



Nature-based solutions as ally for developing sustainable metropolises

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INTERACTIONS BETWEEN CLIMATE CHANGE, NATURE AND PEOPLE

Climate change is a threat to nature

Global warming of 1.1°C has already caused dangerous and widespread disruption to ecosystems and species, including from worsening extreme events and sea-level rise

CLIMATE CHANGE

Global warming is caused by burning fossil fuels, destroying nature and unsustainable food systems

Nature loss amplifies global warming

Ecosystem conversion, such as deforestation, releases carbon dioxide into the atmosphere

Climate change affects people

Melting ice, rising sea levels, worsening extreme weather events and decreased food security are some of the impacts and future risks

Rapid, deep and sustained cuts to greenhouse gas emissions across all sectors are needed

Nature is a powerful ally in the fight against climate change

Land and ocean ecosystems can act as carbon sinks, which helps regulate the climate and slow down global warming

People must safeguard and restore nature

30% to 50% of Earth's land, freshwater, and ocean areas must be conserved to maintain biodiversity and ecosystem services on a global scale

Human activities drive nature loss

Humans drive climate change-related environmental changes and modify natural habitat for food production

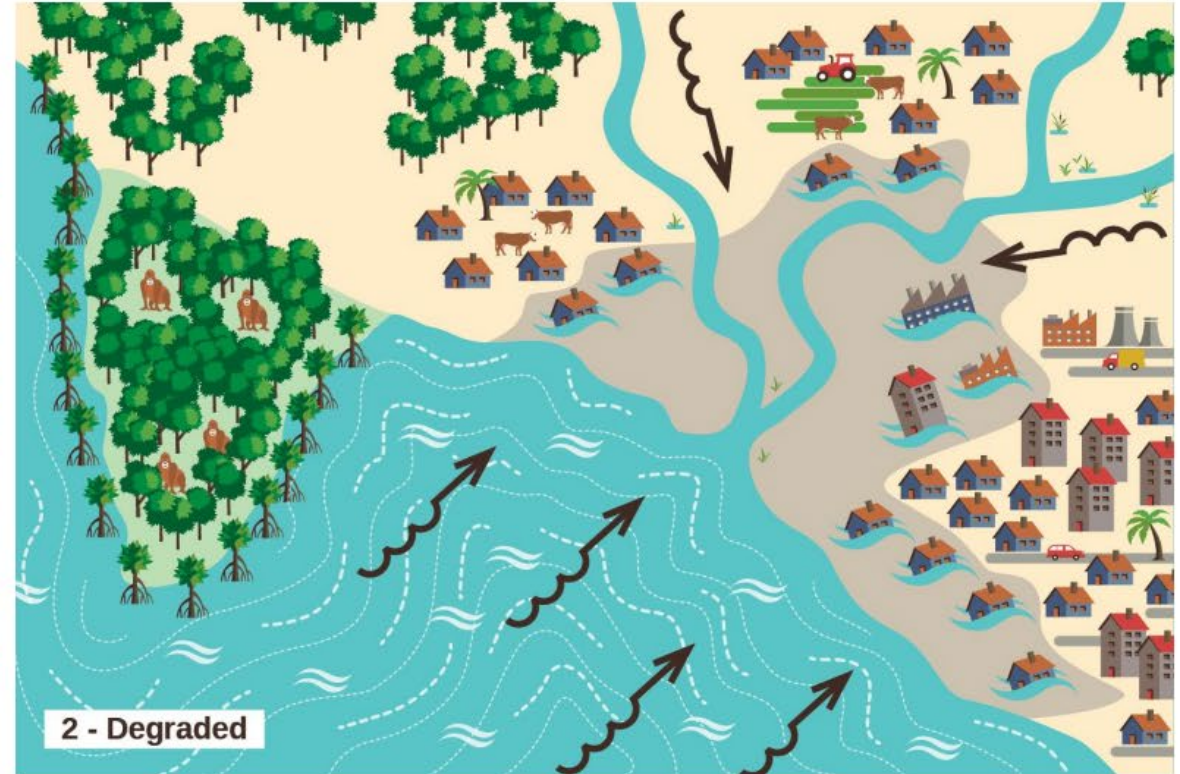
NATURE

PEOPLE

Compromising nature compromises people

When nature is intact, it can provide more ecosystem services such as carbon storage, climate regulation, and enhanced resilience to climate hazards

Human activities drive nature loss and climate crisis



Mindset change



Develop first, conserve later



Holistic Nature-based Solutions (NbS)



What are NbS?



