WATER GLOBAL PRACTICE

Timor-Leste Water Sector Assessment and Roadmap

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Preface

Recognizing the importance of water management to the government's objectives of economic diversification, the World Bank has been supporting the General Directorate for Water and Sanitation in the Ministry of Public Works, Transportation, and Communications. This sector assessment and roadmap has been prepared at the request of the General Directorate for Water Supply and Sanitation as a contribution to the advisory services and analytics. It has been conducted as a just-in-time assessment between April and June 2017, including a 10-day mission to Timor-Leste for data collection and stakeholder discussions. The report was finalized after the parliamentary elections in July 2017. However, after unsuccessful attempts to form a government, the President of Timor-Leste announced in January 2018 that early reelections would be held in the first half of 2018. Given this uncertainty of institutional arrangements in the sector at the time of publication, this assessment builds on the analysis of information and conditions prevalent under the former, 6th Constitutional Government. The assessment and the roadmap are intended to highlight key priority areas in the sector and identify potential investment options necessary to achieve the goals set out in the Strategic Development Plan 2011-30.

Improving water management takes time and has to be undertaken in multiple phases over the course of many years. This rapid assessment should therefore only be considered as a first phase that sets the ground for further discussions about the direction of potential engagement. The information included in this report was based on a review of existing data and analyses, as well as discussions conducted with government representatives and sector stakeholders. Given the reliance on secondary data sources and given the priorities of past donor engagement in the water supply and sanitation sector, this assessment results in a heavier focus on water supply and sanitation, while only providing general information on water resources and irrigation. Nonetheless, the scope included the entire water sector to set the tone for a comprehensive dialogue across the main thematic areas and the importance in providing a foundation for economic growth, diversification, and improved disaster resilience. The roadmap aims at identifying investment options to meet the sector targets outlined in Timor-Leste's Strategic Development Plan 2011-30. Based on this initial work and the resulting dialogue, the government would be able to develop a more comprehensive sector strategy, including recommendations on policy, institutional, and infrastructure development matters.

Abbreviations

ADB	Asian Development Bank
ADN	*Agência Nacional de Desenvolvimento* (National Agency for Development)
AgGDP	agriculture GDP
ARP	Agriculture Rehabilitation Project
BESIK	*Be'e Saneamentu no Ijiene iha Komunidade* (Community Water Supply, Sanitation, and Hygiene Program)
CAP	community action planning
CLTS	community-led total sanitation
CRI	Climate Risk Index
CSC	Community Score Card
CVTL	*Cruz Vermelha de Timor-Leste* (Red Cross)
DFAT	Australian Department of Foreign Affairs and Trade
DGAS	*Direção Geral de Água e Saneamento* (General Directorate for Water and Sanitation)
DNGRA	*Direção Nacional de Gestão de Água* (Directorate for Water Resources Management)
DNSA	*Direção Nacional de Serviços de Água* (National Directorate for Water Services)
DNSB	*Direção Nacional Saneamento Básico* (National Directorate of Basic Sanitation)
DNSP	Direção Nacional de Saúde Pública (National Directorate for Public Health)
DSDMP	Dili Sanitation and Drainage Master Plan
DUWS	Dili Urban Water Supply
EOM	operation and management team
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
FPA	facilitator at postadministrative level
GDP	gross domestic product
GIEWS	global information and early warning system
GMF	*Grupu Maneja Fasilidade* (Community Water Management Group)
HPA	Humanitarian Partnership Agreement
ICT	information and communication technology
IOD	Indian Ocean Dipole
IPG	*Instituto de Petróleo e Geologia* (Institute for Petroleum and Geology)
IWRM	Integrated Water Resources Management
JICA	Japan International Cooperation Agency
JMP	Joint Monitoring Programme
MAP	*Ministério da Agricultura e Pescas* (Ministry of Agriculture and Fisheries)
MCIA	*Ministério do Comércio, Indústria e Meio Ambiente* (Ministry of Commerce, Industry, and the Environment)
MDG	Millennium Development Goal

MNEC	*Ministério dos Negócios Estrangeiros e Cooperação* (Ministry of Foreign Affairs and Cooperation)
MJO	Madden-Julian Oscillation
MMPR	*Ministério dos Minerais e Recursos Petrolíferos* (Ministry of Minerals and Petroleum Resources)
MS	*Ministério da Saúde* (Ministry of Health)
MOPTC	*Ministério das Obras Públicas, Transportes e Comunicações* (Ministry of Public Works, Transport, and Communications)
MoU	memorandum of understanding
MSTAM	*Ministério da Administração Estatal e Gestão Territorial* (Ministry of State Administration and Territorial Management)
NGO	nongovernmental organization
NPP	net primary productivity
NRW	non-revenue water
NVE	Norwegian Water Resources and Energy Directorate
O&M	operations and maintenance
ODF	open-defecation free
PAKSI	*Planu Asaun Komunidade ba Saneamentu no Ijiene* (Community Action Plan for Sanitation and Hygiene)
PDD	*Programa de Desenvolvimento Descentralizado* (Program of Decentralized Development)
PDID	*Planeamento de Desenvolvimento Distrital Integrado* (Integrated District Development Planning)
PDL	*Programa Desenvolvimento Local* (Local Development Program)
PDO	Pacific Decadal Oscillation
PHD	Partnership for Human Development
PNDS	*Programa Nacional de Desenvolvimento dos Sucos* (National Program for Village Development)
SAPIP	Sustainable Agricultural Productivity Improvement Program
SMASA	*Serviços Municipais Água, Saneamento, e Ambiente (Municipal Water, Sanitation, and Environment Services)*
SDG	Sustainable Development Goal
SDP	Strategic Development Plan
SIBS	*Sistema Informasaun Bee no Saneamentu* (Rural Water and Sanitation Information System)
SIDJRI	*Sistema Informasaun Dados Jestaun no Rekursus Idricos* (Water Resources Data and Information Management System)
SOI	Southern Oscillation Index
SoL	Seeds of Life
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WASH	Water Supply, Sanitation, and Hygiene
WHO	World Health Organization
WSSI	Water Supply and Sanitation Index
WSP	Water and Sanitation Program
WUA	Water User Association

Bridge in Aileu. © Nuno Marquez/Wikimedia Commons.

Executive Summary

Despite significant progress since gaining independence in 2002, Timor-Leste's economy is still struggling with declining oil revenues and slowing economic growth, while access to improved basic services is still low and vulnerability to natural disasters remain high. Timor-Leste is one of the smallest countries in Southeast Asia, with a population of 1.18 million people in 2015, about 70 percent living in rural areas.[1] Decades of conflict have left as much as 90 percent of the infrastructure destroyed at the time of independence, including health facilities, water supply, and irrigation systems. The government has since made efforts to rebuild the country and the economy with emphasis on the provision of key public services, restoring infrastructure, and developing the oil and gas sectors. Today Timor-Leste is still fragile in its economic and social development, with high dependence on declining oil and gas resources for state revenue. About 41.8 percent[2] of the population is in poverty, earning less than US$48.37 per month (World Bank, forthcoming[b]), and because of malnutrition and poor access to clean water and sanitation, 50.2 percent of children were stunted in 2013, falling to 49.2 percent in 2014.[3]

Strategic investment in the water sector is critical for economic growth. Some of Timor-Leste's most substantial investments in water have been in irrigation infrastructure, however there has been an underinvestment in the development of the water resources and water supply infrastructure for domestic, sanitation, and industrial needs. Investing appropriately in Timor-Leste's water sector will have a significant positive economic impact on the economy by improving access to safe, reliable, and sustainable water supplies to the economy, including individuals, industry, commerce, and agriculture. The economic benefits

of investments in the water sector are not always immediate, but are accrued because those who are benefiting from the investment, benefit from improved employment opportunities, nutrition, health, and education outcomes and become productive members of the labor market sometime later (WWAP 2016). To date, investment in the water sector has not been a significant part of Timor-Leste's economic development and improvements in water developments and management will benefit the economy.

Addressing water management is crucial for Timor-Leste to meet its national and international development commitments and to stimulate economic growth. Water management is multifaceted and requires coordinated multisector approaches to be addressed. The government needs to establish sector priorities that align to national and international development targets, to enhance economic growth, and to improve the health and well-being outcomes of its citizens. A range of options are available for Timor-Leste, but underlying many of these is the need to undertake strategic analytical studies to guide investment options and decision making. Also, there is a need to consider the conditions in the country, taking into account the water-related natural disasters and climate change.

Institutional and Legal Framework

Many of the institutions as well as the legal and policy frameworks for the water sector are still evolving and developing their capacity. A law and policy for water resources management and a policy for water supply are pending approval by the Council of Ministers. Coordination of water responsibilities across the government, particularly where they intersect with health, catchment management, forestry, irrigation and agriculture, and planning, needs to be improved to reduce inefficiencies and improve outcomes. An overlay to all of this is the government's policy of decentralization, which is currently being implemented. This will have a significant impact on the delivery of water and sanitation services to municipalities in the future, but will require a process of capacity building for municipalities to be able to fulfil their service delivery responsibilities. Delivery models for the operations and maintenance (O&M) of water supply, sanitation, and irrigation infrastructure also lack appropriate guidance from policy and law, and current tariff frameworks to support the cost recovery of the delivery of those services are inadequate and need to be updated.

Water Resources Development

Potential for the development of the water resources exists in Timor-Leste, although it is constrained by limited data as well as by the institutional capacity to implement integrated water resources management (IWRM) solutions. The development of surface water resources is challenged by the steep catchment topography, karst geology, land-use practices, wet-dry tropical monsoon climate, and variable runoff that transports large volumes of sediment, especially during flash floods. To date, surface water development has focused on irrigation diversion weir infrastructure, and while some multipurpose dams are being proposed by the government, none have been constructed yet. Limited data and information means that all water resources development proposals require further detailed investigations and surveys to support decisions around them. The development of groundwater resources offers potential for Timor-Leste to meet some of its water management challenges.

Irrigation

Irrigation scheme rehabilitation has been driven by a target of self-sufficiency in food production. However, recent studies reveal that there are alternatives and more economically viable models for achieving this policy target. Agriculture is the most important non-oil and gas sector to the Timor-Leste economy, with nearly 70 percent of the population participating in the sector, predominantly through subsistence

agriculture. Together with access to safe water supply, sanitation, and hygiene, agriculture is the main contributor to fighting the high malnutrition and stunting rates. Targets on food self-sufficiency and reduced malnutrition cannot be achieved without enhanced water management. The focus until now is on rehabilitation and enhancement of existing river weir diversion irrigation infrastructure. The government's irrigation policy targets the identification of new irrigation schemes, small and large dams, and the expansion of the use of groundwater tube wells to improve production output. While any additional bulk water supply should be supported by further investigations into the sustainability of specific water resources, continuation of the past investment strategies to improve agriculture gross domestic product (AgGDP) should be reconsidered in light of recent studies, which conclude that weather, including droughts, floods, and the recent El Niño, has an impact on the volatility of the agricultural outputs. One option is to achieve higher levels of water management by developing more cost-effective and reliable conjunctive use or groundwater-based irrigation systems.

Urban Water Supply and Sanitation

Timor-Leste met its Millennium Development Goal (MDG) targets in relation to water in urban areas, with 91 percent of the urban population in 2015 having access to improved urban water supply and 73 percent with access to improved sanitation facilities.[4] Starting from a low baseline, Timor-Leste has met the MDG targets on urban water supply and sanitation. Despite this success, access to household connections remains low, and water supply systems in the national capital, Dili, perform poorly on all performance measures with non-revenue water (NRW) estimated to partly be as high as 90 percent of the total volume supplied (WaterAid 2010).[5] Even though Urban Water and Sanitation Master Plans have been finalized for priority municipal capitals (towns) with agreed priorities for interventions to improve water and sanitation, better sector coordination and strong leadership is required to provide efficient services, one of the biggest challenges in water supply and sanitation. If water supply and sanitation is to continue improving in Dili, Timor-Leste's biggest urban center with a population of 277,279 people or 23.4 percent of the total national population,[6] the Dili Sanitation and Drainage Master Plan must be implemented soon, together with the Water Supply Master Plan, which is currently being finalized.

Rural Water Supply and Sanitation

Timor-Leste missed its MDG target for rural water, with only 60 percent of the rural population with improved access to water supply and 30 percent with access to improved sanitation. The targets set out in the MDGs were 75 percent and 55 percent respectively. Investments in rural water supply systems rely heavily on financing from development partners, and on Community Water Management Groups (*Grupu Maneja Fasilidade*, GMFs) for maintenance and operations. Service delivery in rural areas needs to be improved and supported by specific programs to implement O&M, and with tariff collection. The Community Action Plan for Sanitation and Hygiene (*Planu Asaun Komunidade ba Saneamentu no Ijiene*, PAKSI) has been successful in changing community behavior to stop open defecation and encourage the construction of latrines; however, their construction is limited by their affordability and availability. PAKSI has been implemented in a limited number of locations and needs further investments to expand implementation, and as communities improve their sanitation status, their sanitation needs will require access to larger volumes of water necessitating better coordination with water supply development investments.

Roadmap—Priority Responses and Way Forward

Investing in Timor-Leste's water sector will have broad and significant benefits to the economy,

community, and the environment in Timor-Leste. A national water resources management and development strategy supported by strategic studies and analysis is required to guide investment priorities in the water sector in Timor-Leste. The studies and analysis contributing to such a strategy will fill the many knowledge gaps that exist in the sector and will guide Timor-Leste on an appropriate trajectory toward achieving national and international development commitments by 2030 and improve water management to support sustainable economic development. The approach should seek to expand the options available to finance and deliver infrastructure. The investment decisions need to make judicious use of scarce public and concessional resources, to encourage commercial capital, and minimize the public debt burden on governments, while delivering sustainable and affordable infrastructure services. With appropriate investments, Timor-Leste can reduce risks to the quantity and quality of the water resources, improve access to water supply and sanitation, improve the service levels for all citizens, and provide more secure and cost-effective water supplies for various users. The implementation of these priorities further requires improvements in human resources capacity, organizational, governance, and leadership capacity of the government.

Notes

1. Timor-Leste 2015 Census. www.statistics.gov.tl/2015-timor-leste-population-and-housing-census-data-sheet/
2. World Health Organization (WHO) Global Database on Child Growth and Malnutrition.
3. 2015 Census. National Directorate for Statistics.
4. JMP 2017. Data listed for 2015. A census was conducted in Timor-Leste in 2015, which provides detailed data of access to water supply and sanitation services that might differ from the numbers provided here. For water and sanitation access data in this report, JMP is used as a source to maintain consistency with previous years and allow for the estimation of trends.
5. WaterAid 2010 and personal communication from DNSA.
6. 2015 Census. National Directorate for Statistics.

Saline lakes in Tasitolu. (c) Yeowatzup/Wikimedia Commons.

Chapter 1
Sector Overview

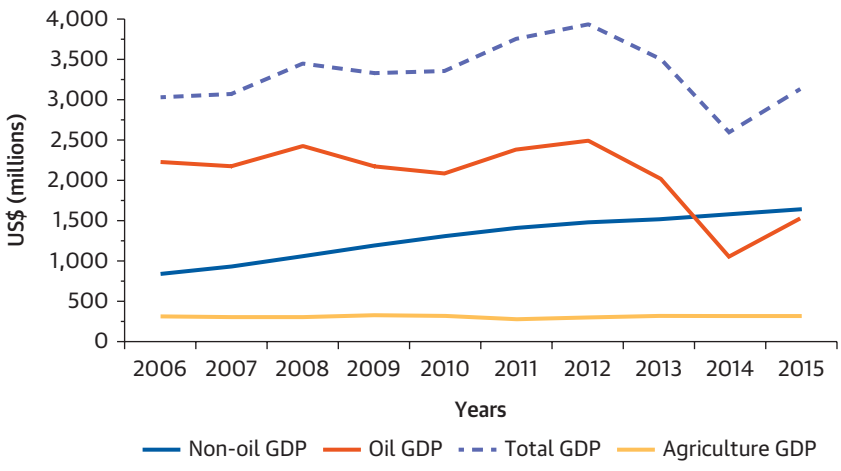
Country Context

Despite significant progress in its 15 years of independence, reduced economic growth and declining oil revenues are affecting efforts to improve and sustain health and livelihoods of the population. While the country has moved away from conflict and violence, Timor-Leste is still fragile in its economic and social development. Per capita gross domestic product (GDP) is US$1,216 (2015, current U.S. dollar) and held high by oil revenues (see figure 1.1). However, economic growth in the oil sector has been hit by declining international prices, with double-digit growth in 2011 falling to 5 percent in 2012 and a contraction of 18.7 percent in 2013. Non-oil growth was 4.3 percent in 2014 and 5 percent in 2015, but remains below the levels seen over the last decade. Public sector spending has been the key driver of growth with elevated government spending directly raising growth in the private construction and service sectors. This has created opportunities for local suppliers and labor. Overall, 46 percent of the growth during 2010-15 was due to public administration, while another 24 percent was seen in the public sector-led construction sector. Consumer price inflation, which was running at above 10 percent in 2012 and 2013, has fallen sharply, remaining below 1 percent from 2014 to early 2017 because a stronger dollar brought down prices of imported goods and remained low at 0.6 percent over 2015.

Development Context

Timor-Leste is one of the poorest countries in Asia and the second-most oil-dependent nation in the world. In 2015, the total population was 1,183,000 and was growing at 2.37 percent per year, with an

FIGURE 1.1. GDP at Constant Prices (2015 = 100), 2010–15



Source: Timor-Leste's National Accounts 2010–15.

estimated 70 percent living in rural areas. The economy has grown rapidly since independence, however, high unemployment and poverty are prevalent. The present level of poverty is 41.8 percent and has reduced from 49.9 percent in 2007 (World Bank, forthcoming[b]). A lack of skilled personnel adversely influences the effective functioning of the government and the delivery of public services. Food security remains fragile. Malnutrition and poor health are widespread and continue to hamper the efforts of the people to improve their livelihoods. At present, around 49.2 percent of Timor-Leste's population experiences stunting, a rate that is among the worst in the world (Lehman et al. 2016). The three-year average of the prevalence of undernourishment in 2016 was 26.9 percent (FAO Aquastat Database, 2017). Timor-Leste ranks 134 on the Human Development Index (United Nations Development Programme [UNDP]-Timor-Leste Data).

Agriculture is the most important sector in the country after oil and gas, contributing to the subsistence of an estimated 63 percent of the country's population. The sector generates 17.5 percent of the non-oil GDP (see table 1.1) and an average of 90 percent of the country's non-oil exports, with coffee being the main commodity. Agriculture also provides direct employment to approximately 64 percent of the total active workforce (2015 census). The total cultivable area of Timor-Leste is 40 percent of the total land area of around 1.5 million ha. Of this about 220,000 ha are cultivated and 34,650 ha are equipped with irrigation facilities, 98 percent of which is from surface water and 2 percent from groundwater. In 2010, only 28,900 ha or only 83.4 percent of the total equipped area was used for agricultural purposes, due to inadequate maintenance of irrigation systems, lack of water, and availability of land prepared for cultivation. Value-added agriculture is essential for both poverty reduction and for addressing seasonal food insecurity. Small farm holdings and resource constraints imply that improved watershed management, farmer groups, and reducing post-harvest losses are essential activities for addressing the economic growth and food security needs in Timor-Leste. This is one of the elements addressed in the World Bank-funded Sustainable Agricultural Productivity Improvement Program (SAPIP).

