

Disaster Risk Reduction in Singapore

Status Report 2020



Asian Disaster
Preparedness Center



UNDRR

UN Office for Disaster Risk Reduction

Disaster Risk Reduction in Singapore

Status Report 2020

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About this report

The disaster risk reduction (DRR) status report provides a snapshot of the state of DRR in Singapore under the four priorities of the Sendai Framework for Disaster Risk Reduction 2015-2030. It also highlights progress and challenges associated with ensuring coherence among the key global frameworks at the national level; and makes recommendations for strengthening overall disaster risk management (DRM) governance by government institutions and stakeholders at national and local levels.

As this report is based on information available as of the end of the year 2019, an update on the COVID-19 impact, response and recovery using a risk-informed approach by countries is provided at the beginning of this report. This report has been prepared by the Asian Disaster Preparedness Center (ADPC) on behalf of the United Nations Office for Disaster Risk Reduction (UNDRR) through country consultations and a desk review of key documents, including legal instruments and DRR policies, plans, strategies and frameworks, etc.

The report has benefited from inputs by the S. Rajaratnam School of International Studies (RSIS), Earth Observatory of Singapore (EOS), Nanyang Technological University (NTU) and Mercy Relief of Singapore. The list of people consulted is enclosed at the end of this report. UNDRR and ADPC also acknowledge the government, international organizations and stakeholder representatives who contributed their valuable input and feedback on this report.

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This report serves as a reference document for the implementation and monitoring of the Sendai Framework. The findings, interpretations, and conclusions expressed in this document are those of the author(s) and do not necessarily represent those of the United Nations, including UNDRR, or its Member States. The presentation of the material in this report concerning the legal status of any country or territory or of its authorities or concerning the delimitations of its frontiers or boundaries, as well as the text and the tables, is intended solely for statistical or analytical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. While every effort has been made to ensure the accuracy of the information, the document remains open for any corrections in facts, figures and visuals.

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Singapore's Response to COVID-19 and Disaster Risk Reduction

The first confirmed COVID-19 case in Singapore was reported on January 23, 2020. Due to the sharp increase in COVID-19 infections in April 2020 safe distancing measures were considerably intensified to break the trend of increasing local transmission. In view of a sustained decrease in community transmissions, the Government announced a three-phased approach to resume activities starting June 2. As community infection rates remained low and generally stable, Phase 2 commenced on June 19. As Singapore has made good progress to support a further resumption of activities, the Multi-Ministry Taskforce (MTF) approved the start Phase 3 along with safe management measures. COVID-19 testing and contact tracing are continuing to help Singapore mitigate the virus spread and to keep community transmission low. Strict checks and enforcement actions are still continuing to ensure that Singapore is safe from the virus.

Real GDP contracted by 5.8 percent in Q3 2020 on a year-on-year basis, following a contraction of 13.3 percent in Q2 2020. The Government announced several packages of fiscal support measures amounting to about S\$100 billion. The Ministry of Social and Family Development (MSF) plans to launch the COVID-19 Recovery Grant (CRG) on 18 January 2021 to support lower- to middle-income employees and self-employed persons (SEPs) who are financially impacted by COVID-19.

The authorities have increased their contingency funds for unforeseen expenditure needs and also set aside loan capital of S\$20 billion to help businesses and individuals facing cash flow challenges with loan obligations and insurance premium payments. Other economic resilience measures include support to R&D investment, a national stockpile of health supplies, and a program on food resilience.

The Ministry of Home Affairs (MHA) is coordinating the Government's pandemic response through the chairmanship of the Homefront Crisis Executive Group (HCEG) by making plans for scenarios related to the crisis. It has established the new Safe Travel Office to oversee, operationalise and streamline processes for safe international travel as Singapore gradually re-opens its borders using science and technology in the fight against COVID-19.

The UNDRR Office in Incheon for Northeast Asia and Global Education and Training Institute for Disaster Risk Reduction (ONEA and GETI) in partnership with the Singapore Cooperation Programme (SCP) of MHA has conducted a number of training activities on disaster risk reduction and the hardcoding of resilience into policy, infrastructure and human behaviour.

Due to the COVID-19 situation and travel restriction, online training courses were organized during September and October 2020 under the auspices of the Singapore-UNDRR Joint Training Programme. Drawing lessons from the COVID-19 global pandemic that demonstrates the 'new normal' of interconnected risk, the training provided an overview of the Sendai Framework for Disaster Risk Reduction (SFDRR) 2015-2030, the 2030 Agenda for Sustainable Development and the Paris Agreement, their interlinkages with international health regulations, and possible applications to Singapore's existing policy and plans. The training also covered Singapore's whole-of-government approach to integrated risk management and multi-stakeholder approach to crisis recovery.

1. Introduction

The Republic of Singapore is a sovereign island city, located in Southeast Asia at the southern tip of the Malay Peninsula, approximately 137 kilometers north of the Equator. The main diamond-shaped island is separated from Malaysia by Johor Strait, a narrow channel which can be crossed by road or rail causeways. In the south, the country is separated from the Indonesian Riau-Lingga Archipelago by the Singapore Strait. Altogether, it covers a total land area of 716 square kilometers, comprising over 60 smaller islets as well (JICA, 2015). In terms of its climate, Singapore is classified as a tropical rainforest region following Köppen's climate classification system, thus having no true seasons. However, there are four distinct monsoonal seasons determined by prevailing wind directions: the Northeast Monsoon (December to Early March), Inter-monsoon Period (Late March to May), Southwest Monsoon (June to September) and another Inter-monsoon period from October to November (National Environment Agency, 2009).

In terms of administration, the small physical size of the country means that it does not have the traditional national subdivisions of provinces, states, regencies or territories. Nevertheless, Singapore has been administratively subdivided for the purposes of effective local administration and urban planning. Following the 1997 Peoples Association Act, nine Community Development Councils (CDCs) were formed to strengthen social community bonds and foster social cohesion (People's Association, 2019). As of now, the CDCs have been reformed to cover five areas: North East, North West, South East, South West, and the Central Singapore CDC. These councils follow existing political divisions, each comprising four to six town councils, or Group Representation Constituencies and Single-member Constituencies. Additionally, the CDCs are further divided into fiftyfive urban planning subdivisions based on the Urban Redevelopment Authority's (URA) Master Plans which were first formulated in 1958 (Urban Redevelopment Authority, 2019). While not being used for administrative purposes, these regions are necessary for managing resilient and sustainable urban development at individual plot levels across the main island.

With regards to the economy, Singapore is classified as a high-income nation with the gross national income exceeding US\$ 54,530 per capita as of 2017 (World Bank, 2019). During the decades after gaining independence, the country rapidly ascended by maintaining an average of 7.7 percent annual GDP growth since 1965 (World Bank, 2019). Key drivers of the growth are manufacturing at 22 percent of the GDP (especially electronics and high-precision engineering), services at 26.2 percent, alongside finance and insurance at 13 percent (Singapore Department of Statistics, 2019). However, between 2017 and 2018 the growth moderated from 3.9 percent to 3.2 percent following decrease in the expansion of manufacturing and services, while domestic demand weakened (ARIC, 2019).

Despite Singapore being located within the world's most disaster-prone region, positioned at the border of the Pacific Ring of Fire, the risks are low as indicated in the WorldRiskReport 2019, which ranked Singapore at 160th (classified as very low risk), among 180 countries assessed, with associated sub-ranking including vulnerability, lack of coping capacities and lack of adaptive capacity at very low level (Bündnis Entwicklung Hilft, 2019). There have been no recorded events that have caused a significant number of deaths or damage. Earthquake risks are minuscule, large-scale tsunami impacts are unlikely (there are no significant impacts found in historical records), and the latest moderate landslide occurred in 2007 causing no fatalities (JICA, 2015). However, given the monsoonal climate, the risk of flooding is moderate, and inundation has impaired infrastructure, such as in the case of 2010 – 2011

flooding when unusually high precipitation damaged malls and underground parking garages. Future sea level rise is also likely to cause challenges to the low-lying island nation, and the risk of epidemics (such as the Severe Acute Respiratory Syndrome or SARS outbreak of 2003) alongside anthropogenic hazards continue to pose threats to the people, economy and infrastructure. As a highly industrialized and densely populated country, industrial-related disasters are one of primary risks to Singapore. Industrial hazards, essentially leakage of hazardous substances during transport or throughout the manufacturing process, and its proceeding consequences including water contamination, air pollution, fires and explosion, could cause health risk and threat to lives of industrial workers and the public, as well as massive physical damage to infrastructure.

