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# TIMOR-LESTE SUB-NATIONAL CASE STUDY



## Authors

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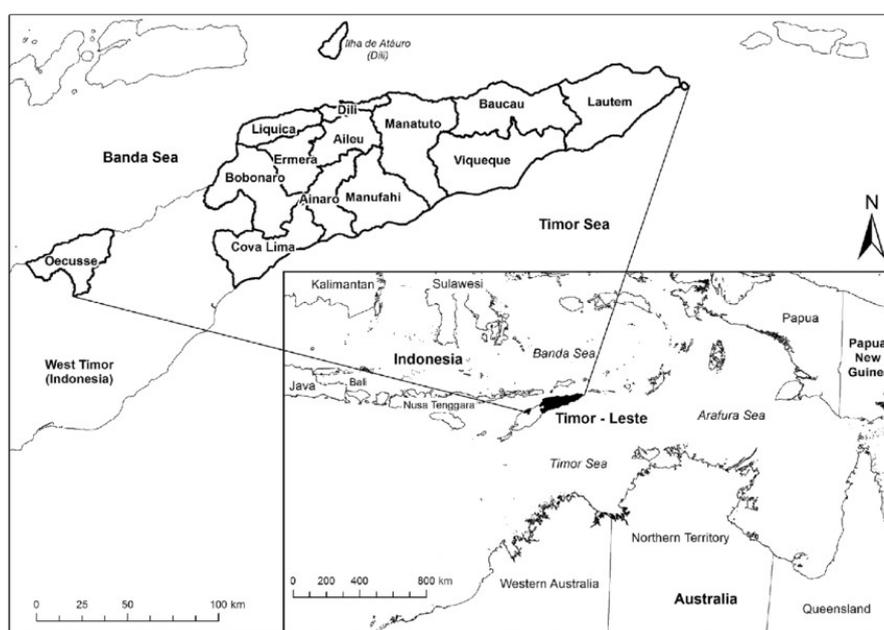


# Summary

The COVID-19 pandemic has highlighted the importance of water security in a country's ability to respond. Water security across the Indo-Pacific is variable and complex and represents only some of the factors that influence risks related to COVID-19. This case study creates a record of the water-related COVID-19 risks to better understand and prioritise what water investments could be made to reduce a country's vulnerability to respond to COVID-19 impacts in the short-term and recover and rebuild in the medium- to long-term. Results are based on the findings of the COVID-19 Water Security Risk Index for the Indo-Pacific region, an initiative of the Australian Water Partnership in support of the Australian Government's *Partnerships for Recovery* policy. The Risk Index builds upon the Asian Development Bank's Asian Water Development Outlook as well as public health risk frameworks and indicators.

To complete this work, COVID-19 risk has been defined as the risk of community-wide impacts caused by an outbreak of COVID-19, including elements of health, economics, and water security. The Risk Index deliberately uses a COVID-19 risk framework that considers all key factors that have a bearing on a country's overall risk from COVID-19, distinguishing those that influence a country's ability to: 1) Stay alert to pandemics in other countries; 2) Prevent/delay 'entry' of the virus across its borders; 3) Contain community transmission of the virus once it has penetrated its borders; 4) To treat those infected with the virus; 5) To mitigate subsequent substantial outbreaks of COVID-19 via immunity; and 6) To recover from the impacts of a COVID-19 outbreak. It is within this broad contextual framework that those factors related to water security in various ways are highlighted. This approach allows for the water-related interventions most likely to reduce a country's risk from COVID-19 to be identified at any given 'phase' of the epidemic.

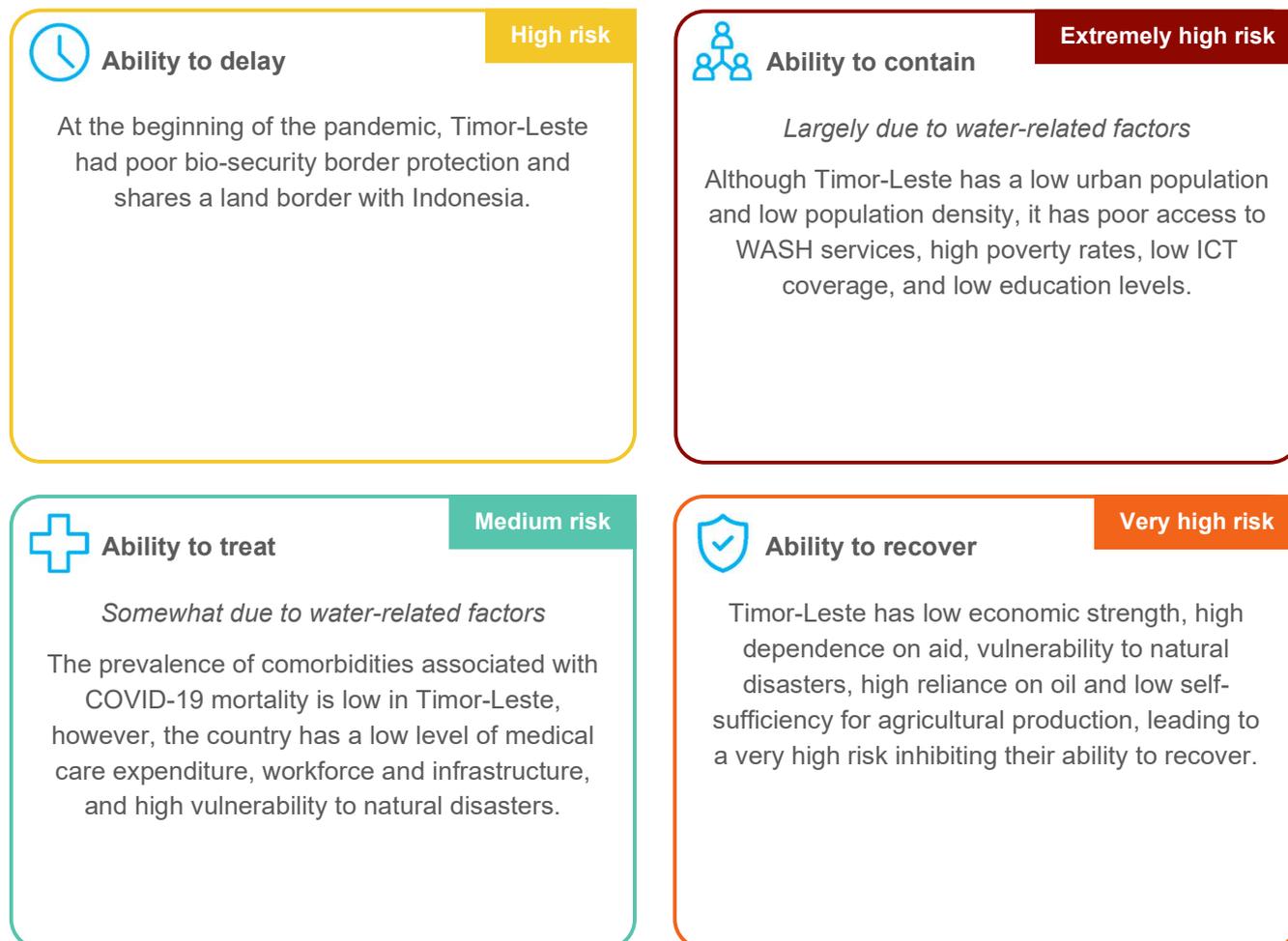
Timor-Leste is the newest country in South East Asia after independence from Indonesia in 2002. Timor-Leste shares an island with the Indonesian province of West Timor. The 1.3 million Timorese live across 13 municipalities, shown in FIGURE 1.



