAFF) is also referred to estimate the standard unit price. The adequacy of the standard unit price prepared by the Survey Team is checked by comparing the unit prices used in the projects implemented by SAED to date. The summary of the unit price is shown in Appendix 5.4.

9) The unit price of the items that are not included in Appendix 5.4 are estimated based on the following:

- Unit price of pump: estimated from market prices of the local contractors,
- Unit price of electric line and transformer: estimated from historical price of construction works of electric line of irrigation projects by SAED,
- Unit price of bar screen: estimated from market price of material and processing of steel,
- Construction cost of pump house and warehouse: estimated from historical unit price per sqm of projects by SAED,
- Amount of reinforcement bar: calculated based on the condition of 70 kg bar per 1 cum concrete, and
- Unit price of O&M equipment: estimated from market prices of the local contractor.

10) Based on the unit price and the work quantities of the Rosso subproject mentioned in Sub-chapter 5.4,

the subproject cost is estimated. The cost breakdown for the Rosso subproject is shown in Table B5.6.1.

5.6.2 Subproject Cost

The total estimated cost for the Rosso subproject is summarized in Table A5.6.2.

Table A5.6.2 Summary of Estimated Cost for the Rosso Subproject

Non-disclosure information

The disbursement schedule based on the implementation schedule shown in Figure 5.5.1 is summarized in Table A5.6.3.

Table A5.6.3 Disbursement Schedule of the Rosso Subproject

Non-disclosure information

5.7 Economic Evaluation

5.7.1 Method of Economic Evaluation

Economic evaluation is carried out to access the economic viability of the pilot site subproject. In order to evaluate the subproject, indicators such as the economic internal rate of return (EIRR), cost-benefit ratio (B/C), and net present value (B-C) are calculated by estimating the cash outflow (costs) and inflow (benefits) on annual basis over the project life with a certain discount rate by discount cash flow method

(DCF method). The EIRR is a discount rate at which the present value of the in and out cash flows become equal. This rate shows the return to be expected from the Project as expressed in the following equation:

$$\sum_{t=0}^{n} B_t \,/\, (1+r)^t \;-\; \sum_{t=0}^{n} C_t \,/\, (1+r)^t \;=\; 0$$

Where,

Ct	:	Cost
Bt	:	Benefit
t	:	Year
n	:	Project Life (year)
r	:	Discount Rate (EIRR)

The sensitivity analysis is also carried out to evaluate the viability of the subproject against possible adverse change in the future.

The financial internal rate of return (FIRR) is not calculated because FIRR is an indicator to access the financial sustainability of the implementation agency with direct return from project activities, such as airport, water supply project, etc.

5.7.2 Basic Assumption of Economic Evaluation

The indicators for economic evaluation of the subproject are estimated with the following conditions and assumptions:

1) The method and conditions for economic evaluation is based on "Manual for Calculation of IRR (Internal Rate of Return), JICA, 2017", "Study on Economic Evaluation Methods for Development Studies, JICA , 2002", and "Manual for Calculation of Internal Rate of Return (IRR) for Japanese ODA loan projects, JBIC (Japan Bank for International Cooperation), 2002".
2) The project life is assumed to be 30 years.
3) All prices and costs are expressed in economic prices of local currency (CFA). The other currencies are converted to the local currency (CFA) by using the following exchange rates as of June 2019 for the estimation:

   USD 1.00 = JPY 108, USD 1.00 = FCFA 581, FCFA 1.00 = JPY 0.186

4) A discount rate of 10% is applied for calculation of B/C and B-C based on the rate used for other irrigation projects and Japanese ODA loan projects in Senegal (Report of Mamelles Sea Water Desalination Project, JICA, 2016 and Report of PDIDAS, *Projet de Développement Inclusif et Durable de l'Agrobusiness au Sénégal*, The Sustainable and Inclusive Agribusiness Development Project, WB, 2013 etc.). For AfD funded projects, such as AIDEP, the discount rate is not applied, and only EIRR is calculated for economic evaluation.
5) All financial prices are converted to economic prices by using the prices and factors as follows. Transfer payment (taxes and subsidies), land acquisition, compensation, price escalation, and interest during construction are excluded for calculation of economic project cost/benefit.
6) Among the traded goods, the economic price of rice (Cost Insurance and Freight (CIF) price) is estimated based on the price in "World Bank Commodities Price Data (The Pink Sheet), Annual average from Jan. to Dec. 2018 in USD, June 4, 2019" (Refer Table B5.4.x);
7) Among the traded goods, seeds, fertilizers, and pesticides are calculated by excluding subsidies

from the market price.

8) Among the traded goods, the CIF price of construction materials is considered to be the cost of the foreign currency portion (price without VAT);
9) Other goods were regarded as non-traded goods. The financial price was converted to the economic price using the standard conversion factor (SCF) of 0.96. The SCF is calculated from the export/import statistics of Senegal. The basis for the calculation is as follows:

Table A5.7.1 Calculation of Standard Conversion Factors

	2017
a) Imports Value (USD in thousand)	6,728,672
b) Exports Value (USD in thousand)	2,989,042
c) Customs and other import duties (USD in thousand)	444,041
d) Taxes on exports (USD in thousand)	4,975
e) = a + b	9,717,714
f) = (a + c) +(b - d)	10,156,780
SCF = e / f	0.96

Source: Prepared by JICA Survey Team based on the statistical data from World Integrated Trade Solution (WITS), https://wits.worldbank.org/

10) The shadow wage rate (SWR) is not applied. The market wage rate is considered as the economic labor cost of unskilled labor with reference to other ODA loan projects in Senegal ("Report of Mamelles Sea Water Desalination Project, JICA, 2016" and "Report of Project for Treatment of Sewage, Rainwater and Wastes in Kaolack City, JICA, 2014").
11) For estimation of the project economic cost, only incremental cost is counted. The sunk cost is not included in the economic cost.

5.7.3 Subproject Economic Cost

Based on the financial cost described in Sub-chapter 5.4.7, the economic project cost is estimated using the abovementioned conversion method to the economic price. Conditions and assumptions for the estimation of the subproject economic cost is as follows:

[redacted]

The subproject economic cost is shown in Table A5.7.2.

Table A5.7.2 Economic Cost for the Rosso Subproject

Non-disclosure information

Based on the disbursement schedule of financial cost, the cash flow table of economic cost is prepared as shown in Table A5.7.3.

Table A5.7.3 Disbursement Schedule of Economic Project Cost for the Rosso Subproject

Non-disclosure information

Details of the subproject economic cost are shown in Appendix 5.5.

5.7.4 Operation & Maintenance and Replacement Cost

(1) Operation & Maintenance Cost (Economic Price)

Annual incremental O&M cost is estimated as shown in Table A5.7.4. The difference between O&M cost without project condition and O&M cost with project condition is the economic annual incremental O&M cost. According to the subproject implementation schedule, the economic annual incremental

O&M cost from first year to third year is calculated separately. Details of the annual incremental O&M cost are shown in Table B5.7.1.

Table A5.7.4 Economic O&M Cost for the Rosso Subproject – Base Case (4th to 30th year)

Non-disclosure information

(2) Replacement Cost (Economic Price)

The following replacement cost is expected 20 years after the commencement of the subproject, considering the economic life of the pumps for irrigation and drainage.

Table A5.7.5 Economic Replacement Cost for the Rosso Subproject

Non-disclosure information

5.7.5 Economic Benefit

Based on the subproject plan described in this chapter, the annual incremental economic benefit is calculated. Assumptions and conditions for estimation of the subproject benefit is as follows:

[redacted]

[redacted]

The estimated economic crop budgets of without and with project conditions are shown in Appendix 5.5.

The annual incremental benefit derived from crop production by change of crop budget and by increase of crop intensity is estimated as shown in Table A5.7.6. According to the subproject implementation schedule, the economic annual incremental benefit of first to third year is calculated separately. Details of the annual incremental benefit is shown in Appendix 5.5.

Table A5.7.6 Economic Benefit of the Rosso Subproject – Base Case (4th to 30th year)

Non-disclosure information

5.7.6 Result of Economic Evaluation

Based on the assumptions and conditions described so far, the indicators for economic evaluation are calculated as shown in Table A5.7.7. The cash flow table for the calculation is shown in Table B5.7.1.

Table A5.7.7 Calculation Result of the Indicators for Economic Evaluation

Non-disclosure information

[redacted]

Table A5.7.8 Result of Sensitivity Analysis

Non-disclosure information

5.8 Environment and Social Consideration

5.8.1 Overview of the Basic Environmental and Social Conditions

The following table gives an overview of the basic environmental and social conditions of the Rosso Irrigation Scheme.

Table A5.8.1 Overview of the Basic Environmental and Social Conditions

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td colspan="2">Environmental Condition</td></tr>
<tr><td>Geology / Topography</td><td>The project area is located in the delta of the Senegal River, which belongs to Senegal and Mauritanian sedimentary basins. The Senegal Valley is generally fairly flat located less than 100 meters above sea level. The project area also has a large flat surface.</td></tr>
<tr><td>Climate</td><td>Located in the Sahel Region, it features a short rainy season from July to October, a cool dry season from November to February, and a hot dry season from March to June. The annual rainfall is 200 to 400 mm.</td></tr>
<tr><td>Hydrology</td><td>In the delta area where the Rosso Irrigation Scheme is located, many tributaries of the Senegal River flow in a complex network. From Gorom to Lampsar is the center of the tributary network.</td></tr>
<tr><td>Vegetation</td><td>The project target area is located in the Sahel area, which is mainly composed of open forests consisting of barbed shrubs and crasidae. From ecological divisions (subzones), regional vegetation is shrub grassland or shrub savanna type.</td></tr>
<tr><td>Invasive alien aquatic plants</td><td>In the valley and delta areas of the Senegal River basin, the area of invasive alien aquatic plants is expanding rapidly. The major invasive alien species in the area are perennial emergent plants such as Pharagmites, Cattail, Giant salvina (Salvinia molesta), and Fern (Pistia stratiotes). The growth of invasive alien aquatic plants is one of the serious environmental problems in the Senegal River basin and delta.</td></tr>
<tr><td>Animal</td><td>Droughts and human activities have moved most animals to the south, but some species are still in the area. There are many migratory birds in the delta wetlands.</td></tr>
<tr><td>Protected area</td><td>There are no protected areas or reserves in and around the Rosso Irrigation Scheme.</td></tr>
<tr><td colspan="2">Social Conditions</td></tr>
<tr><td>Population</td><td>The population in the Saint-Louis Region is shown in the following table.
<table>
<tr><th rowspan="2">Department</th><th colspan="3">Population 2013</th><th colspan="3">Population 2015</th></tr>
<tr><th>Men</th><th>Women</th><th>Total</th><th>Men</th><th>Women</th><th>Total</th></tr>
<tr><td>Dagana</td><td>124 771</td><td>116 924</td><td>241 695</td><td>131 451</td><td>123 183</td><td>254 634</td></tr>
<tr><td>Podor</td><td>180 976</td><td>189 775</td><td>370 751</td><td>190 664</td><td>199 935</td><td>390 599</td></tr>
<tr><td>Saint-Louis</td><td>147 568</td><td>148 928</td><td>296 496</td><td>155 468</td><td>156 901</td><td>312 369</td></tr>
<tr><td>Region</td><td>453 315</td><td>455 627</td><td>908 942</td><td>477 583</td><td>480 019</td><td>957 602</td></tr>
</table>
Source: RGPHAE</td></tr>
<tr><td>Economic Activity</td><td>Agriculture
The main industry of Rosso is agriculture, accounting for 67.5% of local farmers and 59.5% of pastoralists. Among the households, 30.6% grow rain fed crops, 23.2% grow rain fed crops at flooding area, 14.2% grow vegetable crops, and 26.1% irrigate crops other than vegetables (RGPHAE 2013)。
Livestock Breeding
Livestock production accounts for one-third of the GDP, and more than 350,000 families are engaged in livestock production, which is one of the pillars of regional economic development. To provide a brief background, there is a long tradition of the existence of a vast pastoral area (Dieri), breeding, water resources, and use of agricultural residues.
River Transport
River transport activities by ferry and boat have contributed to the reduction of youth unemployment. Boatmen mainly transport vegetables, rice, butane gas cylinders, etc. to Mauritania, and carry luxury goods, washbasins, green tea, etc. to Senegal.</td></tr>
<tr><td>Drainage channel from Rosso City to Rosso Irrigation Scheme</td><td>The Rosso Irrigation Scheme is located at the lowest point in the area and is therefore impacted by runoff from Rosso City.
For sustainable protection of this irrigation area, management of drainage water is necessary. The PUMA (Border Post Modernization Emergency Program) and activities planned for the Rosso Bridge Rehabilitation Project recommend the need for structural rehabilitation to properly manage rainwater.</td></tr>
<tr><td>Land issues</td><td>Currently, several projects have been planed in Rosso City, and these may possibly have an impact on the Rosso Irrigation Scheme.</td></tr>
</table>

Source: JICA Survey Team

5.8.2 Environmental and Social Consideration Systems and Organizations of Senegal

This section is described in Chapter 10.

5.8.3 Comparison of Alternatives (including Zero Option)

The table below shows a comparative analysis of the environmental and socioeconomic impacts of with and without project conditions.

Table A5.8.2 Comparative Analysis of "With Project" and "Without Project" Conditions

Criteria	Without Project	With Project
Environment	▪ Current environmental conditions do not change ▪ Soil salinization due to lack of adequate drainage ▪ Growth of aquatic plants in canals	▪ Environmental impact at the construction stage ▪ Increased drainage, risk of contamination of soil and surface water ▪ Increased salt due to increased water penetration
Socio-economic	▪ Income does not improve ▪ No increase in plot land ▪ High irrigation maintenance costs ▪ Difficulty supplying water to the specific plot ▪ Difficult to transport crops	▪ Improvement of specification level by the rehabilitation of irrigation facilities ▪ Increased income ▪ Increased plot land ▪ Single crop cultivation is promoted ▪ Improvement of on-site water management ▪ Store and transport crops become easy

Source: JICA Survey Team

From the comparative analysis, more benefits are generated when the project is implemented with respect to environmental and socio-economic impacts. In addition, by carrying out the project under an appropriate environmental management plan, it is possible to significantly reduce the negative impact and its scope.

Furthermore, as shown in the following table, the project plan for rehabilitation of irrigation facilities costs more than the current situation, but it improves the water cycle, and it has the advantage of reducing damage caused by heavy rain and flooding in Rosso City, which is one of the major threats to sustainable operation of the irrigation area. This project was proposed by beneficiaries at a stakeholder meeting held in Rosso on 29 August 2019.

Table A5.8.3 Comparison of Alternatives

Alternatives	Technical Evaluation	Economic and Financial Evaluation	Environmental Evaluation
Current situation	- Existing facilities - Irrigated area of the existing main canal is limited - Limited to existing water diversion facilities - Vulnerable to inflow water from Rosso City	- Renovation costs are relatively low - No expansion of the cultivated land area - There is not much increase in the volume of agricultural products carried out by large trucks	- Proper drainage control is difficult and inflow from Rosso City cannot be controlled
Proposed Project	- Rehabilitation of irrigation facilities - Rehabilitation of abandoned farmland - Rearrange of current field plot - Improvement of water control function - -There is potential for redistribution of plots, especially for women	- Requires expensive project costs - Lower maintenance costs due to reduced facility deterioration risk - More efficient transportation of agricultural products by promoting agricultural road development	- Promote proper irrigation and drainage management and better control the inflow from Rosso

Source: JICA Survey Team

5.8.4 Scoping

In order to identify the scope of the environmental impact survey, scoping was conducted for the subprojects. The selected evaluation items and reasons are shown in the table below.

Table A5.8.4 Scoping Results

PC: Pre-construction phase **C**: Construction phase **O**: Operation phase

		Item	Rating		Reason
			PC/C	O	
Pollution	1	Air	B-	D	**PC/C:** Temporary air pollution is expected due to heavy machinery and vehicle operation. **O:** The project is a rehabilitation project and no impact on air pollution is expected.
	2	Water	B-	B-	**C:** There is a possibility of water pollution due to drainage from construction sites, heavy machinery, vehicles, and construction camps. **O:** Inflow of fertilizers and pesticides into drainage channels and rivers is expected.
	3	Waste	B-	D	**C:** General waste to hazardous waste is expected. **O:** The project is a rehabilitation project and no activities generating solid waste, which may cause environmental impact, are expected.
	4	Soil	B-	B-	**C:** There is a possibility of soil contamination due to spillage of construction oil. **O:** There is a risk of soil salinization due to inadequate drainage. Contamination of irrigated soil with fertilizers and pesticides is expected.
	5	Noise/Vibration	B-	D	**C:** Noise and vibration due to heavy machinery and vehicle operation are expected. **O:** The project is a rehabilitation project and no activities generating noise and vibrations are expected.
	6	Grand Subsidence	D	D	**C/O:** Groundwater pumping will not be implemented during the construction and operation phase of this project, and ground subsidence is not expected.
	7	Offensive Odors	D	D	**C/O:** The construction of this project does not assume any work that may cause offensive odors.
Natural Environment	1	Protected Areas	D	D	**C/O:** There are no protected areas or conservation areas in the Rosso Irrigation Scheme.
	2	Flora, Fauna, and Biodiversity	D	D	**C/O:** Since this project is a rehabilitation of the existing irrigation facilities and there are no rare animals and plants in the project area, no impact on the ecosystem is expected.
Social Environment	1	Involuntary Resettlement/Land Acquisition	D	D	**C/O:** Involuntary resettlement/land acquisition is not expected for this project.
	2	Livelihood and Income	B-	B+/-	**C:** There is a possibility that agricultural work may be temporarily suspended during construction. **O:** Livelihood improvement is expected by project implementation. Water-borne diseases are expected to occur in the stagnant water area around irrigation facilities. The risk of poisoning due to inappropriate use of pesticides and insecticides is assumed.
	3	Water use	C	B-	**C:** Extent of impact is unknown. A further examination is needed. **O:** Due to chemical components of fertilizers and pesticides that flow into drains and rivers, there is a risk of poisoning of human bodies and livestock.
	4	Local Conflict of Interests	D	B-	**C:** Local conflict of interests is not expected during construction. **O:** By reusing farmland that was abandoned and grazed before the pilot project, a conflict between farmers and grazing people is expected.
	5	Cultural Heritage	D	D	**C/O:** There are no cultural heritage sites around the project site.

		Item	Rating		Reason
			PC/C	O	
	6	Landscape	D	D	**C/O:** The project is a rehabilitation project, and no impact on the landscape is expected.
	7	Indigenous and Ethnic People	D	D	**C/O:** There are no ethnic minorities or indigenous peoples in and around the project site.
	8	Work Environment (including occupational safety)	B-	D	**C:** It is necessary to consider the working environment of construction workers. **O:** The project is a rehabilitation project, and no impact on the work environment is expected.
	9	Infectious Diseases (such as HIV/AIDS)	B-	D	**C:** There is a possibility that infectious diseases may spread due to the inflow of construction workers from other areas. **O:** The project is a rehabilitation project, and no impact on infectious diseases, such as HIV/AIDS, is expected.
	10	Gender	B-	D	**C:** Harassment to local women can be expected due to the inflow of construction workers from other areas. **O:** The project is a rehabilitation project, and no impact, such as harassment, is expected.
Others	1	Accidents	B-	D	**C:** Accident risk due to inappropriate safety measures is assumed. **O:** No accident is expected during the operation phase.
	2	Across-boarder Problems/Climate Change	D	D	**C/O:** The project is a rehabilitation project, and no transboundary problems are foreseen.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of impact is unknown. A further examination is needed, and the impact could be clarified as the study progresses.
D: No impact is expected.
Source: JICA Survey Team

5.8.5 TOR for Environmental and Social Consideration Survey

From the above scoping, the contents and methods of the survey currently envisaged for items that have been judged to have some negative impact or are unknown are summarized in the TOR of the Environmental and Social Consideration Survey.

Table A5.8.5 TOR for Environmental and Social Consideration Survey

Impact Items	Survey Items	Survey Methodology
Pollution Control		
1. Air Pollution	(1) Regulations and/or act for air quality (2) Impact during construction	(1) To do a literature survey (2) To confirm the type, method, duration, and location of construction work, site visit, and hearing to organizations concerned
2. Water Pollution	(1) Regulations and/or act for water quality (2) Impact during construction (3) Impact in operation phase	(1) To do a literature survey (2) To confirm the type, method, duration, and location of construction work, site visit, and hearing to organizations concerned (3) To carry out field visit and hearing to organizations concerned
3. Solid Waste	(1) Impact during construction	(1) To confirm the type, size, and method of the construction work and capacity of the candidate sites for waste disposal
4. Soil Contamination	(1) Regulations and/or act of soil contamination (2) Impact during construction (3) Impact in operation phase	(1) To do a literature survey (2) To confirm the type, size, method, location, duration, etc. of the construction, hearing, and good practices in other similar projects (3) To carry out field visit and hearing to organizations concerned

Impact Items	Survey Items	Survey Methodology
Pollution Control		
5. Noise/Vibration	(1) Regulations and/or act for noise and vibration (2) Impact during construction	(1) To do a literature survey (2) To confirm the type, method, duration of construction, and existence of buildings which need special attention and hearing to organizations concerned
Social Environment		
2. Livelihood and Income	(1) Impact during construction (2) Impact in operation phase	(1) To confirm the duration of construction and farming system (2) To carry out field visit and hearing to organizations concerned
3. Water use	(1) Impact in operation phase	(1) To carry out field visit and hearing to organizations concerned
4. Local Conflict of Interest	(1) Impact in operation phase	(1) To carry out field visit and hearing to organizations concerned
8. Work Environment (including occupational safety)	(1) Impact on workers during construction	(1) To confirm type and duration of the construction and good practices in other similar projects
9. Infectious Diseases (such as HIV/AIDS)	(1) Impact on infectious disease	(1) To confirm good practices in other similar projects
10. Gender	(1) Impact on harassment	(1) To confirm good practices in other similar projects
Others		
1. Accident	(1) Impact during construction	(1) To confirm good practices in other similar projects

Source: JICA Survey Team

5.8.6 Environmental and Social Consideration Survey Results (Including prediction results)

The results of the survey conducted based on scoping and the results of the impact assessment are shown in the table below. As a result of the survey, there were no items that had a significant positive/negative impact on A.

Table A5.8.6 Environmental and Social Consideration Survey Results (Including prediction results)

PC: Pre-construction phase **C**: Construction phase **O**: Operation phase

		Item	Rating at Scoping		Rating after Survey		Reason
			PC/C	O	PC/C	O	
Pollution	1	Air	B-	D	B-	N/A	**PC/C:** Temporary air pollution is expected due to heavy machinery and vehicle operation.
	2	Water	B-	B-	B-	B-	**C:** There is a possibility of water pollution due to drainage from construction sites, heavy machinery, vehicles, and construction camps. **O:** Inflow of fertilizers and pesticides into drainage channels and rivers is expected. Inflowing pesticides are assumed to include bensulfuron-methyl and propanil. These inflows creates a risk of contamination of aquatic and terrestrial animal habitats. (Senegal Sugar Company discharges wastewater into rivers in the vicinity.)

	3	Wastes	B-	D	B-	N/A	**C:** General waste to hazardous waste is expected. Petroleum products, cartridges, filters, etc. are sources of hazardous waste. The capacity of the landfill site in Rosso is small, and construction waste can have a negative impact if not properly managed.
	4	Soil	B-	B-	B-	B-	**C:** There is a possibility of soil contamination due to spillage of construction oil. **O:** There is a risk of soil salinization due to inadequate drainage. The contamination of irrigated soil with fertilizers and pesticides is expected.
	5	Noise/Vibration	B-	D	B-	N/A	**C:** Noise and vibration due to heavy machinery and vehicle operation are expected. The project site is very far from the nearest residential areas, and no impact on the surrounding residents is expected, but the impact on construction workers is expected.
Social Environment	2	Livelihood and Income	B-	B+/-	B+/-	B+/-	**C:** There is a possibility that agricultural work may be temporarily suspended during construction. On the other hand, temporary employment will be created by the construction, and benefits to neighboring businesses are expected. **O:** Livelihood improvement is expected by project implementation. Water-borne diseases are expected to occur in the stagnant water area around irrigation facilities. The risk of poisoning due to inappropriate use of pesticides and insecticides is assumed.
	3	Water use	C	B-	B-	B-	**PC/C, O:** Due to chemical components of fertilizers and pesticides that flow into drains and rivers, there is a risk of poisoning of human bodies and livestock.
	4	Local Conflict of Interests	D	B-	N/A	B-	**O:** By reusing farmland that was abandoned and grazed before the pilot project, conflict between farmers and grazing people is expected.
	8	Work Environment (including occupational safety)	B-	D	B-	N/A	**C:** It is necessary to consider the working environment of construction workers.
	9	Infectious Diseases (such as HIV/AIDS)	B-	D	B-	N/A	**C:** There is a possibility that infectious diseases may spread due to the inflow of construction workers from other areas.
	10	Gender	B-	D	B-	N/A	**C:** Harassment to local women can be expected due to the inflow of construction workers from other areas.
Others	1	Accidents	B-	D	B-	N/A	**C:** Accident risk due to inappropriate safety measures is assumed.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of impact is unknown. A further examination is needed, and the impact could be clarified as the study progresses.
D: No impact is expected.

Source: JICA Survey Team

The following table shows the use status of pesticides in Senegal that listed in the above Table 10.5.1 Survey results and impact assessment.

Table A5.8.7 Pesticide Usage Confirmed in the Impact Assessment

Name of Pesticide	Usage	EU Approval	Application	Impact on Environment
Bensulfuron-methyl,	Herbicide	Approved	Wheat, Rice	Toxic to humans and animals is low.
Propanil	Herbicide	Not approved	Rice, fruit tree, vegetables	Highly toxic to birds, mammals and organisms.

Source : JICA Surrvey Team based on EU Pesticide Database
(https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=activesubstance.detail&language=EN&selectedID=1010 and https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=activesubstance.detail&language=EN&selectedID=1763) (Access 2019.10.31)

5.8.7 Mitigation Measures and Costs for Implementing Mitigation Measures

As a result of the environmental impact assessment, the environmental management plan, including mitigation measures, implementation system, and cost burden, was formulated for items evaluated as B- (either pre-construction, construction, or operation phases) as shown in the table below.

Table A5.8.8 Environmental Management Plan

	Potential Impact	Mitigation Measures	Implementation	Supervision	Estimated Cost or Burden Organization
Pre-construction/construction phase					
1	Air	• Sprinkle water on the access road to the construction site to prevent dust. • Cover with a sheet when transporting and storing materials, such as construction sand. • All heavy machinery and vehicles are operated to maintain high combustion efficiency and minimize exhaust emissions.	Construction contractor	SAED DREEC	Project cost
2	Water	• One simple mobile toilet will be installed for every 15 workers, and a hygiene awareness panel will be installed. • Install a waste storage area. • Properly maintain heavy machinery to prevent accidental oil leaks.	Construction contractor	SAED DREEC	Project cost
3	Waste	• Set up a waste management plan with the contractor and monitoring committee and obtain DREEC and SAED approval. • Cover waste transport vehicles to prevent waste from spilling or being blown away during transport. • Construction waste is prohibited from being left along the road and is removed regularly for reuse or disposal.	Construction contractor	SAED DREEC	Project cost

	Potential Impact	Mitigation Measures	Implementation	Supervision	Estimated Cost or Burden Organization
4	Soil	• Regular maintenance of construction equipment will be carried out by an authorized company. • Install a waterproof plank on the diesel tank to prevent oil leakage. • Entrust the management of used oil and hazardous waste to an authorized company.	Construction contractor	SAED DREEC	Project cost
5	Noise/Vibration	• Carry out preventive maintenance of vehicles and machines to prevent noise generation.	Construction contractor	SAED DREEC	Project cost
6	Livelihood and Income	• Develop a construction plan that minimizes the interruption duration/hours of agricultural work.	Union of producers Farmers Construction contractor	SAED DREEC	Project cost
7	Work Environment (including occupational safety)	• Ensure that workers are wearing safety armor and, if necessary, provide dust masks and soundproof headphones. • Comply with appropriate working hours. • Encourage workers to drink 1.5 liters of drinking water per day during business hours. • Prepare first aid kits at the construction site and in each vehicle/equipment.	Construction contractor	SAED DREEC	Project cost
8	Infectious Diseases (such as HIV/AIDS)	• Implement HIV/AIDS awareness campaigns. • Distribute condoms.	Construction contractor	SAED DREEC	Project cost
9	Gender	• Inform people about the existence of a grievance mechanism for violence against women	Construction contractor Regional Environmental Monitoring Committee DRDR	SAED DREEC DRDR	Project cost
10	Accidents	• Prepare fire extinguishers in each vehicle/workplace. • Install a sign at the entrance of the construction site to indicate that construction work is being performed.	Construction contractor	SAED DREEC	Project cost
Operation phase					
1	Water*	• SAED and Producers union play a central role in farmer training in pesticide management to ensure that they are used appropriately. • Conduct training in line with SAED's pesticide management plan at sites where environmental monitoring is conducted, and investigate pesticides and fertilizers used at the same time. • Promote the use of organic fertilizers.	SAED Union of producers	SAED DREEC	Producers union SAED

	Potential Impact	Mitigation Measures	Implementation	Supervision	Estimated Cost or Burden Organization
2	Soil*	• SAED and Producers union play a central role in farmer training in pesticide management to ensure that they are used appropriately. • Conduct training in line with SAED's pesticide management plan at sites where environmental monitoring is conducted, and investigate pesticides and fertilizers used at the same time. • Promote the use of organic fertilizers.	Producers union SAED	SAED DREEC	Producers union SAED
3	Livelihood and Income*	• Implement a campaign to prevent waterborne diseases • SAED and producer organizations play a central role in farmer training in pesticide management to ensure that they are used appropriately. • Separate storage locations for pesticides and crops. • Dispose of old pesticides in an appropriate manner.	Producers Union SAED	SAED DREEC	Producers Union SAED
3	Water use*	• SAED and Producers union play a central role in farmer training in pesticide management to ensure that they are used appropriately. • Separate storage locations for pesticides and crops. • Dispose of old pesticides in an appropriate manner. • Instruct people not to use drainage and river water for drinking and daily use. • When drainage or river water is used as livestock drinking water, instruct to use water that has been confirmed to be safe.	Producers union SAED	SAED DREEC	Producers union SAED
4	Local Conflict of Interests	• Establish a 1-m-wide livestock corridor within the project site. • Establish a coordination system between farmers and grazing people.	SAED Producers union	SAED DREEC	SAED

Source: JICA Survey Team

*: In the survey of pesticides and fertilizers through training, if pesticides and fertilizers with high toxicity are used, guidance is provided to farmers to use them in compliance with the pesticide management plan and EU and FAO standards.

5.8.8 Pesticide Management Plan (Draft)

Management and use of pesticides and herbicides are carried out as part of farming activities, and the pesticides and herbicides used are expected to vary from subproject to farmer.

Based on this point, this project considers the pesticide management plan as part of a series of flows necessary for improving farming activities. Furthermore, the plan is to be implemented after the farmers who are responsible for the actual management and use fully understand. For this, in the support for strengthening irrigated rice cultivation implemented in Component 3, with the facilitation by PMU / SAED environment and agricultural specialists (support of pesticide suppliers as necessary), the

producer union and the farmers themselves will prepare a pesticide management plan. It is assumed that the pesticide management plan includes the following items.

Table A5.8.9 Pesticide Management Plan (Draft)

Item	Contents
Environmental outline of the target area	Understanding natural condition and ecosystem
Current and future farming systems	Main cultivated crops, farming methods (timing and frequency of pesticide use, etc.)
Present situation and problems of pesticide management and use	Pesticides used, suppliers, packaging status, storage status, usage status, etc.
Pesticide risk assessment	Risk assessment of local pesticides and other candidate pesticides on the human body, livestock, ecosystem, etc. (including lectures by pesticide suppliers)
appropriate pesticide management and usage	Confirmation of pesticides to be used in the future, appropriate pesticide use amount, usage method, proper storage method, and inventory control method for each pesticide
Capacity evaluation for proper pesticide management and use	Evaluation of technical, organizational and financial capabilities of the implementation system for pesticide management
Measures based on capacity evaluation	Formulating a strengthening plan from the soft and hard aspects
monitoring	Monitoring implementation system and implementation plan

Source: JICA Survey Team

5.8.9 Environmental Monitoring Plan

As a result of the environmental impact assessment, a monitoring plan for environmental and social considerations was formulated for items evaluated as B- (either pre-construction, during construction, or during operation) as shown in the table below. During the operation phase, monitoring activities shall be continued for a minimum of two years.

Table A5.8.10 Environmental Monitoring Plan

Item	Item	Indicator	Point	Frequency	Responsibility	Supervision
Construction phase						
Air	Dust, mechanical exhaust gas	No abnormal emission based on visual observation	Construction area facing the surrounding residents	Monthly (when heavy equipment is in operation)	Construction contractor	DEEC SNH CRSE
Water	pH	6 – 9	Drainage point	Monthly	Construction contractor	DEEC SNH CRSE
	EC	---				
	Temperature	No abnormal heat				
	BOD5	800 mg/L				
	COD	2,000 mg/L				
	Pesticide residue					
Waste	Volume	---	Construction site	Weekly	Construction contractor	DEEC DGTSS SNH CRSE
Soil	pH	5.5 – 6.5	Construction site	Monthly	Construction contractor	DEEC DGTSS SNH CRSE
	Oil film and smell	---				

Item	Item	Indicator	Point	Frequency	Responsibility	Supervision
Noise/Vibration	Noise level	Day: 55 dB(A) Night: 40 dB(A)	Construction site Construction area facing the surrounding residents	As needed during construction When a complaint occurs At the time of equipment change or new procurement	Construction contractor	DEEC DGTSS DPC CRSE
Livelihood and Income	Confirmation of work schedule	---	Construction site	Monthly	Construction contractor	SAED DREEC
Work Environment (including occupational safety)	Environments of working, safe and sanitary	---	Construction site	Daily during construction	Construction contractor	DEEC DGTSS DPC CRSE
Infectious Diseases such as HIV/AIDS	Number of awareness campaigns Status of distributing condoms	---	Construction site construction camps	At the start of construction Then twice a year	Construction contractor	SAED DREEC
Gender	Number and content of complaints about harassment to women	---	Construction site construction camps municipal office Producers Union	As needed during construction When a complaint occurs	Construction contractor DRDR	SAED DREEC DRDR
Accidents	Fire extinguisher installation status Construction site signage Number of accidents	---	Construction site	Monthly	Construction contractor	SAED DREEC
Operation phase						
Water*	pH	6.0 – 7.5	Drainage point	Once per cropping season	SAED	DEEC SNH CRSE
	EC	< 0.3 mS/cm				
	Temperature	---				
	BOD5	---				
	COD	< 6 mg/L				
	Pesticide residue					
Soil*	pH	5.5 – 6.5	Project site	Once per cropping season	SAED	DEEC DGTSS SNH CRSE
	EC	0.8 – 1.5				
	Phosphoric acid	---				
	Nitrogen	---				
Livelihood and Income*	Number of campaigns to prevent waterborne diseases Number of training sessions on pesticide use	---	Municipal office, Producers Union	At the start of the operation, Then as needed	SAED DREEC	SAED DREEC
Water use*	Number of pesticide	---	Municipal office	At the start of the operation, Then as needed	SAED DREEC	SAED DREEC

Item	Item	Indicator	Point	Frequency	Responsibility	Supervision
	management training Confirmation of drinking water location for livestock		Producers union			
Local Conflict of Interests	Number and content of complaints	---	Municipal office, Producers Union	When a complaint occurs	SAED DREEC	SAED DREEC

Source: JICA Survey Team

*: In the survey of pesticides and fertilizers through training, if pesticides and fertilizers with high toxicity are used, guidance is provided to farmers to use them in compliance with the pesticide management plan and EU and FAO standards.

A monitoring form (draft) is shown in Appendix 10.1.

5.8.10 Implementation System and Reporting System

The environmental management and monitoring implementation and reporting system in the Rosso Irrigation Scheme is described in Chapter 10.

5.8.11 Stakeholder Meeting

Stakeholder meetings were held to gain an understanding of the project and to discuss opinions, concerns, and suggestions. The contents of the discussion and the suggestions and recommendations obtained as a result of the discussion are shown in the attached Table A5.8.1.

The environmental checklist (draft) based on the survey results is shown in Appendix 5.6.

5.8.12 Land Acquisition and Involuntary Resettlement

The subproject is based on the rehabilitation project of the existing irrigation scheme, and the donation of part of the land is subject to adjustment within the residents after discussions. Therefore, involuntary resettlement is not expected. Regarding the donation of land, a memorandum of understanding regarding construction work will be signed between SAED and the producer group in consensus building at the time of preliminary design. When signing the memorandum of understanding, appropriate explanations in line with the World Bank's Environmental Social Framework ESS5 shall be provided, and confirmation that compensation for land donation is not required and the land donated will not affect the livelihood of the donor should be done. These shall be agreed in writing. This memorandum will also be signed by the land donor.

CHAPTER 6 PROJECT SCOPE

6.1 General

6.1.1 General Approach for the Project

Based on Chapter 1 and Chapter 2, the general features of the Project and the fundamental issues for the achievement of the Project objectives are summarized as follows:

Objective of the Project:

To improve the efficiency and the productivity of irrigated rice farming practices through the extension and/or rehabilitation of irrigation and agricultural related facilities and the procurement of agricultural machineries.

It is expected to contribute to improve the self-sufficiency of rice in Senegal and reduce the trade deficit through the reduction of rice imports by achieving the above objective.

Project Profile:

1) Rehabilitation/extension of existing irrigation and drainage facilities;
2) Development/rehabilitation of agricultural related infrastructures (rural roads, storage, etc.);
3) Procurement of agricultural machineries (tractors, combine harvesters, milling machines, etc.); and
4) Consulting services (detailed design, bidding assistance, construction supervision, etc.).

Target Area:

Dagana and Podor Departments in Saint-Louis Region

Concerned Agency:

Ministry of Agriculture and Rural Equipment (MAER); and

National Company for the Development and Exploitation of the Senegal River Delta, Senegal River, and Faleme Valley (SAED).

Fundamental Issue in the Target Area:

The fundamental issue in the target area is "improvement of cropping intensity". The inefficient and low production of paddy cultivation, typified by low cropping intensity, have been mainly caused by the following:

i) Problems on irrigation facilities;
   - Deterioration of irrigation facilities,
   - Low quality of irrigation facilities, and
   - Lack of drainage system.

ii) Agricultural related infrastructures; and
   - Lack of access and farm roads for the smooth operation of agricultural machineries and marketing, and
   - Lack of paddy storages.

iii) Farm management and producers' organization
   - Less compliance with the recommended cropping calendar,
   - Difficulties in access to certified seeds,
   - Installation of improper agricultural machineries for the actual site conditions,
   - Inappropriate operation and maintenance of the irrigation facility including water management, and
   - Delay in repayment of loan.

Therefore, the low cropping intensity has been caused by the various problems, which are intricately interrelated, and is difficult to be improved through solving each problem individually. Since most of the projects/programs implemented in the target area are aiming to solve the above listed problems individually, the low cropping intensity which is the fundamental issue in the target area has not been improved so far through these projects/programs.

Based on the general features and the fundamental issues for the Project, the Project scope has been formulated considering the following general approach:

(1) Integrated development to improve the overall process of rice supply chain from rice cultivation to marketing

To achieve the objective of the Project through its activities, it is essential to maximize the multiplier effects among the activities so as to improve the overall process of the rice supply chain. The relationship among each project activity and rice supply chain component is shown in the table below.

Table A6.1.1 Relationship among Project Activities and Rice Supply Chain Components

Project Activity	Objective of the Activity / Related Activity	Concerned Rice Supply Chain
Irrigation improvement	- Fundamental requirement for irrigated rice farming	- Rice cultivation
Drainage improvement	- Proper water management - Effective use of agricultural machineries	- Rice cultivation - Harvesting
On-farm development	- Proper water management - Effective use of agricultural machineries	- Rice cultivation - Harvesting
Rural/farm road improvement	- Timely inputs such as labor, fertilizer and machineries - Smooth transportation of paddy for post harvesting - Smooth transportation of rice to market	- Rice cultivation - Harvesting - Post harvesting - Marketing
Storage development	- To maintain the quality of rice - Adjustment of timing of delivery of rice to market	- Post harvesting - Marketing
Introduction of tractors	- Efficient rice cultivation	- Rice cultivation
Introduction of combine harvesters	- Efficient harvesting	- Harvesting
Introduction of rice mills	- Efficient post-harvesting	- Post harvesting

Source: JICA Survey Team

Therefore, to improve the efficiency and the productivity of irrigated rice farming practices through the Project activities, it is essential to plan and design the Project components as an integrated development including hard and soft components towards the improvement of the overall process of the rice supply chain. Each activity should harmonize with each other to maximize the outcomes of each activity through the multiplier effects. Additionally, the Project components should be planned and designed so as to make facilities, goods, or equipment improved or provided under the Project as user friendly ones for easy operation and maintenance especially by the farmers and farmers' organization.

(2) To realize the high-quality agriculture and irrigation development works for the stages from planning to operation and maintenance

As shown in Chapter 2 and the above fundamental issues in the target area, the main causes of the low cropping intensity in the target area are as follows:

- Deteriorated and/or low-quality irrigation facilities,
- No drainage systems were planned and designed in the planning and the design stages of the irrigation development works,
- Lack of farm roads and storage facilities,
- Deteriorated and/or low-quality farm roads, and
- Introduction of agricultural machineries and/or pumps that did not meet the actual demands at the field.

Therefore, for the improvement of efficiency and productivity of irrigated rice farming practices through the Project activities, it is essential to realize the high-quality agriculture and irrigation development works for all development stages including planning, design, bidding, construction supervision and operation and maintenance.

(3) To secure the sustainability of the Project

1) Irrigation and drainage facilities will be rehabilitated and improved, 2) agricultural related facilities will be constructed and improved, and 3) the required agricultural machineries will be provided under the Project activities. However, the Project objective will be realized only when such facilities and machineries are properly and sustainably operated and maintained by farmers and their organizations with the assistance of SAED and other concerned agencies.

(4) To adopt and utilize the outcomes and experiences obtained through PAPRIZ2

Since middle of 2010, JICA has been implementing its technical cooperation project, namely PAPRIZ2, to support SAED in promoting rice double cropping in the target area. Under PAPRIZ2, many valuable outcomes and experience have been obtained from the project activities that includes the following:

- Trials of rice double cropping in the pilot sites,
- Series of various trainings such as institutional development, O&M and water management, farming techniques and skills, post-harvest and farm mechanization, and
- Improvement of SAED agricultural extension system through trainings for SAED CAs and concerned stakeholders.

Therefore, such valuable outcomes and experience obtained through PAPRIZ2 activities will be fully applied and utilized especially for the formulation of soft component activities under the Project.

Based on the above general approaches, the following major components are proposed for the Project:

Table A6.1.2 Project Components

Component No.	Description
Component-1	Rehabilitation and Improvement of Irrigation Schemes
Component-2	Enhancement of Agricultural Mechanization
Component-3	Soft Component Activities
Component-4	Enhancement of Project Management and Monitoring
Component-5	Consulting Services for Technical Assistance

Source: JICA Survey Team

6.1.2 Summary of Proposed Project Scope

The scope of work of each Project component proposed by the JICA Survey Team is shown in Table A6.1.3:

Table A6.1.3 Proposed Project Scope

No.	Scope of Work	
Component-1: Rehabilitation and Improvement of Irrigation Schemes		
1.1	Rehabilitation and Improvement of Irrigation and Drainage Facilities	1) To execute detailed design works through survey, investigation, and design (SID) works, 2) To procure the contractor(s) and/or supplier(s) for the construction and/or procurement works, 3) To rehabilitate and improve irrigation and drainage facilities as planned and designed, and 4) To procure tools and equipment required for O&M.