1.1 Demographic Characteristics

According to the Singapore Department of Statistics, the population of Singapore has surpassed 5,703,600 people in 2019, of which the largest share are of working age populations aged 20 to 64 years (2,631,300) (Singapore Department of Statistics, 2019). In this context, it should be noted that immigration has historically been a major factor influencing demographics – as of June 2017, permanent and non-permanent resident foreigners comprised 39 percent of the total population (Gee & Chao, 2018). Thus, it is a multicultural, multi-ethnic nation wherein ethnic Chinese (76.6 percent of the population), Malay (15.1 percent) and Indian groups (7.4 percent) had the largest representation as of 2014 (Singapore Department of Statistics & MoHA, 2014).

Given that the city-state has no natural resources, its population has always been the country's cornerstone in development and growth. In recognition of this fact, the government has directed substantial investments to human capital, health and education, which have allowed the country to capture its first demographic dividend (Gee, et al., 2018). However, current projections estimate that if the fertility rates in the country remain at current levels, the rapidly aging population will tip the bascule towards a population structure characterized by high dependencies. The old-age dependency will increase by more than ten times to 91 elder Singaporeans per every 100 working age populations by 2080, which effectively could reverse the demographic dividend and drag the annual GDP capita growth downwards by 1.5 percent between 2011 and 2060 (Gee, et al., 2018). This could be mitigated by social risk-pooling (to protect the elderly from untimely health shocks or unemployment exceeding individual resource capacities), taxation-based financing, supported by immigration (Gee, et al., 2018).

Still, thus far the country has witnessed stellar development, due to which Singapore is positioned 9th out of 189 measured countries and territories with a HDI value of 0.935 in 2018 (UNDP, 2019). However, the HDI value masks levels of inequalities within its all three dimensions (long and healthy life, access to knowledge and standard of living). When Singapore's value is discounted for inequality, it falls to 0.810, representing a loss of 13.3 percent (UNDP, 2019). This represents inequities in the distribution of wealth, as well as in the access to opportunities and services. Oxfam rated Singapore among the lowest 10 countries ranked in terms of their efforts targeted to reduce inequality due to low public social spending, wherein the budgets for education, health and social protection combined are behind South Korea and Thailand (Oxfam, 2018). Also, there are no equal pay or non-discrimination laws for women in work force, no minimum wage apart from cleaners and security guards (Oxfam, 2018). If considering the gender pay gap, according to the Ministry of Manpower, women in Singapore were paid 9 percent less than men in 2017 (Ministry

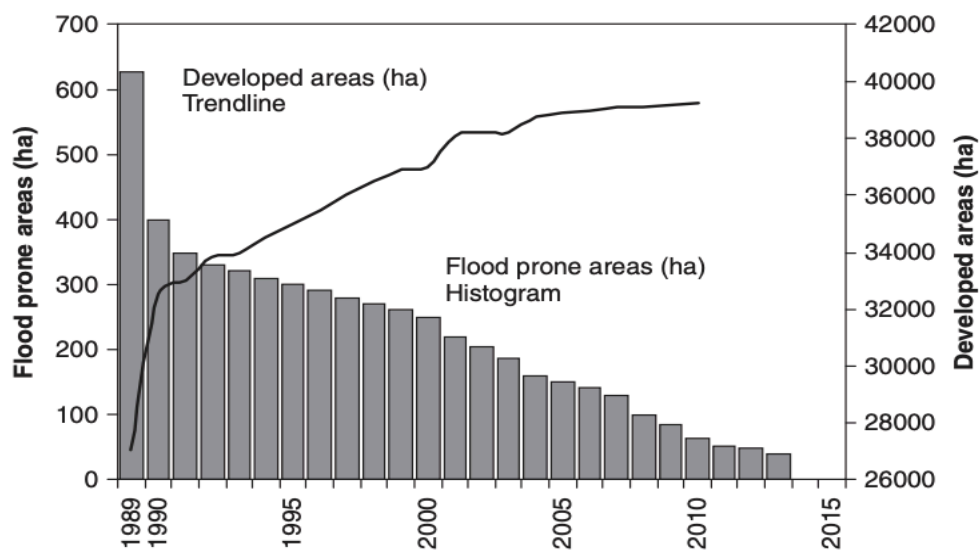
of Manpower, 2019). The starkest differences are found in the highest-paid fields: men in administration and budgeting & finance were paid 10-20 percent more than women on average (on a scale measuring women's 15 top occupations) and on the scale for 15 top occupations for men, male CEOs and engineers got paid 20-40 percent over women (Ministry of Manpower, 2019). Women continue to be paid more on lowly-paid fields only, and lack representation in administration.

Bridging the gender gap in labour forces is crucial towards inclusive growth, as women are compelled to take domestic unpaid work and face time constraints to engage in full-time job and pursue professional endeavours (Nair, 2019). Thus, much remains to be done in terms of improving gender balances on high-paying fields to mitigate gender imbalances and to improve equity in opportunities available for women. Furthermore, investing in social wellbeing, especially given the looming reversal of the demographic dividend is required to expand social support and health services to carry the weight of the increasing numbers of elderly populations.

1.2 Economic Impacts of Disasters

Historically, Singapore has been relatively sheltered from the impact of large-scale disasters, due to which economic impact records about disaster-related caused damages and losses are sparse. For example, the Em-Dat database only returns four epidemics when data is disaggregated based on natural hazards, costs of which have not been measured. Still, flooding and storm hazards have imposed a strain on the economy. In the past, December 1969 flooding rendered 75 percent of the country submerged in water, causing damages of over US\$ 11 million when taking inflation into account (Kennedy, 2015). A similar event in 1978 caused the flood waters to reach 2 meters in some areas, triggered numerous landslides in Telok Blangah, York Hill, Mount Faber, and caused damages exceeding US\$ 16 million. Since 1970s, though, significant improvements made to urban planning have rendered much of the flooding concerns obsolete.

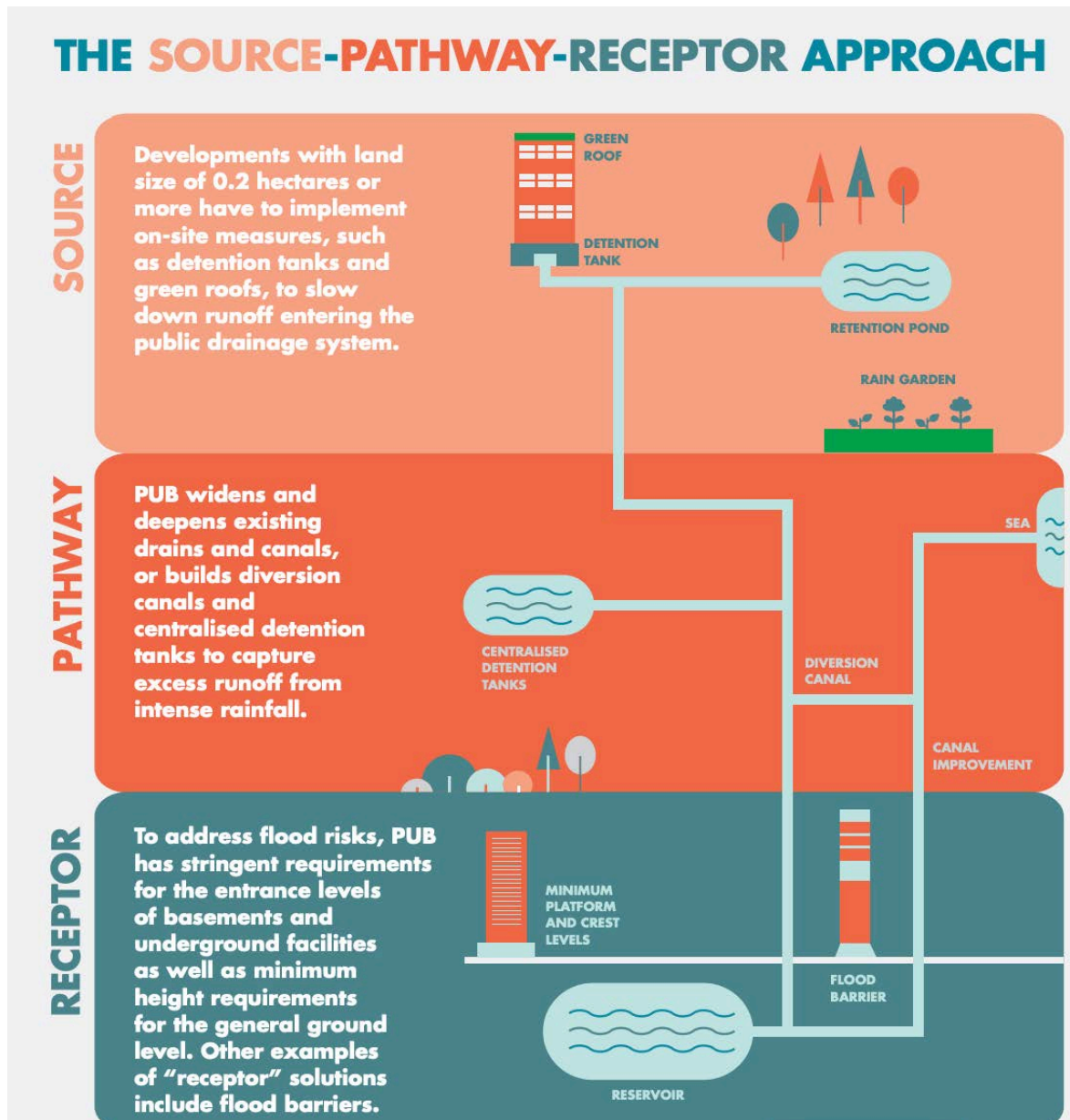
Figure 1. Reduction in flood-prone areas vis-à-vis rate of urban development between 1989 and 2013 (Tortajada & Joshi, 2013).



