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Craig McVeigh, water resource advisor in Timor-Leste

Securing groundwater

This document is intended for decision-makers in Timor-Leste with an interest in water resources, climate change, development and primary industries.

The Australian Government’s **Pacific Adaptation Strategy Assistance Program (PASAP)** assessed the impact of climate change on groundwater resources in Timor-Leste and identified a range of appropriate adaptation responses.

Water science helps secure groundwater for Timor-Leste

The people and economy of Timor-Leste rely heavily on groundwater for drinking water, and agricultural activities in urban and rural areas.

The Timor-Leste Government recognises that if it is to improve its population’s access to safe drinking water over the long term, it needs to understand how climate change will affect its groundwater resources.

Water science

What is groundwater?

Groundwater is water that has seeped into the ground and collects in rocks and soil. The spaces where it collects underground are called *aquifers*.

Globally, the amount of water underground greatly exceeds the amount of water in rivers and lakes. Many people around the world rely on it as their primary source of drinking water.

What affects supplies?

Rainfall and temperature

In Timor-Leste, groundwater is replenished by rainfall during the wet season (December–May). During droughts and low-rainfall periods, surface water evaporates quicker than it can seep through the ground into aquifers.

Extreme rainfall events—which are projected to become more intense due to climate change—cause flooding, which flushes soil and pollutants into surface water and groundwater. Intense rain can also run off too quickly for it to seep into the ground to recharge the groundwater.

Sea-level rise

Aquifers close to coastal areas will be vulnerable to salt water intrusion as a result of sea-level rise, which has been observed at 9 mm per year in Timor-Leste since 1993.

Surface water

Almost all surface water supplies—rivers, lakes, wetlands and estuaries—connect with groundwater. This means that using water from rivers and lakes can affect groundwater supplies and, similarly, using groundwater can impact water supplies in rivers, lakes or wetlands.

Surface water is also vulnerable to faster evaporation during warmer temperatures and extreme heat days. The climate in Timor-Leste is predicted to become 1.5 °C warmer by 2050 and have more extreme heat days.

Growing population

Timor-Leste's 1.1-million population is expected to triple by 2050. This will increase demand on water supplies and increase the risk of water contamination from waste, development and human activities. The impacts of climate change will exacerbate the nation's rapidly growing development issues.



Surface water: People who live in mountainous areas of Timor-Leste channel mountain spring water to their communities. Springs are where groundwater surfaces through the earth's surface.

Research in Timor-Leste

Research has shown that access to freshwater sources throughout the Pacific region is highly challenging, due to extremely varied rainfall patterns and large differences in island geology.

Timor-Leste is dominated by a steep, mountainous ridge that divides its ecology into northern and southern areas. The highest point is 3000 m above sea level. This geographic divide means rainfall figures vary across the country. Floods and landslides are common hazards.