**FIGURE 1. MAP OF TIMOR-LESTE IN SOUTHEAST ASIA AND ITS 13 MUNICIPALITIES<sup>1</sup>**

<sup>1</sup> Brackhane, S., Webb, G., Xavier, F. M., Gusmao, M., & Pechacek, P. (2018). When conservation becomes dangerous: Human-Crocodile conflict in Timor-Leste. *The Journal of Wildlife Management*, 82(7), 1332-1344.

## Timor-Leste Summary Results

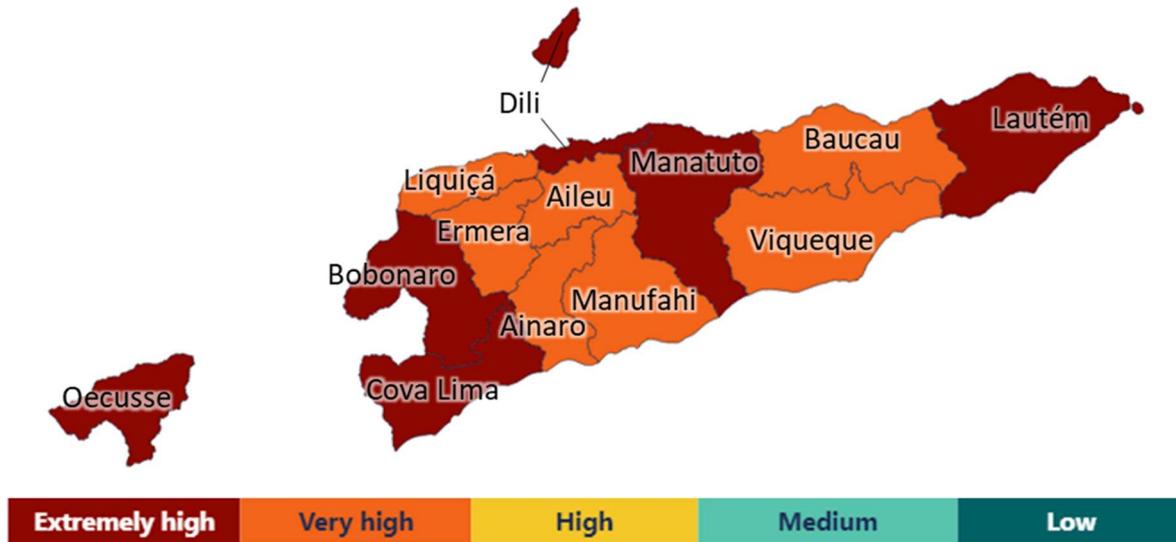


**FIGURE 2. SUMMARY OF COVID-19 WATER SECURITY RISK IN TIMOR-LESTE**

Please refer to the COVID-19 Water Security Risk Index website for more information:  
[www.watercentre.org/research/research-impacts/covid-19-water-security-risk-index](http://www.watercentre.org/research/research-impacts/covid-19-water-security-risk-index).

In its current form, the Risk Index is based on metrics available at the country-level only, meaning that sub-national jurisdictions that may be at greater or lesser risk are not highlighted. However, for the purpose of this in-depth analysis of Timor-Leste, the authors have drawn on information at the sub-national scale to investigate the heterogeneity across the country's 13 municipal districts. This analysis has found that municipalities with either an Indonesian land border (Bobonaro, Cova Lima, and Oecusse) or an international airport (Dili) are at greatest risk regarding the "ability to delay". Also, while Timor-Leste overall has a reasonably low risk in their ability to treat the virus due to low national prevalence of comorbidity illnesses, some municipalities have a significantly higher prevalence, conferring a greater risk (Cova Lima, Lautém, Manatuto, and Oecusse). Other risk elements were relatively similar across the country and it is important to note that Timor-Leste's dependence on oil revenue which, as the global oil price has significantly dropped, will reduce the country's ability to recover from the pandemic.

The overall Risk Index rating of the municipalities is shown in Figure 3.



**FIGURE 3. OVERALL COVID-19 AND WATER SECURITY RISK IN EACH MUNICIPALITY**

The three recommendations regarding water sector interventions that would be most impactful in reducing Timor-Leste’s COVID-19 Water Security Risk are listed below.

