

Commissioned by the Ministry of Health, Labour and Welfare

FY2020 Waterworks Project Planning Guidance Project

(Phase 2)

Nacala Corridor Urban Water Supply Enhancement Project

in the Republic of Mozambique

Final Report

March 2021

Japan Techno Co., Ltd.

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Summary

1. Background of the Project

Japan has been continuously providing assistance to Mozambique, and in particular, the development assistance to the Nacala Corridor is positioned as one of the most important projects in the entire African region. The Nacala Corridor is expected to grow in the future, but it lacks sufficient water services to meet the growing demand for water due to population growth. In particular, the city of Nampula, the capital of Nampula Province, has been receiving many residents from the neighboring province of Cabo Delgado due to the outbreak of attacks by unidentified armed groups in this Province.

The main water source for the city of Nampula, the capital of Nampula Province located in the Nacala Corridor, is a dam on the Monapo River built in the 1960s, which has limited capacity to continue meeting the city's water supply needs. Based on this reality, studies have concluded that the current water sources will face serious water shortages due to the effects of climate change, and research on alternative water sources is recommended for the medium to long term, with the construction of new dams (Sauga Sauga, Meluli, Mecuburi, and Lúrio rivers) being a particular focus. On the other hand, groundwater studies have confirmed the difficulty to secure a large quantity of groundwater sufficient to cover the entire city of Nampula.

Through investments up to 2014, the production capacity of the water treatment plant doubled from 20,000 m³/day to 40,000 m³/day and the service hours more than doubled from 6 hours to 13 hours/day.

Currently, the Nampula municipal water supply system produces about 40,000 m³/day of water, which, according to a 2018 study, represents 50% of the estimated water demand of 77,787 m³/day in 2017, pointing to the limitations of the water source. The current water coverage rate is 51% for an estimated population of 650,000 persons. As mentioned above, refugees from Cabo Delgado are expected to settle in the outskirts of Nampula city, which will further worsen the water supply situation in Nampula, requiring urgent actions by the Mozambican government.

2. Objective of the Project

This project will provide recommendations and advice for contributing to the preparation of plans for solving problems from professional and technical perspectives, based on the issues (facilities development, operation and maintenance, human resources development, etc.) and potential needs of water services.

The project also aims to improve the capacities of the central and local governments of Mozambique to develop water supply projects, formulate water supply policies, and manage water supply facilities by identifying specific measures to solve problems together with the administrative officials and staff in charge of water supply of Mozambique.

Specifically, with regard to the water supply facilities in Nampula City, in which the Fund for Investment and Assets of Water Supply (Fundo de Investimento e Património do Abastecimento de Água: FIPAG) has positioned this project as the top priority project, the feasibility of the project will be assessed in terms of needs, consistency with higher-level plans, degree of urgency, contents of facilities to be improved, and other factors, by compiling existing data and conducting field surveys. The project will provide specific support and guidance to formulate a more feasible plan, including the need for a cooperation scheme and soft component support suitable for the scale of the project.

In the Mozambique water supply project, the ownership of facilities and the operation and maintenance system are clearly divided according to the size of the municipality to be covered. The ownership of each facility and the organization in charge of operation and maintenance are described below.

Organization	Water Supply Investment Promotion Fund (FIPAG)	Water Supply and Sanitation Infrastructure Administration (AIAS)	Provincial Directorate of Public Works (DPOP) District Planning and Infrastructure Service Division (SDPI)
Target	Large cities (Capital, Provincial capital, etc.)	Medium-sized cities (District government, etc.)	Towns and villages other than those listed to the left (Town/village)
Number of Responsible Areas	21	131	Areas not covered by FIPAG and AIAS
Ownership and Responsibility for Operation and Maintenance	FIPAG	AIAS	Each District
Operation and Maintenance	Directly managed by FIPAG	Private In case private outsourcing is difficult, SDPI or Municipality etc.	Piped water supply facilities: Private sector Borehole with hand pump: Water and Sanitation Committee

Note: The specific cities and towns under the jurisdiction of each agency are determined by government ordinance.

The target of this project is Nampula City, the capital of Nampula Province, and the decree stipulates that the competent authority is FIPAG.

3. Problems and Challenges

(1) National Level

At the national level, the following water supply issues have been identified.

Classification	Problems and Issues
PPP	● Delays in dissemination of PPP/PFI to rural cities
Project Scheduling	● Delays in scheduling of loan projects
Operations and Finance	● Securing facilities rehabilitation funds ● Rise in debt-to-water revenue ratio ● Low recovery of non-collected fees
Facilities	➤ Water source ● Scarcity of water sources (drought and increased water

Classification	Problems and Issues
	<ul style="list-style-type: none"> demand due to climate change) ➤ Facility <ul style="list-style-type: none"> ● Insufficient capacity of facilities ● Increase in water leakages ➤ Water supply <ul style="list-style-type: none"> ● Routine implementation of planned water suspensions ● Non-installation of water meters ● No assurance of residual chloride
Management	<ul style="list-style-type: none"> ● Insufficient water pressure and water volume ● Non-implementation of asset management ● No improvement in management of water supply services
Staff	<ul style="list-style-type: none"> ● Low capacity in technical skills of staff

(2) Project Target Area

The problems in Nampula City, which is the project target area, range from lack of basic water sources to leakages due to deteriorating facilities and delayed expansion of facilities due to population growth. The main problems are listed below.

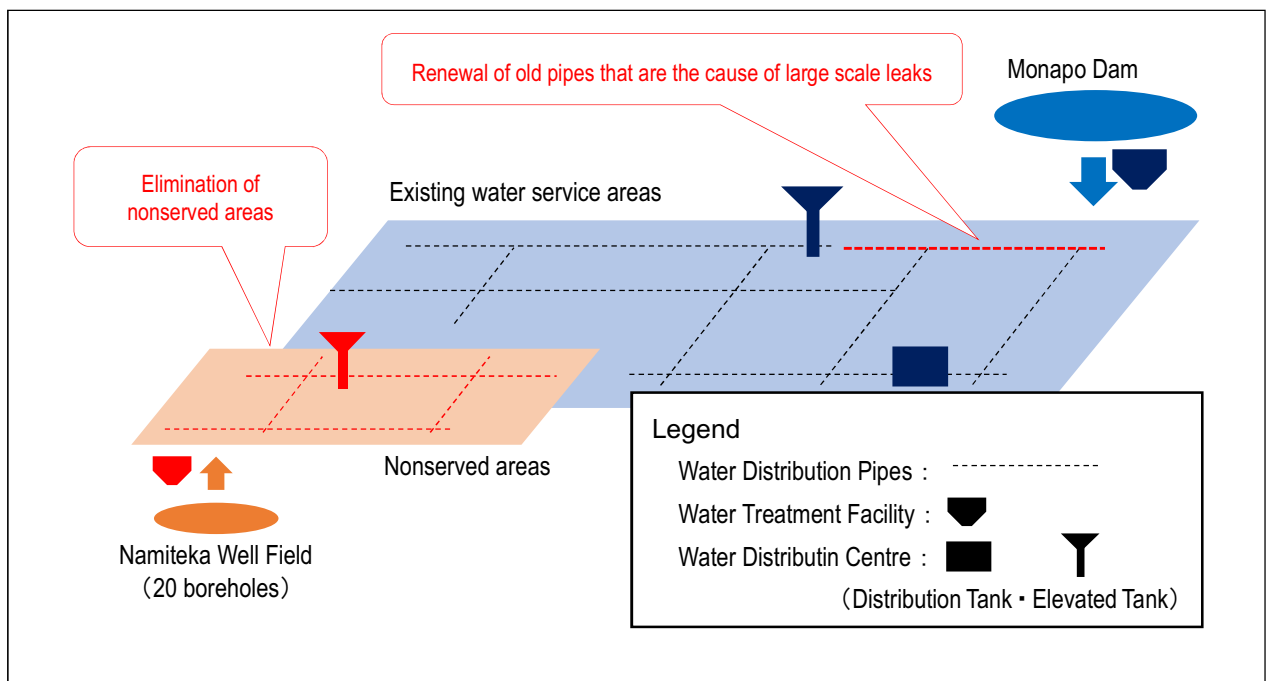
Classification	Problem	Necessary Countermeasure	
		Short term	Medium- to long-term
Services Management	<ul style="list-style-type: none"> • Delays in implementation of large-scale projects 	<ul style="list-style-type: none"> • Planning management and securing financial resources 	-
Water Source	<ul style="list-style-type: none"> • Water source shortage 	<ul style="list-style-type: none"> • Securing alternative water sources such as boreholes 	<ul style="list-style-type: none"> • Water source developments such as Mugica Dam
Facility	<ul style="list-style-type: none"> • Occurrence of large-scale water leakages • Uneven distribution of water volume • Lack of water pressure • Expansion of nonserved areas 	<ul style="list-style-type: none"> • Renewal of deteriorated pipelines (water transmission) • Division of water service areas • Construction of new water distribution centers 	<ul style="list-style-type: none"> • Elimination of nonserved areas • Renewal of deteriorated pipelines (water distribution) • Block service of water pipe network
Fee collection	<ul style="list-style-type: none"> • Insufficient fee collection 	-	<ul style="list-style-type: none"> • Installation of water meters
Staff	<ul style="list-style-type: none"> • Low capacity for operation and maintenance 	-	<ul style="list-style-type: none"> • Conducting technical training • Procurement of maintenance equipment • Planning for renewals

4. Project Outline

The initial request for the high-priority project is as follows

Parameter	Project Target Area
Target area name and population (2017)	Nonserved areas: Namiteka, Mapara => 54,000 persons Expansion/rehabilitation areas: Muahivire, Nampaco, Muhala => 146,302 persons
Design year	2037

Parameter		Project Target Area	
Design population ¹		246,571 persons (2037)	
Unit supply rate		House connections: 125L/person/day Private yard tap: 80 L/person/day Shared yard tap: 50 L/person/day Public tapstand : 30 L / person / day	
Design pumping rate		2,250 m ³ /day	
Planning Stage	Facility name, etc.	Specifications, etc.	Quantity
1. Facility construction	1-1 Borehole drilling 20 wells (10 existing boreholes will also be used)	Depth : 60m Pumping rate : 5.0 m ³ /hr	20 boreholes
	1-2 Borehole facilities (pump operation room, guard room, generator room)	Pillar and beam RC construction (wall CB pile), borehole pump equipment	5 locations
	1-3 Transmission main and transmission pipe	HDPE pipe DN80-250	25km
	1-4 Booster pumping station (receiving water tank, water pump room, power receiving equipment room, generator room)	Receiving basin (V=300m ³) RC construction, water pump equipment, in-plant piping (steel pipes)	1 location
	1-5 Water distribution center (water distribution reservoir, disinfection room, flow meter room)	Water distribution reservoir (ground type V=1000m ³ , elevated tank V=300m ³) RC construction, chlorine dosage system	1 location
	1-6 Water distribution pipe	HDPE pipe DN50-300	80km
2. Design and construction supervision	2-1 Facilities design, construction supervision, etc.	-	1 set



System Outline Diagram

¹Source : Update of the Feasibility Study for City of Nampula, 2018, FIPAG

5. Conclusion

While Mozambique is still at the stage of focusing on cyclone reconstruction assistance, Nampula is one of the cities that should be given the highest priority for expansion of water supply facilities due to the strained demand for water. The urgency of the project is very high due to the deteriorating facilities, the amount of water leakages, the chronic suspension of water supply in the city, and the fact that internally displaced persons have settled in the suburbs of Nampula due to the degrading security situation in Cabo Delgado Province.

In this project, based on the understanding of the current status of the project area and upon consideration of solving the issues, this high priority project is proposed as a grant aid project.

Basic Indicators

Category	Main Item	Sub-Item	Indicator	Source
1 Basic Information	1 Country information	1 Area	799,000 km ²	Ministry of Foreign Affairs of Japan
		2 Population	31.4 million (2019)	World Population White Paper 2019
		3 Population growth rate	2.9% (2018)	World Bank
	2 Politics	1 Form of government	Republic	Ministry of Foreign Affairs of Japan
		2 Former colonial country	Portugal	//
		3 Capital	Maputo	//
	3 Society and Culture	1 Race	About 40 ethnic groups including Makua and Lomwe	//
		2 Language	Portuguese	//
		3 Religion	Christianity (about 40%), Islam (about 20%), traditional religions	//
	4 Climate	1 Climate	The Indian Ocean coast has a tropical savanna climate, the northwestern part near the Malawi border has a temperate rainy climate, and the southern part has an arid climate. Maputo, the capital city located in the south, has an annual average temperature of 22.9°C and annual precipitation of about 800mm. Beira, near the central coast, has an annual average temperature of 24.4°C and annual precipitation of about 1600mm.	Peel, M.C. (2007) Maps, etc.
	5 Travel	1 Security and cautions for traveling	Alert level <u>Level 1</u> : Maputo Province, Niassa Province, part of Manica Province, part of Sofala Province <u>Level 2</u> : Southern part of Cabo Delgado Province, Sofala Province, Manica Province <u>Level 3</u> : Cabo Delgado Province <u>Nampula Province</u> : Not specified	Overseas Safety Homepage, Ministry of Foreign Affairs of Japan (As of February 12, 2021)

Category	Main Item	Sub-Item	Indicator	Source
2 Economic Indicators	1 Indicator	1 GNI	13.8 billion USD (World Bank 2016)	Ministry of Foreign Affairs of Japan
		2 GNI per capita	480USD (World Bank 2016)	„
		3 Economic growth rate	3.6% (2016 World Bank)	„
		4 Price escalation rate	19.8% (2016 World Bank)	„
		5 Unemployment rate	24.5% (2017 World Bank)	„
		6 Literacy rate	60.7% (2017)	UNESCO
		7 Human Development Index (HDI)	0.437 (180th in the world) (2017)	UNDP
	2 Overview	Economic Overview	The main industries are agriculture, forestry, fisheries, and mining. The country has achieved economic growth with the establishment of peace, and although the high economic growth of recent years (7-8% per year) has temporarily declined, the private sector is highly motivated to invest due to abundant natural resources (natural gas, coal), and stable growth is expected in the future.	Ministry of Foreign Affairs of Japan
3 Water Supply	1 Coverage	Service population	16,437 thousand persons (Urban: 8,723, Rural: 7,714) / 29,669 thousand persons (Urban:10,384, Rural:19,285)	JMP (2017 data)
	2 SDGs Reference index	SDGs Reference Indicators	Country 56%, Urban 84%, Rural 40% Percentage of population with access to "basic drinking water" ²	JMP (2017 data)
	3 Governance	1 National Strategy for Water Supply	National Water Policy (amended in 2016)	JICA report ³ ^{*3}
		2 Water Supply Law	Water Law (Act No. 16/91)	
		3 Water quality standards	Ministerial Authorization DM 180/2004	
		4 Financial foundation	Two public corporations (FIPAG for large cities and AIAS for small cities) own the country's water supply. The World Bank has explained that	

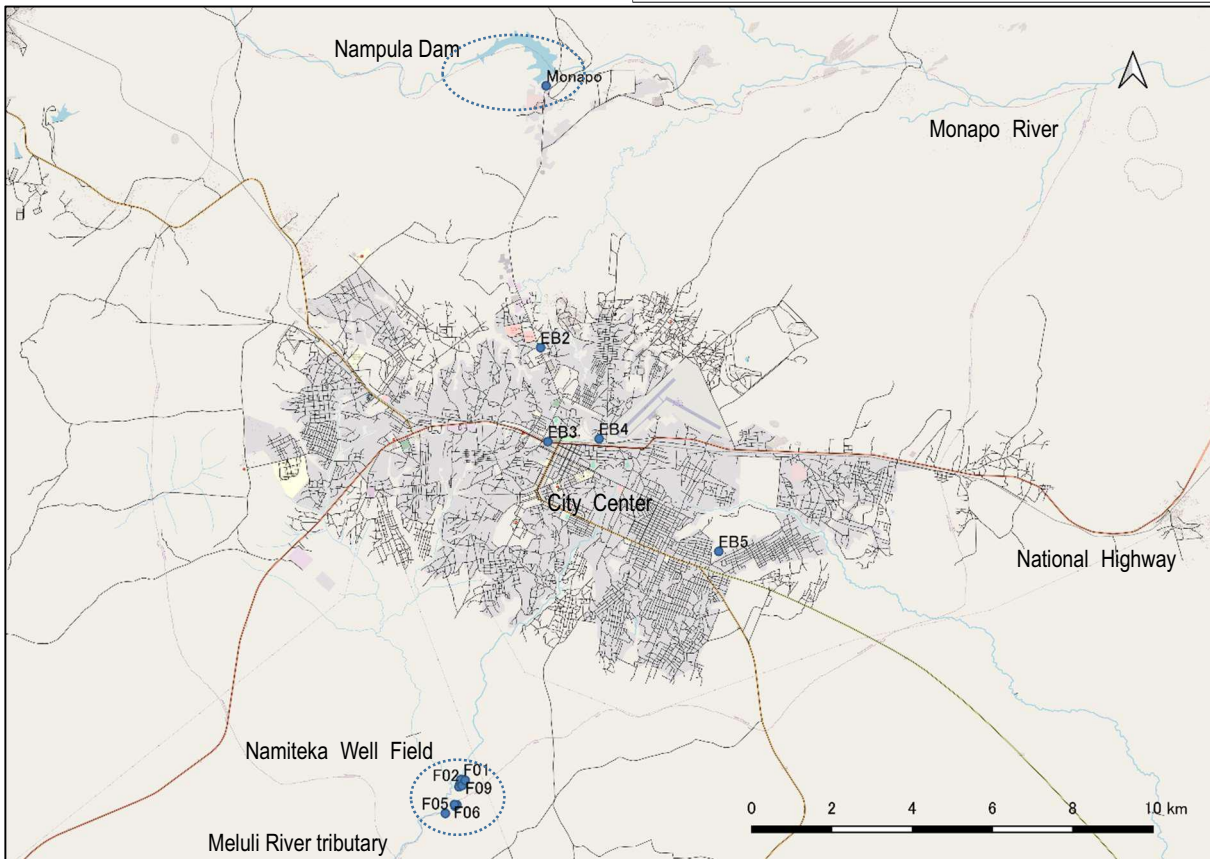
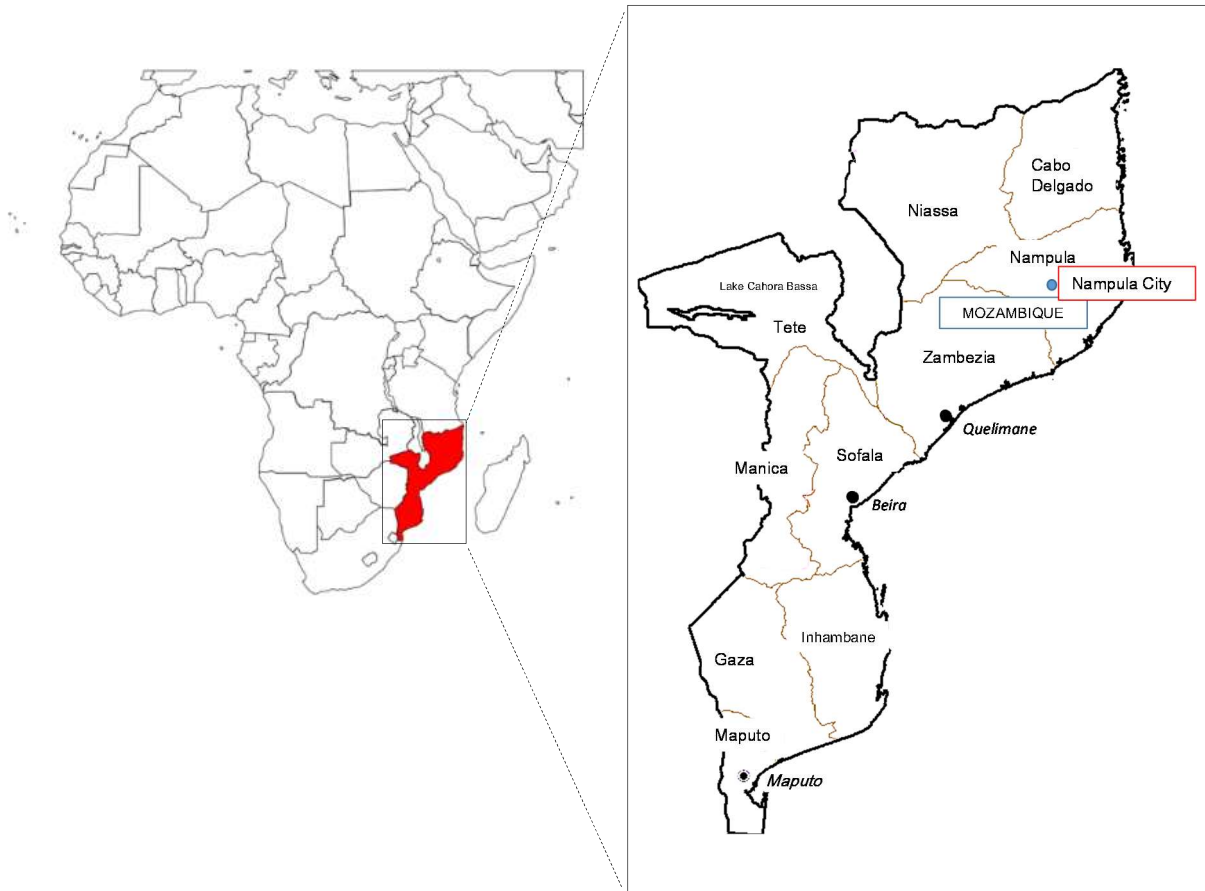
² Estimates for countries that do not provide the percentage of the population using "Safely managed" water, which should be indicated.