Indeed, much of the damages related to hydrometeorological hazards can now be avoided due to significant investments made into sewerage expansion, drainage projects and sustainable public planning. Thus, the flood prone areas in the country have decreased by more than 95 percent despite rapid urbanization, now to less than 30.5 hectares (figure 1). Since 1973, more than US\$ 2 billion has been used to support drainage infrastructure, including flood alleviation projects in Marina Barrage, where seven pumps continue to flush out excess water at rate of 40 cubic meters per second (Koh, 2019). However, unusual events may still have spatially concentrated impacts. In the case of the June 2010 flooding caused by heavy rainfall (100 mm within a timespan of 2 hours) 100 shops were flooded along the Orchard Road, leading to over US\$ 17 million in insurance claims (Chow, 2018). The Severe Acute Respiratory Syndrome (SARS) epidemic of 2003 had economic impacts as well. Visitor arrivals and hotel occupancies plummeted rapidly, revenues at retail shops and restaurants decreased and the stock prices fell, resulting in the contraction of the economy by 4.2 percent during the year (Chew, 2019). The government also had to release nearly a US\$ 170 million relief package to compensate the losses.

In recognition of the harmful potential of hydrometeorological hazards, future costs must be considered here as well given the threats posed by climate change. While very few comprehensive studies dedicated to exploring the tangible impacts of sea-level rise and adverse weather to the economy of Singapore, some general assumptions can be drawn from existing literature. As a low-lying country, it is estimated to be severely impacted by sea-level rise which requires significant investments to flood barriers and embankments to protect critical infrastructure. Current solutions are immensely effective, such as the 'source-pathway-receptor' approach (figure 2) intended to address flood pathways, improved drains and on-site detentions in areas where floods may occur (Government of Singapore, 2015). Yet, costs of protecting the country from the projected rise of 1 meter by 2100, adverse weather and other impacts of climate change may exceed than US\$ 73 billion according to the Prime Minister in 2019 (Mohan, 2019; World Economic Forum , 2019). Additionally, as an import-dependent country where over 90 percent of the food supply is brought in, climate change could potentially cause fluctuation in food supply and pricing, mitigation of which requires research and investments to increase the capacity to support self-sustainability (Government of Singapore, 2015).

Figure 2. Source-pathway-receptor flood mitigation approach (Ministry of Environment and Water Resources, 2016)



1.3 Social Impacts of Disasters

Alongside the economy, disasters always have impact on human wellbeing, health, prevalence of poverty, diseases and psychological issues. They may also impair access to services such as healthcare provision or schooling especially in the more rural or remote regions of the world. In Singapore, such risks are relatively low, and the disasters have caused no significant casualties (apart from the 2003 SARS epidemic). Floods in the past have been relatively low-impact: only 8 casualties were reported during the 1978 floods which were among the most serious ever to affect the country (Chow, et al., 2016). Despite of the fact that large-scale impacts are relatively uncommon to Singapore, the potential impacts disasters may have on the populace cannot be ignored.

For example, the country is situated in a region where vector-borne diseases are endemic, and where dengue – among others – are observed during the warmer months of the year (National Climate Change Secretariat, 2019). Moreover, it should be noted that given the high rate of urbanization, the hot and humid conditions render the peoples of the city-state vulnerable to heat stress due to infrastructure and replacement of natural land cover which retain (or produce) heat (National Climate Change Secretariat, 2019). Thus, especially the children and the elderly are more vulnerable to the impacts of adverse weather and diseases which may occur sporadically. Workers can also be more exposed to heat stress, and climate change is likely to affect work productivity given the tropical conditions wherein workers exposed to the environment (such as construction workers) are at higher risk (WHS Council, 2019).

The outbreak of the Severe Acute Respiratory Syndrome (SARS) in 2003 is a good illustration of the widespread impacts which epidemics and pandemics may have. Across a period of few months, the epidemic spread to 238 people, causing significant fear and stress among the population following quarantines and stringent control measures to prevent further spread of the disease (Chew, 2019). Also, given the economic contraction, numerous people lost their employment.

2. Disaster Risk Profile

2.1 Hazards and Climate Change

As mentioned before, Singapore is located in the peripheries of the Pacific Ring of Fire, thus being exposed to the potential impacts of earthquakes (unlikely as they may be), tsunamis and potential ripple-effects of distant volcanic eruptions. The country is also affected by droughts, habitual flood cycles, inundation, seasonal heavy rainfall and the impacts of storms, even if not to a catastrophic extent. Epidemics are also a concern, as illustrated by the SARS outbreak and the persisting prevalence of vector-borne diseases. Against this background, this section intends to evaluate the characteristics of some of the most pressing hazards occurring in the country and their potential impacts vis-à-vis the exacerbating effects of climate change in the future.

Despite being located on a relatively stable part of the Eurasian plate, Singapore's distance from the Sumatra subduction zone is only about 400 kilometers, due to which large tremors can sometimes be felt in the city as was the case during the 2007 Bengkulu earthquake (Dabral, 2015; Megawati, et al., 2004). Given that the level of damage caused by an earthquake to infrastructure is determined by the wave frequency, type and resistance of the building, the potential damages caused by earthquakes cannot be ruled out altogether. The most intense shaking often occurs on quaternary marine clay deposits and reclaimed land, often in the aftermath of distant earthquakes exceeding level 8 on a moment magnitude scale (Megawati, et al., 2004).

In terms of more frequent hazards, flooding is a definite concern for a low-lying island nation. However, the impacts have high spatial variability, often determined by the proximity from the ocean or present river systems, alongside the effectiveness of installed flood mitigation measures (figure 3). Approximately 30 percent of the country is less than 5 meters above the sea-level, thus rendering one third of Singapore exposed to high tides and pluvial flooding. Often associated with high precipitation (or seismic activity), minor and shallow landslides have occurred in the country (however, there are very few slides exceeding 10 meters in height recorded in the past) (Toll, 2001). Slopes with angles more than 27 degrees are more likely to fail, especially during periods when daily rainfall exceeds 15-20 mm over a period of up to 6 days or more (Toll, 2001).