**To strengthen the country’s ability to contain:**

1. Implement wastewater epidemiology for SARS-CoV-2 in high-risk areas like the airport, quarantine hotels, and hospitals to provide an early warning of the virus’ arrival.
2. Prioritise further improvements in household WASH access to better enable physical isolation and handwashing.

**To strengthen the country’s ability to recover:**

3. Increase investments in agricultural water security through either infrastructure or Integrated Water Resource Management studies for each of the country’s basins.

More details on these recommendations can be found on page 13.

# Timor-Leste's COVID-19 story so far

So far, Timor-Leste has avoided many of the worst impacts from COVID-19. As of 31 December 2020, the country has recorded 44 cases and no deaths (see Figure 4). This has largely been due to the rapid response from the government in closing the borders in mid-March shortly after the first case was confirmed. Further, Timorese that were overseas were provided with support to enable them to remain where they were. Most of the cases were students returning to Dili. However, due to a policy stating that all arrivals needed to quarantine, outbreaks were not widespread in the community. The border has since been reopened in a limited capacity with all travellers needing to isolate for two weeks after arrival.<sup>2</sup> Of particular concern is the land border with Indonesia—previous border closures needed tight police controls and working with local communities to restrict travel across the border. While Indonesia was nearing 750,000 cases nationally toward the end of December 2020,<sup>3</sup> cases in the Indonesian province of Nusa Tenggara Timur, which neighbours Timor-Leste, have been relatively low. Testing rates in Timor-Leste are quite low with only 17,000 total tests (accurate on 18 January 2021) which equates to 13,000 tests per million people. By comparison, Australia has completed 480,000 tests per million people and Indonesia and PNG have completed 30,000 and 4,000 tests per million people, respectively.

As well as border closures to delay COVID-19 entering the country, the government has also invested heavily in helping their citizens contain the spread. Families have received support packages of essential food and hygiene products from the private sector. The government has also provided monetary support to low-income families, all to enable physical isolation and contain the spread.<sup>1</sup> Further, with support from the World Health Organization (WHO), Timor-Leste has been able to increase their capacity to test patients, provide safe quarantine accommodation, improve access to Personal Protective Equipment (PPE) for health workers, and increase the capacity of the public health surveillance and response. It is worth noting that during the first months of the pandemic, Timor-Leste had no testing capacity and needed to send tests to Darwin.<sup>4</sup>

The health impacts of the pandemic have not been significant to date; however, the economic impacts have been great. While Timor-Leste derives only a small percentage of its GDP from tourism, a significant amount of Timor-Leste's GDP comes from oil, an industry that has also collapsed.<sup>5</sup> Oil prices were between USD60–70 per barrel at the end of 2019, before plummeting to approximately USD20 per barrel in April. They have since recovered slightly with the current price at just over USD50 per barrel.<sup>6</sup> Furthermore, Timor-Leste lacks the capacity to grow enough food to meet its own needs and is reliant on imports,<sup>4</sup> due in no small part to poor economic water security and a lack of irrigation infrastructure.

The total number of cases recorded in Timor-Leste as shown by the Johns Hopkins COVID-19 Map are shown in Figure 4.

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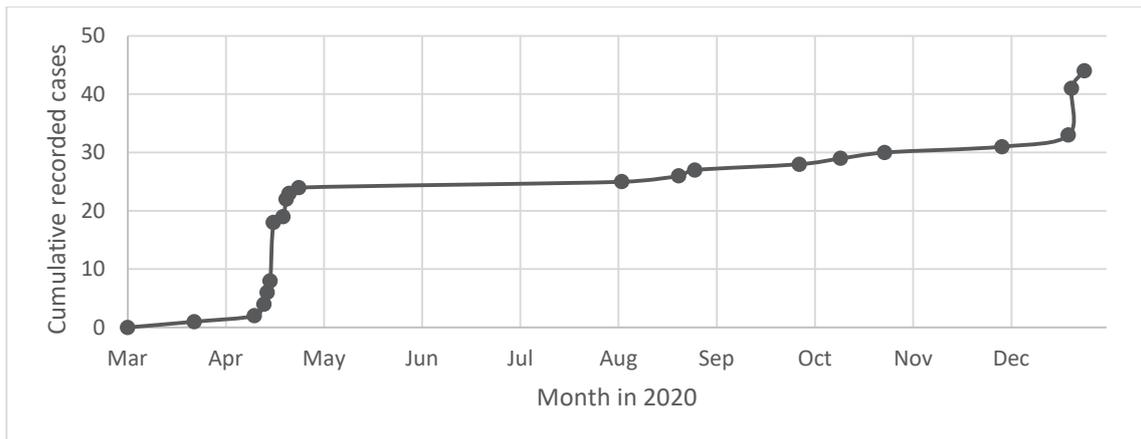
2 Barnes, Susanna, Teresa Hall, Baithasar Kehi, Quintiliano Mok, and Lisa Palmer. 2020. How Timor-Leste has mobilised against COVID-19. <https://pursuit.unimelb.edu.au/articles/how-timor-lestes-has-mobilised-against-covid-19>: University of Melbourne.

3 Dong E, Du H, Gardner L. 2020. "An interactive web-based dashboard to track COVID-19 in real time." *Lancet Inf Dis.* 20(5) 533-534.

4 Neves, Guteriano. 2020. "Timor-Leste's COVID-19 Response." *The Diplomat*, 03 June: <https://thediplomat.com/2020/06/timor-lestes-covid-19-response/>.

5 Da Cruz Cardoso, Joao. 2020. "A Covid-19 wake-up call to reshape Timor-Leste's economy." *The Interpreter*, 28 April: <https://www.lowyinstitute.org/the-interpreter/covid-19-wake-call-reshape-timor-lestes-economy>.