No.	Scope of Work	
1.2	Improvement of Agricultural Related Facilities	1) To execute detailed design works through survey, investigation, and design (SID) works, 2) To procure the contractor(s) and/or supplier(s) for the construction and/or procurement works, 3) To improve agricultural related facilities as planned and designed, and 4) To procure tools and equipment required for O&M.
Component-2: Enhancement of Agricultural Mechanization		
2.1	Introduction of Reapers with Threshers	1) To determine the specifications, quantities, and distribution plan, 2) To procure reaper(s) + thresher(s), and 3) To distribute reaper(s) + thresher(s).
2.2	Introduction of Medium-size Combine Harvesters	1) To determine the specifications, quantities, and distribution plan, 2) To procure medium-size combine harvester(s) with trailer(s), and 3) To distribute medium-size combine harvester(s) with trailer(s).
Component-3: Soft Component Activities		
3.1	Consensus Buildings with Beneficiaries	1) To build consensus with farmers and union/GIEs about the subproject activities and those plan/design, including their obligations and responsibilities required for the works, 2) To build consensus with/among farmers and union/GIEs about lands required for the improvement works, if necessary, and 3) To build consensus with/among farmers and GIEs about the establishment of a union, if necessary.
3.2	Capacity Enhancement of Farmers' Organizations	1) To prepare and plan training programs on management of union/GIE, and 2) To implement training programs as planned.
3.3	Agriculture Support Activities	1) To plan demonstration farm(s) to demonstrate the proper farming management for double cropping, 2) To operate and manage the demonstration farm(s), 3) To prepare and plan training programs on farming management, rice cultivation techniques and post-harvest activities, and 4) To implement training programs as planned.
3.4	Capacity Enhancement of Operation and Maintenance (O&M)	1) To prepare O&M manual(s) for each subproject activities, 2) To prepare and plan training programs on the following: - O&M of irrigation and drainage facilities including water management, - O&M of warehouses including the paddy moisture content control, and - O&M of agricultural machineries for operators, union/GIE, service providers, and repair shops. 3) To implement training programs as planned, and 4) To hand over the facilities, machineries, and goods to beneficiaries.
Component-4: Enhancement of Project Management and Monitoring		
4.1	Establishment of Project Management Unit (PMU) and Project Implementation Units (PIUs).	1) To establish PMU and PIUs, 2) To plan and design offices for PMU and PIUs including office spaces and accommodations for the Consultant, 3) To procure the contractor(s) for the construction/renovation works, 4) To construct/renovate the offices for PMU and PIUs, 5) To procure office furniture and equipment including tools and equipment required for the proper management and monitoring works, and 6) To procure vehicles and motorbikes for PMU, PIUs, and the Consultant.
4.2	Strengthening of PMU and PIUs for Proper Project Management and Monitoring	1) To prepare and establish the following manuals/system: - Operation manual for Project implementation, - Design criteria for the Project, - Cost estimate system for the Project, and - Guidelines for construction supervision and quality control for the Project. 2) To prepare and plan training programs on the above, and 3) To implement training programs as planned.
4.3	Monitoring and Evaluation (M&E)	1) To establish M&E frameworks for overall project activities including selection criteria, evaluation criteria and roles of each agency concerned,

No.	Scope of Work	
		2) To plan and implement the necessary training programs for the proper M&E, and 3) To implement M&E including monitoring and assessment for environmental and social aspects.
Component-5: Consulting Services for Technical Assistance		
5.1	Technical Assistance for the Project Implementation	1) To assist PMU and PIUs in the implementation of the Project components 1, 2, and 3, and 2) To assist PMU and PIUs in the implementation of M&E activities.
5.2	Formulation of the Future Development Plans in the SRV	1) To assist PMU and PIUs in the preparation of the project concept paper, long lists of candidate subprojects, and criteria for the selection of subprojects for the future project in Danaga and Podor departments, and 2) To formulate the development plan including a long list of candidate subprojects for irrigation schemes in Matam and Bakel departments.

Source: JICA Survey Team

6.2 Component 1: Rehabilitation and Improvement of Irrigation Schemes

6.2.1 Basic Concept and General Procedure of Component 1

Component 1 "Rehabilitation and Improvement of Irrigation Schemes" contains the fundamental activities to achieve the objectives of the Project and should be carried out taking the following general approaches described in Sub-chapter 6.1 into consideration:

(1) Integrated development to improve the overall process of rice supply chain from rice cultivation to marketing,
(2) To realize the high-quality agriculture and irrigation development works for the stages form planning to operation and maintenance, and
(3) To secure the sustainability of the Project.

Component 1 includes the following sub-components:

Sub-component 1.1: Rehabilitation and Improvement of Irrigation and Drainage Facilities, and
Sub-component 1.2: Improvement of Agricultural Related Facilities

The basic concepts for the formulation of the scope of Component 1 activities are as follows:

- Modernization of the facilities for a reduction in the operation and maintenance cost,
- Planning and design works that harmonize with the other component activities (for the realization of the integrated development),
- Planning and design works based on the appropriate standards and actual site conditions,
- Proper construction works and construction supervision by means of appropriate control standards and periodical monitoring and construction meetings, and
- Promotion of the operation and maintenance by the farmers' organizations.

Table A6.2.1 shows the facilities to be rehabilitated and/or improved under Component 1 and the suggestions for the implementation of the works.

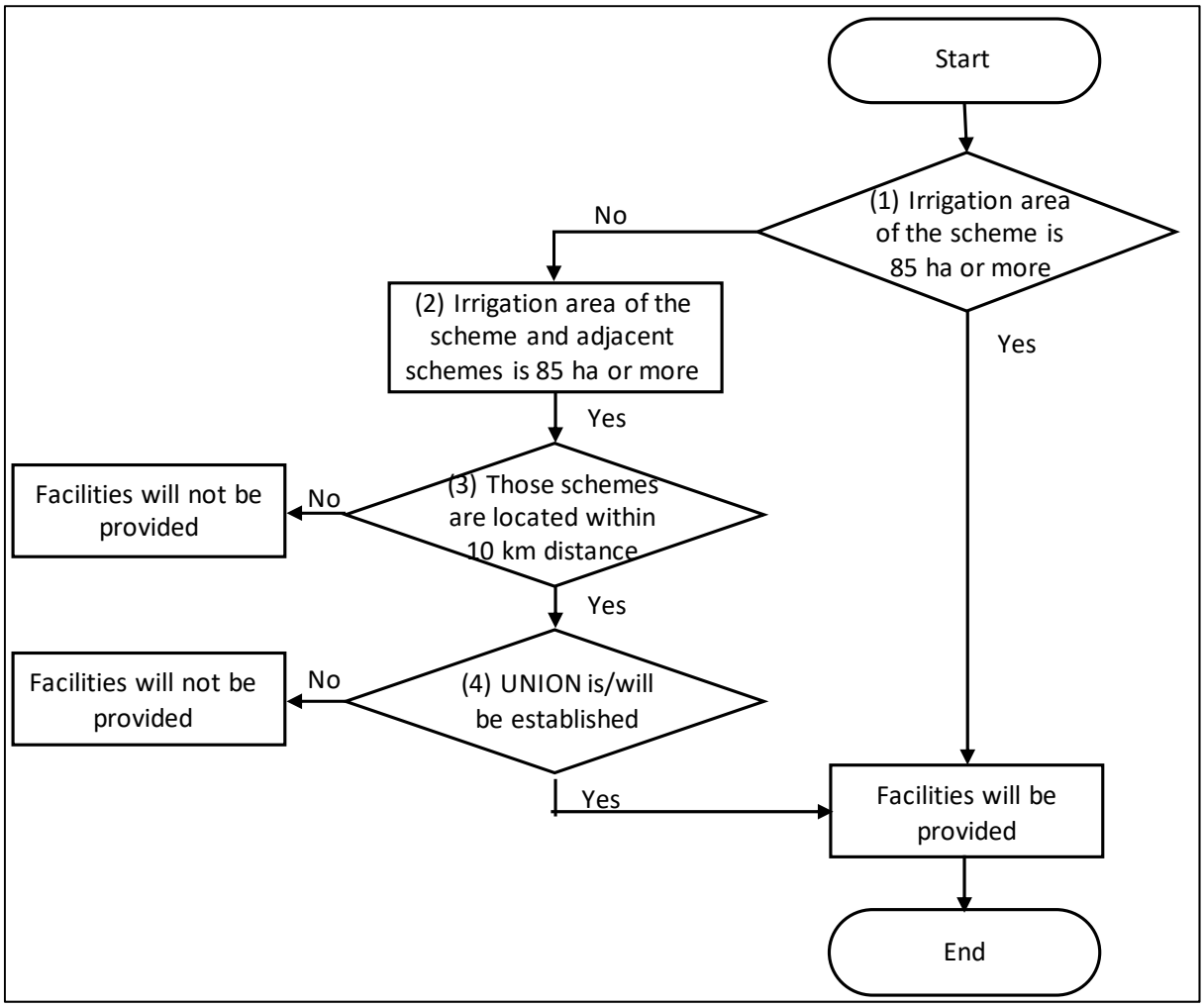
Table A6.2.1 Component 1: Facilities to be Rehabilitated/Improved and Suggestions

Facilities	Suggestions and Remarks
Sub-component 1.1: Rehabilitation and Improvement of Irrigation and Drainage Facilities	
Pump station	・It is proposed to carry out the field experiment using lysimeter tanks to revalidate the crop water requirements to be applied to the Project works (see Sub-chapter 5.3.2), ・Until the above field experiment is carried out, it is proposed to adopt the design water requirements of 2.88 lit/s/ha to the Project design works (see Sub-chapter 5.3.3).

Facilities	Suggestions and Remarks
	・In the Podor Department, the floating type pumps are utilized in some irrigation schemes considering the seasonal fluctuation of river water levels. It is suggested that the present outlet channels using pipes be improved to the permanent structure as far as it is practicable. ・For pump houses, concrete type pump houses are recommended. ・Solar power pump station has been installed in the Union Dagana A Scheme (860 ha) in the Dagana Department. The above solar power system has a capacity of 135 kW with 522 numbers of solar panels and has been operated since December 2018. The investment costs were EUR 400,000. A solar powered system may be considered as one of the alternative power sources for pump operation to reduce operation costs in the future. However, it is suggested that the proper irrigation water supply system with minimum water losses be realized through the improvement of irrigation schemes under this Project considering the current site situations.
Irrigation canal networks	・Main irrigation canals should be improved with concrete flume canals, especially for small irrigation schemes. However, the feasibility of the improvement should be carefully examined and confirmed for the determination of canal types. ・Canal related structures including turnouts, culverts, and check gates should be improved to become permanent structures.
Drainage pump stations	・The necessity of a drainage pump station should be examined whenever the construction/rehabilitation of a drainage canal network is proposed. ・It is proposed to adopt the SAED's unit design drainage requirement of 2.5 L/s/ha in the planning and design of drainage facilities.
Drainage canal networks	・Collector drains should be studied when the improvement/rehabilitation of main and/or branch drainage canals are planned. ・Canal related structures including culverts should be improved to become permanent structures.
On-farm development	・Only land levelling works will be carried out under the Project for on-farm development. ・Only preliminary levelling will be carried out by motor-graders or bulldozers under the Project. The final levelling should be carried out by farmers themselves as part of the land preparation for rice cultivation.
Sub-component 1.2: Improvement of Agricultural Related Facilities	
Farm roads and access roads	・Farm/maintenance roads (3.0 m width) should be provided along main irrigation canals, especially for small irrigation schemes. However, the feasibility of constructing such roads should be carefully examined and confirmed. ・Provision of farm roads along collector drains or secondary irrigation canals should be studied for a smooth access within irrigation schemes. ・Related structures including culverts should be improved to become permanent structures. ・Approach roads should be studied for the smooth access of agricultural machineries from farm roads to farm plots without causing damage to canals. It is proposed that approach roads be provided for each farm plot or at 100-m intervals. ・Basically, public roads will be utilized as access roads from/to irrigation schemes and the required rehabilitation works for such roads should be studied.
Agricultural related facilities	・Agricultural related facilities to be improved under the Project includes paddy storages, union offices, solar dryers, and garages for agriculture machineries. ・Suggestions and remarks for the planning and design of these facilities are described in Sub-chapter 5.3.4 (3). ・The above facilities will be provided only for irrigation schemes that satisfy the criteria shown in "Note 1" below since it is not economically feasible to construct the above facilities individually for a small irrigation scheme.

Source: JICA Survey Team

"Note 1": Agricultural related facilities under the Project will be provided for irrigation schemes that satisfy the criteria and conditions shown below. These criteria and conditions should be consistent with those for agriculture machineries described in Sub-chapter 6.3. This is because agricultural related facilities, such as paddy storages and garages for agriculture machineries, should be studied or designed considering the type or specifications of agriculture machineries that are to be introduced.



Source: JICA Survey Team

Figure A6.2.1 Flow Chart for Provision of Agricultural Related Facilities

(1) Irrigation area of the scheme is 85 ha or more

As described in Sub-chapter 6.3, medium-size combine harvesters will be introduced to irrigation schemes having the area of 85 ha or more. Considering the consistency with the above condition, the agricultural related facilities, such as garages for agriculture machineries and paddy storages, will be also provided to irrigation schemes having the area of 85 ha or more under the Project.

(2) Irrigation area of the scheme and adjacent schemes is 85 ha or more

(3) Those schemes are located within a 10 km distance

(4) Union is/will be established

Even for an irrigation scheme having the irrigation area of less than 85 ha, if the total irrigation area of such irrigation scheme and adjacent irrigation schemes is 85 ha or more, one set of the agricultural related facilities may be provided for one group of such irrigation schemes under the Project. This is provided that such group of irrigation schemes satisfy the following criteria:

- Such irrigation schemes should be neighboring each other for the proper and efficient use and operation of the installed facilities, which will be managed jointly. Considering the walking distance, one group of irrigation schemes should be located within a 10 km distance.

- A union should be established for the proper operation and management of the installed facilities jointly by several irrigation schemes.

Under Component 1, the activities of (1) detailed design works, (2) procurement of contractor(s) and supplier(s), (3) construction works for rehabilitation and improvement of irrigation schemes, and (4) procurement of tools and equipment required for operation and maintenance, will be carried out after the official approval on the preliminary design reports as described in Chapter 4. The suggestions and remarks for the implementation of these activities are described below.

6.2.2 Sub-component 1.1: Rehabilitation and Improvement of Irrigation and Drainage Facilities

(1) Detailed Design Works

After the official approval on the preliminary design reports, the PMU will carry out the detailed design work with the assistance of the Consultant to be employed under Component 5. The following are suggested for the implementation of detailed design works:

- The detailed design works that are carried out based on the design criteria and cost estimate system are to be established under Component 4, and
- The detailed design works are to be carried out considering the suggestions and remarks shown in Sub-chapter 6.2.1.

(2) Procurement of Contractor(s) and Supplier(s)

Based on the results of the detailed design works, the contractors and suppliers will be procured for the relevant works. Details for the procurement works are shown in Sub-chapter 7.3.

(3) Construction Works for Rehabilitation and Improvement of Irrigation Schemes

1) Construction Supervision

To monitor the progress of the construction works and discuss the issues at the site, the following regular or special construction meetings should be held for proper construction supervision:

Table A6.2.2 Regular and Special Construction Meetings

Name	Frequency	Chairman	Co-chairman	Member	Main Agenda
Monthly construction meeting	Monthly	Project Manager (PMU)	Subproject Manager (PIU)	- Assistant engineer and expert (PIU) - Consultant - Contractor - Union/GIE	- Progress, quality, and safety - Decisions for required actions such as special meeting, warning letter, variation order, extension of time, contract amendment, etc.
Weekly constriction meeting	Weekly	Subproject Manager (PIU)	Assistant Engineer (PIU)	- Assistant expert (PIU) - Consultant - Contractor - Union/GIE	- Progress, quality, and safety - Discussion for required actions such as special meeting, warning letter, variation order, extension of time, contract amendment, etc.
Special meeting	As required	Project Manager (PMU)	Subproject Manager (PIU)	- Assistant engineer and expert (PIU) - Consultant - Contractor	- Specific issues for discussion (delay of the works, low quality of the works, etc.)

Note: Refer to Sub-chapter 7.1 for the details of PMU and PIU
Source: JICA Survey Team

Basically, the representatives of union/GIEs should be invited to the above meetings for the purpose of sharing information and enhancing their understanding regarding the construction works implemented in their schemes.

2) Quality Control

Supervision of the quality control done by the contractors will be the responsibility of the assistant engineers in PIU at the field level and subproject manager in PIU at the department level. The quality of construction works should be controlled based on the guidelines for construction supervision and quality control for the Project to be established under Component 4. It is suggested that PMU notify the contractors that the quality of the construction works should be controlled based on such guidelines in the pre-construction meeting.

Based on the monitoring and evaluation through the above construction meetings, warning and penalty imposed upon the contractors should be strictly applied in accordance with the relevant clauses of the specifications and conditions of the contract.

Additionally, for the proper monitoring of the quality control activities, it is recommended to instruct the contractor to submit "Quality Assurance of the Works" at the beginning of the construction and "Monthly Quality Report" in a timely manner.

3) Safety Control

The following safety control activities should be carried out to avoid the serious accidents:

- Submission of "working safety plan" by the Contractor and approval by PIU,
- Weekly and monthly safety patrol by the contractor and PIU assistant engineer,
- Reporting of results of weekly and monthly safety patrol and discussions for proper safety manners to be taken by the contractors in weekly and monthly meetings (recorded as minutes of meeting), and
- Description of the above activities in weekly and monthly reports submitted by the contractors.

(4) Procurement of Tools and Equipment Required for Operation and Maintenance (O&M)

Tools and equipment required for the O&M of irrigation and drainage facilities to be rehabilitated/improved under the Project will be procured and provided with the farmers' organization(s) so that they may operate and maintain such facilities by themselves.

The list of tools and equipment will be prepared during the preliminary design and detailed design works. Such tools and equipment will be procured and supplied through the supplier(s) under the supervision of PMU and PIUs. The tentative list of tools and equipment required for the O&M of the irrigation and drainage facilities for each scheme is shown in the table below.

Table A6.2.3 Tentative List of Tools and Equipment Required for O&M (Sub-component 1.1)

Non-disclosure information

It is noted that the small size backhoe with blade in the above table will be provided for irrigation schemes that satisfy the criteria and conditions shown in "Note 1" of Table A6.2.1.

(5) Hydrological Measurement Instruments

Meteorological and hydrological measurement system is essential for the proper management of the water resources in the Senegal River basin, which are the most important water resources in Senegal. Meanwhile, as described in Sub-chapter 5.3.2, the meteorological and hydrological measurement system is not urgently required in terms of the irrigation and drainage improvement works. This is because the Senegal River has a sufficient capacity to develop all potential irrigation areas along the Senegal River with the expected maximum cropping intensity.

Currently, the meteorological and hydrological measurement instruments are installed at the Diama Dam located near the mouth of the Senegal River for the operation of tender gates (20 m width x 11 m height, 7 nos.). According to the expert in the Diama Dam Control Office, there are several rainfall stations and water level measurement stations in the upstream of the Senegal River and the observed data are transmitted to the dam control office every day. Based on these data and water level observed at the Daima Dam, the tender gates are operated for dam safety and water management. The automatic water level gauge and meteorological station are also installed at the Diama Dam, although they have malfunctioned recently. Additionally, all data are recorded and managed manually.

When the modernized meteorological and hydrological measurement system is planned and designed, it is suggested that the abovementioned current conditions and situations be scrutinized so as to plan and design for the effective systems.

6.2.3 Sub-component 1.2: Improvement of Agricultural Related Facilities

The activities of (1) detailed design works, (2) procurement of contractor(s) and supplier(s), and (3) construction works for the rehabilitation and improvement of the irrigation scheme under Sub-component 1.2 "improvement of agricultural related facilities" will be implemented referring to the same suggestions and remarks as those described in Sub-chapter 6.2.2 (1), (2), and (3), respectively. Additionally, the following should be noted for the implementation of Sub-component 1.2:

- During the preliminary design works, the necessity and feasibility of the provision of agricultural related facilities should be studied referring to the flow and criteria shown in "Note 1" of Table A6.2.1, and
- Such study results should be duly explained to and discussed with the concerned farmers' organization(s) for the final determination.

(4) Procurement of Tools and Equipment required for Operation and Maintenance (O&M)

The tools and equipment required for the O&M of agricultural facilities to be provided under the Project will be procured and provided with the farmers' organization(s) so that they may operate and maintain such facilities by themselves.

The list of tools and equipment will be procured through the same procedure described in Sub-chapter 6.2.1 (4). The tentative list of tools and equipment required for the O&M of the agricultural related facilities for each subproject is shown in the table below.

Table A6.2.4 Tentative List of Tools and Equipment Required for O&M (Sub-component 1.2)

Non-disclosure information

Additionally, plastic pallets, which are required for the proper storage of paddy, should be provided with paddy storages and such should be included in the construction works.

6.3 Component 2: Enhancement of Agricultural Mechanization

6.3.1 Basic Concept and General Procedure of Component 2

To realize the double cropping and improve the cropping intensity in the target area, the timely and smooth harvesting for the dry season paddy is essential due to the short period between harvesting for the dry season paddy and land preparation for the rainy season rice cultivation. As described in Sub-chapter 2.2.5, the number of harvesting machines, such as combine harvesters, is currently not sufficient for the target area. Meanwhile, the agricultural mechanization of harvesting activities may be enhanced through the improvement of the drainage system to be realized under Component 1 activities. Considering these current situations in the target area and expected improvements by the Project, harvesting machines will be introduced under the Component 2 "Enhancement of Agricultural Mechanization" following the approaches and procedures shown below.

Wet soil conditions and small size farm plots are widely observed in the target area. The reaper will be introduced as a main harvesting machine under the Project since it has a small size and a light weight, making it suitable for the above conditions. Since the reaper performs only a cutting function, the thresher will be also introduced together with the reaper. In addition to the "reaper + thresher", the medium-size combine harvester (crawler type) will be also introduced as the prospective and recommended harvesting machine. So far, the medium-size combine harvester is not the common agricultural machine in Senegal and its introduction under the Project should be considered as the model or trial introduction for future mechanization.

The agricultural machineries to be procured under the Project will be the SAED's property. The SAED will make a contract with the farmers' organization for the use of such machineries (refer to Appendix 5.3 for the sample contract agreement). Based on the contract between SAED and the farmers' organizations, SAED will distribute the machineries and transfer the right of use together with the responsibilities of the O&M of the machineries to the farmers' organizations.

Based on the above basic concept of Component 2, the following sub-components are proposed:

Sub-component 2.1: Introduction of Reapers with Threshers
Sub-component 2.2: Introduction of Medium-size Combine Harvesters

As shown in Table B6.3.1, the minimum sizes of irrigation areas for the efficient and economical use of the reaper and the medium-size combine harvester are estimated as follows:

Reaper: 10 ha
Medium-size combine harvester: 75 ha

Considering the above minimum areas for the efficient and economical use of the machines, it is proposed that the type of agricultural machineries to be introduced for each subproject site under the Project be determined as follows:

[Procedure and conditions for determination of the type of agricultural machineries]

1. Medium-size combine harvesters will be introduced to irrigation schemes having the area of 85 ha or more (i.e., 75 ha for one medium-size combine harvester and 10 ha for one reaper),
2. Only reapers will be introduced to irrigation schemes having the area of less than 85 ha,
3. Even for an irrigation scheme having the irrigation area of less than 85 ha, if the total irrigation area of such irrigation scheme and adjacent irrigation schemes is 85 ha or more, one set of the agricultural related facilities may be provided for one group of such irrigation schemes under the Project, provided that such group of irrigation schemes satisfy the following criteria:
   - Such irrigation schemes should be neighboring each other for the proper and efficient use and operation of the installed facilities, which will be managed jointly. Considering the walking distance, one group of irrigation schemes should be located within a 10 km distance.
   - Unions should be established for the proper operation and management of the installed facilities jointly by several irrigation schemes.
4. Threshers will be introduced together with the reapers (same number),
5. The trailers for the transportation of medium-size combine harvesters will be introduced together with the medium-size combine harvesters (one trailer for one subproject), and
6. Horse and carriage will be used for the transportation of the reapers and the required costs for them should be shouldered by farmers' organizations.

Based on the above conditions, the plan of the introduction of the agricultural machineries under the Project is prepared as shown in Table A6.3.1.

Table A6.3.1 Plan of Introduction of Agricultural Machineries under the Project

Irrigation Area (ha)			Reaper		Thresher		Medium-size Combine Harvester		Trailer
ha	～	ha	Harvesting area (ha)	Q'ty	Threshing[*1] (ton)	Q'ty	Harvesting area (ha)	Q'ty	Q'ty
10	～	60	60	1	450	1	0	0	0
61	～	84	84	2	630	2	0	0	0
		85	10	1	75	1	75	1	1
85	～	135	60	1	450	1	75	1	1
136	～	195	120	2	900	2	75	1	1
196	～	255	180	3	1,350	3	75	1	1
256	～	315	240	4	1,800	4	75	1	1
316	～	375	300	5	2,250	5	75	1	1
376	～	510	360	6	2,700	6	150	2	1
511	～	570	420	7	3,150	7	150	2	1
571	～	630	480	8	3,600	8	150	2	1
631	～	765	540	9	4,050	9	225	3	1
766	～	825	600	10	4,500	10	225	3	1
826	～	885	660	11	4,950	11	225	3	1
886	～	1,020	720	12	5,400	12	300	4	1

Note: Threshing volume is estimated based on the planned yields in the dry season with the Project of 7.5 t/ha and the harvesting area by reapers.

Source: JICA Survey Team

6.3.2 Sub-component 2.1: Introduction of Reapers with Threshers

(1) Determination of Specifications, Quantities and Distribution Plans

During the preliminary design works, PMU will estimate the required number of reapers with threshers and prepare the distribution plan for each subproject based on Table A6.3.1. Following the determination of specifications, quantities, and distribution plans for all subprojects, PMU will prepare the bidding documents for the procurement of the planned machineries. Table A6.3.2 and Table A6.3.3 show the recommended specifications of the reapers and the threshers.

Table A6.3.2 Tentative Specifications of Reapers

Non-disclosure information

Table A6.3.3 Tentative Specifications of Threshers

Non-disclosure information

It is noted that the above specifications, quantities, and distribution plan for each subproject should be duly explained to and discussed with the concerned farmers' organization(s) during the preliminary design stage before finalizing such details.

Additionally, it is suggested that the tools and equipment required for the O&M of the reapers with threshers to be provided under the Project be procured and provided with the farmers' organization(s) so that they may operate and maintain such machines by themselves. It is proposed that such tools and equipment be procured and provided with farmers' organizations together with the reapers and threshers. Table A6.3.4 shows the tentative list of tools and equipment required for the O&M of the reapers with threshers.

Table A6.3.4 Tentative List of Tools and Equipment Required for O&M (Sub-component 2.1)

Non-disclosure information

(2) Procurement of Reapers with Threshers

SAED will call the bidding for the procurement of reapers and threshers based on the plan, design, and bidding documents prepared above (1). The bidding will be made based on the procedure described in Sub-chapter 7.4.

(3) Distribution of Reapers with Threshers

The reapers and threshers will be procured by the supplier(s) under the management and supervision of PMU and PIUs based on the plan and design stated above (1).

SAED will make a contract with the farmers' organization for the use of such machineries (refer to Appendix 5.3 for the sample contract agreement). Based on the contract between SAED and the farmers' organizations, SAED will distribute the machineries and transfer the right of use and responsibilities of O&M of the machineries to the farmers' organizations.

Additionally, it is suggested that supplier(s) for the procurement of the reapers and threshers be requested to provide the following trainings for the farmers' organization:

- Assembly of machines and confirmation of operation and performance, and
- O&M of the machines.

6.3.3 Sub-component 2.2: Introduction of Medium-size Combine Harvesters

(1) Determination of Specifications, Quantities and Distribution Plans

During the preliminary design works, the PMU will estimate the required number of medium-size combine harvesters and trailers and prepare the distribution plan for each subproject based on Table A6.3.1. Following the determination of specifications, quantities, and distribution plans for all subprojects, the PMU will prepare the bidding documents for the procurement of the planned machineries. Table A6.3.5 and Table A6.3.6 show the recommended specifications of the medium-size combine harvesters and the trailers.

Table A6.3.5 Tentative Specifications of Medium-size Combine Harvesters

Non-disclosure information

TableA6.3.6 Tentative Specifications of Trailers

Non-disclosure information

It is noted that the above specifications, quantities, and distribution plan for each subproject should be duly explained to and discussed with the concerned farmers' organization(s) during the preliminary design stage before finalizing such details.

Additionally, it is suggested that the tools and equipment required for the O&M of the medium-size combine harvesters and trailers to be provided under the Project be procured and provided with the farmers' organization(s) so that they may operate and maintain such machines by themselves. It is proposed that such tools and equipment be procured and provided with farmers' organizations together with the medium-size combine harvesters. Table A6.3.7 shows the tentative list of tools and equipment required for the O&M of the medium-size combine harvesters and the trailers.

Table A6.3.7 Tentative List of Tools and Equipment Required for O&M (Sub-component 2.2)

Non-disclosure information

(2) Procurement of Medium-size Combine Harvesters with Trailers

SAED will call the bidding for the procurement of medium combine harvesters and trailers based on the plan, design, and bidding documents prepared above (1). The bidding will be made based on the procedure described in Sub-chapter 7.4.

(3) Distribution of Medium-size Combine Harvesters with Trailers

The medium combine harvesters and trailers will be procured by the supplier(s) under the management and supervision of PMU and PIUs based on the plan and design stated above (1).

SAED will make a contract with the farmers' organization for the use of such machineries (refer to Appendix 5.3 for the sample contract agreement). Based on the contract between SAED and farmers' organizations, SAED will distribute the machineries and transfer the right of use and the responsibilities of O&M of the machineries to the farmers' organizations.

Additionally, it is suggested that supplier(s) for the procurement of the medium combine harvesters and trailers be requested to provide the following trainings for the farmers' organization:

- Assembly of machines and confirmation of operation and performance, and
- O&M of the machines.

6.4 Component 3: Soft Component Activities

6.4.1 Basic Concept and General Procedure of Component 3

Component 3 "Soft Component Activities" consists of the following sub-components:

Sub-component 3.1: Consensus Building with the Beneficiaries,
Sub-component 3.2: Capacity Enhancement of Farmers' Organizations,
Sub-component 3.3: Agriculture Support Activities, and
Sub-component 3.4: Capacity Enhancement of Operation and Maintenance (O&M).

In order to formulate the scope of these sub-components, the concepts and general procedures shown in the table below are taken into account.

Table A6.4.1 Basic Concept and General Procedure for Component 3

Sub-component	Basic Concept	General Procedure
1. Consensus building with the beneficiaries	・ Effective use of PAPRI2 experience for selection of pilot sites ・ To avoid the time consuming steps such as land acquisition/resettlement for the smooth implementation of the Project ・ To expedite the procedures through the effective use of the existing forms	・ Proper explanations to the beneficiaries should be done ・ Written agreement should be made with the beneficiaries ・ Consensus building among farmers should be considered to enhance their initiatives and motivations ・ SAED should be involved to secure the sustainability of the Project
2. Capacity enhancement of farmers' organization	・ Effective use of PAPRI2 experience for Union and GIE enhancement at the pilot sites ・ Use of local resource persons from CIFA and CGER for accounting training	・ Harmonizing the process with other activities like agriculture support and O&M ・ Implementation of timely trainings and follow-up trainings, if necessary
3. Agriculture support activities	・ Effective use of PAPRI2 experience in the pilot projects for rice double cropping, improvement of paddy production and grain quality, and improvement of extension system ・ Preparation and execution of practical demonstration and training program considering the available local resources	・ Implementation of the four-level training system to reduce CAs' burden, including 1) PMU/PIU level, 2) the SAED sector level, 3) demonstration plot level, and 4) irrigation block level ・ Farmers' initiatives and motivations should be enhanced to secure the sustainability of the Project ・ Preparation of cropping calendar as an action plan through the discussion among farmers in the irrigation block level
4. Capacity enhancement of O&M	・ Effective use of PAPRI2 experience in the pilot projects for the O&M of irrigation facilities and the introduction of reapers ・ Support both for hardware (tools and equipment) and soft aspects (trainings and follow-up) to realize the O&M by the farmers' organizations	・ Clear demarcation of the responsibilities for O&M and written agreement among the concerned parties ・ Involvement of beneficiaries in the planning, design, and construction stages to enhance the understanding of facilities/equipment ・ Preparation of O&M manual for each subproject and the provision of training for it ・ Provision of timely training according to the construction schedule ・ Provision of timely training for agricultural machinery taking the delivery schedule into account

Source: JICA Survey Team

The suggestions and remarks for the implementation of each sub-component are described below.

6.4.2 Sub-component 3.1: Consensus Building with the Beneficiaries

The following consensus building may be required during the implementation of the Project:

(1) Consensus Building for the Implementation of Subproject Activities,
(2) Consensus Building for the Donation of Lands Required for Subproject Works
(3) Consensus Building for the Establishment of Unions

Additionally, the following contracts or memoranda may be made between SAED and the farmers' organizations during the Project works:

- Contract for handing over the facilities to be improved by the Project,
- Memorandum for block water management and O&M including water management, and

- Contract for handing over the agricultural machineries to be procured under the Project.

(1) Consensus Building for the Implementation of Subproject Activities

Agreement between SAED and the representative of beneficiaries (representative of the union/GIEs, the department governor, and the village chief) for the implementation of subproject activities including the construction or rehabilitation works shall be prepared and signed by the concerned parties before the final approval of the preliminary design report and, if necessary, before the commencement of the subproject activities. The agreement will include the following clauses:

1) The facilities and equipment to be improved/procured under the subproject shall be the government property,
2) Confirmation and agreement on the subproject activities,
3) Roles and responsibilities of beneficiaries for the implementation of subproject activities and the scope of their responsibilities for O&M, and
4) Suspension of farming activities during the construction/rehabilitation works.

Additionally, written agreements on the donation of lands required for subproject works described in (2) and the establishment of union described in (3) will be attached to and constitute a part of the above agreement for the implementation of subproject activities. The draft format of an agreement for implementation of subproject activities is shown in Appendix 5.2.

A half-day workshop for the discussion with beneficiaries on the above will be organized and, if agreed on all details, five copies of an agreement for implementation of subproject activities will be signed by the concerned parties.

(2) Consensus Building for the Donation of Lands Required for Subproject Works

As described in Chapter 4, subprojects that require land acquisition or resettlement will not be selected for the implementation under the Project. Meanwhile, small-scale donations of lands may be required mainly for the construction/rehabilitation works such as the construction of new farm roads. Agreement for the donation of such lands shall be prepared and signed by the concerned parties before the final approval of the preliminary design report.

For the small-scale donation of lands for the construction works, it may be effective to build consensus among beneficiaries through the farmers' own initiatives. The main role of SAED for such consensus building is to support and facilitate the discussion among farmers. Meanwhile, even for the small-scale land donations, it is essential to share information with the commune since the land donations will require the change of land ownership and/or reallocation.

Considering the above conditions, it is suggested that a written agreement for the donation of lands required for subproject works be made and signed by the concerned parties including SAED, farmers concerned, representative of the union/GIEs, department governor, and the village chief. The draft format of an agreement for the donation of lands required for subproject works is shown in Appendix 5.2.

The proposed process for consensus building on the donation of lands required for subproject works is described in Sub-chapter 5.3.7 (1) 2).

(3) Consensus Building for the Establishment of Unions

As shown in the long list for candidate subprojects described in Chapter 3, the rehabilitation of an irrigation scheme, which is irrigated by a single pump, is proposed under most of the subprojects. On

the other hand, the unions may be established under the Project activities by means of merging the small-scale irrigation schemes, considering the merits of large- or medium-scale irrigation schemes and the possible joint operation and management of agricultural related facilities and/or agricultural machineries as described in Sub-chapters 6.2.1 and 6.3.1.

The packaging of subprojects, including the necessity of establishing unions, will be studied during the preliminary design works. If the establishment of unions is planned in the preliminary design stage, a written agreement between SAED and farmers' organizations should be made and attached to an agreement for the implementation of subproject activities shown above (1). After an approval of the preliminary design report, the farmers' organizations with the assistance of SAED should complete the required process for the establishment of a union through the procurement of the contractor(s) or the supplier(s) for the construction/procurement works. The proposed process for the establishment of a union is summarized as follows, while the details are shown in Appendix 6.1:

1) Confirmation of farmers' organizations and stakeholders to be involved to a union,
2) Implementation of workshops with the concerned farmers,
3) Signing of a written agreement on the establishment of a union between SAED and the representative of farmers,
4) Establishment of a "union establishment committee" in the "union establishment workshop,"
5) Discussion on the organizational structure of a union proposed by the committee,
6) Approval on the organizational structure and secretariat of a union in the "general meeting for union establishment,"
7) Preparation of the minutes of discussions on the above,
8) Submission of minutes of discussions to the department governor, and
9) Official registration of a union.

It is proposed to establish the target number of female members for the secretariat and the board of union from a point of view of gender consideration.

6.4.3 Sub-component 3.2: Capacity Enhancement of the Farmers' Organization

It is proposed to provide the capacity enhancement programs not only for the new farmers' organizations but also for the existing ones aiming at the proper operation and maintenance of the facilities to be improved under the Project.

The proposed training programs are shown in Sub-chapter 5.3.7 (2) and those training programs will be implemented before/after completion of the construction works. The PIU staff and/or CAs will carry out the periodical monitoring of the subproject activities and give advice to farmers whenever necessary. The follow-up trainings may be provided if their necessity is confirmed as a result of the above monitoring activities.

6.4.4 Sub-component 3.3: Agriculture Support Activities

In order to achieve the rice double cropping under the project, the agriculture support activities are formulated considering the following basic concepts:

- To utilize the outputs and experiences obtained through PAPRIZ2 activities, and
- To extend them to the subproject sites to be implemented under the Project.

The PAPRIZ2 activities regarding farming practices include the following:

- Trials of rice double cropping at three pilot sites,

- A series of trainings to increase productivity and quality of rice, and
- Improvement of the SAED agricultural extension system.

Considering these activities implemented under PAPRIZ2, the following agriculture supporting activities are proposed for the Project.

- Demonstration program: to establish and operate model plots to demonstrate the improved farming practices for rice double cropping.
- Training program: composed of a series of trainings to ensure that farmers will execute the improved farming practices in their farm plots.

The proposed programs for Rosso irrigation scheme are described in Sub-chapter 5.4.4 and these will also be applied to the overall Project as summarized in Table A6.4.2 below.

Table A6.4.2 Summary of Agriculture Support Activities

Agriculture Support Activities	Description
Demonstration program 1. Preparation of demonstration programs 2. Operation of demonstration programs	Demonstration of improved farming practices - Preparation of demonstration programs by SAED CAs and the Sector Chief under the guidance of PMU and PIU in collaboration with stakeholders and other resource persons (effective use of the PAPRIZ2 experience) - Establishment of demonstration plots (approximately 14 plots, two plots for each sector where the several subprojects are proposed) - Demonstration of two crop seasons (one year) in each demonstration plot - Farm inputs for demonstration should be shouldered by the farmers - The training program described below will be implemented at the demonstration plots - Supports from local resource persons from like agricultural extensions, seed sector, input suppliers, service providers, rice traders, etc. are expected
Training program 3. Preparation of training program 4. Execution of training program	Training of key farmers by the demo farmers at the demonstration plots and the training of farmers by the key farmers at each irrigation block - Training programs to be prepared by SAED CA and the Sector Chief under the support of PMU/PIU in collaboration with the stakeholders - Training materials prepared under PAPRIZ2 will be effectively utilized - CAs will be the training manager of each subproject through the training conducted by PMU/PIU - Cropping calendar will be prepared as an action plan by farmers in each irrigation block of subprojects - Combination of lectures and field trainings for the better understanding of crop growing stage of rice and appropriate farming practices

Source: JICA Survey Team

As shown in the table above, demonstration plots are tentatively planned to be established at 14 and will be operated around for four to five years. This means that demonstration plots will be operated, on average, at three locations simultaneously and that one location may cover one or two sectors. It is noted that these are just tentative plans and are to be reviewed and determined based on the results of the preliminary design works during the course of the Project implementation.

Taking the limited number of SAED CAs available under the Dagana and Podor departments into account, for the implementation of the demonstration and training programs, the four-level training system is proposed to effectively utilize the existing local resources including farmers. The proposed four-level training system is shown in Table A6.4.3.

Table A6.4.3 Proposed Training System for Agricultural Support Activities

Training level and Trainers	Trainees	Main Training Theme
Training at PMU and PIU Level ・ PMU and PIU staff, ・ SAED HQ and department staff, ・ Resource persons[*1] as required	・ 8 Chiefs from 8 Sectors ・ 28 CAs under Dagana and Podor departments ・ Selected demonstration farmers and representatives from Union and GIE	・ Preparation of demonstration program ・ Preparation of training program
Training at Sector Level ・ CAs and Sector Chief ・ Resource persons[*1] as required	・ Demo-farmers ・ Union and GIE representatives	・ Establishment and operation of demonstration plot
Training at Demonstration Plot Level ・ Demo-farmers ・ Union and GIE representatives ・ CAs as required	・ Key farmers from irrigation blocks ・ Block management committee member	・ Execution of training at the demonstration plots for subprojects implemented in the same sector
Training at Irrigation Block Level ・ Key farmers and block management committee member ・ CAs as required	・ Farmers in irrigation block	・ Execution of training at the irrigation block level in each subproject

Note: 1 Such as agricultural research, seeds, extension, finance, input supplier, service provider, buyers and millers, communes, and local administrations.*

Source: JICA Survey Team

As shown in the above table, it is proposed to invite stakeholders to the trainings as resource speakers so as to minimize the burden of CAs. Especially for the training at irrigation block level, it is suggested that the inputs from the Project be minimized in order to assure the sustainability of the activities, which should be realized through the enhancement of farmers' initiatives and motivations. PIU staff and/or CAs will carry out the periodical monitoring of the subproject activities and give advice to farmers whenever necessary. The follow-up trainings may be provided if their necessity is confirmed as a result of the above monitoring activities.

6.4.5 Sub-component 3.4: Capacity Enhancement of Operation and Maintenance (O&M)

Sub-component 3.4 "Capacity Enhancement of O&M" is proposed to realize the proper operation and maintenance works carried out by the farmers' organizations.

(1) Preparation of O&M Manuals

Soon after the completion of the rehabilitation/construction of the irrigation and drainage facilities and/or agricultural related facilities or the procurement of equipment such as agricultural machineries, PMU will prepare the following O&M manuals with the assistance of the Consultant and other departments concerned:

1) O&M manuals for irrigation and drainage facilities (including water management),
2) O&M manuals for paddy storages (including control of paddy moisture contents), and
3) O&M manuals for agricultural machineries (including operation manuals and service manuals)

It is suggested that the above manuals be prepared referring to the following documents:

- Manuals and guidelines prepared through the PAPRIZ2 activities for 1) and 2), and
- Manuals to be distributed to users by suppliers as attachments to the machineries for 3).

The proposed O&M plans are described in Sub-chapter 5.3.7 (4).

Additionally, the roles and responsibilities of the concerned parties should also be incorporated into the above manuals referring to the suggestions shown below.

Roles and Responsibilities of Parties Involved in O&M Activities

The committees or staff responsible for O&M activities have not been established or appointed in some unions/GIEs in the target area. Under the Project, the committees or staff responsible for the following O&M activities should be established or appointed in all unions/GIEs;

- O&M for irrigation and drainage facilities,
- O&M for pumps and pump houses,
- Water management including block water management,
- O&M for paddy storages, and
- O&M for agricultural machineries.

Especially for water management, the establishment of the committee for block water management is essential. It is suggested that the memorandum on block management of an irrigation scheme including O&M and water management be concluded among union members and SAED.

The roles and responsibilities of parties involved in O&M activities are summarized in Table A6.4.4.

Table A6.4.4 Tentative Roles and Responsibilities for O&M Activities

Parties	Roles and Responsibilities
Union Secretariat or GIE Secretariat (All members)	Preparation of cropping calendar/water management plan for each cropping season Explanation at the General Assembly
Block Water Management Committee	Preparation of cropping calendar/water management plan for each cropping season Operation and implementation of water distribution plan for each season to be prepared based on the block management policies
Union General Assembly or GIE Meeting	Approval on cropping calendar/water management plan for each cropping season Approval for outsourced maintenance work
Union Representative or GIE Representative	Procurement of the contractors for the outsourced maintenance works
Person in charge for Pump Operation	Confirmation of pump operation, communication with Union representative and SAED (DAM) in the event of a failure/trouble
SAED (DAM)	Pump trial run before the commencement of the irrigation services for each cropping season Arrangement of repair with suppliers in the event of a breakdown
Agricultural Machinery Operator	Operation and check of the conditions of the agricultural machinery
Person in charge for Agricultural Machinery	Arrangement with service providers for the repair of machines in the event of a breakdown or malfunction

Source: JICA Study Team

(2) Preparation of Training Programs

PMU will prepare the training programs to enhance the understanding on the O&M manuals prepared above (1). The proposed training programs are described in Sub-chapter 5.3.7 (4).

(3) Implementation of Training Programs

PMU will implement the training programs prepared above (2) at the time that the facilities or equipment to be improved or procured under the Project is handed over.

(4) Handing Over Facilities, Equipment and Tools

After the implementation of the training programs shown above (3), a contract for handing over the facilities or equipment to be improved or procured under the Project will be concluded between SAED and the farmers' organizations, while the responsibilities of O&M for the facilities and/or equipment will be transferred to farmers' organizations accordingly. Additionally, the following tools and

equipment required for the proper O&M by the farmers' organizations will be also handed over to farmers' organizations:

- Tools and equipment required for the O&M of irrigation and drainage facilities and agricultural related facilities to be procured under Component 2, and
- Tools and equipment required for O&M for agricultural machineries to be procured under Component 3.

6.5 Component 4: Enhancement of Project Management and Monitoring

6.5.1 Basic Concept and General Work Flow of Component 4

For the smooth and proper implementation of the Project as planned and scheduled, it is essential to enhance the capacity and function of the Project implementation and monitoring works. As details are shown in Sub-chapter 7.1, PMU and PIUs are proposed for the implementation and management of the Project. Under "Component 4: Enhancement of Project Management and Monitoring," it is proposed to enhance the capacity and function of the Project implementation and monitoring works by means of the following:

- Capacity building of PMU and PIUs both in hardware and institutional aspects, and
- Establishment and implementation of a monitoring and evaluation system for the Project.