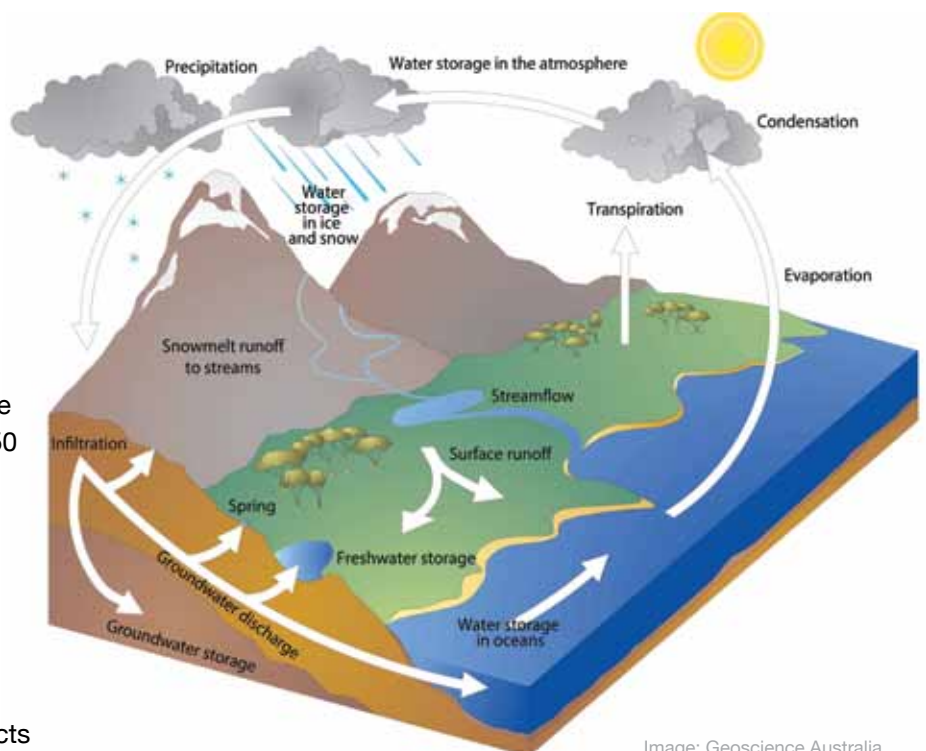


Image: Geoscience Australia

Water cycle: Groundwater is located beneath the earth's surface and is recharged from surface water.

National supplies

Measuring supplies

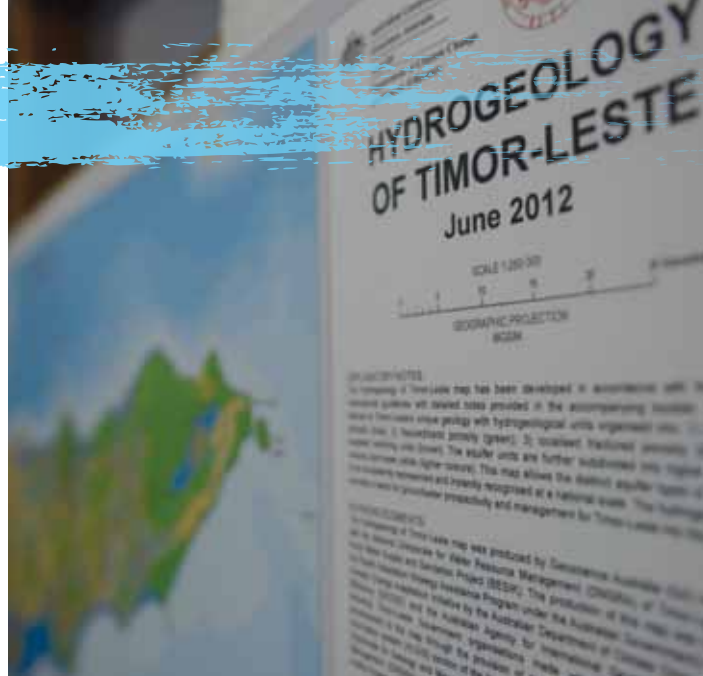
The Australian Government funded research in Timor-Leste, under the Pacific Adaptation Strategy Assistance Program (PASAP), to find out how the impacts of climate change—sea-level rise and changes in rainfall patterns—will impact on the nation's coastal and mountain aquifers.

It was also necessary to improve Timor-Leste's national understanding and management of groundwater, in light of the impacts of climate change.

To do this, Timor-Leste's national water managers and Australian water scientists produced:

- » a national hydrogeological framework that outlines how to collect, categorise, map and monitor groundwater
- » a national hydrogeological map, the first of its kind, that helps agencies to identify aquifers and improve development planning
- » measurements of groundwater flow and quality
- » training programs for how to monitor groundwater, collect and analyse data, and create and use hydrogeological maps.

Researchers have discovered that areas where groundwater supplies are most vulnerable—Baucau, Dili and Liquiça—are all along the northern coastline where rainfall is low and populations are increasing.



Hydrogeological map: The new hydrogeological map developed for Timor-Leste shows the type, size and location of aquifers under the ground, indicating where usable groundwater is likely to occur.