Droughts are also a severe concern for Singapore, not only due to its dependency on imported food (price and availability of which may fluctuate depending on the harvest season) but also due to the fact that the availability of water may be compromised during severe drought events. While the country's adaptive capacity remains high following water retention facilities, desalination plants and water recycling, 60 percent of the country's water remains to be imported from Johor in Malaysia (Chuah, et al., 2018). While the current agreement covering sales of water between the two countries will expire only in 2061, droughts and sea water intrusion may compromise water availability at the Johor site due to its exposure to regional hazards. Given these concerns, it has been suggested that droughts are indeed a greater threat to Singapore's sustainability and development rather than flooding (Biswas, 2012).

2.2 Exposure

Despite its small size, the infrastructure and population of Singapore are exposed to hazards to varying degree depending on the local topography, soil conditions, proximity to rivers and the ocean among other factors. Figure 3. already highlighted some of the flooding hotspots in the country, and in terms of earthquakes, it was mentioned that most severe damages due to seismic activity are likely to occur on reclaimed land and on quaternary marine clay deposits. Exposure to diseases also remains relatively high given the population expansion and tropical conditions. Additionally, it has been suggested that increasing rates of enteric fevers and tuberculosis correlates with numbers of migrants and travellers entering the country (Sadarangani, et al., 2017). On the other hand, exposure to vector-borne diseases, including Zika, dengue and chikungunya, is largely correlated with living and working conditions; the rates are higher among migrants in the construction industry (Sadarangani, et al., 2017).

Much of the critical infrastructure and industrial parks are also exposed to the impacts of hazards, mainly heavy winds and flooding (figure 4). Similarly, primary road access and rail infrastructure are equally exposed to rising sea levels in many areas of the island, thus rendering the country's economy vulnerable and exposed to future impacts of flooding and adverse weather. To lessen existing risks, all road and rail infrastructure undergo regular inspections by engineers, and flood barriers have been installed across the country wherever deemed necessary (Government of Singapore, 2015). Additionally, two-thirds of the land area is used as water catchment, wherein rainwater that falls will be collected through a network of canals, drains and rivers and directed out to 17 reservoirs (PUB, 2019).

However, given the complex interconnectedness of modern infrastructure systems, failure of one component can result in cascading collapse in other systems that cluster across these networks (Steve, et al., 2015). Thus, protective measures to improve resiliency must consider not only these linkages between interconnected facilities (such as hospitals or flood pumps relying on electrical grid) which may be compromised by hazards or terrorism, but also their reliance on the internet. While Singapore is ranking high on elaborate cybersecurity strategies, it is not immune to cyber-attacks. In 2018, its healthcare institutions were compromised during which information of about 1.5 million patients were stolen, which facilitated the formation of the Cybersecurity Act to strengthen critical infrastructure (Marsh & McLennan, 2019). Despite such measures, the country is still increasingly exposed target to malicious activity. In the event where attacks penetrate increasingly connected power systems to bring them down, infiltrates airports or – as was the case in 2018 – compromises healthcare, cyber-attacks may have catastrophic consequences to a highly-developed nation which integrates most of its functions into online systems (Deloitte, 2016). Thus, disaster managers must be increasingly aware about the role of protected internet and connectivity as functions of resiliency of smart cities.

Figure 4. Distribution of Industrial parks in Singapore (JICA, 2015)



2.3 Socio-Economic Vulnerability

It is also important to consider socio-economic vulnerability in the context of hazards and disasters, given the fact that their worst impacts are often distributed along the socio-cultural or economic boundaries of individuals and households. Worsened by discrimination based on ethnicity, gender or marginalization, the access to opportunities, schooling or employment is often determined by hierarchies of power and social structures which determine entitlements – the lines between ‘have and have nots’. In Singapore, a highly developed nation, where rates of marginalization and gender exclusion are relatively low compared to many of South East Asian nations, growing gaps in the inequitable distribution of wealth are among the greatest concerns contributing to vulnerabilities.

While the country has invested in its population significantly, supported by the creation of the Skills Development Fund in 1979 and the Lifelong Learning Endowment Fund in 2001 to upgrade the skills of workforce and to improve socio-economic mobility through provision of learning and opportunities, it is still suggested that productivity rates have not improved, social mobility has declined and the relative quality of life (in comparative terms) is poor (Lee & Morris, 2016). Individual performance and the meritocratic system have been viewed to facilitate upward mobility, but in reality, the ability of an individual to improve their socio-economic status correlates largely with class, ethnicity, gender and education, which frame one’s treatment (inclusion or exclusion from opportunities, for example) in the society (Teo, et al., 2018). Thus, disparities have grown in Singapore, wherein low-income classes have begun to form facing disproportionate economic vulnerabilities as opposed to the majority of the population (Ministry of Social and Family Development, 2018). These groups are also more vulnerable to the impacts of disasters due to lack of support networks, low income or assets which renders them more exposed to external shocks.

However, sometimes vulnerabilities are related to age and disability. Elders have been found to be more prone to hospitalisation even in normal conditions, and it correlates highly with income – those residing in public rental housing (as an indicator of socioeconomic status) were more likely extended support and hospital care (Low, et al., 2018). Thus, in recognition of the fact that elderly are often more severely affected by epidemics, heat stress and hazards such as flooding (often due to limited mobility), it can be assumed that the older generations, especially those with low income and lack of support networks, are more likely to be vulnerable to impacts of disasters.

2.4 Physical Vulnerability

Manifold of physical vulnerabilities are also present in the low-lying island country due to large numbers of critical infrastructure and transportation network being exposed to flooding impacts and adverse weather, especially in the future. Also, the high densities render the buildings vulnerable to fires, and while fire prevention measures are in place, potential damages to high-rise buildings can be high.

In consideration of seismic activity, building standards of the city were improved in 2013 to take into account the possible tremors occurring from distant earthquakes. The new guidelines mandate any building above 20 meters in height to implement structural improvements in consideration of seismic activity, its probability and wave frequency (Building and Construction Authority, 2013). Older buildings were also required to undergo

seismic risk assessments and strengthening if so required – however, there is little evidence available online about the actual implementation of such measures.

The Public Utilities Board (PUB) is Singapore's national water agency, responsible over overseeing and regulating the country's whole water infrastructure from supply to conveyance, wastewater discharge and treatment. About half of the total consumption (about 1.1 billion liters per day) is imported from the Johor River from Malaysia, wherein it is treated in-situ at PUB managed facilities near the town of Kota Tinggi (Chuah, et al., 2018). However, the region, despite its reservoir which was constructed in 1992, is vulnerable to saltwater intrusion during high tides and storms, alongside droughts which may temporarily compromise this supply (Chuah, et al., 2018). Thus, Singapore is considered a water-stressed country due to its inability to retain water domestically to support local demand.

Additionally, much of Singapore's processing industry comprises chemical and energy companies including Mitsui Chemicals, Clariant, Exxon Mobil, Shell, Petrochemical Corporation of Singapore and Infineum. Given the high density of settlements and their proximity to industrial parks and facilities on the Jurong Island (which houses nearly 100 leading petroleum, petrochemicals and specialty chemicals companies), promoting comprehensive safety and risk management is elemental for the city state to protect its citizens from anthropogenic hazards (Gob, et al., 2015).

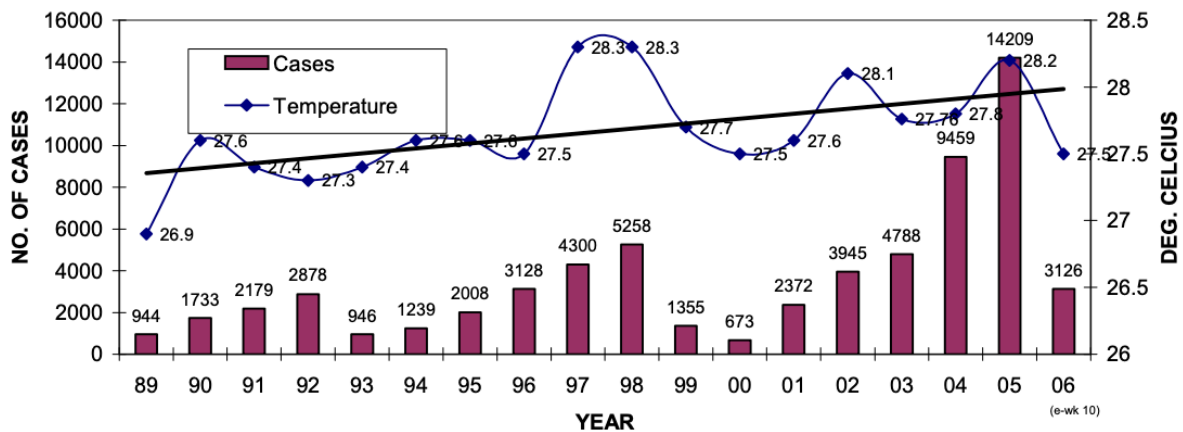
Managing the trade-offs between growth and environmental degradation must also be carefully considered. While the current cityscape incorporates green roofs, and 50 percent of the country is covered by green space, future waste generation and increasing need for land may compromise sustainable development and increase physical vulnerability due to pollution and compromised natural systems. For example, the city generated 7.7 million tonnes of waste in 2017 at an average household recycling rate of 21 percent (Ministry of Foreign Affairs, 2018). Yet, on par with population and economic growth, the amount of waste generation is projected to increase which may threaten the current capacity to manage waste in Singapore, unless new options are explored (Ministry of Foreign Affairs, 2018).