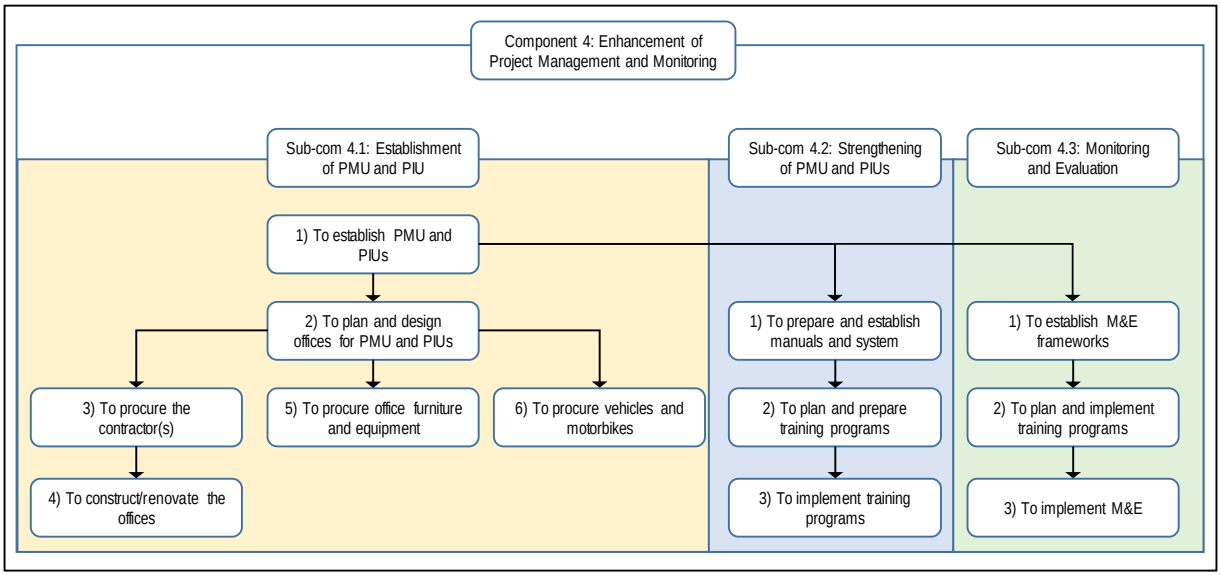
Considering the above concept, the following sub-components are proposed under Component 4:

Sub-component 4.1: Establishment of Project Management Unit (PMU) and Project Implementation Units (PIUs);

Sub-component 4.2: Strengthening of PMU and PIUs for Proper Project Management and Monitoring; and

Sub-component 4.3: Monitoring and Evaluation (M&E).

The general work flow of Component 4 is shown in Figure A6.5.1 and the details are described in the following Sub-chapters.



Source: JICA Survey Team

Figure A6.5.1 General Work Flow of Component 4

6.5.2 Sub-component 4.1: Establishment of Project Management Unit (PMU) and Project Implementation Units (PIUs)

1) To establish PMU and PIUs

Soon after the loan agreement is concluded, the required engineers and experts for PMU and PIUs will be employed by SAED. The PMU and PIUs shall be established by SAED. Details of PMU and PIUs are described in Sub-chapter 7.1.

2) To plan and design offices for PMU and PIUs

For the efficient management of the Project by PMU and PIUs with the assistance of the yen-loan consultant (consultant), it is proposed to construct/renovate the offices for PMU, PIUs, and the consultant, as shown in the following table:

Table A6.5.1 General Features of PMU, PIUs, and Consultant Offices (Tentative)

Non-disclosure information

The following will be planned and designed by PMU and PIUs and approved by SAED for implementation:

- Detailed plan and design drawings for each office and accommodation,
- List of furniture and equipment required for Project management and monitoring works,
- List of vehicles and motorbikes required for Project management and monitoring works, and
- Bidding documents for the procurement of contractor(s) and supplier(s) for the above works.

3) To procure the contractor(s) for the construction/renovation works

SAED will call the bidding for the construction/renovation of PMU and PIUs offices including the Consultant's office and accommodation based on the plan, design, and bidding documents prepared in above 2). The bidding will be made based on the procedure described in Sub-chapter 7.4.

4) To construct/renovate the offices for PMU and PIUs

PMU and PIUs offices will be constructed/renovated by the contractor(s) under the management and supervision of PMU and PIUs based on the plan and design stated above 2).

5) To procure office furniture and equipment

Based on the list of furniture and equipment mentioned above 2), the furniture and equipment for each office and accommodation will be procured and supplied through supplier(s) under the supervision of PMU and PIUs. The tentative list of furniture and equipment for each office and accommodation is shown in the table below.

Table A6.5.2 Tentative List of Office Furniture and Equipment

Non-disclosure information

6) To procure vehicles and motorbikes

Based on the list of vehicles and motorbikes prepared in the above 2), vehicles and motorbikes for PMU, PIUs, and the Consultant will be procured through the supplier(s) under the supervision of PMU. The tentative list of vehicles and motorbikes for PMU, PIUs, and the Consultant is shown in the table below.

Table A6.5.3 Tentative List of Vehicles and Motorbikes for PMU, PIUs and the Consultant

Non-disclosure information

6.5.3 Sub-component 4.2: Strengthening of PMU and PIUs for Proper Project Management and Monitoring

1) To prepare and establish manuals and systems

For the smooth and proper implementation of the Project, the following manuals and systems will be prepared and established by PMU with assistance of JICA and other departments of SAED:

- Operation manual for the Project implementation,
- Design criteria for the Project (for preliminary design and detailed design),
- Cost estimate system for the Project (for preliminary design and detailed design),
- Guidelines for construction supervision and quality control for the Project,

The above manuals and systems shall be authorized by SAED for the use in the operation and implementation of the Project. During the course of the Project implementation, these manuals and systems shall be reviewed and updated from time to time and whenever necessary. Concerned parties shall be informed regarding such updates under the authorization of SAED.

2) To prepare and plan training programs

For the better understanding of the above manual and system by the concerned parties, the following training programs will be prepared and planned by PMU:

Table A6.5.4 Training Programs for Manuals and Systems to be Used in the Project

Manual / System	Target	Timing
Operation Manual for Project Implementation	- PMU and PIUs staff, and - SAED staff from HQ and departments	After authorization of the manual by SAED
Design criteria for the Project	- PMU and PIUs staff, and - SAED staff from HQ and departments	After authorization of the design criteria by SAED
Cost estimate system for the Project	- PMU and PIUs staff, and - SAED staff from HQ and departments	After authorization of the system by SAED
Guidelines for construction supervision and quality control for the Project	- PMU and PIUs staff, and - SAED staff from HQ and departments	After authorization of the guidelines by SAED
	- The Contractors for civil works	Before the commencement of construction works

Source: JICA Survey Team

3) To implement training programs

The training programs will be implemented by PMU as planned above 2).

The refresher trainings shall be planned and implemented to refresh the above training outcomes from time to time and whenever necessary.

6.5.4 Sub-component 4.3: Monitoring and Evaluation (M&E)

1) Establish M&E frameworks

For the proper monitoring and evaluation of the project activities, frameworks for monitoring and evaluation (M&E) shall be prepared by PMU with the assistance of JICA. The M&E framework will include the following:

- Operation and effect indicators set forth in the loan agreement,
- Criteria for selection of subprojects for M&E,
- Method of sampling and survey to examine the indicators,
- Evaluation criteria, and
- Roles and responsibilities of the concerned agencies.

The above M&E frameworks shall be authorized by SAED for the use in the Project works.

2) Plan and implement training programs

For the better understanding of the above manual and system by the concerned parties, the following training program will be planned and implemented by PMU:

Table A6.5.5 Training Programs for Monitoring and Evaluation Frameworks

Training Program	Target	Timing
Monitoring and Evaluation Frameworks	- PMU and staff of PIUs, and - SAED staff from HQ and departments	After authorization of the frameworks by SAED

Source: JICA Survey Team

The refresher trainings shall be planned and implemented to refresh the above training outcomes from time to time and whenever necessary.

3) Implement M&E

The monitoring and evaluation of the Project activities, including the environmental and social aspects, will be implemented based on the M&E frameworks described above 1). Details of frameworks for environmental and social considerations are shown in Chapter 10.

6.6 Component 5: Consulting Services for Technical Assistance

The consulting services will be provided by an international consulting firm (the Consultant) in association with national consultants. Local consultants will be employed by SAED in compliance with the Guidelines for the Employment of Consultants under Japanese ODA Loans, April 2012. For the efficient and proper management and implementation of the Project, the Consultant will assist PMU and PIUs in terms of technical and project management aspects.

The required experts for the Project consulting services who will assist the PMU for the overall project management and the PIU at the department level are listed in Table A6.6.1.

Table A6.6.1 Required Experts for Consulting Services of the Project

Non-disclosure information

The implementation structure of the Consultant is described in Figure A6.6.1.

Non-disclosure information

Figure A6.6.1 Implementation Structure of the Consultant

The terms of references and other detailed explanation regarding the consulting services are given in Attachment 6.2.

CHAPTER 7 ORGANIZATIONAL STRUCTURE AND IMPLEMENTATION PLAN OF THE PROJECT

7.1 Project Implementation Structure

The proposed Project implementation structure is shown in Figure B7.1.1.

7.1.1 Committees for Project Coordination and Monitoring

In the above Project implementation structure, the following committees are proposed for the project coordination and monitoring:

- Project Steering Committee, and
- Project Monitoring Committee.

The proposed members, responsibilities, frequency, and location to be held of each committee are shown in Table B7.1.1.

7.1.2 Project Management Unit (PMU) and Project Implementation Unit (PIU)

As shown in Figure B7.1.1, it is proposed to establish the Project Management Unit (PMU) at the SAED headquarter level and Project Implementation Units (PIUs) at the SAED department level.

Major tasks of the PMU and PIUs are summarized below.

Project Management Unit (PMU):

- Overall Project management with assistance from the Consultant,
- Preparation of the guidelines and manuals required for the smooth implementation of the Project,
- Financial management for loan budget and government budget,
- Procurement of the Consultant and contractors/suppliers,
- Execution of the preliminary and detailed designs or subletting works to local consultants and review of the design reports,
- Recommendations on the required approval by SAED, committees, and/or JICA,
- Construction supervision with assistance from the Consultant,
- Provision of technical advises to PIUs,
- Monitoring and evaluation of the Project activities, and
- Preparation of the Project status and completion reports.

Project Implementation Unit (PIU):

- Overall project management with assistance from the Consultant at the department level,
- Collection of necessary data and information and execution of necessary survey and investigation for design works or subletting these works to local consultants and review of results, with assistance of the Consultant,
- Subproject level construction supervision with assistance from the Consultant,
- Provision of technical advice to farmers and union/GIEs,
- Monitoring and evaluation of the subproject activities and report to PMU, and
- Preparation of the subproject status and completion reports and report to PMU.

The proposed staff members for PMU and PIU are shown in Table A7.1.1 and Table A7.1.2, respectively.

Table A7.1.1 Proposed Staff Members for PMU

Position	Remarks
Project Manager	SAED permanent staff, part-time staff
Deputy Project Manager/Irrigation Engineer	Full-time staff
Chief Accountant/Accountant (for Government Budget)	SAED permanent staff, part-time staff
Accountant (for Loan Budget)	Full-time staff
Secretary/Computer Operator	Full-time staff
Procurement Specialist	Full-time staff
Irrigation and Road Engineer	Full-time staff
Agricultural Machinery Expert	Full-time staff
Agronomist	Full-time staff
Environmental and Social Expert including M&E	Full-time staff

Source: JICA Survey Team

Table A7.1.2 Proposed Staff Members for PIU

Position	Remarks
Subproject Manager	SAED permanent staff, part-time staff
Secretary/Monitoring Officer	Full-time staff
Assistant Engineer for Civil Works	Full-time staff
Assistant Engineer for Civil Works	Full-time staff
Assistant Expert for Soft Components	Full-time staff

Source: JICA Survey Team

7.2 Implementation Schedule

7.2.1 Implementation Schedule for the Project

Figure A7.2.1 shows the proposed implementation schedule of the Project.

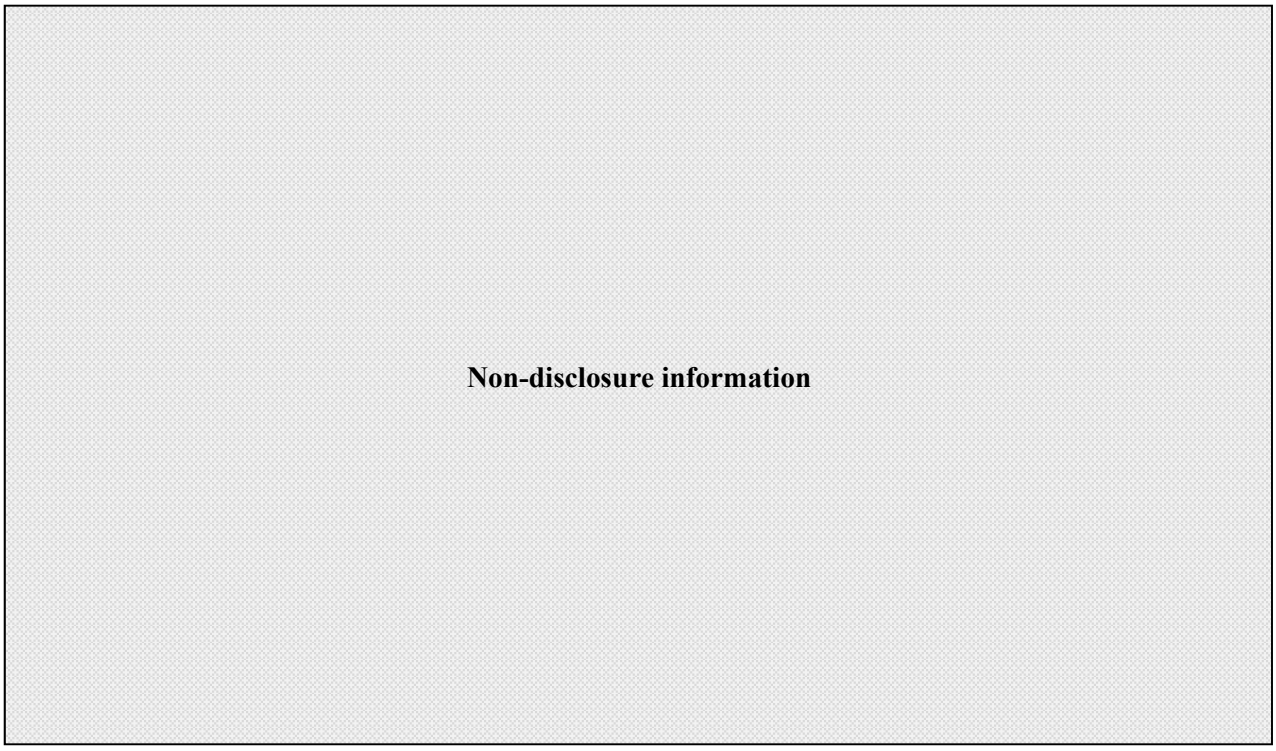


Figure A7.2.1 Implementation Schedule of the Project

[redacted]

Since it will require approximately one year to procure the Consultant, the above activities shall be implemented by PMU and PIUs without the assistance.

Since certain implementation of the above listed activities will be crucial for the smooth and efficient implementation of the Project and in order to fast track the commencement of the rehabilitation and improvement works, it is recommended that SAED and/or JICA should provide a specific input and support to assist PMU and PIUs in the implementation of the said activities.

7.2.2 Implementation Schedule for Component 1: Rehabilitation and Improvement of Irrigation Schemes

[redacted]

[redacted]

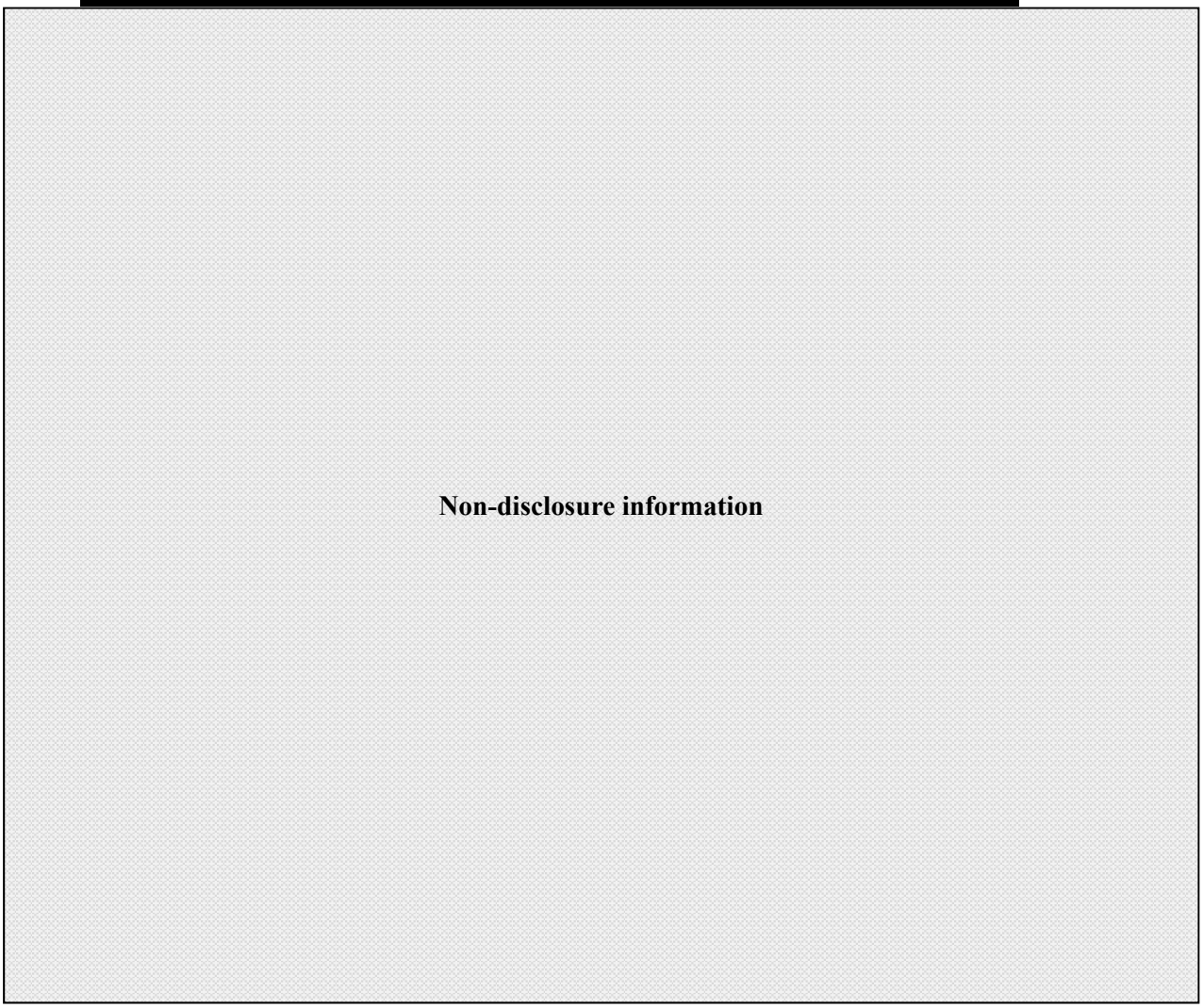


Figure A7.2.2 Implementation Schedule for Component 1

[redacted]

7.2.3 Implementation Schedule for Component 2: Enhancement of Agricultural Mechanization

Figure A7.2.3 shows the proposed implementation schedule of Component 2 "Enhancement of Agricultural Mechanization". As shown in Figure A7.2.3 and Sub-chapter 7.3, agricultural machineries for all subprojects will be procured all together and that the procurement works will be completed at the end of the 5th year.

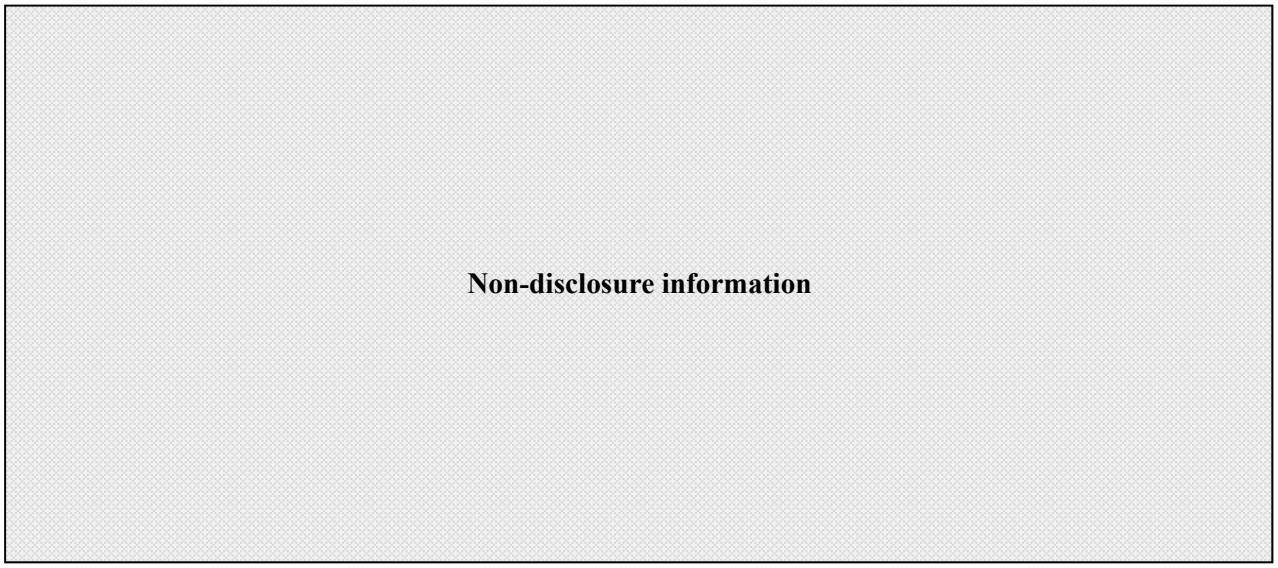


Figure A7.2.3 Implementation Schedule for Component 2

7.2.4 Implementation Schedule for Component 3: Soft Component Activities

Figure A7.2.4 shows the proposed implementation schedule of Component 3 "Soft Component Activities".

Soft component activities will be carried out in combination with Component 1 and Component 2 activities and, therefore, the schedule of the Component 3 should be flexibly adjusted according to the progress of the concerned activities.

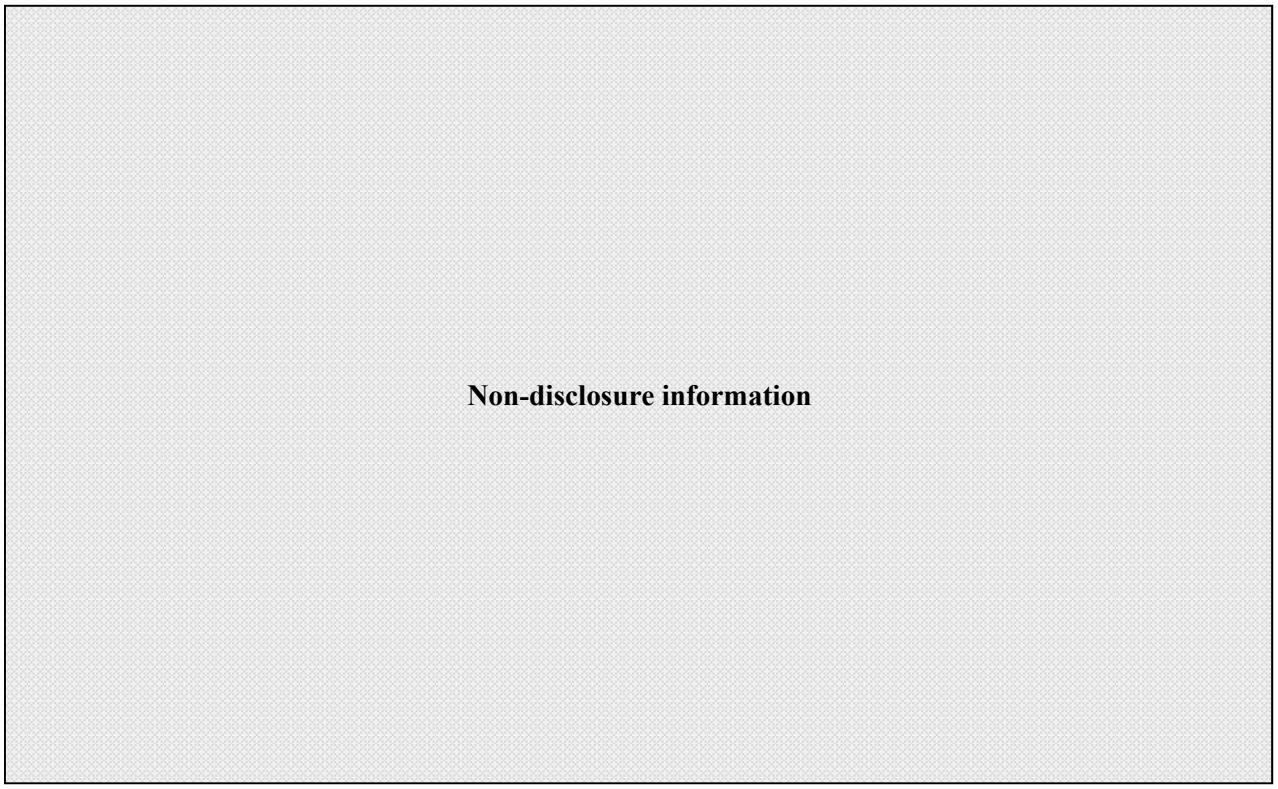


Figure A7.2.4 Implementation Schedule for Component 3

7.2.5 Implementation Schedule for Component 4: Enhancement of Project Management and Monitoring

Figure A7.2.5 shows the proposed implementation schedule of Component 4 “Enhancement of Project Management and Monitoring”.

As shown in Figure A7.2.5, most of the preparatory works for Component 4 shall be completed in the first year. Since certain implementation of these preparatory works will be crucial for the smooth and efficient implementation of the Project and in order to fast track the Project works, it is recommended that SAED and/or JICA provide specific input and support to assist the PMU and PIUs in the implementation of the said activities.

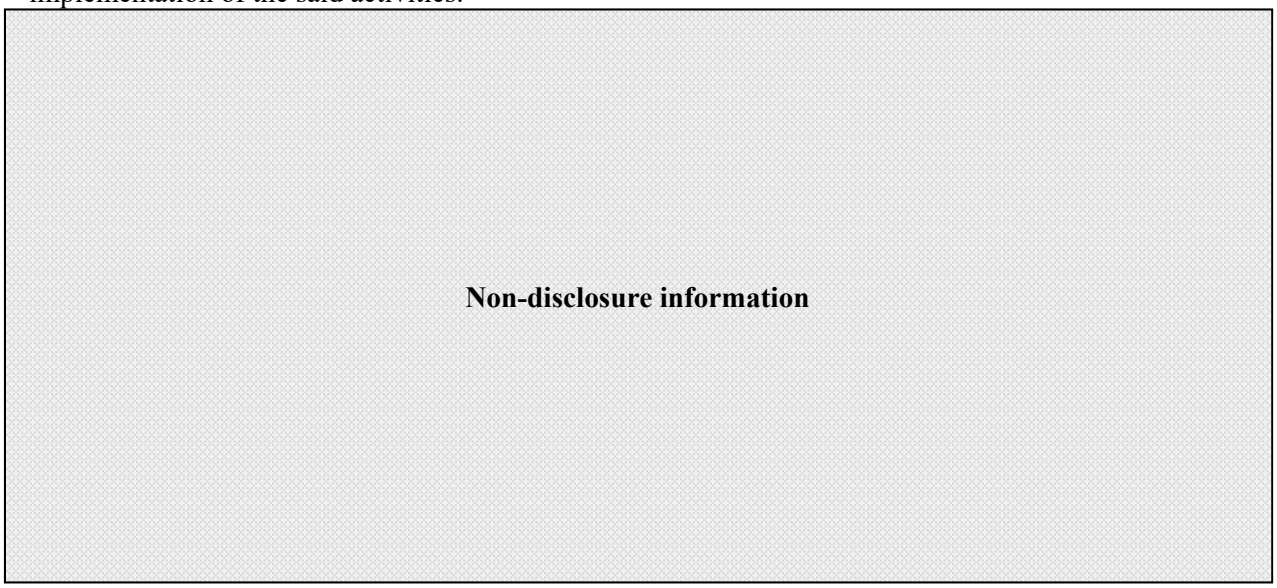


Figure A7.2.5 Implementation Schedule for Component 4

7.3 Procurement Plan

7.3.1 Regulations and Guidelines for Procurement Works

[redacted]

7.3.2 Procurement Plan for Civil Works and Building Works

[redacted]

Table A7.3.1 Tentative Procurement Packages for Component 1

Non-disclosure information

[redacted]

7.3.3 Procurement Plan for Goods and Equipment

[redacted]

[redacted]

7.3.4 Procurement Plan for Consulting Services

[redacted]

CHAPTER 8 COST ESTIMATION

8.1 Basic Conditions of the Project Cost Estimation

(1) Composition of the Project Cost

The project cost is composed of the following items:

I) Procurement and construction cost

(A) Eligible portion

i) Procurement and construction cost (Eligible)

ii) Consulting service cost

(B) Non-eligible portion

i) Procurement and construction cost (Non-eligible)

ii) Land acquisition cost

iii) Incremental administration cost

iv) Value added tax (VAT)

v) Import tax

(C) Interest during construction

The front end fee (FEF) is not included in the project cost since it is not applicable for the project.

(2) Basic Conditions of the Project Cost Estimation

The basic conditions of the project cost estimation are shown in Table A8.1.1. The conditions are set based on the conditions of the official development assistance (ODA) loan in Senegal provided by JICA and the conditions of cost estimation under Mamelles Sea Water Desalination Project, JICA, 2016.

Table A8.1.1 Basic Conditions of the Project Cost Estimation

Non-disclosure information

(3) Approaches for the Project Cost Estimation

The project cost is estimated with the following approaches shown in Table A8.1.2

Table A8.1.2 Approaches for the Project Cost Estimation

Non-disclosure information

8.2 Total Cost of the Project

The total cost of the project is estimated as shown in Table A8.2.1. The breakdown of the project cost (JICA specified format) is shown in Appendix 8.1.

Table A8.2.1 Total Cost of the Project

Non-disclosure information

Disbursement schedule of the project is shown in Table A8.2.2.

Table A8.2.2 Disbursement Schedule of the Project

Non-disclosure information

8.3 Breakdown of the Project Cost by Component

(1) Cost for Component 1: Rehabilitation and Improvement of Irrigation Schemes

Cost for Component 1: Rehabilitation and Improvement of Irrigation Schemes is shown in Table A8.3.1. Details of the cost breakdown is shown in Table B8.3.1. Supporting data for the cost estimation of Component 1 is shown in Appendix 8.2.

Table A8.3.1 Cost for Component 1: Rehabilitation and Improvement of Irrigation Schemes

Non-disclosure information

(2) Cost for Component 2: Enhancement of Agricultural Mechanization

Cost for Component 2: Enhancement of Agricultural Mechanization is shown in Table A8.3.2. Details of the cost breakdown are shown in Table B8.3.2.

Table A8.3.2 Cost for Component 2: Enhancement of Agricultural Mechanization

Item	FC portion (JPY thousand)	LC Portion (FCFA thousand)	Remarks
(1) Cost for equipment	282,588	562,489	Includes 2-year spare parts and manuals for O&M
(2) Cost for transportation & package	28,259	56,249	10% of cost for equipment
(3) Cost for installation and administration	14,129	28,124	5% of cost for equipment
(4) Overhead cost	8,478	16,875	General administration cost is at 3% of the total procurement cost, which is assumed based on the JICA guidelines
Total	**333,454**	**663,737**	

Source: JICA Survey Team

(3) Cost for Component 3: Soft Component

Cost for Component 3: Soft Component is shown in Table A8.3.3. Details of the cost breakdown are shown in Table B8.3.3.

Table A8.3.3 Cost for Component 3: Soft Component

Non-disclosure information

Source: JICA Survey Team

(4) Cost for Component 4: Enhancement of Project Management and Monitoring

Cost for Component 4: Enhancement of Project Management and Monitoring is shown in Table A8.3.4. Details of the cost breakdown is shown in Table B8.3.4.

Table A8.3.4 Cost for Component 4: Enhancement of Project Management and Monitoring

Non-disclosure information

(5) Cost for Component 5: Consulting Services

Cost for Component 5: Consulting Services is shown in Table A8.3.5. The assignment schedule of the consultants and the direct cost of consulting services are shown in Appendix 8.1.

Table A8.3.5 Cost for Component 5: Consulting Services

Non-disclosure information

8.4 Cost Comparison to Similar Foreign Funded Projects

[redacted]

Table A8.4.1 Table of Cost Comparison to Similar Foreign Funded Projects

Non-disclosure information

CHAPTER 9 PROJECT EVALUATION

9.1 Effects of the Project Implementation

In this section, the effects of the project implementation are divided into quantitative effects and qualitative effect and are described below.

9.1.1 Quantitative Effects

The following are implemented as key activities under the project: 1) rehabilitation and improvement of irrigation schemes, 2) development of farm road, 3) development of warehouse, and 4) introduction of agricultural machinery. The combined effect of the implementation of these activities is to increase the unit yield of rice and the cropping intensity in the project area. As a result, rice production in Senegal will increase, and rice imports will be reduced accordingly. The summary of effect and quantitative effects of each activity are shown in Table A9.1.1.

Table A9.1.1 Quantitative Effects of the Project

Project Activities	Summary of Effects	Quantitative Effects
1) Rehabilitation and improvement of irrigation schemes	・ Rehabilitation of aging pump and irrigation facilities will improve water availability in the irrigation area and water conveyance efficiency. ・ Development of drainage facility will improve drainage conditions in the irrigation area in the rainy season. ・ As a result, the unit yield of rice and crop intensity will increase.	・ Increase of unit yield of rice ・ Increase of crop intensity
2) Development of farm road	・ Development of farm roads at the field level will improve access within the field. ・ Development of access roads will improve access from the field to market. ・ As a result, the time required for farming activities can be reduced, and the farm work efficiency will be improved. It also contributes to increasing the unit yield of rice and cropping intensity.	・ Improvement of farm work efficiency ・ Increase of unit yield of rice ・ Increase of crop intensity
3) Development of warehouse	・ The paddy stored in the garden can be stored in the warehouse. This will reduce the damage of paddy before selling. ・ It is regarded that the loan for cultivation have been repaid by storing harvested rice in the warehouse. The warehouse will possibly enable farmers to borrow funds for the next cultivation. ・ As a result, post-harvest losses can be reduced and loan repayment rate can be improved. It also contributes to increase of rice and cropping intensity.	・ Decrease of post-harvest losses ・ Improvement of loan repayment rate ・ Increase of crop intensity
4) Introduction of agricultural machinery	・ The overall time required for the harvesting work is reduced and the harvesting can be completed by the next cropping season. ・ As a result, the crop intensity will increase.	・ Increase of crop intensity

Source: JICA Survey Team

9.1.2 Qualitative Effects

The qualitative effects of the project are assumed as shown in Table A9.1.2.

Table A9.1.2 Qualitative Effects of the Project

Summary of Effects	Qualitative Effects
・ Activities for enhancement of project management and monitoring of SAED will be implemented under Component 4 of the project. Technical assistance will also be provided to SAED by consulting services under Component 5 of the project. This will contribute to the enhanced implementation capacity of projects (technical, and operational aspects) by SAED.	・ Enhancement of implementation capacity of projects (technical, and operational aspects) by SAED
・ Activities for agriculture support will be implemented under Component 3 of the project. This will contribute to the improvement of the capacity of CA, SAED for the extension activities and rice cultivation techniques of farmers.	・ Improvement of capacity of CA, SAED for extension activity ・ Improvement of rice cultivation techniques of farmers
・ Activities for the capacity enhancement of farmers' organizations and capacity enhancement of operation and maintenance (O&M) will be under component 3 of the project. This will contribute to the enhancement of the capacity of unions/GIEs of irrigation schemes for O&M.	・ Enhancement of the capacity of unions/GIEs of irrigation schemes for operation and maintenance
・ The project includes modernization of irrigation and related infrastructures, including development of irrigation facilities with concrete flume canal, which is not common in Senegal. The project will have a demonstration effect as an advanced case of irrigation development in Senegal.	・ Demonstration effect as an advanced case
・ Development plan for the next stage will be planned under the project as part of the consulting service. This ensures the consistency and continuity of irrigation development in the Senegal River Valley.	・ Ensuring the consistency and continuity of irrigation development in the Senegal River Valley

Source: JICA Survey Team

9.2 Operation and Effect Indicators

To measure, monitor, and evaluate the project effect, operation and effect indicators of the project and their target values are set. The target year of the indicators is about three years after the completion of the project. The selected indicators have important relevance to the project objectives and components. The set indicators are based on "Reference of Operation and Effect Indicators for Japanese ODA Loan Project, JICA, 2014".

9.2.1 Operation Indicators

The following operation indicators are proposed for project monitoring and evaluation:

Table A9.2.1 Proposed Operation Indicators of the Project

	Indicators	Current (2019)	Target (2030)
1.	Project beneficiary area (ha)	-	[redacted]
2.	Developed length of the farm road (km)	-	[redacted]
3.	Developed length of the access road (km)	-	[redacted]
4.	Developed area of the warehouses (m^2)		[redacted]
5.	Number of the introduced agricultural machinery (Nos)		[redacted]
6.	Annual operation hour of pump (hour/year)	-	Set in each subproject
7.	Volume of storage in the warehouse (kg/year)	-	Set in each subproject
8.	Operating hour of the agricultural machinery (hour/year)	-	Set in each subproject

Source: JICA Survey Team

The "Reference of Operation and Effect Indicators for Japanese ODA Loan Project, JICA, 2014" mentioned that indicators related to the direct output of the project, such as "developed length of the

farm road", are not included in the operation indicators. These indicators are also proposed as operational indicators since the project is a sector loan type project. It is important to evaluate whether the target development has been achieved for the funds invested. "Annual operation hour of pump" is proposed as an indicator to monitor O&M activity of irrigation facilities.

9.2.2 Effect Indicators

The following effect indicators are proposed for project monitoring and evaluation:

Table A9.2.2 Proposed Effect Indicators of the Project

	Indicators	Current (2019)	Target (2030)
1.	Annual crop intensity (%/year)	[redacted]	[redacted]
2.	Seasonal cultivation area of rice (ha/season)	[redacted]	[redacted]
3.	Unit yield of rice (ton/ha)	[redacted]	[redacted]
4.	Annual production volume of rice (ton/year)	[redacted]	[redacted]
5.	Increase in rice production by the project（ton/year）	[redacted]	[redacted]

Source: JICA Survey Team

The "Reference of Operation and Effect Indicators for Japanese ODA Loan Project, JICA, 2014" mentioned that annual crop intensity and cultivated area of crops is classified as operation indicators. These indicators are also proposed as effect indicators since the project objective includes "improvement of efficiency of irrigated rice cultivation". The current value of each indicator set is based on the questionnaire survey results (see Table A3.3.1). The target value of annual crop intensity and unit yield of rice are set at a level which ensures economic viability based on the economic evaluation results of the Rosso subproject.

9.2.3 Monitoring Method and Structure for Operation and Effect Indicators

Data on the above operational and effect indicators need to be continuously monitored during and after the project. It is proposed to have a monitoring method and system for each indicator, including specific data collection methods shown in Table A9.2.3.

Table A9.2.3 Monitoring Method and Structure for Operation and Effect Indicators

	Indicators	Subproject to be Monitored	Responsible Organization	Timing of Data Collection	Data Source
Operation Indicators					
1.	Project beneficiary area	All subprojects	PMU the Consultant	Every quarter	Completion report of the subproject
2.	Developed length of the farm road	All subprojects	PMU the Consultant	Every quarter	Completion report of the subproject
3.	Developed length of the access road	All subprojects	PMU the Consultant	Every quarter	Completion report of the subproject
4.	Developed area of the warehouses	All subprojects	PMU the Consultant	Every quarter	Completion report of the subproject
5.	Number of the introduced agricultural machinery	All subprojects	PMU the Consultant	Every quarter	Completion report of the subproject
6.	Annual operation hour of pump	Sample subproject	PIU the Consultant	Before the start and one year after the completion of construction	Interview survey from CA in charge and Union/GIE

	Indicators	Subproject to be Monitored	Responsible Organization	Timing of Data Collection	Data Source
7.	Volume of storage in the warehouse	Sample subproject	PIU the Consultant	one year after the completion of construction	Interview survey from CA in charge and Union/GIE
8.	Operating hour of the agricultural machinery	Sample subproject	PIU the Consultant	one year after the provision of machine	Check log book of machine
Effect Indicators					
1.	Annual crop intensity	Sample subproject	PIU the Consultant	Before the start and two year after the completion of construction	Interview survey from CA in charge and Union/GIE
2.	Seasonal cultivation area of rice	Sample subproject	PIU the Consultant	Before the start and two year after the completion of construction	Interview survey from CA in charge and Union/GIE
3.	Unit yield of rice	Sample subproject	PIU the Consultant	Before the start and two year after the completion of construction	Interview survey from CA in charge and Union/GIE
4.	Annual production volume of rice	Sample subproject	PIU the Consultant	Before the start and two year after the completion of construction	Interview survey from CA in charge and Union/GIE
5.	Increase in rice production by the project	-	PMU	3 year after the completion of the project	Estimation based on the date collected

Source: JICA Survey Team

This monitoring method and structure will be finalized and implemented under Sub-component 4.3: Monitoring and Evaluation 1) Preparation of M&E Framework at the implementation stage of the project since the subprojects to be implemented is not selected at present.

It is proposed that the above sample subprojects shall be selected according to the area balance and type of subproject (whether a subproject includes pump, farm road, and drainage facility or not) to ensure representativeness of sample subprojects. Around 12 sample subprojects are planned to be selected for the project.

9.3 Risk Management

The risks anticipated in the implementation of the project are discussed in this section.

9.3.1 Approaches for Risk Management

"Risk" is defined as the possibility that an event will occur and adversely affect the achievement of an objective. According to the concept of risk management, risk is generally classified as the probability of occurrence and the impact (magnitude) of loss when it occurs. Based on the classification, treatments for risks shall be considered, such as avoidance, reduction (optimize, mitigation), sharing, retention, etc. The purpose of risk management is to identify potential problems before they occur so that risk-handling activities may be planned and implemented.

In this project, "loss" is considered to be a "decrease in development effect". Factors that reduce the development effect are called risks, such as decrease of the project benefit, increase of project cost, unachieved development target of the project, project cancellation or suspension, and their multiple occurrence.

Treatment for risks is generally classified as follows:

1) High probability and high impact type:

   Avoidance of the risk (to avoid activity itself with the risk),

2) High probability and low impact type:

   Reduction of the risk (to reduce probability and impact of risk before occurring),

3) Low probability and high impact type:

   Sharing of the risk (to transfer the risk to others, e.g., insurance), and

4) Low probability and low impact type:

   Retention of the risk (not to take action for the risk)

As mentioned above, the concept of risk management aims to treat critical and major risks based on the above categories, considering the costs associated with the treatment of risks. Risk identification and assessment shown below is done based on the concept of risk management.

9.3.2 Identification and Assessment of Risks

According to the JICA's risk management framework, risks of the project are identified and assessed in the following categories. The JICA's risk management framework classifies the risks into 1) stakeholder risk, 2) executing agency risk, and 3) project risk. The identified major risks in each risk category and the assessment results are shown in the following table.

Table A9.3.1 Identification and Assessment of Major Risks of the Project

Major Risks	Risk Assessment	Risk Treatment
1. Stakeholder Risk		
Risk of the project cancellation or suspension resulting from major policy change Appraisal stage / Implementation stage	Probability; Low Impact: High	・ To hold regular high-level policy meeting at the time of the next fiscal year's budget request (Responsible organization: JICA) ・ To monitor the policy trends of the government of Senegal and the position of the project in the overall policy so as to take actions before the risks occurs. (Responsible organizations: SAED, JICA).
2. Executing Agency Risk		
2.1 Capacity risk Risk of decrease of benefit, increase of cost, unachieved development target and delay of the project resulting from the lack of technical and operational experience of SAED for Japanese ODA Loan Project. Appraisal stage / Implementation stage	Probability: Middle Impact: Middle	・ To include activities for improvement of capabilities of SAED as part of the project component and implement continuous capacity enhancement activities for Japanese ODA Loan Project. (Responsible organization: the consultant) ・ To plan appropriate project components, implementation structure, and implementation schedule considering the lack of technical and operational experience of SAED. ・ To support SAED with the guidance of JICA for project implementation before the consultants mobilize (Responsible organization: JICA Survey Team, JICA)
2.2 Governance risk Risk of delay of the project resulting from the improper decision-making process of related organizations including SAED Appraisal stage / Implementation stage	Probability: Low Impact: Middle	・ To clarify the decision-making system (authority and responsibility) before starting the project. ・ To make an appropriate improvement proposal to SAED by JICA or the consultant during the implementation period, if there is a problem with decision-making system. (Responsible organization: SAED, JICA, the consultant)
2.3 Fraud & corruption risk Risk of increase of cost and unachieved development target, delay of the project resulting from fraud of procurement of the project Appraisal stage / Implementation stage	Probability: Low Impact: Middle	・ To adopt the current procurement system of SAED for the project. ・ To properly monitor the procurement by the consultants. (Responsible organization: SAED, the consultant)
3. Project Risk		
3.1 Design risk Risk of decrease of benefit, increase of cost, unachieved development target and delay of the project in the case that the implementation structure is not established according to plan, since the project includes decentralized subprojects. Appraisal stage / Implementation stage	Probability: Middle Impact: Middle	・ To form an appropriate consensus on the project implementation structure among the stakeholders concerned before implementing the project. ・ To support SAED by JICA for establishment of the project implementation structure. (Responsible organization: SAED, JICA, the consultant)

Major Risks	Risk Assessment	Risk Treatment
3.2 Program/donor risk Risk of inefficient cost allocation in SAED resulting from the improper demarcation between the project and projects by other donors Appraisal stage / Implementation stage	Probability: Low Impact: Low	・ To retain the risk since it is not necessary to closely collaborate with other donor projects in terms of generating project benefits currently. ・ To encourage cooperation with the project in the formation of other donor projects, when other donor projects that are highly relevant to the project in the future. (Responsible organization: SAED)
3.3 Delivery quality risk Risk of decrease of benefit resulting from improper operation and maintenance activities by the Union/GIE. Appraisal stage / Implementation stage	Probability: Middle Impact: Low	・ To include activities for the strengthening of operation and maintenance by Union/GIE as a project component. (Responsible organization: JICA Survey Team, consultant) ・ To provide continuous support for the strengthening of operation and maintenance of Union/GIE (Responsible organization: SAED, consultant)

Source: JICA Survey Team

As shown above, the relatively critical risks are assumed to be those resulting from the lack of SAED implementation experience of Japanese ODA Loan Projects and the risk resulting from the establishment of the implementation structure. It is important to take actions to prevent the occurrence of these risks. The result of the risk identification and assessment is also shown in Appendix 9.1 in the form specified by JICA (Risk Management Framework).