The country depends heavily on imports to meet its consumption needs, which increases when dry conditions prevail, such as the El Niño-induced 2015/16 drought, which also resulted in reduced rice and maize crop production levels. According to official estimates, approximately 350,000 people, mainly located in the central highlands and eastern and southwestern parts of the country were affected by prolonged drought during 2015/16.[1]

TABLE 1.1. AgGDP of the Timor-Leste Economy, 2008–15

Year	Non-oil GDP (US$, millions)	Oil GDP (US$, millions)	Total GDP (US$, millions)	AgGDP (US$, millions)	AgGDP (% of non-oil GDP)	AgGDP (% of total GDP)
2006	804	2,191	2,995	277	34.5	9.3
2007	896	2,138	3,034	268	29.9	8.8
2008	1,023	2,387	3,411	268	26.2	7.9
2009	1,156	2,138	3,294	291	25.1	8.8
2010	1,274	2,050	3,323	283	22.2	8.5
2011	1,374	2,345	3,719	241	17.6	6.5
2012	1,443	2,454	3,897	263	18.2	6.7
2013	1,481	1,989	3,470	282	19.0	8.1
2014	1,544	1,022	2,566	280	18.1	10.9
2015	1,607	1,496	3,102	281	17.5	9.1

Source: World Bank, forthcoming (a).

Note: Agriculture GDP (AgGDP) includes all agriculture, forestry, and fisheries occurring within the Timor-Leste economy. Data on weather conditions and agricultural outputs come from the Global Information and Early Warning System (GIEWS) Country Brief published by the Food and Agriculture Organization of the United Nations (FAO) for the period 2009 to 2016. Although weather data are relatively reliable, production data should be considered with caution as low capacity and lack of adequate resources result in low-quality crop monitoring and production estimates by the ministry. Official production estimates tend to be higher than surveyed data from development partner projects/programs.

Timor-Leste has met the Millennium Development Goals (MDGs) for urban water supply and sanitation. According to the Joint Monitoring Programme (JMP) 2015, total coverage of access to an improved water source in urban areas was 91 percent. This rate is beyond the MDG target on urban water supply, which is aimed at 81 percent (JMP 2015). It was therefore recognized by the international community that Timor-Leste has met its MDG target for urban water supply. Aside from the households with access to an improved water source in urban areas, about 2 percent require more than 30 minutes to collect water from an improved source, and 7 percent do not have access to an improved water source at all Total coverage of access to improved sanitation facilities in urban areas was 73 percent in 2015 (JMP 2017). This rate is beyond the MDG target for urban sanitation, which was aimed at 64 percent. The remaining 27 percent of the population without access to improved sanitation facilities consist of 15 percent with limited (shared) access, 7 percent with unimproved access, and 5 percent still practicing open defecation.

Unlike in urban areas, Timor-Leste did not meet the MDGs in the rural water supply and sanitation sector. According to JMP, total coverage of access to improved water sources in rural areas in 2015 was 60 percent and to improved sanitation services only 30 percent.[9] The targets set out in the MDGs for water and sanitation services in rural areas were 75 percent and 55 percent, respectively (JMP 2017). Seven percent of rural households required more than 30 minutes to collect water from an improved source, and 32 percent did not have access to an improved source at all. More than 7 percent used shared sanitation facilities, 30 percent used unimproved sanitation facilities and almost 33 percent still practiced open defecation (JMP 2017). Given the reduction in donor funding, serious efforts must be made to significantly increase the rate at which water supply and sanitation services in rural areas are being expanded and sustained. Improving health and fixing nutrition deficiencies in Timor-Leste will require a multisector approach in which enhancing water resource development will be a key element for all these sectors.

Water Resources Development Challenges

Water resources development is a crucial element for sustainable economic growth and the improved health and livelihoods of the people. In Timor-Leste water resource development priorities are: access to safe, reliable, and sustainable water and sanitation services for households in urban and rural areas; availability of water in sufficient quantities and quality ensure economic development in irrigation, industry, and for businesses; and protection of people, infrastructure, and productive sectors from water-related disasters such as floods and droughts. The vulnerability to water insecurity is considerable due to the present high level of dependence of the population on ecosystem services as the basis for their livelihoods.

Timor-Leste has adequate water resources that can be developed but suffers the lack of adequate infrastructure, institutions, and management. With a long-term average precipitation of 1,500 mm per year, the total annual long-term precipitation by volume in Timor-Leste is estimated at 22,300 million m^3 per year (Mm^3/yr), which results in total internal renewable water resources of 8,215 Mm^3/yr or 6,932 Mm^3/ yr per inhabitant of internally renewable water resources. Timor-Leste ranks 63 out of 179 countries[2] on renewable water resources availability per capita, which is considerably lower than countries in a similar context and development, such as Indonesia, Myanmar, and Laos, who for example, have 7,389, 21,671, and 49,030 m^3/yr per inhabitant[3] respectively. However, there is ample scope to develop the water resources because, in 2004, the total actual water withdrawal was approximately 1,172 Mm^3/yr or 1,203 m^3 per capita, or about 14 percent of the actual renewable water resources. Of this amount 1,071 Mm^3/yr (91 percent) was used for irrigation and livestock, 99 Mm^3/yr for domestic use (9 percent), and only 2 Mm^3/yr for industrial use.[4] These figures are likely be higher now after a decade of economic growth. The data nonetheless suggests that there is potential to enhance water management.

The physical conditions in Timor-Leste combined with inadequate infrastructure investments and capacity to manage water resources services has resulted in a low level of water management, high levels of catchment degradation, and high vulnerability to climate change. Enhancing water management requires important investments in the development of infrastructure, institutions, and management capacity. The main challenge to overcome the regular water shortages during the dry season by the development of inter-seasonal or multiyear water storage facilities at different levels, the development of the huge groundwater potential for agriculture in the river valleys and for domestic water supply, and the development of infrastructure for water supply and irrigation utilities to enhance water productivity and reduce water losses.

Timor-Leste is vulnerable to several natural hazard risks, which include floods, landslides, droughts, sea-level rise, and cyclones that only will be enhanced by climate change. Timor-Leste's topography is characterized by steep slopes and unprotected soils that are prone to erosion and rivers that are susceptible to flash flooding after severe rainfall events. Analysis of disaster impacts from 2001-11 show that more than 20,000 people were affected and 10,000 houses were damaged by natural disasters in that period, with the most severe impacts related to climate disasters, particularly floods (UNDP 2012). From 2003 to 2011, there were about 17 cases of landslides recorded with a total of 234 damaged houses and 222 affected people. Timor-Leste also experiences drought, sometimes induced by El Niño conditions which has a severe impact on precipitation and water availability and AgGDP. AgGDP is highly volatile in volume as it is sensitivity to weather conditions such as drought, floods, and particularly to El-Niño rainfall patterns (World Bank, forthcoming[a]). If risk reduction measures are not implemented over time, the consequences from such hazard-induced events will remain extremely high, potentially reversing development gains. For example, Timor-Leste is expected to incur, on average, US$5.9 million per year in losses.[5]

In the next 50 years, Timor-Leste has a 50 percent chance of experiencing a loss exceeding US$88 million and casualties of more than 300 people, and a 10 percent chance of experiencing a loss exceeding US$ 530 million and casualties of more than 2,100 people.[6] The country is also located in an area of high seismic activity exposing it to periodical earthquakes and tsunamis. This places Timor-Leste at position 181 out of 187 among the most risk-affected countries on the Global Climate Risk Index (CRI) 2017 for the period 1996-2015 (Kreft, Eckstein, and Melchior 2017).

Climate change is predicted to have a negative impact on water management, because the projected increase in rainfall intensity and variability, as well as sea-level rise, increases the risk of floods and droughts. Climate change projections indicate an increase in temperature of around 1.5°C by 2050 and an increase in rainfall of around 0-10 percent over the next 50 years, increasing with altitude. Storm events and heat waves are projected to intensify and sea-level rise is predicted to increase in the order of 11-12 cm by 2020, 18-21 cm by 2050, and 32-42 cm by 2090. This poses not only an inundation risk at the coastlines but also an increased risk of riverine floods due to higher backwater and salt intrusion in freshwater surface and groundwater bodies that are essential for domestic water supply of coastal urban centers.[7] The size of current costs and economic damage due to climate and water-related risks and disasters needs to be updated.[8]

Enhancing water management requires investments in institutions, infrastructure, and sustainable management of water resources and services. It requires the development of a legal and regulatory framework that sets out roles and responsibilities of the numerous stakeholders involved with water resources, including the mandate for technical leadership for broader water-related sectors such as water supply, irrigation, environmental protection, and disaster risk management. The development of this legal framework needs to go hand in hand with the development of the institutional capacities and information systems to support decision makers.

Climate and its Challenges

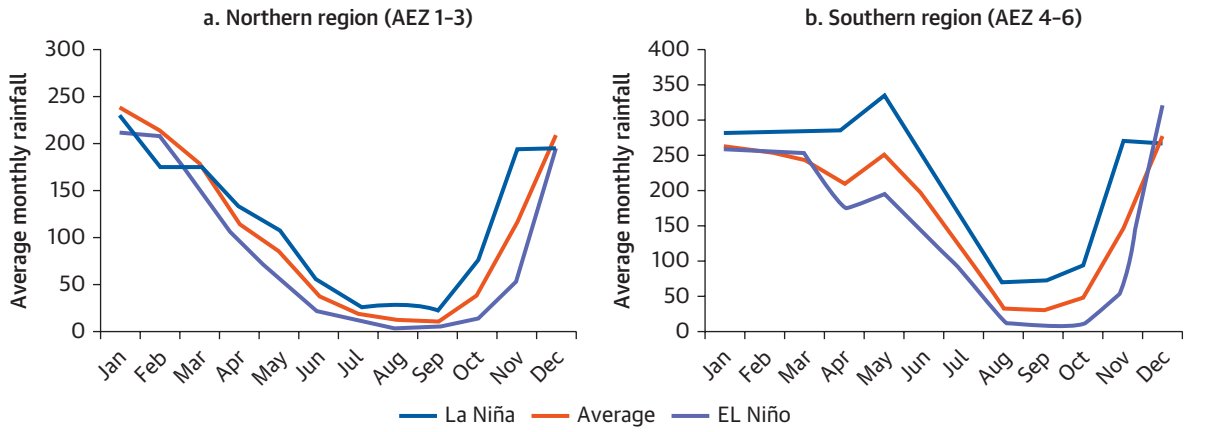
Timor-Leste has a dry tropical monsoon climate, with distinct wet and dry seasons and a high temporal and spatial variability in rainfall because of its mountainous topography and regional climate influences. The monsoon rains in the wet season are influenced by the Asia and Pacific Ocean air masses and the dry season is influenced by the Australian continental air mass (Norplan 2012). The high mountains running east to west along the length of the country contribute to the drier conditions in the north and wetter conditions in the south. The wet season on the north coast generally commences with the northeast trade winds from around November to December and lasts for four to six months, while on the south coast, the wet season is bimodal, peaking first in December with the northeast trade winds and then again with the southeast trade winds in April to June. In the south, this results in seven to nine months of monsoon rain.

Rainfall

Monsoonal influences result in distinct differences in rainfall in the north and south of Timor-Leste (see figure 1.2). Annual rainfall is low along the northern coastline being about 1,000 mm per year and as little as 600 mm per year in some locations, such as Manatuto, whereas Same in the south receives over 2,000 mm per year. In the central and elevated regions of the country, the rainfall generally ranges from 1,500 mm to 2,000 mm per year, up to 2,500 mm per year at the highest elevations. While rainfall generally increases with altitude, some exceptions occur, such as in Liquica and Viqueque, which are near sea level, but receive relatively high annual rainfall, at 1,349 mm and 1,610 mm, respectively.

Interannual variation in rainfall strongly affects the reliability and volume of monsoon wet season rains in Timor-Leste. Several global climate influences impact

FIGURE 1.2. Change in Average Monthly Rainfall in Timor-Leste during El Niño and La Niña Years for the Northern Watershed and for the Southern Watershed



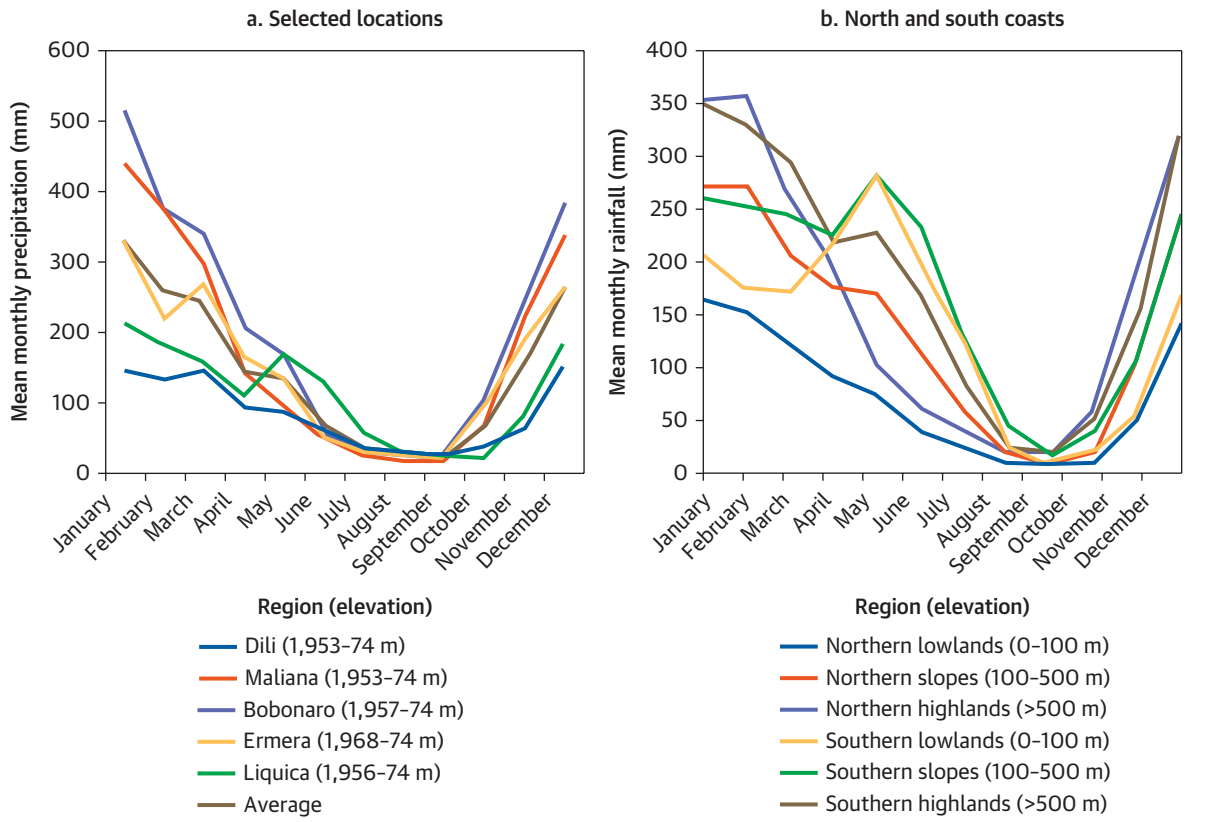
Source: SoL 2012.
Note: AEZ = Agro-ecological zone.

on the regional climate of Timor-Leste, including the El Niño South Oscillation (ENSO), the Madden-Julian Oscillation (MJO), the Indian Ocean Dipole (IOD) and the Pacific Decadal Oscillation (PDO). These influence the regional climate on intra-annual, interannual, and inter-decadal time scales and have a substantial impact on the level of precipitation and water resources availability in Timor-Leste. Improved knowledge is needed about these influences on Timor-Leste's climate and only the impact of ENSO has been investigated specific to Timor-Leste. During an El Niño event, indicated by a positive Southern Oscillation Index (SOI), the monsoon rains generally commence around a month later and will end earlier than normal. This results in reduced total rainfall and increased likelihood of dry periods within the wet season. Daytime temperatures also tend to be higher resulting in increased evapotranspiration (SoL 2012). A negative SOI represents a La Niña event, characterized by a longer wet season. The impact of El Niño and La Niña events can vary considerably depending on location in Timor-Leste (figure 1.3) both with regard to timing and total amount of rainfall.

Climate Change

Climate change will likely increase the variability of water availability and the exposure to water-related disasters. The impacts on the water resources, their availability and use, need to be better understood so that water developments can be designed to provide water users with greater levels of certainty that they will receive the level of water services that the infrastructure has been designed for, during the entire period. Climate change impacts on the water resource in Timor-Leste are generally not well understood at the local scale, however at a national scale it is known that total rainfall is likely to increase and both rainfall and heat wave events are predicted to intensify. Using this information to design climate change resilient water infrastructure is not an established process, because technical capacity to undertake such work and the availability of information and the correct

FIGURE 1.3. Mean Monthly Precipitation Based on Elevation, Selected Locations and the North and South Coasts



Source: Panel a, Kironi 2010; panel b, ADB 2004 (as adapted by Wallace et al. 2012).

scale is generally not available. This places the delivery of water from many water infrastructure developments at risk with projected climate change.

Surface Water Resources

Data on river discharges is limited to a few locations and modeled streamflow estimates have low levels of confidence. Measured river discharge is limited, in Timor-Leste, to two main studies and several disparate monitoring programs conducted by the government and development partners. In 2004, the Asian Development Bank (ADB) completed an assessment of water resource availability and demand based on historical data from between 1952 and 1974, that model monthly estimates of stream flow across all the major river catchments in Timor-Leste. The reliability of these stream flow estimations is subject to data limitations at the time and should be used with caution. The report recognizes the need to update the stream flow estimations as soon as new data becomes available (ADB 2004). Enhanced hydrological monitoring and further river discharge monitoring stations are needed to support development of surface waters.

The monsoon climate results in highly variable river flows from wet season peaks and flash floods to low or no dry season flows. Along the northern coastline are many of the smaller river catchments that are either semi-permanent or ephemeral, flowing for short

periods in the wet season after heavy rainfall events. This contrasts with the south coast where the bimodal wet seasons and higher rainfall has resulted in many large permanent rivers that have high peak flows in the wet season, which are reduced to the base flow during the dry season. At all times, subsurface flows occur below the gravel and cobblestone riverbeds of most rivers, and in the dry season, this can represent the primary flows within a river, particularly in lowland areas.

The steep topography and lack of catchment management activities result in high sediment loads in streams and rivers creating substantial design and management challenges for water resources developments. It is estimated that over 44 percent of the terrestrial landscape is at slopes greater than 40 percent (Wallace et al. 2012). Coupled with generally poor land management practices, such as wood harvesting and slash and burn agriculture, catchment soils are vulnerable to high rates of erosion, particularly in high-intensity rainfall events in the monsoon. Most rivers carry large volumes of fine sediment at all times of the year and with the high wet season flows, the rivers move large volumes of gravels, cobblestones, and other detritus from the catchment. No data of the sediment loads in rivers are available for Timor-Leste (Norplan 2012), but sediment loads in the lower catchment areas along the coast can reach significant volumes with the potential to shift riverbeds.

Groundwater Resources

Groundwater resources development offers potential for Timor-Leste to meet some of its water challenges. Hydrogeological studies at the national level and for some specific groundwater areas have improved the knowledge of their potential for development and for improved water resources management. This potential has resulted in substantial assistance from development partners to support groundwater development investment decisions for domestic water supply. However, to address water management challenges through groundwater development, additional studies into the sustainability of specific aquifer systems is required.

Groundwater is often the cleanest and most accessible water source in Timor-Leste, however the reliability of these sources, especially during drought, could be improved with better aquifer-level data. The availability of groundwater varies considerably across the country depending on the location, the hydrogeological setting, recharge, and the season. In Timor-Leste, there are three types of hydrogeology: localized, fissured karst, and inter-granular alluvial aquifers. The distribution of the hydrogeology has been mapped at the national scale, which provides a useful resource for national scale planning and generalized understanding of their hydrogeological characteristics. Downscaling of the hydrogeological records would enable greater local interpretation and development of groundwater resources.