³ Source: Completion Report for the Sustainable Rural Water Supply and Sanitation Improvement Project, Niassa Province, Mozambique, JICA, February 2017.

Category	Main Item	Sub-Item	Indicator	Source
			FIPAG can achieve full cost recovery to eliminate government subsidies, but external donors continue to make public investments in the water sector.	
4 Official Development Assistance (ODA) Policy	1 Development Cooperation Policy	Support will be provided to the human development sector, as a priority sector, to expand access to safe water through the development of water supply facilities, with the aim of improving the Human Development Index, which is one of the lowest in the world, and achieving the MDGs. (March 2013)		Ministry of Foreign Affairs ODA Country-based Development Cooperation Policy (Former Country Assistance Policy)
	2 Project Development Plan	As part of the "Water Supply and Sanitation Improvement Program," the following programs were implemented from 2015 to 2017: thematic training in water supply and sanitation, urban sanitation project near Maputo (World Bank Social Development Fund), Japan Overseas Cooperation Volunteers (JOCV) in rural water supply and sanitation, and grassroots human security grant aid for the water sector. (April 2016)		Ministry of Foreign Affairs ODA Rolling Plan
5 Relationship with Japan	Trade value	Exports to Japan and Imports from Japan (2017)	Approx. 21.59 billion Yen (timber and similar products, mineral fuels, seeds/fruits for extraction) Approx. 11.31 billion Yen (vehicles, steel products, etc.)	Ministry of Foreign Affairs of Japan
	Business expansion, etc.	Japanese companies operating in Mozambique Number of Japanese residents	- 176 persons (2017)	//

Source: Ministry of Health, Labour and Welfare, FY2040 Report on International Cooperation Study Project in the Water Supply Sector, p. 89-91, March 2020.

Location Map



Nampula City © OpenStreetMap contributors

Photographs



External view of FIPAG Nampula Branch Office



FIPAG Nampula Branch Office, Service Counter



Suburban scenery of Nampula City



View of a residential area in Nampula



View of Nampula city center



View of Nampula city center



Nampula (Monapo) Dam scenery



View of Nampula (Monapo) Dam (water level lowers during the dry season)



Water intake facility installed at Nampula Dam.



Water treatment plant at Nampula Dam



Water treatment plant at Nampula Dam



Interior of Pumping Station No. 1



Pumping Station No. 3 (EB3) and reservoir



Distribution tank at Pumping Station No. 5 (EB5: 5000m³)



Distribution tank at Pumping Station No. 5 (EB5: 5000m³)



Distribution tank at Pumping Station No. 5 (EB5: 5000m³)



Elevated tank at Pumping Station No. 3



Elevated tank at Pumping Station No. 4



House connection installed in Nampula City



House connection installed in Nampula City



Borehole constructed in 2020 in Namiteka area, south of Nampula city



Borehole with pump constructed in 2020 in Namiteka area, south of Nampula city

Abbreviations

AIAS	Administration for Water and Sanitation Infrastructure
AURA	Water Regulation Authority
CRA	Water Regulatory Council (renamed to AURA in 2019)
DIP	Ductile cast iron pipe
DN	Nominal diameter
DNAAS	National Directorate of Water Supply and Sanitation
DPOP	Provincial Directorate of Public Works
EAS	Simplified environmental survey
EB	Pumping station
EIA	Environmental Impact Assessment
ETA	Water treatment plant
FIDIC	International Federation of Consulting Engineers
FIPAG	Water Supply Investment Promotion Fund
F/S	Feasibility study
GDP	Gross domestic product
GIS	Geographic information system
GNI	Gross national income
HDPE	High-density polyethylene pipes
ISO	International Organization for Standardization
JICA	Japan International Cooperation Agency
JMP	Joint Monitoring Program
KPI	Key Performance Indicator
MCA	U.S. Millennium Challenge Accounting
MDGs	Millennium Development Goals
MITA	Ministry of Land and Environment
MOPHRH	Ministry of Public Works, Housing and Water Resources
MZN	Metical (Mozambican currency)
NGOs	Non-governmental organization
NPO	Nonprofit organization
ODA	Official Development Assistance
PBPGA	Good practices related to environmental management
PPP	Public-private partnership
PFI	Private Finance Initiative
PVC	Polyvinyl Chloride
QGD	Delegation management framework
SDGs	Sustainable Development Goals
SDPI	County Planning and Infrastructure Development Division
SPA	Provincial Department of Environmental Improvement
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund

VAT	Value-added tax
WDI	World Development Indicator
WHO	World Health Organization

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Chapter 1 Introduction

1.1 Background and Objectives

1) Country Overview

The Republic of Mozambique (hereinafter referred to as "Mozambique") has a land area about twice of Japan (about 800,000 km²), is located in the southeast of the African continent, faces the Indian Ocean to the east, and is bordered by six neighboring countries: South Africa and Swaziland to the southeast, Zimbabwe to the east, and Tanzania, Malawi, and Zambia to the north. The population is 27.12 million persons (National Statistics Office estimate, 2017), and the population growth rate is 2.8% (World Bank World Development Indicator (WDI) 2016).

Since the end of the civil war in 1992, Mozambique has been promoting democratization and peace building with the support of the international community, and has achieved high economic growth, recording a real GDP growth rate of 6-8% since 2001, and is regarded as an "honorary country of post-war reconstruction". As a resource-rich country with abundant natural resources such as coal, titanium, and natural gas, economic development has been driven by large-scale projects of foreign companies and their related active investment in infrastructure development in the transportation, communications, and energy sectors.

However, it remains one of the poorest countries in the world with a GNI (Gross National Income) per capita of US\$480 (United Nations Statistics, 2016), a poverty rate of 54.7% (National Statistics Office, 2009), and a Human Development Index of 0.418, ranking 181st out of 188 countries (United Nations Development Programme, 2016).

2) Background

Japan has been continuously providing assistance to Mozambique, and in particular, the development assistance to the Nacala Corridor is positioned as one of the most important projects in the entire African region. The Nacala Corridor is expected to grow in the future, but it lacks sufficient water services to meet the growing demand for water due to population growth. In particular, the city of Nampula, the capital of Nampula Province, has been receiving many residents from the neighboring province of Cabo Delgado due to the outbreak of attacks by unidentified armed groups in this Province.

Nampula City's main water source is a dam on the Monapo River built in the 1960s, which has limited capacity to continue meeting the city's water supply needs. Based on this reality, studies have concluded that the current water sources will face serious water shortages due to the effects of climate change and other factors, and research on alternative water sources is recommended for the medium to long term, with the focus on construction of new dams (Suaa Suaa, Meluli, Mecuburi, and Lúrio rivers). On the other hand, groundwater studies have confirmed that it is difficult to secure a large quantity of groundwater sufficient to cover the entire city of Nampula.

Through investments up to 2014, the production capacity of the water treatment plant doubled from 20,000 m³/day to 40,000 m³/day and the service hours more than doubled from 6 hours to 13 hours/day.

Currently, the Nampula municipal water supply system produces about 40,000 m³/day of water, which, according to a 2018 study, represents 50% of the estimated water demand of 77,787 m³/day in 2017,

pointing to the limitations of the water source. The current water coverage rate is 51% for an estimated population of 650,000 persons. As mentioned above, refugees from Cabo Delgado are expected to settle in the outskirts of Nampula city, which will further worsen the water supply situation in Nampula, requiring urgent action by the Mozambican government.

The Fund for Investment and Assets of Water Supply (Fundo de Investimento e Património do Abastecimento de Água: FIPAG) holds the ownership of urban water supply facilities and directly operates, maintains and manages them in all regions except in the metropolitan area of Maputo.

3) Objective

This project will give advice and recommendations that can contribute to the preparation of plans for solving problems from a professional and technical perspective, based on identifying the problems (facilities development, operation and maintenance, human resources development, etc.) and potential needs of water services.

The project also aims to improve the capacities of the central and local governments of Mozambique to develop water supply projects, formulate water supply policies, and manage water supply services by examining specific measures to solve problems together with the administrative officials and staff in charge of water supply in Mozambique.

Specifically, with regard to the water supply facilities in Nampula City, where FIPAG has positioned this project as the top priority project, the feasibility of the project will be assessed in terms of needs, consistency with higher-level plans, degree of urgency, and contents of facilities to be improved, by compiling existing data and conducting field surveys. The project will provide specific support and guidance for the formulation of more feasible plans, such as the need for cooperation schemes and soft component support suitable for the scale of the project.

1.2 Schedule and Survey Method

1) Schedule

The overall schedule of this project is shown in Table 1. Due to the COVID-19 crisis, the survey was conducted remotely using online meetings and e-mail.

Table 1 Implementation Schedule

Activity	2020												2021											
	October				November				December				January				February				March			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1 Collection and compilation of existing information			■																					
2 Sending and collection of questionnaire forms						□		□																
3 Guidance on plan preparation			□			□			■	■	■	■	■	■	■	■								
4 Preparation of report													■	■	■	■								
5 Submission of report (Japanese version)																							△	
6 Submission of report (English version)																							■	■
7 Submission of deliverables																								△
8 Submission of project achievement report																								△

Legend: ■ Local guidance □ Work in Japan △ Submission of reports

2) Survey Method

Existing information and data were collected from the project responsible authority, the supervising agency "National Directorate for Water Supply and Sanitation" (hereinafter referred to as "DNAAS"), and the executing agency FIPAG, and the collected information and data were reviewed. In addition, a questionnaire survey and online and telephone interviews on the current status and operation of existing water supply facilities in Nampula City were conducted.

1.3 Composition of Survey Team

The members of the survey team assigned to this project are listed in Table 2.

Table 2 Composition of Survey Team

Name	Affiliation	Assignment
Shoichi Yokogi	Japan Techno Co., Ltd.	Project Team Leader/Water Source Development
Hiroshi Kojima	Tokyo Water Co., Ltd	Specialist Advisor
Kazuhiro Arita	Japan Techno Co., Ltd.	Facility Planning/Facility Design
Kazuyoshi Honda	Japan Techno Co., Ltd.	Water Supply Planning
Toshiki Horie	Japan Techno Co., Ltd.	Water Supply Planning

Chapter 2 Present Status of Project

2.1 Water Supply Projects of Mozambique and Their Problems

2.1.1 Present Status of Water Supply Sector (National Level)

1) Water Supply Facilities Coverage Rate

The total population of the country is about 27.91 million (2017 census), and as Figure 1 the coverage rate was 56% in 2017 (84% in urban areas and 40% in rural areas), which is a significant improvement compared to the coverage rate of 20% in 2000. However, about 1.6 million persons in urban areas and 10.8 million persons in rural areas do not have access to safely managed drinking water*1 or basic drinking water*2 (urban population is 35% of the country's total).

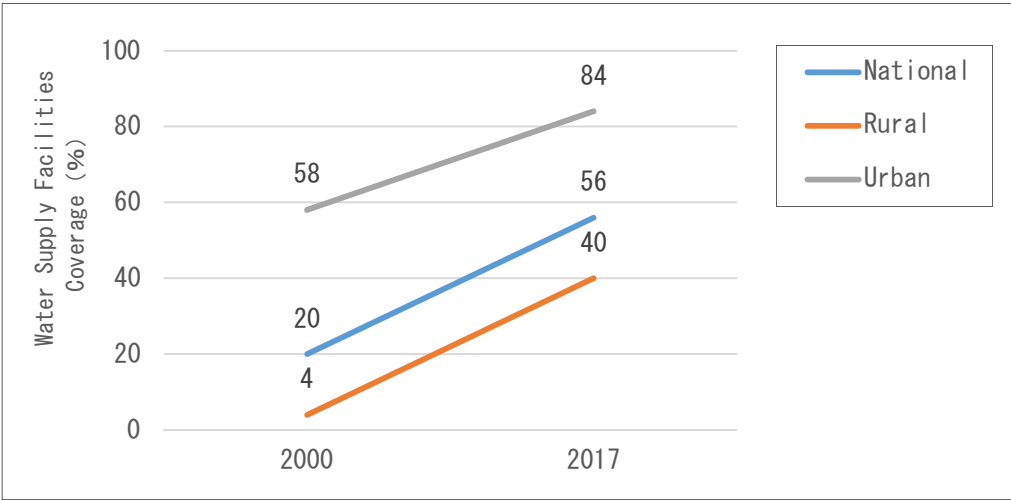


Figure 1 Water Supply Facilities Coverage

Source: UNICEF/WHO, Progress on household drinking water, sanitation and hygiene 2000-2017

*1: Safely managed drinking water (supply service): Drinking water that is available on premises, available when needed, free from contamination by excreta or chemicals, and obtained from an improved water source.

*2: Basic drinking water (supply service): drinking water obtained from an improved water source that allows people to fetch water from their homes within 30 minutes round trip (including waiting time).

2) Legislation

(1) Water Supply Law

The design and technical requirements for water supply and wastewater facilities are set forth in Decree No. 30/2003 (Regulation on Public Water Supply and Wastewater Drainage, Nr. 30/2003), dated July 1, 2003. In addition, the ISO standards are to be adopted for the standards that are not specified in this Decree.

(2) Water Quality Standards

Water quality standards are set forth in "Diploma Ministerial Nr. 180/2004 - Regulamento sobre a Qualidade de Água para o Consumo Humano, de 15 de Setembro (Regulation on Quality of Water for Human Consumption)". Table 3 shows the comparison with those of Japan.

Table 3 Water Quality Standards

Parameter	Japanese Standard (R2.4.1)	Mozambique Standard
Standard Plate Count	100 Per 1 ml	-
Escherichia coli (E. coli)	Not to be detected	Not to be detected
Cadmium and its compounds	Less than or equal to 0.003 mg/L as cadmium	0.003 mg/L or less
Mercury and its compounds	0.0005mg/L or less as mercury	0.001 mg/L or less
Selenium and its compounds	Less than or equal to 0.01 mg/L as selenium	0.01 mg/L or less
Lead and its compounds	0.01 mg/L or less as lead	0.01 mg/L or less
Arsenic and its compounds	0.01 mg/L or less in terms as arsenic	0.01 mg/L or less
Chromium (VI) compounds	0.02 mg/L or less as hexavalent chromium	0.05 mg/L or less
Nitrite-Nitrogen	0.04mg/L or less	-
Cyanide ion and Cyanogen chloride	Less than or equal to 0.01 mg/L as cyanide	0.07 mg/L
Nitrate and Nitrite	10mg/L or less	50 mg/L
Fluoride and its compounds	0.8mg/L or less as fluorine	1.5 mg/L
Boron and its compounds	1.0 mg/L or less as boron	0.3 mg/L
Carbon tetrachloride (CCl4)	0.002mg/L or less	-
1,4-Dioxane	0.05mg/L or less	-
cis-1,2-dichloroethylene and trans-1,2-dichloroethylene	0.04mg/L or less	-
Dichloromethane	0.02mg/L or less	-
Tetrachloroethylene	0.01mg/L or less	-
Trichloroethylene	0.01mg/L or less	-
Benzene	0.01mg/L or less	-
Chloric acid	0.6mg/L or less	-
Chloroacetic acid	0.02mg/L or less	-
Chloroform	0.06mg/L or less	-
Dichloroacetic acid	0.03mg/L or less	-
Dibromochloromethane	0.1mg/L or less	-
Bromic acid	0.01mg/L or less	-
Total trihalomethane	0.1mg/L or less	-
Trichloroacetic acid	0.03mg/L or less	-
Bromodichloromethane	0.03mg/L or less	-
Bromoform	0.09mg/L or less	-
Formaldehyde	0.08mg/L or less	-
Zinc and its compounds	Less than or equal to 1.0 mg/L of zinc	3.0 mg/L
Aluminum and its compounds	0.2mg/L or less as aluminum	0.2 mg/L
Iron and its compounds	Less than or equal to 0.3 mg/L as iron	0.3 mg/L
Copper and its compounds	Less than or equal to 1.0 mg/L as copper	1.0 mg/L
Sodium and its compounds	Less than 200 mg/L of sodium	200 mg/L
Manganese and its compounds	Less than or equal to 0.05mg/L for the amount of manganese	0.1 mg/L
Chloride ion	200mg/L or less	250 mg/L
Calcium, Magnesium, etc. (hardness)	300 mg/L or less	50 mg/L
Evaporation residue (Total residue)	500mg/L or less	1000 mg/L
Anionic surface active agent	0.2mg/L or less	-
Geosmin	0.00001mg/L or less	-
2-methylisobolneol	0.00001mg/L or less	-
Non-ionic surface active agent	0.02mg/L or less	-
Phenols	0.005 mg/L or less in terms of the amount of phenol	-
Organic substances (Total Organic Carbon (TOC))	3mg/L or less	2.5 mg/L
pH value	5.8 to 8.6	6.5 - 8.5
Taste	Not abnormal	Not abnormal

Parameter	Japanese Standard (R2.4.1)	Mozambique Standard
Odor	Not abnormal	Not abnormal
Color	Less than 5 degrees	15TCU
Turbidity	Less than 2 degrees	5NTU

(3) PPP Related Laws

In 2011, the law to establish the Public-Private Partnerships (PPP) framework in Mozambique was enacted by Law No. 15/2011. It establishes guidelines for the contracting process, implementation, and auditing of all PPP projects, large projects, and business concessions.

Regarding the water sector, the Government of Mozambique has approved the Delegated Management Framework (Quadro de Gestão Delegada: QGD, Decree 72/98) as part of the sector reform. For water supply in provincial capitals and large cities, FIPAG, the executing agency for the Project, and the Water Regulatory Authority (AURA), the regulatory agency, were created. Under the QGD, an institutional framework has been established in which FIPAG, a public corporation, invests in water supply infrastructures, while private companies provide water supply services and are audited by AURA, an independent regulatory agency. On the other hand, the private sector is currently providing water supply services only in the Mozambique Capital Region. In other cities, water supply is provided directly by FIPAG.

(4) Environmental Impact Assessment

Environmental impact assessment in Mozambique is specified as follows

1) Regulations and Related Organizations

Environmental impact assessment in Mozambique is regulated by the Decree on Environmental Impact Assessment (Decree No. 54/2015) and the Approval of the Overall Policy on Environmental Impact Assessment (Ministerial Degree No. 129/2006). The agency responsible for environmental impact assessment is the Ministry of Land and Environment (Ministério da Terra, Ambiente: MITA, formerly MITADER), and for this project, the agency responsible for environmental impact assessment and environmental license approval is Provincial Service for Environment of Nampula (SPA-Nampula) (formerly DPTADER).

2) Responsible Agency for Environmental Impact Assessment and Environmental License Application

In Mozambique, there are four environmental categories: A⁺, A, B and C. For each category, licenses for environmental impact assessment can be applied from the following offices.

- Category A⁺ and A: MITA (Ministry of Land and Environment)
- Category B and C: SPA-Nampula (Land and Environment Department, Nampula Province)

3) Procedures for Environmental Impact Assessment and Acquisition of Environmental Licenses

The procedure for environmental impact assessment and environmental licensing in Mozambique is as follows.

- ① The Provincial Infrastructure Service (Serviço Provincial de Infra-Estruturas: SPI) submits an

application for an environmental impact license to the Director General of SPA-Nampula, and a fee of MZN1,000.- is transferred to the bank.

- ② SPA-Nampula conducts a pre-evaluation of the project target site. Two SPA staff accompanied by one staff member from SPI's Water and Sanitation Division (Departamento do Serviço de Infra-Estruturas - Água e Saneamento: DSI-AS) will visit the project site and carry out the pre-evaluation.
- ③ The project is categorized (A⁺, A, B or C) according to the result of a preliminary assessment by the SPA.
- ④ For Categories A⁺ and A, an Environmental Impact Assessment (EIA) is required to be conducted and a report submitted to MITA.
- ⑤ In the case of Category B, a Simplified Environmental Study (EAS) needs to be conducted and a report submitted to SPA-Nampula.
- ⑥ In the case of Category C, a Procedure of Good Practice of Environmental Management (PBPGA) should be prepared and submitted to SPA-Nampula.
- ⑦ After approval of the report by SPA-Nampula, an environmental license will be issued to SPI (in the case of this project).

3) Planning for Urban Water Supply

The plan for urban water supply and sanitation in Mozambique was formulated in 2011 by the Ministry of Public Works, Housing and Water Resources in the form of the National Strategy for Urban Water Supply and Sanitation, 2011-2025.