9.4 Adaptation Measures for Climate Change

Senegal has been experiencing the effects of climate change, such as shift of rain pattern and increase in temperature in the past decades. According to USAID Climate Change Risk Profile of Senegal (2017), since 1960, the average temperature increased by 0.9 ℃, with higher rates of warming in the north and becoming more pronounced between October and December. Rainfall has been declining despite partially recovering since the mid-1990s. The rainfall level has not recovered to the pre-1970 levels and remains 15% below the long-term average. The Climate Change Risk Profile also mentioned that there will be rising average annual temperatures by 1.1–3.1°C by the 2060s, and the projected rates of warming are faster in the north and the interior and during the dry season. Uncertainties exist whether rainfall will increase or decrease, but overall increase in heavy rainfall events are expected.

The project area is located in the northern area of Senegal, where the higher rates of warming were recorded and faster speed of warming is projected. Thus, the irrigation and agriculture sector in the project area shall be vulnerable to the effects of climate change.

Several activities proposed under the project are considered as “adaptation measures for climate change” to decrease the degree of vulnerability. Therefore, the project could contribute to reduce vulnerability of farmers for climate change. Vulnerability for climate change, effect on agriculture and irrigation sector, and project activities as “adaptation measure” are summarized in Table A 9.4.1.

Table A9.4.1 Vulnerability and Adaptation Measures for Climate Change under the Project

Vulnerability for Climate Change	Effect/Risk on Agriculture and Irrigation Sector	Project Activities as "Adaptation Measures" for Climate Change
・ Rising temperatures ・ Reduced or variable rainfall	・ Reduced crop quality and yields due to lack of water ・ Severe damage to rain-fed agriculture ・ Change of suitable crop variety ・ Food shortages and increased food insecurity	・ The project develops and rehabilitate irrigation and drainage facilities. It contributes to provision of stable water supply for rice cultivation even if there is reduced or variable rainfall. ・ Through the project, the rice self-sufficiency rate shall increase because of the increase of crop production in the project area. It contributes to reduce the risk for food shortage and increase food security.

Source: JICA Survey Team referencing JICA Climate Finance Impact Tool for Adaptation Ver 1.0 and USAID Climate Change Risk Profile of Senegal (2017)

Based on the above discussion, the project is considered to contribute to the adaptation of climate change.

9.5 Project Evaluation

The viability of the project was evaluated from the following viewpoints. The evaluation results for each item are shown in Table A9.5.1.

Table A9.5.1 Result of Evaluation of the Project

Viewpoints	Outline of the Evaluation Result
1) Consistency with national policies and strategies	・ As shown in Section 2.1 and Section 2.4, the purpose of this project is consistent with the national/sector policy and strategy in Senegal. Therefore, the relevance of the project implementation is high.
2) Necessity of the Project	・ As shown in Section 2.4, it is judged that the necessity of this project is high in terms of the project outline, project area, and related organizations.
3) Project Scope	・ As shown in each section of Chapter 6, the soft components for the enhanced development effects are proposed appropriately according to the current situation in addition to the components of the development of irrigation and drainage facilities and the introduction of agricultural machinery. It also includes components to enhance SAED capacity based on the lack of experience in ODA loan projects by SAED. Therefore, it is judged that the project scope is proposed appropriately.
4) Project Implementation Structure	・ As shown in Section 7.1, the project implementation structure at each level is proposed according to the project characteristics with decentralized and multiple subprojects. Organizations related to decision-making are also included in the implementation structure. Therefore, it is judged that the project implementation structure is proposed appropriately.
5) Project Implementation Plan	・ As shown in Section 7.2, the project implementation schedule is proposed based on the technical and operational capacity of the implementation agency. Therefore, it is judged that the project implementation schedule is proposed appropriately.
6) Technical Soundness	・ As discussed in Chapter 5, regarding the technical aspects, the project does not apply more advanced technology than necessary since SAED has little experience in implementing ODA loan projects. It is judged that the appropriate technology has been selected based on

Viewpoints	Outline of the Evaluation Result
	the local situation and the capacity of the implementing agency.
7) Economic Viability	・ As shown in Section 5.7, the economic evaluation result of the pilot site subproject is economically viable. As shown in Chapter 4, the selection criteria for keeping the EIRR more than the standard (EIRR and crop intensity is included in the selection criteria) is proposed. Therefore, it is judged that the economic viability of the project shall be ensured.
8) Environmental, Social and Gender Consideration	・ As shown in Chapter 10, the result of environmental and social consideration shows that the project does not have large negative impacts. Gender issues are also considered for the project preparation. Therefore, it is judged that the project has no large problems with regards to the environmental and social aspects. ・ As shown in Section 9.4, the project could contribute to reduce the vulnerability of farmers to climate change.
9) Risk Management	・ As shown in Section 9.3, through the risk assessment, major risks are identified, and the countermeasures for the risks are considered.
10) Sustainability	・ As shown in each section in Chapter 6, the project components include the capacity enhancement of the implementation agency and beneficiaries. Therefore, the project has high sustainability in the future.

Source: JICA Survey Team

CHAPTER 10 ENVIRONMENTAL IMPACT ASSESSMENT FRAMEWORK (DRAFT)

10.1 Environmental and Social Consideration Systems and Organizations in Senegal

10.1.1 Legal System for Environmental and Social Considerations

(1) Environmental Laws

The laws concerning environmental and social considerations in Senegal are as follows:

- The Environmental Law No. 2001-01 (January 15, 2001)
- Decree No. 2001-282(April 12, 2001) (Environmental law enforcement regulations)

The provisions for environmental impact assessment (EIA) are shown in the L49, L50, L51, L52, L53, and L54 of the Environmental Law. The specific procedures are detailed in the following ministerial ordinances:

Reference Document	Regulations
• Ministry Order No. 009468 of 28 November 2001:	On the public participation in the environmental impact study
• Ministry Order No. 009469 of 28 November 2001:	On the organization and operation of the technical committee
• Ministry Order No. 009470 of 28 November 2001:	On the conditions for issuing the accreditation for carrying out activities relating to environmental impact studies;
• Ministry Order No. 009471 of 28 November 2001:	On the content of the terms of reference for EIAs
• Ministry Order No. 009472 of 28 November 2001:	On the content of the EIA report

Other environmental law clauses applicable to this Project are as follows:

Clause	Regulations
• Articles L9, L13, and L25:	Facilities classified for environmental protection（ICPE）
• Articles L60 and L63:	Water pollution
• Articles L76 and L78 :	Air pollution and offensive odor
• Article L84 and R 84:	Noise

(2) Standards

There are no specific standards regulating agricultural drainage water. The standard NS 05-061 (Wastewater: discharge standards dating from July 2001) applies more to industrial and domestic wastewater.

There are no specific standards regulating noise emissions, but the Environmental Law stipulates that "the maximum noise thresholds not to be exceeded without exposing the human body to dangerous consequences are 55 to 60 decibels a day and 40 decibels a night ".

(3) Legal Provisions Applicable to the Use of Natural Resources

Other legal provisions applicable to the use of natural resources are as follows:

- Water Charter of the Senegal River drawn up by the Organization for the Development of the Senegal River (OMVS)
- The Water Code (Law No. 81-13 of 4 March 1981)
- The Mining Code (Law No. 2016-32 of 8 November 2016)
- The Forest Code (Law No. 14-2018 of 2 November 2018)
- National Procedures for Land Acquisition and Compensation of Affected Persons (The Constitution of 22 March 2016)
- Expropriation and Compensation of Lands in the National Domain
  - ✓ Article 30 of the Decree No. 64-573 of 30 July 1964, Fixing the Conditions of Application of the Law No. 64-46 of 17 June 1964, Relating to National Domain
  - ✓ Article 32 of the Decree No. 64-573 of 30 July 1964 Fixing the Conditions of Application of the Law No. 64-46 of 17 June 1964 Relating to National Domain
  - ✓ Article. 38 of Decree No. 64-573 of 30 July 1964 (amended by Decree 91-838 of 22 August 1991)
- Expropriation and Compensation of Land in the Domain of the State
  - ✓ Articles 13, 37, 38, 39 of the Law No. 76-66 of 02 July 1976
- Expropriation and Compensation of Land Belonging to Individuals (ECUP)
  - ✓ Articles 1 to 31 of Law No. 76-67 of 02 July 1976
- Labor Code (Law No. 97-17 of December 1997)

(4) Laws Applicable to Pesticide Management

The following laws apply to pesticide management.

1) International treaties, etc.

Senegal has signed and ratified the following international treaties on pesticide management:

- April 1994 Code of Ethics on International Trade in Chemicals
- International Code of Conduct for the Distribution and Use of Pesticides FAO (FAO, 2002)

  Article 6.1.1 states that the "Governments should take measures to introduce the necessary regulation of pesticides, including registration, and to take provisions to ensure its effective implementation."
- International Convention for the Protection of Plants (IPPC) ratified by Senegal on 28 November 1979;
- Basel Convention on Transboundary Movements of Hazardous Wastes of 22 March 1989;
- Bamako Convention: African Convention on the Prohibition of the Importation in Africa of Hazardous Wastes in All Forms and Transboundary Control of Such Wastes Produced in Africa - entered into force on 20 March 1996

  Adopted under the auspices of the African Unification Organization. Applies within the continent of Africa with a system similar to the Basel Convention procedure.
- Rotterdam Convention on the Principle of Information and Preliminary Consent (PIC) September 1998;
- Stockholm Convention on Persistent Organic Pollutants (POPs) of 22 May 2001;

- International Standards for Phytosanitary Measures (ISPM) FAO;
- London Guidelines for the Exchange of Information on Chemicals in International Trade UNEP (1989);
- Common Regulation to the Member States of CILSS (the Permanent Inter-State Committee for Drought Control in the Sahel) on the approval of pesticides (1992)

  Rules for managing pesticides used in the Sahel countries. Pesticides prohibited by the Rotterdam Convention and the Stockholm Convention are not approved.

2) Senegal National Law

The regulation of pesticides in Senegal is based on "Law No. 84-14 on the Regulation of Pesticides and Related Chemicals (February 1984) " and its enforcement law, "Law No. 84-503 (May 1984). " In addition, "Decree 47-47 (April 1971)", regulates the packaging used for packaging agricultural chemicals.

In addition, the ministry orders for the establishment of the approval committee as the organization responsible for the approval of pesticides in Senegal, and to ensure the proper functioning of the organization are: Ministry Order No. 05381 (May 1985), No. 10777 (August 1992)), No. 000149 (January 1994), and No. 10390 (December 1994).

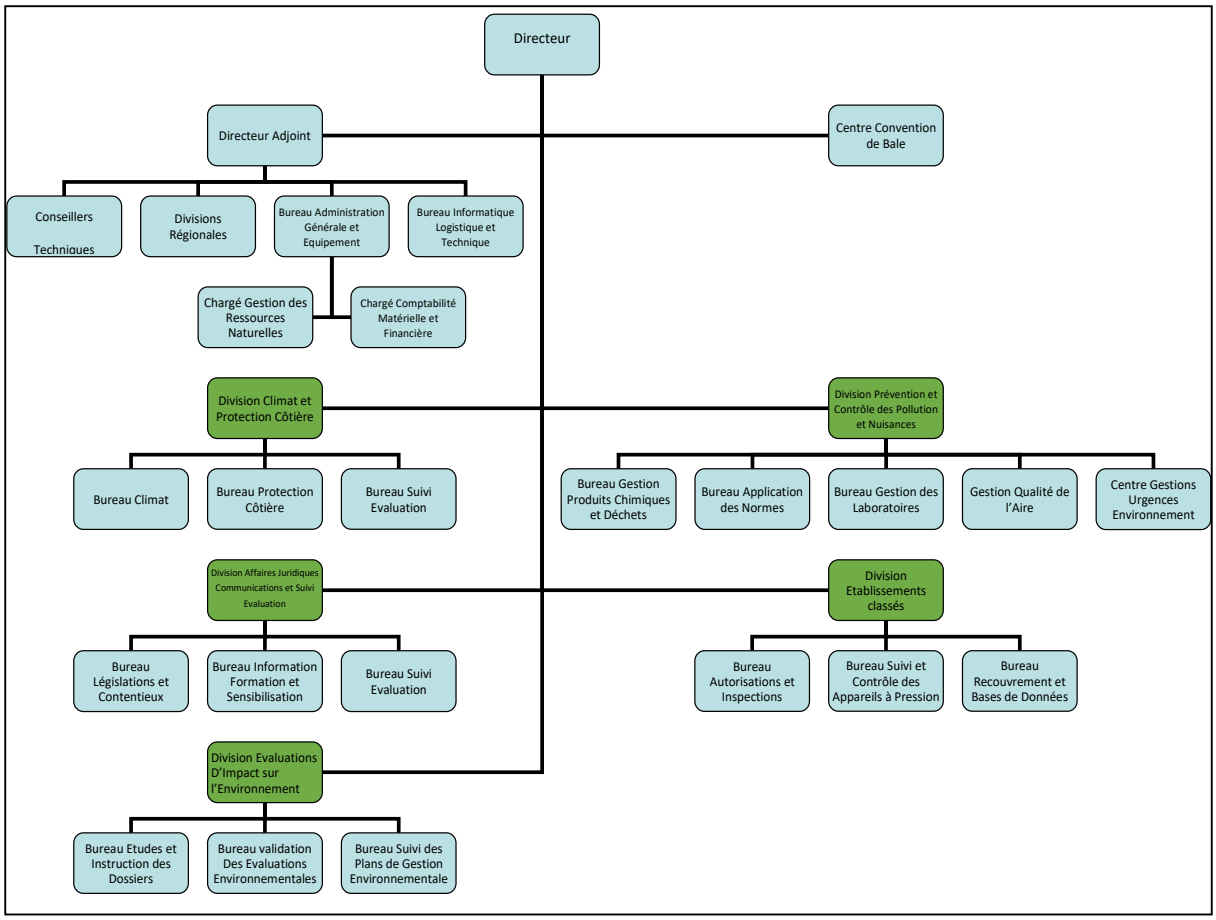
Other laws related to agricultural chemicals include the following:

- Ministry Order No.000852 (February 2002) (Committee for Chemical Substance Management);
- Catalog of Senegalese Standards (1996)（Standards for Pesticide Residues）
- Ministry Order No. 3504 (May 2001) (Establishment of Monitoring Committee for Residual Pesticides in Fruits and Vegetables for Export)

10.1.2 Organizations Responsible for Environmental Impact Assessment

The institute responsible for the environmental impact assessment is the Department of Environment and Specific Facilities (*Direction de l'Environnemnet et des Establissements Classees*: DEEC) within the Ministry of Environment and Sustainable Development (*Ministére de l'Environnment et du Development Durable*: MEDD). The department in charge is the Environmental Impact Assessment Department (*Division des Evaluation d' Impact sur l' Environnement*). Other departments related to environmental and social considerations within MEDD are the Department of Water, Forestry, Hunting and Soil Conservation (DEFCCS) and the National Park Service (DPN). The Technical Committee (TC) is formed at the local level to support DEEC in the environmental impact assessment.

The organization chart of DEEC is shown in Figure A10.1.1.



Source: DEEC

Figure A10.1.1 Organizational Chart of the DEEC

10.1.3 Projects Subject to Environmental Impact Assessment

In the provisions for environmental impact assessment in Title 2 of Chapter 5 of the Environmental Law, certain policies, plans, programs, and sectors that may affect development activities or the environment require an environmental impact assessment. In the facility classification for environmental protection (ICPE), projects subject to environmental impact assessment are classified into the following two categories.

- Category 1: Items that may have a significant negative impact on the environment
- Category 2: Those that may have a negative impact on the environment but are limited, or those that are mitigated by appropriate measures or changes to the plan

Table A10.1.1 Project Category based on ICPE Classification

Item	Project Activities	Category	Requested Type of Study
A 102	**Irrigation and Drainage Project**		
	Assignment of land for irrigation and drainage whose surface is: • Greater than or equal to 50 ha • Greater than 10 ha and less than 50 ha	 1 1	 EIA IEE
A 104	**Land Consolidation**		
	Hydro-agricultural development whatever the area	1	EIA
A 105	**Clearing**		
	Where the holding area is: • Greater than or equal to 50 ha • Greater than 10 ha and less than 50 ha	1 1	EIA IEE

Item	Project Activities	Category	Requested Type of Study
A 106	**Pesticide Use, Aerial Spraying, Ground Spraying**		
	When the holding area is: • Greater than or equal to 500 ha • Greater than 10 ha and less than 500 ha • Greater than 1 ha and less than 10 ha	 1 1 2	 EIA IEE

1*: Authorisation required* ***2****: No action necessary*

Source: Prepared by the JICA Survey Team based on the Environmental Law

In addition, the Environmental Law Annexes 1 and 2 list projects (programs) that require EIA (Annex 1) and projects (programs) that require an initial environmental examination (IEE) (Annex 2). Items applicable to the subprojects implemented in this Project are shown in Tables A10.1.2 to A10.1.3.

Table A10.1.2 Projects (Programs) that Require EIA (Annex 1)

No.	Types of Projects that Require a Thorough Environmental Impact Study, EIA	Conformity with the Project
1	Projects and programs likely to cause significant changes in the exploitation of renewable resources	x
2	Projects and programs that profoundly change the practices used in agriculture and fisheries	x
3	Exploitation of water resources	x
4	Infrastructure works	x
5	Industrial activities	x
6	Extractive and mining industries	x
7	Production or extension of hydroelectric and thermal energy	x
8	Waste management and disposal	x
9	Manufacture, transportation, storage and use of pesticides or other hazardous and / or toxic materials	x
10	Hospital and educational facilities (large scale)	x
11	New constructions or significant improvements of the road network or rural roads	x
12	Projects undertaken in ecologically very fragile areas and protected areas	x
13	Projects that may have harmful effects on endangered species of flora and fauna or their critical habitats or have adverse impacts on biological diversity	x
14	Population transfer (displacement and resettlement)	x

X: Not triggered by the Project **O**: Triggered by the Project

Source: Décret n° 2001-282 du 12 avril 2001 portant Code de l'Environnement (partie réglementaire)

Table A10.1.3 Projects (Programs) that Require Initial Environmental Examination (IEE) (Annex 2)

Type of Project that Requires an IEE	Conformity with the Project
Small and medium-sized agro-industrial enterprises	x
Rehabilitation or modification of existing small-scale industrial facilities	x
Power transmission lines	x
Small-scale irrigation and drainage	o
Renewable energy (other than hydroelectric dams)	x
Rural electrification	x
Housing and commercial projects	x
Rehabilitation or maintenance of road network or rural tracks	o
Tourism	x
Rural and urban water supply and sanitation	x
Recycling plants and household waste disposal units	x
Surface water irrigation projects ranging from 100 to 500 hectares, and underground water ranging from 200 to 1,000 hectares	o
Intensive livestock breeding (more than 50 heads), poultry farming (more than 500 head);	x
Extraction and treatment of non-metallic minerals or energy producers and aggregate extraction (marble, sand, gravel, shale, salt, potash and phosphate)	x
Protected areas and conservation of biological diversity	x
Energy efficiency and energy conservation	x

X: Not triggered by the Project **O**: Triggered by the Project

Source: Décret n° 2001-282 du 12 avril 2001 portant Code de l'Environnement (partie réglementaire)

10.1.4 Environmental Impact Assessment Procedures and Cost Estimates

Since this Project is a sector loan type project that plans to implement multiple subprojects and selects these subprojects at the project implementation stage; subprojects have not been decided prior to the approval of this Project. Therefore, no environmental impact assessment has been conducted.

In addition, as described in Section 10.1.3, each subproject to be implemented in this Project is classified as Category 1 and requires IEE. In the implementation of this IEE, from the viewpoint of speeding up the Project based on the following, it is proposed that the Project should not implement IEE for each subproject but instead a subproject group with a certain degree and implement IEE for the group.

- It takes about 4 to 5 months from the implementation of the environmental impact survey to the acquisition of the environmental certificate, as shown in Figure A10.1.2.
- More than 30 subprojects will be implemented at multiple sites in this Project.
- The DEEC suggested that it is not realistic to implement an IEE for each subproject, and it would be better to implement an IEE for the subprojects group.

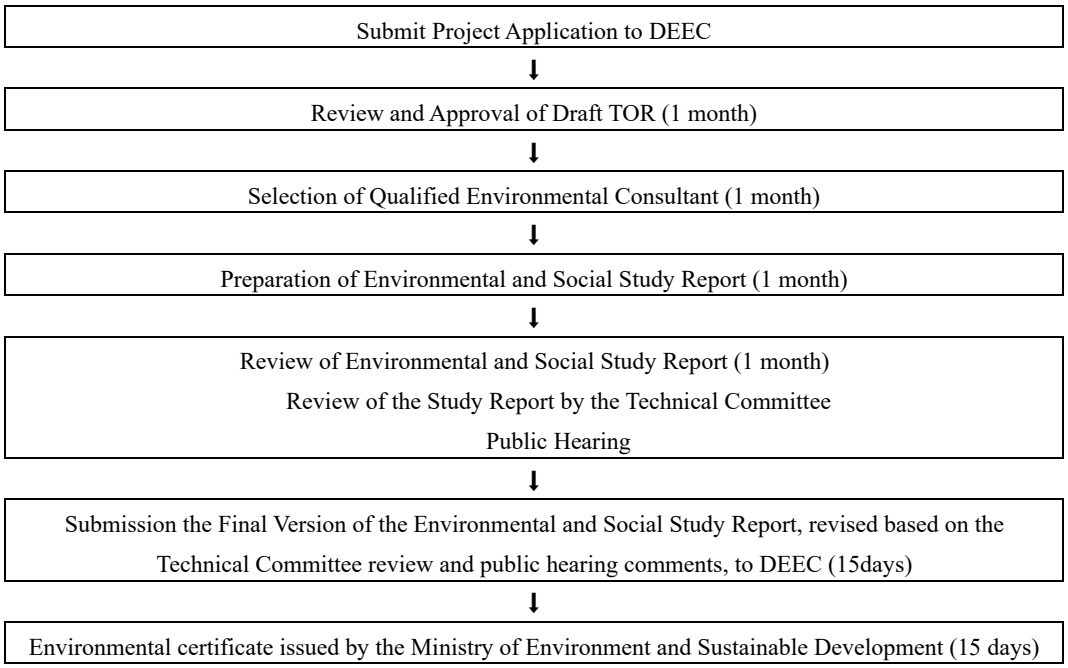
(1) Proposed Procedure for Environmental Impact Assessment

The following is the proposed procedure for the environmental impact assessment.

1) Submission of project application form to DEEC by the project proprietor
2) Categorization: DEEC will categorize projects based on project contents, regional characteristics, and project impacts. An environmental impact assessment must be performed by an environmental consultant qualified by the Ministry of the Environment at the responsibility of the proprietor
3) Project explanation to local residents and stakeholders
4) Preparation of TOR for environmental impact assessment: This is equivalent to JICA's scoping procedure. The project proprietor and DEEC will examine and determine the environmental impact assessment survey items and methods according to the location, contents, and scale of the project.
5) Implementation of environmental impact survey: An environmental consultant hired by the proprietor conducts the survey according to TOR.
6) Preparation of environmental impact assessment report
7) Submission of the draft report: Submit a draft report on environmental impact assessment to the Technical Committee.
8) Revision based on the comments from the Technical Committee
9) Explanation report of the results of environmental impact assessment to local residents and stakeholders: This procedure only applies to Category 1. The proprietor holds public hearings, reports the results of environmental impact assessments to local residents, and receives opinions and comments.
10) Revised report based on opinions and comments from public hearings
11) Submit the revised version to the DEEC Director as the final version
12) Temporary certification of environmental impact assessment by the Director of the Environmental Bureau

13) Approval by the Minister of the Environment: If the project does not start within two years after approval, a new application must be made again.

The flowchart of the above procedure is shown in Figure A10.1.2.



Source Prepared by the JICA Survey Team based on interviews with SAED and DEEC

Figure A10.1.2 Flow of Environmental Impact Assessment in Senegal

(2) Cost Estimates for Conducting Environmental Impact Assessment

Estimated costs for the environmental impact assessment of this Project are as follows:

Table A10.1.4 Cost Estimates for Environmental Impact Assessment Implementation

Item	Unit	Quantity	Unit Cost (FCFA)	Subtotal (FCFA)
Procurement of MEDD qualified environmental consultants*1	Lump sum	1	25,000,000	25,000,000
Expenses required for reviewing environmental and social study reports TOR approval workshop Holding Technical Committee	unit	2	2,500,000	5,000,000
			Total	**30,000,000**

*Note*1: Adjust as necessary to work with PMU environmental experts.*
Source: JICA Survey Team

Since the environmental impact assessment is conducted as part of the preliminary design, these cost estimates are included in the cost for the preliminary design.

10.1.5 Gap Analysis between Senegal EIA Legal Framework and JICA Guidelines for Environmental and Social Considerations

Table A10.1.5 below shows the gap between the main requirements described in the JICA Guidelines for Environmental and Social Considerations and the relevant legal framework in Senegal and implementation policy for this Project.

Table A10.1.5 Gap Analysis between JICA Environmental and Social Consideration Guidelines and Senegal Related Laws and Implementation Policy

Item	Requirements from JICA Guidelines	Senegal Related Law	Gap and Implementation Policy for this Project
Basic matters	When implementing a project, at the planning stage, investigation and consideration for the impact of the project on the environment and society should be done as early as possible, and alternatives and mitigation measures should be avoided or minimized. The results must be reflected in the project plan. (Attachment 1)	Environmental Law L48, It describes the necessity of evaluating the impact on the natural environment and living environment and avoiding or minimizing the impact in the implementation of policies, plans, and programs that are expected to affect all environments. Environmental Law L51 It states that EIA includes impact assessment before, during, and after project implementation.	No gap. This project will proceed according to the JICA Guidelines and Senegal legal system.
Examination of measures	Several alternatives must be considered in order to avoid undesired impacts of the project, to minimize it and to select a better one for environmental and social considerations. When considering countermeasures, first consider avoidance of impacts, and if this is not possible, consider measures to minimize or mitigate impacts. Compensation measures shall be considered only if the effects are still unavoidable even if avoidance measures, minimization or mitigation measures are taken. (Attachment 1)	Article 9 of Ministerial Ordinance on Environmental Impact Assessment Report (No.9472) It states that various alternatives should be considered.	No gap. This project will proceed according to the JICA Guidelines and Senegal legal system.
Examination of measures	Appropriate follow-up plans and systems such as environmental management plans and monitoring plans, costs for them, and procurement methods must be planned. For projects that are assumed to have a particularly large impact, a detailed plan for environmental management must be prepared. (Attachment 1)	Article 9 of Ministerial Ordinance on Environmental Impact Assessment Report (No.9472) It states that monitoring and environmental management plans should be considered.	No gap. This project will proceed according to the JICA Guidelines and Senegal legal system.
Scope of impact to consider	The scope of impacts that should be investigated and considered for environmental and social considerations includes impacts on human health and safety and natural environment through the air, water, soil, waste, accidents, water use, climate change, ecosystems and biota (including cross-border or global environmental impacts) and items listed below. Involuntary resettlement and other population movements, local economy such as employment and livelihood, land use and local resource use, Social organizations such as social capital and local decision-making bodies, existing social infrastructure and services, socially vulnerable groups such as the poor and indigenous peoples, distribution of damage and benefits and fairness in the development process, gender, children's rights, cultural heritage, conflict of interest in the region, infectious diseases such as HIV / AIDS, work environment (including occupational safety). (Attachment 1)	Environmental Law L39, The scope of environmental impact assessment is defined and covers the items in the left column.	No gap. This project will proceed according to the JICA Guidelines and Senegal legal system.

Item	Requirements from JICA Guidelines	Senegal Related Law	Gap and Implementation Policy for this Project
Alignment with laws, standards, plans, etc.	Projects must comply with laws and standards related to environmental and social considerations established by governments (including central and local governments) at the project site. It must be in line with environmental and social consideration policies and plans established by the government at the site. (Attachment 1)	Environmental Law L50, It states that the project must comply with the laws and regulations stipulated by the Minister of the Environment.	No gap. This project will proceed according to the JICA Guidelines and Senegal legal system.
Social agreement	Projects must be well coordinated so that they can be agreed in a socially appropriate manner in the country or region where they are planned. In particular, for projects that are assumed to have a significant impact on the environment, information must be disclosed and fully discussed with local residents and other stakeholders from an early stage when considering alternatives to the project plan. The result is necessary to be reflected in the project contents. (Attachment 1)	Environmental Law L52, L53, and L54 stipulate that public hearing shall be conducted and the need for community participation in decision making during the implementation of environmental impact assessment.	No gap. This project will proceed according to the JICA Guidelines and Senegal legal system.
Monitoring	During the implementation period of the project, it is necessary to grasp the situation that was difficult to predict, the implementation status and effects of mitigation measures planned in advance, and take appropriate measures based on the results. (Attachment 1) If sufficient monitoring is considered essential for proper environmental and social considerations, such as projects that should implement mitigation measures while grasping the effects, it should be ensured that the project plan includes a monitoring plan and a feasibility study. (Attachment 1)	Article 9 of Ministerial Ordinance on Environmental Impact Assessment Report (No.9472) It states that monitoring and environmental management plans should be considered.	No gap. This project will proceed according to the JICA Guidelines and Senegal legal system.

Source: JICA Survey Team

10.2 Comparison of Alternatives (including Zero Option)

The table below shows a comparative analysis of the environmental and socio-economic impacts of with project and without project.

Table A10.2.1 Comparative Analysis of "With Project" and "Without Project"

Criteria	Without Project	With Project
Environment	▪ Current environmental conditions do not change ▪ Soil salinization due to lack of adequate drainage ▪ Growth of aquatic plants in canals	▪ Environmental impact at the construction stage ▪ Increased drainage, risk of contamination of soil and surface water ▪ Increased salt due to increased water penetration
Socio-economic	▪ Income does not improve ▪ No increase in plot land ▪ High irrigation maintenance costs ▪ Difficulty supplying water to the specific plot ▪ Difficult to transport crops	▪ Improvement of specification level by the rehabilitation of irrigation facilities ▪ Increased income ▪ Increased plot land ▪ Single crop cultivation is promoted ▪ Improvement of on-site water management ▪ Storing and transporting crops become easy

Source: JICA Survey Team

From the comparative analysis in the table above, more benefits are generated when the project is implemented with respect to environmental and socio-economic impacts. In addition, by carrying out the project under an appropriate environmental management plan, it is possible to significantly reduce the negative impact and its scope.

Furthermore, as shown in Table A10.2.2, the project plan for the rehabilitation of irrigation facilities costs more than the current situation, but it improves the water cycle, and it has the advantage of reducing the damage caused by heavy rain and flooding in Rosso City, which is one of the major threats to the sustainable operation of the irrigation area. This project proposal was proposed by beneficiaries at a stakeholder meeting held in Rosso City on 29 August 2019.

Table A10.2.2 Comparison of Alternatives

Alternatives	Technical Evaluation	Economic and Financial Evaluation	Environmental Evaluation
Current situation	- Existing facilities - The irrigated area of the existing main canal is limited. - Limited to existing water diversion facilities - Vulnerable to inflow water from Rosso City	- Renovation costs are relatively low - No expansion of the cultivated land area - There is not much increase in the volume of agricultural products carried out by large trucks	- Proper drainage control is difficult and inflow from Rosso City cannot be controlled
Proposed Project	- Rehabilitation of irrigation facilities - Rehabilitation of abandoned farmland - Rearrangement of current field plot - Improvement of water control function. There is potential for the redistribution of plots, especially for women	- Requires expensive project costs - Lower maintenance costs due to reduced facility deterioration risk - More efficient transportation of agricultural products by promoting agricultural road development	- Promote proper irrigation and drainage management and better control the inflow from Rosso City

Source: JICA Survey Team

10.3 Scoping

In order to identify the scope of the environmental impact survey, scoping was conducted for the subprojects. The selected evaluation items and reasons are shown in Table A10.3.1.

Table A10.3.1 Scoping Results

***PC**: Pre-construction phase **C**: Construction phase **O**: Operation phase*

		Item	Rating		Reason
			PC/C	O	
Pollution	1	Air	B-	D	**PC/C:** Temporary air pollution is expected due to heavy machinery and vehicle operation. **O:** The project is a rehabilitation project and no impact on air pollution is expected.
	2	Water	B-	B-	**C:** There is a possibility of water pollution due to drainage from construction sites, heavy machinery, vehicles and construction camps. **O:** Inflow of fertilizers and pesticides into drainage channels and rivers is expected.
	3	Waste	B-	D	**C:** From general waste to hazardous waste is expected. **O:** The project is a rehabilitation project and no activities to generate solid waste which may cause environmental impact is expected.
	4	Soil	B-	B-	**C:** There is a possibility of soil contamination due to spillage of construction oil. **O:** There is a risk of soil salinization due to inadequate

		Item	Rating		Reason
			PC/C	O	
					drainage. The contamination of irrigated soil with fertilizers and pesticides is expected.
	5	Noize/vibration	B-	D	**C:** Noise and vibration due to heavy machinery and vehicle operation are expected. **O:** The project is a rehabilitation project and no activities to generate noise and vibrations are expected.
	6	Grand subsidence	D	D	**C/O:** Groundwater pumping will not be implemented during the construction and operation phase of this project, and ground subsidence is not expected.
	7	Offensive odors	D	D	**C/O:** The construction of this project does not assume any work that may cause offensive odors.
Natural Environment	1	Protected areas	D	D	**C/O:** There are no protected areas or conservation areas in the Rosso Irrigation Scheme.
	2	Flora, fauna and biodiversity	D	D	**C/O:** Since this project is a rehabilitation of existing irrigation facilities and there are no rare animals and plants in the project area, no impact on the ecosystem is expected.
Social Environment	1	Involuntary resettlement/land acquisition	D	D	**C/O:** Involuntary resettlement /land acquisition is not expected for this project.
	2	Livelihood and income	B-	B+/-	**C:** There is a possibility that agricultural work may be temporarily suspended during construction. **O:** Livelihood improvement is expected from project implementation. Water-borne diseases are expected to occur in the stagnant water area around the irrigation facilities. The risk of poisoning due to inappropriate use of pesticides and insecticides is assumed.
	3	Water use	C	B-	**C:** Extent of impact is unknown. A further examination is needed. **O:** Due to chemical components of fertilizers and pesticides that flow into drains and rivers, there is a risk of poisoning of human bodies and livestock.
	4	Local conflict of interests	D	B-	**C:** Local conflict of interests is not expected during construction. **O:** By reusing farmland that was abandoned and grazed before the pilot project, a conflict between farmers and grazing people is expected.
	5	Cultural heritage	D	D	**C/O:** There are no cultural heritage sites around the project site.
	6	Landscape	D	D	**C/O:** The project is a rehabilitation project and no impact on the landscape is expected.
	7	Indigenous and ethnic people	D	D	**C/O:** There are no ethnic minorities or indigenous peoples in and around the project site.
	8	Work environment (including occupational safety)	B-	D	**C:** It is necessary to consider the working environment of construction workers. **O:** The project is a rehabilitation project and no impact on the work environment is expected.
	9	Infectious diseases such as HIV/AIDS	B-	D	**C:** There is a possibility that infectious diseases may spread due to the inflow of construction workers from other areas. **O:** The project is a rehabilitation project and no impact on infectious diseases such as HIV/AIDS is expected.
	10	Gender	B-	D	**C:** Harassment to local women can be expected due to the inflow of construction workers from other areas. **O:** The project is a rehabilitation project and no impact such as harassment is expected.
Others	1	Accidents	B-	D	**C:** Accident risk due to inappropriate safety measures is assumed. **O:** No accident is expected during the operation phase.
	2	Across-boarder problems/climate change	D	D	**C/O:** The project is a rehabilitation project, and no transboundary problems are foreseen.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of impact is unknown. A further examination is needed, and the impact could be clarified as the study progresses.
D: No impact is expected.
Source: JICA Survey Team

10.4 TOR for Environmental and Social Consideration Survey

In the above scoping, the contents and methods of the survey that are currently envisaged for items that have been judged to have some negative impacts or are unknown are summarized in the TOR of the Environmental and Social Consideration Survey.

Table A10.4.1 TOR for Environmental and Social Consideration Survey

Impact Items	Survey Items	Survey Methodology
Pollution Control		
1. Air pollution	(1) Regulations and/or act of air quality (2) Impact during the construction	(1) To do a literature survey (2) To confirm the type, method, duration, and location of construction work, site visit and hearing to organizations concerned
2. Water pollution	(1) Regulations and/or act of water quality (2) Impact during the construction (3) Impact in the operation phase	(1) To do a literature survey (2) To confirm the type, method, duration, and location of construction work, site visit and hearing to organizations concerned (3) To carry out field visit and hearing to organizations concerned
3. Solid waste	(1) Impact during the construction	(1) To confirm the type, size, and method of the construction work and capacity of the candidate sites for waste disposal
4. Soil contamination	(1) Regulations and/or act of soil contamination (2) Impact during the construction (3) Impact in operation phase	(1) To do a literature survey (2) To confirm the type, size, method, location, duration, etc. of the construction, hearing, and good practices in other similar projects (3) To carry out field visit and hearing to organizations concerned
5. Noise/ vibration	(1) Regulations and/or act of noise and vibration (2) Impact during the construction	(1) To do a literature survey (2) To confirm the type, method, duration of construction and existence of buildings which need special attention, and hearing to organizations concerned
Social Environment		
2. Livelihood and income	(1) Impact during the construction (2) Impact in operation phase	(1) To confirm the duration of construction and farming system (2) To carry out field visit and hearing to organizations concerned
3. Water use	(1) Impact in operation phase	(1) To carry out field visit and hearing to organizations concerned
4. Local conflict of interest	(1) Impact in operation phase	(1) To carry out field visit and hearing to organizations concerned
8. Work environment (including occupational safety)	(1) Impact on workers during the construction	(1) To confirm type and duration of the construction and good practices in other similar projects
9. Infectious diseases such as HIV/AIDS	(1) Impact on infectious disease	(1) To confirm good practices in other similar projects
10. Gender	(1) Impact on harassment	(1) To confirm good practices in other similar projects
Others		
1. Accident	(1) Impact during the construction	(1) To confirm good practices in other similar projects

Source: JICA Survey Team

10.5 Environmental and Social Consideration Survey Results (Including Prediction Results)

The results of the survey conducted based on the above scoping and the results of the impact assessment are shown in Table A10.5.1. As a result of the survey, there were no items that had a significant positive/negative impact on A.

Table A10.5.1 Environmental and Social Consideration Survey Results (Including Prediction Results)

***PC**: Pre-construction phase **C**: Construction phase **O**: Operation phase*

		Item	Rating at Scoping		Rating after Survey		Reason
			PC/C	O	PC/C	O	
Pollution	1	Air	B-	D	B-	N/A	**PC/C:** Temporary air pollution is expected due to heavy machinery and vehicle operation.
	2	Water	B-	B-	B-	B-	**C:** There is a possibility of water pollution due to drainage from construction sites, heavy machinery, vehicles and construction camps. **O:** Inflow of fertilizers and pesticides into drainage channels and rivers is expected. Inflowing pesticides are assumed to include bensulfuron-methyl and propanil. These inflows create a risk of contamination of aquatic and terrestrial animal habitats. (Senegal Sugar Company discharges wastewater into the rivers in the vicinity)
	3	Waste	B-	D	B-	N/A	**C:** From general waste to hazardous waste is expected. Petroleum products, cartridges, filters, etc. are sources of hazardous waste. The capacity of the landfill site in Rosso is small and construction waste can have a negative impact if not properly managed.
	4	Soil	B-	B-	B-	B-	**C:** There is a possibility of soil contamination due to spillage of construction oil. **O:** There is a risk of soil salinization due to inadequate drainage. The contamination of irrigated soil with fertilizers and pesticides is expected.
	5	Noise/vibration	B-	D	B-	N/A	**C:** Noise and vibration due to heavy machinery and vehicle operation are expected. The project site is very far from the nearest resident houses, and no impact on the surrounding residents is expected, but the impact on construction workers is expected.
Social Environment	2	Livelihood and income	B-	B+/-	B+/-	B+/-	C: There is a possibility that agricultural work may be temporarily suspended during construction. On the other hand, temporary employment will be created by the construction, and benefits to neighboring businesses are expected. O: Livelihood improvement is expected by project implementation. Water-borne diseases are expected to occur in the stagnant water area around irrigation facilities. The risk of poisoning due to inappropriate use of pesticides and insecticides is assumed.
	3	Water use	C	B-	B-	B-	**PC/C, O:** Due to chemical components of fertilizers and pesticides that flow into drains and rivers, there is a risk of

							poisoning of human bodies and livestock.
	4	Local conflict of interests	D	B-	N/A	B-	**O:** By reusing farmland that was abandoned and grazed before the pilot project, a conflict between farmers and grazing people is expected.
	8	Work environment (including occupational safety)	B-	D	B-	N/A	**C:** It is necessary to consider the working environment of construction workers.
	9	Infectious diseases such as HIV/AIDS	B-	D	B-	N/A	**C:** There is a possibility that infectious diseases may spread due to the inflow of construction workers from other areas.
	10	Gender	B-	D	B-	N/A	**C:** Harassment to local women can be expected due to the inflow of construction workers from other areas.
Others	1	Accidents	B-	D	B-	N/A	**C:** Accident risk due to inappropriate safety measures is assumed.

A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C: Extent of impact is unknown. A further examination is needed, and the impact could be clarified as the study progresses.
D: No impact is expected.
Source: JICA Survey Team

The following table shows the use status of pesticides in Senegal that are listed in the above Table A10.5.1, survey results and impact assessment.

Table A10.5.2 Pesticide Usage Confirmed in the Impact Assessment

Name of Pesticide	Usage	EU Approval	Application	Impact on the Environment
Bensulfuron-methyl,	Herbicide	Approved	Wheat, rice	Toxicity to humans and animals is low.
Propanil	Herbicide	Not approved	Rice, fruit tree, vegetables	Highly toxicity to birds, mammals, and organisms.

Source: JICA Study Team based on EU Pesticide Database (https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=activesubstance.detail&language=EN&selectedID=1010 and https://ec.europa.eu/food/plant/pesticides/eu-pesticides-database/public/?event=activesubstance.detail&language=EN&selectedID=1763) (Access 2019.10.31)

10.6 Mitigation Measures and Costs for Implementing Mitigation Measures

As a result of the above environmental impact assessment, the environmental management plan including mitigation measures, implementation system, and cost burden was formulated for items evaluated as B- either pre-construction, construction, or operation phases as shown in Table A10.6.1.