Localized aquifers are commonly found in the mountain areas and have low potential yield and limited opportunities for development of groundwater resources. Localized aquifers with confining units are found in the central mountain areas and to the west. Aquifers with confining units cover large areas of the municipalities of Bobonaro and Oecusse and parts of Manatuto and Manufahi, and they are very low yielding and tend to have lower potential yield than the localized fractured rock aquifers (Wallace et al. 2012). The low porosity of the rock results in water infiltrating and flowing along the rocks fractures, later emerging as springs. In general, springs discharging from fractured rock localized aquifers have highly variable flow characteristics related to seasonal recharge (Wallace, et al. 2012). In areas of localized rock aquifers, potential water sources have already been identified and exploited. The development of more secure water sources needs to be supported by hydrogeological studies.

Fissured karst aquifers have a high potential yield and many springs discharging from them are already

TABLE 1.2. Overall Aquifer Vulnerability

Aquifer Type	Vulnerability to Rainfall Changes	Vulnerability to Sea-Level Rise
Intergranular (large catchments)	Medium (PI = H, AC = H)	Medium (PI = H, AC = H)
Intergranular (small catchments)	High (PI = H, AC = L)	High (PI = H, AC = L)
Fissured (topographic high)	High (PI = H, AC = L)	Low (PI = L, AC = M)
Fissured (topographic low)	Medium (PI = M, AC = M)	Medium (PI = L, AC = L)
Localized (topographic high)	High (PI = H, AC = L)	Low (PI = L, AC = M)
Localized (topographic low)	Medium (PI = M, AC = M)	Medium (PI = L, AC = L)

Source: Wallace et al 2012.
Note: Vulnerability Classes: High = higher potential impact + lower adaptive capacity; Medium = comparable potential impact and adaptive capacity; Low = lower potential impact + higher adaptive capacity. PI = potential impact; AC = adaptive capacity; H = high; M = medium; L = low.

developed for water supply; however, to date, the drilling of boreholes has generally been unsuccessful because of their complex hydrogeology. Fissured karst aquifers can be found throughout Timor-Leste, but are principally located in the municipalities of Baucau and Lautem in the east. Some springs venting from fissured karst aquifers have very high discharges, from tens to hundreds of liters per second. Fissured karst aquifers generally support large communities at their natural points of discharge, springs, however in some fissured karst aquifers, such as those near Baucau, it is expected that further hydrogeological studies will reveal important exploitable groundwater resources (Wallace et al. 2012). This is important for the city of Baucau as it does not have secure water supplies identified to match population growth projections of the city.

Inter-granular alluvial aquifers can store large volumes of groundwater, have high potential yield, and present opportunities for further development if supported by studies to define their sustainability. The sedimentary deposits that form intergranular aquifers can be found throughout Timor-Leste in sedimentary plains that are concentrated around the coastline and along river channels. In general, these aquifers are more resilient to climate variability than other hydrogeological types because they have the potential to store large volumes of groundwater, but they are susceptible to seawater intrusion from inefficient management practices and sea-level rise, particularly when coincident with the small catchments (Wallace et al. 2012).

Current approaches to groundwater development need a better planning framework to meet strategic targets of the government and reduce risks to the sustainable management of the groundwater. In line with the country's draft of the policy objectives,[9] groundwater is currently developed by the government for the provision of public water supplies and at the household level to supplement or replace unreliable public water supply. Only 2 percent of groundwater is used for irrigated agriculture and the volumes used for industry is unknown. This approach is uncoordinated and places the total groundwater resource at risk of unsustainable practices in some areas. Most households in urban areas source water supplies from shallow aquifers that often also receive untreated wastewater. The density of boreholes and volume of water extracted from them in large urban areas, such as Dili, is unknown but it is expected to continue to grow while water supply services under perform.

The groundwater resources in Timor-Leste are vulnerable to rainfall changes and sea-level rise (see table 1.2). The principal impacts of climate change on the aquifers of Timor-Leste will be a prolonged dry season extending the period of stress and, along coastal areas, an estimated sea-level rise of 9 mm per year, exceeding the tectonic uplift rates of 0.5 mm per year. Aquifers with

the highest vulnerability are the coastal inter-granular alluvial aquifers associated with small catchments and the fissured karst and localized aquifers at high topographic elevations. When combined with their limited adaptive capacity for management, these aquifers are highly vulnerable to the impacts of climate change.

Water Quality and Pollution Control

Bacteriological contamination of water sources is widespread in urban and rural areas and within some public water supply systems. Routine water quality testing occurs annually at each public water supply system and at other locations for a range of different purposes. Other than widespread bacteriological contamination, natural water quality is generally within WHO guidelines. There are no known locations of naturally occurring levels of metals or arsenic. It is not known whether inorganic pollutants are present in Timor-Leste's water resources, and there are no testing facilities for inorganic chemistry in Timor-Leste.

Coastal aquifers, especially along the northern coastline, are susceptible to saline intrusion. The risk of seawater intrusion in Timor-Leste is the result of groundwater extraction without sufficient recharge. It comes because of climate change driving projected sea-level rises (9 mm per year) at a rate greater than Timor-Leste's tectonic uplift (0.5 mm per year). The risk of seawater intrusion is greater along the northern coastline because of limited groundwater recharge to maintain hydraulic pressure against the ocean and inadequate regulation of groundwater extraction which can lead to overuse resulting in reduced groundwater pressure. The risks are greater during storm surges and enhanced weather events, such as La Niña, when the local sea level can be 20 cm above normal (Wallace et al, 2012).

Protection from Water-Related Disasters

Climate, topography, geology, and land management practices result in Timor-Leste being susceptible to natural disasters such as flash floods, landslides, drought, and earthquakes, which can have a significant impact on water management. These events have a substantial impact on both the government's ability to deliver water-related services, and on the life, livelihoods, and property of communities. Mitigating against natural disasters and adapting to climate change requires improvements in the design and maintenance of water-related infrastructure, improvements and better coordination in catchment and land management practices, and establishment of monitoring and warning alert systems.

AgGDP is sensitive to weather conditions, such as floods, droughts, and changes, in particular, due to El Niño rainfall patterns. A recent expenditure review of the Timor-Leste agriculture sector has revealed that weather patterns were the strongest determinant of AgGDP in Timor-Leste during 2008-14. AgGDP has increased in response to favorable rainfall and good weather conditions at certain times and decreased at other times as a result of severe flooding and landslides. The 2015/2016 El Niño caused erratic rainfalls resulting in crops losses, a reduction in planted area, low yields, and consequently a reduction in AgGDP (World Bank, forthcoming[a]). Later, in Chapter 4, the role of public sector investment in this scenario of weather and AgGDP is discussed further.

Floods

In Timor-Leste, floods are frequent and they have a significant impact on property, infrastructure, food production, water supply, and health. Flash flooding has one of the most severe disaster impacts on people and damage to housing in Timor-Leste (UNDP 2012). Despite flash flooding being a regular event in Timor-Leste, flood preparedness, such as flood monitoring and flood warning systems, has not been established. The main focal point for disaster risk management, including floods, is the National Directorate for Disaster Risk Management in the Ministry of Social Solidarity. However, MSTAM is responsible for works to prevent disasters and provide protection and assistance to

populations affected in the event of fires, floods, landslides, and earthquakes, and develop, in coordination with other competent entities, civic education programs to face natural disasters.

Droughts

While floods cause damage, droughts can have impacts that are deeper and longer lasting than previously believed. Damania et al. (2017) note that despite the well-known impacts of floods on the economy and society, droughts can have a deeper and longer-lasting impact on health, hamper firm productivity, accelerate the destruction of forests, and compromise agricultural systems. There are few documented drought events recorded in Timor-Leste before independence, though anecdotally droughts are known to be a frequent occurrence in the country. Periods of below-average precipitation in a given region, resulting in shortages in its water supply and causing adverse impacts on vegetation, animals, and/or people are common in Timor-Leste. Southeast Asia is among the regions most severely affected by food production losses due to changes in rainfall patterns, and Timor-Leste is one of the most severely affected countries in Southeast Asia. Recent investigations have identified that several significant droughts have occurred since 1990, which are correlated to recorded El-Niño events (Barnett, Dessai, and Jones 2007; SoL 2012): 1991-95; 2002-03; 2006-07; and 2015-16 (ADPC 2012; Wallace et al. 2012). The improved understanding of the linkages between El Niño and drought in Timor-Leste, and the predictability of El Niño through monitoring of the SOI has enabled preparation by the government and development partners to the impacts of drought, such as the one during the 2015-16 El Niño event (HPA 2016).

El Niño-induced drought conditions have a substantial impact on the vulnerability of communities to food insecurity in Timor-Leste. The impact of the 2015/16 El Niño was well documented through improved monitoring efforts and mitigation programs. Many vulnerable communities were affected by reduced water availability for drinking water supplies, sanitation, and agriculture (HPA 2016). The prolonged El Niño-induced dry weather thereby affecting crop production. Actual harvest figures for selected crops are not available for 2016, however FAO's forecast in December 2016 for aggregate rice production for 2016 was set at 60,000 tons, 6 percent below the sharply reduced 2015 output levels, and 30 percent below the five-year average. The municipalities of Bobonaro, Covalima, and Lautem, as well as coastal regions of Viqueque, Oecusse, and parts of Baucau, which together account for close to two-thirds of the country's annual paddy production, were among the most affected. The same conditions affected the 2016 maize crop, which was forecast at 60,000 tons, 8 percent down from the 2015 reduced level and 21 percent below the five-year average.[10]

Past El Niño events reportedly also had civil and social impacts, including internal displacement. The 2006/07 El Niño resulted in a 30 percent drop in agricultural production in 2007 because of the late onset of the rainy season and erratic rainfall pattern. In many areas, seeds were planted late and crops did not grow well, such as in Manatuto where it was reported that farmers had to plant seeds three times, because the crop kept failing because of lack of rain (NDDM 2007). The Seeds of Life (SoL) Program have since identified that, during an El Niño, Manatuto generally does not receive wet season rains (SoL 2012). While the reduced crop production was driven by the El Niño induced drought, the scenario was made even more serious by the civil and social impacts of displaced people from the April and May 2006 violence across the country. This also resulted in food stocks running out earlier than normal during the dry season and, with regional shortages, the market price of rice and other foods increased significantly (NDDM 2007).

Notes

1. FAO GIEWS: Country Brief, Timor-Leste. Accessed 14 June, 2017. http://www.fao.org/giews/countrybrief/country.jsp?code=TLS.

2. Index Mundi: Renewable Internal Freshwater Resources Per Capita. www.indexmundi.com Accessed June 2017.
3. FAO AquaStat Database, 2013-17 for selected countries. Accessed May 30,2017.
4. FAO Aquastat Database, data from 2002-04.
5. http://siteresources.worldbank.org/EXTDISASTER/Resources/TimorLeste.pdf.
6. http://siteresources.worldbank.org/EXTDISASTER/Resources/TimorLeste.pdf.
7. World Bank Climate Change Portal, accessed May 1, 2017.
8. There are no records from which the current cost of climate/water related risks/disasters can be estimated.
9. The proposed Water Resources Law and Policy outline the objective of promoting the coordinated planning, development, management, and protection of the nation's water resources, to optimise social, economic, and cultural benefits without compromising the sustainability of essential water dependent ecosystems and the environmental benefits which those ecosystems provide for people. See also table B.1 in appendix B.
10. FAO GIEWS: Country Brief, Timor-Leste. Accessed June 14, 2017. http://www.fao.org/giews/countrybrief/country.jsp?code=TLS.

Municipality of Liquiçá. (c) Torbin Brinker/Wikimedia Commons.

Chapter 2
Institutional and Legal Framework

Institutional Sector Arrangements

In Timor-Leste, the protection, preservation, and management of water as a natural resource is part of the fundamental rights of the citizens and the duty and priority of the state. The Constitution of Timor-Leste aims to improve the well-being of citizens and develop, conserve, and preserve water in accordance with national interests. Under the 6th Constitutional Government, Decree Law No. 6.2015 further established the division of responsibilities among the ministries of the Government of the Republic of Timor-Leste for the management of water resources, public water supply, sanitation, catchment management, and irrigation water management[1]. In relation to water, the following ministries had responsibilities.

(a) Ministry of Public Works, Transport, and Communications (MOPTC) is responsible for the management of water resources, the distribution of public water supply, sanitation, and drainage.

(b) The Ministry of Agriculture and Fisheries (MAP) is responsible for the management of irrigation water associated with conducting feasibility studies for irrigation schemes and water storage, and their construction, and in coordination with the Ministry of Commerce, Industry, and the Environment (MCIA) manage forest resources and catchments.

(c) The MCIA is responsible for protecting the environment by assessing the environmental impact of developments and by establishing environmental

licensing and prevention measures and monitoring of pollution.

(d) The Institute for Petroleum and Geology (IPG) is responsible for improving knowledge on and undertaking investigations into the geological structure of soils, sub-soils, and hydrogeological resources of the nation (Article 28 (1) n).

(e) The Ministry of Foreign Affairs and International Cooperation (MNEC) is responsible for any treaties and bilateral and multilateral agreements concerning shared water resources with any other state.

(f) The Ministry of Petroleum and Mineral Resources (MPRM) is responsible for activities related to the extraction of minerals and petroleum, including sand and gravel mining on the riverbeds and banks.

The legal and policy framework for water, as well as the main institutional organizational chart for the water sector is outlined in more detail in appendix A.

The administration of public expenditure for water infrastructure often lies with other agencies of the government. The National Agency for Development (ADN) administers grants for infrastructure greater than US$1 million through public tender. Line ministries administer infrastructure expenditures between US$500,000 and US$1 million. The Integrated District Development Planning (PDID) program administers infrastructure investments between US$150,000 and US$500,000. The MOPTC through the National Directorate of Water Services (DNSA), administers investments of over US$150,000, and the Ministry of State Administration and Territorial Management (MSTAM) administers grants to the *Suco* Administration for less than US$50,000. When these grants are for water and sanitation infrastructure, the General Directorate for Water and Sanitation (DGAS) provides some guidance in survey and design, on technical aspects, and in operation and maintenance (O&M).

The MOPTC is responsible for water resources, the distribution of public water supply, and sanitation and these responsibilities are delivered through the DGAS and its three national-level directorates: the DNSA, the National Directorate of Basic Sanitation (DNSB), and the National Directorate of Water Resources Management (DNGRH).

The sanitation responsibilities within the MOPTC evolve primarily around sanitation infrastructure development, while the MS through the National Directorate for Public Health (DNSP) takes leadership in sanitation and hygiene promotion at the household level.

Water Resources

The DNGRH is responsible for monitoring and research on the quality and volume of water resources to support current water supply needs and future development of the water resource. Alignment of their work program to the water supply needs of the rest of the government and the private sector is limited, under-resourced and challenged by institutional capacity. The DNGRH is primarily focused at the national level on developing law and policy and implementing monitoring programs, for hydrometeorology and seawater intrusion. The DNGRH has approximately 60 staff, 45 of whom are throughout the municipalities supporting the National Hydrometeorological Monitoring Program. Water Resources staff of the Municipal Water, Sanitation Service and Environment Services (SMASA) coordinates that program for that municipality.

Water Supply and Sanitation

The DNSA and DNSB are responsible for the management, regulation, and oversight of planning, design, financing, constructing, O&M, monitoring, rehabilitating, and replacing of water supply and sanitation systems and their assets.

According to the Decree Law 4/2004, the DNSA is responsible for establishing national policy priorities, financing capital investments, and all capital maintenance cost of public water supply, and community water management groups (*Grupu Maneja Fasilidade,* GMF) support the delivery of water by maintaining public water supply services. The National Policy on Public Water Supply, which is pending approval, provides guidance to achieving access to potable water for all of Timor-Leste's citizens and outlines how roles and responsibilities are distributed across the water supply sector.

At the municipal level, rural supply provision is managed by the SMASA, which under the decentralization, is part of the municipal government and reports to the municipal administration. Previously, all municipal water supply systems were part of a municipal department of the DNSA and received an annual budget from them. Under decentralization, SMASA is required to plan its own program to be reviewed and approved by the municipal administration that will receive a bulk transfer from the central government to implement the approved programs. Under guidance of the SMASA, and technical assistance of DNSA, rural public water supply systems can be managed by a GMF. In addition to the government, many development partners actively provide support of capital investment and technical assistance for provision and sustaining water service to rural areas. The water supply systems are then recorded and transferred to state ownership, with their management and support for the GMFs being provided by the DNSA/SMASA.

Part of SMASA staff includes the facilitators at post administrative level (FPAs) to provide support to the GMFs. However, most of the FPAs are not technical and cannot provide direct support to the GMFs once the system is nonfunctional and requires repair beyond the technical capacity or finances of the GMFs.

For sanitation, the National Basic Sanitation Policy guides this sector on programs. For urban areas, the DNSB has the mandate to construct, operate, and maintain wastewater treatment facilities and construct public toilets in urban areas. Staff under SMASA in each of the 12 municipalities have the responsibility to perform DNSB-related tasks at the municipal level and submit monthly reports to the DNSB on sanitation development in the respective municipalities. The DNSB is also responsible for execution of sewerage and drainage management in Dili, especially for storm water collection systems, with the overall responsibility at the Ministry of Development and Institutional Reform. However, those connected to roads such as trenches, pits, and pipelines are under the responsibility of the National Directorate for Roads, Bridges, and Flood Control.

Rural sanitation is led by the MS through the implementation of the Community Action Plan for Sanitation and Hygiene (*Planu Aksaun Komunidade Saneamentu no Ijiene,* PAKSI). It embraces the concept of community-led total sanitation (CLTS), which focuses on behavior change as the driver of change toward safe access to sanitation and hygiene services. The goal outlined in the Strategic Development Plan (SDP) 2011–30 is to achieve open-defecation free (ODF) communities nationwide by 2018.

PAKSI implementation at the municipal level is led by the municipal administration and involves several institutions such as the MS, SMASA, and the administrative post. They are organized into sanitation working groups. Supported by local nongovernmental organizations (NGOs),[2] these working groups mobilize local stakeholders such as chiefs of administrative posts, chiefs of *Suco* and *Aldeia*, and other informal leaders to mobilize the communities attending "PAKSI triggering"[3] and its follow-up activities to achieve ODF status.

Agriculture and Fisheries

The MAP broad responsibilities from forestry, agriculture, fisheries, and livestock. Those most directly related to water include the National Directorate for Irrigation

Water Management and the National Directorate for Forestry and Catchment Management.

National directorates are responsible for the development of the various subsectors, including planning, monitoring and policy development, administration and finance, and regulatory services. Outside of Dili, the MAP is supported by municipal directorates, who follow government policy and program direction. Each municipal directorate consists of three departments: Agricultural Extension, Technical Services Support, and Administration and Programs.

The MAP has a large role in the development of the rural sectors, with personnel from national to local levels working with farmers, other government agencies, the private sector, and development partners. The MAP, therefore, has established coordinating mechanisms at all levels for harmonizing functions, planning, implementation, and monitoring progress toward the achievement of impact in rural development.

Forestry and Catchment Management

Formally under the responsibility of MAP, there are, however, no laws governing forestry or catchment management activities. The Environmental Framework Law provides high-level principles by which catchments should be managed and identifies other laws that should be developed. The National Policy and Strategy for Forestry, provides policy guidance on forestry activities and catchment management.

Environmental Licensing

The Environmental Licensing Law, requires the environmental impact of all developments to be assessed. Developments are categorized based on size and impact, which determine the type of impact assessment to be completed and conditions for the development that are issued with the environmental license. Environmental management plans and monitoring of impacts is generally required. Licenses are issued by the MCIA and the process of obtaining a license is long and often unclear. This Decree Law has an impact on developments in all sectors, including water, and its implementation has improved in recent years.