2.5 Future Disaster and Climate Risks

As mentioned earlier, climate change will have an exacerbating effect on the impacts of hydrometeorological hazards from droughts to rainfall and flooding, which may compromise the safety and wellbeing of people alongside infrastructure in Singapore, despite the wide range of protective measures which have been installed. It has been projected that the daily average temperature will increase between 1.4 to 4.6 degrees Celsius towards the end of the century, the contrast between monsoons will become more pronounced, the sea level could rise more than 1 meter by 2100, and the impacts of storms may become more severe (Ministry of Environment and Water Resources, 2016). Thus, worsened flooding may cause damages to properties and disrupt traffic. Against this background, the government has identified some primary objectives to increase national resilience. They include the protection of coasts, managing water resources (and flooding), protecting biodiversity, strengthening public health as well as safeguarding critical infrastructure (Ministry of Environment and Water Resources, 2016). However, no detailed or cost assessments are available to determine the potential sectoral costs of adaptation and protection measures.

Additionally, occurrence of flash flooding has already increased, coinciding with localized storm events, and storms of the recent years have become more intense and frequent (Chow, et al., 2016). Also, when measured on the Palmer Drought Severity Index, drought episodes have increased over time, which suggests greater exposure to said hazard (Chuah, et al., 2018). Similarly, the prevalence of dengue (carried by mosquitoes) has become more common over time as temperature and rainfall has allowed more prolific breeding seasons for the insects carrying the disease (as seen in figure 5).

Figure 5. Dengue cases and temperature in Singapore between 1989-2006 (WHO , 2007).



3. Disaster Risk and Climate Action Interventions

Today, Singapore is facing the challenges of the 21st century, and is required to uphold its commitments to the post-2015 development agenda, in recognition of the fact that relative security of the past is now dwindling in the future. The following chapters provide an overview of the country's progress vis-à-vis the mandates of international agreements and frameworks (Sendai Framework for Disaster Risk Reduction, Sustainable Development Goals and the Paris Climate Agreement), highlight some of the key issues relating to their implementation, and provide suggestions for improving the further mainstreaming of DRR, CCA and sustainable growth in the country.

Priority 1. Understanding Disaster Risk Analysing, collecting and managing disaster and climate risk-related data are the cornerstones for achieving a comprehensive understanding of disasters, by helping in the processes of conducting risk and vulnerability assessments, in prioritizing investments for resilient development, as well as in supporting sustainable and risk-informed land use planning. Data should also be categorized as well as appropriately disaggregated to facilitate disaster trend projections and identification of impacts to different demographics, and all the information should be accessible to the public and authorities at all levels, stored within well-managed disaster information management systems. This would be the first step to facilitate disaster and climate risk management from a whole-of-society perspective, wherein governments, the private sector, communities, households and individuals are aware of the risks and their responsibilities in societal risk management.

In Singapore, the Public Utilities Board is among the most important stakeholders in managing risk-related information especially in terms of flooding, by maintaining a comprehensive flood-exposure map and by engaging with building owners to provide their advice in developing protective measures vis-à-vis up to date hazard information (PUB, 2019). The Singapore Monetary Authority has also funded external stakeholders (Institute of Catastrophe Risk Management, ICRM) to develop comprehensive risk assessment mechanism for earthquakes, informed by baseline data from the Singapore National Inventory to explore the current urban development context, contrasted to secondary data and open-source software (GIS) (Nanyang Technological University, 2015). The country also hosts the Earth Observatory of Singapore, which is a regional research center monitoring earthquakes, volcanic eruptions, tsunamis and climate change in and around Southeast Asia, leading the change towards safer and sustainable societies (Earth Observatory of Singapore, 2019).

At the National Level, Singapore Department of Statistics is the main authority collating baseline data about the population, households, labour and productivity, and the sectors of industry among others. The agency also maintains an overview of the regional climate averages, progress made in terms of Sustainable Development Goals and levels of air pollution, monitored closely through the Telemetric Air Quality Monitoring and Management System (Singapore Department of Statistics, 2019). Yet, it seems that while these stand-alone services are advanced and serve their purpose for various practitioners, much of the hazard and climate change-related data remain fractioned across different stakeholders. Research conducted under this report has revealed no national, easily accessible database which would collate all disaster and climate risk related information

or existing vulnerability and risk assessments, and it remains unclear how the existing information is utilized tangibly in sectoral development (especially given that much of the construction is led by the private sector).

Priority 2. Strengthening Disaster Risk Governance to Manage Disaster Risk Given the small size of the country, Singapore utilizes a somewhat unique system for disaster management, based on the Whole-of-Government Integrated Risk Management Policy Framework (WOG-IRM). It incorporates provisions for disaster response, including medical emergencies and mass fatality management, alongside outlining an integrated approach to DRR across sectors and ministries. It is intended to provide effective cross-agency management of crises through closely managed collaboration and communication structure, characterized by a rigid hierarchy (CFE-DM, 2017). Four key agencies constitute to the core disaster management structure: The Strategic Planning Office, The Home front Crisis Ministerial Committee (HCMC), the National Security Coordination Secretariat and the Ministry of Finance. In the event of a disaster, the HCMC, headed by the Ministry of Home Affairs, leads the strategic incident management (through the Homefront Crisis Management System, HCMS), and during peacetime, it is the primary policy-making body related to governing emergencies, safety and security. The HCMC also comprises various other groups including the Homefront Crisis Executive Group (charge in planning and managing of all disaster categories which reports to the HCMC), alongside numerous inter-agency management groups which support coordination across relevant stakeholders (Lai & Tan, 2013). For implementation of disaster management activities, the Singapore Civil Defence Force (SCDF) plays a primary role in emergency response, fire safety enforcement, public projection and community engagement under the direction of Ministry of Home Affairs (CFE-DM, 2017). The SCDF also operates an Emergency Response Plan (ERP) and supportive guidelines which integrate Fire Emergency Plan (FEP), In-Place Protection Plan (IPP) and Arson Prevention Plan (APP). As of now, public buildings are mandated to develop their own FEPs, but process is underway to mainstream wider ERPs to public development (SCDF, 2019).

In terms of legislation, no comprehensive disaster management law exists in the country, only individual laws based on specific events (JICA, 2015). They include the Fire Safety Act of 1986, Environmental Pollution Control Act, (2002), Civil Defence Act of 1986 and the Defence Shelter Act of 1997. These are supported by the comprehensive Operation Civil Emergency (Ops CE) plan, which outlines the national contingency and operations plan to prepare for an emergency. National Tsunami Response Plan and Infectious Disease Act have also been implemented. For climate change-related concerns, National Climate Change Strategy (2012), Climate Change Awareness Programme (2006), Singapore Green Plan (2012) and the Sustainable Development Blueprint (2009) have all been implemented to respond to the challenges, supported by the formation of the National Climate Change Secretariat in 2010, providing coordination at the highest level for domestic and international policies, plans and action (Naon, 2014). Current initiatives include the Public Sector Sustainability Plan for 2017-2020, Climate Action Plan (2016) and the establishment of the Inter-Ministerial Committee on Climate Change to ensure coordinated approach (National Environment Agency, 2019). The Climate Action plan is especially important, as it comprises two publications outlining how Singapore intends to reduce its greenhouse gas emissions and to improve its energy efficiency by 2030, and defines a strategy for climate adaptation at all levels (Ministry of Environment and Water Resources, 2016). The adaptation strategy focuses on coastal protection (including restoration of mangrove ecosystems in Pulau Tekong), managing water resources sustainably, improving biodiversity and greenery, protecting public health (especially from heat stress and vector-borne diseases) alongside

improving public infrastructure and its resiliency (Ministry of Environment and Water Resources, 2016).