Table A10.6.1 Environmental Management Plan

	Potential Impact	Mitigation Measures	Implementation	Supervision	Estimated Cost or Burden Organization
Pre-construction/Construction Phase					
1	Air	• Sprinkle water on the access road to the construction site to prevent dust. • Cover with a sheet when transporting and storing materials such as construction sand. • All heavy machineries and vehicles are operated to maintain high combustion efficiency and minimize exhaust emissions.	Construction contractor	SAED DREEC	Project cost
2	Water	• One simple mobile toilet will be installed for every 15 workers, and a hygiene awareness panel will be installed. • Install a waste storage area. • Properly maintain heavy machinery to prevent accidental oil leaks.	Construction contractor	SAED DREEC	Project cost
3	Waste	• Set up a waste management plan with the contractor and monitoring committee and obtain DREEC and SAED's approval. • Cover waste transport vehicles to prevent waste from spilling outside or being blown away during transport. • Construction waste is prohibited from being left along the road and removed regularly for reuse or disposal.	Construction contractor	SAED DREEC	Project cost
4	Soil	• Regular maintenance of construction equipment will be carried out by an authorized company. • Install a waterproof plank on the diesel tank to prevent oil leakage. • Entrust the management of used oil and hazardous waste to an authorized company.	Construction contractor	SAED DREEC	Project cost
5	Noise/vibration	• Carry out preventive maintenance of vehicles and machines to prevent noise generation.	Construction contractor	SAED DREEC	Project cost
6	Livelihood and income	• Develop a construction plan that minimizes the interruption duration/hours of agricultural work.	Producers union Farmers Construction contractor	SAED DREEC	Project cost
7	Work environment (including occupational safety)	• Ensure that workers are wearing safety armor and, if necessary, provide dust masks and soundproof headphones. • Comply with appropriate working hours. • Encourage workers to drink 1.5 liters of drinking water per day during business hours.	Construction contractor	SAED DREEC	Project cost

	Potential Impact	Mitigation Measures	Implementation	Supervision	Estimated Cost or Burden Organization
		• Prepare first aid kits at the construction site and in each vehicle / equipment.			
8	Infectious diseases such as HIV/AIDS	• Implement HIV / AIDS awareness campaigns. • Distribute condoms.	Construction contractor	SAED DREEC	Project cost
9	Gender	• Inform people about the existence of a grievance mechanism for violence against women	Construction contractor Regional Environmental Monitoring Committee DRDR	SAED DREEC DRDR	Project cost
10	Accidents	• Prepare fire extinguishers in each vehicle / workplace. • Install a sign at the entrance of the construction site to indicate that construction work is being performed.	Construction contractor	SAED DREEC	Project cost
Operation Phase					
1	Water*	• SAED and producers union play a central role in farmer training in pesticide management to ensure that they are used appropriately. • Conduct training in line with SAED's pesticide management plan at sites where environmental monitoring is conducted, and investigate pesticides and fertilizers used at the same time. • Promote the use of organic fertilizers.	SAED Producers union	SAED DREEC	Producers union SAED
2	Soil*	• SAED and Producers union play a central role in farmer training in pesticide management to ensure that they are used appropriately. • Conduct training in line with SAED's pesticide management plan at sites where environmental monitoring is conducted, and investigate pesticides and fertilizers used at the same time. • Promote the use of organic fertilizers.	Producers union SAED	SAED DREEC	Producers union SAED
3	Livelihood and income*	• Implement a campaign to prevent waterborne diseases • SAED and producer organizations play a central role in farmer training in pesticide management to ensure that they are used appropriately. • Separate storage locations for pesticides and crops. • Dispose of old pesticides in an appropriate manner.	Producers union SAED	SAED DREEC	Producers union SAED

	Potential Impact	Mitigation Measures	Implementation	Supervision	Estimated Cost or Burden Organization
4	Water use*	• SAED and Producers union play a central role in farmer training in pesticide management to ensure that they are used appropriately. • Separate storage locations for pesticides and crops. • Dispose of old pesticides in an appropriate manner. • Instruct people not to use drainage and river water for drinking and daily use. • When drainage or river water is used as livestock drinking water, instruct to use water that has been confirmed to be safe.	Producers union SAED	SAED DREEC	Producers union SAED
5	Local conflict of interests	• Establish a 1m-wide livestock corridor within the project site. • Establish a coordination system between farmers and grazing people.	SAED Producers union	SAED DREEC	SAED

Source: JICA Survey Team

*: In the survey of pesticides and fertilizers through training, if pesticides and fertilizers with high toxicity are used, guidance is provided to farmers to use them in compliance with the pesticide management plan and EU and FAO standards.

10.7 Pesticide Management Plan (Draft)

The management and use of pesticides and herbicides are carried out as part of farming activities, and the pesticides and herbicides used are expected to vary from subproject to farmer.

Based on this point, this Project considers the pesticide management plan as part of a series of flows necessary for improving farming activities. Furthermore, the plan is to be implemented after the farmers who are responsible for the actual management fully understand the use of the pesticides. Thus, the producer union and the farmers themselves will prepare a pesticide management plan to support the strengthening irrigated rice cultivation implemented in Component 3 with the facilitation of the PMU/SAED environment and agricultural specialists (support of pesticide suppliers as necessary). It is assumed that the pesticide management plan includes the following items.

Table A10.7.1 Pesticide Management Plan (Draft)

Item	Contents
Environmental outline of the target area	Understanding the natural condition and ecosystem
Current and future farming systems	Main cultivated crops, farming methods (timing and frequency of pesticide use, etc.)
Present situation and problems of pesticide management and use	Pesticides used, suppliers, packaging status, storage status, usage status, etc.
Pesticide risk assessment	Risk assessment of local pesticides and other candidate pesticides on the human body, livestock, ecosystem, etc. (including lectures by pesticide suppliers)
Appropriate pesticide management and usage	Confirmation of pesticides to be used in the future, appropriate pesticide use amount, usage method, proper storage method, and inventory control method for each pesticide
Capacity evaluation for proper pesticide management and use	Evaluation of technical, organizational, and financial capabilities of the implementation system for pesticide management
Measures based on capacity evaluation	Formulating a strengthening plan from the soft and hard aspects
Monitoring	Monitoring implementation system and implementation plan

Source: JICA Survey Team

10.8 Environmental Monitoring Plan

As a result of the above environmental impact assessment, a monitoring plan for environmental and social considerations was formulated for items evaluated as B- in either the pre-construction, during construction, or during operation, as shown in Table A10.8.1. During the operation phase, monitoring of activities shall be continued for a minimum of two years.

Table A10.8.1 Environmental Monitoring Plan

Item	Item	Indicator	Point	Frequency	Responsibility	Supervision
Construction Phase						
Air	Dust, mechanical exhaust gas	No abnormal emission based on visual observation	Construction area facing the surrounding residents	Monthly (when heavy equipment is in operation)	Construction contractor	DEEC SNH CRSE
Water	pH	6 – 9	Drainage point	Monthly	Construction contractor	DEEC SNH CRSE
	EC	---				
	Temperature	No abnormal heat				
	BOD5	800 mg/L				
	COD	2,000 mg/L				
	Pesticide residue					
Wastes	Volume	---	Construction site	Weekly	Construction contractor	DEEC DGTSS SNH CRSE
Soil	pH	5.5 – 6.5	Construction site	Monthly	Construction contractor	DEEC DGTSS SNH CRSE
	Oil film and smell	---				
Noize/Vibration	Noise level	Day: 55 dB(A) Night: 40 dB(A)	Construction site, construction area facing the surrounding residents	As needed during construction when a complaint occurs at the time of equipment change or new procurement	Construction contractor	DEEC DGTSS DPC CRSE
Livelihood and income	Confirmation of work schedule	---	Construction site	Monthly	Construction contractor	SAED DREEC
Work environment (including occupational safety)	Safe and sanitary working environment	---	Construction site	Daily during construction	Construction contractor	DEEC DGTSS DPC CRSE
Infectious diseases such as HIV/AIDS	Number of awareness campaigns Status of distributing condoms	---	Construction site, construction camps	At the start of construction and then twice a year	Construction contractor	SAED DREEC
Gender	Number and content of complaints about harassment to women	---	Construction site, construction camps, municipal office, producers union	As needed during construction when a complaint occurs	Construction contractor DRDR	SAED DREEC DRDR

Item	Item	Indicator	Point	Frequency	Responsibility	Supervision
Accidents	Fire extinguisher installation status Construction site signage Number of accidents	---	Construction site	Monthly	Construction contractor	SAED DREEC
Operation Phase						
Water*	pH	6.0 – 7.5	Drainage point	Once per cropping season	SAED	DEEC SNH CRSE
	EC	< 0.3 mS/cm				
	Temperature	---				
	BOD5	---				
	COD	< 6 mg/L				
	Pesticide residue					
Soil*	pH	5.5 – 6.5	Project site	Once per cropping season	SAED	DEEC DGTSS SNH CRSE
	EC	0.8 – 1.5				
	Phosphoric acid	---				
	Nitrogen	---				
Livelihood and income*	Number of campaigns to prevent waterborne diseases Number of training sessions on pesticide use	---	Municipal office, producers union	At the start of the operation, Then as needed	SAED DREEC	SAED DREEC
Water use*	Number of pesticide management training Confirmation of drinking water location for livestock	---	Municipal office, producers union	At the start of the operation, Then as needed	SAED DREEC	SAED DREEC
Local Conflict of Interests	Number and content of complaints	---	Municipal office, producers union	When a complaint occurs	SAED DREEC	SAED DREEC

Source: JICA Survey Team

*: In the survey of pesticides and fertilizers through training, if pesticides and fertilizers with high toxicity are used, guidance is provided to farmers to use them in compliance with the pesticide management plan and EU and FAO standards.

A monitoring form (draft) for the above monitoring is shown in Appendix 10.1.

10.9 Implementation System and Reporting System for Environmental and Social Considerations of the Project

The implementation system for environmental and social considerations for this Project is proposed as shown in Table A10.9.1.

Table A10.9.1 Implementation System for Environmental and Social Considerations for the Project (Draft)

Actors	Role and Responsibilities
Project Management Unit (SAED)	▪ Screening of subprojects ▪ Procurement of qualified consultants to conduct environmental impact assessments and initial environmental surveys ▪ The arrangement between environment-related organizations and other organizations and responsible facilities ▪ Reflecting environmental and social considerations in the tender documents ▪ Prepare unit price list for environmental and social components ▪ Establishing a collaboration with DEEC to promote environmental monitoring ▪ Monitoring of environmental monitoring and related monitoring systems ▪ Review of environmental monitoring reports submitted by contractors ▪ Report submission to DEEC and JICA ▪ Follow-up of complaint handling mechanism ▪ Distribute environmental assessment report ▪ Training for the producer union members on the use, storage, and management of pesticides, negotiations with the department in charge of plant protection for implementation of enlightenment activities, and monitoring of storage and processing facilities and product dosage
Regional Directorate of Environment and Classified Establishments (DREEC) of Saint Louis	▪ Supervision of subproject screening investigation ▪ Detailed examination of the implementation procedures, management methods and technical matters of the environmental impact assessment survey ▪ Reporting work ▪ Issuance of certificates related to environmental compliance
Regional Directorate of Rural Development (DRDR)	▪ Support for PMU/SAED for the formation of women promotion groups (GPF) and youth groups ▪ Follow-up on gender complaint mechanisms and violence damage
Saint-Louis/Local labor offices	▪ Labor and social security inspectors need to ensure adherence to working conditions (schedule, treatment, protection, hygiene and site safety etc.).
Municipality in charge of each irrigation scheme	▪ Enlightenment activities ▪ Monitoring of Environmental and Social Management Plan (ESMP) recommendations ▪ Dissemination of ESMP items, participation in social mobilization,
Producers Union	▪ Response to various environmental requirements (during project implementation) ▪ Measures against invasive aquatic plants (maintenance of irrigation facilities) ▪ Health management for plant protection (against harmful pesticides etc.) ▪ Cleaning of irrigation and drainage channels ▪ Enlightenment activities for residents in relation to drainage water use risks

Source: JICA Survey Team

In order to follow up on the above implementation system, the reporting system was formulated as shown in Table A10.9.2.

Table A10.9.2 Reporting System for Environmental and Social Considerations of the Project (Draft)

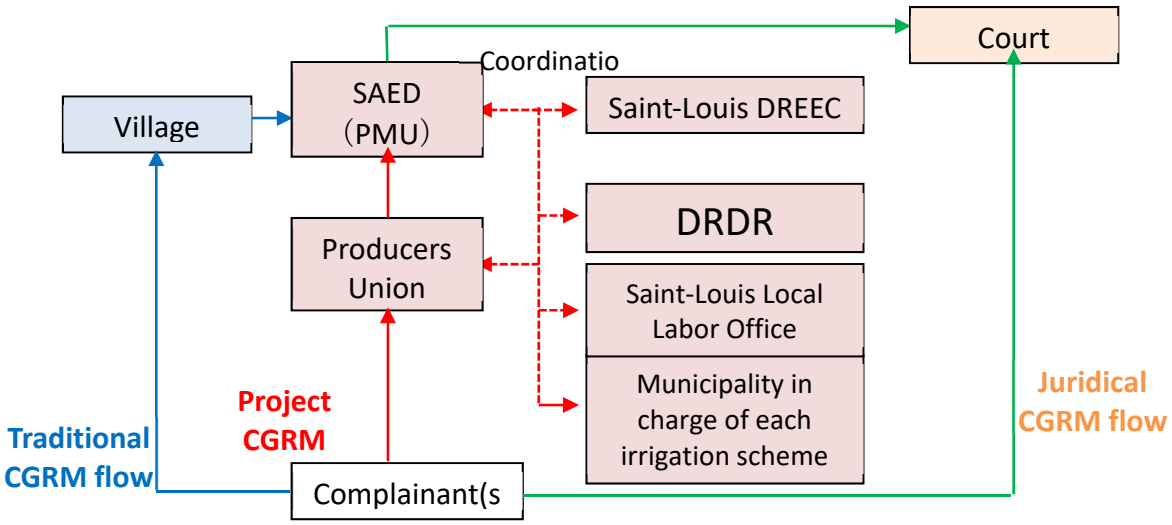
Submit from	Reporting Contents	Submit to	Frequency
Construction contractor	Implementation status of ESMP and safety management	PMU/SAED	Monthly
SAED	Implementation status of ESMP and safety management	DEEC/JICA	Every six months

Source: JICA Survey Team

In addition, the environmental complaint handling mechanism is suggested as follows:

Opponents of the project can have access to three complaint processing flows: (1) traditional complaint processing to the village head, (2) complaint processing through PMU/PIU established in the producers union and SAED, and (3) complaint processing by the court.

Complaints that could not be resolved in (1) will be reported to SAED through the producer's union, and SAED will carry out coordination discussions with the relevant authorities in accordance with the content and proceed to resolve them. Complaints that cannot be resolved there will be resolved through court proceedings, but it is recommended that SAED and related organizations resolve as much as possible considering economic and time burden.



Note; CGRM: Complaint and Grievance Redress Mechanism, DREEC: Regional Directorate of Environment and Classified Establishments, DRDR: Regional Directorate of Local Development

Source: JICA Survey Team

Figure A10.9.1 Environmental Complaint Handling Mechanism

10.10 Stakeholder Consultations

Stakeholder consultations shall be conducted to gain an understanding of the subproject and to discuss opinions, concerns, and suggestions. In conducting stakeholder consultations, the following matters should be noted.

- Participants (number, percentage of affected people, affiliation, gender, etc.)
- Minutes (date, time, location, contents of discussion, comments from participants, responses by the executing agency, results of reflection of received comments for the plan and the project)
- Consideration for socially vulnerable people
- Follow-up to affected persons who could not participate in the consultation (information provision, etc.)
- In the community consultation, the executing agency will explain not only the outline and validity of the project but also the results of the examination of alternatives and negative impacts (scoping results, environmental and social consideration survey results, etc.).

Table B5.8.1 shows the contents of the discussions conducted in the Rosso irrigation scheme of the pilot site and the suggestions and recommendations obtained as a result of the discussions.

10.11 Capacity Building Plan for Environmental and Social Considerations

The proposed ESMS checklist is shown in Appendix 10.2. The capacity building plan for environmental and social considerations based on this checklist is shown in Table A10.11.1.

Table A10.11.1. Capacity Building Plan for Environmental and Social Considerations

Training target	PMU、PIUs、SAED staff in charge
Training timing	After the establishment of PMU、PIUs
Implementer	PMU environmental expert (If necessary, external consultants will be contracted.)
Training contents	・ Environmental and social consideration framework for this project ・ Implementation, monitoring methods and system for environmental and social consideration

Source: JICA Survey Team

10.12 Land Acquisition/Involuntary Resettlement

The subproject is based on the rehabilitation project of the existing irrigation scheme, and the donation of part of the land is subject to adjustment within the residents after discussions. Therefore, involuntary resettlement is not expected. Regarding the donation of land, a memorandum of understanding regarding construction work will be signed between SAED and the producer's union during the consensus building at the time of preliminary design. When signing the memorandum of understanding, appropriate explanations in line with the World Bank's Environmental Social Framework ESS5 shall be provided, and confirmation should be done that compensation for land donation is not required and the land donated will not affect the livelihood of the donor. These discussions shall be agreed in writing. This memorandum will also be signed by the land donor.

CHAPTER 11 SUGGESTIONS AND RECOMMENDATIONS

11.1 Long List and Questionnaires for Candidate Subprojects

As described in Chapter 3, 121 candidate subprojects have been included in the current long list though SAED proposed 238 subprojects in the workshops held at Dagana and Podor departments. It is recommended that the long list should be updated by SAED to include the above 238 subprojects by the commencement of the Project since the long list can be utilized as a master list of the potential subprojects not only for the Project but also for the SAED future development plan.

Additionally, as also described in Chapter 3, there are a number of missing data and information in the questionnaires for the candidate subprojects submitted by SAED. Since those data and information will be referred and used for the selection of the priority subprojects, it is suggested that the questionnaires for the candidate subprojects be updated and reviewed by SAED by the commencement of the Project for smooth process of selection of priority subprojects, of which detailed procedure and criteria are shown in Chapter 4.

11.2 Required Actions soon after the Commencement of the Project

As described in Chapter 7.1, for smooth and efficient implementation of the Project, it is suggested that the following activities be commenced soon after the loan agreement will be concluded between GoJ and GoS and completed by the end of first year:

(1) Pre-screening based on long list and data sheet of candidate subproject,
(2) Scoring and prioritization based on short list and data sheet of candidate subproject,
(3) Preliminary design works for prioritized candidate subprojects (top priority subprojects),
(4) Establishment of Project Management Unit and Project Implementation Units,
(5) Construction/renovation of offices for PMU and PIUs including office spaces and accommodations for the Consultant,
(6) Procurement of vehicles, office furniture and equipment including tools and equipment required for the proper management and monitoring works,
(7) Preparation of the following manuals and guidelines:
    - operation manual for Project implementation,
    - design criteria for the Project,
    - cost estimate system for the Project,
    - guidelines for construction supervision and quality control for the Project, and
    - M&E frameworks for overall project activities.
(8) Implementation of training programs on the above manuals and guidelines, and
(9) Procurement of the Consultant for the Project.

Since it will require approximately one year to procure the Consultant, the above activities shall be implemented by PMU and PIUs without the assistance of the Consultant.

From the following viewpoint, it is recommended that SAED and/or JICA should provide a specific input and support including budget arrangement and technical and administrative assistance to assist PMU and PIUs in the implementation of those activities.

- the certain implementation of the above listed activities will be crucial for the smooth and efficient implementation of the Project and to fast track the commencement of the rehabilitation and improvement works,
- the Project is the first yen-loan project for SAED, and
- the Project is the first project type sector loan project for SAED.

Details of the above activities are described in the relevant Chapters and the additional suggestions and recommendations on the activities (3) and (9) are shown below.

(3) Preliminary Design Works for Prioritized Candidate Subprojects (Top Priority Subprojects)

It is suggested that the preliminary design works for prioritized candidate subprojects be carried out referring to the work flow and procedures applied to the preliminary design works for pilot site subproject as details are shown in Chapter 5. The above work flow and procedures for the preliminary design works were explained to SAED technical staffs in the workshop held on 6th September 2019 and the presentation material for this workshop is shown in Appendix 11.1.

(9) Procurement of the Consultant for the Project

It is suggested that SAED employ the qualified Consultant for the Project, who has sufficient qualifications including the following:

- To be familiar with the yen-loan projects and project type sector loan projects,
- To have a wide range of skills and knowledges for each development stage including plan and study, preliminary design, detailed design, procurement works, construction supervision, operation and maintenance, and monitoring and evaluation,
- To have sufficient experiences and management skills to manage a variety of the Project components including irrigation and drainage improvement, farm roads, agricultural related facilities, agricultural machineries and soft components, and
- To secure the quality of the works throughout the above stages for the above components.

This is because of the following:

- The Project is the first yen-loan project and the first project type sector loan project for SAED,
- The Project scope covers all development stages and various components, and
- As shown in Sub-chapter 6.1.1, the fundamental issues for the Project include 1) to realize high-quality agriculture and irrigation development works and 2) to secure the sustainability of the Project.

Table B

Table B2.2.1 List of registered staff (SAED headquarters)

N° MAT	PRENOM	NOM	D NAISS	QUALIFICATION	D ENTR
1. DIRECTION GENERALE					
602697D	Adiaratou	DIALLO	1959/3/16	DACTYLOGRAPHE	1983/5/9
605358E	Souleymane	BA	1960/1/22	DUT / COMPTABLE	1986/8/18
605360N	Mamoudou	DEME	1959/2/7	INGENIEUR AMENAGISTE	1986/10/6
606017/Q	Mahamoud *	GASSAMA	1962/12/31	INGENIEUR AGRO HYDRAULICIEN	1988/6/21
606025/G	Mankeur	DIA	1960/4/4	ECONOMISTE	1989/1/19
606028J	Aboubacry	SOW	1961/2/12	INGENIEUR GENIE RURAL	1989/12/1
606053I	Abdoulaye	SOW	1970/1/31	DUT INFORMATIQUE	1995/6/1
606078/G	Libasse	DIOP	1968/4/24	CHAUFFEUR	1999/1/2
606079H	Cheikh Sidibé	DIOUF	1967/7/19	CHAUFFEUR	1999/1/4
606093V	Mamadou	WANE	1965/12/31	TECH-INFOR-DE GESTION	2000/1/1
606099B	Abdoulaye	CAMARA	1962/3/2	AGT. TECH. INFORM	2000/2/1
606106I	Abdou	MBODJI	1963/4/4	Dr BIOLOGIE DEVELOPMT	2000/7/1
606117T	Cheikh	COULIBAL	1971/11/18	TECHNICIEN HORTICOLE	2001/3/1
606135L	Cheikh Ahmed Khaly	FALL	1972/11/8	SOCIOLOGUE	2002/1/2
606149Z	Mamadou Bra	THIENE	1973/7/4	INGENIEUR AGRO ECONO.	2005/7/4
606153D	Ousmane	DEME	1959/12/31	ING- TRAVAUX AGRICOLES	2006/7/1
606158I	Amadou	KANE	1962/7/12	CHAUFFEUR	2006/8/1
606159J	Mouhamed Alpha	DIALLO	1976/5/3	ARCHIVISTE	2006/7/1
606162M	Ibrahima	NDIAYE	1977/5/22	TECHNICIEN EN INFORMATIQUE	2007/2/8
606165P	Ely Yous.dit Elimane	BA	1970/6/10	OPERATEUR ECONOMIQUE	2007/8/1
606170U	Alhousseynou Nini	DEMBA	1974/9/5	GESTIONNAIRE D'ENTREPRISE	2007/12/1
606172W	Amadou Moussa	NDIAYE	1973/12/19	STATISTICIEN	2007/11/1
606181F	Sara	NDIAYE	1959/3/2	CHAUFFEUR	2008/7/1
606218N	Khadidiatou	DIENG	1974/6/12	SECRETAIRE	2009/7/1
606233C	Ami Collé Tall	SALL	1973/7/9	SECRETAIRE DE DIRECTION	2010/5/10
606235E	Malick	DIONE	1976/3/20	INGENIEUR GENIE RURAL	2010/5/2
606237G	Magatte	SAMBE	1976/8/31	OPERATRICE DE SAISIE	2010/7/1
606238H	Nimzath	SY	1977/4/7	OPERATRICE DE SAISIE	2010/7/1
606239I	Djibril Mamadou	BA	1959/12/31	MAÎTRISE SCES ECONO.	2010/7/1
606251U	Mamadou Diop	SOW	1979/2/8	PLANTON	2011/1/1
606264/H	Awa	DIARRA	1985/5/24	DUT SCE DE L'INF DO	2011/7/1
606272/P	Mamadou	DIARRA	1981/2/16	LICENCE PROF.GEST	2011/12/6
606284/B	Mame Magatte	NDIAYE	1967/8/17	OPERATRICE DE SAISIE	2012/7/1
606285/C	Aïchatou	THIAM	1973/9/3	SECRETAIRE	2012/7/1
606294/L	Aby	SECK	1975/12/15	TECH.SUP.SECRETARIAT	2012/10/9
606326/R	Youssoupha	NDIAYE	1983/10/10	ING- TRAVAUX AGRICOLES	2013/8/1
606327/S	Abdoulaye	SYLLA	1971/9/11	CHAUFFEUR	2013/8/1
606328/T	El Hadj Ngom	DIOP	1977/6/11	ING- TRAVAUX AGRICOLES	2013/8/1
606331/W	Maïmouna	DIA	1964/10/18	SECRETAIRE DE DIRECTION	2013/9/1
606337/C	Waly*	DIOUF	1968/6/9	INGENIEUR AMENAGISTE	2014/2/1
606354/T	Serigne Mbaye	DIALLO	1984/9/6	MAS.R.ECO.BANC.FIN.QUAN.	2014/6/1
606361/A	El Hadji Ibrahima	GUEYE	1975/8/17	MASTER EN MARKETING	2014/11/1
606367/G	Ndèye Fatou	SALL	1983/4/17	DIPLÔME SUP. GESTION	2015/1/1
606389/C	Omar Cissé	BA	1989/1/2	MAITRISE EN INFORMATI.	2016/3/1
606391/E	Mohamadou	BA	1984/4/4	MAÎTRISE ECO. APPLIQUEE	2016/4/1
606399/M	Moussa	DIOP	1978/9/28	INGENIEUR PLANIFICATEUR	2016/10/1
606405/S	Lika	MBACKE	1980/11/20	MASTER DROIT DES AFFAIRES	2017/1/1
606407/U	Moustapha	PENE	1979/7/3	CHAUFFEUR	2017/3/1
606420/H	Samba Ndiobène	KA	1979/6/5	ING. AGROECONOMISTE	2017/9/22
606421/I	Abdou	KA	1988/4/10	AGENT ADMINISTRATIF	2017/11/1
606422/J	Mamadou	SY	1978/4/3	BFEM	2017/12/6
606423/K	El Hadji Malick	WADE	1989/1/5	BACALAUREAT	2017/12/6
606425/M	Mama	BA	1980/1/5	CHAUFFEUR	2018/3/1
606432/T	Saly	BAKHOUM	1982/9/10	LICENCE S.ECO.GEST.	2018/9/1
606435/W	Aminata Hamath	SY	1962/12/31	ANIMATRICE	2018/11/1
606438/Z	Adama	KA	1978/7/12	CHAUFFEUR	2018/11/1
606439/A	Amadou	THIAM	1991/10/13	LI. S.ECO.G.OP. MARK.COM	2018/12/1
TOTAL	**57**				

N° MAT	PRENOM	NOM	D NAISS	QUALIFICATION	D ENTR
2. DIRECTION FINANCIERE ET COMPTABLE (DRHA)					
606139/P	Aïssatou	MBAYE	1979/10/22	COMPTABLE	2003/1/2
606240J	Khadime	NIANG	1983/9/20	DIPLÔME SUP. DE GESTION	2010/7/1
606249S	Atoumane	HANE	1977/7/18	CHAUFFEUR	2011/1/1
606291/I	Aminata	THIOUNE	1983/2/25	COMPTABLE / BEP	2012/8/16
606293/K	Lala	FALL	1987/9/5	TECH.SUP.SECRETARIAT	2012/10/9
606301/S	Nazirou	DIOL	1981/6/30	AGENT ADMINISTRATIF	2012/12/17
606307/Y	Kany	CISSE	1982/8/4	DIPLÔME SUPE. COMPTABLE	2012/12/6
606335/A	Seydina Ababacar	BITEYE	1978/3/7	MAITRISE G.INFORMATISEE	2013/12/1
606373/M	Ndack	GUEYE	1984/10/20	DIP.SUP.COM.ADMI.ENTRE.	2015/6/1
606376/P	Ahmadou Bamba Khad	FALL	1980/3/3	MASTER EN AUDIT CON. DE GE.	2015/8/1
606394/H	Amadou Bator	THIAM	1988/4/30	MASTER COMP. CONT.AUDIT	2016/6/1
606415/C	El Hadji Pèdre	DIOP	1981/5/20	MAITRISE SCES ECONOMI.	2017/7/1
TOTAL	**12**				
3. DIRECTION DU DEVELOPPEMENT ET DE L'APPUI AUX COLLECTIVITES TERRITORALES (DDAC)					
601525A	El Hadji *	SENE	1959/6/5	INGENIEUR AGRONOME	1999/1/1
606054J	Aissatou	NDIAYE	1959/3/18	CONS. PROM. FEMININE	1995/7/1
606072A	Adama Fily	BOUSSO	1962/3/10	GEOGRAPHE	1996/1/1
606080I	Papa	NGOM	1970/1/29	CHAUFFEUR	1999/1/2
606090S	Amadou	THIAM	1970/8/31	INGENIEUR AGRONOME	2000/1/1
606108K	Amadou	NIANG	1970/9/23	GEOGRAPHE	2001/1/2
606116/S	Bécaye	BA	1968/3/13	INGENIEUR AGRONOME	2001/3/1
606136M	Aly	CISSOKHO	1970/4/4	GEOGRAPHE	2002/1/2
606173X	Samba Hamady	DIALLO	1964/6/12	FORMATEUR	2008/1/1
606174Y	Rokhaya	GUEYE	1979/1/1	SOCIOLOGUE	2008/3/1
606176A	Sadio	BAKHOUM	1979/1/3	CHAUFFEUR	2008/7/1
606182G	Badara	YADE	1977/1/31	CHAUFFEUR	2008/7/1
606255/Y	Mouhamadou	DIA	1982/3/15	DESS EN AM.D.D.R	2011/5/1
606271/O	Mbaye	DIEDHIOU	1985/1/15	ING.AGRONOME	2011/12/1
606292/J	Sokhna Astou Gaye	DIOP	1985/2/5	ING.AGRONOME	2012/9/1
606295/M	Salamba	TALL	1984/2/10	T.S.SECRETARIAT	2012/10/9
606306/X	Ndèye Fary	NDIAYE	1977/5/2	ING.T. l'AME.TERROIR	2013/1/15
606315/G	El Hadji Aïssa	TOURE	1977/9/18	AGT ADMINISTRATIF	2013/3/1
606349/O	Al Ousseynou	TALL	1981/11/25	MAITRISE GEO/OP.AMEN.RU.	2014/4/1
606360/Z	Mansour	FALL	1983/9/6	MATRISE DE L.E.APPLIQUEES	2014/10/1
606363/C	Demba	KA	1978/7/23	MAITRISE MATHEMATIQUES	2014/11/1
606380/T	El Hadji Malick	FALL	1985/7/30	MASTER M.STAT.ECONOME.	2015/8/1
606390/D	Amadou Oury	DIALLO	1990/8/13	INGENIEUR AGRONOME	2016/4/1
606436/X	Ndiaga	SECK	1978/10/23	INGENIEUR AGRONOME	2018/11/1
606440/B	Oumou Kalsom	DIOP	1985/6/9	MASTER DVP RURAL COOP.	2018/12/1
TOTAL	**25**				

N° MAT	PRENOM	NOM	D NAISS	QUALIFICATION	D ENTR
4. DIRECTION DES AMENAGEMENTS ET DES INFRASTRUCTURES HYDROAGRICOLES (DAIH)					
606058N	Hawa	LY	1965/11/18	AGENT ADMINISTRATIF	1995/7/1
606096Y	Mademba	DIAO	1961/12/5	CHAUFFEUR	2000/4/1
606146W	Mouhamadou	DIOP	1960/12/2	ING-AGRO-PEDOLOGUE	2004/1/1
606169T	Djibril	SALL	1980/3/7	ING. GENIE CIVIL	2007/11/1
606192/N	Cheikh Mbacke	KAMARA	1975/9/25	CHAUFFEUR	2009/1/1
606214J	Papa Abd. Mboutou	MBAYE	1975/12/7	CHAUFFEUR	2009/7/1
606216L	Ibrahima	KONE	1971/5/30	ELECTRICIEN	2009/7/1
606246P	Moustapha	LO	1979/2/7	MAST. HYDROLO. HYDROCH.ENVIRONNEMENT	2010/10/16
606262/F	Awa	SARR	1978/12/3	ING.EQUI.RURAL	2011/7/1
606283/A	Landing	GOUDIABY	1966/11/23	CHAUFFEUR	2012/7/1
606303/U	Ndèye Aîssatou	DIEYE	1968/9/24	SECRETAIRE	2013/1/1
606311/C	Rabiétou	DIOUF	1989/7/4	ASSISTANTE ADMINISTRA.	2013/1/1
606322/N	Seydou	GAYE	1986/2/11	INGENIEUR GENIE RURAL	2013/5/1
606351/Q	Aminata	SANGARE	1984/2/6	DEA GEO/OP.ECOSYS.ENV.	2014/4/1
606364/D	Abdoul Aziz	CISSE	1969/3/31	AIDE- LABORANTIN	2014/12/1
606374/N	Bouna	DIOP	1977/9/13	MASTER A.D.RE.LO.URB.	2015/7/1
606387/A	Thierno Mamadou	GUEYE	1988/10/13	ING.CONCEPTION/G.ELECTRO.	2015/11/1
606409/W	Ababacar Sedikh	SECK	1973/7/15	CHAUFFEUR	2017/3/1
606410/X	Thierno Sadou	SOW	1989/8/11	ING. GENIE CIVIL ET HYDRAU.	2017/5/1
606411/Y	Ousmane	THIAM	1989/2/15	ING. GENIE CIVIL	2017/6/1
606418/F	Thierno Mountaga	NDIAYE	1992/8/16	ING. GENIE CIVIL ET HYDRAU.	2017/7/1
606419/G	Mame Mbagnick	NDIAYE	1986/4/26	LICENCE G.INFORMA.EAU ENV	2017/8/1
TOTAL	**22**				
5. DIRECTION AUTONOME DE LA MAINTENANCE DES INFRASTRUCTURES HYDROAGRICOLES (DAM)					
606029K	Mbaye	NIASS	1965/3/7	ING.R AGRO AMENAGISTE	1989/12/1
606094W	Cheikh Sidatty	GUEYE	1965/7/29	MAITRISE SC. NAT.	2000/1/1
606196R	Mbagnick	SECK	1977/1/17	CHAUFFEUR-MECANICIEN	2009/1/2
606215K	Macodou	DIENG	1969/1/10	AIDE ELECTRICIEN	2009/7/1
606217M	Makhtar	WADE	1965/4/30	AIDE ELECTRICIEN	2009/7/1
606219O	Amadou	FALL	1966/6/22	PLANTON	2009/7/1
606220P	Djiby	DEMBELE	1962/5/23	AIDE MAGASINIER	2009/7/1
606234D	Bernard	PASSOU	1975/3/10	TECH. SUP. ELECTRI.	2010/4/1
606245O	Papa Saër	DIOP	1974/1/3	TECH.SUP. GESTION ENTREPRISES	2010/8/1
606267/K	Djibril Abdoulaye	DIALLO	1984/9/26	ING.G.ELECTROM.	2011/10/1
606269/M	Aminata	SY	1986/6/16	DUT GEN.ELECTROM	2011/11/1
606273/Q	Mouhamadou M.	GAYE	1980/1/12	LICENCE P.TECH F. C.	2012/1/2
606276/T	Ibra	NIANG	1982/1/20	MASTER ING EAU ENV.	2012/2/1
606287/E	Laobé	DIAGNE	1973/4/2	TECH. INFORMA.	2012/7/1
606302/T	Mouhamadou	GUEYE	1972/9/24	AGT ADMINISTRATIF	2012/12/17
606317/I	El Hadji Mamadou S.	BA	1981/1/20	CHAUFFEUR	2013/3/1
606318/J	Oumar	KANE	1962/12/29	CHAUFFEUR	2013/3/1
606320/L	Malal Bocar	KAMARA	1987/6/9	TEC.SUP.GENIE MECANIQUE	2013/4/1
606321/M	Mohamadou Kalfa	NDIAYE	1977/3/23	TECH.SUP. G. MECA.	2013/4/1
606323/O	Abdoulaye Dione	DIOUF	1986/7/16	ING.AGRO/S.GENIE R.	2013/5/1
606332/X	Thiombane	SOW	1989/6/18	SECRETAIRE	2013/10/1
606352/R	Ousmane	BADJI	1982/11/2	TECH.MAINTE.INDUS.	2014/5/1
606358/X	Malick	KANTEYE	1986/6/16	LICENCE PRO.COMP.GESTION	2014/8/1
606382/V	Bakary Djiley	DIALLO	1979/4/20	T.S.ELECTROMECANI.	2015/10/1
606383/W	Mbaye	DIOUF	1989/2/4	T.S.ELECTROMECANI.	2015/10/1
606401/O	Ibrahima	TOURE	1981/12/31	AGENT ADMINISTRA.	2016/10/1
606402/P	Malamine	SARR	1990/1/1	TECH.FACTURA.REC.	2016/11/1
606404/R	Soukeyna	FAYE	1979/2/10	T.S.SECRETARIAT	2016/11/1
606429/Q	Papa Abdoulaye	DIOKH	1991/3/18	BEP MECANI.AUTO.	2018/7/1
606430/R	Oumar	DIOP	1989/8/10	BAC T1 FABRI.MECA.	2018/7/1
606431/S	Alassane Amadou	DIALLO	1993/7/23	BACCALAUREAT	2018/9/1
606437/Y	Mohamet	BALDE		CAP ELECTRICITE	2018/11/1
TOTAL	**32**				

Source: SAED

Table B2.2.2 List of registered staff (SAED Dagana Delegation）

N° MAT	PRENOM	NOM	D NAISS	QUALIFICATION	D ENTR
606055K	Mbasla	THIAM	1967/2/19	CONS. PROM. FEMININE	1995/7/1
606056L	Aminata	LY	1962/10/28	CONS. PROM. FEMININE	1995/7/1
606102E	Anta Gaye	TALLA	1962/9/21	CONS. PROM. FEMININE	2000/4/1
606105/H	Baïdy	BA	1962/6/15	ING- TRAVAUX AGRICOLES	2000/6/1
606113P	Absatou	SECK	1976/11/27	TECHNICIEN SUP GR	2001/3/1
606114Q	Ababacar Sadikh B	KANE	1972/9/4	ING- TRAVAUX AGRICOLES	2001/3/1
606121X	Alassane	BA	1964/11/14	INGENIEUR AGRONOME	2001/3/1
606143T	Mansour	CISSE	1969/8/20	ING- TRAV. AGRICOLES	2003/6/1
606154E	Ibrahima	DIAGNE	1961/12/31	TECHNICIEN HORTICOLE	2006/7/1
606157H	Fatoumata	DANFA	1969/9/21	CONS. PROM. FEMININE	2006/8/1
606183H	Papa Saér	DIOP	1981/1/20	CHAUFFEUR	2008/7/1
606184I	Waly	HANNE	1975/1/17	CHAUFFEUR	2008/7/1
606190/L	Moustapha	GUEYE	1970/4/23	CHAUFFEUR MECANICIEN	2008/7/1
606200V	Sérigne Ab. Aziz	FAYE	1980/11/9	TECHNICIEN SUP GR	2009/1/1
606204Z	Harouna	DRAME	1980/12/14	ING- TRAV. AGRICOLES	2009/1/1
606205A	Aliou	NDIAYE	1976/4/10	ING- TRAVAUX AGRICOLES	2009/1/1
606221Q	Papa	NDIAYE	1974/4/28	ING- TRAVAUX AGRICOLES	2009/5/1
606225U	Idrissa	DIACK	1981/8/21	ING- TRAVAUX AGRICOLES	2010/3/1
606227W	Bassirou	NDIAYE	1983/2/8	ING- TRAVAUX AGRICOLES	2010/3/1
606228X	Ndiaga	NDIAYE	1975/5/30	ING- TRAVAUX AGRICOLES	2010/3/1
606230Z	Lamine	SANE	1975/3/10	ING- TRAVAUX AGRICOLES	2010/3/1
606247/Q	Fallou	DIENG	1982/10/12	INGENIEUR AGRONOME/S.GR	2010/11/1
606248R	Awa Ndoye	NIAKH	1981/1/6	INGENIEUR AGRONOME	2010/9/1
606258/B	Ahmadou Lamine	SALL	1979/10/19	ING.TRAV.AGRI.	2011/5/1
606259/C	Ousseynou	TALL	1976/7/12	ING.TRAV.AGRI.	2011/5/1
606261/E	El Hadji Iba	BOYE	1979/7/12	DEA AN.ECO.QUA.	2011/6/1
606266/J	Abdoulaye	FAYE	1977/12/3	ING.TRAV.AGRI.	2011/9/1
606280/X	Mamadou	SOW	1985/1/21	ING.TRAV.AGRI.	2012/6/1
606290/H	Idrissa Ndiaye	DIEYE	1975/7/30	ING.TRAV.AGRI.	2012/7/1
606296/N	Seydou	BA	1979/9/12	MASTER 2 PRO. ECO.RURALE	2012/9/1
606325/Q	Youssou	NIANG	1972/9/20	INGENIEUR DES TRAV.AGRI	2013/8/1
606338/D	Al Hadji	KOUTA	1976/1/11	INGENIEUR DES TRAV.AGRI	2014/4/1
606339/E	Cheikh M. Fadel	DIAGNE	1985/7/24	INGENIEUR DES TRAV.AGRI	2014/4/1
606368/H	Bougouma	KA	1986/10/10	AGENT ADMINISTRATIF	2015/1/1
606372/L	Salif	KA	1980/8/18	SOCIOLOGUE	2015/5/1
606378/R	Mbenda	FALL	1976/9/9	ING.TRAV.AMEN.TERRITOIRE	2015/7/1
606393/G	Mouhamadou M.	DEM	1982/1/8	MASTER 2 PRO. ECO. RURALE	2016/6/1
606414/B	Ndongo	LOUM	1971/5/19	MAITISE G. D'ENTRE.AGRI	2017/6/1
606426/N	Famata	NIANG	10/01/1086	D.F.F.EC.ATE.AGRICUL.	2018/3/1
606408/P	Amath	SY	1989/1/15	ING.TRAV.AGRICOLES	2018/7/1
TOTAL	**40**				

Source: SAED

Table B2.2.3 List of registered staff (SAED Podor Delegation）

N° MAT	PRENOM	NOM	D NAISS	QUALIFICATION	D ENTR
606063R	Mariame	DIOP	1963/12/31	CONS. PROM. FEMININE	1995/7/1
606071Z	Ibrahima	BA	1964/2/11	ING- TRAVAUX AGRICOLES	1996/1/2
606100C	Pape Ousmane	DIOP	1962/3/10	CONSEILLER AGRICOLE	2000/4/1
606103J	Aissata Cire	WONE	1964/7/18	CONS. PROM. FEMININE	2000/4/1
606111N	Amadou Tidiane	MBAYE	1967/8/10	INGENIEUR GENIE RURAL	2001/3/1
606112O	Assane	DIARRA	1971/8/28	ING.TRAV.AGRI.	2001/3/1
606118U	Modou	NDIONE	1976/4/6	TECHNICIEN HORTICOLE	2001/9/1
606120W	Ameth Fary	DIATTA	1974/9/1	AGENT TECH. D'AGRICULTURE	2001/3/1
606126C	Babacar	SOW	1959/9/7	ING TRAVAUX AGRICOLES	2001/3/1
606144U	Abdoul Baila	DIALLO	1974/10/1	AGT TECH. D'AGRICULTURE	2003/6/1
606164O	Khassim Malick	SARR	1981/3/4	ING AGRO ECONOMISTE	2007/5/1
606185J	Mohamed Lamine	NDIAYE	1975/12/25	CHAUFFEUR	2008/7/1
606186H	Coumba	SY	1968/10/11	SECRETAIRE	2008/7/1
606187I	Suzanne Angèle	AMAH	1969/7/5	SECRETAIRE	2008/7/1
606198T	Aissata	BA	1972/10/30	CONS. PROM. FEMININE	2009/1/2
606201W	Aboubakry	LY	1983/8/14	TECHNICIEN SUP GR	2009/1/1
606206B	Alpha Baba	SALL	1980/7/27	ING- TRAVAUX AGRICOLES	2009/1/1
606210F	Amadou	DIALLO	1975/10/6	ING- TRAVAUX AGRICOLES	2009/4/1
606211G	Ibrahima	DIAW	1977/1/3	AGENT TECH. D'AGRICULTURE	2009/4/1
606223S	Abdoul Rahmane	SOW	1976/11/8	DEUG/INF.GESTION	2009/11/1
606226V	Mamadou Malick	DIALLO	1985/1/1	ING- TRAVAUX AGRICOLES	2010/3/1
606229Y	Alassane Ibrahima	SALL	1974/1/3	ING- TRAVAUX AGRICOLES	2010/3/1
606242L	Ibrahima	CAMARA	1976/1/2	LICENCE PRO.GESTION	2010/7/1
606244N	EL Hadji Koïmyle	FALL	1979/11/17	COMPTABLE	2010/7/1
606265/I	El Hadji	MAR	1981/7/30	ING.AGRO SP. G.RURAL	2011/8/11
606286/D	Oumar Amadou	BA	1966/5/18	CHAUFFEUR	2012/7/1
606288/F	Amadou	SY	1971/3/6	CHAUFFEUR	2012/7/1
606319/K	Idrissa Guiro	SENE	1969/4/8	AGENT ADMINISTRATIF	2013/3/1
606345/K	Abdoulaye	SOW	1989/2/3	INGENIEUR DES TRAV.AGRI	2014/4/1
606346/L	Ibou	NDIAYE	1986/1/1	INGENIEUR DES TRAV.AGRI	2014/4/1
606347/M	Matar	DIOP	1989/10/16	INGENIEUR DES TRAV.AGRI	2014/4/1
606348/N	Samba	WANDIANGA	1985/2/21	INGENIEUR DES TRAV.AGRI	2014/4/1
606371/K	Ibrahima	DIA	1981/10/1	MAÎTRISE EN GEOGRAPHIE	2015/5/1
606377/Q	Mohamadou Lamine	BA	1979/1/3	TECHNICIEN HORTICOLE	2015/6/1
606379/S	Ahmadou Ibrahima	THIAM	1979/4/11	LICENCE MANAGEMENT ENV	2015/8/1
606386/Z	Penda	BA	1966/7/5	SECRETAIRE	2015/11/1
606397/K	Abdoul	DIA	1960/5/26	PLANTON	2016/7/1
606403/Q	Cherif Mouha. El M	FALL	1990/9/22	D.ING CONCEP EN GEOTECHNI.	2016/11/1
606406/T	Hassamiou	SANGHOTT	1964/3/15	ING.TRAV.AGRICOLES	2017/2/1
606408/V	Babacar	DIENG	1976/2/13	CHAUFFEUR	2017/3/1
606416/D	Aboubacry	GAYE	1988/10/3	INGENIEUR DES TRAV.AGRI	2017/6/1
606417/E	Thierno	NGAMB	1989/9/22	MASTER I SCES TECH/SECU ALI.	2017/6/1
606433/U	Amadou	KANE N°1	1993/7/9	M.G.DURABLE TERRES	2018/9/1
TOTAL	**43**				