The hydrogeological map can be used to:

- » provide a baseline to monitor and assess the effects of climate change on groundwater
- » help design programs that monitor groundwater quality and quantity
- » assist with planning and managing rates of water extraction
- » help with calculating sustainable use now and in the future.



'By having a sound understanding of water resources we are able to increase access to people all year round and also look at how we can sustain those water resources that exist, particularly with population increases and climate change.'

Joao Jeronimo, Directorate General for Water & Sanitation Services, Ministry of Public Works



'The greatest thing about the hydrogeological map is it tells us the location of groundwater sources and their potential yield. This provides us with a baseline measurement for our monitoring networks and allows us to manage for any changes.'

Craig McVeigh, water resource management advisor for BESIK, Timor-Leste's rural water supply and sanitation program

Future framework

Managing supplies

Under the new national hydro-geological framework, strategies for managing groundwater supplies include:

Training water managers

- » train water managers to regularly assess and monitor resources
- » develop a groundwater monitoring program
- » integrate groundwater and surface water management
- » develop policies and legislation to provide awareness and support to local governments, practitioners and communities.

Building new infrastructure

- » pipe water closer to communities
- » monitor and manage aquifer recharge
- » build environmentally sensitive infrastructure that will not impact natural recharge.

Monitoring change

Monitoring groundwater provides data on its quality and quantity, and is an integral part of water management. Monitoring can:

- » establish the baseline quality of groundwater in aquifers
- » assess any change in storage and quality of water over time
- » investigate land-use change and its impact on recharge rates
- » predict how recharge will be affected by natural climate variability and over-extraction.

Ideally, monitoring should be carried out regularly where groundwater is extracted, particularly in areas vulnerable to salt water intrusion. Early detection of any changes can help maintain water quality.

People who monitor water can combine their data with climate data to make projections about water supply, and make more informed water management decisions during extended dry seasons.

Next steps

Timor-Leste is committed to protecting its groundwater by:

- » assessing the vulnerability of coastal groundwater resources currently affected by sea water intrusion
- » filling in groundwater knowledge gaps using the new hydrogeological map and measurements
- » developing groundwater monitoring networks
- » developing guidelines that support informed monitoring of groundwater
- » developing national policies and programs to foster best practice management
- » raising public awareness about groundwater and its use as a water supply.



‘We enforce *Tara Bandu* (traditional laws) in our *suco* (village) to protect the water from contamination and monitor how much is taken.’

Alyairo Moritz, Chief of the *suco* Dato in Liquiça province



‘The support we have received is crucial for protecting Dili’s drinking water and health into the future. I’ve learnt how to collect [water] data and use it to improve our knowledge of Dili’s groundwater resources.’

Osorio Belo Da Piedade, Chief of Department of Water Resources Management, National Directorate for Water Control and Water Quality, Ministry of Public Works

Climate science

Climate in Timor-Leste

Timor-Leste has a tropical climate with two distinct seasons: wet season (December to May) and dry season (June to November).

Total annual rainfall varies across the country. It ranges from 1000 mm on the northern coast, to 1500–2000 mm in the central highlands, and over 2500 mm in the higher altitude areas in the west of the country.

People frequently experience water shortages in Timor-Leste, typically during dry seasons and drier-than-average years. Total annual rainfall and dry-season rainfall has noticeably decreased over the last 60 years.

The warmest temperatures are recorded during March and November. July is normally the coldest month.

Climate projections

Scientists have projected the following climate changes for Timor-Leste:

- » continued rise in sea levels
- » increasing air and sea temperatures
- » more very hot days
- » continued ocean acidification
- » more extreme rainfall events.