Table 1. Singapore's legislative plans and policies relating to disaster risk management and risk reduction

IMPLEMENTATION	PLAN/POLICY	SCOPE	PURPOSE
STRATEGIC PLANNING OFFICE, HCMC, NATIONAL SECURITY COORDINATION SECRETARIAT, MINISTRY OF FINANCE	Whole-of-Government Integrated Risk Management (WOG-IRM) Policy Framework	National	Seeks to improve disaster management, risk reduction and risk awareness at all levels, incorporates medical response and other relevant measures required to manage crisis and improve emergency preparedness
MINISTRY OF HOME AFFAIRS AND RELEVANT AUTHORITIES	Civil Defence Act (1986)	National	Legal framework for declaring a state of emergency and to deploy national service rescuers if so required to support the Singapore Civil Defence Force
NATIONAL CLIMATE CHANGE COMMITTEE, RELEVANT AUTHORITIES AND STAKEHOLDERS	National Climate Change Strategy (2012)	National	Comprehensive framework intending to improve climate change adaptation efforts across sectors. Includes provisions for urban vulnerability reduction
GOVERNMENT OF SINGAPORE, RELEVANT AUTHORITIES AND STAKEHOLDERS	Climate Action Plan 2016	Whole-of-society	Two complementary publications containing information about plans to achieve reductions in greenhouse gas emissions and outlining the strategy to respond to climate change-related challenges proactively

Priority 3. Investing in Disaster Risk Reduction for Resilience In terms of funding disaster risk reduction initiatives or climate change adaptation, limited secondary data is available for the purposes of this report. No detailed studies, research or other material about the exact functioning of financing disaster governance in Singapore exist online, thus rendering this assessment incomplete. However, it is clear that funding to ministries is fixed to a percent of the GDP, falling and rising depending on the country's revenues. Ministries do plan on a multi-year basis, but they must recognize the potential fluctuation of their budgets depending on the wider market conditions (Ministry of Finance, 2019). Yet, the governments analysis of revenue and expenditure for the financial year of 2019 provides no details about investing to DRR, CCA, risks mitigation, sustainable development nor to low-carbon development (Government of Singapore, 2019).

Despite insufficient online source to review budgetary allocations for DRR, it is fair to highlight that investing for resilient development, especially in water security and flood risk reduction is paramount for Singapore. There are a number of initiatives targeting the improvement of available and accessible clean water through increasing reservoirs and water retention areas, drainage capacity, and development of structural mitigation for flood control, which have been integrated into overall architecture of the island. Various projects aim to create multiple benefits, for example, the construction of the Marina Barrage in 2008, on the mouth of Marina Channel in the southern part of Singapore, as part of a comprehensive flood control scheme, resulted in the triple benefits of steady water supply, flood control, and a recreational space for the community. The Active, Beautiful, Clean Waters (ABC Waters) Programme, started in 2006, has also transformed utilitarian drains and canals into attractive waterways by using green cleansing features and will expand into 100 potential sites until 2030. Another flagship program - NEWater and desalinated water - is expected to meet up to 85 percent of Singapore's water needs by 2060, thus addressing the long-term issue of water scarcity in dry weather and enhance water security (Ministry of Foreign Affairs, 2018).

In term of budgeting for disaster risk management, unlike most nations which have regular budgetary provisions for potential disaster relief and early recovery purposes, the Government of Singapore has no annual budgetary allocations for disaster response due to low risks (Lai & Tan, 2013). However, the government is able to activate budgetary mechanisms by drawing funding from other sources rapidly in the event of a disaster to guarantee adequate financial capacity. On preparedness and capacity building, the Singapore Civil Defence Force (SCDF) has been elemental in implementing a range of preparedness activities for the public, volunteers, as well as trainings and provision of equipment and technology to strengthen DRM functions of concerned agencies and SCDF staff (CFE-DM, 2017).

Priority 4. Enhancing Disaster Preparedness for Effective Response to “Build Back Better” in Recovery, Rehabilitation and Reconstruction Despite Singapore being relatively sheltered from the impacts of major hazards, and has experienced very few disasters in the past, the government has well prepared to respond to catastrophic events by establishing a rigid, hierarchical framework for operations. The SCDF leads disaster response, operating through a three-tiered command structure consisting of four Civil Defence Divisions (CDDs). The CDDs oversee 14 fire stations, providing resources of incident management on the ground. Satellite Fire Posts have also been established for firefighting purposes, which enable faster response on site where fire incidents may occur (CFE-DM, 2017). In an event of a major disaster, the SCDF will activate the Operations Civil Emergency Plan (Ops CE), outlining roles and responsibilities of all agencies with roles in emergency management. Ops CE is practiced responding to various scenarios from refinery fires to airplane crashes, fires in high-rise buildings, hazardous material events, epidemics and building collapses among others. The public plays an important part in Singapore's preparedness as well. Public education covers fire prevention and safety, evacuation, rescue and first aid across various demographics from children to senior citizens. The long-term objective of public engagement is to have at least one person in every household educated or trained in emergency preparedness under this initiative (CFE-DM, 2017). Response also considers the mitigation of impacts of trauma during and after crises as well as emergencies. The country has also established Caring Action in Response to an Emergency teams, purpose of which is to provide psychological and emotional support for the victims, relatives and rescue workers affected by disaster events (Institute of Mental Health, 2015).

For effective early warnings, the SCDF operates a Public Warning System (PWS) which is a network of sirens that have been placed to strategic locations throughout the main island (SCDF, 2019). It will sound different alarms depending on the event, covering alarms from natural to man-made hazards, as well as attacks or other messages. The system is also capable of signalling to all smartphones which have installed the SGSecure mobile app and are not on silent or vibration mode (SCDF, 2019). Currently, there are 284 omni-directional sirens located in the populated areas.

Building Back Better considerations in Singapore have not been necessary up to date, given the low prevalence of catastrophic disasters. Yet, measures have been put to place to improve the infrastructure vis-à-vis improved knowledge about hazard risks. For example, the national building codes were revised in 2013 to better accommodate considerations for seismic risks. Furthermore, following the collapse of the Nicoll Highway in 2004 (titled as the greatest civil engineering disaster of the last decade to occur in the country) spurred significant improvements to excavation practices (Hansford, 2012). While braced excavation has always been a feature of transport construction projects in the past, extra measures were added ever since the incident, including improved, more evenly placed support struts and beam earth retaining wall systems (Hansford, 2012).

4. Coherence with Sustainable Development Goals and the Paris Climate Agreement

Disaster management, climate change adaptation and sustainable development share similar characteristics, overlapping strategic objectives and synergies which should be harmonized across various policies to guarantee maximum efficacy. Separate legislative provisions, strategies, frameworks and plans targeting DRR, CCA and sustainable development may create overlapping, redundancies, repeated efforts and thus, wasted resources. Existing DRM frameworks should be revised in accordance with the post-2015 development agenda to identify how countries could best prioritize and synchronize their domestic efforts vis-à-vis on-going projects, available funding, risks and vulnerabilities to achieve the highest potential for holistic disaster risk management. While Singapore has not had much need to revise its disaster management framework vis-à-vis contemporary challenges, it is crucial to comprehensively institutionalize climate change adaptation and risk reduction (with clear provisions of funding) into government's policy approaches, to be mainstreamed throughout the sectors of development.