The strategy aims to guide the effective implementation of the key objectives of the National Water Policy in urban areas. In the water supply sector, the goal is to achieve a coverage of 70% as the medium-term target (2015) set by the government within the scope of the Millennium Development Goals, which is about 6.6 million people, and a long-term target (2025) to achieve a water supply rate to cover all citizens and ensure sustainability. The target for sanitation in urban areas is to increase the coverage to about 67% or about 6.3 million people in 2015, gradually approaching coverage for the entire population by 2025.

4) Assistance and Water Sector Organization

The supervisory authority in the water supply sector in Mozambique is the DNAAS, which belongs to the Ministry of Public Works, Housing and Water Resources and is responsible for policy formulation and financing. In addition, AURA has been established as the regulatory related supervisory authority. The owners of water supply facilities and the agencies responsible for operation and maintenance are classified according to the importance of each city (Ministerial Decree No. 237/2010 (Official Gazette, December 27, 2010)). In the case of the capital city and provincial capitals such as Nampula, FIPAG holds the ownership of the water supply facilities and is responsible for operation and maintenance.

In addition, the Administration of Water Supply and Sanitation Infrastructure (AIAS: Administração de Infra-Estruturas de Abastecimento de Água e Saneamento) has jurisdiction in medium-sized cities such as district headquarters, and the Provincial Public Works Department (DPOP: Direcção Provincial das Obras Públicas) or the District Planning and Infrastructure Service (SDPI: Serviço Distrital de Planeamento e Infra-Estruturas) for smaller towns and villages.

The operation and maintenance works are mainly outsourced to the private sector, but at the provincial capital level, such as Nampula, FIPAG, the owner of the facility, is responsible for the operation and maintenance.

Table 4 Ownership of Water Supply Facilities and Organizations in Charge of Operation and Maintenance

Organization	Water Supply Investment Promotion Fund (FIPAG)	Water Supply and Sanitation Infrastructure Administration (AIAS)	Provincial Department of Public Works (DPOP) District Planning and Infrastructure Service Division (SDPI)
Target	Large cities (Capital, Provincial capital, etc.)	Medium-sized cities (District Headquarter, etc.)	Towns and villages other than those listed to the left (Town/village)
Number of Responsible Areas	21	131	Areas not covered by FIPAG and AIAS
Ownership and Responsibility for Operation and Maintenance	FIPAG	AIAS	Each District
Operation and Maintenance	Directly managed by FIPAG	Private In case private outsourcing is difficult, SDPI or Municipal council, etc.	Piped water supply facilities: Private sector Borehole with hand pump: Water and Sanitation Committee

5) Private Outsourcing

FIPAG has plans to promote concession contracts in the provinces of Sofala, Zambezia, and Manica in addition to the concessions in the metropolitan area. The World Bank continues to support the promotion of concession contracts.

Table 5 Records of Concession Contracts

Company Name	Water Distribution Area	Number of Contracts	Water Supply Rate
Águas da Região de Maputo (FIPAG is the main stakeholder)	Maputo Metropolitan Area (Maputo City, Matola City, southern part of Marracuene City)	254,064	147,000m ³ /day

6) Financial Condition

FIPAG's financial balance is on an improving trend. Expenditures are also on an upward trend, but revenues from fee collection is increasing at an even faster rate. It should be noted that personnel costs account for 30% of expenditures and cover a major portion of the expenditures. In addition, since impairment due to uncollected fees is increasing yearly, except for special reasons such as relief for affected persons, resolution of this situation is highly required.

Table 6 Financial Balance (Unit: million Yen)

		2016	2017	2018	2019
a)	Fee income	2,261	2,629	3,128	3,622
	Trading investment cost	-219	-265	-228	-282

		2016	2017	2018	2019
	Subtotal (1)	2,042	2,364	2,900	3,340
b)	Labor cost	-888	-904	1,015	1,138.
	Commissioning expense	-816	-975	1,099	1,229
	Depreciation cost	-527	-533	-533	-523
	Procurement cost of chemicals, materials and equipment	-199	-30	-96	-20
	Impairment cost of uncollected fees	-6	-3	-34	-47
	Other operating expenditures	179	-23	-150	-140
	Subtotal (2)	-2,257	-2,468	-2,927	-3,097
Balance c) = a) + b)		-215	-104	-27	243

Source: FIPAG, Business Report (calculated using local currency = 1.4184 Yen)

For loan assistance, the country is having assistance mainly from the World Bank. The ratio of loans from donor agencies to tariff revenues in 2019 is high at about 1.9 times ($8,737 \div 4,597$). In order to meet the water demand and maintain sound management, it is necessary to ensure that financial resources are secured through tariff revenues.

Table 7 Donors and Breakdown of Investments (Unit: Million Yen)

Organization	2018		2019	
World Bank	2,273	63%.	5,025	73%.
Dutch Government	1,160	32%.	711	10%.
Águas de Portugal	85	2%.	25	0%.
UNICEF	0	0%.	63	1%.
Mozambique Government	64	2%.	1,061	15%.
Total	3,582		6,885	

Source: FIPAG, Business Report (calculated using local currency = 1.4184 Yen)

Totals do not add up to 100% due to rounding.

7) Training Center

FIPAG has a technical training center (Academy for the Development of Skills and Professional Careers). The center is located in the FIPAG headquarters and has basic facilities such as staff rooms, training rooms, work space, and storage room.

The center is self-funded by FIPAG. It is supported by Nuffic (a Dutch international non-profit organization for the internationalization of education) with a partnership agreement for technical support.

Table 8 below shows the training achievements. As training programs, 3 courses on project management, waterworks facility operation and maintenance, and facility management have been held with the aim of improving expertise and skills in each field.

Table 8 Training Achievements (2019)

Course Title	Subject	Number of Days	Participants
Project Management	Contract Management - FIDIC	5 days	98 persons
	Construction Management	5 days	

Course Title	Subject	Number of Days	Participants
	Water Supply Planning	5 days	
	Water Distribution Design	5 days	
Operation and Maintenance of Water Supply Facilities	Water Quality Analysis	5 days	137 persons
	Water Demand Analysis	5 days	
	Pipe Network Analysis (Hydraulic Calculation)	5 days	
	Loss Calculation and Pipeline Planning	5 days	
Service Management	Water Supply Service Management	5 days	227 persons
	Facilities Management	5 days	
	Acquisition	5 days	

In addition, discussions are underway to expand the training courses shown in Table 9 and to establish a training system at FIPAG regional branches.

Table 9 Expansion of Training Courses

Course	Contents	Course	Contents
Social Audit	Environmental, quality, and safety management	Asset Management	Asset management
	Environmental and social impact assessment and monitoring		Deterioration diagnosis
Promotion of Private Sector Outsourcing	Promotion and management of outsourcing contracts	Finance	Public services and international accounting
	Feasibility study		Budget handling and management
Mechanical and Electrical Equipment	Equipment operation	Designing	Pipeline design
	Maintenance of mechanical and electrical equipment		Drawing
	Maintenance of water quality analysis equipment		

2.1.2 Problems of Water Supply Services (National Level)

In order to meet the growing demand for water as the country recovers from the civil war, the country's major urban water supply systems have been operated by FIPAG, which has been restoring and expanding the functions of the devastated water supply facilities, and at the same time, FIPAG has been directly managing the operation and maintenance of the systems and promoting PPP.

During the decade from 2007 to 2017, the population of major cities has almost doubled, and this trend is expected to be maintained. As a result, the scale of problems that need to be tackled, such as securing large-scale water sources and using water sources that require costly treatment, is expanding even further. In addition, in order to maintain the safety and stability of supplied water, it is necessary to further improve the efficiency of operations and work on thorough implementation of the principles of water services. Based on interviews with the executing agency, FIPAG, the main problems and issues of water supply services are shown below in Table 10.

Table 10 Major Problems and Issues of Water Supply Services (National Level)

Classification	Problems and Issues
PPP	● Delays in dissemination of PPP/PFI to rural cities
Project	● Delays in scheduling of loan projects

Classification	Problems and Issues
Scheduling	
Operations and Finance	<ul style="list-style-type: none"> ● Securing facilities rehabilitation funds ● Rise in debt-to-water revenue ratio ● Recovery of non-collected fees
Facility	<p>Water source.</p> <ul style="list-style-type: none"> ● Scarcity of water sources (drought and increased water demand due to climate change) <p>Facilities</p> <ul style="list-style-type: none"> ● Insufficient capacity of facilities ● Increase in water leakages <p>Water supply.</p> <ul style="list-style-type: none"> ● Routine implementation of water suspensions ● Non-installation of water meters ● No assurance of residual chloride
Management	<ul style="list-style-type: none"> ● Insufficient water pressure and water volume ● Non-implementation of asset management ● No improvement in management of water supply services
Staff	<ul style="list-style-type: none"> ● Low capacity in technical skills of staff

2.1.3 Issues related to Sanitation and Waterborne Diseases (National Level)

1) Sanitation Facilities (Latrine) Coverage Rate

The country's total population is about 27.91 million (2017 census), and as Figure 2, エラー! 参照元が見つかりません。 the coverage rate was 29% in 2017 (52% in urban areas and 17% in rural areas), which is a significant improvement compared to the 10% coverage rate in 2000. The number of people without access to safely managed sanitation facilities⁴ or basic hygiene facilities⁵ is about 4.7 million in urban areas and about 15.1 million in rural areas.

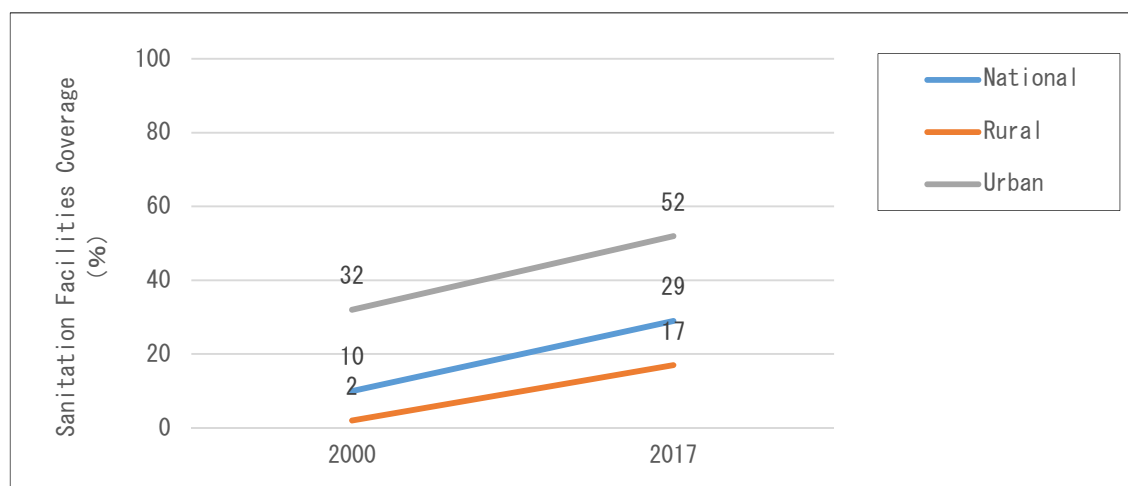


Figure 2 Sanitation Facilities Coverage Rate

Source: UNICEF/WHO, Progress on household drinking water, sanitation and hygiene, 2000-2017

The number of deaths attributed to unsafe water supply and lack of sanitation and health services is about 28 per 100,000 persons.

Table 11 Sanitation and Health Indicators

Percentage of Population using Basic Hygiene Services (%)	Number of Deaths due to Unsafe Water Supply and Lack of Sanitation and Health Services. (per 100,000 persons)	Infant Mortality Rate Number of deaths after birth of less than 1 year per 1000 births per year
29.34 (2017)	27.63 persons (2016)	61 persons (2011)

Source: WHO, <https://www.who.int/data/gho>

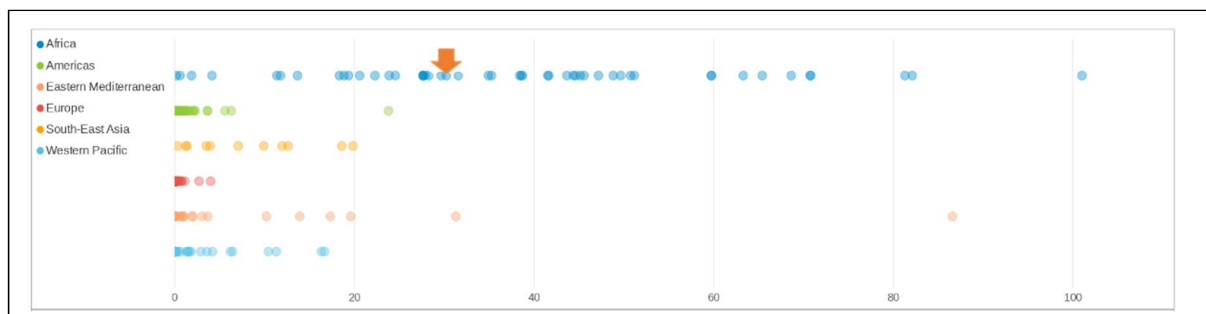


Figure 3 Number of Deaths due to Unsafe WASH Services (per 100,000 persons)

Source: WHO, <https://www.who.int/data/gho>

2) Waterborne Diseases

(1) National Scale

Although the number of deaths due to waterborne diseases has been decreasing since 1990, it has remained unchanged since 2011. The most common type of waterborne disease is diarrhea, with 10,689 cases in 2017. Of these cases, 41.1% (4,393 cases) were under 4 years of age, and the percentage of other classes, excluding the class of 80 years and older, was below 5%.

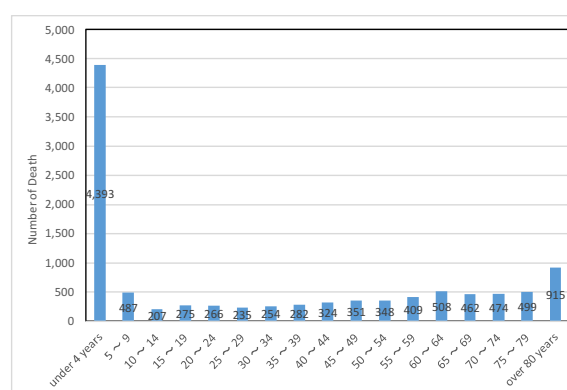
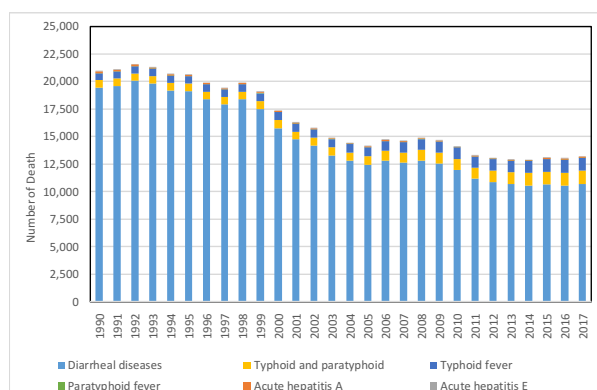


Figure 4 Number of Deaths due to Waterborne Diseases Figure 5 Number of Deaths caused by Diarrhea (2017)

Source: IHME, <https://vizhub.healthdata.org/gbd-compare/>

IHME: Institute for Health Metrics and Evaluation, Washington University, School of Medicine, USA

2.1.4 Current Status of Water Supply Services (Project Area)

1) Priority Order

The National Water Supply and Sanitation Agency (DNAAS) has prepared a list of priority projects for major cities in accordance with the government's five-year plan, and FIPAG has also prepared a list of priority projects in line with the government's plan as follows

As a result of interviewing FIPAG and confirming the status of each project with reference to the priority project list, several priority projects are already under implementation or scheduled to be implemented by the World Bank and other donors. In addition, FIPAG replied to Japan that it expects Japan to implement the expansion and renewal of the water supply facilities in Nampula because of the serious situation of water supply in the city, as described in Chapter 1. With this background, this project can be expected to be realized in accordance with the high-level plans of the Mozambican government and executing agency.

FIPAG Priority Projects List (Unit: USD)

City Name	Project Cost	Project Outline	Results of Confirmation through Hearings, etc.
Nampula City (proposed site)	62.6 million	Develop a water source in the suburbs to provide water supply to additional 10,800 households. *Because it is difficult to secure a budget to deal with the development of water sources such as dams, facilities using groundwater as water source that can be dealt with in the short to medium term will be developed.	Expecting assistance from Japan
Quelimane City	23.6 million	Increase in water supply volume, expansion of water supply area in the city, replacement of deteriorating pipes, improvement of facilities, etc.	Consider World Bank support
Nacala City	27.1 million	Design water supply rate: 34,000 m ³ /day Water intake facilities, water treatment facilities, water transmission pipes, pump stations, water distribution center, and piping networks using dams as water sources	[In progress] Public announcement of bidding for design and construction management services funded by the World Bank was made in June 2020.
Tete City	41.9 million	Design water supply rate: 90,000 m ³ /day	[In progress] Rehabilitation of the existing water source, construction of a distribution center and expansion of the piping network is underway since July 2018.
Beira City, Dondo City	74.3 million	Project to meet demand in 2020 New water supply house connections for 265,000 households	[In progress] Plans are underway as part of disaster recovery efforts for Cyclone Idai which landed in 2019.
Lichinga City	57.0 million	Design water supply rate: 20,500 m ³ /day New house connections for 275,000 households Expansion of water storage dams, expansion of the city's water supply area, replacement of deteriorated distribution pipes, increase of individual house connections and installation of water meters.	[In progress] March 2019 - March 2021
Pemba City	44.1 million	Design water supply rate: 34,000 m ³ /day New house connections for 275,000 households	Unidentified groups have been attacking villages around Pemba City, the provincial capital, and many people have been killed. Security is deteriorating in the area, and the Ministry of Foreign Affairs has designated it as Level 3.

Source: Water Sector Overview and Urban Water Supply Development Status, JETRO, December 2015, and edited with

reference to FIPAG interviews.

2) Project Summary

(1) Scale

The water supply facilities in Nampula City are managed by FIPAG, where the water source is Monapo dam located about 10km north of Nampula city, consist of one water treatment plant and five water transmission and distribution facilities. The served population for 2019 was about 330,000 persons and the daily water supply capacity (nominal value) was 40,000 m³. The average water supply rate per person per day is 121 liters, which is close to the 125 liters per person unit rate adopted by the country. Although the leakage rate is lower than that of Nampula City, the increase in leakages is a serious problem given the shortage of water sources.

Table 12 Summary of Project Area (Nampula City)

Parameter	Present Condition	Remarks
Water supply area	Nampula City (capital of the province)	
Water source	Monapo Dam	Completed in 1959
Number of water treatment plants and distribution centers	1 water treatment plant, 2 water transmission stations, 3 water distribution centers	
Population of water supply area	660,240 persons	2019
Annual population growth rate	6.1 %	
Service population	329,206 persons	
Number of house connections (2019)	35,732 houses	
Number of public tapstands (2019)	498 units	
Daily maximum water supply rate (2019)	36,940 m ³ /day	2019
Daily average water supply rate (2019)	10,240 m ³ /day	2019
Water supply hours	10 hours	Dry season
Daily average per capita water supply rate (2019)	31 liters/person/day	
Unit water supply rate	125 liters/person/day	Design criteria
Leakage rate	59%.	Amount of water metered / amount of water distributed
Fee collection rate	90%.	

(2) Water Tariff

Water tariff rates in Mozambique are set by AURA.

The current tariff system is shown in Table 13 below. A two-stage tariff system with increasing rates has been introduced for house connections, and a separate tariff system has been established for water supply from public tapstands. In addition, there are exemptions for those with low income.

It should be noted that the fee collection rate in Nampula City is reported to be 90%, but this may not be an accurate figure due to the low installation rate of water meters (44%).