Source: SAED

Table B3.3.1 SUMMARY OF QUESTIONNAIRE SURVEY RESULTS

(44 Schemes in Dagana Delegation)

Sector	No	Name of Scheme	Construct in year	Irrigation Area (ha)		Farmer nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		Ware-house	Required Farm Machine (nos)		
				Potential	Irrigated		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Rehab. Length	Total Length	Rehab./ New		Tractor	Combine Hervester	Thresher
Lower Delta	1	PIV Djebemdou	1985	720	300	540	2,000	O	10.00	9.00	?	?	9.00	9.00	?	2		
	2	Amenagement Ngao	1980	49	137	11	?	O	4.50	2.00	0.50	0.50	0.70	0.70	O		1	
	3	PIV Mberaye	2001	30	26	26	GIS	X	?	?	?	?	?	?	O	1	1	
	4	PIV de Taaba	2008	50	45	74	GIS	O	?	?	?	?	?	?	O	1		
	5	PIV Treiz Peulh	2000	***30***	30	30	GIS	X	1.20	1.20	0.40	0.40	?	?	O			
	6	Ndiawdoune	1987	206	20	20	?	O	?	?	?	?	?	?	O	1	1	
	7	Union Savagne Biggeehe	1979	168	132	240	1,260	O	6.00	6.00	2.50	2.00	6.00	6.00	?			
	8	Union Lampsar	2018	155	105	220	760	O	0.80	0.80	2.00	1.50	5.00	5.00	?			
	9	PIV Debit Tiguet 1	1989	210	50	?	500	O	1.50	1.50	?	1.00	4.00	4.00	?			
	10	PIV DT2 Village Diadiam 2	1980	800	300	410	1,500	O	6.00	0.00	0.00	6.00	4.00	4.00	O	2		
	11	GIE Khar yalla de Hgome	2008	6	3	198	?	X	1.50	1.50	1.00	1.00	2.00	2.00	O			1
	12	GIE Borom Daradji de Ndiate	2008	6	6	222	?	X	?	?	1.00	1.00	2.00	2.00	?			
	13	GIE Takku And Liguey de Ndelle	?	5	?	61	?	?	?	?	?	?	?	?	?			1
	14	Union de Thilene	1979	35	25	20	?	O	?	?	?	?	3.00	3.00	?			
	15	Foyer des GIE Savoigne Peulh	1990	100	14	100	?	?	?	?	?	?	6.00	6.00	O	1	1	
	16	Union de Ndelle	(New)	100	?	95	?	?	?	?	?	?	15.00	15.00	O	1	1	1
	17	Union de Pont Gendarme	?	300	272	350	?	O	?	?	?	?	20.00	20.00	O	1	1	5
	18	PIV Diadiam	?	180	?	80	?	?	?	?	?	?	18.00	18.00	O	1	1	
	19	Amenagement Union Ndiaye	?	45	?	40	?	?	?	?	?	?	10.00	10.00	O	1		10
	20	And Liguey de Mbeurbeuf	?	275	30	196	?	?	?	?	?	?	3.00	3.00	O	1	1	
	21	PIV Gueum Yalla	1980	65	50	40	?	?	?	?	?	?	2.00	2.00	O	1	1	
	22	PIV Bok Xalat	2015	25	10	30	?	?	?	?	?	?	1.00	1.00	O	1	1	
	23	PIV Thianthiou Penda	?	30	20	42	?	?	?	?	?	?	1.00	1.00	O	1	1	
	24	PIV Polo 4	(New)	121	?	54	?	?	?	?	?	?	3.00	3.00	O	1	1	
Delta Central	25	Kassack Sud	1976	497	450	635	5,328 2,239	O	2.00	2.00	2.00	2.00	5.00	5.00	O	1	1	1
	26	Kassack Nord	1990	346	346	511	2,196	O	5.00	5.00	12.00	6.00	16.00	16.00	O	1	1	1
	27	Refection et extension damenagement	?	?	?	?	?	?	?	?	?	?	5.00	5.00	O	1	1	
	28	Kassack Lampsar	2010	1,000	1,200	1,028	?	?	20.00	16.00	10.00	10.00	25.00	25.00	O	2		
OPB	29	PIV GIE Book Jef	1991	45	37	325	?	?	1.50	1.50	2.00	2.00	?	?	?	1	1	

Table B3.3.1 SUMMARY OF QUESTIONNAIRE SURVEY RESULTS

(44 Schemes in Dagana Delegation)

Sector	No	Name of Scheme	Construct in year	Irrigation Area (ha)		Farmer nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		Ware-house	Required Farm Machine (nos)		
				Potential	Irrigated		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Rehab. Length	Total Length	Rehab./ New		Tractor	Combine Hervester	Thresher
Upper Delta	30	Mbagan	1965	650	510	1,200	1,800	O	61.22	61.22	8.32	5.00	3.00	3.00	O	1	1	
	31	Rosso	1985	250	200	300	684 540 540	O	28.17	?	0.00	?	?	?	O		1	1
	32	GIE Worbe	1985	46	42	108	800	O	6.86	0.00	0.00	1.00	2.50	0.00	O	1		
	33	PIV Mbolom Diam	1990	250	225	210	900	O	7.00	7.00	?	?	10.00	10.00	O		1	
	34	Foyer 1 Deggo Bokk Diom 2	1982	127	70	183	1,600	O	12.60	12.60	?	?	?	?	O	1		
	35	Foyer 1 Deggo Bokk Diom 1	1982	99	80	200	1,500	O	1.80	1.80	?	?	?	?	?	1		
	36	PIV Thiagar	2004	200	92	109	?	X	20.20	20.20	?	?	?	?	?	1		
Dagana	37	Union de SV	?	300	200	681	2,052	O	8.00	8.00	30.00	30.00	80.00	80.00	O	2		
	38	Keur Nbaye	1980	147	147	449	700	?	20.00	20.00	10.00	10.00	5.00	5.00	O			
	39	Union des Producteur S SP3	2000	650	500	?	1,674	O	16.00	16.00	18.00	18.00	80.00	80.00	O	4		
	40	SV de Lagde	1974	60	44	76	?	X	10.00	6.00	5.00	0.00	?	?	?			
	41	Mbilor	1993	204	140	273	300	?	9.00	9.00	9.00	9.00	7.00	7.00	O			
	42	Union Dagana A	1974	860	600	380	?	X	5.00	5.00	10.00	10.00	10.00	10.00	O			
	43	Section Villageois de le zone de Guidakhar	1980	152	152	431	700	O	4.00	4.00	15.00	15.00	5.00	5.00	O			1
	44	Section Villageois de le zone de Hare	1980	30	30	47	300	O	2.00	2.00	?	?	5.00	5.00	O			2
Total				9,623	6,639	10,245			271.85	219.32	138.72	131.40	373.20	370.70	33	34	19	24

GIS: Gravity Irrigation Scheme O: Need Rehabilitation/Construction X: No Rehabilitation/Construction ?: No Data

Source: JICA Survey Team

Table B3.3.1 SUMMARY OF QUESTIONNAIRE SURVEY RESULTS

(77 Schemes in Podor Delegation)

Sector	No	Name of Scheme	Construct in Year	Irrigation Area (ha)		Farmer nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		Ware-house	Required Farm Machine (nos)		
				Potential	Irrigated		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Rehab. Length	Total Length	Rehab./ New		Tractor	Combine Hervester	Thresher
Guede	1	PIV Laboudou Offadec	1983	110	96	176	400	?	?	?	Non	?	?	?	O	1	1	2
	2	PIV Lewone Donde Mayo	2004	80	25	?	?	O	2.50	?	Non	?	?	?	?			
	3	Goosse 1	1990	***20***	20	60	300	O	2.60	?	Non	?	?	?	O	1		2
	4	Goosse 2	1990	30	20	73	400	O	2.30	2.30	?	?	2.50	2.50	O			
	5	PIV Beckweek	1986	20	15	35	200	O	2.10	?	?	?	?	?	?			2
	6	Kolondel	1990	38	30	?	400	O	2.75	2.75	Non	?	?	?	?			
	7	Fmille Omar Younoura	1991	20	12	60	300	O	0.70	0.70	Non	?	1.00	1.00	?			
	8	Toguel Belel	1993	50	15	40	1,400	O	2.30	2.30	0.40	0.40	?	?	?			
	9	Birasse Soubalbe	1990	40	28	60	300	O	2.50	?	0.00	?	?	?	?			
	10	Kolko N2	2004	200	13	160	300	O	1.50	?	0.00	?	?	?	?			
	11	Cuvette Guede Chantier	1994	595	250	1,675	3,600	X	4.00	4.00	?	?	1.50	1.50	O	2	1	
Doue	12	Sinthion Amadou Marian	1987	30	25	102	200	X	3.00	3.00	0.00	0.00	?	?	?			2
	13	Ganguel	(New)	15	?	95	300	?	?	?	?	?	?	?	?			1
	14	Galoya	(New)	15	?	?	200	?	?	?	?	?	?	?	?			
	15	Dougon	1987	32	17	97	200	X	2.00	2.00	0.00	0.00	?	?	?			2
	16	Galoya	2014	15	0	4	100	O	2.00	2.00	0.00	0.00	?	?	O			1
	17	Medina Torobe 1	1986	35	20	102	?	O	3.75	3.75	1.57	1.57	8.00	8.00	O	1		7
	18	Medina Torobe 2	1986	24	23	87	?	O	3.80	3.80	0.75	0.75	12.00	12.00	O	1		5
	19	Soubala Madina	1986	24	20	80	?	?	2.50	2.50	0.80	0.80	5.00	5.00	O	1		1
	20	PIV Garba Liboube	1976	40	15	?	?	?	?	?	?	?	13.00	13.00	O	1		4
	21	PIV Diarra	1984	50	?	897	?	O	?	?	?	?	13.00	13.00	O	1		3
	22	GIE Gamadji 1	1978	28	20	18	?	O	?	?	?	?	1.40	1.40	O	1		2
	23	GIE Gamadji 2	1978	27	27	105	?	O	4.00	3.00	0.00	?	1.40	1.40	O	1		3
	24	GIE Gamadji 3	1974	22	16	23	?	O	0.06	0.03	0.00	?	1.40	1.40	O	1		2
	25	Cuvette Aere Lao Phase 1	1994	500	370	673	?	X	3.00	2.00	2.50	2.00	5.00	5.00	O	1	1	8
	26	Guvette Aere Lao Phase 2	1996	1,005	750	1,172	2,800	?	3.90	2.00	2.00	0.90	7.00	7.00	O	2		
	27	PIV Kogga 2	1978	40	28	168	?	X	1.00	1.00	Non	?	0.60	0.60	O	1		1
	28	PIV Kogga 1 et 2	1987	70	26	202	?	X	?	?	?	?	4.00	4.00	O	1		3
	29	PIV Dounga Lao 1 et 2	1997	60	50	173	?	X	4.00	4.00	?	?	6.00	6.00	O	1		4
	30	PIV AS SALAM Mama Aw	2000	23	15	169	?	X	1.30	1.00	?	0.90	7.00	7.00	O	1		
	31	PIV Wande	1979	50	43	98	?	X	1.80	1.30	Non	?	3.00	3.00	O			2
	32	GIE Dodel 3	1984	22	18	22	?	?	1.00	0.50	?	?	1.50	1.50	O			
	33	GIE Dodel 2	1984	30	24	189	?	O	1.30	0.40	?	?	1.50	1.50	O			
	34	GIE Dodel 1	1984	28	22	156	200	O	1.20	0.90	?	?	1.50	1.50	O	1	1	
	35	GIE Dewbe 1	1981	26	18	73	200	O	?	0.40	?	?	11.00	11.00	O			2

Table B3.3.1 SUMMARY OF QUESTIONNAIRE SURVEY RESULTS

(77 Schemes in Podor Delegation)

Sector	No	Name of Scheme	Construct in Year	Irrigation Area (ha)		Farmer nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		Ware-house	Required Farm Machine (nos)		
				Potential	Irrigated		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Rehab. Length	Total Length	Rehab./ New		Tractor	Combine Hervester	Thresher
	36	GIE Garbo Lidoube 2	2012	28	28	200	?	O	?	?	?	?	11.00	11.00	O			
	37	PIV Thialma	2010	42	30	98	?	O	1.00	0.80	?	?	1.50	1.50	O			3
	38	PIV Diawel 2	1983	21	?	204	?	O	1.10	0.70	?	?	?	?	O			2
	39	PIV Diawel 1	1996	14	?	64	?	O	?	?	?	?	7.50	7.50	O			2
	40	Fine Dewbe Bocar DIOP Nianga Edy	2015	19	14	44	?	O	0.06	0.04	?	?	16.00	16.00	O	1		1
	41	GIE Dewbe 2	2014	18	13	55	200	?	0.50	0.15	?	?	5.00	5.00	O			2
	42	Nianga Edy PIV 1	1989	21	17	38	?	?	?	?	?	?	6.00	6.00	O	1		2
	43	Union Wodos	2003	500	305	947	?	O	20.00	20.00	15.00	15.00	2.00	2.00	O	1		
	44	Union Yirlabe	2002	113	110	600	?	O	15.00	15.00	12.00	?	?	?		1		10
3,027	45	Nanodiral Golere	1998	40	40	140	?	X	?	?	Non	?	1.00	1.00	O	1		1
Ngallenka	46	Union Ngora Fanaye (SP1)	2000	1,500	1,000	1,880	4,652	O	16.00	16.00	?	?	?	?	O	2		2
		Thiangaye														6	1	15
	47	Dimarh 4	1983	34	15	45	?	O	0.80	0.00	?	?	18.00	18.00	X			
	48	Dimarh 5	1983	32	23	49	?	O	3.00	3.00	?	?	18.00	18.00	O			
	49	Dimarh 6	1982	61	35	60	?	O	4.00	2.00	?	?	?	?	X			
	50	Dimarh 7	1983	45	45	40	?	O	3.00	3.00	?	?	?	?	X			
	51	Dimarh 8	1982	22	17	44	?	O	0.90	0.50	?	0.30	18.00	18.00	X			
	52	Dimarh 9	1982	35	30	44	?	O	1.60	1.00	?	0.80	?	?	X			
	53	PIV Kakabe	2005	25	20	79	?	O	1.20	1.20	0.80	0.80	2.50	2.50	O	1		1
	54	Diarnguel	?	27	24	89	?	O	1.00	1.00	0.00	0.00	0.00	0.00	O	1		1
	55	Diaynga Soubalo	1977	50	45	161	?	O	1.20	1.20	0.60	0.60	1.50	1.50	O	1		1
	56	Kogga Boyndou	1989	25	20	200	?	O	1.11	1.11	0.00	0.00	2.00	0.00	O	1		
	57	Kogga 3	?	30	18	148	?	X	1.50	1.50	0.00	0.00	0.00	0.00	O	1		
	58	Sabil 2	1986	30	20	136	400	X	1.50	1.00	?	?	?	?	?			
	59	Ndiawar 23	1985	30	25	120	400	O	0.30	0.20	?	?	?	?	?			
	60	5 D Decolhe	1999	32	18	79	?	O	1.00	0.80	0.05	0.05	?	?	?			
	61	6 C Sawonabe	1999	29	19	50	60	O	1.00	0.50	0.50	0.50	?	?	?			
	62	1 D Ngendar	2001	35	35	80	80	O	3.00	3.00	2.00	0.50	?	?	?			
	63	ABRAS	2016	25	15	30	100	O	2.00	1.00	0.60	0.30	?	?	?			
	64	GIE Fanaye 1	1984	30	25	41	300	O	4.00	4.00	?	?	?	?	?			
	65	GIE Fanaye 2	1984	30	30	40	300	O	5.00	5.00	?	?	?	?	?			
	66	GIE Fanaye 3	1984	50	50	50	?	X	3.00	3.00	?	?	?	?	?			
	67	GIE Fanaye 4	1984	30	30	41	300	O	5.00	4.00	?	?	?	?	?			
	68	GIE Fanaye 5	1984	40	30	41	300	O	5.00	5.00	?	?	?	?	?			

Table B3.3.1 SUMMARY OF QUESTIONNAIRE SURVEY RESULTS

(77 Schemes in Podor Delegation)

Sector	No	Name of Scheme	Construct in Year	Irrigation Area (ha)		Farmer nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		Ware-house	Required Farm Machine (nos)		
				Potential	Irrigated		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Rehab. Length	Total Length	Rehab./ New		Tractor	Combine Hervester	Thresher
	69	GIE Fanaye 6	1984	30	30	42	100	O	4.00	4.00	?	?	?	?	?			
	70	GIE Fanaye 7	1984	30	30	40	300	O	6.00	5.00	?	?	?	?	?			
	71	GIE Fanaye 8	1984	30	30	44	300	O	5.00	5.00	?	?	?	?	?			
	72	GIE Thiathioum 1 Fanaye	1984	35	25	47	200	O	4.00	4.00	?	?	?	?	?			
	73	GIE Thiouding	1984	68	33	112	?	X	?	4.00	?	?	?	?	?			
	74	Ndiawara	2012	351	0	889	?	X	10.00	0.00	10.00	0.00	5.00	5.00	X			
	75	PIV Ndiawara2	?	12	12	100	300	X	1.00	1.00	0.00	0.00	1.00	1.00	X			
2,832	76	14 Donaye	2001	29	20	511	250	O	1.00	1.00	?	?	1.00	1.00	X			
ile a Morphil	77	Wassetake-Torobe	1986	80	24	400	700	X	3.00	3.00	?	?	?	?	X			
Total				7,142	4,421	15,166			200.63	168.33	49.57	26.17	225.30	223.30	40	38	5	102

O: Need Rehabilitation/Construction X: No Rehabilitation/Construction ?: No Data

Source: JICA Survey Team

Table B3.4.1 LONG LIST OF CANDIDATE SUB-PROJECTS
DAGANA DELEGATION

Sector	No	Name of Scheme	Construct in year	Irrigation Area (ha)			Farmers Nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		PHF Required
				Potential	Irrigated	(%)		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Improv. Length	Total Length	Improv. Length	
Lower Delta	1	PIV Djebemdou	1985	720	300	41.7%	540	2,000	O	10.00	9.00	(13.68)	(13.68)	9.00	9.00	X
	2	Amenagement Ngao	1980	49	137	279.6%	11	(490)	O	4.50	2.00	0.50	0.50	0.70	0.70	O
	3	PIV Mberaye	2001	30	26	86.7%	26	***GIS***	X	(1.02)	(1.02)	(0.57)	(0.57)	(0.66)	(0.66)	O
	4	PIV de Taaba	2008	50	45	90.0%	74	***GIS***	X	(1.70)	(1.70)	(0.95)	(0.95)	(1.10)	(1.10)	O
	5	PIV Treiz Peulh	2000	***30***	30	100.0%	30	***GIS***	X	1.20	1.20	0.40	0.40	(0.66)	(0.66)	O
	6	Ndiawdoune	1987	206	20	9.7%	20	(2,060)	O	(7.00)	(7.00)	(3.91)	(3.91)	(4.53)	(4.53)	O
	7	Union Savagne Biggeehe	1979	168	132	78.6%	240	1,260	O	6.00	6.00	2.50	2.00	6.00	6.00	X
	8	Union Lampsar	2018	155	105	67.7%	220	760	O	0.80	0.80	2.00	1.50	5.00	5.00	X
	9	PIV Debit Tiguet 1	1989	210	50	23.8%	?	500	O	1.50	1.50	(1.00)	1.00	4.00	4.00	X
	10	PIV DT2 Village Diadiam 2	1980	800	300	37.5%	410	1,500	O	6.00	0.00	0.00	6.00	4.00	4.00	O
	11	GIE Khar yalla de Hgome	2008	6	3	45.0%	198	?	X	1.50	1.50	1.00	1.00	2.00	2.00	O
	12	GIE Borom Daradji de Ndiate	2008	6	6	100.0%	222	?	X	(0.19)	(0.19)	1.00	1.00	2.00	2.00	X
	13	GIE Takku And Liguey de Ndelle	?	5	?		61	?	?	(0.17)	(0.17)	(0.10)	(0.10)	(0.11)	(0.11)	X
	14	Union de Thilene	1979	35	25	71.4%	20	(350)	O	(1.19)	(1.19)	(0.67)	(0.67)	3.00	3.00	X
	15	Foyer des GIE Savoigne Peulh	1990	100	14	14.0%	100	?	?	(3.40)	(3.40)	(1.90)	(1.90)	6.00	6.00	O
	16	Union de Ndelle	***(New)***	100	?		95							***15.00***	15.00	O
	17	Union de Pont Gendarme	?	300	272	90.7%	350	(3,000)	O	(10.20)	(10.20)	(5.70)	(5.70)	***20.00***	20.00	O
	18	PIV Diadiam	?	180	?		80	?	?	(6.12)	(6.12)	(3.42)	(3.42)	***18.00***	18.00	O
	19	Amenagement Union Ndiaye	?	45	?		40	?	?	(1.53)	(1.53)	(0.86)	(0.86)	***10.00***	10.00	O
	20	And Liguey de Mbeurbeuf	?	275	30	10.9%	196	?	?	(9.35)	(9.35)	(5.23)	(5.23)	3.00	3.00	O
	21	PIV Gueum Yalla	1980	65	50	76.9%	40	?	?	(2.21)	(2.21)	(1.24)	(1.24)	2.00	2.00	O
	22	PIV Bok Xalat	2015	25	10	40.0%	30	?	?	(0.85)	(0.85)	(0.48)	(0.48)	1.00	1.00	O
	23	PIV Thianthiou Penda	?	30	20	66.7%	42	?	?	(1.02)	(1.02)	(0.57)	(0.57)	1.00	1.00	O
	24	PIV Polo 4	***(New)***	121	?		54	?	?	(4.11)	(4.11)	(2.30)	(2.30)	3.00	3.00	O
Delta Central	25	Kassack Sud	1976	497	450	90.5%	635	5,328 2,239	O	2.00	2.00	2.00	2.00	5.00	5.00	O
	26	Kassack Nord	1990	346	346	100.0%	511	2,196	O	5.00	5.00	12.00	6.00	16.00	16.00	O
	27	Refection et extension damenagement	?	?			?	?	?	?		?		5.00	5.00	O
	28	Kassack Lampsar	2010	1,000	1,200	120.0%	1,028	?	?	20.00	16.00	10.00	10.00	25.00	25.00	O
OPB	29	PIV GIE Book Jef	1991	45	37	82.2%	325	?	?	1.50	1.50	2.00	2.00	(0.99)		X

Table B3.4.1 LONG LIST OF CANDIDATE SUB-PROJECTS
DAGANA DELEGATION

Sector	No	Name of Scheme	Construct in year	Irrigation Area (ha)			Farmers Nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		PHF Required
				Potential	Irrigated	(%)		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Improv. Length	Total Length	Improv. Length	
Upper Delta	30	Mbagan	1965	650	510	78.5%	1,200	1,800	O	61.22	61.22	8.32	5.00	3.00	3.00	O
	31	Rosso	1985	250	200	80.0%	300	684 540 540	O	19.95	(19.95)	0.00		?		O
	32	GIE Worbe	1985	46	42	91.3%	108	800	O	6.86	0.00	0.00	1.00	2.50	X	O
	33	PIV Mbolom Diam	1990	250	225	90.0%	210	900	O	7.00	7.00	(4.75)	(4.75)	10.00	10.00	O
	34	Foyer 1 Deggo Bokk Diom 2	1982	127	70	55.1%	183	1,600	O	12.60	12.60	(2.41)	(2.41)	(2.79)	(2.79)	O
	35	Foyer 1 Deggo Bokk Diom 1	1982	99	80	80.8%	200	1,500	O	1.80	1.80	(1.88)	(1.88)	(2.18)	(2.18)	X
	36	PIV Thiagar	2004	200	92	46.0%	109	?	X	20.20	20.20	(3.80)	(3.80)	(4.40)	(4.40)	X
Dagana	37	Union de SV	?	300	200	66.7%	681	2,052	O	8.00	8.00	30.00	30.00	***80.00***	80.00	O
	38	Keur Nbaye	1980	147	147	100.0%	449	700	?	20.00	20.00	10.00	10.00	5.00	5.00	O
	39	Union des Producteur S SP3	2000	650	500	76.9%	?	1,674	O	16.00	16.00	18.00	18.00	***80.00***	80.00	O
	40	SV de Lagde	1974	60	44	73.3%	76	?	X	10.00	6.00	5.00	0.00	(1.32)	(1.32)	X
	41	Mbilor	1993	204	140	68.6%	273	300	?	9.00	9.00	9.00	9.00	7.00	7.00	O
	42	Union Dagana A	1974	860	600	69.8%	380	?	X	5.00	5.00	10.00	10.00	10.00	10.00	O
	43	Section Villageois de le zone de Guidakhar	1980	152	152	100.0%	431	700	O	4.00	4.00	15.00	15.00	5.00	5.00	O
	44	Section Villageois de le zone de Hare	1980	30	30	100.0%	47	300	O	2.00	2.00	(0.57)	(0.57)	5.00	5.00	O
Total				9,623	6,639	72.4%	10,245		21	313.70	289.34	194.68	186.37	391.94	388.45	33

GIS : Gravity Irrigation Scheme O: Need Rehabilitation/Construction X: No Rehabilitation/Construction ***80.00*** : Access Road

(490), (13.68): Estimated data ?: No Data

Source: JICA Survey Team

Table B3.4.1 LONG LIST OF CANDIDATE SUB-PROJECTS
PODOR DELEGATION

Sector	No	Name of Scheme	Construct in Year	Irrigation Area (ha)			Farmers Nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		PHF Required
				Potential	Irrigated	(%)		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Rehab. Length	Total Length	Improv. Length	
Guede	1	PIV Laboudou Offadec	1983	110	96	87.3%	176	400	X	3.52	(3.52)	(1.65)	(1.65)	(2.20)	(2.20)	O
	2	PIV Lewone Donde Mayo	2004	80	25	31.3%	?	(800)	O	2.50	(2.50)	(1.20)	(1.20)	(1.60)	(1.60)	X
	3	Goosse 1	1990	***20***	20	100.0%	60	300	O	2.60	(2.60)	(0.30)	(0.30)	(0.40)	(0.40)	O
	4	Goosse 2	1990	30	20	66.7%	73	400	O	2.30	2.30	(0.45)	(0.45)	2.50	2.50	O
	5	PIV Beckweek	1986	20	15	75.0%	35	200	O	2.10	(2.10)	(0.30)	(0.30)	(0.40)	(0.40)	X
	6	Kolondel	1990	38	30	78.9%	?	400	O	2.75	2.75	(0.57)	(0.57)	(0.76)	(0.76)	X
	7	Fmille Omar Younoura	1991	20	12	60.0%	60	300	O	0.70	0.70	(0.30)	(0.30)	1.00	1.00	X
	8	Toguel Belel	1993	50	15	30.0%	40	1,400	O	2.30	2.30	0.40	0.40	(1.00)	(1.00)	X
	9	Birasse Soubalbe	1990	40	28	70.0%	60	300	O	2.50	(2.50)	(0.60)	(0.60)	(0.80)	(0.80)	X
	10	Kolko N2	2004	200	13	6.5%	160	300	O	1.50	(1.50)	(3.00)	(3.00)	(4.00)	(4.00)	X
	11	Cuvette Guede Chantier	1994	595	250	42.0%	1,675	3,600	X	4.00	4.00	(8.93)	(8.93)	1.50	1.50	O
Doue	12	Sinthion Amadou Marian	1987	30	25	83.3%	102	200	X	3.00	3.00	0.00	0.00	(0.60)	(0.60)	X
	13	Ganguel	***(New)***	15			95	300								
	14	Galoya	***(New)***	15			?	200								
	15	Dougon	1987	32	17	53.1%	97	200	X	2.00	2.00	0.00	0.00	(0.64)	(0.64)	X
	16	Galoya	2014	15	0	0.0%	4	100	O	2.00	2.00	0.00	0.00	(0.30)	(0.30)	O
	17	Medina Torobe 1	1986	35	20	57.1%	102	(350)	O	3.75	3.75	1.57	1.57	***8.00***	8.00	O
	18	Medina Torobe 2	1986	24	23	93.8%	87	(240)	O	3.80	3.80	0.75	0.75	***12.00***	12.00	O
	19	Soubala Madina	1986	24	20	83.3%	80		X	2.50	2.50	0.80	0.80	***5.00***	5.00	O
	20	PIV Garba Liboube	1976	40	15	37.5%	?		X	1.28	(1.28)	(0.60)	(0.60)	***13.00***	13.00	O
	21	PIV Diarra	1984	50	?		897	(500)	O	1.60	(1.60)	(0.75)	(0.75)	***13.00***	13.00	O
	22	GIE Gamadji 1	1978	28	20	71.4%	18	(280)	O	0.90	(0.90)	(0.42)	(0.42)	1.40	1.40	O
	23	GIE Gamadji 2	1978	27	27	100.0%	105	(270)	O	4.00	3.00	(0.41)	(0.41)	1.40	1.40	O
	24	GIE Gamadji 3	1974	22	16	72.7%	23	(220)	O	0.06	0.03	(0.33)	(0.33)	1.40	1.40	O
	25	Cuvette Aere Lao Phase 1	1994	500	370	74.0%	673	?	X	3.00	2.00	2.50	2.00	5.00	5.00	O
	26	Guvette Aere Lao Phase 2	1996	1,005	750	74.6%	1,172	2,800	X	3.90	2.00	2.00	0.90	7.00	7.00	O
	27	PIV Kogga 2	1978	40	28	70.0%	168	?	X	1.00	1.00	(0.60)	(0.60)	0.60	0.60	O
	28	PIV Kogga 1 et 2	1987	70	26	37.1%	202	?	X	2.24	(2.24)	(1.05)	(1.05)	4.00	4.00	O
	29	PIV Dounga Lao 1 et 2	1997	60	50	83.3%	173	?	X	4.00	4.00	(0.90)	(0.90)	***6.00***	6.00	O
	30	PIV AS SALAM Mama Aw	2000	23	15	65.2%	169	?	X	1.30	1.00	(0.90)	0.90	***7.00***	7.00	O
	31	PIV Wande	1979	50	43	86.0%	98	?	X	1.80	1.30	(0.75)	(0.75)	3.00	3.00	O
	32	GIE Dodel 3	1984	22	18	81.8%	22		X	1.00	0.50	(0.33)	(0.33)	1.50	1.50	O
	33	GIE Dodel 2	1984	30	24	80.0%	189	(300)	O	1.30	0.40	(0.45)	(0.45)	1.50	1.50	O
	34	GIE Dodel 1	1984	28	22	78.6%	156	200	O	1.20	0.90	(0.42)	(0.42)	1.50	1.50	O

Table B3.4.1 LONG LIST OF CANDIDATE SUB-PROJECTS
PODOR DELEGATION

Sector	No	Name of Scheme	Construct in Year	Irrigation Area (ha)			Farmers Nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		PHF Required
				Potential	Irrigated	(%)		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Rehab. Length	Total Length	Improv. Length	
	35	GIE Dewbe 1	1981	26	18	69.2%	73	200	O	(0.40)	0.40	(0.39)	(0.39)	***11.00***	11.00	O
	36	GIE Garbo Lidoube 2	2012	28	28	100.0%	200	(280)	O	0.90	(0.90)	(0.42)	(0.42)	***11.00***	11.00	O
	37	PIV Thialma	2010	42	30	71.4%	98	(420)	O	1.00	0.80	(0.63)	(0.63)	1.50	1.50	O
	38	PIV Diawel 2	1983	21	?		204	(210)	O	1.10	0.70	(0.32)	(0.32)	(0.42)	(0.42)	O
	39	PIV Diawel 1	1996	14	?		64	(140)	O	0.45	(0.45)	(0.21)	(0.21)	7.50	7.50	O
	40	Fine Dewbe Bocar DIOP Nianga Edy	2015	19	14	73.7%	44	(190)	O	0.06	0.04	(0.29)	(0.29)	***16.00***	16.00	O
	41	GIE Dewbe 2	2014	18	13	72.2%	55	200	X	0.50	0.15	(0.27)	(0.27)	5.00	5.00	O
	42	Nianga Edy PIV 1	1989	21	17	81.0%	38		X	0.67	(0.67)	(0.32)	(0.32)	6.00	6.00	O
	43	Union Wodos	2003	500	305	61.0%	947	(5,000)	O	20.00	20.00	15.00	15.00	2.00	2.00	O
	44	Union Yirlabe	2002	113	110	97.3%	600	(1,130)	O	15.00	15.00	12.00	12.00	(2.26)	(2.26)	X
	45	Nanodiral Golere	1998	40	40	100.0%	140	?	X	1.28	(1.28)	(0.60)	(0.60)	1.00	1.00	O
Ngallenka	46	Union Ngora Fanaye (SP1)	2000	1,500	1,000	66.7%	1,880	4,652	O	16.00	16.00	(22.50)	(22.50)	(30.00)	(30.00)	O
		Thiangaye														
	47	Dimarh 4	1983	34	15	44.1%	45	(340)	O	0.80	0.00	(0.51)	(0.51)	***18.00***	18.00	X
	48	Dimarh 5	1983	32	23	71.9%	49	(320)	O	3.00	3.00	(0.48)	(0.48)	***18.00***	18.00	O
	49	Dimarh 6	1982	61	35	57.4%	60	(610)	O	4.00	2.00	(0.92)	(0.92)	(1.22)	(1.22)	X
	50	Dimarh 7	1983	45	45	100.0%	40	(450)	O	3.00	3.00	(0.68)	(0.68)	(0.90)	(0.90)	X
	51	Dimarh 8	1982	22	17	77.3%	44	(220)	O	0.90	0.50	(0.30)	0.30	***18.00***	18.00	X
	52	Dimarh 9	1982	35	30	85.7%	44	(350)	O	1.60	1.00	(0.80)	0.80	(0.70)	(0.70)	X
	53	PIV Kakabe	2005	25	20	80.0%	79	(250)	O	1.20	1.20	0.80	0.80	2.50	2.50	O
	54	Diarnguel	?	27	24	88.9%	89	(270)	O	1.00	1.00	0.00	0.00	0.00	0.00	O
	55	Diaynga Soubalo	1977	50	45	90.0%	161	(500)	O	1.20	1.20	0.60	0.60	1.50	1.50	O
	56	Kogga Boyndou	1989	25	20	80.0%	200	(250)	O	1.11	1.11	0.00	0.00	2.00	0.00	O
	57	Kogga 3	?	30	18	60.0%	148		X	1.50	1.50	0.00	0.00	0.00	0.00	O
	58	Sabil 2	1986	30	20	66.7%	136	400	X	1.50	1.00	(0.45)	(0.45)	(0.60)	(0.60)	X
	59	Ndiawar 23	1985	30	25	83.3%	120	400	O	0.30	0.20	(0.45)	(0.45)	(0.60)	(0.60)	X
	60	5 D Decolhe	1999	32	18	56.3%	79	(320)	O	1.00	0.80	0.05	0.05	(0.64)	(0.64)	X
	61	6 C Sawonabe	1999	29	19	65.5%	50	60	O	1.00	0.50	0.50	0.50	(0.58)	(0.58)	X
	62	1 D Ngendar	2001	35	35	100.0%	80	80	O	3.00	3.00	2.00	0.50	(0.70)	(0.70)	X
	63	ABRAS	2016	25	15	60.0%	30	100	O	2.00	1.00	0.60	0.30	(0.50)	(0.50)	X
	64	GIE Fanaye 1	1984	30	25	83.3%	41	300	O	4.00	4.00	(0.45)	(0.45)	(0.60)	(0.60)	X
	65	GIE Fanaye 2	1984	30	30	100.0%	40	300	O	5.00	5.00	(0.45)	(0.45)	(0.60)	(0.60)	X
	66	GIE Fanaye 3	1984	50	50	100.0%	50		X	3.00	3.00	(0.75)	(0.75)	(1.00)	(1.00)	X

Table B3.4.1 LONG LIST OF CANDIDATE SUB-PROJECTS
PODOR DELEGATION

Sector	No	Name of Scheme	Construct in Year	Irrigation Area (ha)			Farmers Nos.	Pump		Irr. Canal (km)		Drain Canal (km)		Road (km)		PHF Required
				Potential	Irrigated	(%)		Capacity (m3/hour)	Rehab.	Total Length	Rehab. Length	Total Length	Rehab. Length	Total Length	Improv. Length	
	67	GIE Fanaye 4	1984	30	30	100.0%	41	300	O	5.00	4.00	(0.45)	(0.45)	(0.60)	(0.60)	X
	68	GIE Fanaye 5	1984	40	30	75.0%	41	300	O	5.00	5.00	(0.60)	(0.60)	(0.80)	(0.80)	X
	69	GIE Fanaye 6	1984	30	30	100.0%	42	100	O	4.00	4.00	(0.45)	(0.45)	(0.60)	(0.60)	X
	70	GIE Fanaye 7	1984	30	30	100.0%	40	300	O	6.00	5.00	(0.45)	(0.45)	(0.60)	(0.60)	X
	71	GIE Fanaye 8	1984	30	30	100.0%	44	300	O	5.00	5.00	(0.45)	(0.45)	(0.60)	(0.60)	X
	72	GIE Thiathioum 1 Fanaye	1984	35	25	71.4%	47	200	O	4.00	4.00	(0.53)	(0.53)	(0.70)	(0.70)	X
	73	GIE Thiouding	1984	68	33	48.5%	112	?	X	(4.00)	4.00	(1.02)	(1.02)	(1.36)	(1.36)	X
	74	Ndiawara	2012	351	0	0.0%	889		X	10.00	0.00	10.00	0.00	5.00	0.00	X
	75	PIV Ndiawara2	?	12	12	100.0%	100	300	X	1.00	1.00	0.00	0.00	1.00	1.00	X
	76	14 Donaye	2001	29	20	69.0%	511	250	O	1.00	1.00	(0.44)	(0.44)	1.00	1.00	X
ile a Morphil	77	Wassetake-Torobe	1986	80	24	30.0%	400	700	X	3.00	3.00	(1.20)	(1.20)	(1.60)	(1.60)	X
Total				7,142	4,421	62.9%	15,166		51	217.86	192.36	112.52	99.12	286.18	279.18	40

O: Need Rehabilitation/Construction X: No Rehabilitation/Construction ***80.00*** : Access Road

(800), (3.52): Estimated data ?: No Data

Source: JICA Survey Team

Table B5.2.1 Present Production Cost for Dry Seaon Rice Crop

(Unit: FCFA)

	Quantity	Unit	Price		Amount
A. Gross Income					
1. Sales of Paddy					
Grain production (dry season)	6,300	kg/ha	(6,300 kg x 78%)		
Marketable surplus	4,830	kg/ha	125	per kg	604,000
(home consumption: 0.5 ha/family, 7 persons, @105 kg)					
B. Production Cost					
1. Land Preparation					
Labour	-	L.S.	40,000	per L.S.	0
Offset harrow (disc harrow)	1	times/ha	25,000	per time	25,000
Disk or mold plough	-	times/ha	90,000	per time	0
Manual maintenance (family labor)	0	L.S.	2,000	per L.S.	0
Sub-total					25,000
2. Seeds (certified seeds to be used once a three years)					
Certified seeds (1/3 renewal)	40	kg/ha	300	per kg	12,000
Self-multiplied seeds	80	kg/ha	0	per kg	0
Sub-total	120	kg/ha			12,000
3. Inputs					
Fertilizer					
DAP (18-46-00)	0	kg/ha	200	per kg	0
Urea (46-00-00)	300	kg/ha	120	per kg	36,000
Agro-chemicals					
Herbicide					
Propanyi/ 2,4-D (8 lit/time)	8	lit/ha	3,000	per lit	24,000
Insectide & fungicide					
Insecticide / Fungicide	0	lit/ha	0	per lit	0
Sub-total					60,000
4. Irrigation					
Fee to union	1	L.S.	85,000	per L.S.	85,000
On-farm tools (PVC tubes etc.)	0	L.S.	0	per L.S.	0
Sub-total					85,000
5. Labour work					
Seediing (family labour)	0	times/ha	5,000	per time	0
Fertilizer application (family labour)	0	time/ha	1,000	per time	0
Chemial application (family labour)	0	times/ha	5,000	per time	0
Weeding (family labour: 50%)	1	times/ha	10,000	per time	10,000
Sub-total					10,000
6. Harvesting					
Machine harvesting (10% of harvests)	0	kg	125	per kg	0
Manual harvesting (25 man-days/ha)	25	man-day/h	3,000	man-day	75,000
Sub-total					75,000
7. Others					
Transport for fertilizer	0.30	ton	3,500	CFA/ton	1,000
Renewal of bags (1/5 per annum)	12	bags	450	per bag	5,000
Transport for harvests	60	L.S.	100	per L.S.	6,000
OMVS fees	1	L.S.	1,000	per L.S.	1,000
Contingency	10%	L.S.	280,000	per L.S.	28,000
Sub-total					41,000
8. Financial expences					
Interest @7.5% per annum, 12 month	7.50%	L.S.	308,000	per L.S.	23,000
Others	0	L.S.	0	per L.S.	0
Sub-total					23,000
9. Grand Total					331,000
C. Net Income (=Gross Income - Production Cost)					273,000
				proportion	45%

Source: JICA Survey Team, through compiling information and data from SAED and PAPRIZ2.

Table B5.3.1 Future Crop Budget for Dry Season Rice Crop

(Unit: FCA)

	Quantity	Unit	Price		Amount
A. Gross Income					
1. Sales of Paddy					
Grain production (dry season)	7,500	kg/ha			
Marketable surplus	6,765	kg/ha	125	per kg	846,000
(home consumption: 0.5 ha/family,7 persons, @105 kg)					
B. Production Cost					
1. Land Preparation					
Labour	-	L.S.	40,000	per L.S.	0
Offset harrow (disc harrow)	1	times/ha	25,000	per time	25,000
Disk or mold plough	1	times/ha	90,000	per time	90,000
Manual maintenance (family labor)	1	L.S.	2,000	per L.S.	2,000
Sub-total					117,000
2. Seeds					
Certified seeds	40	kg/ha	300	per kg	12,000
Self-multiplied seeds	-	kg/ha	0	per kg	0
Sub-total					12,000
3. Inputs					
Fertilizer					
DAP (18-46-00)	50	kg/ha	200	per kg	10,000
Urea (46-00-00)	250	kg/ha	120	per kg	30,000
Agro-chemicals					
Herbicide					
Propanyi (8 lit/time x 2)	16	lit/ha	3,000	per lit	48,000
Insectide & fungicide					
Insecticide / Fungicide	1	lit/ha	5,000	per lit	5,000
Sub-total					93,000
4. Irrigation					
Fee to union	1	L.S.	85,000	per L.S.	85,000
On-farm tools (PVC tubes etc.)	0	L.S.	0	per L.S.	0
Sub-total					85,000
5. Labour work					
Seediing (family labor)	0	times/ha	5,000	per time	0
Fertilizer application	4	time/ha	1,000	per time	4,000
Chemial application	2	times/ha	5,000	per time	10,000
Weeding (family labour: 50%)	1	times/ha	10,000	per time	10,000
Sub-total					24,000
6. Harvesting					
Machine harvesting (10% of harvests)	750	kg	125	per kg	94,000
Manual harvesting (25 man-days/ha)	0	man-day/h	2,000	man-day	0
Sub-total					94,000
7. Others					
Transport for fertilizer	0.30	ton	3,500	CFA/ton	1,000
Renewal of bags (1/5 per annum)	17	bags	450	per bag	8,000
Transport for harvests	85	L.S.	100	per L.S.	9,000
OMVS fees	1	L.S.	1,000	per L.S.	1,000
Contingency (ridk reduction)	3.5%	L.S.	444,000	per L.S.	16,000
Sub-total					35,000
8. Financial expences					
Interest @7.5% per annum, 12 month	7.50%	L.S.	460,000	per L.S.	30,000
Others	0	L.S.	0	per L.S.	0
Sub-total					30,000
9. Grand Total					490,000
C. Net Income (=Gross Income - Production Cost)					356,000
				proportion	42%

Source: JICA Survey Team, through compiling information and data from SAED and PAPRIZ2.