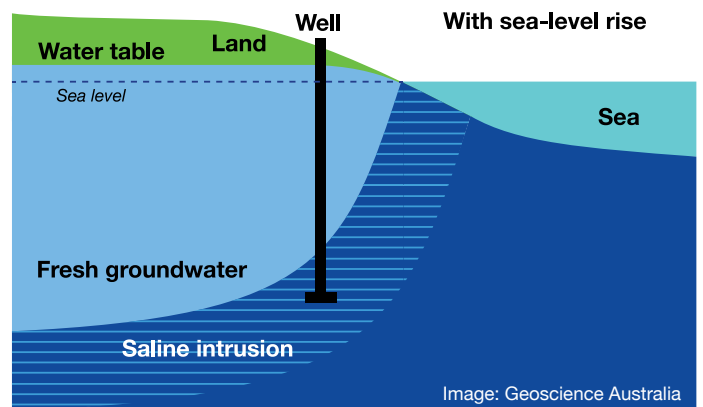
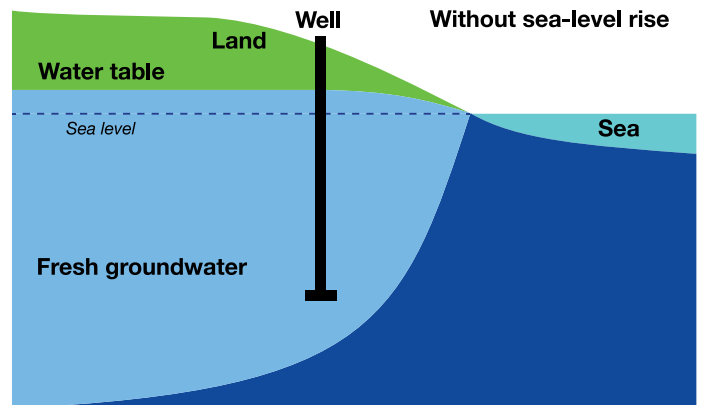


Image: Geoscience Australia

Sea-level rise: Increases in sea level are likely to cause sea water to infiltrate freshwater aquifers, which will make the water used for drinking and agriculture more saline.



‘Having a conversation is an effective way to communicate complex concepts surrounding climate change.’

Sam Bacon, climate change advisor, Seeds of Life, Dili



‘Since our village had a water tap installed, I no longer have to walk two hours each day to fetch water. I can now spend more time with my family and in my garden.’

Carmelita da Cruz, resident in the Lullibaba suco, Liqueiça

Fact file

Timor-Leste comprises the eastern part of the island of Timor, which lies to the east of the Indonesian archipelago in Southeast Asia.

Its population is about 1.1 million, and is growing by 2.4 per cent each year. Most people live in the capital city Dili. Rapid population growth is putting pressure on infrastructure, planning, development and natural resources. More than 64 per cent of people lack reliable food sources. Fifty per cent lack reliable drinking water.



Source: CIA

Timor-Leste

Population: Approximately 1.1 million and predicted to triple by 2050.

Area: Approximately 15 000 km². The country is divided into 13 administrative districts. The capital (and largest) city is Dili, where the majority of the population lives and works.

Geography: A mountain range divides the north and south coasts; some peaks are close to 3000 m high.

Education: Literacy and education levels are low; half of the population is illiterate.

Economy: Low- to middle-income economy that continues to suffer the after-effects of decades-long conflict that damaged infrastructure and displaced hundreds of thousands of people. Oil and gas deposits are the largest source of revenue.

Exports: Major exports include coffee, vanilla, coconut, sandalwood and marble.

Agriculture: Major crops include coffee, rice, maize and cassava. Farming is mainly subsistence.

Climate: Tropical climate, with little variation in seasonal air temperature. In Dili the temperature in the warmest months is about 2.5 °C warmer than those in July. There is a marked wet season from December to May. For most of the wet season, average monthly rainfall is above 100 mm. During the dry season it is less than 30 mm per month.

More information

The Australian Government's **Pacific Adaptation Strategy Assistance Program (PASAP)** assisted 15 Pacific island countries to assess their vulnerability to climate change and incorporated adaptive measures into planning and development.

For further information on Timor-Leste groundwater or other PASAP projects, go to www.tiny.cc/t5axxw or contact InternationalAdaptation@climatechange.gov.au

Photography: Econnect Communication



Australian Government

Department of Industry, Innovation, Climate Change,
Science, Research and Tertiary Education

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