Table 13 Water Tariff System

Town/ System Name	Public Tap	Domestic (House Connections)					Municipality	General (Commerce, public and industry)		
		Service availability fee	Consumption up to 5m ³	Consumption above 5m ³				(Commerce and Public) Minimum Consumption of 25m ³ /month	(Industry) Minimum Consumption of 50m ³ /month	Above minimum consumption
				1st 5m ³	5-10m ³	> 10m ³				
(MZN/m ³)	(MZN/month)	(MZN/month)	(MZN/m ³)	(MZN/m ³)	(MZN/m ³)	(MZN/m ³)	(MZN/m ³)	(MZN/m ³)	(MZN/m ³)	
Nampula	10.00	60.00	58.40	139.88	41.96	46.90	20.23	1,160.51	2,321.01	46.42
Maputo, Matola, Boane	10.00	60.00	58.40	132.66	39.80	54.29	19.87	1,386.97	3,773.94	55.48
Chókwè, City and District	10.00	60.00	58.40	110.10	33.03	40.85	16.26	1,185.04	2,370.08	47.40
Xai-Xai	10.00	60.00	58.40	112.39	33.72	40.07	19.78	1,108.55	2,217.10	44.34
Inhambane	10.00	60.00	58.40	116.85	35.06	42.40	17.27	1,201.05	2,402.10	48.04
Maxixe	10.00	60.00	58.40	133.28	39.98	45.23	19.73	1,231.63	2,463.26	49.27
Beira, Dondo, Mafambisse	10.00	60.00	58.40	132.37	39.71	45.22	20.15	1,070.05	2,140.10	42.80
Chimoio, Manica, Gondola	10.00	60.00	58.40	111.77	33.53	39.84	17.70	1,007.51	2,015.03	40.30
Tete, Moatize	10.00	60.00	58.40	109.75	32.93	39.20	17.70	1,007.51	2,015.03	40.30
Quelimane, Nicoadala	10.00	60.00	58.40	130.58	39.17	41.77	19.78	1,065.92	2,131.83	42.64
Nacala	10.00	60.00	58.40	100.82	30.25	35.43	16.26	1,072.76	2,145.52	42.91
Angoche	10.00	60.00	58.40	105.28	31.59	36.79	17.17	1,000.00	2,000.00	40.00
Pemba, Morrêbuê, Metuge	10.00	60.00	58.40	134.29	40.29	46.79	19.82	1,198.49	2,396.98	47.94
Lichinga	10.00	60.00	58.40	119.17	35.75	38.64	17.70	1,036.09	2,072.18	41.44
Cuamba	10.00	60.00	58.40	96.93	29.08	33.37	16.26	953.74	1,907.48	38.15

Source: Ordinance No. 2/2018, Official Gazette, July 20, 2018

(3) Organization (FIPAG Nampula Branch Office)

- Organizational structure

The FIPAG Nampula branch office has 85 technical staff members, with 33 assigned to the operation and maintenance of the water treatment plants and distribution centers, 28 to the maintenance of the distribution pipe network, and 7 to the management of facilities through GIS and other means. The General Affairs and Accounting Department has 68 employees. A diagram of the organization is shown in Figure 6.

- Status of ledger management

Information on facilities such as pipelines is managed by GIS, and the status of mechanical and electrical equipment such as pumps is also managed. In addition, EPANET has been developed for pipe network analysis.

- Maintenance system

A total of 28 persons are employed in the department for the maintenance of the water distribution network. The past repair records are shown in Table 14. However, renewal of pipelines and equipment is postponed unless it has a significant impact on water supply. Maintenance is carried out by FIPAG staff.

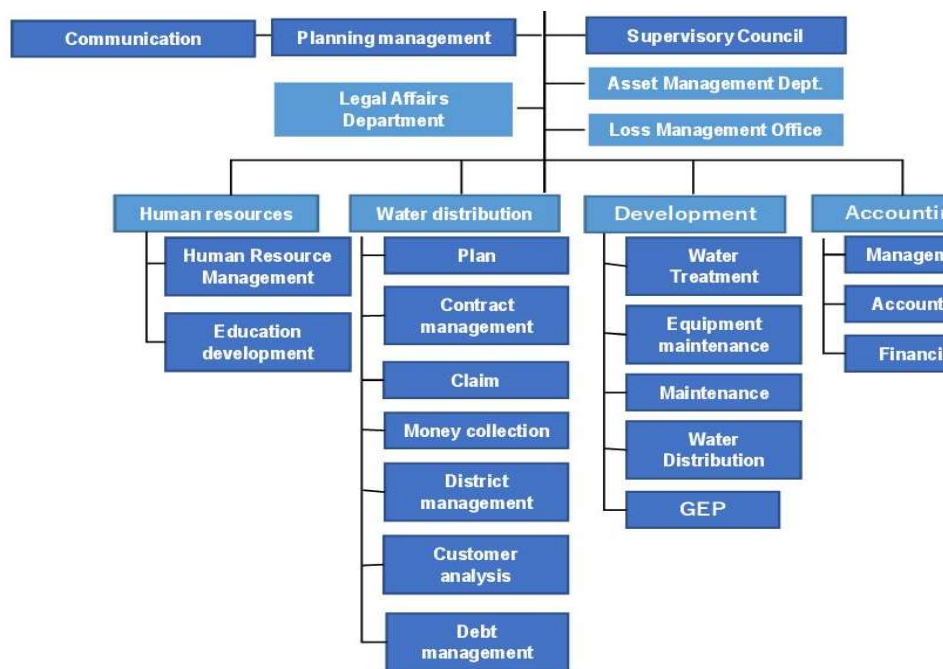


Figure 6 Organization Chart of FIPAG Nampula Branch Office

Table 14 Major Repair Works carried out in the past 3 years (2018-2020)

Target	2018	2019	2020
Water transmission pipes	Repairs at 33 locations	Repairs at 23 locations	Repair at 12 locations
Water distribution pipes	Repairs at 8423 locations	Repairs at 7126 locations	Repair at 2351 locations
Mechanical and electrical equipment (pumps, control panels, electrical equipment)	21 repairs	31 repairs	22 repairs
Water distribution reservoirs, buildings	4 repair works	2 repair works	3 repair works
Repair Cost	MZN4,954,141 (¥7,026,954)	MZN5,962,735 (¥8,457,543)	MZN7,669,704 (¥10,878,708)

Source: FIPAG questionnaire (calculated assuming local currency = 1.4184 Yen)

(4) Project Planning

From 2021 to 2022, FIPAG have plans to develop a water supply Master Plan and conduct a feasibility study for the expansion project of water supply facilities using the privately owned Mugica Dam as the source of water supply, with the support of the World Bank (Table 15). In addition, due to the strained situation of water resources, the government wants to fasten the construction of water supply facilities using the boreholes from Namiteka well field as water source, but no donor has been decided yet. The situation is similar for other projects.

Table 15 Project Planning

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Water Supply Master Plan (World Bank) • Water demand forecasting, water source assessment • Project formulation	●	●								
Mugica Dam Utilization Plan (World Bank) (Mugica Dam) • F/S, schematic design, environmental impact assessment	●	●								
Water Supply Facility Expansion Project I (Namiteka Well Field) • Detailed design, environmental impact assessment • Construction work (boreholes, water treatment and distribution facilities)	○	○	○							
Water Supply Facility Expansion Project II (Mugica Dam) • Detailed design • Construction work (water intake, treatment and transmission facilities)				○	○	○	○			
Water Source Development and Water Supply Facility Improvement Project (Meluli Dam) • Basic design, F/S					○	○				
Water Source Development and Water Supply Facility Improvement Project (Meluli Dam) • Detailed design • Construction work (dams, water intake, treatment and distribution facilities)						○	○	○	○	○

Legend: ●Projects with confirmed financial resources, ○Projects without confirmed financial resources

3) Water Source Facilities

The Monapo Dam was constructed in 1959. It has an effective storage capacity of 3.7 million m³, and intakes 40,000 m³/day during the six months of the rainy season, but due to the decrease in precipitation caused by climate change, water intake is restricted to 25,000 m³ during the six months of the dry season.

FIPAG has a plan to increase the capacity of the water source to about five times the current level in 20 years. In the past, FIPAG was planning to construct the Saua Saua Dam (planned intake capacity of 20,000 m³) downstream of the Monapo Dam, but as shown in Table 15, FIPAG is currently planning to construct the Meluli Dam (effective storage capacity of 500 million m³) and the use of the private Mugica Dam presently used for plantations as the water source.

4) Water Intake Facilities and Water Treatment Facilities

The Millennium Challenge Account (MCA), a US aid fund, is being used to update and expand the existing facilities at a total construction cost of about 5 billion Yen. The facility has been in service since 2013.

The facilities were designed by a Canadian company, where the facilities from intake to distribution centers are designed in compliance with the water source capacity.



Figure 7 Nampula Water Treatment Facilities

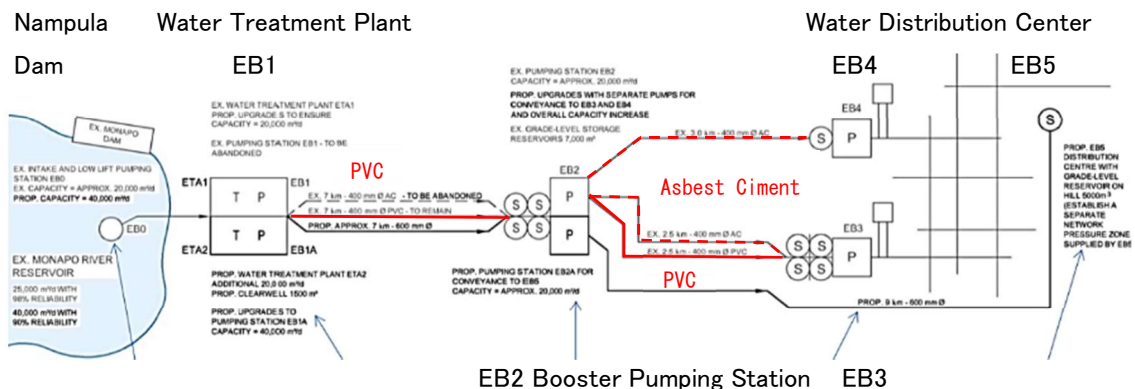
The water treatment plant uses the typical rapid filtration method of coagulation sedimentation, filtration, and chlorine disinfection. Aluminum sulfate is used as the common coagulant, and polymer coagulant is also used. The quality of the raw water is good, and there are no water quality parameters that are difficult to treat, but it is reported that they are having problems removing iron and manganese.

In addition, calcium carbonate for pH adjustment and calcium hypochlorite for chlorine disinfection are used. No particular problems have been reported regarding the quality of the chemicals. During the rainy season, the amount of chemicals used tends to increase due to the increase in turbidity caused by rainfall, but appropriate removal of turbidity is possible.

One of the problems at the time of the survey was that the electro-mechanical equipment stops operating due to power failures because an in-house generator was not equipped. In addition, since the scraping device in the sedimentation tank is out of order, it is currently being handled manually.

5) Transmission Pump and Water Distribution Stations

The water transmission facility consists of a water transmission pump (EB1) in the water treatment plant. Then, water is pumped at the booster pumping station (EB2) to the distribution centers from EB3 to BE5.



Source: Information provided by FIPAG

Figure 8 Conceptual Diagram of Water Supply Facilities (Water Source to Distribution Centers)

(1) Water Transmission Facilities (EB1, EB2)

Only the EB5 water distribution center was built in 2014, while the other facilities were built when the plant was founded in 1958, and each of the facilities from EB1 to EB4 was also partially updated in 2014. However, the water transmission pumps and booster pumps are not equipped with spare units, causing problems with stable supply in case of failure.

(2) Water Transmission Pipes

According to MCA, water transmission pipes (16km, 600mm diameter) have been laid and some old pipes have been removed, but 400mm diameter asbestos and PVC pipes are still in operation concurrently.

Ductile iron pipes were laid by MCA, and one line was added from the water treatment plant (EB1) to EB5. Asbestos pipes were laid at the time of establishment (1958) and account for about 1/4 of the total water transmission pipe length, which is assumed to be the cause of large-scale leakages. PVC pipes are relatively new, having been installed in 1996, but there is concern about leakages from the joints.

Table 16 Pipe Lengths by Diameter (Treatment Plant to Water Distribution Center)

Type of Pipe	Route	Diameter (mm)	Length (km)	Year Laid	Percentage
Asbestos Pipe	EB2 to EB3, EB4	400	9.5	1958	24%.
Polyvinyl Chloride Pipe	EB1~EB2~EB3	400	12.5	1996	32%.
Ductile Cast Iron Pipe	EB1~EB2~EB5	600	17.2	2013	44%.
Total	-	-	39.2	-	100%.

(3) Water Distribution Centers (EB3, EB4, EB5)

As for the water distribution centers, the total capacity of the distribution reservoirs is considered to be sufficient in terms of water source capacity, but the problem seems to be the small capacities of EB4 and EB5. In addition, since each distribution center is located in the central and southeastern parts of the city, water pressure shortage is likely to occur in the western part of the city. Each facility is equipped with a flow meter and a monitoring control device.

Table 17 Summary of Existing Facilities (Nampula City)

Facility	Year of Construction	Pump Capacity	Ground Type Distribution Reservoir Capacity	Elevated Water Tank Capacity
EB1 (Water Transmission Facility in Water Treatment Plant)	1958	40,000 m ³ /day	-	-
EB2 (Booster Pumping Station)	1958	40,000 m ³ /day	7,500 m ³	-
EB3 (Water Distribution Center)	1958	-	10,000 m ³	300 m ³

Facility	Year of Construction	Pump Capacity	Ground Type Distribution Reservoir Capacity	Elevated Water Tank Capacity
EB4 (Water Distribution Center)	1958	-	1,000 m ³	300 m ³
EB5 (Water Distribution Center)	2013	Gravity flow	(Constructed on residual hill) 5,000 m ³	-

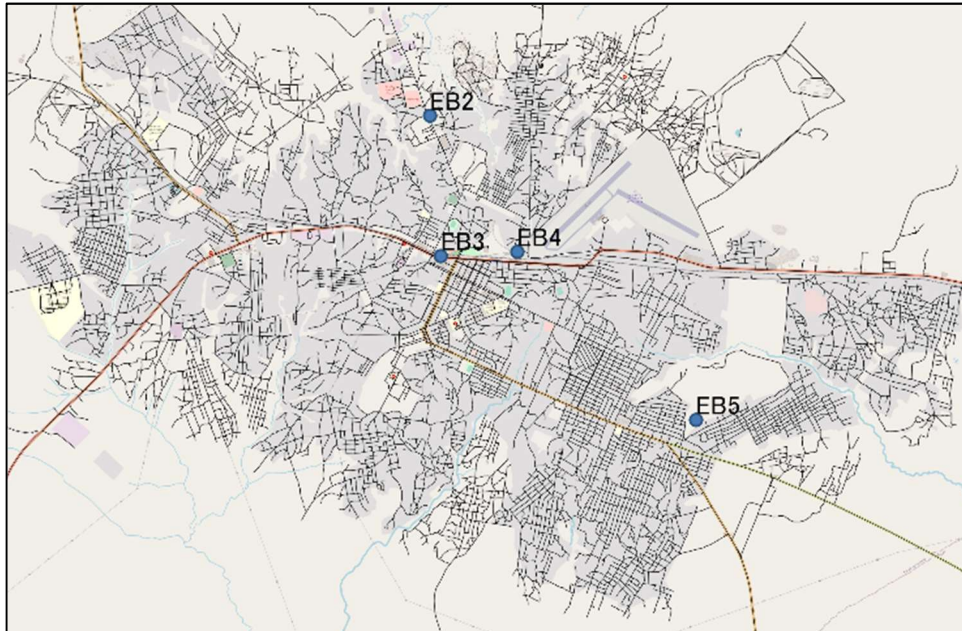


Figure 9 Location Map of Distribution Centers

6) City Pipeline

(1) Pipe Network

The urban area of Nampula City is expanding rapidly. In the periphery, water distribution pipelines are still inadequate (non served areas). In low-income areas, only the minimum number of water distribution pipes have been laid, resulting in illegal connections of water pipes.

The problem of water supply scarcity is expected to continue as long as the water sources of the Mugica or Meluli dams do not become stably available. Therefore, in order to properly manage water quantity and water pressure, it is advisable to develop distribution blocks by comprehensively considering the regional distribution of water demand, the location of distribution points, piping networks and topographical features.

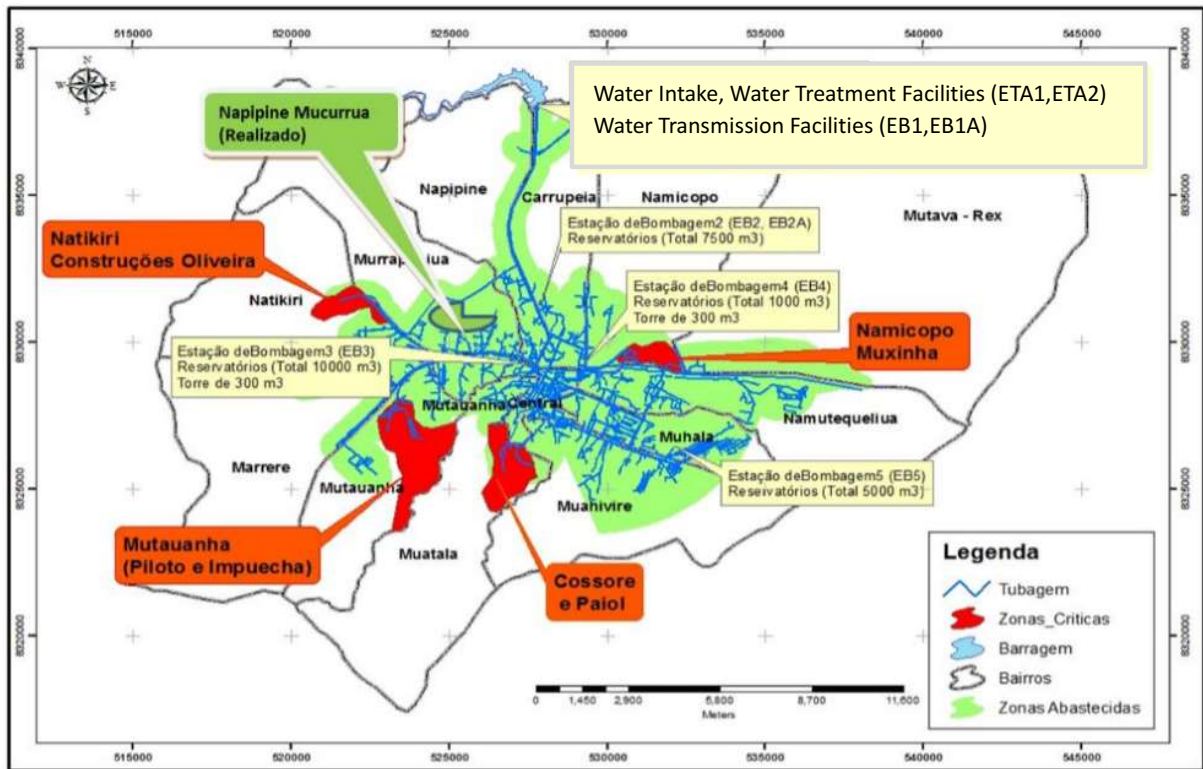


Figure 10 Pipeline Network Map

(2) Distribution Pipes

The maximum diameter of water distribution pipes is 400 mm, and 90% of the pipes have a diameter of 200 mm or less. Asbestos pipes account for one quarter of the total number of pipes, and polyvinyl chloride pipes account for three quarters. The asbestos pipes were laid when the city was founded (1958), and are thought to be concentrated in the central part of the city.

Table 18 Pipe Lengths by Diameter

Diameter (mm)	Pipe Length (km)			Total
	Asbestos Pipe	Polyvinyl Chloride Pipe	Total	
50	11.5	12.4	23.9	270.0 (55%)
60	17.8		17.8	
63		90.2	90.2	
75		55.9	55.9	
80	70.3		70.3	
90		5.9	5.9	171.9 (35%)
100	6		6.0	
110		94.6	94.6	
125	8.4		8.4	
160		31.7	31.7	
200	7.5	29.7	37.2	9.9 (2%)
250		9.4	9.4	
300	0.5	0.5	0.5	
315		9.0	9.0	39.2

Diameter (mm)	Pipe Length (km)			
	Asbestos Pipe	Polyvinyl Chloride Pipe	Total	
350		1.3	1.3	(8%)
400		28.9	28.9	
Total	122.0 (25%)	369.0 (75%)	491.0	

(3) Water Meters

Common mechanical water meters are used, and the installation rate is very low at 44%. In addition, prepaid meters (1,300 units) have been introduced in some areas on a pilot basis. Meter readings are basically made monthly, but the frequency varies by area. At public tapstands, the fee is collected through a designated manager.

7) Current Status of Nonserved Areas with Insufficient Water Volume and Pressure

With the economic growth of Nampula city, the population has been increasing rapidly in the surrounding areas. Since no emergency facilities have been built by NGOs and other organizations, the residents obtain water for daily use from surface water or unsafe dug wells.

Since some areas in the city are served by public tapstands, the boundary between the nonserved areas and the water service areas is ambiguous. In the periphery of the city, water supply service is not as adequate as in the central part of the city due to problems such as insufficient water volume and water pressure even within the water service areas.