6 Market Insider. 2021. Crude Oil Price. 1 January. [https://markets.businessinsider.com/commodities/oil-price?type=wti?utm\\_source=markets](https://markets.businessinsider.com/commodities/oil-price?type=wti?utm_source=markets).



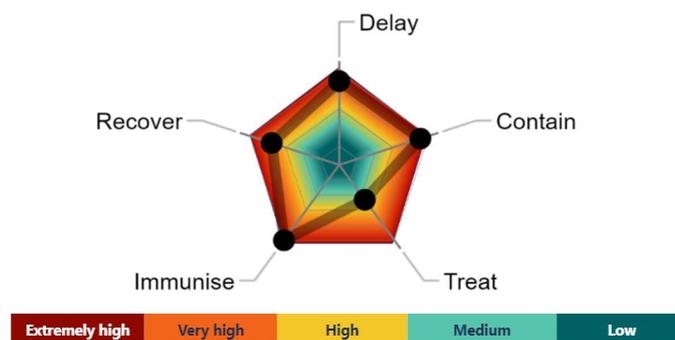
**FIGURE 4. CUMULATIVE CASES IN TIMOR-LESTE AS OF 31 DECEMBER 2020<sup>7</sup>**

## Results

Overall, Timor-Leste is at extremely high risk regarding COVID-19 and Water Security. Due to the low levels of comorbid illnesses, the country’s ‘ability to treat’ represents the lowest risk of all the temporal risk elements, with the country being rated high to extremely high risk in all other elements (see Figure 5 for the country risk profile).

The following sections present the results of the COVID-19 Water Security Risk Index assessment undertaken at the municipal level for all six temporal elements that comprise the Risk Index, which are the ability to: stay alert; delay the spark; contain the spark; treat those in need; immunise; and recover.

### Timor-Leste



**FIGURE 5. TIMOR-LESTE COUNTRY RISK PROFILE**

Many metrics are available at the sub-national level. For these, the same calculation method was used. A greater proportion of metrics were only available at the national level, in which case the same value was assumed for the entire country so as not to bias the results. Most governance indices and the International Health Regulation (IHR) index were the most influential metrics that were not available at the sub-national level, however for these, the national level is likely to be the most appropriate scale for analysis. Metrics that were not available at either the national or sub-national scale were not considered in the same way as the national assessment method. Furthermore, there were some metrics that were not available at the sub-national level, but similar metrics could be found. For these, the calculation method was slightly altered and has been explained each time this happened. Finally, the literature review identified additional factors important for Timor-Leste. In addition to including the additional factors in this analysis, the Risk Index methodology was also updated. Table 1 explains each of these types of metrics.

<sup>7</sup> Dong E, Du H, Gardner L. 2020. "An interactive web-based dashboard to track COVID-19 in real time." *Lancet Inf Dis.* 20(5) 533-534.

**TABLE 1. HOW TO INTERPRET SUMMARY TABLES IN EACH RISK ELEMENT RESULT SECTION**

Same sub-national metric	Similar sub-national metric	National metric	Not considered	Identified as a gap
The exact same metric was found at the sub-national scale and considered in the calculation as if it were another country with that score.	A similar, but not identical, metric was available at the sub-national level; minor changes to calculations were required. The changes are explained in detail as appropriate.	Sub-national metric was not available, so the national value was used. This ensures consistent risk scores but reduces nuances between the municipalities.	Sub-national or national data were not available.	Through this case study a data gap in the existing calculation was found. The changes are explained in detail as appropriate.

 **Ability to stay alert** **Low risk**

As with all countries in the Risk Index, Alert has been rated as a low risk due to COVID-19 being well publicised. It is important to note that Timor-Leste has a public health institute as a member of The International Association of National Public Health Institutes, the Instituto Nacional de Saúde Pública. However, as discussed in the Risk Index it is unknown how relevant this is as an indicator.

 **Ability to delay** **High risk**

For the country as a whole, Timor-Leste has been rated as a high risk for their ability to delay the arrival of the virus in country. This is largely due to the poor bio-security measures at the border and the land border it shares with Indonesia, both of which have been addressed by the government. Table 2 summarises how the metrics have been applied at the sub-national level.

**TABLE 2. HOW THE ABILITY TO DELAY METRICS HAVE BEEN APPLIED AT THE SUB-NATIONAL LEVEL**

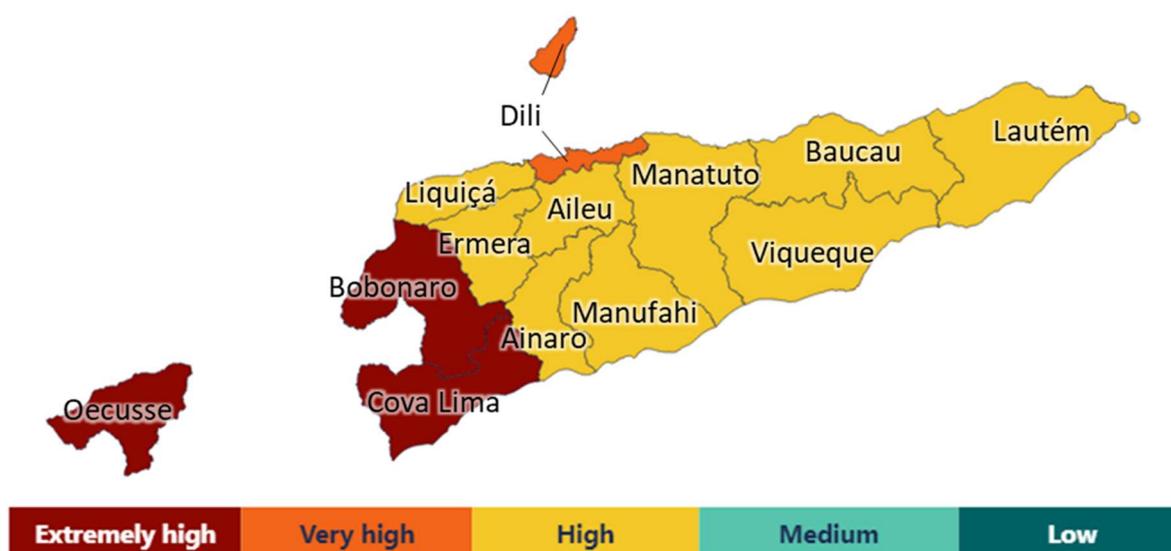
Same sub-national metric	Similar sub-national metric	National metric	Not considered	Identified as a gap
–	Presence of an international land border	International Health Regulation points of entry capacity score Tourism income %GDP IHR Legislation and Financing index	–	Population mobility

