

Publication: Channel News Asia Online

Date: 25 August 2019

Headline: Commentary: How effectively can Singapore adapt to sea level rise?

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Even as Singapore strives to adapt to rising sea levels, let's not win that battle yet end up losing the larger war against climate change, says the Singapore Management University's Winston Chow.



As a low-lying island, Singapore is especially vulnerable to the "grave threat" of rising sea levels, Prime Minister Lee Hsien Loong warned. (File photo: AFP/Roslan RAHMAN)

SINGAPORE: Singapore isn't alone in confronting the consequences of rising seas.

Several other coastal cities and small islands also face this hazard, and lessons can be drawn from how they plan for and adapt to it.

Recent research shows three general approaches can be considered when dealing with the threat of sea level rise. First, accommodate the threat, which includes flood-proofing existing buildings and infrastructure, or designating areas that would be allowed to flood during high tide.

Second, retreat from the threat, which includes the removal and reallocation of key infrastructure and assets to areas that the sea cannot inundate.

Third, protection from the threat, which includes planting and managing mangrove coasts, or engineered options like sea walls, land reclamation and polders described during Prime Minister Lee Hsien Loong's National Day Rally speech.

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Aerial view of polder site at Pulau Tekong. (Photo: Housing & Development Board)

THE PROBLEM: WE STILL CANNOT ANSWER MANY QUESTIONS DEFINITELY

Our best estimates suggest we can expect sea levels rising by at least a metre in Singapore under current emission scenarios by 2100.

It is very likely this magnitude is an underestimate, as recent measurements taken at Greenland indicate melt rates of its ice sheets are significantly increasing every year.

Herein lies the challenge: A major consideration in assessing the effectiveness of the options Singapore has in dealing with rising sea levels is that we are unable to definitively answer questions of how much and how fast sea level will rise for Singapore 80 years from today despite access to the best climate models available.

The reason isn't so much the quality or accuracy of models used for gauging future sea levels in Singapore. The uncertainty arises because these levels depend on how much future global greenhouse gas emissions arise from our actions locally and globally.

The amount and rate of these emissions strongly affects how quickly large continental ice sheets in Greenland and Antarctica – these large kilometres-thick ice sheets are the main sources of global sea level rise – melt and contribute water to the oceans.

Hence, the recent governmental initiative to fund S\$10 million into future sea level rise research is a welcome one, especially as improved understanding of physical processes affecting sea level rise is critical for adaptation decision-making.

DECISIONS WE NEED TO TAKE IN THINKING THROUGH ADAPTATION

The physical sciences can help in lowering uncertainties of long-term model forecasts of sea levels, but assessing the total effectiveness of coastal adaptation to rising seas requires an arguably more important social scientific approach.

How effective these adaptation measures are strongly depends on the confluence of several factors. First, the role of geography, such as questions of “is there a hinterland that enables coastal retreat?” or “how does the natural or pre-urban coastline historically adapt to rising sea levels?”.

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Continued growth in the world's population and global economic activity will inevitably lead to rising consumption levels and resource depletion. (File photo)

Second, the types of coastal land use exposed, such as the proportion of commercial, residential or industrial areas subject to flooding from rising seas.

Third, the prevailing socio-economic context, with important questions such as “are there areas of commercial and cultural heritage are worth protecting more than others?”, or “are there socio-political and economic resources to implement these for the long term?”

In Singapore’s case, two relevant examples apply. First, identifying low lying flood-prone areas will not give a full picture of the total vulnerability to rising seas of a region.

What’s needed is an assessment of the costs accrued when installing and maintaining coastal protection, and the potential loss of natural ecosystems during its construction. These costs must then be balanced against the benefits of protecting critical infrastructure and property of financial and historical value.

This evaluation requires an in-depth socio-economic assessment of current and future land use, as well as the value judgments of existing natural capital or its ecosystem services provided. The net cost-benefits are needed prior to deciding on the coastal adaptation option.

WHAT’S NEEDED TO DECIDE ON LONG-TERM PROTECTION MEASURES

Second, evaluation of the long-term resilience of each protection measure to increasing sea levels is needed.

An engineered dyke or sea wall for polders may be relatively inexpensive and quick to construct, but it serves one protective function and can be prone to catastrophic failure under severe events.

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Reclamation work at Marina Bay in 1977. (Photo: Urban Redevelopment Authority)

In contrast, a reclaimed coastline with a restored mangrove buffer – like in Chek Jawa or Sungei Buloh – may take more time to develop and requires more careful management.

However, this buffer has multiple functions; mangroves can naturally “adjust” to rising sea levels to protect inland areas while reducing coastal erosion, as well as providing both a natural habitat for wildlife, and a recreational park space for visitors.

In this case, multi-disciplinary research suggests that nature-based adaptation solutions, which often provide more than one function when protecting coasts from hazards, likely result in more resilient outcomes.

Such research, combining science with humanities and social sciences, is clearly needed before deciding on long-term protection measures to sea level rise in Singapore.

WINNING THE BATTLE BUT LOSING THE WAR

Even when all relevant research is completed, and the “best” measure selected to protect Singapore from rising seas, we must not lose sight that adaptation to climate change alone is insufficient.

Mitigation, through reductions of total carbon emissions causing climate change, must go hand-in-hand with adaptation.

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Napping under the sun during a spell of hot weather in Singapore. (File photo: Marcus Mark Ramos)

The S\$100 billion that may be spent on adaptation is likely an underestimate; especially when climate science indicates it is virtually certain sea levels will continue to rise beyond 2100, and more resources would have to be spent on maintaining coastal protection in Singapore in the 22nd century.

Further, there are other short-term climate risks that will affect Singapore before sea level rises beyond a metre.

These include direct climate impacts such as heatwaves, severe storms, droughts and floods, and their indirect effects on food, water, and disease. These cumulative impacts also require potentially costly adaptation measures.

It would thus be sensible to place greater attention on climate change mitigation to greatly lower these risks. While the global response on mitigation is slow but steady, local action can be enhanced considerably.

In Singapore, aside from the government-led mitigation measures like the carbon tax, or individual actions involving lowering personal carbon footprints, local companies in the private sector can also act.

For instance, financial divestment from fossil-fuel industries, and R&D towards renewable energy technologies in the power generation and transport sectors can be effective in significantly reducing carbon emissions.

To extend the military analogy used by PM Lee, ensuring Singapore's survival from climate change requires fighting multiple battles simultaneously. A strategy of focussing only on the battle against sea level rise may end up being a Pyrrhic victory, especially if other fronts are neglected.

Winston Chow is an Associate Professor of Humanities at the Singapore Management University's School of Social Sciences and Office of Core Curriculum. He is a Lead Author for the chapter on Cities, Settlements and Key Infrastructure, and the Cities and Settlements by the Sea paper for the Intergovernmental Panel on Climate Change's Sixth Assessment Report to be published in 2021.

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Source: CNA/si