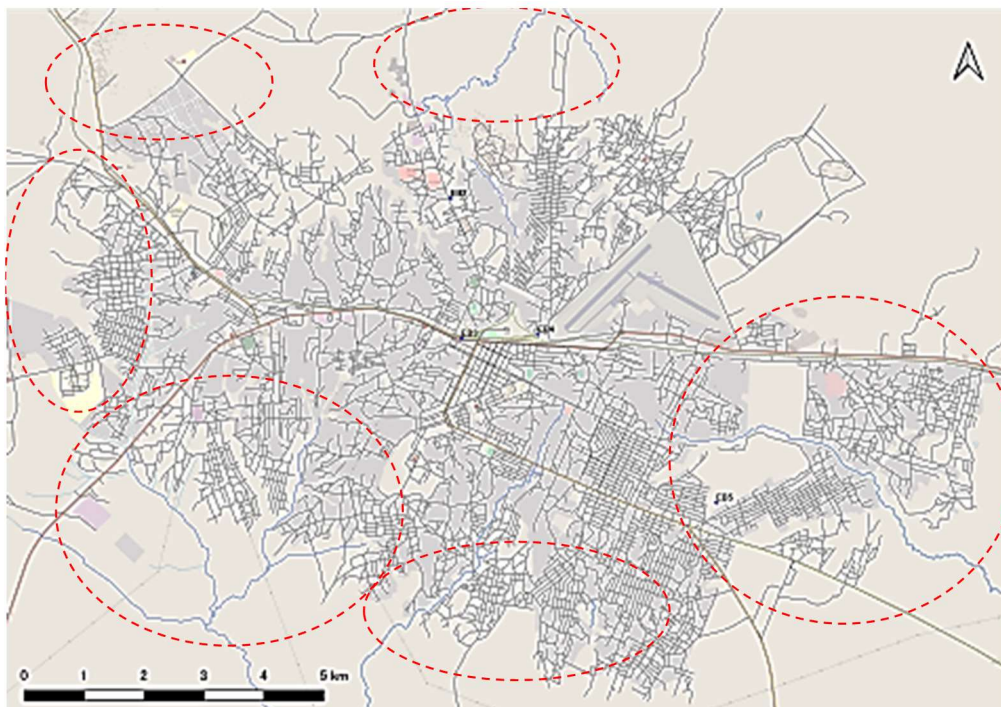
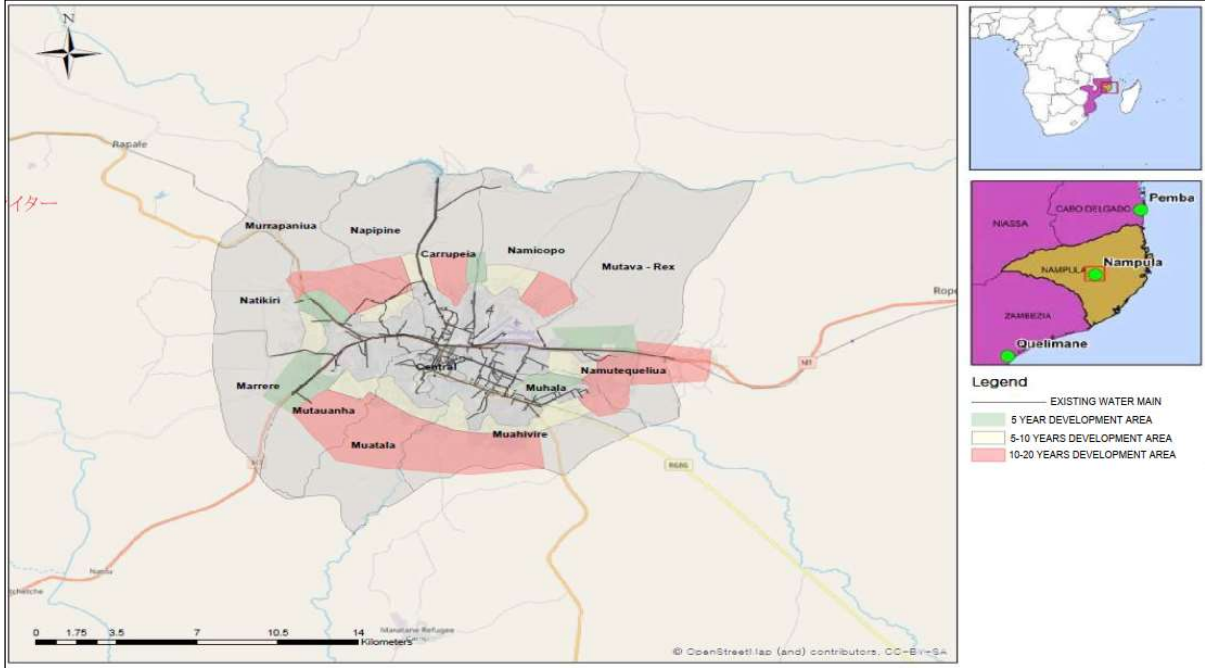


Figure 11 Underserved areas and areas with inadequate water quantity and pressure

In response to the current situation, FIPAG has divided the areas to be developed in the short, medium, and long term by 2037 as shown in Figure 12, taking into account future population growth and other factors.



Source : Volume 3. Update of the Feasibility Study for City of Nampula (Draft), 2018, FIPAG

Figure 12 Areas to be Developed

2.1.5 Problems of Drinking Water Supply (Project Area)

The main problems of water supply services are explained in "2.1.4 Current Status of Water Supply Services (Project Area)," and these problems and corresponding issues are organized in Table 19. Projects that directly lead to an increase in tariff revenue are considered to have higher priority. Therefore, securing alternative water sources, such as boreholes, and renewal of deteriorating water transmission pipes as a measure to improve large-scale leakages are considered to be the most important issues.

In addition, in order to eliminate areas with water pressure deficits and to distribute water evenly, it is important to develop pipelines after developing a medium- to long-term plan for organizing water service areas, rather than extending pipelines along the current line.

It is desirable that the location and size of new distribution centers be determined after considering the division of water service areas. It is also important to systematically address the elimination of nonserved areas and the renewal of old pipes (water distribution) by setting priorities in each service area or service block.

Table 19 Major Problems and Issues of Water Supply Services (Project Area)

Classification	Problem	Necessary Countermeasure	
		Short Term	Medium- to Long-Term
Service Management	<ul style="list-style-type: none"> Delays in large scale projects 	<ul style="list-style-type: none"> Planning management and securing financial resources 	-
Water Source	<ul style="list-style-type: none"> Water source shortage 	<ul style="list-style-type: none"> Securing alternative water sources such as boreholes 	<ul style="list-style-type: none"> Water source developments such as Mugica Dam

Classification	Problem	Necessary Countermeasure	
		Short Term	Medium- to Long-Term
Facility	<ul style="list-style-type: none"> • Occurrence of large-scale water leakages • Uneven distribution of water volume • Lack of water pressure • Expansion of nonserved areas 	<ul style="list-style-type: none"> • Renewal of deteriorating pipelines (water transmission) • Division of water service areas • Construction of new water distribution centers 	<ul style="list-style-type: none"> • Elimination of nonserved areas • Renewal of deteriorating pipelines (water distribution) • Block service of pipe network
Fee Collection	<ul style="list-style-type: none"> • Insufficient fee collection 	-	<ul style="list-style-type: none"> • Installation of water meters
Staff	<ul style="list-style-type: none"> • Low capacity for operation and maintenance 	-	<ul style="list-style-type: none"> • Conducting technical training • Procurement of maintenance equipment • Planning for renewal

2.1.6 Issues related to Sanitation and Waterborne Diseases

According to the UNICEF, WHO and World Bank definitions of stunting, the cumulative percentage classified as stunting, underweight and weakening is highest in the province of Cabo Delgado. The province of Nampula, which is the project area, ranks 10th and has a relatively high rate of undernutrition in Mozambique.

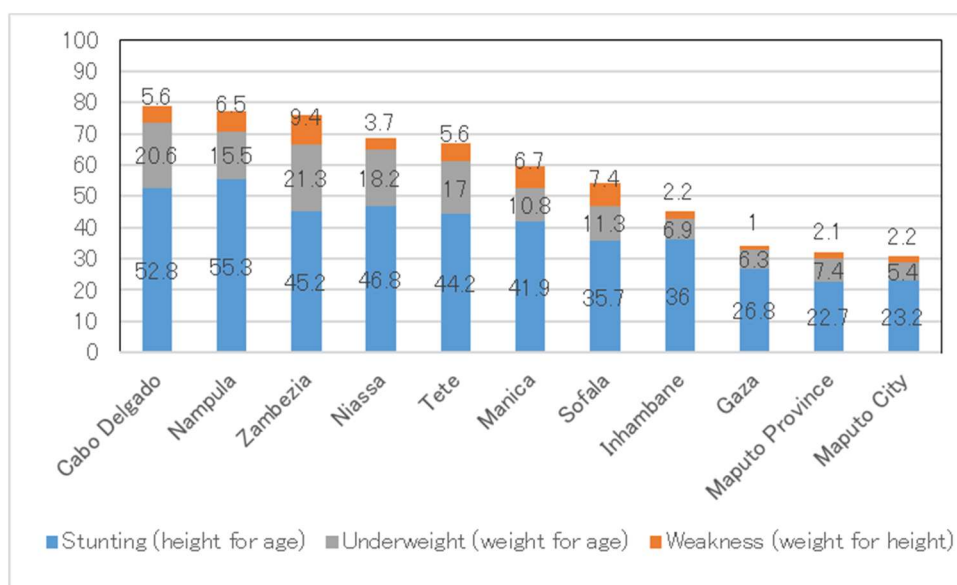


Figure 13 Undernutrition Status by Province (Percentage less than 2 standard deviations)

2.2 Related Projects

2.2.1 Outline of Development Plan

The country of Mozambique is urbanizing in the course of its development. By 2025, it is estimated that 6.3 million persons, or 52% of the 12.5 million urban population, will live in the 12 cities with a population of 250,000 or more, or 21% of the national population. This is about twice the number of persons living in urban areas, and about three-quarters of them will live in peri-urban areas, with insecure housing, water supply, and sanitation.

According to the National Strategy of Urban Water and Sanitation 2011-2025 developed in 2012,

under the implementation of the Delegated Management Framework for Major Water Systems, major cities have made significant investments to achieve improved quality and extension of services to the peri-urban areas. The management and viability of these systems is becoming increasingly sustainable, and against this background, the water subsector is attracting funds to secure the future of these systems.

According to the National Five-Year Plan (2020-2024) of the Government of Mozambique, the following goals have been set for urban water supply and sanitation.

Strategic Objectives	Indicator	Baseline Year (2019)	Target Year (2024)	Responsible Body
Promote the development of economic, social, and administrative infrastructure	xx% of urban residents will have access to safe water	83%.	90%.	Ministry of Public Works, Housing and Water Resources
	xx% of urban residents use proper sanitation facilities	56%.	80%.	

2.2.2 High Level and Related Plans of Project Area

The mission and vision of FIPAG are as follows.

- Mission : Promote water services in major cities through effective management with private sector participation, efficient and sustainable investment and asset utilization, promotion of fair pricing, and environmental protection.
- Vision. : Provide excellent and sustainable urban water services to drive the country's development.

The following is the plan for Nampula city's water supply from 2021 to 2050.

Schedule	Project Name (If Realized)	Project Outline	Donor (If Confirmed)	Proposed Project Cost (Million U.S. Dollars)
2021 - 2022	Master Plan for Nampula City Water Supply	<ul style="list-style-type: none"> • Water Demand Assessment • Water Source assessment • Master Plan • Environmental and Social Screening 	World Bank	1.0
2021 - 2022	Feasibility study and design for use of the Mugica dam for water supply to the city of Nampula	<ul style="list-style-type: none"> • Options Preliminary Design • Mugica Dam Safety Assessment • Detail Design • E&S Impact Assessment and Management Plan 	World Bank	1.5
2021 - 2023	Nampula City Water Supply System Design and Extension <i>Works - Phase I (Namiteka Groundwater Source)</i>	<ul style="list-style-type: none"> • Water Supply Project Design & EIA/Plan services • Drilling of 20 boreholes and installation of pumping equipment • Construction of Storage Tank • Installation of Pumping 	JICA	20.8

Schedule	Project Name (If Realized)	Project Outline	Donor (If Confirmed)	Proposed Project Cost (Million U.S. Dollars)
		Stations <ul style="list-style-type: none"> • Construction of distribution centers and network • Consulting Services 		
D2024 - 2027	Nampula City Water Supply System Design and Extension <i>Works - Phase II (Mugica Dam Source)</i>	<ul style="list-style-type: none"> • Project Detail Design & Supervision • Installation of Water Intake and Pumping equipment • Construction of Treatment Plan, Reserve Storage • Installation of Pumping Stations • Construction of distribution centers and network • Work Supervision Services 	To be identified	175.0
024 - 2025	Feasibility Study for Meluli Dam as Additional for Supply Nampula City	<ul style="list-style-type: none"> • Options Preliminary Design • Technical, Financial and Economic Feasibility Assessment and Study • Meluli Detail Design • E&S Impact Assessment and Management Plan 	To be identified	2.0
2025 - 2030	Meluli Dam Development Work for Water Supply Nampula City	<ul style="list-style-type: none"> • Project Detail Design & Supervision • Dam Civil Works • Installation of spillway gate and hydromechanics equipment • Construction of Treatment Plan, Reserve Storage • Water Supply Main Construction - 110 km 	To be identified	400.0

Source: FIPAG, 2020

2.2.3 Project Urgency and Priority of Mozambican Side

In response to Goal 7 of the MDGs, "By 2015, halve the proportion of people without continuous access to safe drinking water and sanitation," the government has developed the National Rural Water Supply and Sanitation Program 2010-2015, especially for rural areas where water supply facilities are lagging, with the goal of increasing the country's overall water supply rate to 70% by 2015. However, according to data from the World Bank, the water supply rate for the entire country in 2015 was 58%, indicating a large gap between the target and the actual situation. When the water supply rate is classified into urban and rural areas, the urban water supply rate is as high as 88%, while the rural water supply rate remains low at 45%. However, since the population growth rate in urban areas is higher than that in rural areas, the facility capacity has not been able to keep up with the increase in water demand. This has resulted in problems such as insufficient water pressure, in addition to the implementation of time restricted water supply and planned water suspensions due to chronic water shortages.

These problems are not only affecting the lives and health of the citizens, but also the development of commerce and industry, and are becoming an important factor in maintaining public safety. Furthermore, the need to provide safe water to the resettled people from Cabo Delgado Province has made the improvement of water supply services in the city one of the major challenges in the urban area.

FIPAG has identified the water supply facilities project in Nampula, the top city in the northern part of Mozambique, as the most important project after the capital city, and it is given a very high priority.

2.2.4 Mutual Comparison with Other Candidate Projects

There are no other candidate projects.

2.3 Responsible Authorities and Executing Agency

2.3.1 Relevant Government Authorities

The Ministry of Public Works, Housing and Water Resources (MOPHRH) is the central government agency with authority over public works and water resources management, and is responsible for and supervises the water sector. The National Water Supply and Sanitation Authority (DNAAS) is the central agency of the MOPHRH responsible for drinking water supply and sanitation to the population.

Under Decree No. 72/98 of December 23, 1998 and Decree No. 18/2009 of May 13, 2009, the participation of private entities in the management of public water services was approved. Through the enactment of Decree No. 73/98 of December 23, 1998, Water Supply Investment Promotion Fund (FIPAG) will be responsible for investing in and ensuring the operation of water supply systems in major cities. Decree No. 19/2009 of May 13, 2009 established the Administration for Water and Sanitation Infrastructure (AIAS), which will be responsible for the development of water supply systems and sewerage networks in all semi-major cities. The same decree establishes a provincial level advisory body, the Provincial Water and Sanitation Council.

Legislative Decree No. 74/98 of December 23, 1998, as part of the creation of the Delegated Management Framework (QGD), established the Council for Water Regulation (CRA), the body responsible for regulating the operation of water utilities and the relationship between FIPAG and private operators, particularly with regard to water tariffs, quality of service, and the water network expansion program. According to Decree No. 18 of 2009, "the powers of the CRA are extended to the regulation of all public water distribution and drainage systems in a manner appropriate to the technical and system-specific management conditions. The CRA was renamed as the Water Regulatory Authority (AURA) by Decree No. 8/2019 of February 18, 2019.

The following is an organizational chart of the Ministry of Public Works, Housing and Water Resources, to which FIPAG, the implementing agency of the project, belongs.

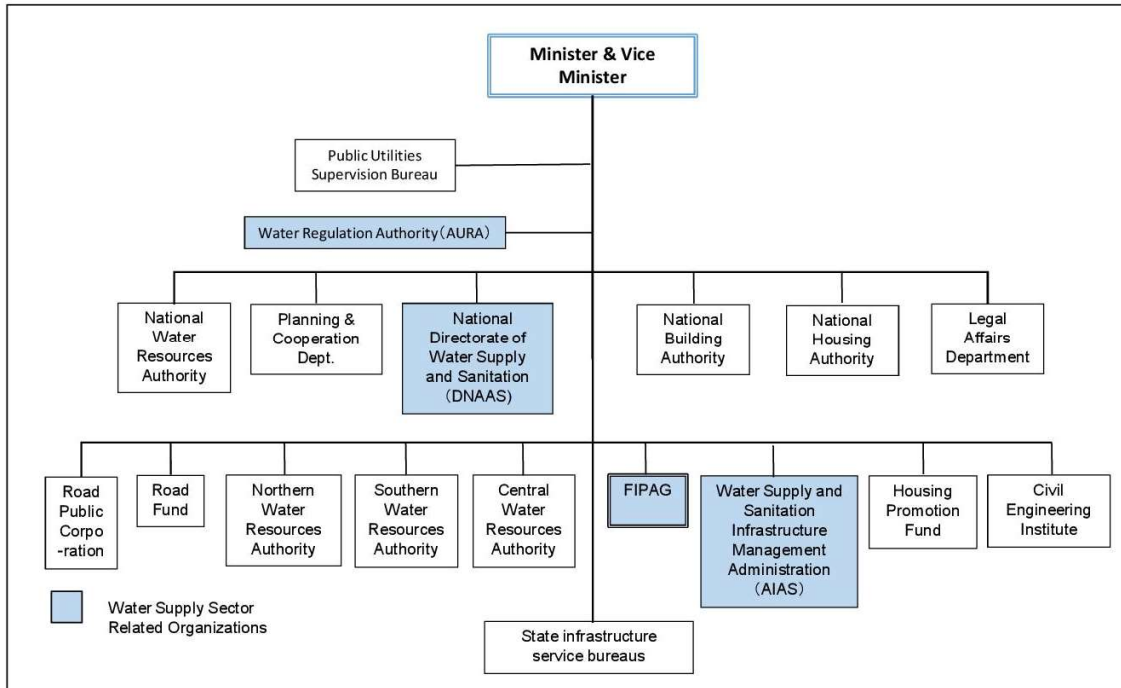


Figure 14 Organization Chart of Ministry of Public Works, Housing and Water Resources

2.3.2 Organization of Executing Agency

The FIPAG headquarters has 2,800 staff members, and the organizational structure is shown in the figure below. Planning and other activities are carried out by the Administration Department, which also serves as the contact point for this project.

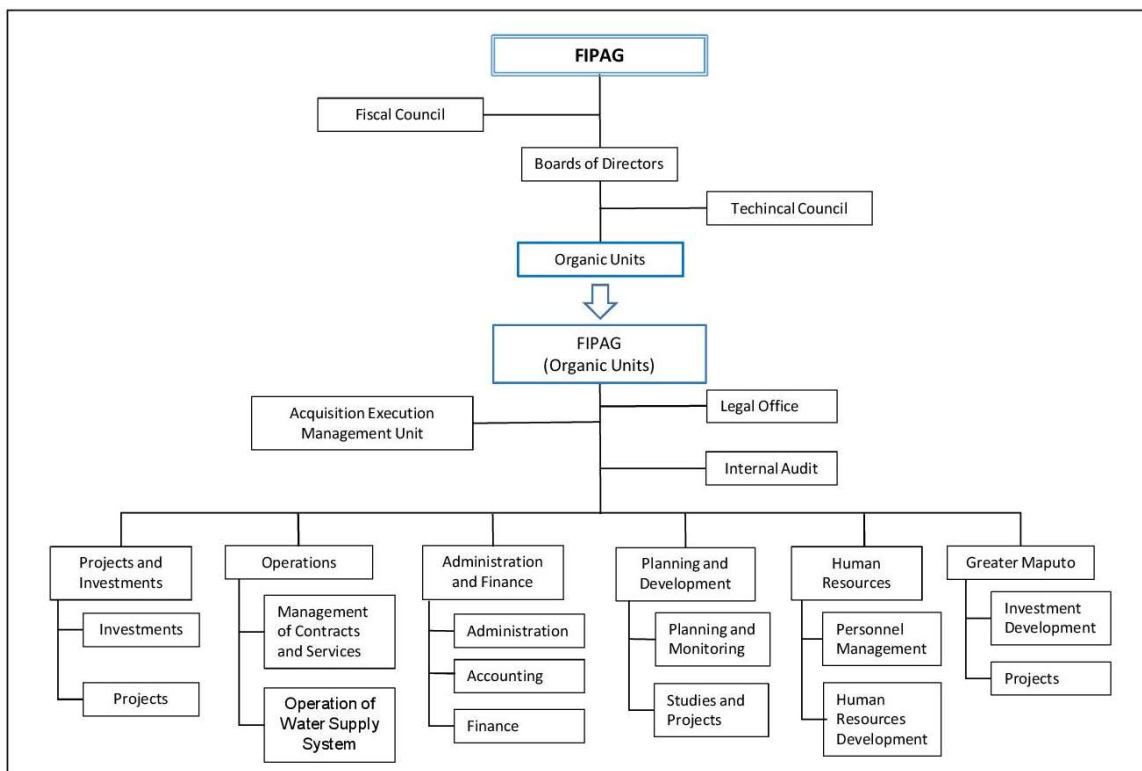


Figure 15 Organization Chart of FIPAG Headquarters

2.3.3 Duties of Executing Agency

FIPAG owns and has jurisdiction over the operation and maintenance of water supply facilities in the designated cities of Mozambique as listed in the table below. Its main roles are as follows

- Planning, supervision, and promotion of projects
- Various procedures related to budget and coordination with donors
- Planning and implementation of capacity building training within the organization
- Follow-up on national level programs

Table 20 List of Water Supply Facilities in Major Cities under FIPAG's Jurisdiction

Province	Niassa	Cape Delgado	Nampula	Zambezia	Tete	Manica	Sofala	Inhambane	Gaza	Maputo
City	Lichinga	Pemba	Nampula	Quelimane	Tete	Chimoio	Beira	Inhambane	Xai-xai	Maputo
	Cuamba		Nacala		Moatize	Manica	Dondo	Maxixe	Chókwè	Matola
			Angoche			Gondola				Boane

2.4 Progress of Japan's Cooperation

2.4.1 Progress of Financial Assistance

Japan has continued to provide assistance to rural areas in Mozambique as part of its support for achieving the MDGs and SDGs. For the water sector, the target provinces were Zambezia and Niassa in the northern part of Mozambique.