At the sub-national level, land border percentage becomes less relevant, so the metric has been appropriated to instead be a yes/no question on the existence of an international land border. The border municipalities of Bobonaro, Cova Lima, and Oecusse all have a land border with Indonesia—a country with a considerable outbreak—significantly increasing their risk. However, the Indonesian province that they share a border with currently has few cases.

As mentioned earlier, many of the economic and governance indicators are only available at the national level, therefore three metrics have been assumed to be the same in all municipalities.

Using the initial calculation method, Dili was rated as the equal lowest risk of any municipality in the country, despite Dili having had most of Timor-Leste's COVID-19 cases. This is because Dili has the only international airport and has received all the cases from people returning home. The metric of passengers carried was included for the existing factor of population mobility, which previously had no appropriate metric.

There are three groups of similar municipalities: i) those sharing a land border with Indonesia; ii) Dili; and iii) the rest. Municipalities without a land border or airport are at the lowest risk compared to the other two groups (see Figure 6 for risk map).



**FIGURE 6. RISK OF TIMOR-LESTE'S ABILITY TO DELAY THE ARRIVAL OF COVID-19 IN EACH MUNICIPALITY**

During the pandemic, most of the Government's response was targeted at delaying the 'spark'. This included restricting entry then closing the airport in Dili, ensuring all arrivals remained in quarantine, and working with communities and increasing policing on the Indonesian land border. This addresses the two key factors in the country's delay risk: the land border, and the weak protection of points of entry. There is increasing pressure to ease restrictions on the land border to ensure that imports, which Timor-Leste is reliant upon, can start supplying the country again, however, a similar pressure does not exist in regards to opening for tourism.



## Ability to contain

Extremely high risk

Due to the high levels of poverty and low access to water and sanitation in the home, Timor-Leste has been rated an extremely high risk for their ability to contain.

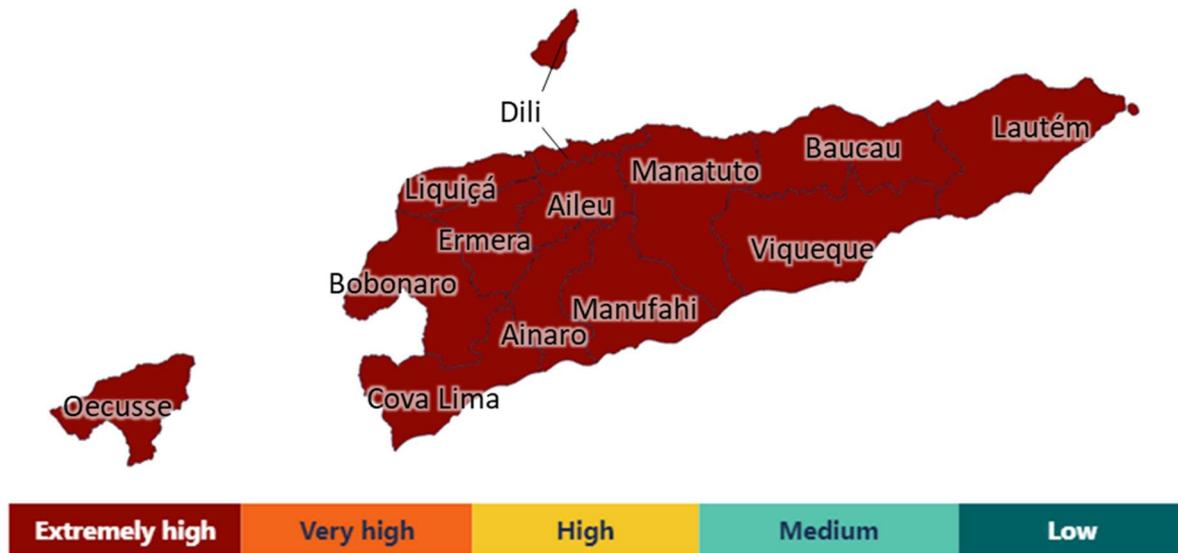
Table 3 summarises how the metrics have been applied at the sub-national level.

**TABLE 3. HOW THE ABILITY TO CONTAIN METRICS HAVE BEEN APPLIED AT THE SUB-NATIONAL LEVEL**

Same sub-national metric	Similar sub-national metric	National metric	Not considered	Identified as a previous gap
Population density				
Urban population %				
Household size		Gross national savings %GDP	All World Justice project indices	
% population <USD1.90/day		All health governance and infrastructure metrics	Proportion of schools that have access to basic handwashing	
AWDO KD5 ICT and education indices		Corruption and political stability indices		
Access to water on premises (household)	–	Urban water service affordability	Proportion of health care facilities that have access to basic handwashing	–
Access to basic sanitation (household)		Three generations households		
Proportion of households that have access to basic handwashing				
Proportion of population registration births				

Many of the contain factors are available at the sub-national level through the 2015 Census and a 2014 World Bank poverty study. This results in a reasonably accurate assessment of the ability to contain in each municipality. For the most part, majority of the metrics found at the sub-national level are in line with the expectations based on the national assessment metrics, except for access to water on premises, and the information and communication technology index. For these two metrics, the sub-national analysis referenced the 2016 Census. It is likely that the sub-national figures are more accurate, however, the discrepancy had little impact on the results.