Legal and Regulatory Framework

Water Resources

Guidance for the sustainable management of water resources comes from the Environmental Framework Decree Law as there is no water resources law or policy. This law requires that the state must, protect, conserve, and improve the quantity and quality of the surface and groundwater, and promote the sustainable use of the water resources through the adoption of integrated water resources management (IWRM).

A legal and policy framework for water resources has been prepared, which addresses the water management and water productivity challenges associated with economic development and adaptation to climate change, but the government is yet to approve the framework. The Water Resources Management Policy and Decree Law are pending decision by the Council of Ministers. They were designed to support the objectives of the National Policy on Public Water Supply, which is also pending approval, and the 2012 National Basic Sanitation Policy, among others the draft decree law and policy create an enabling environment for the development of water resources by establishing principles and legal instruments to guide and regulate water resources management in Timor-Leste. Key legal instruments include the institutional framework for water resources; water resources management planning; use of water resources; requirements and conditions for water abstraction; flood, drought, pollution, safety, and contingency protection plans; compliance and emergency, inspection and monitoring, and sanctions for not complying with regulations. Both the Constitution and the drafted decree law and policy recognize the role of customary practices of natural resource management. The water resource legal and policy framework has the potential to

provide greater clarity on rights to access and use water, which will contribute to the certainty of water access for all water users.

The legal and policy framework is designed to support the development of water resources and sets out the obligations of water users to obtain an entitlement to abstract water. The framework clarifies the rights to use public water, restrictions on those rights, and priorities for water usage. It also further details requirements and conditions of water abstraction from the two types of water resources recognized under the Civil Code—public water and private water. Different types of licenses, concessions, or permits are proposed and they form the basis of sustainable water abstraction management by the government. The decree law and policy are important for addressing water management issues in Timor-Leste, however the implementation of these needs considerable technical assistance if they are to be effective.

Water Supply and Sanitation

SDP 2011-30 establishes the target of improving access to clean water and improved sanitation for all citizens by 2030.[4] This includes the construction of a major sewerage collection system as well as a drainage system Dili, providing a safe, 24-hour, piped water supply to households in 12 municipal centers, and installing water supply systems, community and household latrines in rural areas. The target for urban districts is to provide 93 percent access to appropriate and improved sanitation facilities by 2020.[5] The SDP includes targets for the rehabilitation of existing sewers, the separation of sewage from storm water drainage through intercepting sewers, the installation of example toilet facilities in households, and the facilitation of local treatment of sewerage. These initiatives include investing in appropriate treatment facilities in a staged way—connecting commercial properties first, then residential septic tanks, followed by all households with flush toilets. Other options include building a trunk sewer along the waterfront to take the effluent from the intercepting sewers. The expectation is that by 2020 there will be appropriate, well-operated and maintained, sustainable infrastructure for the collection, treatment, and disposal of sewage in Dili (Democratic Republic of Timor-Leste 2011, 77-81). Although not by 202, to be achievable by 2030, the works must be outsourced, and a proper, operational, and detailed infrastructure plan established.[6]

Decentralization of the government's responsibilities will result in institutional and financial arrangements for the water and sanitation sector devolving to rural areas. The government has commenced this transition; however, considering the challenges of institutional capacity at the national level it is highly unlikely to find sufficient institutional capacity in the municipalities. The government needs to devolve budgetary power gradually so that the municipalities put the skills and systems in place before being given a large budget.[7]

The Water Supply for Public Consumption Decree Law provides the legal framework for managing public water supply systems in a sustainable manner and collecting cost recovery from customers in both urban and rural settings. It includes an obligation for the establishment of universal water distribution service but no commitment on timing to deliver this. It also includes an obligation to establish water supply services in urban areas appropriately, securely, and sustainably and it has provisions for the total recovery of costs from customers 'in the long run.'

The public water supply sector requires a national policy to clarify roles and responsibilities, and to provide guidance on financing, investment, construction, and management if it is to achieve national and international commitments by 2030. The National Policy for Public Water Supply is pending approval by the Council of Ministers and has been required by the sector for some time. This draft policy establishes principles for the delivery of water services in Timor-Leste, aligns to national and international commitments identified to be achieved by 2030 in the SDP and the SDG, provides

guidance on service delivery models, and outlines priorities for the government and sector.

The current tariff framework is inadequate for the delivery of water services and needs to be updated to reflect the greater complexity of the sector since 2004. The 2004 regulations establishing tariffs for water supply are inadequate for the current context. Currently, this framework is applied only to parts of Dili and rates of tariff collection are very low. In rural areas, GMFs collect fees from households to cover the cost of minor water supply system maintenance, however the fee level is not based on the tariff framework or a cost recovery model. In addition, the role of GMFs in collecting and managing public finances is unclear legally and needs updated legislation. The pending national policy on public water supply requires a new tariff framework that is transparent, equitable, and affordable, with provisions for subsidies for vulnerable households, cross-subsidies from commercial, industrial, or institutional water uses, and the tariffs and charges covering at a minimum the O&M costs for the delivery of water. There is little data available on the full cost of delivering water services in Timor-Leste to guide the effective setting of tariff levels, however it is widely acknowledged in the government that establishing a new tariff framework is critical to the delivery of financially sustainable public water supply in Timor-Leste.

The provision of sufficient and recurrent financing for the O&M of water supply infrastructure along with defining a model for their delivery still needs to be addressed to improve the delivery of water-related services. For public water supply infrastructure, the maintenance of services to consumers is challenged by financial and human resources, organizational capacity and governance, and leadership. As a result, reliability of water supply is very low, which has a considerable impact on the health and well-being outcomes of individuals and the potential for economic development of water dependent industries (World Bank, forthcoming[a]). Guidance on the delivery model for O&M is outlined in the pending national policy on public water supply.

Key Policy and Institutional Challenges

To overcome the fragmentation of roles and responsibilities in the water supply and sanitation sector, the coordination among sector institutions needs to be systematically strengthened. A lack of coordination not only inhibits effective and efficient work between government institutions internally, but also creates overlaps, delays, and inefficiencies between national stakeholders and development partners due to an absence of strategic direction and agreed milestones. To overcome these issues, sectoral strategic plans are required outlining sector targets and investments and clearly defining institutions in charge. These plans can also consider grouping or splitting investments and management packages to reduce complexity of the system and improve management for their O&M. At the implementation level, given complexity and multiple factors influencing sustainability of rural water services, in particular, a collaborative action among ministries, is required to formulate an integrated platform for sustaining rural water systems. A common result framework should be developed that combines specific interventions to improve institutional, technical, and financial aspects in parallel.

Along with strengthening roles and responsibilities, legislation is required to clearly define entitlements for water use for each user or user group. While this is pending the current draft legislation, it is worth emphasizing the importance of establishing a legal framework that outlines the rights and entitlements of water use per user type to prevent unsustainable use, pollution, and water shortages and all consequences associated with that.

Notes

1. Until the time of publication of this report, the responsible political parties of Timor-Leste have not been able to form a government following the parliamentary elections in July 2017. Consequently, the president announced in January 2018 that early reelections were to be held in the following months. A Decree-Law (No. 35/2017) was proposed in November 2017 outlining the structure and responsibilities of the cabinet ministries, which also affected the institutional

arrangements for the water sector. However, with new elections scheduled for the first half of 2018, the institutional arrangements are likely to change again. This report therefore maintains its assessment based on the institutional arrangements of the 6th Constitutional Government, which was in place until July 2017 and which drove water sector development over the past years.

2. NGOs contracted by the Partnership for Human Development (PHD) funded by Australian Department of Foreign Affairs and Trade (DFAT), whose one objective is to continue work on rural sanitation and behavior change and strengthen existing rural sanitation services.

3. PAKSI triggering is an interactive community gathering event that helps communities to analyze and identify their sanitation situation and commit to change their behavior toward ODF status. Also, refer to the rural sanitation section in chapter 6.

4. The link between the Sustainable Development Goals (SDGs), SDP, and national policy targets is identified in appendix B.

5. As of 2015, access to improved sanitation in urban areas was 73 percent (JMP 2017). See chapter 4 for more information.

6. Timor-Leste Strategic Development Plan, 2011-30, as cited in "Progress and Challenges of Infrastructure Spending in Timor-Leste" by Antonio Vitor, ADB.

7. http://www.eastasiaforum.org/2015/04/03/decentralisation-and-rural-development-in-timor-leste/.

Sand mining in the Comoro River in Dili. © Martin Benedikt Albrecht/World Bank.

Chapter 3
Water Resources Management, Development, and Water Use

The sustainable development of Timor-Leste's water resources is challenged by limited available data and technical knowledge of water resources, by the high investment costs for infrastructure solutions in remote areas, and by the capacity of the government to apply effective IWRM. Addressing these challenges has the potential to have a substantial impact on the economy of Timor-Leste by improving the water management to water-dependent areas of the economy, including irrigated agriculture, water supply and sanitation, and industry, and by enhancing the resilience of vulnerable communities against the impacts of water-related disasters.

Water Resources Management

The government needs to systematically increase activities to manage water resources. Technical and organizational capacity, budgetary constraints, and the lack of a legal and policy framework results in most management actions being ad hoc because they are neither informed by monitoring efforts nor conducted as part of broader strategic planning. Considering the importance of water resources development as part of improving water management, the government needs to improve its IWRM to identify effective and cost-efficient solutions to the most pressing challenges.

Individual data collection and monitoring systems set up by former externally funded projects are still being used, but no analysis or reports are being produced that inform management actions. The collection of water resources data in Timor-Leste has mainly been associated with programs of development partners, two of which have resulted in continued systematic monitoring by the government. The National

Hydropower Master Plan project supported by the Norwegian Government resulted in a National Hydrometeorological Monitoring Program which consists of 35 rainfall stations and 6 river height monitoring stations, which have been collecting daily data from 2009 to the present. In 2012, with support from Community Water Supply, Sanitation, and Hygiene Program (*Be'e Saneamentu no Ijiene iha Komunidade,* BESIK), four seawater intrusion monitoring boreholes were established in the Dili Aquifer to record groundwater depth and water quality, every hour. However, there is no public reporting on the data or internal analysis informing management action or decision making from either of these programs.

Uncoordinated meteorological and hydrological data collection programs result in duplication of efforts and missed opportunities. Nationally, there are approximately 76 meteorological monitoring stations in Timor-Leste collecting either just precipitation or a full suite of meteorological parameters. These sites are supported by the MAP Agrometeorology Program and the MOPTC National Hydrometeorological Program. There is little standardization of equipment and processes of quality control of the data, however these ministries have a data-sharing the Memorandum of Understanding (MoU) in place, but no systematic processes for efficient data sharing. For severe droughts, such as the 2015/16 El Niño, improved access to these data sets across ministries would have improved monitoring of its impact and the responses of the government and relief agencies.

Ad hoc and disparate datasets on water resources are available but many are not readily accessible in one location with the information and communication technology (ICT) infrastructure being finalized. Since independence, development partners and the government have been collecting water resources data from many locations to support their projects and programs. This has resulted in a large volume of data that currently exists in inaccessible or incompatible formats across different organizations. A centralized database for water resources data and information is being finalized within the MOPTC, however the ICT capacity to manage the information and training needed for the operators of the database is limited. Thus, the current scenario results in missed opportunities to convert this data into knowledge and water management actions.

Past hydrological modeling studies suggest that there are substantial volumes of water resources available for development, but more in-depth studies are required to support concrete investment decisions. In 2004, hydrological modelling studies calculated water balances for total water demand and total water availability (both surface and groundwater) at hydrologic unit and river basin scale, based on modeled estimates of stream flow and groundwater sustainable yield (ADB 2004). This study then defined water balances under future scenarios with increased water demand and climate change for 2020. Predictions indicate future availability of substantial groundwater resources available for development, however, low data availability at the time of modelling (2004) resulted in low confidence levels in the streamflow data; it is suggested that this modeling exercise be repeated to verify the results, especially as new data are now available on the water resources, on per capita water supply demand, and for irrigation. Downscaling of the results to specific water resources would also benefit water resources development investment decisions.

Detailed studies on specific water resources issues are needed to support further water resource development, particularly to reduce the vulnerability of public water supplies to climate variability and climate change. Detailed studies on specific water resources to determine spatial and temporal characteristics and sustainable yield are generally not available. The development of water sources for water supply to Timor-Leste's major population centers is generally based on a few spot data over several years or primary data collection of a few years to support water supply augmentation projects. Generally, there is no systematic monitoring on these water resources or long-term datasets (greater than

10 years) that capture their natural variability. This leaves them at risk to climate change and climate variability. Hydrogeological studies have occurred on a few aquifer systems, including the Baucau Karst Limestone Aquifer, Dili Aquifer, and Liquica Coastal Aquifer, which contributed substantially to the improved knowledge of those resources, however these studies remain incomplete with regard to providing the necessary levels of confidence needed to support investment decisions for water resource development. Appendix B provides more information on the development of lakes and springs as a water resource.

Better cross-ministerial coordination is needed for areas where different ministries have overlapping objectives related to water resources management. There are no formal coordination avenues within the government or between development partners to coordinate activities related to the management of catchments for watershed protection, forestry, and water resources management. As outlined in chapter 2, MOPTC, MAP, and MPRM are involved in catchment management, water resources management, or environmental management or other activities related to water resources management. Coordination of these activities will become more important in the future with the implementation of the World Bank-funded Sustainable Agricultural Productivity Improvement Program (SAPIP) and if the government approves the pending National Water Resources Management Policy and finalizes the draft National Forest Policy.

Plans to develop water resources must consider the communities' cultural and spiritual connections to water as these still guide most communities in their water resources management decisions. Water has a strong cultural and spiritual significance for many people in Timor-Leste, and, over time, a system of traditional norms and customs (*tara bandu*) has evolved for the protection, management, and sharing of water resources. *Tara bandu* is still in effect across the country, forms the basis of most local scale water decisions, and is important for the management of water resources within the community and for sacred (*lulik*) sites. Water resources management will benefit from understanding how *tara bandu* guides decisions on how to protect, manage, share, and resolve conflicts around water. Sustainability and community participation in water resources management or the development of water resources will need to take *tara bandu* principles into account.

Water Use

The latest national level data for water usage are from 2004 and identify that total actual water withdrawal was at around 1,172 Mm^3/yr or 14 percent of the actual renewable water resources. Of this, 1,071 Mm^3/yr (91 percent) was used for irrigation and livestock, 99 Mm^3/yr for domestic use (9 percent), and only 2 Mm^3/yr for industrial use (ADB 2004). More recent data is not available, but these figures are likely to be higher after a decade of economic growth.

Irrigation

Irrigation is the highest water user in the country abstracting 90 percent of the total freshwater withdrawals mainly from free or unregulated river intakes (ADB 2004). This makes abstraction during the dry season difficult and limits the area that can be irrigated during the dry season.

Agriculture is the most important sector in the country, but faces challenges of low productivity, inadequate infrastructure, weak institutions, and a variable climate besides natural resource depletion and degradation. Agriculture holdings tend to be small with 97 percent of plots being under 1 ha. Typical crops of a farming household in mountainous Timor-Leste are grains (maize and rice), root crops (sweet potato and cassava), peanuts and various vegetables, fruits, spices and tree crops. Maize and other rain-fed crops are usually grown in mixtures in homestead plots or in 'slash and burn' fields, often on sloping land, usually using farmer recycled seed and without chemical fertilizer or pesticide or even organic manure, resulting in low yields.[1]

Consequently, most farming families suffer from food insecurity because they have produced insufficient cereal staples of maize and/or rice to last a full 12 months. In most farming households, this 'maize deficit period' can range from 1 to 9 months and households are required to purchase maize or rice, or rely on foraging from the natural vegetation. There is seasonal food insecurity, with 90 percent of rural households exhausting their homegrown maize and rice supplies by September of each year. To address this deficit, rice imports in average years of around 100,000 megatons are required. Despite these imports, about 70 percent of the population felt moderately or severely food insecure according to the 2011 Food and Nutrition Survey.

Increasing production and productivity by improving agriculture practices and enhancing water management for agriculture are important for enhancing nutrition and food security. Currently there is a renewed recognition of the fundamental importance of agriculture to Timor-Leste's economy and the central role it plays in poverty reduction, food and nutrition security, economic growth, and income and employment generation through its linkages with the other sectors of the economy.

Timor-Leste has a long experience with irrigation. Irrigation in Timor-Leste began during the Portuguese colonial period, when numerous small-scale communal irrigation systems were developed using simple irrigation technology that relied on water supplies from small springs and runoff from mountainsides. During the Indonesian occupation, free-intake river diversion irrigation schemes were constructed with total design irrigation area estimated at 72,159 ha, covering more than 427 schemes. In 2002 after independence, only 34,649 ha (48 percent) remained, of which 5,384 ha are technical schemes, 7,770 ha are semi-technical schemes, and 21,495 ha are traditional schemes.[2] After independence, development partners funded a series of Agriculture Rehabilitation Projects (ARPs) in the period from 2000 to 2008. These projects mainly involved small-scale communal irrigation schemes. Considerable support was provided by the Japanese Government especially for the rehabilitation and expansion of irrigation areas for rice production (JICA 2008). Post 2008, development partners in the agriculture sector changed their focus to improvement in productivity and the market supply value chain.

The irrigation policy is embedded in the MAP Strategic Plan 2014-20 which targets sustainable increase in production and productivity and identification of areas for water resource development. The target is to increase agricultural production through more efficient use of available water supply and includes rehabilitation, extension, and protection of irrigation systems, water use efficiency, and groundwater exploration and production, including popularization of tube wells. Proposed activities include a comprehensive irrigation system inventory, a large dam feasibility study, and small dams and schemes in appropriate locations, building new dams (for water conservation), rehabilitation and construction of new irrigation schemes, groundwater exploration, and tube well development.

The current irrigation policy is based on the rehabilitation of irrigation schemes connected to cross diversion weirs, some of which have not been designed sufficiently to supply water to second and third season crops. After independence, designs changed from free intakes to weir-based river diversion systems. While the latter are more reliable with regard to ensuring sustainable water supplies, these schemes are much more expensive to construct and maintain, especially as climate change and land degradation begin to increase the already enormous sediment loads in the wet season and reduce the basal stream flows in dry season. These weir diversion irrigation systems will be unable to ensure reliable supplies of irrigation water late in the growing season, particularly in the dry season, as crops mature. This means that second and perhaps third season crops can only be grown in very limited areas.

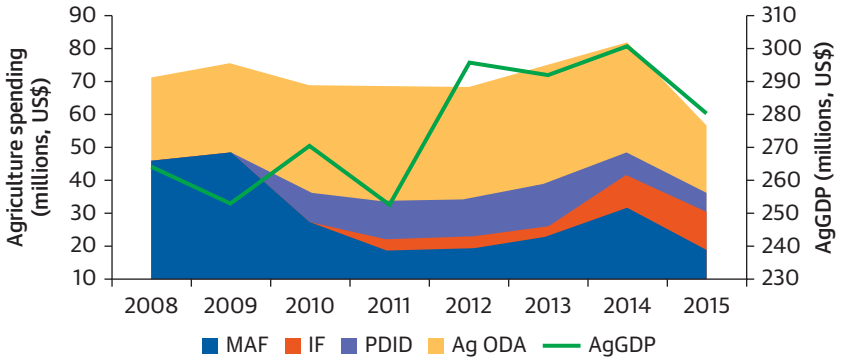
TABLE 3.1. MAF Plans for Irrigation Development 2013–20—Areas to be Irrigated (ha)

	2013	2014	2015	2016	2017	2018	2019	2020	Total
Area currently irrigated	46,300	46,300	46,300	46,300	46,300	46,300	46,300	46,300	46,300
9 schemes in pipeline		2,488	5,946	11,909	12,409	12,409	12,409	12,409	12,409
20 new schemes					2,500	5,000	7,500	10,000	10,000
6 schemes + new dams					1,500	3,000	4,500	6,000	6,000
PDD I and II schemes	2,500	5,000	7,500	10,000	10,000	10,000	10,000	10,000	10,000
Total hectares irrigated		48,800	53,788	59,746	68,209	72,709	76,709	80,709	84,709
Incremental hectares irrigated	2,500	4,988	5,958	8,463	4,500	4,000	4,000	4,000	**38,409**

Source: World Bank 2015.
Note: The current irrigated area reported by the MAF is approximately 46,300 ha. However, investigations (Freach 2013) indicate that the currently irrigated area may cover only 33,300 ha.