The project for the construction of water supply facilities, which will directly contribute to the improvement of the water supply coverage, after the completion of the preparatory study for the grant aid "Niassa Region Water Supply Facilities Construction Project" in 2020, actually is scheduled to be implemented in 2021.

Table 21 Japan's Grant Aid Achievements (Water Supply Sector)

Project Name	Implementation Year	Project Cost (100 Million Yen)	Project Summary
Zambezia Province Groundwater Development Project 1/3	2001-2002	9.90	Eight northern districts in Zambezia Province <ul style="list-style-type: none"> • Construction of boreholes (148 locations) • Renewal of existing hand pumps (13 locations) • Procurement of equipment and materials related to borehole drilling • Promotion of smooth operation and maintenance of facilities. • Support for strengthening the organization
Zambezia Province Groundwater Development Project 2/3	2001-2003	5.07	
Zambezia Province Groundwater Development Project 3/3	2002-2004	4.28	
Zambezia Province Sustainable Water Supply and Sanitation Improvement Project (Technical Cooperation Project)	2007-2011	4.20	Four districts in Zambezia Province <ul style="list-style-type: none"> • Strengthening of the support system by the administration • Support for sustainable operation and maintenance of water supply facilities • Sensitization activities to improve hygiene
Emergency Water Supply Project	2009	10.00	<ul style="list-style-type: none"> • Procurement of equipment related to climate change countermeasures (water tankers and other equipment, water quality

Project Name	Implementation Year	Project Cost (100 Million Yen)	Project Summary
			equipment, borehole drilling rigs and other related equipment, solar-powered water supply equipment, etc.) <ul style="list-style-type: none"> • Guidance on operation and maintenance of procured equipment
Sustainable Rural Water Supply and Sanitation Improvement Project in Niassa Province (Technical Cooperation Project)	2013-2017	9.18	Four districts in Niassa Province <ul style="list-style-type: none"> • Construction of 50 boreholes with hand pumps and latrines for schools (20 schools) • Renewal of 65 existing water supply facilities • Strengthening of the operation and maintenance system of water supply facilities • Improvement of the hygienic behavior of residents. • Dissemination and sharing at the national level

Source: Compiled using information from JICA website.

2.4.2 Progress of Technical Cooperation

As technical cooperation, Japan has been working on the construction of boreholes with hand pumps, which is directly related to the improvement of the water supply rate in rural areas, as well as capacity building of local government and communities to enable maintenance and renewal of the existing facilities. In addition to water supply, construction of sanitation facilities such as latrines and improvement of hygiene practices such as hand washing with soap are also being implemented.

Furthermore, the Niassa Sustainable Water Supply System and Sanitation Promotion Project, a technical cooperation project to promote the strengthening of the capacity of municipalities in rural areas such as district seats to operate and maintain water supply facilities, is scheduled to be implemented from 2021 to 2026.

2.4.3 Comments by Mozambique on Japan's Cooperation

As an agency of the Ministry of Public Works, Housing and Water Resources, which is also responsible for the project, although it was not directly involved in the implementation of the project, Japan's assistance in the construction of facilities and implementation of technical projects to date is highly appreciated, and Japan's continued cooperation in the future is desired.

2.5 Progress of Cooperation by Third Countries and International Organizations

The city of Nampula is undergoing intensive investment of US\$45,000,000 by the US MCA in 2013. Another project that has been accepted is the formulation of a master plan for the use of Mugica Dam, which is scheduled for 2021-2022.

Table 22 Projects by Third Countries/International Organizations

Project Name	Aid Organization	Contents
Water Supply Master Plan	World Bank	<ul style="list-style-type: none"> • Water demand forecast • Water source assessment • Project implementation plan

Project Name	Aid Organization	Contents
Mugica Dam Utilization Project (Mugica Dam)	World Bank	<ul style="list-style-type: none"> • F/S • Outline design • Environmental impact assessment

2.5.1 Assistances related to the Project

There is currently no assistance from third countries/international organizations to Nampula City related to this project. The survey of the Namiteka boreholes was carried out with FIPAG's own financial resources.

2.5.2 Request for the Project

FIPAG will prepare a request for cooperation for the enhancement of water supply in Nampula and submit it to the Embassy of Japan in Mozambique and the JICA Mozambique office by March 2021, in order to approach them for implementation of the grant aid.

2.5.3 Compliance of the Project with Japan's Assistance Policy

The country-specific development cooperation policy for 2013 states that the country will focus on supporting (1) regional economic revitalization, including corridor development, (2) human development, and (3) disaster prevention and climate change countermeasures so that the country can realize its high potential for sustainable economic growth and achieve poverty reduction.

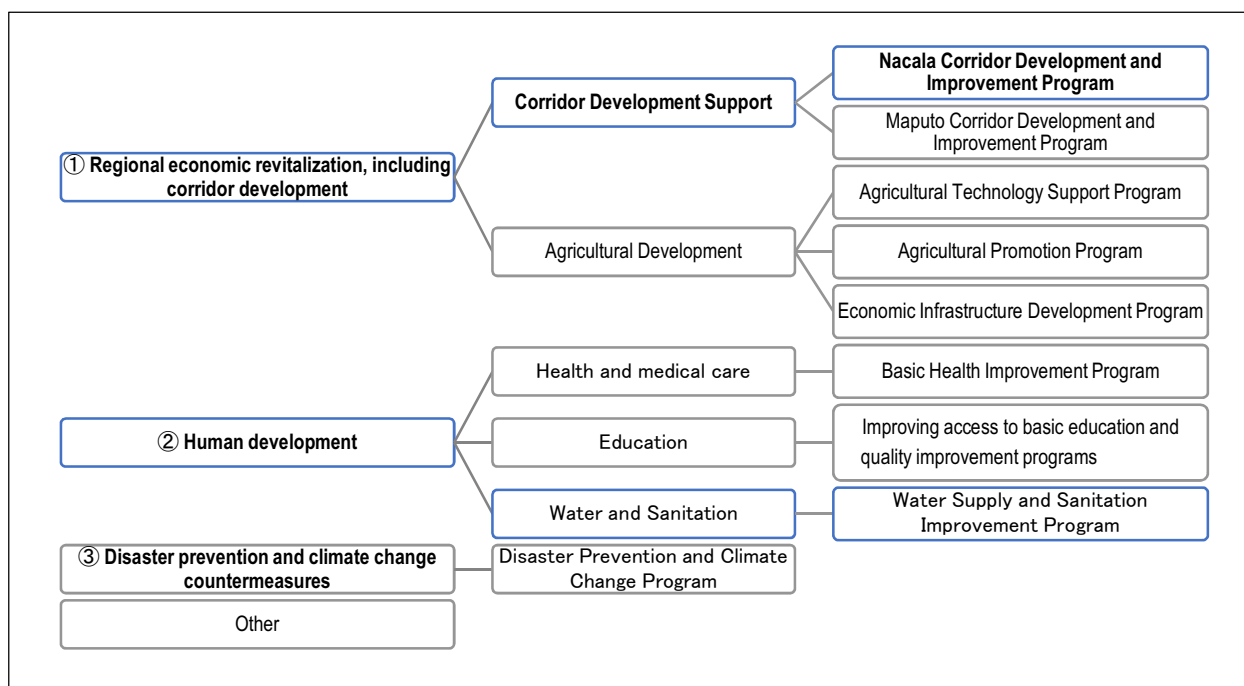


Figure 16 Country-wise Development Assistance Policy

The aid policy for water supply is stated in "(2) Human Development", which states, "To improve the human development index, which is the lowest in the world, and to achieve the MDGs, assistance will be provided to improve access to health services and basic education, and to expand access to safe water through the construction of water supply facilities. The plan also states that "In addition, this plan targets

the city of Nampula, the largest city in the Nacala corridor, and the proposal will contribute to supporting the development of the corridor”.

2.5.4 Necessity of Project Linkage with Cooperation by Third Countries/ International Organizations

In 2013, some of the existing water supply facilities in Nampula were upgraded and expanded from intake facilities to distribution facilities at a total construction cost of about 5 billion Yen, using MCA, a US aid fund. At this point, the Monapo Dam was already experiencing seasonal depletion problems, making it difficult to implement further facility expansions. Therefore, the project is positioned as an augmentation project for the purpose of stable water supply by reducing large-scale leakages and eliminating nonreserved areas through development of new water sources.

2.5.5 Reasons for not Implementing this Project by Third Countries /International Organizations

To date, FIPAG has been actively utilizing loans from the World Bank and other donors to improve urban water supply. However, since the World Bank and other donors provide assistance to the entire country, priority is currently being given to the reconstruction of the metropolitan areas and cyclone-affected cities that are facing serious problems. Furthermore, the project has been excluded as a major project from the perspective that improvement of water source capacity will be limited without large-scale investments such as dam construction.

Currently, there are no plans for construction of facilities at the project site, although other donors are expected to provide support in the form of F/S and master plan in 2021-2022. However, in the future, if the situation in Nampula does not improve when projects such as the cyclone damage control project in Beira are completed, the project may be budgeted due to its high importance. As for Nampula, although there is a possibility of budgeting for water source development projects such as dams when the Bank resumes full-scale assistance, there are various issues to be addressed, including environmental impact assessment.

Since the World Bank, African Development Bank and other donors have been providing continuous support to FIPAG, it is necessary to promptly share information with each donor and coordinate assistance when this project is adopted.

Chapter 3 Project Related Information

3.1 Improvement of Problems

3.1.1 Problems in Water Supply Services (National Level) and Relation to the Project

Urban areas have not been able to cope with the growing demand for water due to delays in large-scale projects and rising leakage rates caused by deteriorating facilities. Therefore, the main objective of this project is to effectively solve the problems faced by water supply facilities through a scheme that does not place a financial burden on the recipient country, taking into consideration the future water supply service conditions. Among the problems (at the national level), the proposed project is expected to improve the shortage of water sources, insufficient capacity of facilities, increase in water leakages, and routine execution of water suspensions.

Table 23 Relationship between Problems in Water Supply Services (National Level) and the Project

Classification	Problems
PPP	<ul style="list-style-type: none"> ● Delays in dissemination of PPP/PFI to rural cities
Project Scheduling	<ul style="list-style-type: none"> ● Delays in scheduling of loan projects
Operations and Finance	<ul style="list-style-type: none"> ● Securing facilities rehabilitation funds ● Rise in debt-to-water revenue ratio ● Recovery of non-collected fees
Facility	<p>Water source</p> <ul style="list-style-type: none"> ● Scarcity of water sources (drought and increased water demand due to climate change) <p>Facility</p> <ul style="list-style-type: none"> ● Insufficient capacity of facilities ● Increase in water leakages <p>Water supply</p> <ul style="list-style-type: none"> ● Routine implementation of water suspensions ● Non-installation of water meters ● No assurance of residual chloride
Management	<ul style="list-style-type: none"> ● Insufficient water pressure and water volume ● Non-implementation of asset management ● No improvement in management of water supply services
Staff	<ul style="list-style-type: none"> ● Low capacity in technical skills of staff

3.1.2 Current Status of Water Services and Problems in Drinking Water Supply (Project Area) and Relation to the Project

This project will address the problems of water sources and facilities among the problems of water supply services in the project area. Specifically, the project will solve the problems of large-scale leakages, uneven distribution of water volume and insufficient water pressure, and the expansion of non-served areas.

3.2 Purpose of the Project

3.2.1 Short-Term Objectives

This project, which can be roughly divided into two sub-projects, aims to contribute to the stable supply of water that conforms to water quality standards as well as to reliably secure revenues. The short-term objectives of this project are as follows.

- ① In order to eliminate nonserved areas, new water supply facilities sourced by boreholes will be constructed in Nampula City to expand the water supply area.
- ② To reduce the amount of non-revenue water and increase the water supply, old pipes that are the cause of large-scale leakages will be replaced.

3.2.2 Medium- to Long-Term Objectives

In the medium and long term, the project aims to contribute to the improvement of the health of the residents, the stable growth of the city, and economic development by implementing hygiene awareness activities in conjunction with the construction of the facility. The following are the medium- to long-term objectives of the project.

- ① In addition to supplying safe water to slums and other inappropriate living environments, the project will promote the improvement of the health of the beneficiaries and the stable growth of the city by implementing hygiene awareness activities such as measures against infectious diseases.
- ② Eliminating large-scale water leakages will ensure a stable water supply for Nampula City and promote economic development.

3.3 Contents of the Project

3.3.1 Outline of the Project

The initial request for the high-priority project is shown in Table 26.

Table 26 Project Outline (Initial Request)

Item		Project Area		
Target Area Name and Population (2017)		Nonserved areas: Namiteka, Mapara => 54,000 persons Expansion/Rehabilitation areas: Muahivire, Nampaco, Muhala => 146,302 persons		
Design Year		2037		
Design Population ⁴		246,571 persons (2037)		
Unit Supply Rate		House connections : 125L/person/day Private yard tap: 80 L/person/day Shared yard tap: 50 L/person/day Public tapstand: 30 L / person / day		
Design Pumping Rate		2,250 m ³ /day		
Project Division		Facility	Specifications	Quantity
1. Facilities Construction	1-1	20 Borehole drillings (10 existing boreholes will also be used)	Depth : 60m, pumping rate : 5.0 m ³ /hr	20 boreholes

⁴Source: Update of the Feasibility Study for City of Nampula, 2018、 FIPAG

	1-2	Borehole facilities (pump operation room, guard room, generator room)	Pillar and beam, RC construction (wall CB pile), borehole pump equipment	5 locations
	1-3	Transmission main and transmission pipes	HDPE pipe, DN80-250	25km
	1-4	Booster pumping station (water receiving basin, pump room, power receiving room, generator room)	Receiving basin (V=300m ³) RC construction, transmission pump equipment, in-plant plumbing (steel pipe)	1 location
	1-6	Water distribution center (water distribution reservoir, disinfection room, flow meter room)	Water distribution reservoir (ground type, V=1000m ³ , elevated water tank, V=300m ³) RC construction, chlorine dosage equipment	1 location
	1-7	Distribution pipe	HDPE pipe, DN50-300	80km
2. Design and Construction Supervision	2-1	Facilities design, construction supervision, etc.	-	1 lot

3.3.2 Description, Scale, and Quantity of the Project

The overall system and each facility of the project are described below.

1) Outline of Overall System (Facilities Construction)

The Monapo Dam water source is susceptible to changes in rainfall due to climate change, and due to population and economic growth in the existing service area, the current water supply system cannot adequately cover the water demand of the entire city of Nampula. Therefore, since expansion of the water service area using the Monapo Dam as the source of water supply is difficult, new boreholes to be drilled in the Namiteka well field will be used as the source of water to eliminate the nonserved areas.

In addition, pipelines will be upgraded to eliminate large-scale leaks that have been a problem in existing service areas.

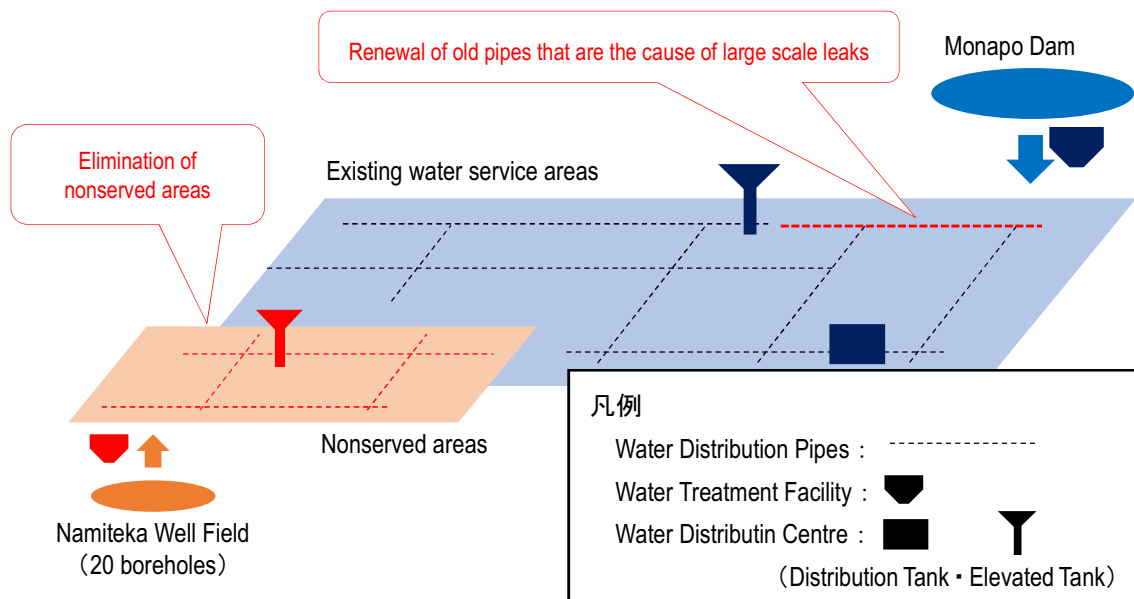


Figure 17 System Outline

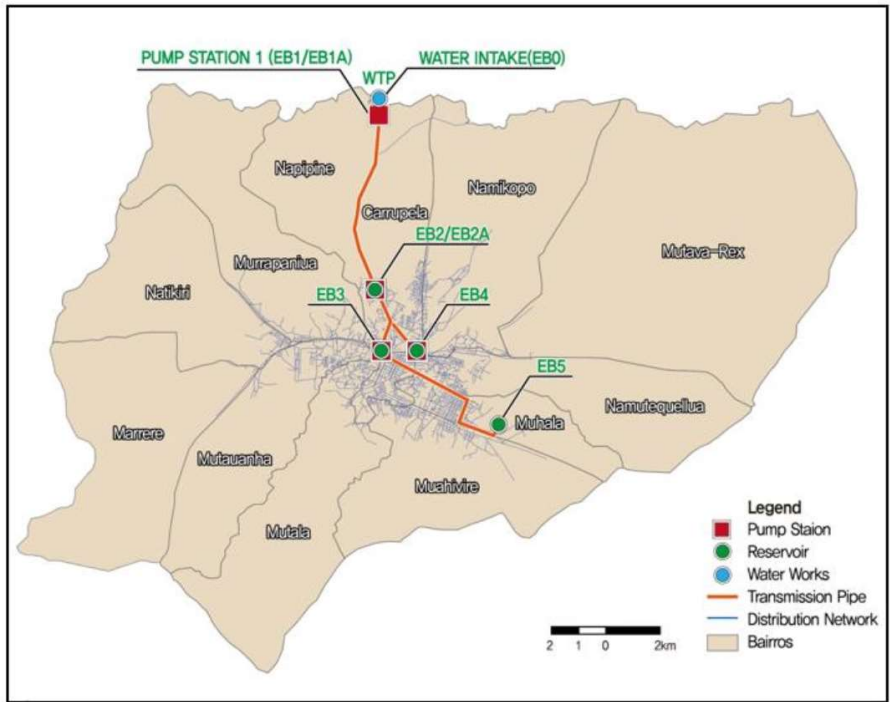


Figure 18 Project Target Area

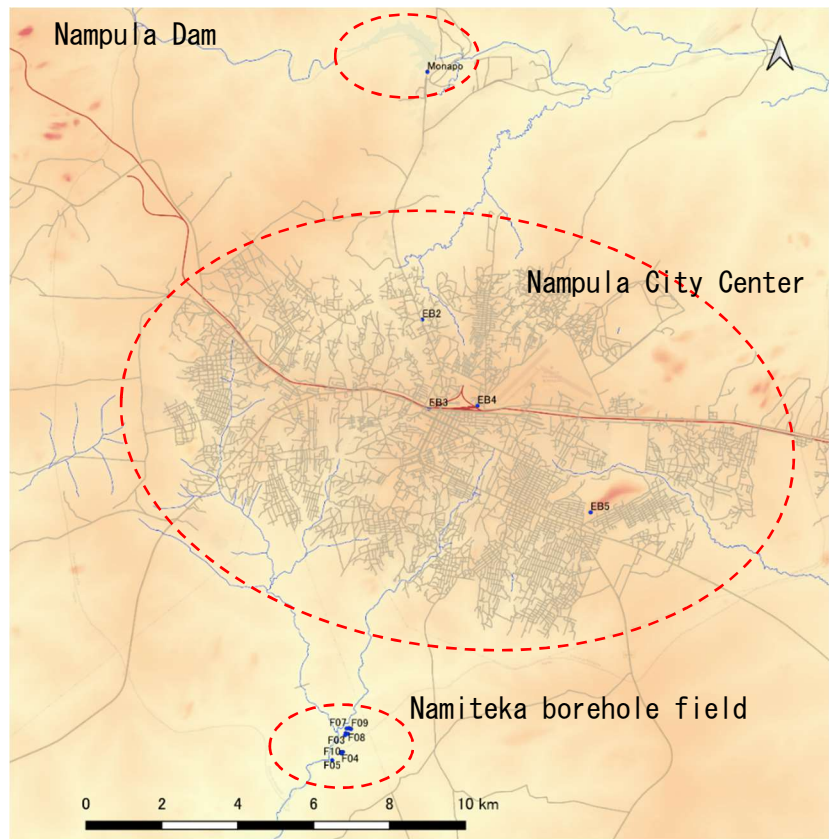


Figure 19 Location of Facilities in the City

2) Outline of Each Facility (Proposed Construction Site, Scale, Capacity and Quantity)

(1) Water Source

The 20 new boreholes are planned to be constructed in the Namiteka borehole field. The Namiteka water source field is located at the confluence of several tributaries of the south-flowing Meluli River, and 10 boreholes were constructed on the left bank in 2020. The catchment area is not large, as the Nampula urban area is a watershed. The Namiteka boreholes are located about 8 km south of the city center at an elevation of about 300 meters. The elevation of the urban area of Nampula is in the range of 350m to 440m.