Overall, there are two narratives that are told through the ability to contain scores—one for Dili and one for the other municipalities. As expected from the most urbanised municipality, Dili is more densely populated than the other municipalities and has better WASH access at home, though it is still poor. The other municipalities have relatively low population density, but very poor access to WASH at home. On both accounts, all municipalities are at extremely high risk due to their lack of ability to contain the spread, and water-related elements have a greater impact on the score outside of Dili. These results are shown in Figure 7.



**FIGURE 7. RISK OF TIMOR-LESTE'S ABILITY TO CONTAIN COVID-19 IN EACH MUNICIPALITY**

Most of the responses that help contain the spread have been provided with assistance from the WHO. The WHO have helped the government of Timor-Leste i) to improve their ability to monitor and surveil the virus in the community, ii) to enforce quarantine and isolate those infected, iii) to provide adequate PPE to health care professionals, and iv) to increase their ability to test for COVID-19. At the beginning of the pandemic, Timor-Leste needed to send tests to Darwin as they had no local testing capacity. Although testing is now conducted in-country, the testing rates are low, with only 17,000 total tests (accurate on 18 January 2021) which equates to 13,000 tests per million people. By comparison, Australia has completed 480,000 tests per million people and Indonesia and PNG have completed 30,000 and 4,000 tests per million people, respectively.

Ability to treat

Medium risk

While Timor-Leste has poor medical infrastructure, the country has very low level of comorbidities, this has resulted in a rating of medium risk. Table 4 **Error! Reference source not found.** summarises how the metrics have been applied at the sub-national level.

Many of the demographic metrics were available at the sub-national level through the Demographic Health Survey (2016), however as previously discussed, many of the governance metrics and indices were only available at the national level. Medical infrastructure metrics, the number of doctors, nurses, and hospital beds, and the health budget were also only available at the national level. Unfortunately, all the water-related metrics related to the ability to treat were only available at the national level, so a sub-national assessment of water impact on the ability to treat was not possible.

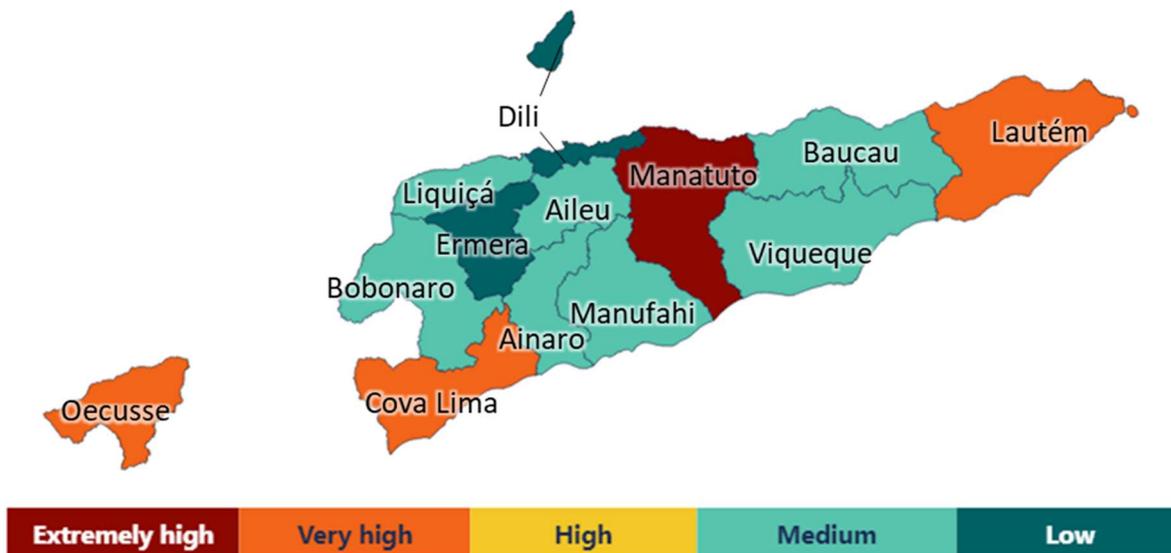
Approximate comorbidity risk profiles were adapted using the data available for the sub-national level assessment.. Hypertension and heart and lung disease were recorded in the Demographic Health Survey, although they were measured as the percentage of population that was diagnosed with the illness, not Disability Adjusted Life Years (DALYs) as in the national assessment. The same weightings used for the national assessment were used for these three illnesses to create a Timor-Leste specific COVID-19 comorbidity risk profile for each municipality, and for the country as a whole. A ratio was calculated between the Timor-Leste specific COVID-19 comorbidity risk profile and the National Risk profile used in the national assessment. This

ratio was then applied to each of the municipality risk profiles to find a risk profile metric that was comparable to other countries.

**TABLE 4. HOW THE ABILITY TO TREAT METRICS HAVE BEEN APPLIED AT THE SUB-NATIONAL LEVEL**

Same sub-national metric	Similar sub-national metric	National metric	Not considered	Identified as a previous gap
Vaccination coverage	Comorbidity risk profiles	Human Rights Index	—	—
Percentage of population smoking		Doctors, nurse, and hospital beds per capita		
Percentage of population over 65		Health budget		
Percentage of population that are obese		Water collection burden		
		Logistics Performance Index		
		Resilience to water-related disasters (KD5 of the AWDO 2020)		
		Governance corruption from the World Governance Index (WGI)		

Most municipalities are at low risk in this element, as would be expected from the national score; however, there is great discrepancy between municipalities. Cova Lima, Lautém, Manatuto, and Oecusse are all rated very to extremely high risk, with Manatuto being the highest risk. Manatuto reports heart and lung disease rates approximately 2.5 times the national rates. It also has the highest obesity and the second highest proportion of elderly people. It should be noted that these statistics could be skewed by potential relative over-reporting of illness in Manatuto, noting they have the second highest medical service delivery amongst the municipalities. This analysis highlights that the national average for comorbidities can be misleading as certain communities can have much greater prevalence of relevant illnesses, making them high risk regardless of the national average. These results are summarised in Figure 8.