The MAP Strategic Plan contains approximately US$590 million for investment in the irrigation sector from 2014 to 2021, however the sources of funds to implement this fully have not been identified. These plans include (a) further sector planning; (b) completion of a master plan prepared with support from Japan International Cooperation Agency (JICA); (c) farmer resettlement in irrigation schemes which are sparsely populated; (d) rehabilitation of nine schemes which are in the approved pipeline (see table 3.1 and figure 3.1); (e) a study of 20 new schemes for which sites have been selected; (f) studies for and the construction of 12 large multipurpose dams; (g) irrigation schemes associated with these dams; (h) ongoing Programs of Decentralized Development (PDD I and PDD II), and National Program for Village Development (PNDS)[3] support for irrigation; and (i) the funding of maintenance and operational costs. An evaluation which has been incorporated in the Public Expenditure Review mentioned below indicates that there are more cost-effective ways to enhance the productivity of irrigated agriculture.

FIGURE 3.1. Public Spending in Agriculture versus AgGDP at Constant Prices (2016 US$)



Source: World Bank, forthcoming (a).
Note: Data on weather conditions and agricultural outputs come from the Global Information and Early Warning System (GIEWS) Country Brief published by the Food and Agriculture Organization of the United Nations (FAO) for the period 2009 to 2016. Although weather data are relatively reliable, production data should be considered with caution as low capacity and lack of adequate resources result in low quality crop monitoring and production estimates by the ministry. Official production estimates tend to be higher than surveyed data from development partner's projects/programs. Agriculture GDP (AgGDP) includes all agriculture, forestry, and fisheries occurring within the Timor-Leste economy. Ag ODA = Agriculture Official Development Assistance; IF = Infrastructure Fund Expenditure; MAF = Ministry of Agriculture and Fisheries; PDID = Integrated District Development Planning.

The Master Plan for Agriculture and Irrigation Development, prepared with JICA funding, was

TABLE 3.2. Completed, Ongoing, and Planned Irrigation System Development and Rehabilitation—MAP Systems to be Funded Out of the Infrastructure Fund

Funding Source	System Name	System Area (ha)	District	Status
ARP3	Caraulun	600	Manufahi	Completed
JICA	Maliana 1	1,050	Bobonara	Completed
JICA	Laclo	507	Manatuto	Completed
JICA	Buluto	1,371	Bacau	Under construction
MAP	Bebui	1,090	Viqueque	—
MAP	Galata	216	Baucau	Under construction
MAP	Larisula	347	Lautom	Under construction
MAP	Dardau	356	Viqueque	Under construction
MAP	Beikala	1,547	Ainaro	Under preparation
MAP	Raibere	225	Ainaro	Under preparation
MAP	Oebaba	2,263	Covalima	Under preparation
MAP	Muakola	2,916	Covalima	—
MAP	Tono	1,717	Oecusse	Under construction

Note: — = not available; ARP3 = Third Agricultural Rehabilitation Program; JICA = Japan International Cooperation Agency; MAP = Ministry of Agriculture and Fisheries.

completed in November 2014. The aim of the master plan is to increase the production of local commercial rice in designated rice bowl areas to achieve national self-sufficiency and to enhance subsistence farming in other areas. Selection of priority systems is led by irrigation potential, paddy productivity, and market development potential.

To ensure and enhance production potential in the south coast systems under rehabilitation, a program of incentives for farmers to settle in the area is required. The south coast schemes have been suffering from a lack of farming population since independence[4] while self-sufficiency objectives require farmers to operate these systems. Details of the resettlement program, however, are not available.

The government developed an investment plan for rehabilitation and development of new irrigation systems. The program of rehabilitation of nine irrigation systems is now being implemented, however currently only six of the nine planned schemes are completed or under construction (table 3.2). The remaining three schemes are planned for implementation in the coming fiscal year. Detailed designs have been made, by international consultants, of intakes as part of the 20 new schemes, which are financed by JICA. In 2015, the Ministry of Planning and Strategic Development decided that the responsibility for the development of dams be shifted from the MAF to themselves for implementation through the Infrastructure Fund. To date, there are no activities planned to proceed with these potential dam sites.

There are insufficient studies to support investment decisions on the three rivers identified to have potential irrigation dam sites. A preliminary study was conducted by the MAP and Salu Corporation Unipessoal Ltd. of 15 rivers for potential dam sites, but only three rivers were considered to have potential for further development: Beiruli, Caraulun, and Laclo Rivers.[5] Less favorable but still with a potential for dam sites were the Sahen, Malibaka, Laleia, Weberek, and Watuwa Rivers. For all identified dam sites, further studies and investigations on hydrology, geology, morphology, and water utilization are required before investment decisions can be made.

Generally, reliance of infrastructure is justified as buffer against the effects of rainfall variability. A study by Damania et al. (2017) confirms that large irrigation infrastructure provides a healthy boost to net primary productivity (NPP), the primary parameter of crop production used in this analysis. The benefits are largest in middle-income countries, where NPP increases by 12 percent on average in regions where infrastructure is present, and perhaps more importantly, in most

areas that are equipped for irrigation, NPP shows little sensitivity to rainfall variability, both for positive and negative rainfall shocks. This implies that irrigation infrastructure provides a complete buffer against rainfall shocks in these areas.

In arid areas and low-income countries, large irrigation infrastructure can be less effective at buffering agricultural yields against shocks and halting the expansion of cropland; this possibly applies to Timor-Leste. In some regions, large irrigation infrastructure is found to be less effective at buffering agricultural yields against shocks and may also accentuate their impact. In these areas, NPP declines when negative rainfall shocks occur, and if irrigation infrastructure is in place, NPP declines even further. This finding may seem surprising at first, but it is also entirely predictable. Infrastructure fails to buffer against dry shocks in those arid regions where a disproportionate amount of land is used to cultivate water-intensive crops. As the water resource is provided for (almost) free, it will inevitably increase the cultivation of water-intensive crops, which increases vulnerability to drought, that in turn magnifies the impacts of dry shocks. The end result is maladaptation—a dependence on water sensitive crops in arid areas that increases vulnerability to dry shocks (Damania et al. 2017).

Weather and water-related natural disasters have a greater impact on AgGDP than public investment in the sector. A review of public expenditure in the agriculture sector between 2008 and 2014 has revealed the comparative influences of weather and investment on AgGDP. During the period, favorable weather and high level of public spending led to high level of output in 2010 and 2014. In the absence of an adequate private sector, Timor-Leste's predominantly subsistence farming sector is dependent on the delivery of public funding inputs, including extension services and as a result is highly sensitive to levels of goods and services public spending for increases in AgGDP, and the return from public funded capital investment is more tenuous. Favorable weather at the end of 2011 and into 2012, combined with government programs promoting the adoption of new technologies, resulted in higher yields in 2012. State allocations are decided from one year to the next, based on expected weather patterns. The government tries to adapt to changing circumstances through virements and budget rectifications, but with very limited results with regard to impact on the overall budget allocated to the sector in a year. Large investments in irrigation are yet to deliver the expected results and have been slow to improve water management, which could be instrumental to farmers' resilience. In parallel to the 2015/16 El Niño, the government started reducing allocation to the agriculture sector from 2015 onward, while major development partners were simultaneously reaching the end of a program cycle, which temporarily translated into lower expenditures in the sector and reduced AgGDP (World Bank, forthcoming[a]).

A public expenditure review recommended revising the current irrigation strategy to a hybrid strategy that maintains past investments in physical infrastructure, optimizes surface water abstraction, while it complements this with investments for high returns in tubewell irrigation, as well as in farmer support services and market development programs. The Public Expenditure Review (World Bank 2015) identified that better results might be obtained with a more cost-effective groundwater-based supplementary irrigation strategy. This was based on the high investment, high O&M costs, and disappointing results from past investments in the rehabilitation of irrigation schemes. The review proposes a hybrid strategy that maintains past investment in infrastructure combined with a strengthening of agriculture support services and introduction of groundwater-based irrigation systems. This approach could not only result in higher cost effectiveness but it also opens opportunities for higher levels of crop diversification, introduction of horticulture, higher levels of farm productivity and possibilities for irrigated agriculture at locations traditionally not used for irrigation.

O&M of irrigation schemes is inadequate because they rely on water user associations (WUAs) with limited financial resources and capacity, while more sustainable funding mechanisms and implementation arrangements await approval. The National Directorate for Irrigation Water Management has limited budget for the O&M of irrigation infrastructure. Once constructed, the O&M of irrigation schemes is in principle managed at the local level by WUAs with some guidance from MAP officers. Each municipal administration office has around two MAP irrigation officers who train and assist WUAs in O&M of the irrigation infrastructure. While maintenance is in some cases partly covered by WUA membership fees, on an ad hoc basis, the MAP also provides some annual funding support of approximately US$5,000 per system. Generally, however, the O&M budgets are the first to be cut when budget savings are sought.

Meanwhile, several O&M models are in discussion to improve the sustainability of the systems. It is proposed that depending on the size of the scheme, maintenance should be shifted to an outsourcing model whereby multiyear maintenance contracts are awarded to local contractors at an estimated annual value of US$10,000 per system. It is further proposed to implement these contracts by moving the O&M budget from "Goods and Services" to "Capital Investment" of the National Directorate's budget. This proposal has not been approved, as the legal framework to enable such an approach is not in place and capacity to manage maintenance contracts is lacking. Moreover, investments in irrigation infrastructure comes mainly from the Infrastructure Fund which does not allow its money to be used for maintenance, because it is only for investments in new infrastructure. This issue persists not only for irrigation but also for other public infrastructure such as roads and water supply.

Communities play an essential role in the management and protection of water resources, water use, and land use. Enhanced participation of communities in the management and O&M of public facilities is an obvious path for governments but this needs to be supported technically and financially especially in the case of larger and complicated improvement works. The development of an O&M fund that can be accessed by organized communities is a logical step that merits some piloting.

Domestic Water Supply

Improved water safety planning is required to improve the management of risks in delivering safe water supply. Bacteriological analysis on samples of surface and groundwater resources and in water supply networks regularly indicate widespread bacteriological contamination. Contamination at the water source is generally at unprotected water sources from animal and domestic waste. In urban areas, distribution system leakage and inadequate construction standards have resulted in multiple sources of contamination throughout the distribution network. Further effort is required on water source protection and water safety planning if the government is to achieve its national and international commitments for the delivery of safely managed water from public water supply systems, by 2030. This must be done in conjunction with improved sanitation drainage and wastewater treatment, especially in areas of higher population density found in urban and peri-urban areas (administrative posts).

Additional secure water sources are needed to increase coverage and improve water supply and sanitation services to households. Many water sources are vulnerable to changes in rainfall because of climate variability and climate change, and some water supply systems are not designed to deliver water supplies at the levels required to meet the higher levels of services that are planned under the achievement of the SDG 2030 targets. Providing the additional supply is challenged by limited knowledge of the sustainability of specific water resources currently being used. Also, there are no large operational water storages available for water supply, and no feasibility studies

have been completed to support the development of large water storage facilities. The use of decentralized storage options, such as domestic rainwater tanks has had limited adoption in Timor-Leste, despite widespread promotion of this concept.

Water Supply for Industrial Use

Industries are poorly served with water supply, affecting the potential for economic growth in this area, particularly where water is a key input to production. Water supply for industrial and commercial purpose needs to be reliable regardless of climate variability to allow certainty in production and investment returns. At the moment, the level of industrial or commercial water use in Timor-Leste is unknown as there is no data separating the water use of different parts of the economy. Outside of the petroleum industry, however, industrial water use is expected to be small with only a few industrial developments with significant water consumption. In most areas, reliability of public water supply is low, resulting in industries relying on private groundwater abstractions to meet their water needs.

Hydropower

Small-scale hydropower development has been identified as viable at several locations in Timor-Leste, however in their current energy policy, the government is prioritizing other sources of energy. Installed capacity for energy supply is adequate for present needs and comes from two oil fueled power stations that rely on imported fuel. There is no significant hydropower facility in Timor-Leste. From 2009-14, the Water Resources and Energy Directorate of the Government of Norway (NVE) supported the Government of Timor-Leste to investigate opportunities for the development of hydropower at locations across the country. As a result, the National Hydropower Master Plan was finalized in 2012 and it identified 14 locations as economically viable for hydropower development. Full feasibility studies were completed for three locations: the Iralalaru, the Atsabe Magapu, and the Maliana Bulobo Hydropower Plants. Despite NVE constructing the Gariuai Mini-Hydropower Plant in Baucau for demonstration purposes, the Government of Timor-Leste has not committed to developing any of the hydropower sites from the master plan (Norplan 2012) and prioritizes other sources of energy under their current energy policy. The master plan provided a strong economic case for the development of small-scale hydropower to compliment the current heavy oil power plants in Timor-Leste. Current reliance on imported fuels for energy limits national energy security, leaving Timor-Leste vulnerable to international oil price fluctuations. Any investigations into multipurpose infrastructure should consider hydropower as a source of available energy and also to enhance national energy independence.

No multipurpose surface water storages exist in Timor-Leste yet, though the concept has been discussed for water supply to the city of Dili. Development of the water resources in Timor-Leste for public water supply are primarily related to groundwater boreholes, hand dug wells, and springs. The sediment loads of rivers, peak flow events, and geotechnical constraints challenge the design and O&M of constructing water storage structures across rivers in Timor-Leste. To date, no comprehensive studies have been completed on potential sites for constructing large multipurpose water storage facilities. Only one possible site has been identified in the Comoro Catchment combining the needs of urban water supply to the capital, Dili; recreation; hydropower; and flood control. Current weir structures for irrigation and the proposed small dams for hydropower, each use low dam wall heights, from a few meters to 15 m, for the diversion of flows rather than the storage of water (Norplan 2012; ADB 2004).

Key Water Management Challenges

Management of water resources still lacks coherent and systematic management practices leading to ad hoc, inefficient, and ineffective actions. This is partly due to unavailability of data and partly to a lack of

analysis of existing data, falling short of producing information necessary for decision makers. It also makes it difficult to further explore the water resource development potential for which it is necessary to systematically carry out in-depth studies and process the analysis into concrete information necessary for investment decisions.

Water use for irrigation lacks clarity on which service delivery model is best suited for the circumstances in Timor-Leste. Although plans for investment into rehabilitation and development of irrigation schemes exist, conventional flood irrigation schemes should be combined with tube well irrigation where necessary to increase productivity and ensure the viability of the schemes. This should be combined with optimization of surface water abstraction practices based on sound water management and improved O&M capacity.

Key challenges for domestic water use is to ensure sustainability and functionality of services through proper O&M carried out systematically by the responsible entities and with sufficient resources. With large parts of existing water supply systems not functioning anymore, only a few years after construction, this needs to be addressed as a priority. Additionally, existing water supply schemes are vulnerable to variations in water availability at the source. Solutions could entail storage capacity to overcome variations in water discharge at the source, but more studies and analyses are needed before making decisions.

Notes

1. SoL website. Accessed April 28, 2017.
2. According to the definition by FAO, technical schemes are irrigation systems in which distribution of water can be fully controlled from the source to the field. It is characterized by permanent canals, control structures, and measuring devices. Semi-technical schemes are characterized by permanent canals and a few control or measuring devices. Traditional schemes are characterized by only a few permanent control or distribution structures.
3. PDD is the Program of Decentralized Development and has been delivered in two program phases, I and II. PNDS is the National Program for Village Development, providing support to *Sucos* following a community-driven development approach.
4. During Indonesian times, before independence, these systems at Timor-Leste's south coast were mainly operated and maintained by transmigration workers from other parts of Indonesia, who left Timor-Leste after independence.
5. Based on a desk study and site reconnaissance (Salu Corporation Unipessoal Ltd., October 2015).

Urban coastline in Dili. © Martin Benedikt Albrecht/World Bank.

Chapter 4
Urban Water Supply and Sanitation Services

Status of Operation and Service Delivery

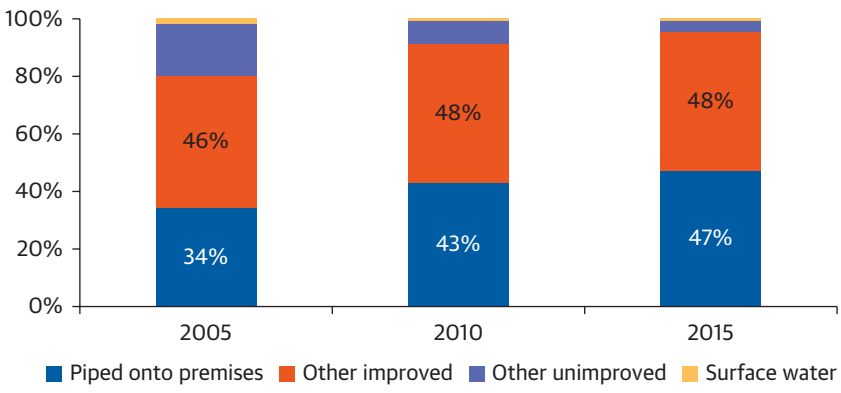
Water Supply

Timor-Leste has met the MDGs for urban water supply. According to JMP 2017, total coverage for urban improved water supply in 2015 was 91 percent (figure 4.1). This rate is beyond the MDG targets on urban water supply, which aimed at 81 percent (JMP 2017). It was therefore recognized by the international community that Timor-Leste has met its MDG targets for urban water supply.

Despite high access rates in urban areas, the capacity and funding of the DNSA to operate and manage the system is limited. The responsibility for O&M of Timor-Leste's 13 urban water supply schemes lies with the DNSA. The DNSA comprises the following departments: (a) Planning and Design, (b) Customer Service, (c) Dili Urban Water Supply (DUWS), (d) Desalination, and (e) Program and Technical Support. Although established with a strategic plan and clear mandate, the DNSA operates with a limited autonomy in decision making, other than for basic operations, and exhibits little accountability to service users. The capacity of the DNSA to operate and maintain urban water supply systems is constrained by the limited annual budget to fund O&M. Consequently, maintenance is reactive, planned asset maintenance programs are not implemented, and system functionality and service quality are declining.

In line with decentralization, institutional arrangements and the capacity to manage water supply services need to be strengthened at the local level. Before decentralization, part of the current SMASA's staff belonged to DNSA, receiving an annual budget allocated for their operations. With decentralization,

FIGURE 4.1. Access to Urban Water Supply



Source: JMP 2017.

TABLE 4.1. Basic Figure of Population Served in Selected Municipalities

Municipality	Urban Population in Service Area[a]	Population Served (%)[b]
Dili	128,033	30–35
Baucau	22,461	49
Los Palos	13,435	39
Same	16,732	70
Viqueque	10,005	86

a. 2010 census.
b. Estimation from ADB 2015a.

the mandate for water supply and sanitation service provision is transferred to the municipal administration including the authority for both programming and budget allocation. However, without the staff previously provided through DNSA, there now is a shortage of qualified staff at the municipal level assisting with the management of urban systems. In 2017, the first year that decentralization has come into effect, the SMASA has experienced difficulties in developing proposals and getting approvals for them from the municipal administration. This resulted in generally low disbursements under the SMASA, with several municipality administrations being unable to approve SMASA proposals in time.[1] Municipal administrations need to develop their understanding about water supply and sanitation service provisions, specifically the SMASA service model, the sector targets, and service standard needs to be performed as part of municipal obligation to serve the citizens.