Table B5.3.2 Future Crop Budget for Rainy Season Rice Crop

(Unit: FCA)

	Quantity	Unit	Price		Amount
A. Gross Income					
1. Sales of Paddy					
Grain production (dry season)	6,500	kg/ha			
Marketable surplus	5,765	kg/ha	125	per kg	721,000
(home consumption: 0.5 ha/family, 7 persons, @105 kg)					
B. Production Cost					
1. Land Preparation					
Labour	-	L.S.	40,000	per L.S.	0
Offset harrow (disc harrow)	2	times/ha	25,000	per time	50,000
Disk or mold plough	0	times/ha	90,000	per time	0
Manual maintenance (family labor)	1	L.S.	2,000	per L.S.	2,000
Sub-total					52,000
2. Seeds					
Certified seeds	40	kg/ha	300	per kg	12,000
Self-multiplied seeds	-	kg/ha	0	per kg	0
Sub-total					12,000
3. Inputs					
Fertilizer					
DAP (18-46-00)	50	kg/ha	200	per kg	10,000
Urea (46-00-00)	200	kg/ha	120	per kg	24,000
Agro-chemicals					
Herbicide					
Propanyi (8 lit/time x 2)	16	lit/ha	3,000	per lit	48,000
Insectide & fungicide					
Insecticide / Fungicide	1	lit/ha	5,000	per lit	5,000
Sub-total					87,000
4. Irrigation					
Fee to union	1	L.S.	85,000	per L.S.	85,000
On-farm tools (PVC tubes etc.)	0	L.S.	0	per L.S.	0
Sub-total					85,000
5. Labour work					
Seediing (family labor)	0	times/ha	5,000	per time	0
Fertilizer application	4	time/ha	1,000	per time	4,000
Chemial application	2	times/ha	5,000	per time	10,000
Weeding (family labour: 50%)	1	times/ha	10,000	per time	10,000
Sub-total					24,000
6. Harvesting					
Machine harvesting (10% of harvests)	650	kg	125	per kg	81,000
Manual harvesting (25 man-days/ha)	0	man-day/h	2,000	man-day	0
Sub-total					81,000
7. Others					
Transport for fertilizer	0.25	ton	3,500	CFA/ton	1,000
Renewal of bags (1/5 per annum)	14	bags	450	per bag	6,000
Transport for harvests	72	L.S.	100	per L.S.	7,000
OMVS fees	1	L.S.	1,000	per L.S.	1,000
Contingency	3.5%	L.S.	356,000	per L.S.	12,000
Sub-total					27,000
8. Financial expences					
Interest @7.5% per annum, 12 month	7.50%	L.S.	368,000	per L.S.	26,000
Others	0	L.S.	0	per L.S.	0
Sub-total					26,000
9. Grand Total					394,000
C. Net Income (=Gross Income - Production Cost)					327,000
				proportion	45%

Source: JICA Survey Team, through compiling information and data from SAED and PAPRIZ2.

Table B5.4.1 Hydraulic Design of Concrete Flume Irrigation Canal

Rosso Scheme: Main Canal (Concrete Flume Canal) ***Strickler Coefficient (k)=67, Manning Coefficent (n)=0.015***

Station No.	Distance (m)	Works Canal Base Width: B Canal Height: H	Design Discharge (cum/sec)	Hydraulic Gradient	Velocity (m/sec)	Energy Line (m)	Hydraulic Loss (m)	Water Surface EL. (m)	Water Depth (m)	Canal Bed EL. (m)	Canal Height (m)	Canal Bank EL. (m)	Existing Canal Bed EL. (m)	Elcb - Elecb (m)
	L		Q	I	V	Ele	HL	Elw	d	Elcb	H	Elch	Elecb	
BP of OC														
	39	Outlet Channel	0.72											
BP + 39		Secondary Canal (SC) No.9												
	4	Flume (B=3.0, H=1.15)	0.61											
BP of MC						9.735		**9.700**	0.67	9.030	1.00	10.030	9.010	0.020
	815	Flume (B=1.1, H=1.00)	0.61	0.000769	0.83		0.627							
0 + 815		SC No.1				9.108		9.073	0.67	8.403	1.00	9.403	7.848	0.555
0 + 815						9.108		9.074	0.63	8.444	1.00	9.444		
	144	Flume (B=1.1, H=1.00)	0.56	0.000769	0.82		0.111							
0 + 959		SC No.9-1				8.998		8.963	0.63	8.333	1.00	9.333	7.689	0.644
0 + 959						8.998		8.964	0.62	8.344	1.00	9.344		
	61	Flume (B=1.1, H=1.00)	0.55	0.000769	0.81		0.047							
0 + 1020		SC No.2				8.951		8.917	0.62	8.297	1.00	9.297	7.829	0.468
0 + 1020						8.951		8.919	0.57	8.349	1.00	9.349		
	201	Flume (B=1.1, H=1.00)	0.50	0.000769	0.79		0.155							
0 + 1221		SC No.3				8.796		8.764	0.57	8.194	1.00	9.194	7.809	0.385
0 + 1221						8.796		8.766	0.57	8.196	0.85	9.046		
	147	Flume (B=1.0, H=0.85)	0.44	0.000769	0.77		0.113							
0 + 1368		SC No.9-2				8.683		8.653	0.57	8.083	0.85	8.933	7.859	0.224
0 + 1368						8.683		8.654	0.55	8.104	0.85	8.954		
	59	Flume (B=1.0, H=0.85)	0.42	0.000769	0.76		0.045							
0 + 1427		SC No.4				8.638		8.608	0.55	8.058	0.85	8.908	7.844	0.214
0 + 1427						8.638		8.611	0.49	8.121	0.85	8.971		
	209	Flume (B=1.0, H=0.85)	0.36	0.000769	0.73		0.161							
0 + 1636		SC No.5				8.477		8.450	0.49	7.960	0.85	8.810	7.734	0.226
0 + 1636						8.477		8.452	0.43	8.022	0.85	8.872		
	131	Flume (B=1.0, H=0.85)	0.30	0.000769	0.7		0.101							

Table B5.4.1 Hydraulic Design of Concrete Flume Irrigation Canal

Rosso Scheme: Main Canal (Concrete Flume Canal) ***Strickler Coefficient (k)=67, Manning Coefficent (n)=0.015***

Station No.	Distance (m)	Works Canal Base Width: B Canal Height: H	Design Discharge (cum/sec)	Hydraulic Gradient	Velocity (m/sec)	Energy Line (m)	Hydraulic Loss (m)	Water Surface EL. (m)	Water Depth (m)	Canal Bed EL. (m)	Canal Height (m)	Canal Bank EL. (m)	Existing Canal Bed EL. (m)	Elcb - Elecb (m)
	L		Q	I	V	Ele	HL	Elw	d	Elcb	H	Elch	Elecb	
0 + 1767		SC No.9-3				8.376		8.351	0.43	7.921	0.85	8.771	7.584	0.337
0 + 1767						8.376		8.352	0.41	7.942	0.85	8.792		
	69	Flume (B=1.0, H=0.85)	0.28	0.000769	0.69		0.053							
0 + 1836		SC No.6				8.323		8.299	0.41	7.889	0.85	8.739	7.584	0.305
0 + 1836						8.323		8.301	0.46	7.841	0.70	8.541		
	101	Flume (B=0.8, H=0.70)	0.24	0.000769	0.66		0.078							
0 + 1937		SC No.7-1				8.246		8.223	0.46	7.763	0.70	8.463	7.684	0.079
0 + 1937						8.246		8.224	0.43	7.794	0.70	8.494		
	99	Flume (B=0.8, H=0.70)	0.22	0.000769	0.65		0.076							
0 + 2036		SC No.7-2				8.169		8.148	0.43	7.718	0.70	8.418	7.716	0.002
0 + 2036						8.169		8.148	0.43	7.718	0.70	8.418		
	33	Flume (B=0.8, H=0.70)	0.22	0.000769	0.65		0.025							
0 + 2069		SC No.9-4				8.144		8.123	0.43	7.693	0.70	8.393	7.486	0.207
0 + 2069						8.144		8.126	0.34	7.786	0.70	8.486		
	71	Flume (B=0.8, H=0.70)	0.16	0.000769	0.6		0.055							
0 + 2140		SC No.7-3				8.089		8.071	0.34	7.731	0.70	8.431		
0 + 2140						8.089		8.072	0.32	7.752	0.70	8.452		
	100	Flume (B=0.8, H=0.70)	0.15	0.000769	0.59		0.077							
0 + 2240		SC No.7-4				8.013		7.995	0.32	7.675	0.70	8.375	7.466	0.209
0 + 2240						8.013		7.995	0.31	7.685	0.70	8.385		
	150	Flume (B=0.8, H=0.70)	0.14	0.000769	0.58		0.115							
0 + 2390		SC No.9-5				7.897		7.880	0.31	7.570	0.70	8.270	7.471	0.099
0 + 2390		End of MC												
				(1/1,300)										

Source: JICA Survey Team

Table B5.4.2 Hydraulic Design of Earth Irrigation Canal

Rosso Scheme: Main Canal (Trapezoidal Earth Canal) ***Strickler Coefficient (k)=33, Manning Coefficent (n)=0.03***

Station No.	Distance (m)	Works (Canal Type: B, n) (Structure Type: Dimension)	Design Discharge (cum/sec)	Hydraulic Gradient	Velocity (m/sec)	Energy Line (m)	Hydraulic Loss (m)	Water Surface EL. (m)	Water Depth (m)	Canal Bed EL. (m)	Canal Height (m)	Canal Bank EL. (m)	Existing Canal Bed EL. (m)	Elcb - Elecb (m)
	L		Q	I	V	Ele	HL	Elw	d	Elcb	H	Elch	Elecb	
BP of OC		Outlet Channel												
	39		0.85											
BP + 39		SC No.9												
	4	Flume (B=3.0, H=1.15)	0.72											
BP of MC						9.714		**9.700**	0.72	8.980	1.00	9.980	9.010	-0.030
	815	(B=1.2, H=1.00)	0.72	0.000769	0.52		0.627							
0 + 815		SC No.1				9.087		9.073	0.72	8.353	1.00	9.353	7.848	0.505
0 + 815						9.087		9.074	0.69	8.384	1.00	9.384		
	144	(B=1.2, H=1.00)	0.67	0.000769	0.51		0.111							
0 + 959		SC No.9-1				8.976		8.963	0.69	8.273	1.00	9.273	7.689	0.584
0 + 959						8.976		8.963	0.68	8.283	1.00	9.283		
	61	(B=1.2, H=1.00)	0.65	0.000769	0.51		0.047							
0 + 1020		SC No.2				8.929		8.916	0.68	8.236	1.00	9.236	7.829	0.407
0 + 1020						8.929		8.917	0.65	8.267	1.00	9.267		
	201	(B=1.2, H=1.00)	0.59	0.000769	0.50		0.155							
0 + 1221		SC No.3				8.775		8.762	0.65	8.112	1.00	9.112	7.809	0.303
0 + 1221						8.775		8.763	0.65	8.113	0.85	8.963		
	147	(B=1.0, H=0.85)	0.52	0.000769	0.48		0.113							
0 + 1368		SC No.9-2				8.662		8.650	0.65	8.000	0.85	8.850	7.859	0.141
0 + 1368						8.662		8.650	0.64	8.010	0.85	8.860		
	59	(B=1.0, H=0.85)	0.50	0.000769	0.48		0.045							
0 + 1427		SC No.4				8.616		8.605	0.64	7.965	0.85	8.815	7.844	0.121
0 + 1427						8.616		8.606	0.58	8.026	0.85	8.876		
	209	(B=1.0, H=0.85)	0.42	0.000769	0.46		0.161							
0 + 1636		SC No.5				8.456		8.445	0.58	7.865	0.85	8.715	7.734	0.131
0 + 1636						8.456		8.446	0.53	7.916	0.85	8.766		
	131	(B=1.0, H=0.85)	0.35	0.000769	0.44		0.101							

Table B5.4.2 Hydraulic Design of Earth Irrigation Canal

Rosso Scheme: Main Canal (Trapezoidal Earth Canal) ***Strickler Coefficient (k)=33, Manning Coefficent (n)=0.03***

Station No.	Distance (m)	Works (Canal Type: B, n) (Structure Type: Dimension)	Design Discharge (cum/sec)	Hydraulic Gradient	Velocity (m/sec)	Energy Line (m)	Hydraulic Loss (m)	Water Surface EL. (m)	Water Depth (m)	Canal Bed EL. (m)	Canal Height (m)	Canal Bank EL. (m)	Existing Canal Bed EL. (m)	Elcb - Elecb (m)
	L		Q	I	V	Ele	HL	Elw	d	Elcb	H	Elch	Elecb	
0 + 1767		SC No.9-3				8.355		8.345	0.53	7.815	0.85	8.665	7.584	0.231
0 + 1767						8.355		8.346	0.51	7.836	0.85	8.686		
	69	(B=1.0, H=0.85)	0.33	0.000769	0.43		0.053							
0 + 1836		SC No.6				8.302		8.292	0.51	7.782	0.85	8.632	7.584	0.198
0 + 1836						8.302		8.293	0.51	7.783	0.70	8.483		
	101	(B=0.8, H=0.70)	0.28	0.000769	0.41		0.078							
0 + 1937		SC No.7-1				8.224		8.216	0.51	7.706	0.70	8.406	7.684	0.022
0 + 1937						8.224		8.216	0.50	7.716	0.70	8.416		
	99	(B=0.8, H=0.70)	0.27	0.000769	0.41		0.076							
0 + 2036		SC No.7-2				8.148		8.140	0.50	7.640	0.70	8.340	7.716	-0.076
0 + 2036						8.148		8.140	0.49	7.650	0.70	8.350		
	33	(B=0.8, H=0.70)	0.26	0.000769	0.40		0.025							
0 + 2069		SC No.9-4				8.123		8.115	0.49	7.625	0.70	8.325	7.486	0.139
0 + 2069						8.123		8.116	0.41	7.706	0.70	8.406		
	71	(B=0.8, H=0.70)	0.18	0.000769	0.37		0.055							
0 + 2140		SC No.7-3				8.068		8.061	0.41	7.651	0.70	8.351		
0 + 2140						8.068		8.062	0.39	7.672	0.70	8.372		
	100	(B=0.8, H=0.70)	0.17	0.000769	0.36		0.077							
0 + 2240		SC No.7-4				7.991		7.985	0.39	7.595	0.70	8.295	7.466	0.129
0 + 2240						7.991		7.985	0.39	7.595	0.70	8.295		
	150	(B=0.8, H=0.70)	0.17	0.000769	0.36		0.115							
0 + 2390		SC No.9-5				7.876		7.869	0.39	7.479	0.70	8.179	7.471	0.008
0 + 2390		End of MC												
				(1/1,300)										

Source: JICA Survey Team

Table B5.4.3 Hydraulic Design of Concrete Lining Irrigation Canal

Rosso Scheme: Main Canal (Trapezoidal Concrete Lining Canal) ***Strickler Coefficient (k)=67, Manning Coefficent (n)=0.015***

Station No.	Distance (m)	Works (Canal Type: B, n) (Structure Type: Dimension)	Design Discharge (cum/sec)	Hydraulic Gradient	Velocity (m/sec)	Energy Line (m)	Hydraulic Loss (m)	Water Surface EL. (m)	Water Depth (m)	Canal Bed EL. (m)	Canal Height (m)	Canal Bank EL. (m)	Existing Canal Bed EL. (m)	Elcb - Elecb (m)
	L		Q	I	V	Ele	HL	Elw	d	Elcb	H	Elch	Elecb	
BP of OC		Outlet Channel												
	39		0.72											
BP + 39		SC No.9												
	4	Flume (B=3.0, H=1.15)	0.61											
BP of MC						9.736		**9.700**	0.51	9.190	0.75	9.940	9.010	0.180
	815	(B=0.9, H=0.75)	0.61	0.000769	0.84		0.627							
0 + 815		SC No.1				9.109		9.073	0.51	8.563	0.75	9.313	7.848	0.715
0 + 815						9.109		9.074	0.49	8.584	0.75	9.334		
	144	(B=0.9, H=0.75)	0.56	0.000769	0.83		0.111							
0 + 959		SC No.9-1				8.999		8.963	0.49	8.473	0.75	9.223	7.689	0.784
0 + 959						8.999		8.964	0.48	8.484	0.75	9.234		
	61	(B=0.9, H=0.75)	0.55	0.000769	0.82		0.047							
0 + 1020		SC No.2				8.952		8.917	0.48	8.437	0.75	9.187	7.829	0.608
0 + 1020						8.952		8.919	0.46	8.459	0.75	9.209		
	201	(B=0.9, H=0.75)	0.50	0.000769	0.80		0.155							
0 + 1221		SC No.3				8.797		8.764	0.46	8.304	0.75	9.054	7.809	0.495
0 + 1221						8.797		8.766	0.45	8.316	0.70	9.016		
	147	(B=0.8, H=0.70)	0.44	0.000769	0.78		0.113							
0 + 1368		SC No.9-2				8.684		8.653	0.45	8.203	0.70	8.903	7.859	0.344
0 + 1368						8.684		8.654	0.44	8.214	0.70	8.914		
	59	(B=0.8, H=0.70)	0.42	0.000769	0.77		0.045							
0 + 1427		SC No.4				8.639		8.608	0.44	8.168	0.70	8.868	7.844	0.324
0 + 1427						8.639		8.611	0.41	8.201	0.70	8.901		
	209	(B=0.8, H=0.70)	0.36	0.000769	0.74		0.161							
0 + 1636		SC No.5				8.478		8.450	0.41	8.040	0.70	8.740	7.734	0.306
0 + 1636						8.478		8.453	0.37	8.083	0.70	8.783		
	131	(B=0.8, H=0.70)	0.30	0.000769	0.70		0.101							

Table B5.4.3 Hydraulic Design of Concrete Lining Irrigation Canal

Rosso Scheme: Main Canal (Trapezoidal Concrete Lining Canal) ***Strickler Coefficient (k)=67, Manning Coefficent (n)=0.015***

Station No.	Distance (m)	Works (Canal Type: B, n) (Structure Type: Dimension)	Design Discharge (cum/sec)	Hydraulic Gradient	Velocity (m/sec)	Energy Line (m)	Hydraulic Loss (m)	Water Surface EL. (m)	Water Depth (m)	Canal Bed EL. (m)	Canal Height (m)	Canal Bank EL. (m)	Existing Canal Bed EL. (m)	Elcb - Elecb (m)
	L		Q	I	V	Ele	HL	Elw	d	Elcb	H	Elch	Elecb	
0 + 1767		SC No.9-3				8.377		8.352	0.37	7.982	0.70	8.682	7.584	0.398
0 + 1767						8.377		8.354	0.35	8.004	0.70	8.704		
	69	(B=0.8, H=0.70)	0.28	0.000769	0.68		0.053							
0 + 1836		SC No.6				8.324		8.301	0.35	7.951	0.70	8.651	7.584	0.367
0 + 1836						8.324		8.301	0.37	7.931	0.60	8.531		
	101	(B=0.6, H=0.60)	0.24	0.000769	0.67		0.078							
0 + 1937		SC No.7-1				8.246		8.224	0.37	7.854	0.70	8.554	7.684	0.170
0 + 1937						8.246		8.225	0.35	7.875	0.70	8.575		
	99	(B=0.6, H=0.60)	0.22	0.000769	0.65		0.076							
0 + 2036		SC No.7-2				8.170		8.149	0.35	7.799	0.70	8.499	7.716	0.083
0 + 2036						8.170		8.149	0.35	7.799	0.70	8.499		
	33	(B=0.6, H=0.60)	0.22	0.000769	0.65		0.025							
0 + 2069		SC No.9-4				8.145		8.123	0.35	7.773	0.70	8.473	7.486	0.287
0 + 2069						8.145		8.127	0.30	7.827	0.70	8.527		
	71	(B=0.6, H=0.60)	0.16	0.000769	0.60		0.055							
0 + 2140		SC No.7-3				8.090		8.072	0.30	7.772	0.70	8.472		
0 + 2140						8.090		8.073	0.29	7.783	0.70	8.483		
	100	(B=0.6, H=0.60)	0.15	0.000769	0.59		0.077							
0 + 2240		SC No.7-4				8.013		7.996	0.29	7.706	0.70	8.406	7.466	0.240
0 + 2240						8.013		7.996	0.28	7.716	0.70	8.416		
	150	(B=0.6, H=0.60)	0.14	0.000769	0.59		0.115							
0 + 2390		SC No.9-5				7.898		7.880	0.28	7.600	0.70	8.300	7.471	0.129
0 + 2390		End of MC												
				(1/1,300)										

Source: JICA Survey Team

Table B5.4.4 Hydraulic Design of Main Drain

Rosso Scheme: Main Drain (Trapezoidal Earth Canal) ***Strickler Coefficient (k)=29, Manning Coefficient (n)=0.035***

Station No.	Distance (m)	Works (Canal Type: B, n) (Structure Type: Dimension)	Design Discharge (cum/sec)	Hydraulic Gradient	Velocity (m/sec)	Energy Line (m)	Hydraulic Loss (m)	Water Surface EL. (m)	Water Depth (m)	Canal Bed EL. (m)	Canal Height (m)	Canal Bank EL. (m)	Existing Canal Bed EL. (m)	Elcb - Elecb (m)
	L		Q	I	V	Ele	HL	Elw	d	Elcb	H	Elch	Elecb	
0 + 000		BP of MDC, CD-R1				8.001		**8.000**	0.26	7.740	0.50	8.240	8.005	-0.265
	350	(B=0.5, m=1.0)	0.03	0.000333	0.15		0.117							
0 + 350		CD-R2 & CD-R3				7.884		7.883	0.26	7.623	0.50	8.123	8.525	-0.902
0 + 350						7.884		7.883	0.40	7.483	0.64	8.123		
	250	(B=0.5, m=1.0)	0.07	0.000333	0.19		0.083							
0 + 600		CD-R4 & CD-R5				7.801		7.799	0.40	7.399	0.64	8.039	8.555	-1.156
0 + 600						7.801		7.799	0.43	7.369	0.67	8.039		
	280	(B=0.8, m=1.0)	0.11	0.000333	0.21		0.093							
0 + 880		CD-R6 & CD-R7				7.708		7.706	0.43	7.276	0.67	7.946	8.265	-0.989
0 + 880						7.708		7.705	0.48	7.225	0.72	7.945		
	220	(B=1.0, m=1.5)	0.20	0.000333	0.24		0.073							
0 + 1100		CD-R8 & CD-R9				7.635		7.632	0.48	7.152	0.72	7.872	8.515	-1.363
0 + 1100						7.635		7.631	0.54	7.091	0.78	7.871		
	240	(B=1.0, m=1.5)	0.24	0.000333	0.25		0.080							
0 + 1340		CD-R10 & CD-R11				7.555		7.551	0.54	7.011	0.78	7.791	8.600	-1.589
0 + 1340						7.555		7.551	0.60	6.951	0.84	7.791		
	760	(B=1.0, m=1.5)	0.30	0.000333	0.26		0.253							
0 + 2100		CD-R12				7.301		7.298	0.60	6.698	0.84	7.538	8.430	-1.732
0 + 2100						7.301		7.298	0.60	6.698	0.84	7.538		
	110	(B=1.0, m=1.5)	0.30	0.000333	0.26		0.037							
0 + 2210		CD-R13				7.265		7.261	0.60	6.661	0.84	7.501	8.555	-1.894
0 + 2210						7.265		7.261	0.61	6.651	0.85	7.501		
	120	(B=1.0, m=1.5)	0.31	0.000333	0.27		0.040							
0 + 2330		CD-R14				7.225		7.221	0.61	6.611	0.85	7.461	8.300	-1.689
0 + 2330						7.225		7.221	0.63	6.591	0.87	7.461		
	120	(B=1.0, m=1.5)	0.33	0.000333	0.27		0.040							

Table B5.4.4 Hydraulic Design of Main Drain

Rosso Scheme: Main Drain (Trapezoidal Earth Canal) ***Strickler Coefficient (k)=29, Manning Coefficient (n)=0.035***

Station No.	Distance (m)	Works (Canal Type: B, n) (Structure Type: Dimension)	Design Discharge (cum/sec)	Hydraulic Gradient	Velocity (m/sec)	Energy Line (m)	Hydraulic Loss (m)	Water Surface EL. (m)	Water Depth (m)	Canal Bed EL. (m)	Canal Height (m)	Canal Bank EL. (m)	Existing Canal Bed EL. (m)	Elcb - Elecb (m)
	L		Q	I	V	Ele	HL	Elw	d	Elcb	H	Elch	Elecb	
0 + 2450		CD-R15				7.185		7.181	0.63	6.551	0.87	7.421	8.100	-1.549
0 + 2450						7.185		7.181	0.64	6.541	0.88	7.421		
	80	(B=1.0, m=1.5)	0.34	0.000333	0.27		0.027							
0 + 2530		CD-R16 & CD-R17				7.158		7.154	0.64	6.514	0.88	7.394	8.130	-1.616
0 + 2530						7.158		7.154	0.66	6.494	0.90	7.394		
	560	(B=1.0, m=1.5)	0.36	0.000333	0.28		0.187							
0 + 3090		End of Main Drain				6.971		6.967	0.66	6.307	0.90	7.207	7.955	-1.648
0 + 3090														
				(1/3,000)										

Source: JICA Survey Team

Table B5.6.1 Cost Breakdown for Rosso Subproject

Non-disclosure information

Table B5.7.1 Cash Flow Table and Calculation of EIRR, NPV and B/C

Non-disclosure information

Table B5.8.1 Contents of Stakeholder Meeting

Stakeholders	Date/Place	Opinion/Concern	Suggestion／Recommendation
Organizations related to technical content			
Directorate of Environment and Classified Establishments DEEC	03 June19 at DEEC in Dakar	• Useful projects related to increasing rice production are national priorities. • The intention of the project must be officially notified to the Directorate of Environment and Classified Establishments • A detailed impact assessment is not necessary for the rehabilitation project for the agricultural sector. • The operation of environmental and social monitoring plans should be prioritized. • The project site in the Rosso Irrigation Scheme is located near the construction site of the Rosso Bridge.	• SAED needs to plan and implement to screen subproject groups together, not individual subproject. • Environmental consultants need to conduct a comprehensive environmental assessment. • Environmental consultants need to establish an environmental monitoring system and strengthen the capacity of supervisory agencies in this process. • DEEC needs capacity building for water resources, drinking water classification and logistics monitoring. • Promoting communication with local stakeholders who have a better understanding of field issues is important. • Review alternatives to identify ways to avoid connecting to the Senegal Sugar Company (CSS) drainage network. • It is necessary to analyze the cumulative impact of bridge construction (auxiliary construction work) activities at Rosso Bridge.
Regional Directorate of Environment and Classified Establishments (DREEC) of Saint Louis	22 Aug.19 at DREEC in Saint-Louis		
Regional Section of Hydraulics	26 Aug.19 at the offices of the section in Saint-Louis	• Risk of surface water contamination due to the intensive use of herbicides and prohibited pesticide products • The impact of river water purification facilities on public health • Groundwater contamination	• Consideration of the modernization of the water-saving irrigation system is necessary. • Establishing a monitoring network for surface water, drainage, and groundwater is necessary. • SAED should closely monitor the environmental aspects of the project.
Regional Directorate of Rural Development DRDR	26 Aug.19 at DRDR in Saint-Louis	• Welcome JICA's support. • Mentioned the need for improvement of VIP (ventilated pit toilets). • Poor drainage in many irrigation areas causes soil physicochemical degradation. • Accurate adjustment between DRDR and SAED is necessary	• Care must be taken not to contaminate other sites during drainage. • Capacity building and logistical measures are required not only for monitoring during operation but also for controlling fertilizer products.

Stakeholders	Date/Place	Opinion/Concern	Suggestion／Recommendation
SAED	22 Aug. 19 at SAED Headquarters in Saint-Louis	• SAED welcomes cooperation with JICA • SAED has high expectations for the project and hopes to improve many irrigation areas within the framework of the program. • the environmental department has been established within the SAED Water Environment Management Department. • Two environmental specialists are in charge of environmental monitoring at the construction phase. • Regarding water quality monitoring, physicochemical parameters (EC, pH, dissolved oxygen) have been made, but chemical analysis has not been performed. • Overall, there are financial, logistical and personnel issues. • There are also issues regarding project implementation and monitoring.	• The necessity of strengthening human resources. • Logistics need to be strengthened to better monitor project implementation. • SAED needs cooperation in setting up a laboratory for water quality analysis to monitor chemical parameters and predict potential soil degradation. • SAED participation is required in the implementation process of the environmental management system. • SAED needs assistance to establish agricultural drainage standards.
Regional Section of Local Development	26 Aug. 19 at offices of the Section in Saint-Louis Governorate	• The project is beneficial to the residents. • Need to renovate Rosso Irrigation Scheme • The necessity of clear collaboration with existing projects (Rosso Bridge by AGEROUTE and PUMA)	• The project should avoid connecting to the CSS drainage network. • It is necessary to monitor agricultural products that need phytosanitary to and from the border. • Analyze the need to connect to Delta waters with alternatives is necessary.
AGEROUTE	28 Aug. 19 at Ageroute office in Saint-Louis	• Welcome the initiative of this project for people living in the valley of the Senegal River Basin. • It is necessary to establish a cooperation system with the Rosso Bridge project personnel.	• Good coordination with the management unit of the Rosso Bridge Project is necessary for related auxiliary construction. • Promote information sharing is necessary.

Stakeholders	Date/Place	Opinion/Concern	Suggestion／Recommendation
Local government and public organizations			
The municipality of Rosso	22 Aug. 19 at Rosso Municipality	• We welcome the project in general and the selection of the Rosso Irrigation Scheme as a pilot site. • Local residents have very high expectations for the irrigation rehabilitation project that they have been waiting for for a long time. • Rosso city is very vulnerable to flooding, and the irrigation area is located in the lowland where the runoff converges. • The city of Rosso, once an important traffic hub, will become even more important due to the construction of the Rosso Bridge and related works including the Mbagam-Rosso-Thiagar Road covering 65 km.	• It is important to establish an appropriate drainage system at the irrigation scheme level. • If possible, building a combined drainage system that can treat runoff from Rosso city is expected. • Training and capacity building for farmers' organizations, women's groups, and youth are necessary for the proper management of installed equipment. • Good coordination with other ongoing projects in the city is required.
Rosso Union of producers	27 and 29 Aug. 19 at Offices of Rosso Municipality	• The Union has high expectations for the project. • The project was a long-standing hope of the residents. • Farmers are very motivated and collaborate for project success. • In the Rosso Irrigation Scheme, basic facilities are also severely deteriorated. • Drainage is also a major issue. • In the irrigated area, the land is threatened by salt damage.	• Reshape the layout as much as possible. • Building an appropriate drainage system is necessary. • Union intends to be well involved in technical planning and selection of materials and equipment. • Training in all areas of the value chain is necessary. (Farmer organization management, facility management, machinery and equipment management, etc.)

Source: JICA Survey Team

Table B 6.3.1（1/3） Calculation table for Minimum Utilization Area (ha) of Combine Harvester

Item		Calculating formula	Value	Unit	Remarks
	Purchase price	①	24,575	Thousand FCFA	*Yanmar AW70GV
	Fixed annual fee rate	②	23.6	%	*case example in Japan, Common type combine harvester
Fixed annual fee		③=①＋②	5,799,763	FCFA	
	Fuel consumption	④	10	L/hour	*Catalogue value
	Unit price	⑤	593	FCFA/L	USD1.02/L Diesel
Machine operating efficiency		⑥	2.78	hour/ha	0.36ha/hour
Utility charges/ha		⑦=④*⑤*1.3*⑥	21,431	FCFA	
	Actual operation rate	⑧	70%		
	Number of operator(s)	⑨	1	person(s)	
	Unit cost of operator	⑩	4,000	FCFA/day	
	Number of subsidiary(s)	⑪	1	person(s)	
	Unit cost of subsidiary	⑫	2,500	FCFA/day	*Unskilled Labor cost
Labor cost/ha		⑬=⑥/⑧*(⑨*⑩+⑪*⑫)	25,814	FCFA/ha	
Variable cost/ha		⑭=⑦+⑬	47,245	FCFA/ha	
Planned utilization area (ha)/year		⑮	150	ha/year	75ha x double cropping（Rosso, Pilot site）
Variable cost		⑯=⑭*⑮	7,086,796	FCFA/year	
Machine utilization cost		⑰=③+⑯	12,886,559	FCFA/year	
Machine utilization cost/ha		⑱=⑰/⑮	85,910	FCFA/ha	
Service contract cost/ha		⑲	87,500	FCFA/ha	
Minimum utilization area (ha)		X＞③/(⑲-⑭)	**144.1**	**ha**	

Hired harvesting cost/ha		87,500	FCFA/ha	7 ton/ha x 10% x 125 FCFA/kg

Average yields of dry and rainy season	7,000	kg/ha
Rate of hired combine harvester cost	10%	
Unit price of grains	125	FCFA/kg

Source: JICA Survey Team

Table B 6.3.1（2/3） Calculation Table for Minimum Utilization Area (ha) of Reaper

Item		Calculating formula	Value	Unit	Remarks
	Purchase price	①	2,040	Thousand FCFA	*Quotation（reaper）
	Fixed annual fee rate	②	23.6	%	*case example in Japan, Common type combine harvester
Fixed annual fee		③=①＋②	481,440	FCFA	
	Fuel consumption	④	0.62	L/hour	*Measured figure from PAPRIZ2
	Unit price	⑤	593	FCFA/L	USD1.02/L Diesel
Machine operating efficiency		⑥	3.45	hour/ha	0.29ha/hour, Catalogue value
Utility charges/ha		⑦=④*⑤*1.3*⑥	1,649	FCFA	
	Actual operation rate	⑧	70%		
	Number of operator(s)	⑨	1	person(s)	
	Unit cost of operator	⑩	4,000	FCFA/day	
	Number of subsidiary(s)	⑪	0	person(s)	
	Unit cost of subsidiary	⑫	2,500	FCFA/day	*Unskilled Labor cost
Labor cost/ha		⑬=⑥/⑧*(⑨*⑩+⑪*⑫)	19,714	FCFA/ha	
Variable cost/ha		⑭=⑦+⑬	21,363	FCFA/ha	
Planned utilization area (ha)/year		⑮	20	ha/year	10ha(dry season)+10ha(rainy season)
Variable cost		⑯=⑭*⑮	427,265	FCFA/year	
Machine utilization cost		⑰=③+⑯	908,705	FCFA/year	
Machine utilization cost/ha		⑱=⑰/⑮	45,435	FCFA/ha	
Service contract cost/ha		⑲	50,000	FCFA/ha	
Minimum utilization area (ha)		X＞③/(⑲-⑭)	**16.8**	**ha**	

Hired harvesting cost/ha		50,000	FCFA/ha	Chose same price as manual harvesting cost

Manual harvesting cost/ha		50,000	FCFA/ha	Value from progress report of PAPRIZ2

Source: JICA Survey Team

Table B 6.3.1（3/3） Calculation Table for Minimum Utilization Area (ha) of Thresher

Item		Calculating formula	Value	Unit	Remarks
	Purchase price	①	1,530	Thousand FCFA	*Quotation（thresher）
	Fixed annual fee rate	②	23.6	%	*case example in Japan, Common type combine harvester
Fixed annual fee		③=①＋②	361,080	FCFA	
	Fuel consumption	④	0.62	L/hour	Same as reaper
	Unit price	⑤	593	FCFA/L	USD1.02/L Diesel
Machine operating efficiency		⑥	3.04	hour/ha	2.3 ton/hour, Catalogue value
Utility charges/ha		⑦=④*⑤*1.3*⑥	1,453	FCFA	
	Actual operation rate	⑧	70%		
	Number of operator(s)	⑨	1	person(s)	
	Unit cost of operator	⑩	4,000	FCFA/day	
	Number of subsidiary(s)	⑪	0	person(s)	
	Unit cost of subsidiary	⑫	2,500	FCFA/day	*Unskilled Labor cost
Labor cost/ha		⑬=⑥/⑧*(⑨*⑩+⑪*⑫)	17,371	FCFA/ha	
Variable cost/ha		⑭=⑦+⑬	18,824	FCFA/ha	
Planned utilization area (ha)/year		⑮	20	ha/year	10ha(dry season)+10ha(rainy season)
Variable cost		⑯=⑭*⑮	376,488	FCFA/year	
Machine utilization cost		⑰=③+⑯	737,568	FCFA/year	
Machine utilization cost/ha		⑱=⑰/⑮	36,878	FCFA/ha	
Service contract cost/ha		⑲	37,500	FCFA/ha	
Minimum utilization area (ha)		X＞③/(⑲-⑭)	**19.3**	**ha**	

Threshing cost/ha		37,500	FCFA/ha	Combine hired cost 87,500FCFA/ha - Reaper hired cost 50,000FCFA/ha

Consideration as same cost between reaper with thresher, and combine harvester

Source: JICA Survey Team

Table B7.1.1 Committee for coordination and monitoring of the project

Membres	Le Ministère de l'Agriculture et du Développement Rural - Le Secrétaire Général (président) - Le Coordinateur PNAR - La Direction de l'Agriculture - La Direction de la Modernisation du Matériel Rural - La Direction de la Facilitation et du Partenariat avec les Entreprises Le Ministère de la Finance et du Budget - Représentant Le Ministère de l'Économie, du Plan et de la Coopération - Représentant Le Ministère de l'Eau et de l'Assainissement (si nécessaire) - Représentant La SAED - Le Directeur Général - Le Directeur Général Adjoint - Le Directeur de la Direction des Aménagements des Infrastructures Hydroagricoles (DAIH) - Le Directeur de la Division du Développement et de l'Appui aux Collectivités Locales (DDAC) - Le Chef de Project (Unité de Gestion du Projet)
Responsabilités	1 Conseils sur la direction et la gestion générales du projet 2 Coordination entre les différentes agences au niveau supérieur 3 Suivi de l'avancée de l'ensemble du Projet 4 Ratification et accord sur les changements importants aux activités du Projet, si il y en a
Fréquence et lieu	Tous les six mois à Dakar

Nom du Comité	Comité de Suivi du Projet
Membres	La SAED - Le Directeur Général (Président) - Le Directeur Général Adjoint - Le Directeur de la DAIH - Le Chef de chaque division (DAIH) - Le Directeur de la DDAC - Le Chef de chaque division (DDAC) - Le Représentant de la Direction Autonome de la Maintenance (DAM) - Le Représentant de la Direction de la Finance et de la Comptabilité (DFC) - L'Ingénieur délégué de la délégation de Dagana - L'Ingénieur délégué de la délégation Podor La Direction Régionale du Développement Rural (DRDR) - Le Représentant (si nécéssaire) Institut Sénégalais de Recherches Agricoles (ISRA) - Le Représentant (si nécéssaire) Unité de Gestion du Projet (UGP) - Le Chef de Projet - Les Agents et Ingénieurs en charge Unité d'Exécution du Projet (UEP) - Le Chef du sous-projet de Dagana - Le Chef du sous-projet de Podor
Responsabilités	1 Coordination entre les départements de la DG de la SAED, l'UGP et les UEP 2 Suivi de l'avancée des travaux dans chaque délégation 3 Discussions et suggestions autour des contre-mesures pour les contraintes et les problèmes 4 Ratification et accord sur les changements ou les décisions relatives aux activités du Projet
Fréquence et lieu	Tous les trois mois à Saint Louis

Source: JICA Survey Team

Table B8.3.1 Cost Breakdown for Component 1: Rehabilitation and Improvement of Irrigation Schemes

Non-disclosure information

Table B8.3.2 Cost Breakdown for Component 2: Enhancement of Agricultural Mechanization

Non-disclosure information

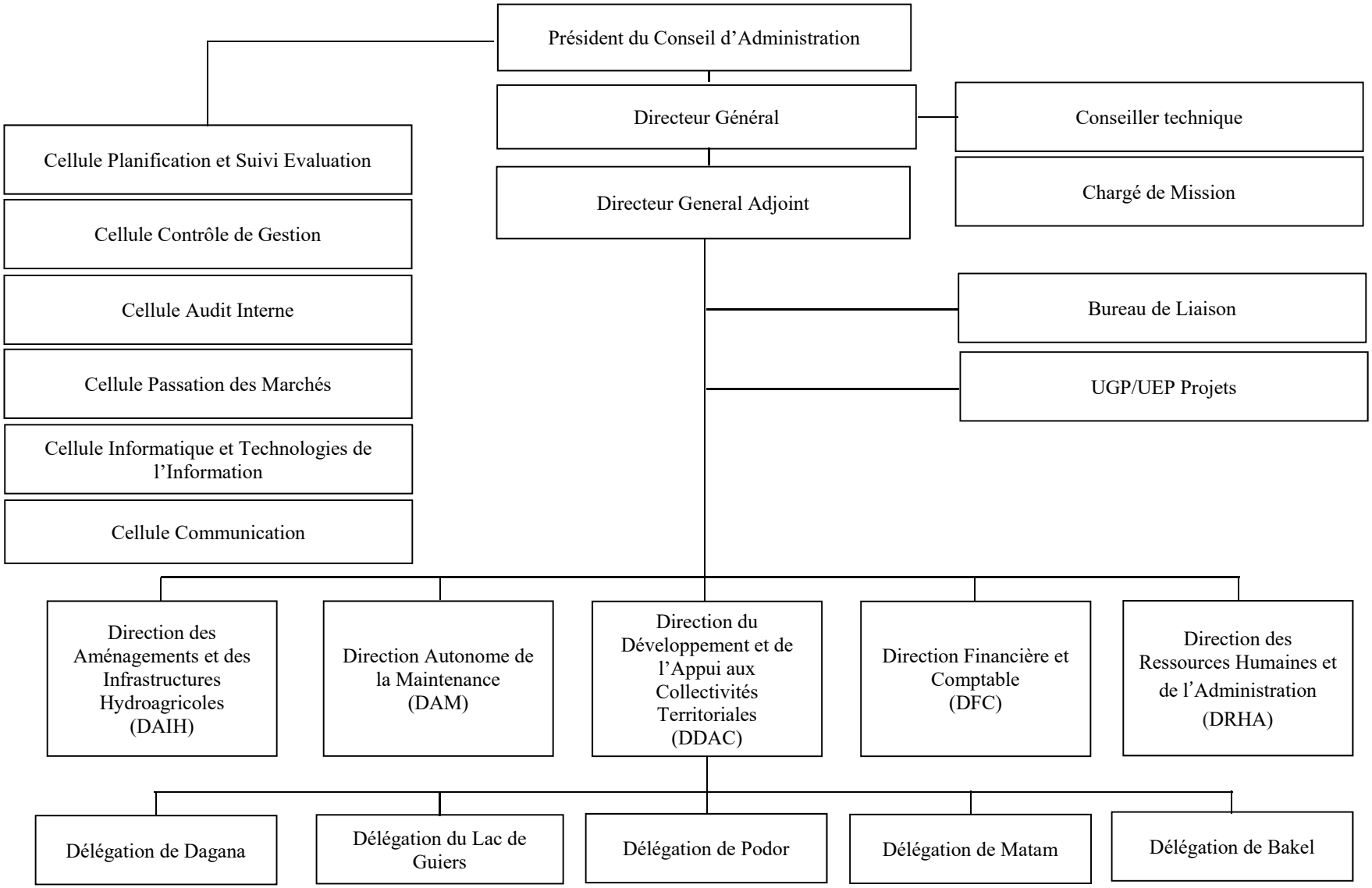
Table B8.3.3 Cost Breakdown for Component 3: Soft Component

Non-disclosure information

Table B8.3.4 Cost Breakdown for Component 4: Enhancement of Project Management and Monitoring