**FIGURE 8. RISK OF TIMOR-LESTE'S ABILITY TO TREAT COVID-19 IN EACH MUNICIPALITY**

There have been very few cases of COVID-19 reported in Timor-Leste (44) with most being students returning from studying overseas. Therefore, while there have been no deaths, it is too small a sample size and not representative of the community to determine whether this validates the analysis. Most of the government response has been towards the delay and contain elements, as it should be, due to the higher risk posed. It is, therefore, difficult to assess and ground-truth the assessment.

Ability to immunise

Extremely high risk

As with all countries in the Risk Index, there is currently no vaccine that has been proven effective. Therefore, the sub-national analysis could not be undertaken either. It should, however, be noted that there is significant discrepancy between municipalities regarding the health reach and service delivery that must be considered when completing an eventual vaccination plan.

Ability to recover

Very high risk

Timor-Leste has a low economic security as a country and is reliant on oil revenues, therefore it has received a very high-risk rating for the ability to recover. Table 5 summarises how the metrics have been applied at the sub-national level.

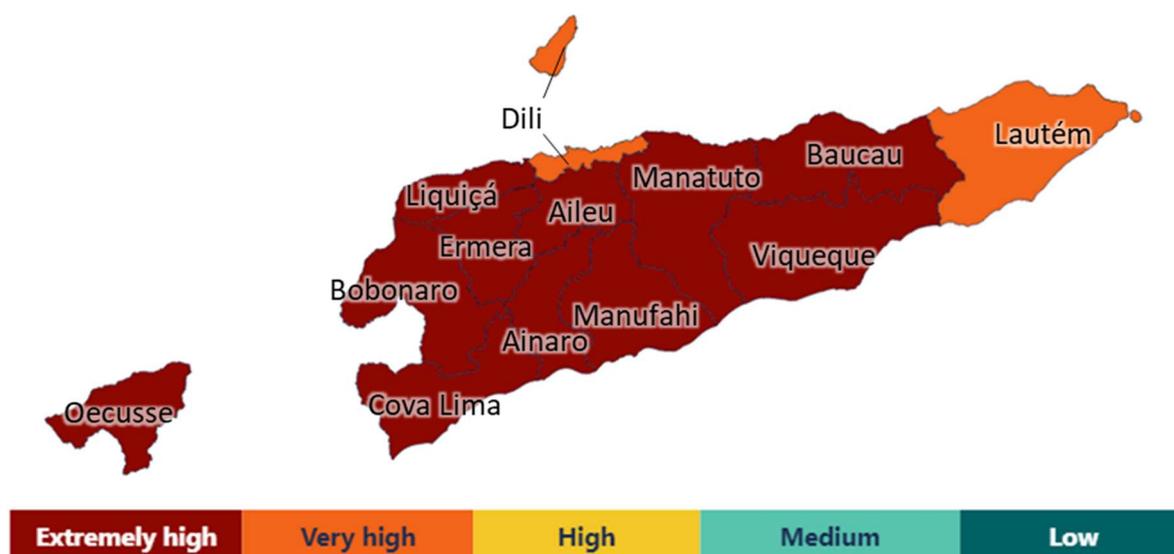
**TABLE 5. HOW THE ABILITY TO RECOVER METRICS HAVE BEEN APPLIED AT THE SUB-NATIONAL LEVEL**

Same sub-national metric	Similar sub-national metric	National metric	Not considered	Identified as a previous gap
–	GDP per capita	Governance metrics Economic metrics Water security metrics Mental health workforce capacity Water utilities ability to generate income	–	Dependence on tourism and oil

Unfortunately, the vast majority of the metrics used in the ability to recover element were not available at the sub-national scale, meaning that only the national score is accurate. In general, Timor-Leste’s poor ability to recover is due to low GDP, high levels of poverty, and poor economic water security which includes agricultural water security. One key factor lowering the risk score is that Timor-Leste is not overly reliant on tourism.

As GDP per capita is not recorded at the sub-national level, household expenditure was used to estimate a metric comparable to GDP. There is minor variation between the municipalities—all have low GDP, and this had little impact on the assessment.

After investigating the impact that COVID-19 has had and is likely to have on Timor-Leste’s recovery, two important factors were noted. While Timor-Leste is not reliant on tourism, it is reliant on revenue from oil—an industry that has also significantly retracted due to the pandemic. For this reason, oil revenue was added to the tourism revenue factor as these are the two most impacted industries worldwide. Furthermore, due to the country’s high reliance on imported goods, food security is now more vulnerable. Food self-sufficiency is a component of economic water security that is already explicitly included in the Risk Index, however, there was a gap in the dataset for Timor-Leste. These results are shown in Figure 9.



**FIGURE 9. RISK OF TIMOR-LESTE'S ABILITY TO RECOVER FROM COVID-19 IN EACH MUNICIPALITY**

# Overall results and recommendations

Overall, Timor-Leste has responded appropriately and effectively to the COVID-19 pandemic by prioritising interventions to address their major risk factors and has so far avoided a public health crisis like the one seen in neighbouring Indonesia. By strengthening points of entry protection at the Dili airport and along the land border with Indonesia, the country has prevented COVID-19 from ‘sparking’. Furthermore, the Government and donors have strengthened their ability to contain the spread—another high-risk element for the country. While on the whole Timor-Leste has a low prevalence of comorbidities, there is a high prevalence in some municipalities. Manatuto is at highest risk and would be of great concern if the virus spreads to this municipality. Finally, Timor-Leste has not been immune to the economic consequences of the pandemic, with a high proportion of their GDP coming from oil, and as the oil price dropped significantly, they are economically very vulnerable.