Efficiency of water supply systems in Dili is performing below standard with extremely high non-revenue water (NRW) and O&M without proper planning. Performance levels of urban water systems are particularly challenging in the capital, Dili, where the water supply system is constrained by low pressures in the distribution system, inadequate maintenance of main pipes, and a high record of illegal connections, resulting in NRW estimated to be partly higher than 90 percent of the total volume supplied (WaterAid 2010). The reason why the network is so difficult to maintain is because of (a) the poor condition of much of the piped network, (b) the extremely high NRW rate, (c) frequent modifications to the system without following the overall system design, (d) insufficient budget allocated, (e) a lack of documentation for many small upgrades and repairs, creating a complicated and inefficient distribution system, and (f) a lack of archiving and record keeping practice (ADB 2015b).

Service in other municipal towns varies and details about the quality of urban service provision is often unknown (table 4.1). In some reports (ADB 2014; WSP 2015), the water supply systems in municipal centers are characterized as low service levels with low coverage; highly intermittent supplies and low pressures; unmetered and uncontrolled connections without a stop valve installed; illegal connections with poor quality of construction and insufficient maintenance, leading to high leakages during transmission, distribution, and household connections; lacking systematic water quality monitoring and irregular water

treatment with chlorination; and generally low levels of satisfaction by households with public water supply. Although national drinking water standards exist, water quality monitoring is not systematically carried out outside of Dili, due to the cost, time, and logistics of collecting samples and transporting them between municipal towns and the DNSA laboratory in Dili.

Water tariffs for urban areas have been established by the Minister of Finance[2] together with DNSA, the collection is not yet done systematically. Water tariffs in Dili are around US$7.54 per household per month (ADB 2015a), but only around 27 percent of DUWS connections are registered and billed. Billing is limited because the DNSA currently only bills those who have a water meter. Normally, there are no penalties for customers who do not pay their bills and corrective actions to address illegal water connections are not taken. Payment procedures are complex and time consuming for customers.[3] Discrete trials of metering and tariff collections in piped water subzones in Dili have been conducted with ADB financing. After technical assistance support for training and procurement of equipment to support the reintroduction of tariffs including billing and collection, the DNSA is now continuing billing without external support. The valuable experiences from the Dili trials are expected to inform a broader tariff implementation program.

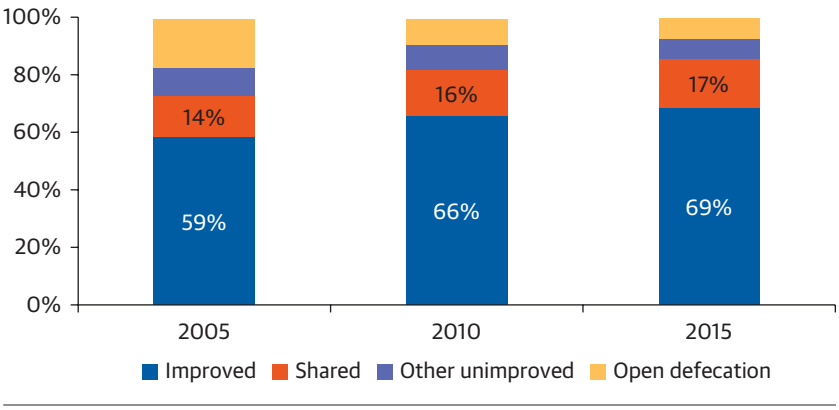
Lack of revenues from user fees restricts the execution of O&M necessary to maintain a quality service, which in turn users are willing to pay for. Without tariffs, the direct accountability between customer and service provider is absent. Tariffs used in the subzone trials in Dili are identical to those in the Ministerial Diploma n. 1/2004 of 11th of February, and while deemed adequate for present circumstances, a tariff policy and review process will need to be developed in future that rationally sets prices for water. Tariff reform would also need to address greater autonomy for the DNSA to retain and control revenues, rather than the Ministry of Finance, so that O&M can be effectively addressed. This reform would require a utility approach with autonomous service provision and regulation functions to be separated. A regulation study would be needed to assess the best institutional and organizational arrangements for hosting economic and service regulation (WSP 2015).

Sanitation

Timor-Leste has met the MDG target for urban sanitation. According to JMP, total coverage for urban access to improved sanitation in 2015 was percent (figure 4.2). This rate is beyond the MDG target for urban sanitation, which aimed at 64 percent (JMP 2017). The remaining 27 percent of population without access of improved sanitation consist of 17 percent shared, 7 percent unimproved, and 7 percent people in urban areas still practicing open defecation.

Access rates to urban sanitation is relatively high compared to its peers, but most of these services are on-site without a properly functioning fecal sludge service. Almost all sanitation facilities in urban area comprise simple pit latrines, septic tanks, or direct discharge to public surface water. No centralized piped wastewater collecting system exists despite

FIGURE 4.2. Access to Urban Sanitation Facilities



Source: JMP 2017.

the development of several master plans in Dili, Baucau, Same and Viqueque. In urban areas, it is ubiquitous to observe the wastewater from residential areas flowing into small channels dug in the ground, discharging directly into the environment without treatment. A septage treatment plant exists in Tibar to treat fecal sludge collected from some government facilities, hotels, hospitals, companies, and some residencies. Fecal sludge is collected by private fecal sludge collection services, serving based on requests. A total of nine private fecal sludge collection companies exist in Dili, collecting fecal sludge mostly from nonresidential areas.

Overall development of Water, Sanitation, and Hygiene (WASH) in urban areas has been dominated by water supply programs with little attention to sanitation or hygiene promotion initiatives. There is limited information available on the progress of urban sanitation development in Timor-Leste. None of the urban areas have centralized sewage treatment facilities. Only Dili has one simple septage treatment facility. Meanwhile, by regulation, individual households in urban areas are obligated to install on-site sanitation. The operation and service delivery of urban sanitation is under the responsibility of the DNSB. There is no regular program for urban sanitation at the municipal level, rather ad hoc programs implemented both by the central government and external partners. There is no clarity yet on how this implementation arrangement will be affected by decentralization. In March 2016, the government launched the development of master plans for the Water and Sanitation Master Plans in four municipalities: Baucau, Lospalos, Viqueque, and Same, supported by the ADB. In May 2017, the draft sanitation master plans were under discussion for final inputs by various stakeholders.

Dili Drainage and Sanitation

Efforts are under way to rehabilitate and improve sewers and drainage urban areas of Dili. Similar to urban sanitation, the DNSB is responsible for the sewerage systems with regard to planning, design, and management. In 2012, the Dili Sanitation and Drainage Master Plans (DSDMPs) were approved by the Council of Ministers. The plans aim at improving sewerage and drainage in Dili for the overall purpose of reducing health risks and contributing to economic development. Concretely, the sanitation master plan seeks to achieve improvements to sanitation through a staged approach, as well as to rehabilitate existing sewers to separate sewage from storm water drainage. Various projects on sewerage and drainage, have been designed in accordance with the DSDMPs since August 2014. As a part of the drainage master plan, plans exist to construct and improve drainage facilities in priority areas in Central Dili, West Dili, and East Dili regarding cleaning of regular channels and drains, channel resloping, channel reshaping, and construction of road side drains and curb inlets from 2013 to 2017 (JICA, Nippon, and Pacet 2016). Implementation of the detailed engineering designs is currently waiting decision on funding options.

Financing

After external funding has been reduced in recent years, overall investments into the urban water supply and sanitation sector have declined with the majority of funding coming from the government. In the national budget, there are currently two major sources of capital spending for water supply and sanitation infrastructure, (a) the Consolidated Fund of Timor-Leste and (b) the Infrastructure Fund (table 4.2). The Consolidated Fund captures all minor capital expenditures as well as expenditures for O&M carried within the budget of ministries (particularly MSTAM, Ministry of Finance and MOPTC), including the local development programs, as well as salaries, goods and services, and transfers as part of local development programs. The Consolidated Fund finances many local development programs that are

TABLE 4.2. Timor-Leste Capital Spending from the Consolidated Fund of Timor-Leste and the Infrastructure Fund Relevant to Water Supply and Sanitation, 2011–15

(US$ millions)

Spending Item	2011	2012	2013	2014	2015
Total Capital and Development from Consolidated Fund of which:	**86.6**	**124.8**	**152.5**	**158.6**	**164.9**
PDD I subdistrict, *Suco*, and *Aldeia* (reappropriation)	15.8	34.4	9.4	—	—
PDD II district (reappropriation)	26.6	30.1	6.3	—	—
PDID program (from 2013 on)	—	—	71.3	90.5	94.1
Ministries/agencies	44.1	60.3	65.5	68.1	70.8
Total Capital and Development from Infrastructure Fund, of which:	**—**	**430.8**	**604.4**	**868.3**	**918.4**
Water and sanitation	—	4.9	10.1	13.2	27
MDGs	—	14	46.3	81.5	64

Source: WSP 2015.

Note: — = not available; MDGs = Millennium Development Goals; PDD = Program of Decentralized Development.

major sources of decentralized spending for investments in rural and urban water supply services, as well as in public sanitation services. The MSTAM manages funds for local development programs such as the Local Development Program (PDL), the PDD and the PNDS. The Infrastructure Fund currently includes funding for five major areas under the water supply and sanitation program: (a) Studies for master plans regarding water and sanitation at national level; (b) The DSDMP; (c) Construction and supervision of sewers and drainage in Dili; (d) Construction and supervision of water and sanitation systems at national level; and (e) Improvement of water supply system in Dili. In addition, the MDG Suco Fund included a budget of US$6.9 million in 2013 and US$7.5 million in each year from 2014 to 2018 for water and sanitation.[4]

Key Urban Water Supply and Sanitation Challenges

Despite achieving the MDGs, access to piped household connections in urban areas remains low. From the households with access to improved water supply in urban areas, only about half are connected through house connections. The rest receive drinking water through other methods. According to the 2015 census, 34 percent of urban households have individual connections with piped water onto their premises. Significant sections of the population still rely on public taps (30 percent), tubewells or bore holes (16 percent), and protected springs (5 percent)[5]. The number of urban people that had access to improved water source in 2015 (around 320,000) has more than doubled compared to 1995 (129,000), suggesting access has more than kept pace with population growth and high rates of urbanization.

The biggest challenge for the urban water supply sector is to improve efficiency of service. This can be achieved by reducing the NRW rate and by applying corporate principles into the management of the service that has more independent and clearer role and responsibility. This, however, not only requires political will but also institutional transformation in line with realistic expectations around the availability of human resources and sources of financing.

In the urban sanitation sector, it is crucial to ensure the incorporation of elements of the National Basic Sanitation Policy into planning at the municipal level. A special effort will be required to ensure urban sanitation is included in the municipalities' priority agenda. The implementation of this policy further requires the dissemination and enforcement of the need to install proper sanitation facilities based on national standards and a functioning sludge management service.

To properly manage drainage development, the implementation of the DSDMP should proceed. Focusing on a new organizational and regulatory framework is the first part of implementation of the master plan. Developing a detailed engineering design, establishing social safeguards, and ensuring quality construction should be observed carefully, as this could be a model for similar development for other municipalities in the coming years.

Notes

1. The SMASA in the Liquiça municipality did not disburse any funds due to pending approvals of their proposals.
2. WaterAid 2010 and personal communication from DNSA.
3. Households report that in addition to their water bill of around US$7.54 per month, they have to pay around US$3.76 on transportation cost to pay the bill. (ADB 2015a).
4. Government of Timor-Leste: The MDG Suco Fund provides water and sanitation to the new houses in *Sucos* (5 per year per *Aldeia*). Water Supply and Sanitation in Timor-Leste: Turning Finance into Services for the Future, April 2015.
5. Government of Timor-Leste: The MDG Suco Fund provides water and sanitation to the new houses in *Sucos* (5 per year per *Aldeia*). Water Supply and Sanitation in Timor-Leste: Turning Finance into Services for the Future, April 2015.

Unprotected water source. © Guilherme Valle/UN Women.

Chapter 5
Rural and Peri-Urban Water Supply and Sanitation Services

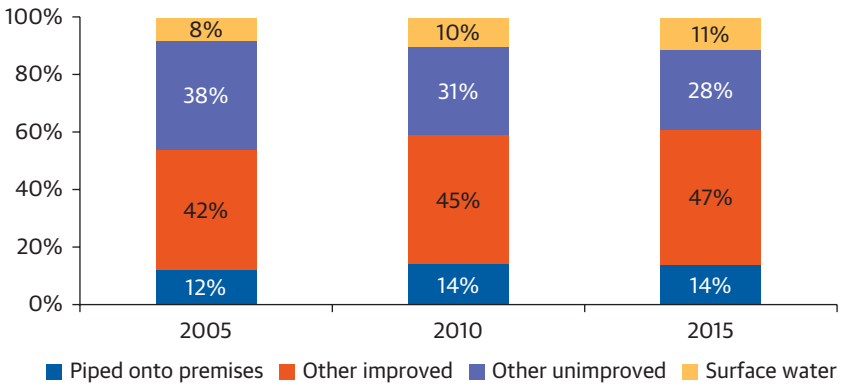
Status of Operation and Service Delivery

Rural Water Supply

Unlike in urban areas, Timor-Leste did not meet the MDGs in the rural water supply and sanitation sector. According to the JMP, total access to rural improved water supply in 2015 was 60 percent and to improved sanitation services only 27 percent (JMP 2015). The targets set out in the MDGs for water and sanitation services in rural areas were 75 percent and 55 percent, respectively. Access to rural improved water supply has increased at an average rate of only 1.2 percent per year over the last 10 years (figure 5.1). Over the last 5 years, this rate was even less at only 0.4 percent per year. Given the reduction in foreign funding, great efforts must be made to significantly increase the rate at which water supply and sanitation services in rural areas are being expanded and sustained.

Development of rural water supply systems heavily relies on financing from development partners and NGOs. In rural areas, where approximately 70 percent of the population lives, the development of water supply systems relies heavily on the support from development partners and NGOs for financing. BESIK was a program largely funded and supported by the Department of Foreign Affairs and Trade of the Government of Australia (DFAT). DFAT has provided substantial support for rural water supply and sanitation from 2003-15, but has scaled down its commitments for the sector since. National and international NGOs play an important role in rural

FIGURE 5.1. Access to Rural Water Supply



Source: JMP 2017.

WASH, with a number of international organizations also active in the sector including the United Nations Children's Fund (UNICEF), Plan International, WaterAid, Triangle, *Cruz Vermelha de Timor-Leste* (CVTL) (Red Cross), World Vision, and Child Fund.

O&M of community water supply systems are done by communities (GMF), assisted by the DNSA if larger works are required. The Decree Law No. 4/2004, Water Supply for Public Consumption, allows the government to delegate some management responsibilities for rural water supply systems to communities, either through formal GMFs or informal structures. This is complemented and strengthened by the community action planning approach (CAP) introduced by DNSA. GMFs are tasked with the day-to-day O&M of community water supply systems. If maintenance requirements of a particular water supply system are beyond the technical capacity and resources of GMFs, they will request the DNSA and SMASA assistance, but the mechanisms for them to register for assistance is generally unclear. The DNSA has limited capacity or budget to provide support to rural water supply systems.

Few GMFs are able to recover costs for basic O&M, and many are not functioning sufficiently well to collect any payment for water services. Evidence from studies has found that the capacity of communities to operate and maintain community water supply systems is limited, and the failure rate is high (as much as 50 percent within 2 years of commissioning) (ADB 2015c). Tariffs are usually between US$0.25 and US$0.50 per family per month and in several cases cover basic maintenance works. Larger repair or replacement costs, however, cannot be financed through tariffs. The primary causes of failure of the community schemes are likely to be the lack of funding for O&M, lack of replacement parts, and limited maintenance skills within communities. Whalen and Belo (2013) found in their GMF study that approximately 90 percent of GMFs formed since 2010 were at least partially functioning and that GMFs are essential for ensuring the functionality of rural water supply schemes, particularly as the system ages. However, many GMFs are struggling to organize and undertake all of their responsibilities. Most GMF members have little exposure outside of their village and have limited access to information that can support them in fulfilling their responsibilities.

Management, financial, and technical issues are the major causes of rural water supply system breakdown. Hamel's 2009 review of rural water supply sustainability in Timor-Leste found that the major causes of breakdown were issues with community management and technical problems. Addressing these issues could resolve 81 percent of the problems for nonfunctioning systems surveyed. Whalen and Belo (2013) found that post-construction support to the GMF is an essential ingredient to the success of community managed service delivery and the FPAs perform an essential support role. However, further support and resourcing for many community water management groups would

be required in the case of substantial rehabilitation and replacement.

The issues on O&M are confirmed with the PNDS technical evaluation report on 2015 that quotes:

> *Some of these EOM (operation and management teams) did not seem to be very active - we inspected many reservoirs that had not been cleaned in over a year. Most systems are not yet collecting any user fees from the villagers. We heard from several EOM that the setting and collection of fees to pay for system maintenance were being discussed at Aldeia meetings, but that no firm plans to institute a user fee had been made. It was not clear whether a GMF has been established to oversee the facilities.* (Neate and Herawati 2015)

Based on data from the Rural Water Information System (*Sistema Informasaun Bee no Saneamentu* -SIBS and Sector Planning Tool) in June 2017, 889 rural water supply systems were registered across the country. Also, based on SIBS, 84 percent of the rural *Aldeias* (hamlets) report that they have access to a water system, however only 46 percent of those have access to a water system that is always functioning. Moreover, 979 rural "aldeias" have a GMF, and from those "aldeias" with a GMF, 60 percent have access to a water system that is always functioning.

To strengthen the sustainability of water supply systems, a variety of activities are supported by NGOs at the community level. These activities range from post-construction support to communities, improving service provision through citizen engagement, and providing post construction support in selected municipalities. These activities try to strengthen the link between GMFs and municipal governments so that rural water supply is better integrated into the municipal administration agenda. These programs regularly monitor and conduct field visits to selected *Aldeias* and get direct feedback from communities of water supply and sanitation services. The task force also facilitates peer learning among GMFs, with each GMF disseminating best practices and diagnosing problems as well as developing actions to mitigate issues.

To strengthen citizen engagement, a community score card (CSC) has been introduced in selected communities to compile user perceptions on the quality of the service provider. This initiative, supported by WaterAid, targets community members during two gender-segregated community meetings, by asking each group to rank the quality of their service provided using a scale from "1" (very good) to "5" (very bad), across criteria they perceive to be important. Meanwhile, the service provider, in this case the GMF, is asked to rank the quality of the service they provide using the same criteria and scale. The scores are then consolidated and discussed at the interface meeting to arrive at a consensus. Actions are agreed for items that score lower than "3."

To support GMFs, umbrella organizations have been established in selected municipalities to provide coordinated support. In Liquiça Municipality (2010) and Manufahi Municipality (2014), associations were established to act as umbrella organizations that provide support to member GMFs. The support of these associations includes guidance to work with local government staff (FPAs) in monitoring services and collecting data. Currently the A-GMF in Liquiça has approximately 90 GMFs as members, representing around 45 percent of the total in the municipality. The association in Manufahi has 67 GMFs as members representing around 84 percent of the total GMFs. The joint process of information collection, sharing, and analysis has helped to significantly strengthen working relations between municipal government and the associations, to the extent that the local government now recognizes the added value of the work of the associations (Lockwood, Grumbley, and Casey 2017).