In terms of Sustainable Development Goals (SDGs), sustainability in planning and growth has underpinned the country's policymaking since gaining its independence due to its small size and dependence on external sources for food, energy and water. Thus, development has been human-focused with priorities in healthcare, housing and education and growth has been controlled carefully to avoid disruptions to the natural environment (Ministry of Foreign Affairs, 2018). With its 50-percent green cover, Singapore remains as one of the 20 most carbon efficient countries in the world, and smart city planning seeks to develop bottom-up solutions to sustain the current pathway (Ministry of Foreign Affairs, 2018). Yet, numerous challenges are compromising the current objectives to maintain growth and stability vis-à-vis the pressures of demographic changes, climate stressors and disaster risks. They include, without limiting to, the aging population, increasing inequities, limited availability of land, reliance on gas, vulnerability to water and food scarcity as well as complexities in sustainable waste management (Ministry of Foreign Affairs, 2018). Responses to these challenges should be further rooted into policy and the operations of the private sector to guarantee tangible impacts, but planning is already on a robust foundation. For example, the Sustainable Singapore Blueprint of 2015 has outlined plans to maintain green growth, to improve energy efficiency, to protect quality of life and the environment, as well as to foster community spirit among the citizens. Similarly, the Public Sector Sustainability Plan for 2017-2020 further strives towards improved efficiency, waste management, water conservation and adoption of solar technologies in the public sector (Ministry of Environment and Water Resources, 2017).

Responding to climate-change concerns, Singapore ratified the Paris Agreement alongside 30 other countries on 21st of September in 2016 and has now committed to reduce emissions by limiting vehicular emissions and from other sources. By July 2015, the targets were set to reduce emissions intensity by 36 percent by 2030 (Ministry of Foreign Affairs, 2019). In the 2016 Climate Action Plan, the government recognized the synergies between the Paris pledge and SDG13 by asserting that emissions must be reduced within all sectors from industry to transport, power, water and even households (Ministry of Environment and

Water Resources, 2016). Thus, the government's aspirations are clearly rooted into planning for the upcoming decade.

Yet, the scope of disaster considerations remains absent from the climate adaptation and sustainable development planning. It is rather clear that disasters and emergencies are considered a separate element of public governance, latter of which are under the responsibility of the SCDF. However, when facing the mounting threats of worsened flooding, adverse weather, sea-level rise and other hazards, mainstreaming synergized DRR and CCA into development planning should be increasingly focused on. Moreover, the aspirational plans targeted to respond to climate change and sustainable development concerns, framed as elements of productive industries, should be addressed from a perspective which seeks transformation to mitigate risks as opposed to focusing on mere carbon taxation and structural changes when facing the conditions of a risk society, continuously reproducing and contributing to its already existing risks.

Table 2. Some of the synergies between international agreements and different policies, plans and programmes in Singapore

Sectoral Aim	Policies/programs with potential links to Sendai Framework for Disaster Risk Reduction	Policies/programs with potential links to Sustainable Development Goals	Policies/programs with potential links to the Paris Climate Agreement or Environment
National Development	-	Public Sector Sustainability Plan (2017-2020) Sustainable Singapore Blueprint (2015)	National Climate Change Strategy (2012) Climate Action Plan (2016)
Resource Management	Climate Action Plan (2016)	Environmental Pollution Control Act (2002) Climate Action Plan (2016)	Climate Action Plan (2016)
Disaster and Climate Risk Reduction	Whole-of-Government Integrated Risk Management Policy Framework Infectious Diseases Act (1977, last revised 2008) National Tsunami Response Plan	Singapore Green Plan (2012) Sustainable Singapore Blueprint (2015)	Climate Action Plan (2016) National Climate Change Strategy (2012)
Vulnerability Reduction	Enabling Masterplan (2017-2021) Climate Action Plan (2016)	Central Provident Fund and other public support services Enabling Masterplan (2017-2021) Sustainable Singapore Blueprint (2015)	Climate Action Plan (2016) Singapore Green Plan (2012)
Urban Development	Urban Master Plan (2019) Sewerage and Drainage Act (1999)	Sustainable Singapore Blueprint (2015)	Climate Action Plan (2016) Urban Master Plan 2019

5. Issues in the Implementation of Disaster Risk Reduction and Climate Policy

Policies in Singapore, as in any democracy, originate from peoples' aspirations represented through an electorate. Thus, politics and policies cannot be assessed separate from political goals and prevailing ideologies of the government, and most importantly, the people. Now that Singapore is facing the challenges of the post-growth period, wherein increasing pressures such as climate change, inequalities and emerging needs of educated population (influenced by both the prevailing inherent values of Singapore and globalism) are shaping development, the political representation must respond in a manner that provides satisfying policy solutions to the needs of its peoples to maintain their trust. (Loong, Lee, 2016). So far, the country has unarguably maintained a stellar success in its approach to governance and policy, at least when measured in economic terms. However, political immobility when facing evolving and immensely complex 'wicked problems' sourcing from increasingly interconnected systems, environmental stressors and influences penetrating geographical boundaries can be disastrous to any stable governance, unless it is able to integrate changing landscape of risks and vulnerabilities arising from anthropogenic or environmental factors into its policy.

As of now, no clear policy approach (apart from the strategic Climate Action Plan of 2016) has been implemented to further mainstream and synergize DRR and CCA, and it is not clear how much money is currently spent (and how future developments will be funded). Furthermore, policy considerations must explore the options of responding to the challenges posed by ageing population, slowing population growth, and rising costs alongside declining productivity growth (Bhaskaran, 2018). Without adjustments and innovation, the country is unlikely to be able to adapt to the contemporary challenges if the high rates of GDP growth cannot deliver durable and tangible benefits to its people so that citizens can create value in a sustained manner in the future as well (Bhaskaran, 2018).

In terms of reducing GHG emissions and to achieve its targets to transform the energy sector to renewable sources, the government is also facing challenges to implement their policy approaches due to small size and dense urban landscape which limits the development of alternative electricity facilities. Singapore lacks conventional geothermal resources, cannot explore hydroelectric power, and is unable to explore tidal power generation due to its location; and current nuclear technologies remain to be unsuitable to be utilized in the country (National Environment Agency, 2019), and is subject for further study. Approximately 96 percent of the energy in the power sector is sourced from gas, and apart from aspirational plans and carbon taxing (implemented in 2019) there are no other clear policy signals to move away from gas reliance (Climate Action Tracker, 2019). While there are on-going projects to increase solar capacity for electricity generation such as floating solar farms over water infrastructures and reservoirs (PUB, 2019) and installation of rooftop solar photovoltaic (PV) systems on public buildings and properties (Housing & Development Board, 2019), increasing sustainability of the energy sector and reducing carbon footprint remains a challenge given the rising demand for electricity output from the industry and infrastructure sectors.

6. Stakeholder Analysis

Numerous national level stakeholders play an important part in the management of emergencies and disasters in Singapore. As explored earlier, the Ministry of Home Affairs, Singapore Civil Defence Force, Ministry of Health, and the Police among other ministries and agencies are elemental in supporting the government's activities not only in disaster response, but preparedness as well. Due to its multi-agency approach, a wide range of expertise from different fields have been involved in disaster operations in the country, which benefits from its hierarchical and robust coordination system.

It should also be mentioned that Singapore has sought to build a strong network of bilateral agreements and relationships throughout Asia and globally. The country is a member of the Association of Southeast Asian Nations (ASEAN), which is the cornerstone of Singapore's foreign policy as a means to support its economic competitiveness, and to provide the region with a platform wherein key international actors may collaborate on strategic issues (CFE-DM, 2017). Similarly, the ASEAN Regional Forum is an important for security dialogue, drawing from its members in the Asia Pacific region. Australia and Singapore also cooperate on many integral issues relating to trade and security through a bilateral agreement covering aspects of defence, education, trade and tourism. Similarly, trade between Singapore and Indonesia in 2015 reached US\$ 58 billion, and Singapore is among its top foreign investors.

Under the ASEAN mechanism, Singapore is a signatory party of the ASEAN Agreement on Disaster Management and Emergency Response (AADMER), serving as a policy backbone and platform for cooperation on DRR among ASEAN member states. Through ASEAN, and other multilateral and bilateral partnerships, Singapore collaborates with countries and partner agencies on DRR initiatives and policy discourse, including ASEAN Strategic Policy Dialogue on Disaster Management, ASEAN Senior Executive Programme on Leadership in Disaster Management, and by providing support to overseas humanitarian assistance and disaster relief missions through the Singapore Civil Defence Force (SCDF)'s USAR Team, also known as the SCDF's Ops Lionheart Team - the first team in the Asia-Pacific region classified as Heavy Urban Search and Rescue (USAR) or the highest classification provided to USAR Teams by the United Nations (AHA Centre, 2018).