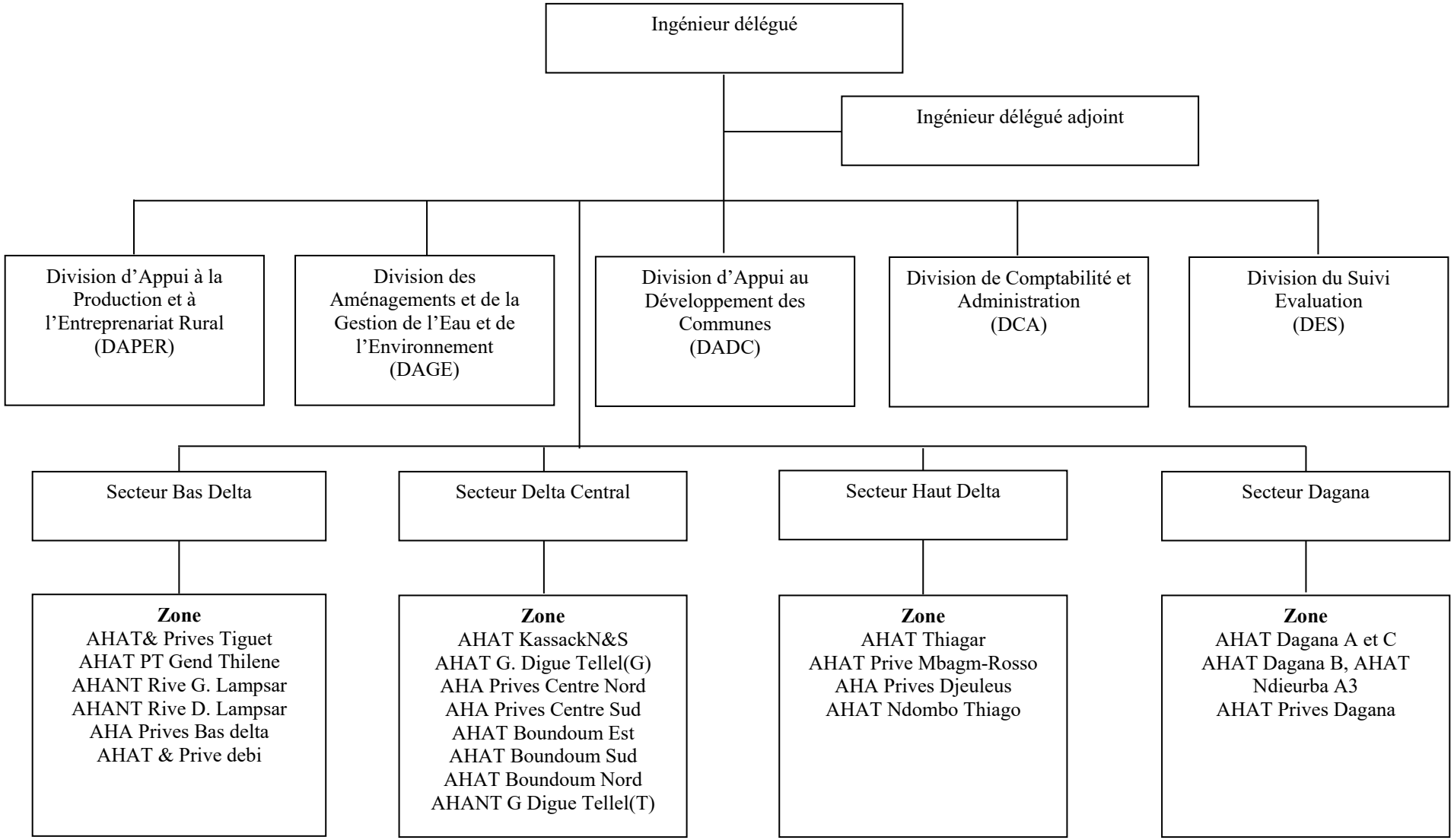
Non-disclosure information

Figure B



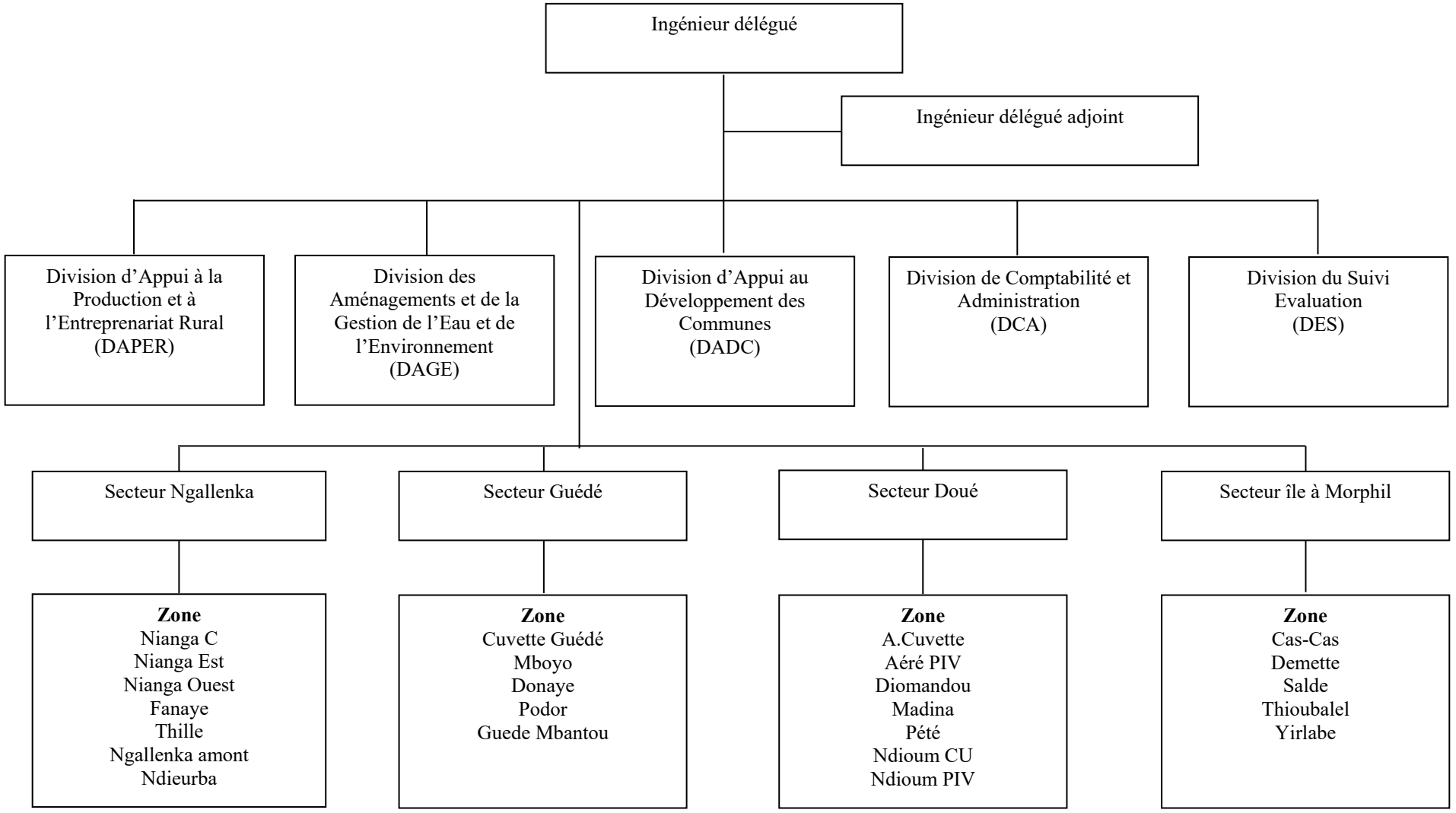
Source : SAED

Figure B2.2.1 SAED Organization Chart - March 2018



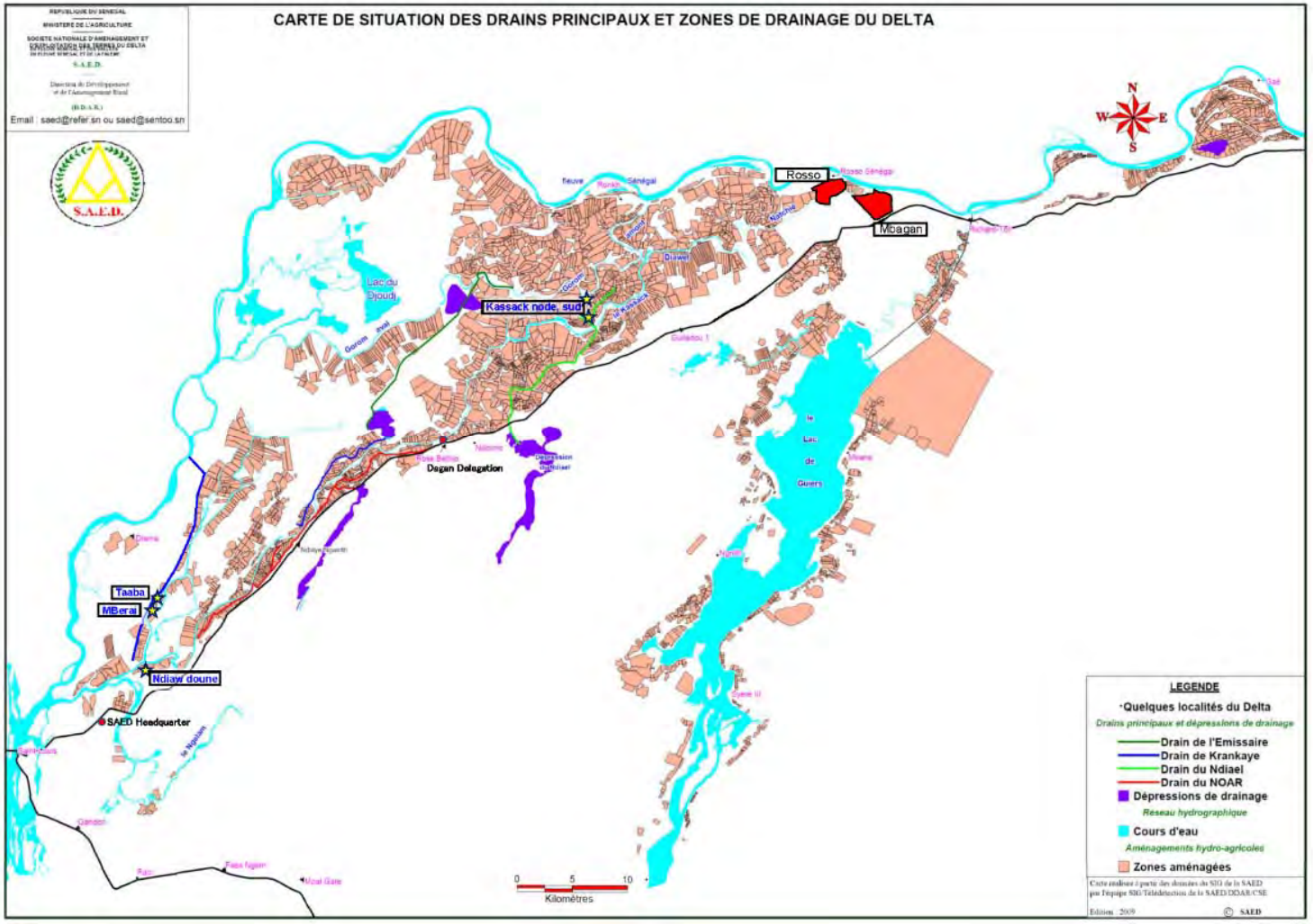
Source : SAED

Figure B2.2.2 Organization Chart for Dagana Delegation (23 Novembre 2018)



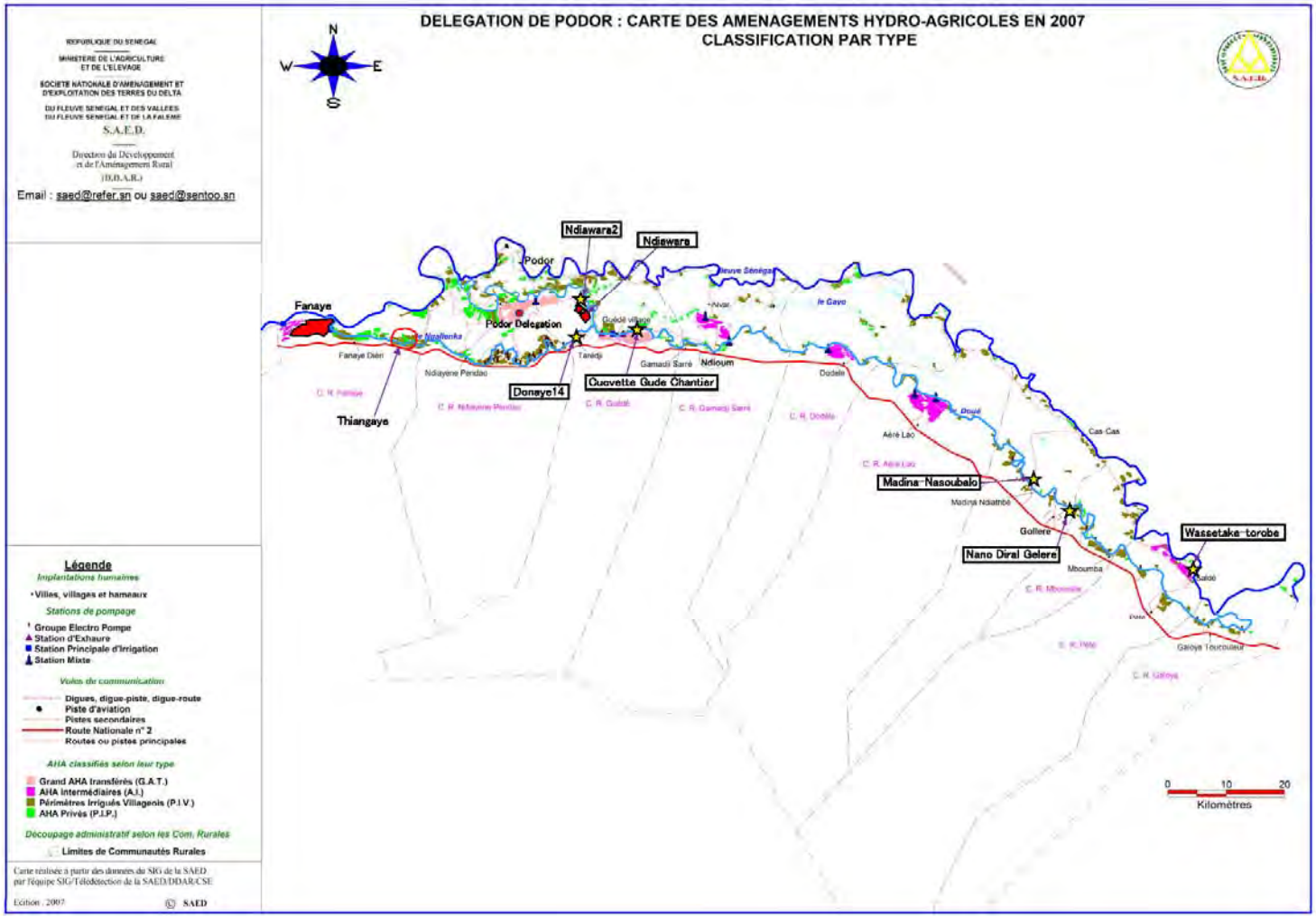
Source: *SAED*

Figure B2.2.3 Organization Chart for Podor Delegation (23 Novembre 2018)



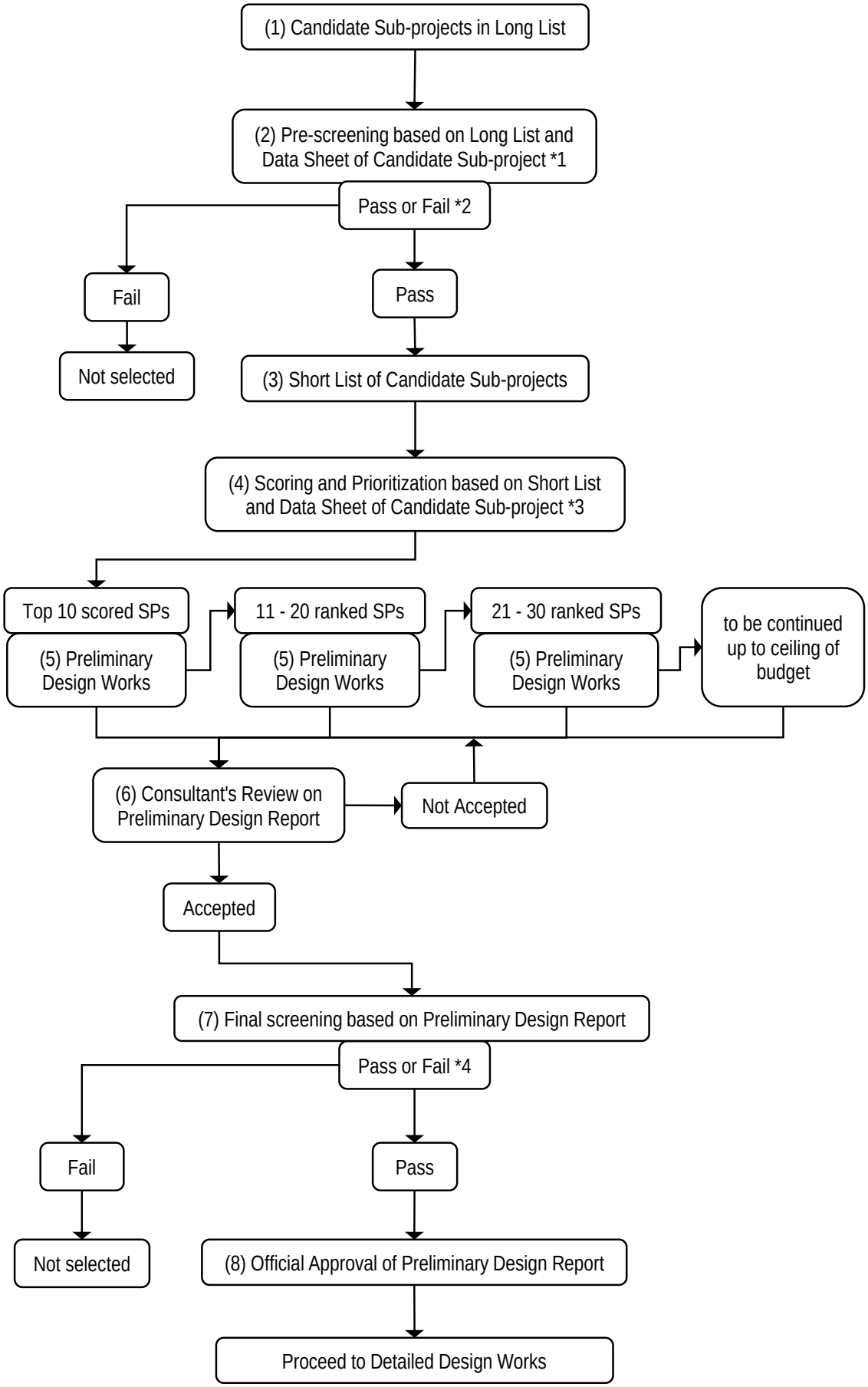
Source : *Préparé par l'équipe d'étude de la JICA sur la base de la carte de la SAED*

Figure B3.3.1 Model Site of Field Visit in Dagana Department



Source : *Préparé par l'équipe d'étude de la JICA sur la base de la carte de la SAED*

Figure B3.3.2 Model Site of Field Visit in Podor Department



Source: JICA Survey Team

Figure B4.2.1 Selection criteria and selection process of Sub-project (1/2)

NOTES:

*1: See Attachment 1 for format of "Data Sheet of Candidate Sub-project"

*2: Criteria for Pre-screening: the following criteria shall be satisfied:

1) Main crop shall be paddy
2) Proposed works shall include the irrigation development works, and
   Type of irrigation development works shall be rehabilitation works
3) Facilities and/or goods improved and/or provided by the project shall be government property
4) Proposed works/activities shall not require any land acquisition and/or resettlement
   (unless union/GIE can settle such issues by themselves without the government financial support)
5) Irrigation servise area after the project implementation shall be in the range of 10 ha to 1,000 ha
6) Water source for irrigation development shall be sufficiently available even in the dry season
7) Any programs/projects of other donors or GoS shall not be ongoing in the target scheme
8) Union/GIE shall be functioning and willing to cooperate with the project activities
9) Any significant environmental and social impact due to project activities shall not be anticipated
10) Crop intensity shall be improved by more than 50% and to more than 130% by the project implementation
11) Proposed works shall not include large scale flood prevention works

*3: Criteria for Scoring and Prioritization

1) Priority in the SAED policy
   (score: 1 (low) - 5 (high), weight: x8, weighted score: 40)
2) Expected improvement of crop intensity
   (score: 1 (50% ~), 2 (60% ~), 3 (70% ~), 4 (80% ~), 5 (90% ~), weight: x3, weighted score: 15)
3) Year after latest rehabilitation/construction
   (score: 1 (~ 10 yrs), 2 (~ 20 yrs), 3 (~ 30 yrs), 4 (~ 40 yrs), 5 (40 yrs ~), weight: x3, weighted score: 15)
4) Availability of data and information for preliminery design works (for "fast track")
   (score: 1 (low) - 5 (high), weight: x 2, weighted score: 10)
5) Access to site (exhibition effects to public as model case)
   (score: 1 (bad) - 5 (good), weight: x 2, weighted score: 10)
6) Potential for synergy effects among the components (number of components)
   (score: 1 (one), 2 (two), 3 (three), 4 (four), 5 (five), weight: x1, weighted score: 5)
   * irrigation development, PHF, agricultural machinery, farming practice and institutional development
7) Potential of gender related activities (gender consideration)
   (score: 1 (low) - 5 (high), weight: x1, weighted score: 5)

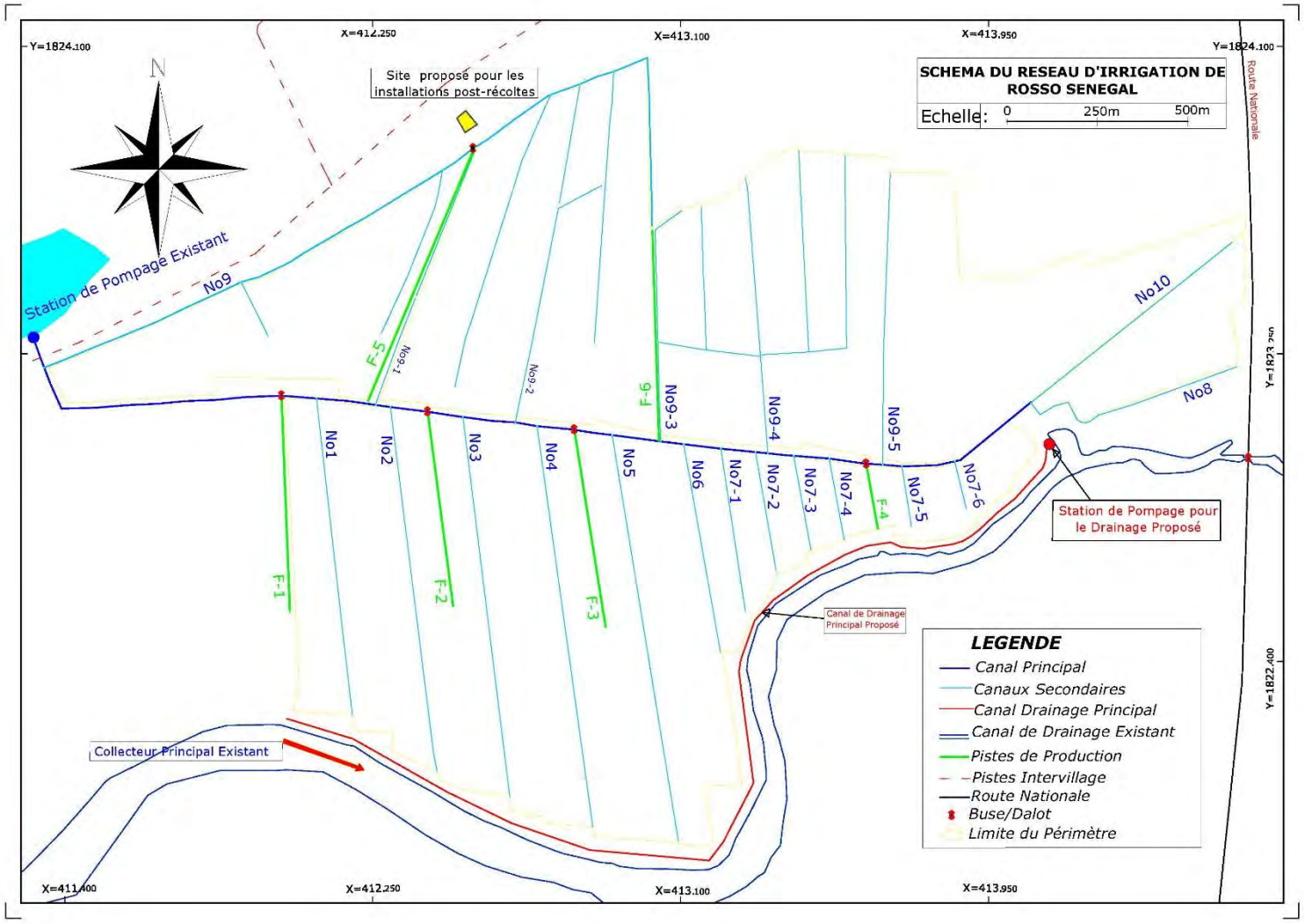
TOTAL Score: 100

*4: Criteria for Final Screening: In addition to the criteria shown in *2, the following criteria shall be satisfied:

1) EIRR of candidate sub-project shall not be less than 10%
2) Sub-project shall not be categorized as Category A pursuant to JICA Guidelines for environmental and social consideration
3) MOU including the following shall be signed by the concerned parties:
   - Statement of agreements/consensus among affected farmers, union, GIE leaders and SAED
     (for required lands for the proposed works/activities)
   - Statement of understandings among union/GIE and SAED
     (facilities and/or goods improved and/or provided by the project shall be government property)
     (understanding and agreements on the proposed works and activities)
     (commitments to fulfill duties and obligations required for implementation of the project)
4) Duration of construction works shall not be more than 3 years (or stage-wise development shall be considered)
5) Cost of sub-project shall not be more than 2.5 bil. FCFA (or stage-wise development shall be considered)

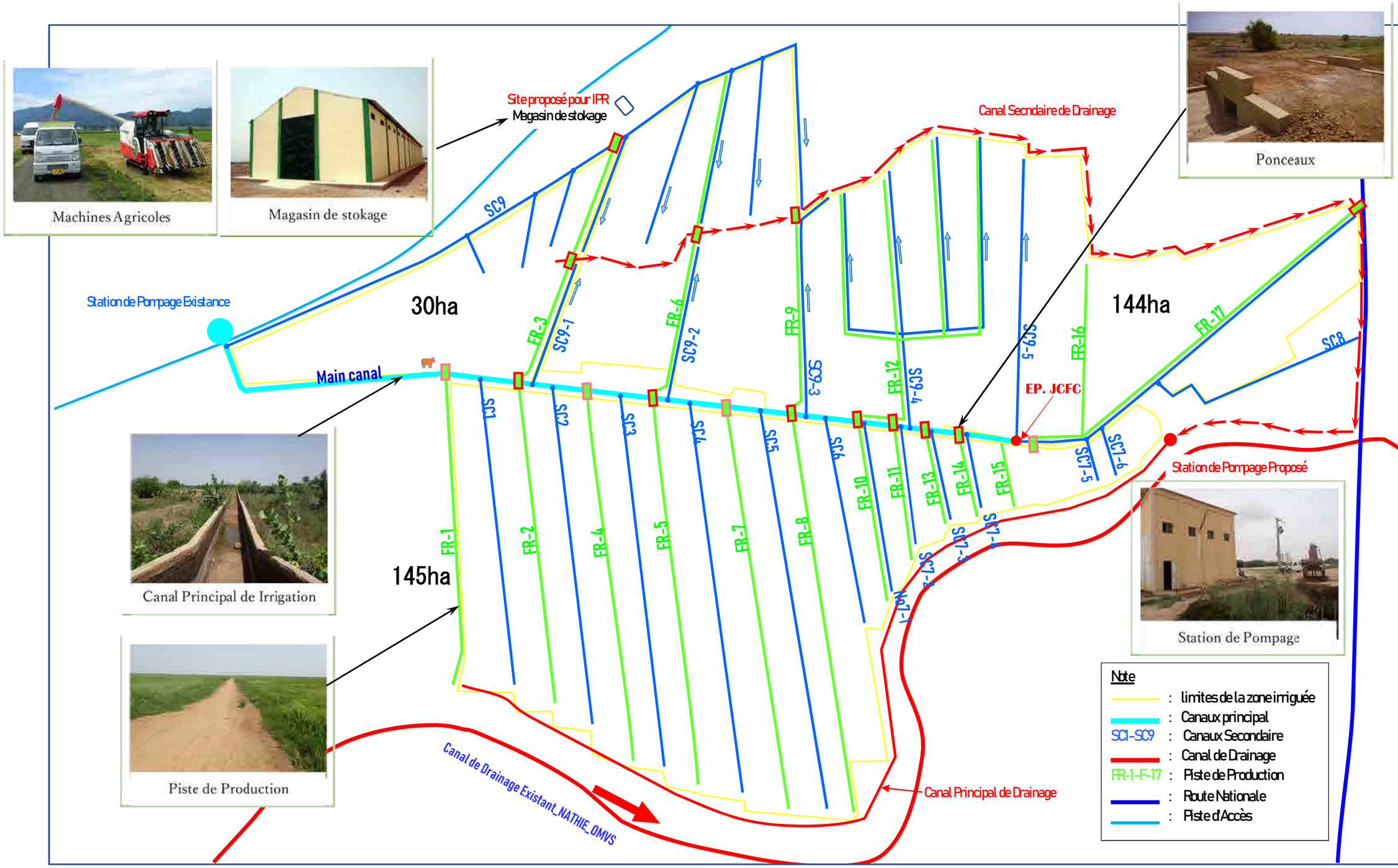
Source: JICA Survey Team

Figure B4.2.1 Selection criteria and selection process of Sub-project (2/2)



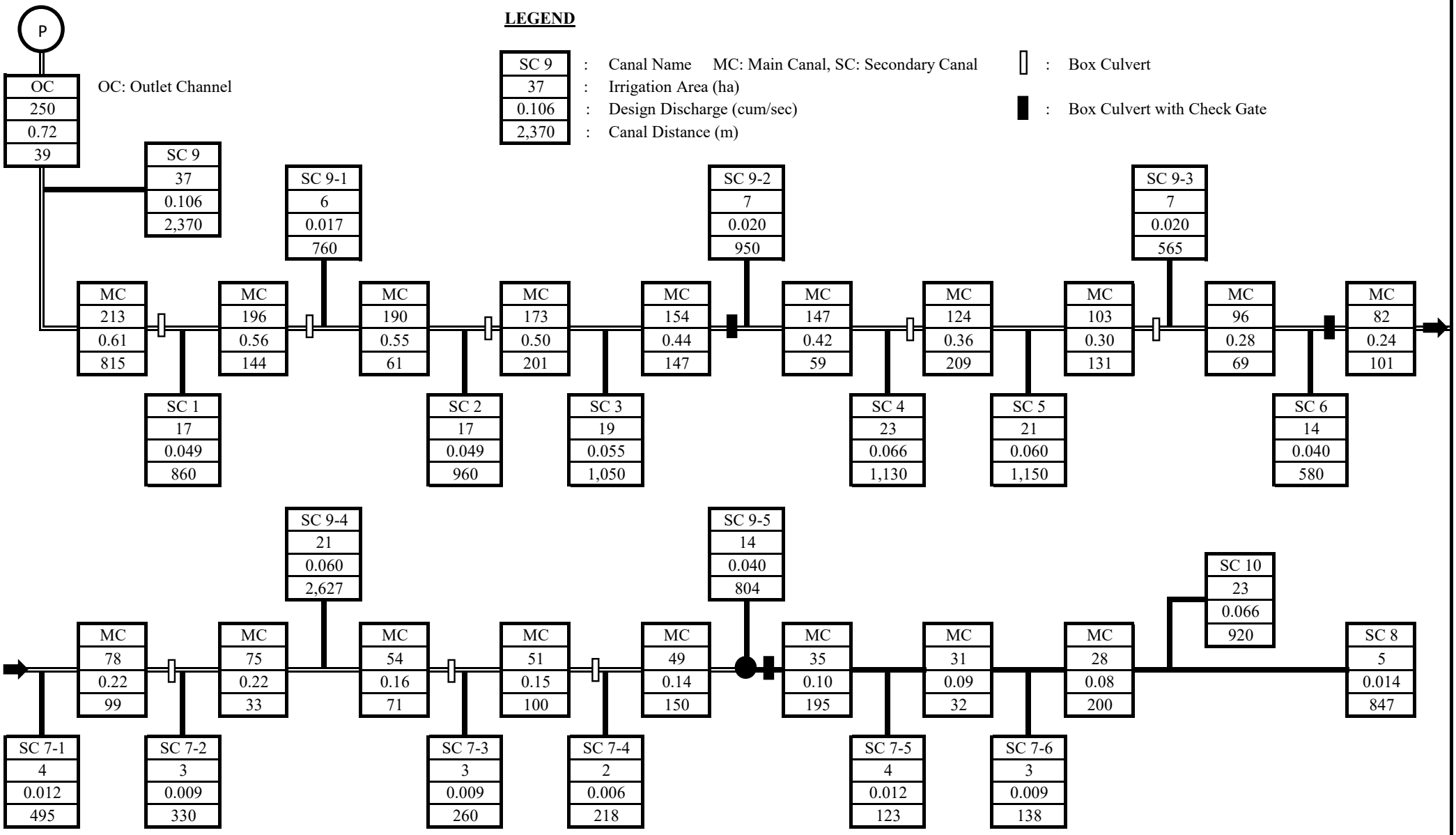
Source: JICA Survey Team

FigureB5.2.1 General Layout for Rosso Irrigation scheme



Source: JICA Survey Team

Figure B5.4.1 General Plan for Rosso irrigation scheme



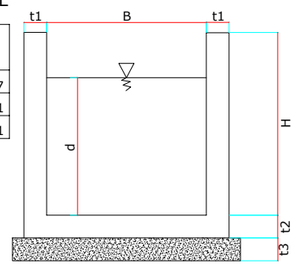
Source: JICA Survey Team

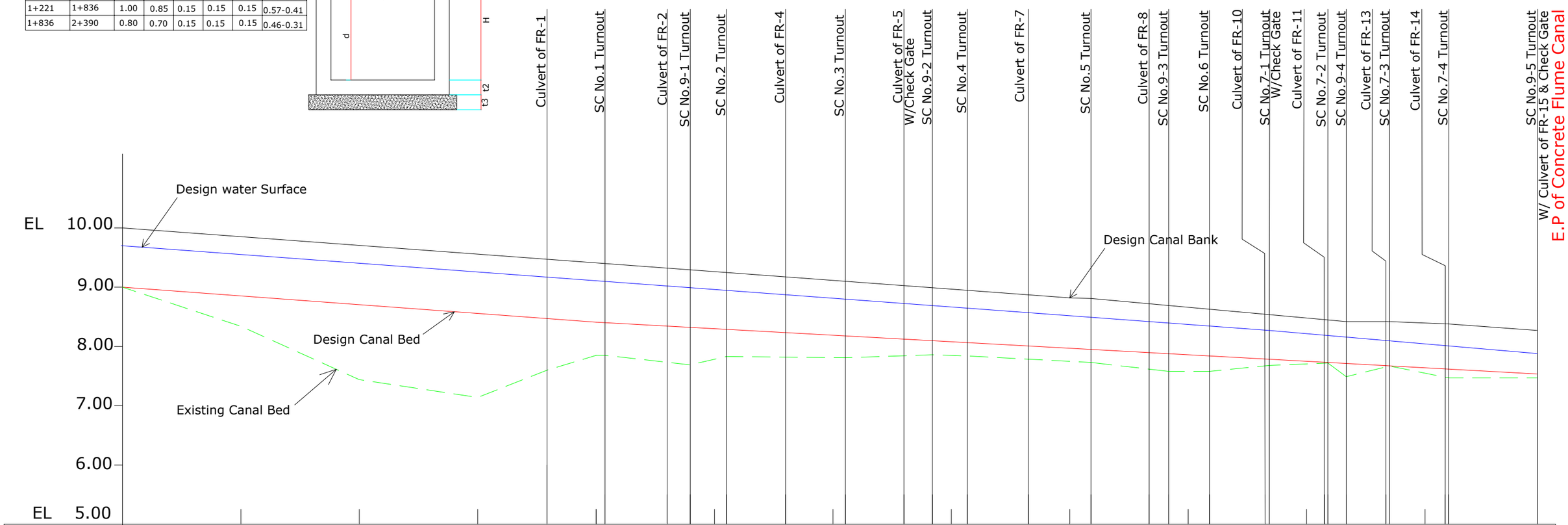
Figure B5.4.2 Irrigation Diagram

TYPICAL SECTION OF CONCRETE FLUME CANAL

DIMENSION TABLE OF CONCRETE FLUME CANAL

STATION		B	H	t1	t2	t3	d
From	To	(m)	(m)	(m)	(m)	(m)	(m)
0+000	1+221	1.10	1.00	0.15	0.15	0.15	0.67-0.57
1+221	1+836	1.00	0.85	0.15	0.15	0.15	0.57-0.41
1+836	2+390	0.80	0.70	0.15	0.15	0.15	0.46-0.31

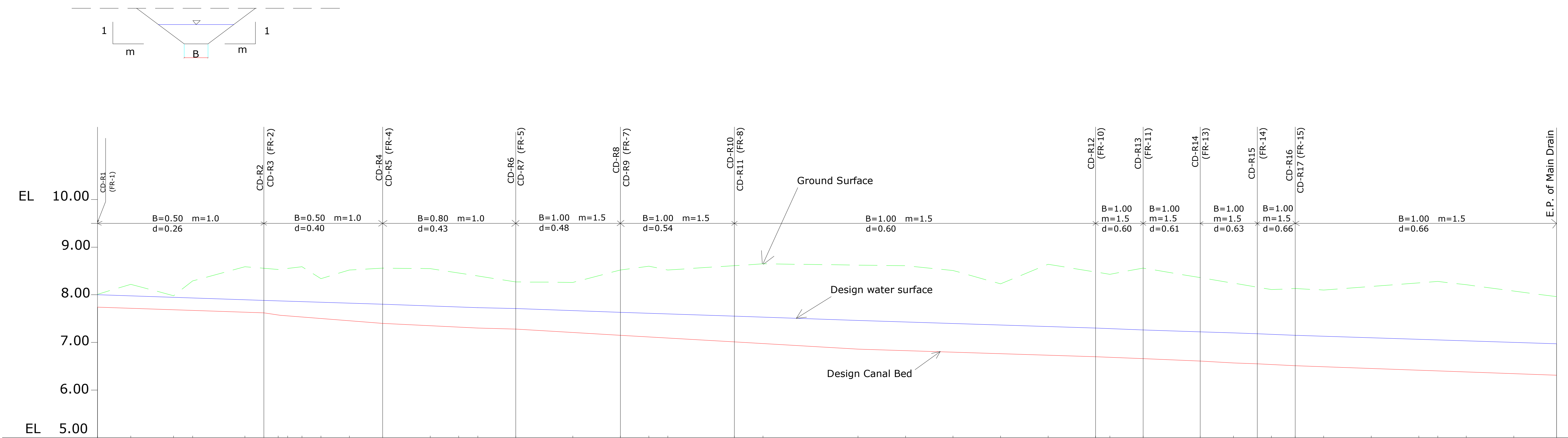




	STATION	0+000	0+200	0+400	0+600	0+717	0+800	0+815	0+920	0+959	1+000	1+020	1+120	1+200	1+221	1+320	1+368	1+400	1+427	1+530	1+600	1+636	1+734	1+767	1+800	1+836	1+930	1+937	2+000	2+030	2+036	2+067	2+134	2+140	2+200	2+234	2+240	2+390
	EXISTING CANAL BED	9.00	8.34	7.44	7.14		7.85	7.85		7.69		7.83		7.81			7.86		7.84		7.73			7.58	7.58		7.68			7.72	7.49		7.67			7.47		7.47
DISIGN EL.(m)	CANAL BANK	10.03	9.88	9.72	9.57		9.41	9.40		9.33		9.30		9.20			8.93		8.91		8.82			8.77	8.74		8.46			8.42	8.39		8.43			8.38		8.27
	WATER SURFACE	9.70	9.55	9.39	9.24		9.08	9.07		8.96		8.92		8.77			8.65		8.61		8.46			8.35	8.30		8.22			8.15	8.12		8.07			8.00		7.88
	CANAL BED	9.03	8.88	8.72	8.57		8.41	8.40		8.33		8.30		8.20			8.08		8.06		7.97			7.92	7.89		7.76			7.72	7.69		7.73			7.68		7.57

Source: JICA Survey Team

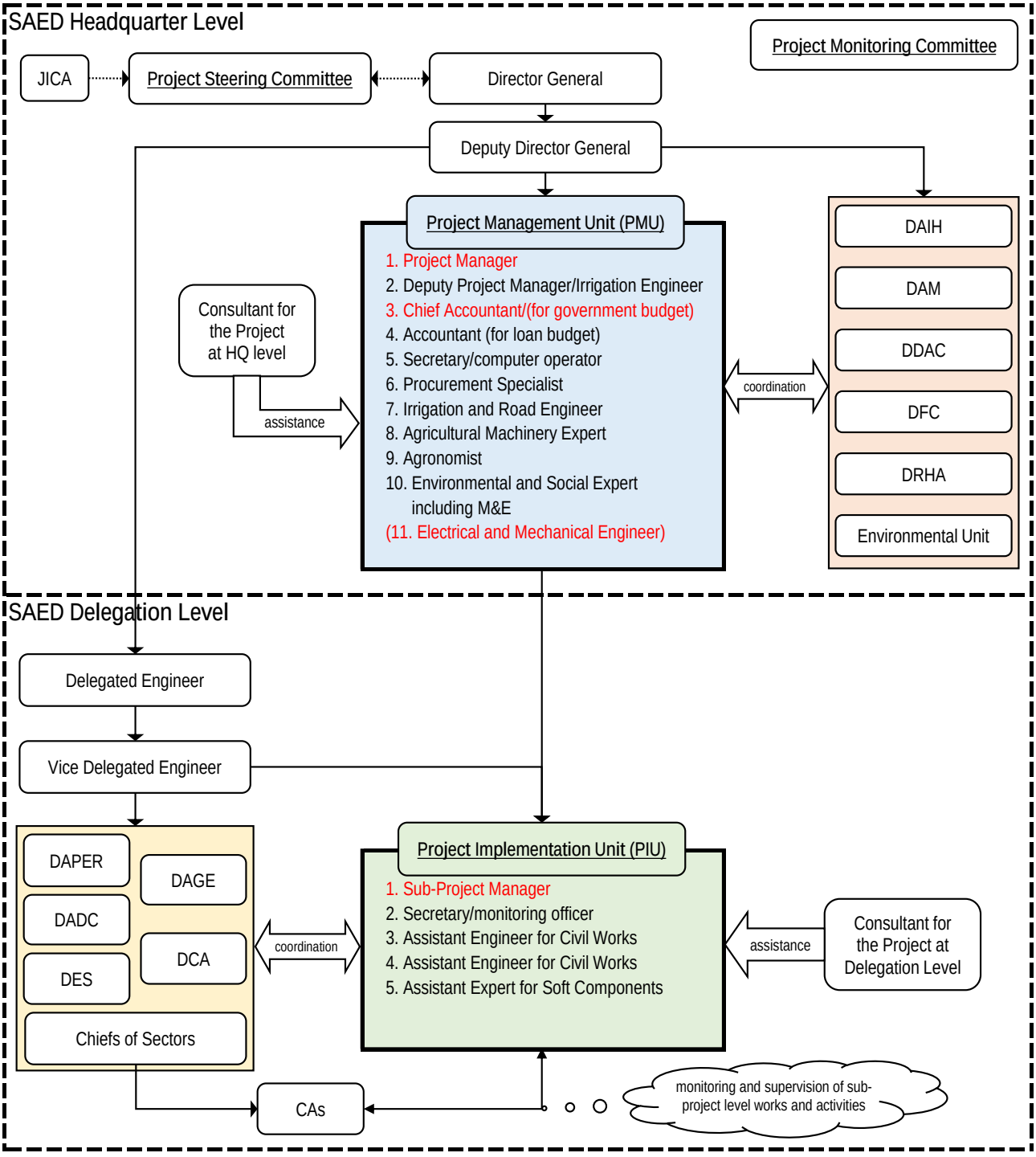
Figure B5.4.3 Longitudinal Profile of Main Irrigation Canal for Rosso Scheme



STATION	GROUND ELEVATION	DISIGN EL.(m) CANAL BANK	DISIGN EL.(m) WATER SURFACE	DISIGN EL.(m) CANAL BED
0+000	8.01		8.00	7.74
0+070	8.22		8.00	7.74
0+160	7.98			
0+200	8.29			
0+310	8.59			
0+350			7.88 / 7.88	7.62 / 7.48
0+380	8.53			
0+400				
0+430	8.59			
0+470	8.34			
0+530	8.52			
0+600	8.56		7.80 / 7.80	7.40 / 7.37
0+700	8.55			
0+760	8.52			
0+800			7.73	7.30
0+880	8.27		7.71 / 7.71	7.28 / 7.23
1+000	8.26			
1+100	8.52		7.63 / 7.63	7.15 / 7.09
1+160	8.60			
1+200	8.52			
1+340			7.55 / 7.55	7.01 / 6.95
1+400	8.65			
1+600			7.46	6.86
1+700	8.61			
1+800	8.51			
1+900	8.23			
2+000	8.64			
2+100			7.30 / 7.30	6.70 / 6.70
2+130	8.43			
2+200	8.56		7.26 / 7.26	6.66 / 6.65
2+210				
2+330			7.22 / 7.22	6.61 / 6.59
2+400			7.20	6.57
2+450			7.18 / 7.18	6.55 / 6.54
2+480	8.11			
2+530			7.15 / 7.15	6.51 / 6.49
2+540	8.13			
2+600	8.10			
2+800				
2+840	8.28			
2+900	8.21			
3+000				
3+090	7.96		6.97	6.31

Source: JICA Survey Team

Figure B5.4.4 Longitudinal Profile of Main Irrigation Drain for Rosso Scheme



Note: 1. Red colored staff in PMU and PIU should be the permanent staff of SAED
2. Underlined organization will be newly established for the Project

DAIH: Department of Development and Hydro-agricultural Infrastructues
DAM: Independent Department of Maintenance
DDAC: Department of Development and Support to Territorial Communities
DFC: Financial and Accounting Department
DRHA: Department of Human Resources and Administration
DAPER: Division for Support of Rural Production and Entrepreneurship
DAGE: Division of water and environmental management
DADC: Municipal Development Support Division
DCA: Accounting and Administration Division
DES: Evaluation Monitoring Division
CA: Extension Officer of SAED

Source: JICA Survey Team

Figure B7.1.1 Project Implementation Structure Chart