Rural Sanitation and Hygiene

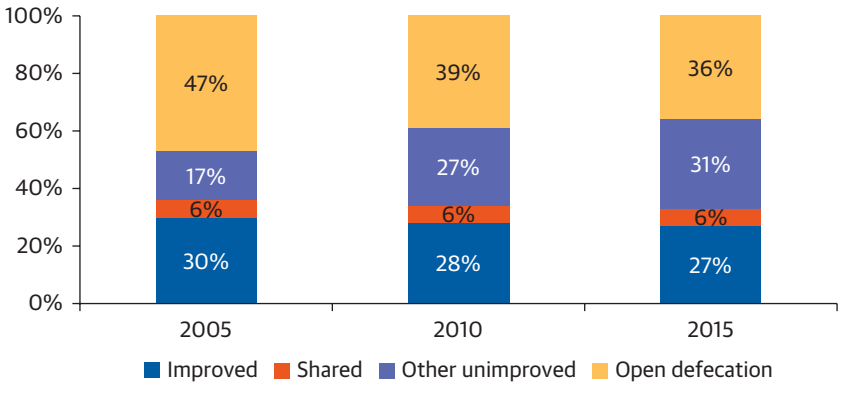
Timor-Leste also did not meet the MDGs for rural sanitation and access rates have been decreasing. According to JMP, only 30 percent of rural households had access to improved sanitation facilities in 2015, thereby not meeting the targets set out in the MDGs for sanitation services in rural areas, of 55 percent. While open defecation rates in rural areas has been decreasing over the past 10 years, access to improved sanitation facilities has grown at a very slow rate of only 0.2 percent per year (figure 5.2). In recent years, PAKSI has been expanding with a non-hardware subsidy approach to households. While the program has been comparatively successful in changing community behavior to stop open defecation, the latrines constructed by communities are mostly simple and unimproved ones. This is a typical development when progressing along the first steps of the sanitation ladder[1] but further assistance is required to help communities continue progressing up the sanitation ladder toward improved (safe) sanitation and hygiene.

The CLTS approach to sanitation was introduced in Timor-Leste in 2007 by international NGOs and has now been established as the lead approach to sanitation in Timor-Leste. In 2012, the National Basic Sanitation Policy was adopted, which establishes the MS as the lead national agency for rural sanitation and promulgates that demand-led approaches, in particular, CLTS, lead the implementation of rural sanitation with technical guidance from the MOPTC. CLTS is encapsulated within the MS's national approach to improving sanitation and hygiene practice, PAKSI.

PAKSI evolved from several years of experimenting with participatory approaches at community level and was formalized into a national program in 2012. Over the past decade, Timor-Leste has piloted different approaches to CLTS and ultimately adopted a phased sanitation approach in the National Basic Sanitation Policy. PAKSI includes a form of CLTS modified to suit Timorese conditions and cultural sensitivities for behavior change which is designed to be easier for field workers and communities to understand and support. Further contributing to the creation of PAKSI was the success of the DNSA's CAP approach to water supply development and the decision that the MS district offices should lead the process. Since 2012, BESIK has supported the MS in delivering the PAKSI program. PAKSI further includes hand washing with soap and undertook a major campaign on this topic between 2012 and 2013.

Over the past five years, PAKSI has delivered results in increasing access to rural sanitation through the use of trained facilitators, however attrition levels are high. It spread to all 12 municipalities in Timor-Leste, and to approximately 80-128 *Sucos* (villages) out of 401 rural *Sucos* (20-30 percent). Since 2012 there has been a consolidation of local NGOs implementing CLTS with both local and international NGOs leading the sector.[2] By 2016, PAKSI has trained

FIGURE 5.2. Access to Rural Sanitation Facilities



Source: JMP 2017.

approximately 200 facilitators nationwide but only 55 of them are still active.[3] Of these 55, 15 are from WaterAid, 20 from UNICEF, and 5 from PLAN and the remaining are from local NGO partners. Facilitator attrition is often the result from NGO staff moving to new unrelated jobs. Out of the 55 trained facilitators, a core group of 10–15 are classified as "super-trainers." who are highly competent trainers and CLTS facilitators. Facilitator skills have been improved through training, particularly focusing on pre- and post-triggering.[4] Five batches of trainings to improve facilitations skills involving 200 facilitators have also been held.

Aside from community triggering, institutional triggering has also been introduced to motivate participation by municipal authorities and to increase awareness on sanitation issues, showing significant results. The first institutional triggering occurred in 2015 in the Bobonaro Municipality, with a process to motivate and gain commitment from leading institutions (administrative post, *Suco*, and *Aldeia*) in mobilizing communities to participate in PAKSI. A roadmap for Bobonaro to become ODF was developed under the leadership of the municipal administrator, and BESIK/PHD, UNICEF, and World Vision are supporting the plan on the ground. The result of this triggering has been a sharp increase in access to sanitation in Bobonaro from 46 percent in 2015 to 96 percent currently. Lessons learned in Bobonaro have been disseminated through a national workshop by inviting municipal administration and other district leaderships.

A voucher system has also been introduced by the PHD program to support the communities to gain access to improved sanitation, not just to stop open defecation. PAKSI is assumed to be a successful program to change community behavior to stop open defecation. However, as reflected in the JMP report and mentioned above, most of latrines constructed by communities are unimproved, so there remains a risk that communities declared as "ODF" may slip back to practicing open defecation. Based on a study conducted by UNICEF, about 20 percent of ODF communities could not sustain their status beyond two to three years after achieving ODF status. Despite generally following a non-subsidy approach under PAKSI, a "smart subsidy" concept in the form of a voucher system to support ODF communities to move up the sanitation ladder has been developed with UNICEF and currently is being tested by the DFAT-PHD program. The intention is to provide financial support to the community to have access to improved latrines.

Peri-Urban Areas (Capital of Administrative Post)

Compared to water supply services in urban and rural areas, the service provision in peri-urban areas follows a different approach that is not as formalized as in urban areas, but requires a higher degree of investment and management than rural systems. No clear definition exists of what comprises peri-urban areas in Timor-Leste. Using a common international definition, peri-urban areas can be identified as the capital of an administrative post. A total of 65 administrative posts exist in Timor-Leste. When applying the national average proportion of urban-rural distribution of the population, an estimated 152,732 persons live in peri-urban areas (table 5.1).

Water supply services at administrative post level are managed by the municipal water supply department (SAS) although services are basic, O&M requirements are limited, and customer satisfaction is low. Findings from field visits to the administrative post of Maubara in Liquica Municipality identified very basic water services comparable to rural systems with limited operation and management responsibilities for the SAS officer, basically comprising only of switching the power on and off to distribute water to customers on a daily basis. There is no record on either the amount of water distributed to customers (no master meter exists at the main reservoir) or on the actual water usage by each customer. Any service

TABLE 5.1. Peri-Urban (Capital of Administrative Post) Population Estimation

Timor-Leste Peri-Urban Population	
Total Population:	**1,183,643**
Urban (29.5%)	349,208
Rural (70.5%)	834,435
Total population excluding Dili, Oecusse, and other municipal capitals is the total population in 65 administrative posts in the country	553,134
Administrative Post (total):	553,134
Peri-Urban (29.5%) ratio applied	**163,174**
Rural (70.5%) ratio applied	389,960

Source: Based on 2015 census data.
Note: Although no clear data and definition for peri-urban population is available, they are estimated to be located in administrative posts and were calculated by applying the national urban/rural ratio to the total population in administrative posts. Percentages are rounded and can differ from the exact number.

expansion is conducted by the customers after they receive an informal/verbal permit from the SAS. The quality of the water distribution system is often poor. Piped networks are mostly above the ground and water distribution is done unsystematically with a lack of proper maintenance for the overall facilities. Community satisfaction about the quality of service is low and consequently the willingness to pay for water services is low as well.

To improve the service quality in the capitals administrative posts would require substantial ground-up planning and investment, starting with an audit of existing infrastructure to establish an inventory of assets and their condition. Further, based on gaps in the system, it is necessary to develop a comprehensive plan to expand the system as well as to improve quality of the existing system through proper O&M as well as management according to basic corporate principles.

There is no separate program for peri-urban sanitation. The only sanitation intervention that covers peri-urban areas is PAKSI, which intends to create ODF status for all municipal residents, including those who live in peri-urban areas. In fact, people living in peri-urban areas have the benefit of better access to market where sanitation products and services are available, while other sanitation infrastructure interventions are still being focused on the municipal centers.

Financing

Although the government has allocated funding for capital investment in rural water supply through various decentralization development programs, O&M funding appears to be a lower priority. In 2015, the government allocated US$13 million for construction or rehabilitation of new water systems (an increase of about 100 percent from US$6.7 million in 2014). Funding allocated for O&M in the same year only reached US$3 million (including US$1 million for a pump maintenance program with BESIK), which is not enough to meet O&M funding needs (DFAT n.d. 9).

Similar to urban settings, rural communities are expected to invest in their own sanitation facilities. Household investments are supported by subsidies to vulnerable households and community incentives to offset some sanitation hardware cost. A total sanitation program, using a non-subsidy approach, costs approximately US$110 per household per year (BESIK 2010). Based on this cost estimate, the total budget required to reach all households without access to improved sanitation facilities in 2017

(using the 2015 annual growth rate) would be approximately US$12.25 million.

Key Rural Water and Sanitation Challenges

One of the biggest challenges to sustain and expand rural water services is the absence of funds for O&M. Financing recurrent expenditures for repairs and life cycle asset replacement from public funds is limited and only conducted on an ad hoc basis. In addition, tariffs are only collected sporadically, limiting available funding in the majority of community organizations.

While the SMASA has a staff member in each administrative post, technical and organizational capacity at the administrative post level is a constraint. This has led to delays in providing support for repairs that cannot be resolved by GMFs alone and to ineffective monitoring and reporting of service levels and sector performance. To address this issue, a systematic and comprehensive approach will need to be adopted.

Given the limited availability and affordability of improved sanitation products, other aspects of the rural sanitation approach need to be strengthened to ensure inclusive progress. Sanitation in rural areas is implemented through hygiene promotion and sanitation behavior change. But limited availability and affordability of services, specifically has a negative impact on the poor, who might not be able to improve access to safe sanitation at the same rate as higher-income households. It is therefore important to leverage the PAKSI program to strengthen the sanitation supply side through developing options for affordable sanitation products and developing financing mechanisms such as smart/targeted subsidies.

Scaling up best practices through horizontal and peer learning among municipalities. The PAKSI program has proven to be successful, once municipal leaders support the program and mobilize district resources and stakeholders. Creating peer learning events among municipalities is one alternative way to scale up the program. The event should be designed to not only share the best practices, but also as an advocacy venue to create a competitive environment among municipalities with regard to their sanitation issues.

In parallel, coordination between the MS and DNSB needs to be improved. This would ensure more effective interventions, especially in peri-urban areas so that behavior-change messages and infrastructure can be delivered in synergy for an overall better outcome.

Notes

1. The simplified concept of the sanitation ladder refers to the gradual improvements in access to sanitation services that a normal household would go through, starting from becoming ODF (lowest status), moving to an unimproved pit-latrine, then to an improved pit latrine, to an on-site septic tank, to a communal system and finally to a centralized, piped wastewater collection and treatment system.
2. http://www.communityledtotalsanitation.org/country/timor-leste-east-timor.
3. http://www.communityledtotalsanitation.org/country/timor-leste-east-timor.
4. Triggering is awareness raising at the community level through analysis of their sanitation behavior and facilitating of collective action toward an ODF status.

Sedimentation in the Comoro river. © Martin Benedikt Albrecht/World Bank.

Chapter 6
Roadmap—Priority Responses and Way Forward

The following proposed priority options represent the results of the first phase of the engagement, which aimed at undertaking an assessment of the water sector and identifying specific options of how existing challenges can be addressed. The priority actions build on the key challenges elaborated in the previous chapters and were derived through a consultative process that included discussions with government officials from different ministries as well as sector stakeholders and development partners. They are intended to be a foundation for a future sector dialogue in a second phase to elaborate these options further, including an estimation of costs. Tables 6.1 to 6.6 provide an overview of the proposed priority options.

Roadmap Overview

TABLE 6.1. Overview Priority Actions for Water Resources—Policy, Regulations, and Strategies

Activity	Description	Expected Outcome	Timeline
Develop a national strategy for the development and management of water resources	• Determine water resources availability and water demand under a range of water demand and climate scenarios; conducted at a national scale, with downscaling to priority areas. • Determine the sustainable yield of water resources, including the identification trade-offs focusing on water used for traditional and customary uses and by the environment. • Investigate options to provide long-term secure water for public water supply and other water resources developments, based on new studies that identify specific water resources for development. • Based on the above analysis develop investment options and priorities for the development of Timor-Leste's water resources to meet its water needs.	Provide the necessary data and information to support effective investment decisions on water resources development for water supply for domestic, agricultural, and industrial uses. Provide a strong foundation for developing water supplies that are more resilient to climate change and climate variability.	Short term (1–5 years)
Monitoring and early warning systems to reduce the vulnerability of communities	• Enhance the exiting hydrological monitoring network for water resources to align water supply and sanitation needs more closely. • Establish monitoring of the water supply system to support the provision of safe, secure, and sustainable water supply. • Establish monitoring and alert systems for early warning of climate-driven events that have an impact on water management, such as drought and flood.	Protect communities, livelihoods, and the economy from the impact of water-related disasters. Improve the safety of water resources development infrastructure.	Short term (1–5 years)
Improving the certainty of rights to access water	• Support the completion of regulations, technical, and operational guidelines for the establishment of the water entitlement system, water borehole licensing, construction, and water bore driller accreditation. • Establishing monitoring and compliance of water entitlement users.	The government will be managing the nation's water resources assets more sustainably and the rights of all water users to access water will be better protected, giving greater certainty of water supply.	Short term (1–5 years)

table continues next page

TABLE 6.1. Overview Priority Actions for Water Resources—Policy, Regulations, and Strategies (continued)

Activity	Description	Expected Outcome	Timeline
Strengthen the service delivery model for existing irrigation infrastructure	• Develop a strategy for the operations, maintenance, and funding for existing irrigation infrastructure including financing models and a framework of fees and charges to cover costs. • Provide professional development and benchmarking of WUAs.	The project will improve the functionality of irrigation schemes by improving the technical skills of WUA's and the funding for the O&M of irrigation infrastructure. As a result, irrigation infrastructure will be more sustainable and will contribute to the targets of national self-sufficiency in food production.	Short term (1–5 years)
Improved water sector coordination and integrated planning models	• Carry out pilots of integrated models for water development. At a peri-urban level, test delivery of improved integration of water resources data into investment decisions for water supply and sanitation and irrigation water needs. • Integration of rural water supply development and watershed conservation program/water resources conservation program.	This project would improve intra-government coordination on water supply development by improving the policies, systems and procedures for coordination. This will result in improved delivery of water services in Timor-Leste and contribute to the delivery of national and international development commitments.	Short term (1– 5 years)

TABLE 6.2. Overview Priority Actions for Water Resources—Service Delivery

Activity	Description	Expected Outcome	Timeline
Invest in tube well irrigation schemes	• Investigate opportunities for the optimization of surface water abstraction and the development of tube well irrigation schemes. • Improve the market value chain for irrigation, including access to famer support services.	Higher productivity of farm systems, diversified cropping, and improved nutrition outcomes	Short term (1–5 years)

TABLE 6.3. Overview Priority Actions for Water Resources—Institutional Development

Activity	Description	Expected Outcome	Timeline
Integrated basin development pilots for catchment management and water resources protection	In selected (sub)basins covering 2–3 *Sucos*, the program will • Investigate and determine existing water availability, water use, and use rights • Investigate the potential for enhancing water management for water supply and sanitation, agriculture, ecosystems, and so on also in the context of the bigger basin • Through participatory planning processes with users and government agencies and based on regulations: (a) decide on a governance structure for the sub-basin; (b) map and agree on present water-use rights and water-sharing arrangements; (c) identify water management and safety issues and further study options for enhancement of water management levels; (d) agree on a plan for water resource protection and erosion control through agriculture practice improvement, social forestry and household fuel management, to be leveraged by enhanced water supply and sanitation services and improved accessibility (roads and all-weather tracks) • Development of a multiyear investment plan using participatory implementation approach Preconditions: Enabling legal framework (pending approval), political willingness to invest in local institutions, firm agreement, and commitment on decentralized funding and assurance of O&M funding of government assets.	Protected and developed water resources providing communities with higher levels of water management, irrigation, water supply, and sanitation services and increased productivity of households. More (climate change) resilient system through established institutional governance structure on sub-basin levels and established and strengthened local government services.	Short to medium term (1–7 years)

TABLE 6.4. Overview Priority Actions for Water Supply and Sanitation—Policy, Regulations, and Strategies

Activity	Description	Expected Outcome	Timeline
Strengthen and expand existing PAKSI initiative for broader outcomes	• Develop guidance and manual for intervention beyond access to improved sanitation outcomes (such as hand washing with soap, domestic solid waste, and food and drink handling at the household level) • Develop enhanced monitoring instrument to measures key indicators including access to improved sanitation and other related means • Strengthen the regulatory framework for wastewater systems, including constructions guidelines	MS implements the five pillars of PAKSI. MS has an improved monitoring instrument to measure key indicators in sanitation programs. DNSB implements regulation within the wastewater sector.	Short term (1–5 years)
Water sector service delivery benchmarking	• Giving priority to the SIBS and SIDJRI and improvement of the information value chain. • Develop WSSI for benchmarking the urban water supply services. • Develop water services performance indicators to benchmark the delivery of rural water supply. • Develop a benchmarking and possibly competition for managing water supply system. • Review the regulatory framework of the water supply sector.	With better information and data on the water resource and the performance of the water services delivery, the sector will be able to manage its resources better and make more effective investment decisions to improve water service delivery. DNSA implements regulation within the wastewater sector.	Short term (1–5 years)

TABLE 6.5. Overview Priority Actions for Water Resources—Service Delivery

Activity	Description	Expected Outcome	Timeline
Expanding and sustaining rural and peri-urban water and sanitation services	• Infrastructure audit and develop investment options for public water supply and sanitation to achieve national and international commitments. This includes updating the GMFs profile and registering and benchmarking their performance. • Pilot finance options for rural water supply and sanitation (financing portion from various sources including public [central/municipal], development partners, and customers through application of tariff for services). Experience from other countries could be used as reference.	• The updated status of water supply system functionality, and availability information of their infrastructure quality and investment options, including updated and registered GMFs' profiles. • The availability of sanitation market information and different service provider models for both sanitation and rural water supply system management.	Short term (1–5 years)

table continues next page

TABLE 6.5. Overview Priority Actions for Water Resources—Service Delivery (continued)

Activity	Description	Expected Outcome	Timeline
	• Investigate tariff framework options and means of collecting tariffs and delivering recovered fees and charges back to the water delivery.Assess market opportunities for sanitation products and services in rural areas • Assess market opportunities for sanitation products and services in rural areas. • Test and pilot smart subsidy to support, particularly for vulnerable households to gain access to improved sanitation.	• Policy inputs and recommendation for implementation of smart subsidy for sanitation.	
Develop new safe, secure, and sustainable water sources	• Based on new information invest in the development of new water sources for the provision of safe, secure, and sustainable water supplies.	The construction of new safe, secure, and sustainable water supplies will give Timor-Leste a strong foundation for the achievement of national and international development commitments related to water. It will also have a substantial impact on the health and well-being of Timor-Leste's citizens.	Long term (5+ years)