The average well depth of the existing boreholes (10 boreholes) is 53m, the average safe pumping rate is 17.6m³/hr, the average static water level is -5m, and the average drawdown is about 4m. The area around the Namiteka Borehole field is mainly used as agricultural land, and some houses are scattered in the surroundings. The area around the Namiteka Borehole is used for public purposes.

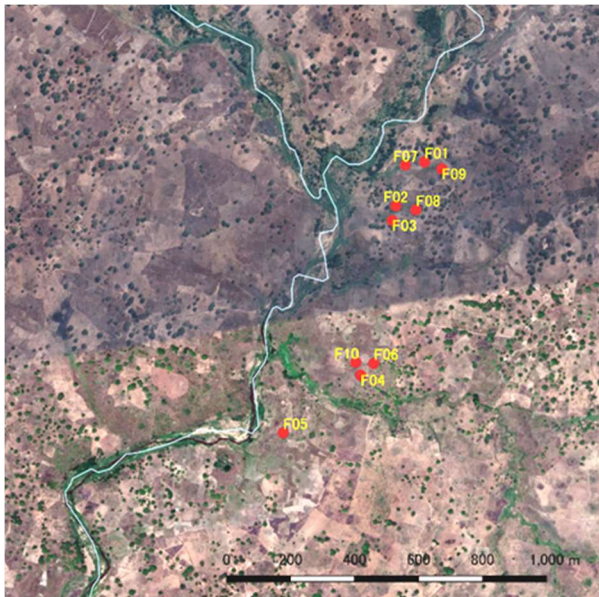


Figure 20 Existing Water Sources (Namiteka Well Field)



Figure 21 Existing Borehole (Pump Installation expected in 2021)

Table 27 Namiteka Well Field

Borehole Number	Depth(m)	Static Water Level(m)	Drawdown(m)	Safe Yield (m ³ /hr)
F-01	51	-4.77	2.20	18.0
F-02	62	-4.79	3.24	18.0
F-03	54	-4.75	3.21	18.0
F-04	51	-5.46	6.55	18.0
F-05	52	-6.57	4.04	14.0
F-06	51	-3.19	2.38	18.0
F-07	51	-2.43	7.00	18.0
F-08	51	-5.74	3.44	18.0
F-09	55	-6.12	4.12	18.0
F-10	53	-5.40	5.13	18.0
Minimum	51	-6.57	2.20	14.0
Average	53	-4.92	4.13	17.6

Borehole Number	Depth(m)	Static Water Level(m)	Drawdown(m)	Safe Yield (m ³ /hr)
Maximum	62	-2.43	7.00	18.0

The water quality of the above group of boreholes was analyzed in three boreholes, and the results were as follows.

Table 28 Water Quality of Namiteka Well Field (Partial)

Parameter*	Unit	Mozambique Standard	Borehole F-01	Borehole F-02	Borehole F-03
Electrical conductivity	µS/cm	2,000	1,284	1,590	N/A
pH		6.5-8.5	7.6	7.8	7.7
TDS	mg/L	1,000	706	875	N/A
Turbidity	NTU	5	1.3	1.0	89.0
E. Coli group	NMP/100ml	0	0	0	0
Color	TCU	15	0	0	> 100
Calcium (Ca)	mg/L	50	16	20	87
Chloride	mg/L	250	163	123	112
Total Hardness	mg/L	500	336	336	500
Total iron	mg/L	0.3	0.0	0.1	0.1
Magnesium (Mg)	mg/L	50	48.54	35.46	40.90
Silicon dioxide (SiO ₂)	mg/L		2.26	2.28	2.01

Analyses were conducted in the laboratory at the FIPAG Nampula branch office. Red figures indicate values that exceed the standard.

(2) Transmission Main and Transmission Pipe

Considering the future plan and conditions of the existing pipelines, the project plans to lay about 6 km of pipelines with diameters of 100 mm to 200 mm from each borehole to the booster pump station. The roads are unpaved, but river crossings are required along the way. Depending on the location of the water treatment plant and distribution centers, it may be necessary to construct new water pipe bridges.

(3) Booster Pumping Station

The booster pumping station shall have a fence around the perimeter for security and environmental consideration. In addition, gates and small doors will be installed to facilitate access of materials, maintenance vehicles, operation and maintenance personnel, guards, and other required conveniences. The site will be equipped with a retention pond to stabilize the raw water flowing into the pump, a transformer room for receiving high-voltage power, a water transmission pump room, a private generator room, a guard room, and toilets. The capacity of the retention pond is 300m³, which is equivalent to one hour of water supply, and the structure is a ground type RC cylindrical water tank in accordance with the structure of the existing water tank.

(4) Transmission Main

Considering the future plan and the conditions of the existing pipelines, the plan is to lay about 20km of 200mm to 300mm diameter pipelines to the existing distribution reservoir (EB5: V=5,000m³) and the newly constructed distribution center. The transmission mains will be installed in the utility zone between the road structure and private structures, and river crossings will be required along the way.

(5) Water Distribution Center

The capacity of the distribution reservoir will be 30% to 50% of the design average daily water supply rate at 1,300m³ (1,000m³ for the ground tank and 300m³ for the elevated water tank, for a total effective capacity of 1,300m³). The structure of the distribution reservoir will be a cylindrical RC water tank to match the structure of the existing water tank. In addition to the inflow and outflow pipes, drainage pipes and overflow pipes for maintenance are to be installed in the reservoir. The reservoir will be equipped with valve boxes for outflow and drainage valves, ventilators for suction and exhaust due to water level fluctuations, outer walls, ladders inside the tank, and manholes for maintenance. In addition, a flow meter and a flow meter room will be installed to measure the current water distribution volume and to monitor leakages in the distribution pipes as well as seasonal, weekly, and hourly flow rate fluctuations.

In addition, there will be a disinfection room in the site for storing calcium hypochlorite, a mixing tank, and a chemical dosage pump. In addition, power receiving equipment will be installed at both water distribution centers to operate the chemical dosage pumps.

(6) Distribution Pipe

The existing water distribution pipes are PVC or DIP pipes. The distribution pipes of this project are planned to be HDPE pipes of relatively small diameters of DN300 or less in consideration of facilitating future maintenance. The water distribution pipes will be located in the utility zone between the road structure and the private structures. In accordance with local standards for pipe laying depths, the cover soil thicknesses shall be 600mm for pipes up to DN63, and 1,000mm for transmission pipes and pipes of DN75 and above.

3.3.3 Contents, Scale and Quantity of Dispatch of Experts and Equipment Procurement

If this project is implemented with Japanese technical assistance, it is expected that the water supply facilities will be properly operated due to the improvement in technical skills of FIPAG staff through the dispatch of experts or the implementation of technical cooperation projects in the following areas

- Training on operation and maintenance of boreholes (dispatch of experts, etc.) and procurement of maintenance equipment
- Training on inspection of electro-mechanical equipment (dispatch of experts, etc.)
- Implementation of technical cooperation for non-revenue water measures and water service block formation

3.3.4 Project Cost Estimation

The estimated project cost is shown in Table 29.

Table 29 Project Cost Estimation

	Facilities to be Constructed and Other Items	Quantity	Construction Cost (million Yen)
I	Construction cost		
1	Water source facilities construction (borehole drilling, pump equipment, pump pit, etc.)	20 boreholes	140
2	Booster pumping station construction (receiving water tank 300m ³ , water pump room, power receiving equipment room, generator room)	1 location	57
3	Transmission main and transmission pipeline laying (HDPE pipe DN75-200)	25km	589
4	Distribution pipe laying (new installations and rehabilitations) (HDPE pipe DN50-250)	80km	491
5	Water distribution center construction (reservoir V=1000m ³ , elevated water tank V=300m ³ , disinfection room, flow meter room, generator room)	1 location	82
6	Total direct construction cost		1,359
7	Site supervision cost		544
	Subtotal		1,903
II	Design and construction supervision cost		
1	Design and construction supervision cost		190
2	Soft component cost		20
	Subtotal		210
III	Contingencies		
1	Contingencies such as price escalation, etc.		106
	Subtotal		106
	Total		2,219

3.4 Site Conditions

3.4.1 Location (Land Acquisition, Land Use, Pollution causing Facilities, etc.)

The area around the Namiteka borehole field is being used as forest and farmland. Since the area around the water source is public land, securing land for the project is not a problem. Since the pipeline will be laid under the road, there is no particular problem although the locations of occupancy need to be discussed with the road administrator. Furthermore, the sites for water distribution centers have not yet been decided, but priority is planned to be given to selection of unused land in the city.

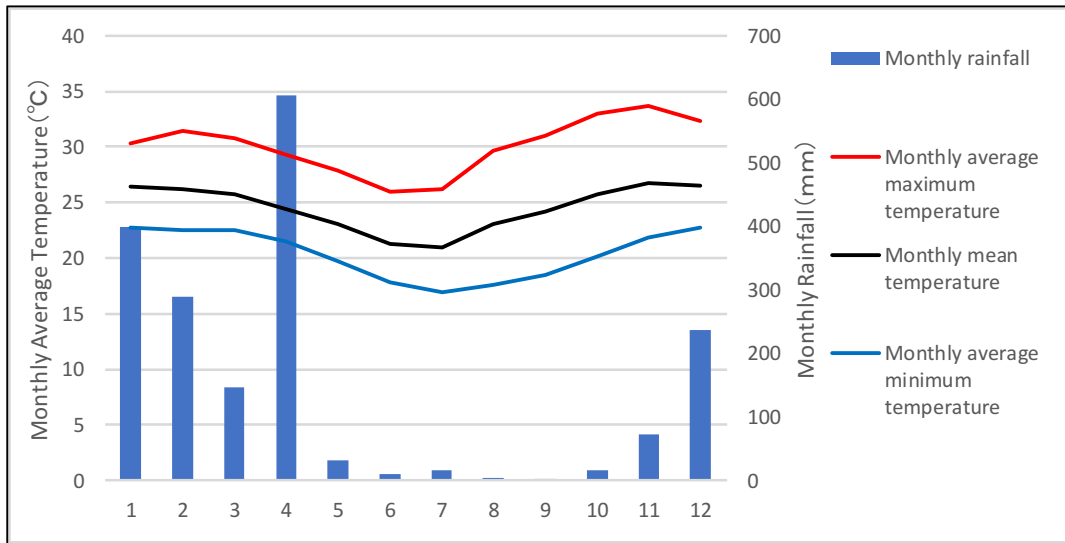
3.4.2 Natural Conditions

(In Particular, Descriptions of Water Sources such as Precipitation, River and Groundwater)

1) Precipitation Rate

The average annual rainfall is relatively high at about 1,700 mm, and the wet and dry seasons are clearly divided. The average minimum temperature is over 15 degrees even in the winter. However, since the area around Nampula City is located upstream of a large river, the catchment area is small and not

suitable for development of a large dam.

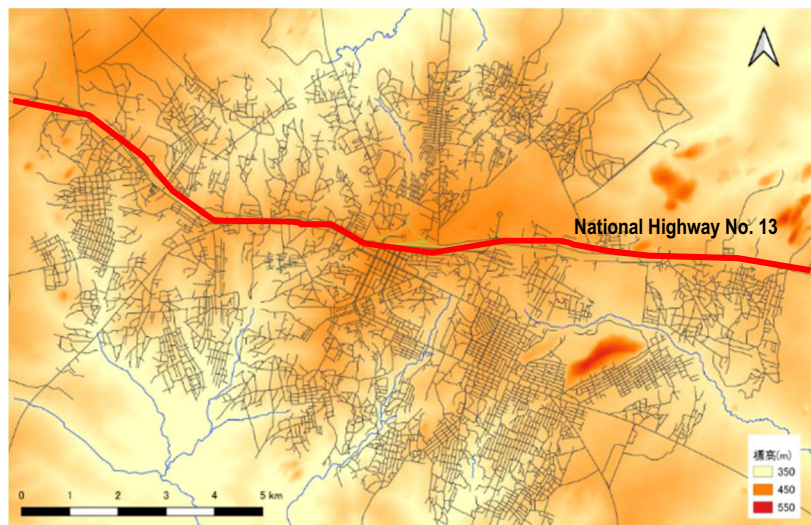


Source: ClimatView, Japan Meteorological Agency

Figure 22 Temperature and Precipitation Rates (Average Values for 2018 and 2019)

2) Topography

The elevation difference in Nampula city is about 100 m (350 to 450 m above sea level). National Highway 13, which runs east to west along the ridge, serves as a dividing line. Bounded by the national highway, the north side is the catchment area of the Monapo River flowing eastward and the south side of the Meluli River flowing southward. The water supply nonserved area is in the periphery of the city where the elevation is relatively low. The elevation of the Namiteka boreholes, which will be the new water source, is about 300 m.



Source: ALOS Data of JAXA

Figure 23 Elevations of Nampula City

3) Groundwater

Gneiss and metamorphic rocks are distributed around Nampula City as residual hills are found in the city. The Namiteka well field is located south of Nampula City, and weathering has progressed to depths

of 35 to 60 m in this area. Since it is located at the point where the tributaries of the Meluli River (Muhala, Muepelume and Natuko Rivers) converge, it is assumed that rainwater and river water are supplied to the underground from the surface, allowing for the storage of large amounts of groundwater.

According to the pumping test of 10 boreholes drilled by FIPAG, most of the boreholes have relatively large yields of 18.0 m³/hr per borehole. However, the distances between boreholes are short in some cases, and it is difficult to evaluate the continuity of fractures in the fracture zone, so it is necessary to determine the safe pumping rate after thoroughly evaluating the mutual interference of 30 boreholes. In addition, it should be noted that the catchment area of the Namiteka boreholes is not so large because they are located in the relatively upstream area, and that the flow rate in the downstream area of the tributaries may decrease.

Table 30 Namiteka Well Field

Borehole Number	Borehole Depth	Static Water Level	Pumping Rate	Drawdown
F-01	51.0m	4.77m	18.0m ³ /h	2.20m
F-02	62.0m	4.79m	18.0m ³ /h	3.24m
F-03	54.0m	4.75m	18.0m ³ /h	3.21m
F-04	51.0m	5.46m	18.0m ³ /h	6.55m
F-05	52.0m	6.57m	14.0m ³ /h	4.04m
F-06	51.0m	3.19m	18.0m ³ /h	2.38m
F-07	51.0m	2.43m	18.0m ³ /h	7.00m
F-08	51.0m	5.74m	18.0m ³ /h	3.44m
F-09	55.0m	6.12m	18.0m ³ /h	4.12m
F-10	53.0m	5.40m	18.0m ³ /h	5.13m

Source: Geophysical prospecting and supervision of borehole construction in surrounding Nampula City, 2020, FIPAG.

3.4.3 Access

Nampula City is located about 200 km west of Nacala International Port. The national highway is well paved, which provides good conditions for transporting materials. Nampula International Airport, which has daily flights to and from the capital city of Maputo, can make traveling more convenient.

An access road to the Namiteka borehole field, which is planned as the water source, does not have to be constructed since an unpaved road already leads to the site.

3.4.4 Power and Communication

The coverage and stabilization of electrical power have become a national issue, and power lines are being developed in the northern part of Mozambique. Since power failures occur regularly in Nampula City, it is necessary to install an emergency power generator and even if a power failure occurs, adopting a gravity type distribution method similar to the existing facilities is desirable for continued water distribution during a certain period of time.

Since cell phones, Internet and other means of communication are widespread, the environment is generally free of inconvenience.

3.4.5 Safety

In terms of security, there are no major problems in Nampula Province except for general crime. However, in the northeastern part of the province of Cabo Delgado, located to the north of Nampula, there have been frequent attacks by armed groups, and some residents have fled as refugees to the Nampula City area.

Chapter 4 Effectiveness and Impacts of the Project

4.1 Effectiveness of Project Implementation

4.1.1 Extent of Solving Current Situation of Water Supply Sector

Although the project will not directly solve the scarcity of water resources, it can be expected to improve the amount of water leakages and thus the efficient use of water.

4.1.2 Extent of Solving Problems of Drinking Water Supply

The project is expected to solve the problems of nonserved areas and also function as a backup for existing water supply areas.

4.1.3 Extent of Solving Problems related to Sanitation and Waterborne Diseases

Water supply to nonserved areas is expected to prevent COVID-19 infection and reduce the number of patients with waterborne diseases.

4.2 Impacts from Project Implementation

4.2.1 Political Impact

In Nampula, the government is encouraging people to wash their hands due to the Corona crisis as planned water suspensions during the drought period have been prolonged.

4.2.2 Social Impact

In the nonserved areas of Nampula, people are forced to use unsafe water sources, and there are many sanitary problems. The project is expected to contribute to solving these problems and improve the living conditions of the poor in particular.

4.2.3 Economic Impact

The city of Nampula, the main city in the Nacala corridor, has been experiencing stable economic growth, but it is inadequate in terms of water supply. It is feared that the current level of water service will be a hindrance to growth. The construction of facilities to meet the growing demand for water is essential for the growth of the economy.

4.2.4 Technical Impact

In addition to population growth, deterioration of facilities in Mozambique is significant, and the

country needs to resolve both issues: expansion of facilities capacity and renewal of existing facilities. A technological proposal that can solve both issues in the medium to long term should have a great impact. It is also expected that technology transfer through the cooperation of the Japanese side will be meaningful not only for FIPAG but also for the water supply sector in Mozambique.

4.2.5 Diplomatic and Public Relations Impact

The northern part of Mozambique and the Nacala Corridor are areas where rapid economic development is expected, and Japan has been providing continuous support. The development of urban water supply can directly contribute to the economic development and improvement of people's lives, which is a challenge for Mozambique, and the highly attention receiving project in Nampula City will further increase the presence of Japan's contribution, and is expected to have a great impact diplomatically and in terms of public relations.

Chapter 5 Project Feasibility

5.1 Results of Comparison with Main Alternatives

There are no alternative plans for this project.

5.2 Organizational Relevance and Sustainability of Project Implementation

5.2.1 Organizational Capacity for Management

Since FIPAG's financial balance is improving, its financial condition seems to be good. Although the water supply rate is low at 50%, for the time being, FIPAG will be able to stabilize its management by making investments that directly lead to an increase in water supply revenue. However, it is necessary to allocate the necessary budget to reduce leakages by upgrading deteriorating facilities and to optimize billing through the installation of water meters, in order to achieve sustainable management.

5.2.2 Organizational Capacity during Construction

Although the input of the engineers to be involved in construction supervision is to be borne by the donor agency, FIPAG, as the executing agency, will assign staff to supervise the construction in cooperation with the dispatched engineers.

5.2.3 Organizational Capacity during Operation and Maintenance

The capacity of FIPAG for operation and maintenance is shown in Table 31.