Table 6 shows the overall risk rating and the relevant elements for each municipality. The overall risk rating is calculated by multiplying Likelihood and Consequence. Likelihood is determined by the average of the Delay and Contain scores, while Consequence is the average of the Treat, Immunise (rated five for all municipalities), and Recover scores.

**TABLE 6. OVERALL RISK RATING AND OTHER KEY RISK ELEMENT RATING IN EACH MUNICIPALITY**

Municipality	Overall (1-25)	Delay (1-5)	Contain (1-5)	Treat (1-5)	Recover (1-5)
<b>Timor-Leste national</b>	Ex. high (16.5)	Ex. high (4.1)	Ex. high (4.5)	Medium (2.3)	Ex. high (4.1)
Aileu	V. high (14.5)	High (3.0)	Ex. high (4.6)	Medium (2.2)	Ex. high (4.2)
Ainaro	V. high (14.6)	High (3.0)	Ex. high (4.5)	Medium (2.4)	Ex. high (4.2)
Baucau	V. high (14.3)	High (3.0)	Ex. high (4.4)	Medium (2.4)	Ex. high (4.1)
Bobonaro	Ex. high (16.2)	Ex. high (4.1)	Ex. high (4.5)	Medium (2.2)	Ex. high (4.2)
Cova Lima	Ex. high (17.7)	Ex. high (4.1)	Ex. high (4.4)	V. high (3.5)	Ex. high (4.2)
Dili	Ex. high (15.2)	V. high (3.8)	Ex. high (4.6)	Low (1.9)	V. high (3.9)
Ermera	V. high (14.0)	High (3.0)	Ex. high (4.5)	Low (1.9)	Ex. high (4.2)
Lautém	Ex. high (16.0)	High (3.0)	Ex. high (4.4)	V. high (3.8)	V. high (4.0)
Liquiçá	V. high (14.6)	High (3.0)	Ex. high (4.5)	Medium (2.4)	Ex. high (4.2)
Manatuto	Ex. high (17.1)	High (3.0)	Ex. high (4.5)	Ex. high (4.5)	Ex. high (4.2)
Manufahi	V. high (14.5)	High (3.0)	Ex. high (4.5)	Medium (2.4)	Ex. high (4.2)
Oecusse	Ex. high (18.5)	Ex. high (4.1)	Ex. high (4.4)	V. high (4.0)	Ex. high (4.2)
Viqueque	V. high (14.4)	High (3.0)	Ex. high (4.5)	Medium (2.4)	Ex. high (4.1)

Informed by the analysis, there are three recommendations that will most reduce COVID-19 water security risk in Timor-Leste:

To strengthen the country’s ability to contain:

## 1. Implement sewage surveillance for SARS-CoV-2

Timor-Leste currently has very few COVID-19 cases and a poor ability to delay the spark of infections in some municipalities. As Timor-Leste also has a low ability to test potentially infected people (qPCR for SARS-CoV-2 RNA in rhino-pharyngeal swabs), it cannot be relied upon for effective public health surveillance. On the other hand, surveillance of sewage may allow the rapid detection of SARS-CoV-2 RNA in human waste, indicating the presence of infected individuals who are excreting the virus, whether they are showing symptoms or not. Such environmental surveillance would allow the government to respond before a significant spark has occurred.

Timor-Leste has few reticulated sewage connections; however, it may be possible to set up a monitoring project that collects samples from high-risk areas like the airport, quarantine hotels, and hospitals. Not only will this program give the government early warning of the virus's arrival, but it will also give them more confidence to re-open borders. Not only would this program give the government early warning of the presence of COVID-19 in the community, but it will also give them and other governments more confidence to re-open borders and establish international travel bubbles to facilitate recovery across all sectors.

Although no laboratories in Timor-Leste currently have the capacity to conduct sewage surveillance—otherwise known as wastewater-based epidemiology—measures could be put in place to address the limitations. If adopted, it is crucial that correct procedures are used to collect and analyse the samples, interpret the public health significance of the results, and communicate the findings. Fortunately, improved guidance on the factors to consider to ensure meaningful results are generated is beginning to emerge in the literature.<sup>8</sup>

The Australian Water Association, through the support of the Australian Water Partnership, already has a program to pilot sewage surveillance programs in other South-East Asian countries. The results of this pilot could be used to inform a similar pilot in Timor-Leste.

## **2. Prioritise further improvements in WASH access**

Access to safe and reliable WASH is vital for people to follow handwashing and social distancing guidelines recommended by the WHO. However, most Timor-Leste municipalities have very poor access to WASH at home. Improving the access to WASH would significantly reduce the risk posed by COVID-19 throughout Timor-Leste by reducing overcrowding at water access points, facilitating hygiene practices in the home, and allowing for better physical distancing. While WASH access is already a priority area in Timor-Leste, COVID-19 has increased its importance and the resources it should be given. Additionally, given their land border with Indonesia and their high prevalence of comorbid illnesses, these improvements would be most beneficial in Cova Lima and Oecusse, the two highest risk rated municipalities.

To strengthen the country's ability to recover:

## **3. Increase investments in agricultural water security**

Due to their reliance on oil revenue, the economic impacts on Timor-Leste have been and will be severe. Throughout the country, there is currently only a small amount of irrigation infrastructure, and as such, there is much room for improving their economic water security. Medium- to long-term investment in agricultural water security, either as infrastructure or water resource studies for each of the country's basins, would be an impactful water sector intervention that would greatly improve Timor-Leste's economic recovery and reduce their dependency on imported food items, thereby improving the country's food security.

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<sup>8</sup> Medema, G, F Been, L Heijnen, and S Petterson. 2020. "Implementation of environmental surveillance for SARS-CoV-2 virus to support public health decisions: opportunities and challenges." *Current Opinion in Environmental Science & Health* <https://doi.org/10.1016/j.coesh.2020.09.006>.