The country is indeed a key strategic nation among the Southeast Asian Nations, and shares five defence arrangements with Australia, New Zealand, Malaysia and United Kingdom, which are an important mechanism for partnership engagement, intended to support interoperability between the members' armed forces through joint exercises. The country is also a home to approximately 140 non-profit organisations, including the World Bank (finding solutions to urban development challenges), Worldwide Fund for Nature (environmental conservation), World Vision (Asia Pacific Headquarters in Singapore) and Save the Children, also operating its Asia Regional office in the country (CFE-DM, 2017). The newly established Southeast Asia Disaster Risk Insurance Facility (SEADRIF) is also domiciled in Singapore, which is an insurance pool intended to provide insurance solutions to the ASEAN member states to narrow their protection gaps in disaster risk management (SEADRIF, 2018).

Community First Responders (CFRs) volunteers are instrumental to supporting the government on search and rescue operations, relief work as well as reaching out to communities for skill building on simple first-aid and basic fire-fighting. Necessary technological hardware and software for CFRs to perform the work is provided by the government (ASEAN, 2019). A partnership between the SCDF, the Singapore Red Cross (SRC) and Mercy Relief (MR) has also been formalized to continue building capacity of community volunteers (SCDF, 2019).

7. Future Priorities

While Singapore is well prepared for disaster events among the nations of Southeast Asia, some challenges are still prevalent in the country. This section intends to provide a brief and concise overview of the most pressing challenges, vis-à-vis recommended priority actions, in recognition of the fact that issues addressed here do contain a level of subjectivity and may change from sector to sector.

7.1 Challenges

Due to its small size, Singapore is facing a range of challenges related to high levels of urbanization and growth of settlements. Among them, loss of natural green spaces and biodiversity are among the highest concerns, especially when combined to the cascading impacts of climate change. Lack of space also limits the options for alternative power generation, thus rendering the country reliant on natural gas to the foreseeable future. This may compromise the efforts to reduce carbon footprint. However, in this context it should be acknowledged that Singapore's contribution to global GHG outputs is marginal, producing only about 0.1 percent of the global emissions (Ministry of Environment and Water Resources, 2016).

Another challenge relates to the rapidly ageing population and persisting income inequality which has risen significantly over the last two decades. The determinate pursuit of economic neo-liberal policies have been suggested to contribute to the formation of groups with poor quality of life and high levels of unhappiness following increasing costs of housing and living combined with descending salaries, a situation which is structural in nature and cannot be fixed 'by working hard' (Lee & Morris, 2016). Most importantly, the lifelong learning aspirations mainstreamed by the government have not improved productivity, reduced inequality nor increased social mobility – thus, new challenges require assessing ways which can support the growth trajectory while acknowledging its gaps, by identifying that well-being cannot be achieved (or measured) solely by economic growth (Lee & Morris, 2016).

Furthermore, climate change is also likely to significantly exacerbate the impacts of hydrometeorological hazards in the country. Adverse weather, rising sea-levels and heavy rainfall are likely to increase the costs of mitigation efforts rapidly in the upcoming decade, while rising food prices (following regional droughts and crop losses) combined with decreasing availability of water may constitute to budget strains at the household levels. All things considered, the economy of Singapore could be reduced drastically given its high dependency on imports, not to mention concerns over individual health and wellbeing. In urban conditions, heat absorption will continue to increase heat-stress and related mortalities, while vector-borne diseases and epidemics are reemerging as more threatening than ever.

Finally, given the rapidly mounting interconnectedness of infrastructure, where much of the operations of a contemporary society are integrated into online systems, cybersecurity concerns are becoming increasingly prevalent in the sector of emergency and disaster management. Cyberattacks which may have the power to compromise electricity production, healthcare provision or the transport sector have a devastating potential from a systems perspective, where a fall of a one individual element may compromise the whole, connected network of interdependent facilities.

7.2 Priority Issues

Firstly, evidence collated here suggests that emergency management and development planning (sustainability and reduction of GHGs) are treated as separate issue, and no synergies exist between various policy pieces. Integrating DRR as a cornerstone of sustainable and climate resilient development would be elemental given the prevalent climate-related concerns. Rooting these aspects into policy is also necessary. Currently, aspirations are expressed in various sectoral and national plans, but comprehensive mainstreaming of synergised DRR, CCA and sustainable development into policy are yet to be made. This calls for a national DRR strategy as an overarching framework to address prevalent hazards and climate-associated risks across all government functionaries and wide stakeholders in a systematic, holistic and coherent manner, serving as a blueprint for all toward resilient and risk-informed development. The strategies shall also guide comprehensive mainstreaming of synergised DRR, CCA and sustainable development in all sectors and complex interconnectedness of the sectors in the country context.

Also, the lack of dedicated fund to DRM is an issue, despite the fact that there is no need to maintain a reserve fund for disaster response. Currently, it is unclear how much of the national government's budget is spent to DRR and CCA activities, whether prioritizations are being made, and what are the priority investment sectors. General provisions for key concerns have been highlighted in many documents (flood vulnerability, water dependency etc.) but no mentions are made about tangible investment plans. Singapore could also benefit from comprehensive risk information database, directed to all public planners and stakeholders in disaster and climate risk management in the country. As of now, while comprehensive exposure, vulnerability and other risk assessments exist, they are stored by numerous stakeholders such as the PUB and are seemingly not available to the public. Compiling this critical information into one national database could significantly improve other stakeholders' capacity (such as the private sector) to integrate risk considerations into private-owned investment such as in construction or land development, and it would ease external risk assessment and consultation processes.

Despite Singapore's past success, driven by growth-orientated policy agenda and low social spending to boost the economy, it seems that this pathway is now closing towards its end. Given that poverty levels (discussed in relation to employment conditions, social challenges and living standards) are now deteriorating, inequalities are increasing and now that limited social mobility is becoming intergenerational, social inclusion should be increasingly adopted as national priority (Ng, 2015). It is also important that gender equality in employment is improved by enhancing women's opportunity to enter or re-enter the workforce through policy frameworks that reduce gender gaps in education and bridge the current divide in science, technology, engineering, and math (STEM) professionals, while providing attractive subsidies and incentives to retain women in employment (Nair, 2019).

Increasing the rates of social spending is also elemental to sustain the growing numbers of elderly and to avoid the adverse impacts of reversed demographic dividend. High levels of self-sustenance, as well as they may work for a profit-seeking economy, will be impossible to maintain in a context characterized by increasing costs of living, food, goods and services (again, a feature of free-market economies) wherein personal resources begin running low rapidly. An introduction of more inclusive measures common to welfare states shall be pursued, as anti-welfare policy, after forty successful years, might not adequately respond to the current social challenges and social stratification. Responding to income inequality

and rising poverty may entail short and long-term policy actions including introducing a minimum wage, unemployment insurance, limiting the number of foreign workers, reforming the education system, as well as reforming the taxation system to include taxation of assets as well (Smith, et al., 2015).

Given the increasing severity of disasters in the region as a result of changing climate, close cooperation on DRR should be widened and deepened. As Singapore is dependent on external supplies, especially food and water - wherein the availability of such commodities is under greater risk induced by potential regional climate shocks and stressors - prior arrangements should be established through partnerships to ensure food and water security in the long run. It is also important that partnership be strengthened to exchange and promote cross-learning on different DRM approaches and resilience building, as well as on transboundary risk which require collective efforts of countries in the region (ASEAN, 2019). The existing platforms such as the Changi Regional Humanitarian Assistance and Disaster Relief (HADR) Coordination Centre (RHCC) which serves as the regional center to facilitate military-to-military coordination in HADR on foreign military assistance to support affected countries as well as strengthen regional capacity for HADR shall be optimized for knowledge sharing and joint exercises (Cook & Chen, 2019).

Building a common understanding on disaster risk of individuals is a key factor for safer community. In the context of Singapore in which disasters are infrequent, raising awareness and sensitizing people on impending hazards, for better preparedness and coping with the impacts would require vigorous efforts (ASEAN, 2019). More collaboration with the private sector shall be sought, especially on developing innovative solutions to address climate threats and security issues (ASEAN, 2019).

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