Table 31 Organizational Capacity for Operation and Maintenance (FIPAG Nampula Branch Office)

Item		Description
Organization in charge of Operation and Maintenance	Department name	Development Department (Water Treatment, Facility Maintenance, Operation and Maintenance)
	Number of staff	33 persons
	Operating conditions	Since the newly constructed boreholes and distribution centers will be equipped with the same mechanical and electrical equipment as the existing water treatment plant and distribution centers, there will be no problems in operation and maintenance.
	Status of repairs	Long-term water suspensions due to large-scale leaks from pipes or

		equipment failure have not occurred.
	Problems and issues of department	<ul style="list-style-type: none"> • Budget Since there is no budget for repairs, repairing of facilities that seriously affect the water supply cannot be made. Therefore, it is necessary to secure a certain amount of annual budget for repairs. • Operation/Maintenance Technology and Equipment Since the department does not have the skills and equipment to operate and maintain boreholes, it is necessary to provide maintenance equipment as well as training for staff.

5.2.4 Relationships with Local Residents

1) Anticipated Interests

The construction of water supply facilities brings a variety of benefits to the local residents, such as the elimination of water supply suspensions and time restricted water supply, as well as employment for a certain period of time. Therefore, local governments and users are very interested in this project.

2) Possibility of Involuntary Resettlement

The locations of the Namibian boreholes and the pipelines that are planned to be renewed are on land managed by the government of Namibia. Although the planned sites for the water distribution centers have not yet been determined, the government will give priority to selecting lands that are not in use, and will start the procedures for land acquisition once the locations of lands required are determined. Therefore, problems such as involuntary resettlement should not arise.

5.3 Financial Viability and Sustainability of Project Implementation

5.3.1 Source of Funds to be Borne by Mozambican Side

The main burden of this project is to secure the land. The area around the Namiteka well field is government land. Land parcels for the construction of the water distribution centers are yet to be determined, and if they are privately owned, it will be funded from the FIPAG budget.

5.3.2 Current Status of Water Supply Service Indicators

FIPAG uses Key Performance Indicators (KPIs) to evaluate the performance of FIPAG and its concession contractors. Important KPIs are water supply service population, annual water distribution volume, average water supply hours, billing status, number of house connections, and water quality analysis status. The following table shows the current status of water service indicators.

Table 32 Current Status of Water Supply Service Indicators (All Facilities under FIPAG's Jurisdiction)

Item		2019	2020
Water Supply Service Population and Water Supply Rate	Population in water supply area	6,494,436	7,142,690
	Population served by house connections	2,710,876	2,936,524
	Population served by public tapstands	561,728	658,628
Water Supply Rate	Water supply rate (%)	51	50
	Water supply rate for house connections (%)	9	9
	Water supply rate for public tapstands (%)	42	41
Water Supply Hours and Unit Supply Rate	Water supply hours (hr)	14	15
	Unit water supply rate per person per day (liters/day)	60	55
Leakage Rate	Water production rate (thousand m ³ /year)	187,388	134,522
	Metered water supply rate (thousand m ³ /year)	175,404	125,681

Item		2019	2020
	Leakage rate (%)	51	52
Fee Collection Rate	Billing rate by water meter (%)	85	80
	Fee collection rate (%)	89	-
	Fee collection rate (house connections) (%)	86	85
	Fee collection rate (public tapstands) (%)	51	37
Water Quality Analysis	Water quality test items	30	30
	Analyses results	29	26
Number of Staff	Number of staff members	2,734	2,828
	Number of staff / 1000 taps	5	5

5.3.3 Trends in Financial Balance

Figure 24 shows the status of revenues and expenditures. The balance between revenue and expenditure has been on an improving trend since 2016 and has shifted to the positive side in 2019. Expenditures are on an increasing trend, but tariff revenues are increasing more rapidly. Since the demand for water is expected to continue increasing in the future, revenue is expected to grow in proportion to the development of water supply facilities.

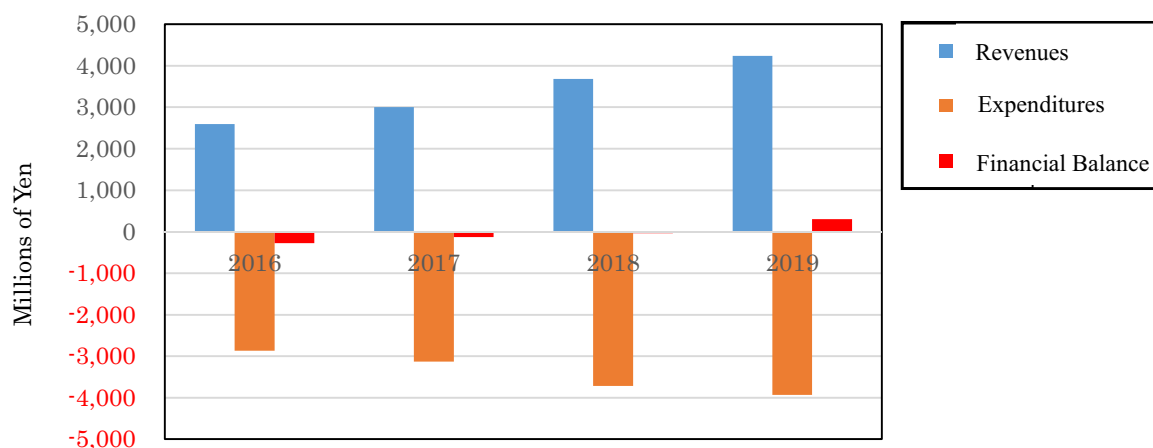


Figure 24 Financial Balance

5.3.4 Projected Financial Balance

For stable management, it is necessary to carry out effective service operations that directly lead to an increase in tariff revenue. Even if the annual debt payment due to investment increases, sustainable service operations is possible if the tariff revenue also increases concurrently.

5.4 Technical Feasibility and Sustainability of Project Implementation

5.4.1 Consistency with Technical Level of Mozambique

The FIPAG Nampula branch office is responsible for operation and maintenance of the water supply facilities. The branch office has a technical staff of 85 persons, consisting of engineers who graduated from universities and technical schools in the country. The staff of the branch offices regularly attend training courses at the training center established by FIPAG.

The facilities to be constructed under this project will use the same mechanical and electrical equipment as the existing facilities. From the perspective of consistency with the technical level of the

receptient country, there is no problem. However, since it is desirable to conduct regular operation and maintenance of boreholes, technical guidance is necessary.

5.4.2 Staff Allocation and Employment Status

For operation and maintenance of the new facilities, the project will provide initial guidance on the system structure and management techniques. However, since the number of management personnel needs to be increased, the knowledge and experience of the current staff should be fully utilized.

5.4.3 Operation and Maintenance Status of Facilities and Equipment

This project will provide technical guidance on facilities operation through soft component support, which is anticipated to be more effective than previous efforts.

5.5 Environmental Considerations

5.5.1 Expected Environmental Impacts

In this project, borehole drillings, new and renewal pipe installations, and construction of water distribution centers are planned. Since there are no rare animals or plants living in the project area and along the proposed pipe laying route, and also, residents do not need to be relocated, serious impacts should not occur. Based on these results, this project is considered to fall under Category B of Environmental and Social Considerations.

Other possible impacts on society and the environment are shown in Table 33. As negative impacts on society due to the construction, there is a possibility of the spread of infectious diseases and occupational accidents due to the influx of workers from outside the area, noise and dust, and traffic accidents. In addition, as negative impacts on the environment due to the operation of the facilities, there are possibilities of disturbance on the hydrologic cycle and land subsidence.

Preventive measures need to be taken in order to minimize or eliminate the impacts on society. For environmental impacts, monitoring should be conducted, and if widespread or localized land subsidence is expected to occur, the expected damage should be identified and the water source should be changed to another source such as surface water in the future.

Table 33 Social and Environmental Impacts

Impact Type	Impact on Society	Impact on Environment
Positive Impact	<ul style="list-style-type: none"> ● Stable supply of water ● Improving the health of infants and children ● Creation of employment opportunities ● Increase in volume of water distributed to slum areas around the city. 	<ul style="list-style-type: none"> ● Effective use of water resources (reduction of water leakages)
Negative Impact	<ul style="list-style-type: none"> ● Spread of infectious diseases due to influx of workers from outside the region 	<ul style="list-style-type: none"> ● Disturbance on hydrologic cycle (increased pumping rate) ● Decreased flow in the lower reaches of

Impact Type	Impact on Society	Impact on Environment
	<ul style="list-style-type: none"> ● Occurrence of occupational accidents ● Generation of noise, dust, etc. ● Occurrence of traffic accidents, etc. 	tributaries

5.5.2 Assessment of Environmental Impacts

Here, the magnitude of environmental and social impacts related to this project is assessed by referring to the Environmental and Social Consideration Guidelines of the Japan International Cooperation Agency.

- 1) Location of the project site, scale and contents of the project
 - (1) Project site: Nampula City, Nampula Province
 - (2) Type of project: Expansion and renewal
 - (3) Scale and contents of the project

The scale and contents of the project are shown in Table 34.

Table 34 Project Scale and Description

Facility	Item	Number/Capacity
Borehole	Number of facilities	30 boreholes (10 existing wells, 20 new wells)
(New)	Pumping rate	Average 5 m ³ /h x 30 wells x 15 hours = 2,250 m ³ /day
	Static water level/drawdown	Average: Static water level = 4.9m, drawdown = 4.1m
Water Distribution Center (New)	Number of facilities	1 location (2 distribution reservoirs)
	Facility capacity	V=1000m ³ , V=300m ³
Pipeline	Pipe removal	None
(Renewal)	Pipe renewal	Site survey required
(New)	New pipe laying	Site survey required

- 2) Project Summary

As described in "3.3 Contents of the Project" of this report.
- 3) Necessity of the Project (High-level and related plans)

As described in "2.2.2 High Level and Related Plans for Project Area" of this report.
- 4) Zero options and alternative plans

As described in "5.1 Results of Comparison with Main Alternatives" of this report.
- 5) Status of stakeholders consultations

The table below shows the status of consultations with stakeholders.

Table 35 Status of Consultations with Stakeholders (Legend: ■YES□NO)

Target	Held or Not Held	Contents of Consultation
Relevant Ministries and Agencies	■	Information on this project is shared with DNAAS, the supervisory organization.
Local Residents	□	Although we have received requests from residents for water supply, we have not yet held any consultations in order to avoid creating extra expectations regarding this project.
NGOs	□	Same as above
Others	□	Same as above

6) Residents' feelings toward similar past projects

- No complaints
- Have complaints

7) Names and procedural status of environmental impact assessment laws or guidelines

Law or Guideline: Environmental impact assessment in Mozambique is regulated by the Decree on Environmental Impact Assessment (Decree No. 54/2015) and the Approval of the Overall Policy on Environmental Impact Assessment (Ministerial Degree No. 129/2006).

Procedural status:

- Approved (without additional conditions)
- Approved (with additional conditions)
- Under review
- Procedure not yet started
- Other

8) Permit Application System and Procedural Status

Name of permit: As stipulated in "Decree No. 54/2015, Law on Environmental Impact Assessment", it is mandatory to obtain an "Environmental License" for projects involving construction of facilities.

Procedural status: After the project and its details are finalized, the application will be submitted to the Provincial Land and Environment Department.

- Acquired
- Required but not yet acquired: To be applied after the project details are finalized.
- Not required
- Other (not considered necessary, but needs to go through a formal review process)

9) Whether the Project falls under a sensitive sector or not (Legend: ■YES□NO)

- (1) Mining development (including oil and natural gas development)
- (2) Pipeline
- (3) Industrial development
- (4) Thermal power generation (including geothermal)
- (5) Hydropower, dams and reservoirs
- (6) Power transmission lines, power distribution (involving large-scale involuntary resettlement, large-scale deforestation, submarine power lines)

- (7) River and erosion control
- (8) Roads, railways, and bridges
- (9) Airports
- (10) Ports
- (11) Water supply, sewage and wastewater treatment (having sensitive characteristics or located in sensitive areas)
- (12) Waste treatment and disposal
- (13) Agriculture

1 0) Applicable characteristics likely to have impacts (Legend: YES NO)

- Large-scale involuntary resettlement (scale: household members)
- Large-scale groundwater pumping (scale: 821,250 m³/year)
- Large-scale land reclamation, land development, and land clearing (scale: ha)
- Large-scale deforestation and logging (scale: ha)

1 1) Applicable sensitive areas (Legend: YES NO)

- National parks, nationally-designated protected areas (coastal areas, wetlands, areas for ethnic minorities or indigenous peoples, cultural heritage sites, etc. designated by national governments)
- Areas that are thought to require careful consideration by the country or locality

1 2) Potential of the Project to have environmental and social impacts

- YES
- NO
- Do not know.

Table 36 shows the expected impacts of this project on the surrounding environment and society.

Table 36 Social and Environmental Impacts (Reproduced)

Impact Type	Impact on Society	Impact on Environment
Positive Impact	<ul style="list-style-type: none"> ● Stable supply of water ● Improving the health of infants and children ● Creation of employment opportunities ● Increase in the volume of water distributed to slum areas around the city. 	<ul style="list-style-type: none"> ● Effective use of water resources (reduction of water leakages)
Negative Impact	<ul style="list-style-type: none"> ● Spread of infectious diseases due to influx of workers from outside the region ● Occurrence of occupational accidents ● Generation of noise, dust, etc. ● Occurrence of traffic accidents, etc. 	<ul style="list-style-type: none"> ● Disturbance on hydrologic cycle (increased pumping rate) ● Decreased flow in the lower reaches of tributaries

Chapter 6 Conclusion

6.1 Particular Remarks

In addition to population growth, the country's lifestyle is expected to change gradually as the economy grows, leading to further increase in water demand. At the same time, the need for high quality services such as safe and reliable water supply, water pressure, and water volume is expected to gradually increase. To meet such diverse needs, it is necessary to comprehensively improve the capabilities required of water services.

In order to maintain water supply services at a high level, it is necessary to have a sufficient margin in design and rapid construction of facilities to anticipate increases in water demand, to secure financial resources that can be used reliably at the discretion of the management, and to improve the technical level of the staff. Since it is difficult for FIPAG to solve the issues on its own, public-private partnerships (PPP) are being promoted mainly in the capital area. In the future, PPP will also be required in rural cities that are directly managed by FIPAG. We are currently in a transitional period for PPP, and it is expected that FIPAG will play a major role in strengthening the technology and management of water services not only through facility maintenance but also through technical cooperation on non-revenue water reduction and other measures.

6.2 Notes on Project Implementation

1) Assistance to Long Term Projects

This project proposal is for a high priority short-term project. Efforts should be made to promote each project appropriately in line with the changes in water demand.

2) Assistance to Facilities Operation and Maintenance (e.g., Reduction of Water Leakages)

Japan is contributing to the operation and maintenance of water supply facilities in developing countries (e.g., reduction of water leakages) through technical cooperation projects implemented by JICA, and Japanese water utility officials are participating in these projects. Water leakage in Nampula and other major cities is one of the most serious problems, and it is also one of the projects that FIPAG wants to promote. Therefore, there is a high need for technical guidance along with its effect. In addition, we believe that FIPAG should focus on the operation and maintenance of boreholes, which can be an effective countermeasure against climate change in rural areas.

However, in order to sustain the operation and maintenance process, the country should secure its own financial resources which does not rely on loan projects from international aid organizations.

6.3 Concluding Remarks

While Mozambique is still in the process of focusing on cyclone reconstruction assistance, Nampula is one of the cities that should be given the highest priority to expand its water supply facilities due to its distressed water demand. The urgency of the project is considered to be very high due to the deteriorated conditions of the facilities, the amount of water leakages, and the chronic water supply suspensions in the city. In this project, based on the understanding of the current situation of this project, we recommended the plan to solve the problem and proposed the high priority project as a grant aid project.

6.4 Final Remarks

Through the field survey, we found that FIPAG was highly motivated to implement the project, and we were able to smoothly carry out mutual communications and discussions with relevant organizations despite conducting the survey through remote measures.

As has been frequently reported in the news recently, Nampula City is facing a serious water shortage due to the shortage of capacity of the Monapo Dam, which is the main source of water for Nampula City's water supply. In addition, as a result of drought, population growth and other issues, Nampula City is in a state of emergency, and the expectations of the government are high for the realization of this project.

ANNEXES

Annex-1 Schedule

Since the survey team could not travel to the site due to the Corona crisis, the survey and information collection were conducted through online meetings, e-mail, and phone calls. The following is the schedule of the major events.

Number of Days	Date	Activity	Remarks
1	Wednesday, October 28, 2020	10:00 Hearing at the First Country Development Cooperation Division, International Cooperation Bureau, Ministry of Foreign Affairs	
	Friday, October 16, 2020	16:00 FIPAG Headquarters, Mozambique, Explanation of the project, Explanation of general grant aid, Discussion on selection of target sites	Zoom Conference
	Wednesday, November 11, 2020	14:00 Hearing with Water Resources Team 2, Water Resources Group, Global Environment Department, Japan International Cooperation Agency	
	Wednesday, November 25, 2020	International Affairs Division, Minister's Secretariat, Ministry of Health, Labour and Welfare (MHLW) issued a letter to FIPAG requesting cooperation in this project.	
	Thursday, November 26, 2020	Receipt of a reply letter from FIPAG stating their approval to implement this project	
	Friday, January 15, 2021	Consultation with FIPAG: Request for additional information and data, and discussion on project contents	Zoom Conference
	Friday, Feb. 5, 2021	Discussions with FIPAG: Discuss project contents	Zoom Conference
	Tuesday, February 9, 2021	Discussion with FIPAG and Ministry of Health, Labour and Welfare: Contents, overall schedule, urgency of the project in Nampula	Zoom Conference

Annex 2 List of Persons Visited or Interviewed

Affiliation	Name	Position
National Water Supply and Sanitation Bureau (DNAAS)	Mr. Arlindo Correia	Head of Unit, Urban Water Supply
Fund for Investment and Assets of Water Supply (FIPAG)	Mr. Victor Tauacale	Director General
	Mr. Stelio Manuel J. Chire	Director, Central Services
	Mr. Elidio Khossa	Director, Operation
	Mr. Belarmino M. Chivambo	Director, Projects and Investments
	Ms. Sheila M. Abdul	Head, Investment Department
Ministry of Foreign Affairs of Japan	Takashi Ishii	Deputy Director, Country Assistance Planning Division III, International Cooperation Bureau
Japan International Cooperation Agency (JICA)	Yoko Hattori	Director, Water Resources Team 2, Water Resources Group, Global Environment Department
	Izumi Shoji	Senior Deputy Director, Water Resources Team 2, Water Resources Group, Global Environment Department
	Tomoko Matsunaga	Technical Advisor, Water Resources Team 2, Water Resources Group, Global Environment Department

Annex 3 List of Collected Information

No.	Document Name	Language	Document Form	Issuing Organization/ Author	Published Year
1	FIPAG Annual Report and Accounts (2017)	Portuguese	PDF	FIPAG	2017
2	FIPAG Annual Report and Accounts (2018)	Portuguese	PDF	FIPAG	2018
3	FIPAG Annual Report and Accounts (2019)	Portuguese	PDF	FIPAG	2019
4	Strategic Plan 2019-2023	Portuguese		FIPAG	2019
5	Business Plan of the Strategic Plan 2019-2023	Portuguese	PDF	FIPAG	2019
6	Geophysical Prospecting and Supervision of Borehole Drilling in Surrounding Nampula City	Portuguese	PDF	FIPAG-North	2020
7	Water Quality of Namiteka Boreholes	Portuguese	PDF	FIPAG	2021
8	National Strategy for Urban Water and Sanitation 2011-2025	Portuguese	PDF	MOPHRH	2012
9	Establishment of Water Supply Master Plan for Cities of Lichinga, Nampula and Xai-Xai in Mozambique, Volume 3: Update of the Feasibility Study for City of Nampula (Draft)	English	PDF	FIPAG	2018
10	Regulation on Process for Environmental Impact Assessment, Decree Nr. 54/2015	Portuguese	PDF	Official Gazette	2015
11	General Directive for Environmental Impact Assessment, Ministerial Diploma Nr. 129/2006	Portuguese	PDF	Official Gazette	2006
12	Five-Year Program of Government 2020-2024	Portuguese	PDF	Government of Mozambique	2020
13	Water Quality for Drinking Purpose, Ministerial Diploma Nr. 180/2004	Portuguese	PDF	Official Gazette	2004
14	Organic Structure of FIPAG, Decree Nr. 48/2012	Portuguese	PDF	Official Gazette	2012
15	Regulation for Public System for Water Supply and Drainage of Waste Water, Decree Nr. 30/2003	Portuguese	PDF	Official Gazette	2003
16	Water Policy, Resolution Nr. 42/2016	Portuguese	PDF	Official Gazette	2016
17	Change of name from CRA to AURA, Decree Nr. 8/2019	Portuguese	PDF	Official Gazette	2019