Invest in water supply and wastewater services	• Improvement of selected urban water supply and systems:
	  • Establishment of zoning system for the distribution network to control leakage
	  • Investment program to reduce NRW
	  • Construct new water supply system and rehabilitate, and/or expand the existing water system
	• Construct new water supply systems and rehabilitate and/or expand existing water systems in rural and peri urban areas.
	• Application of smart subsidy to help vulnerable households gain access to improved sanitation.
	• Support development of water safety planning for water supply systems.
		Improvement of overall urban water supply services. NRW is reduced to the acceptable level and increased urban water supply access/household connections.
		Improved water system quality equipped with water safety plan program and increased access of water supply service for rural and peri-urban (administrative post) areas.
		Well-targeted subsidy program for sanitation implemented.
			Medium term (3–5+ years)

Invest in wastewater systems	• Develop and pilot appropriate and scalable wastewater treatment technology for urban and prei-urban areas. • Construct new wastewater systems and rehabilitate and/or expand existing wastewater in urban and peri-urban areas. • Implement wastewater treatment in priority areas and develop the institutional systems, including the O&M to support their sustainability.	Increased access to improved sanitation with impacts to health, education and nutrition. These outcomes will have an accrued positive impact on the economy.	Medium term (3–5+ years)

table continues next page

TABLE 6.5. Overview Priority Actions for Water Resources—Service Delivery (continued)

Activity	Description	Expected Outcome	Timeline
Application of service delivery models to improve the functionality and management of water systems as part of municipal development program	• Integrate the rural water service program into a municipal development cycle to ensure that water supply and sanitation is a sector priority for municipal administration with clear targets and to develop a municipal rural water profile and strategy. • Strengthen O&M program for water services such as through financing match (options) for O&M Pathway (O&M Roadmap) and creation of rural water supply chain: spare parts, pump system, borehole contractor, O&M operators, and application of tariff setting for rural/peri-urban water supply. • Develop, pilot, and implement a tariff framework, including collection systems for the delivery of water services in both urban and rural areas. • Strengthen citizen engagement initiative for rural water development through various feedback and participation mechanisms.	• The municipal administrators have the capability to design rural water service program and provide adequate budget and develop their strategy to achieve the water supply service targets • The MOPTC and MSTAM determine the financing option and deliver improved O&M programs for rural water systems including the development of rural water supply chains • The DNSA has tested the citizen engagement initiative and feedback mechanism and is ready to implement it nationally	Short term (1–5 years)

TABLE 6.6. Overview Priority Actions for Water Resources—Institutional Development

Activity	Description	Expected Outcome	Timeline
Water sector capacity development	• Capacity development programs to support water sector human resources, organizational capacity, and leadership and governance capacity. Develop staff performance indicators for the water sector. • Development of water supply training center for urban and rural area, to strengthen performance of water supply operators, services provider, including urban water utilities and GMFs. • Technical assistance to support program for decentralization development program/village development program (PDD/PNDS).	• The MOPTC and municipal administrators gain measurable improvement capacity development program in water sector. The key performance indicators for water sector human development programs has been tested and are ready to be implemented, • Regional training center for water supply system are established and operationalized in target areas, • The MOPTC has better cooperation and measurable performance with decentralization development program/ village development program related to the water supply infrastructure development.	Short term (1–5 years) to medium term (more than 5 years) for development of training center

Realizing the Roadmap

The proposed priority responses provide a strong framework for improving water management and sustained service delivery in Timor-Leste. The strategic studies and analyses, infrastructure, and measures to improve institutional and management capacity are estimated to be implemented with a phased approach over the next 5 to 10 years.

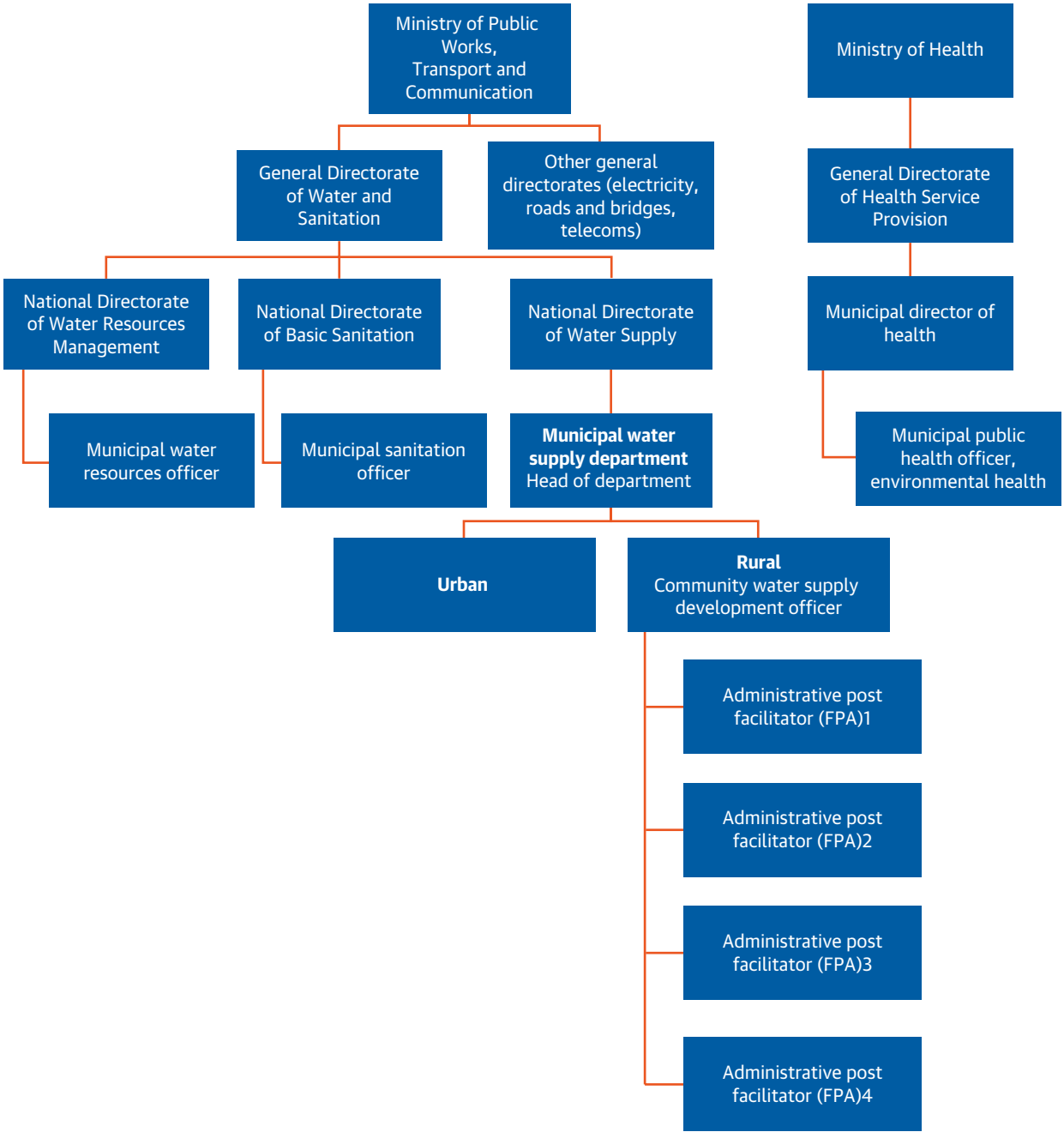
Public sector spending has been the key driver of growth and is likely to continue over the short term. However, dependency on the oil sector and its volatility coupled with increasingly scarce public and concessional resources calls for a range of options to finance and deliver infrastructure. The priority interventions are structured to help identify opportunities that can minimize the public debt burden and crowd in commercial capital, while delivering sustainable and affordable infrastructure services.

The sector assessment and roadmap provide a structured diagnostic to look at the structure of the water sector, the legal and regulatory framework, and governance arrangements. These inform the framework for decision making required to improve infrastructure access and performance. Systematically addressing the conditions for facilitating investments, while advancing the enabling environment through support to the policy framework, and prioritizing reforms that remove binding constraints will help expand infrastructure finance and delivery options over time. Realizing the roadmap will require a sustained commitment from a range of government and other stakeholders but has the potential to improve water management and provide the foundations for a more sustainable, diverse economy, and prosperous nation.

Appendix A
Organigram of the Water Sector

Institutional arrangements for water supply, sanitation, and water resources management in the MOPTC as well as in the MS.

FIGURE A.1. Organigram for Water Supply and Sanitation Service Delivery in Timor-Leste



Appendix B
Water Sector Targets

TABLE B.1. Legal Documents Related to Water and Sanitation Development

Title	Description	Status
Strategic Development Plan 2011–30	The plan provides water supply coverage targets for Timor-Leste. In particular, stating the target of having "…a safe piped 24-hour water supply to all households" by 2030.	Current
Decree Law No. 3/2016 on The Statutes of the Municipal Administrations and Municipal Authorities	Municipal administration and the municipal authorities are required to ensure the conduct of administrative functions of the state through the implementation of policies and government programs at the local level, for the promotion and guidance of economic and social development through the provision of goods and public services in the municipalities, including health, water, sanitation, and environment	Current
National Basic Sanitation Policy, 2012	The policy objective is to reduce mortality and morbidity and bring about social, economic, educational, and environmental gains for all through the safe elimination of harmful waste from the environment and the practice of healthy behaviors.	Current
National Drinking Water Quality Standards and Monitoring Guidelines, 2011	This document provides details of the methods and procedures for routine sampling and testing of water quality and the standards which apply. The standard is issued by the MS but designed to be used by the key stakeholders in water supply for both urban systems managed by government and rural systems managed by communities.	Current
Decree Law No. 5/2011 Environmental licensing	Establishes requirements for all developments to undergo an assessment for environmental impact. Large water supply, sanitation, and water resources development projects are affected by this law.	Current
Decree Law No. 4/2004 on Water Supply for Public Consumption	The key objective of the decree is to guarantee people of Timor-Leste have access to adequate, safe, and sustainable domestic water supply services.	Current
Ministerial Diploma No. 1/2004 Table of Tariffs	Outlines a table of tariffs for the consumption of public water supply	Current
Decree Law National Water Resources Management	This Decree Law sets out the institutional framework for water resources; water resources management planning; use of water resources; requirements and conditions for water abstraction; flood, drought, pollution, safety and contingency protection plans; compliance and emergency, inspection and monitoring, and offences and sanctions.	Final Draft
National Water Resources Policy, 2017	The policy sets out the government's responsibilities, intentions, and objectives for water resources management. The policy provides a general framework and direction for the National Water Resources Management Policy until 2030, and indicates early implementation priorities (2015–20).	Final Draft

table continues next page

TABLE B.1. Legal Documents Related to Water and Sanitation Development (continued)

Title	Description	Status
National Policy in Public Water Supply, 2017	The policy (a) clarifies ownership of public water supply assets; (b) directs public water supply investment activities; (c) defines the government's objectives for expanding and sustaining access to public water supply; (d) provides guidance on the policy instruments, operational guidelines, and standards, and financing rules; and (e) clarifies institutional roles and responsibilities in public water supply planning, delivery, and management in Timor-Leste.	Final Draft
Decree-Law n.5 / 2009 Regulation of licensing, commercialization and quality of drinking water.	This regulation establishes procedures for the licensing related to bottled water business intended for human consumption. The provisions are applicable to bottled water production, excluding the public water supply system provided for under Decree-Law No. 4/2004.	Current
Diploma ministerial n.1/2009 de 5 de Outubro – Fiscalização ao sistema de abastecimento de água	Regulizes water supply and sanitation services, ensuring economic development;	

TABLE B.2. National Policy Objectives and Targets for Water in Timor-Leste Compared to SDG No. 6 for Water

SDG 2030	SDG 2030 Subtargets	Strategic Development Plan 2011-30		National Policy Objectives of Timor-Leste for Water and Sanitation
		Medium Term (2020)	Long Term (2030)	
Goal 6. Ensure availability and sustainable management of water and sanitation for all	6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all.	• Dili and 12 municipal centers will have safe piped 24-hour water supply to households (priority given to Baucau, Manatuto, Lospalos, Dili, and Suai). • In rural areas, water systems will be installed. • Provide clean piped water to all government schools by 2020.	• All citizens will have access to improved water supply by 2030.	To provide equitable access to adequate, safe, and sustainable water services at an affordable cost to all citizens guaranteeing at least their vital human needs, and to institutional and commercial and industrial uses. (pending approval)
	6.2: By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.	• 90% of MS buildings will have access to electricity, water, and basic sanitation.	• All citizens will have improved access to sanitation by 2030. • All municipalities and administrative posts will have appropriate sewerage systems.	To reduce death and disease and bring about social, economic, educational, and environmental gains for all through the safe elimination of harmful waste from the environment and the practice of healthy behaviors.

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TABLE B.2. National Policy Objectives and Targets for Water in Timor-Leste Compared to SDG No. 6 for Water (continued)

SDG 2030	SDG 2030 (sub targets)	Strategic Development Plan 2011-30		National Policy Objectives of Timor-Leste for Water and Sanitation
		Medium Term - 2020	Long Term - 2030	
	6.3: By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater, and substantially increasing recycling and safe reuse globally.	• DSDMP • Sewerage collection system in Dili • Community latrines in rural areas	• All administrative posts will have improved drainage systems.	Draft of Decree-Law.
	6.4: By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity.	–	–	–
	6.5: By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate.	–	–	To promote the coordinated planning, development, and management and protection of the nation's water resources, to optimize social, economic, and cultural benefits without compromising the sustainability of essential water-dependent ecosystems and the environmental benefits which those ecosystems provide for people. (pending approval)

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TABLE B.2. National Policy Objectives and Targets for Water in Timor-Leste Compared to SDG No. 6 for Water (continued)

SDG 2030	SDG 2030 (sub targets)	Strategic Development Plan 2011-30		National Policy Objectives of Timor-Leste for Water and Sanitation
		Medium Term - 2020	Long Term - 2030	
	6.6: By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers, and lakes.	—	—	—
	6.a: By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programs, including water harvesting, desalination, water efficiency, wastewater treatment, recycling, and reuse technologies.	—	—	—
	6.b: Support and strengthen the participation of local communities in improving water and sanitation management.	—	—	—

Note: — = not available; DSDMP = Dili Sanitation and Drainage Master Plan; MS = Ministry of Health.

Appendix C
Development of Lakes and Springs as a Water Resource

Lakes in Timor-Leste are generally small and/or unsuitable for augmentation to create additional water storage. Most lakes in Timor-Leste are small, being less than 1 km^2 and are located along the coastline. A few larger lakes exist at higher altitudes, such as Lake Iralalalu and Seloi Kriak Lake (DNCQA 2012). These larger lakes are generally located in remote areas away from population centers and/or their geographical setting creates other limitations on their appropriateness for development.

While springs are widespread in Timor-Leste the development potential of these resources is limited as many are already in use for community water supplies.

In Timor-Leste, springs are generally confined in distribution to localized and fissured karst aquifer systems and take many different forms ranging from high to low permanent to perennial flows. In localized aquifers, discharge rates are typically a few liters per second or less, while in springs venting from fissured karst aquifers discharge rates can be up to hundreds of liters per second (see Table C.1). The water resources from many of the more productive springs have already been developed by rural communities as sources of water supply to households or for irrigation, as historically these are the locations that communities have settled in.

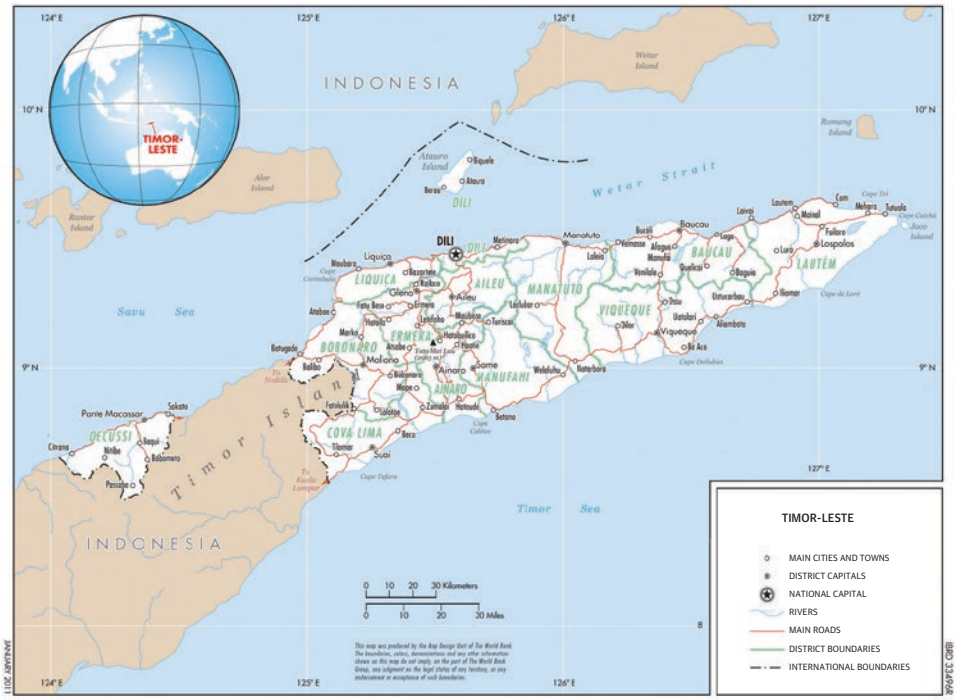
TABLE C.1. Examples of Spring Yield and Associated Hydrogeology from Timor-Leste

Spring name	Hydrogeology	Flow (l/s)	Municipality
Merabati Spring	Fissured karst	280	Same
Uailia Spring	Fissured karst	40	Baucau
Loi Huno Spring	Fissured karst	60	Viqueque
Assor	Localized fractured rock	0.1	Ermera
Makoke	Localized confining unit	0.8	Bobonaro
Boralara	Localized confining unit	3.52	Bobonaro

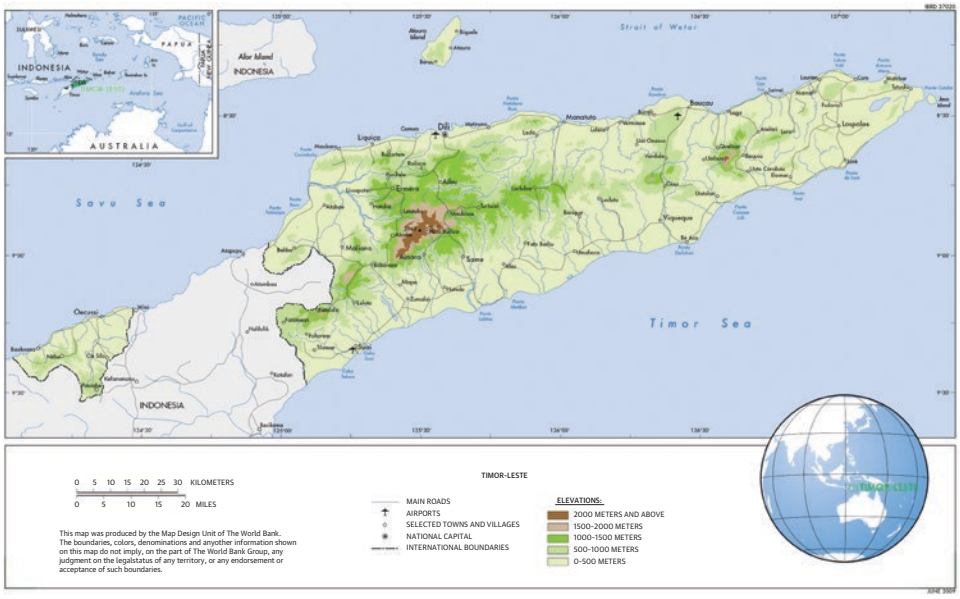
Source: National Directorate for Water Quality and Control (DNCQA) (2008) unpublished dataset of spring yields.

Appendix D
Maps of the Republic of Timor-Leste

MAP D.1. Political Map of Timor-Leste



MAP D.2. Topographical Map of Timor-Leste



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