**Nature-based
Solutions**



**Nature-derived
Solutions**



**Nature-inspired
Solutions**

Background of NbS

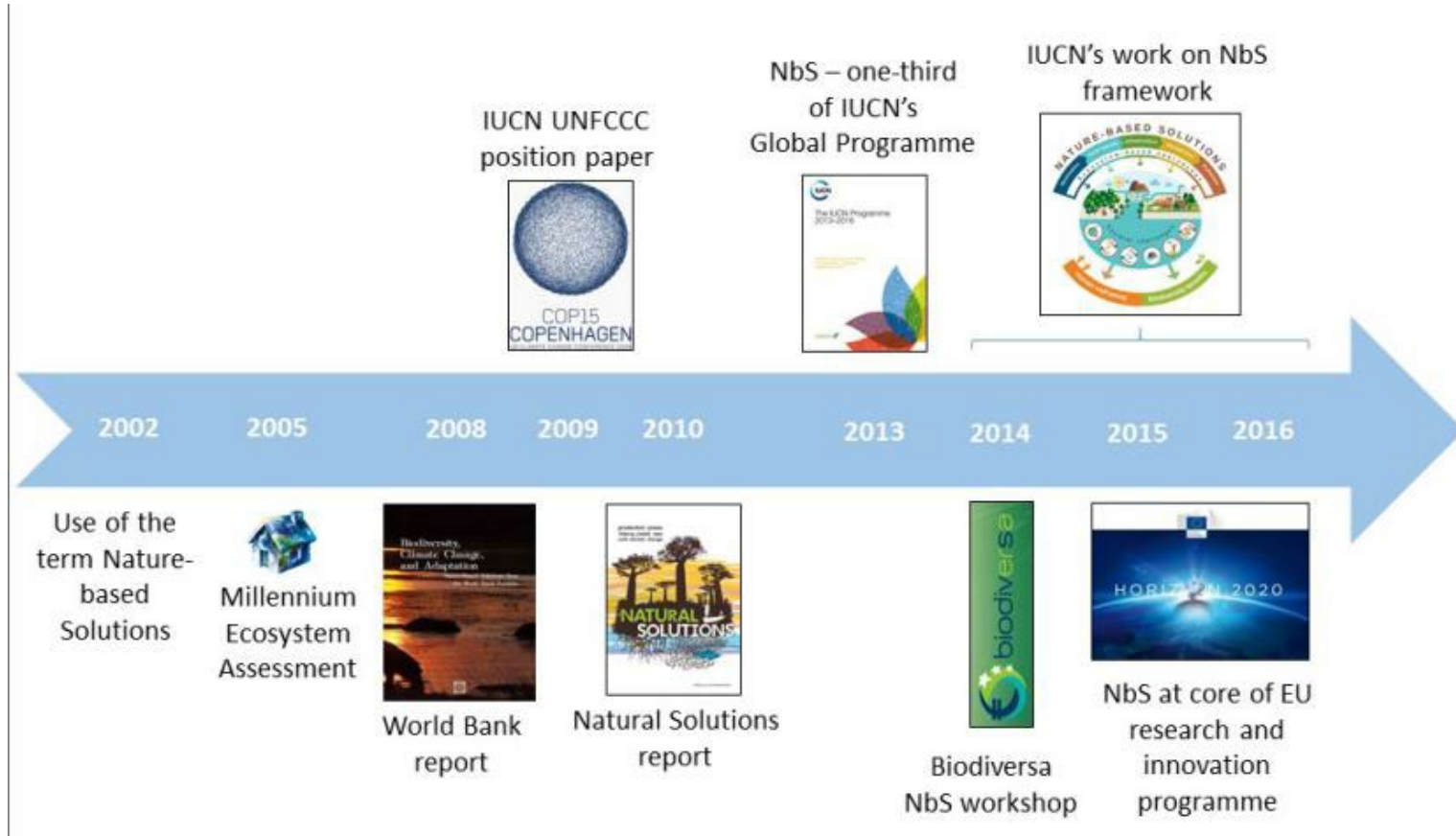


2008

Nature-based Solutions (NbS) were used by the World Bank to highlight importance of biodiversity conservation for climate change mitigation and adaptation

2016

International Union for Conservation of Nature (IUCN) defined NbS



Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S. (eds.) (2016). Nature-based Solutions to address global societal challenges. Gland, Switzerland: IUCN. xiii + 97pp

Defining NbS



Nature-based Solutions (NbS)

IUCN definition	European Commission definition
Actions to protect, sustainably manage and restore natural or modified ecosystems that <u>address societal challenges</u> effectively and adaptively, simultaneously providing <u>human well-being and biodiversity benefits</u> .	Living solutions inspired by, continuously supported by and using Nature designed to <u>address various societal challenges</u> in a resource efficient and adaptable manner and to provide simultaneously <u>economic, social and environmental benefits</u> . (see Maes & Jacobs, 2015)

overall goal of addressing major societal challenges through the effective use of ecosystem and ecosystem services

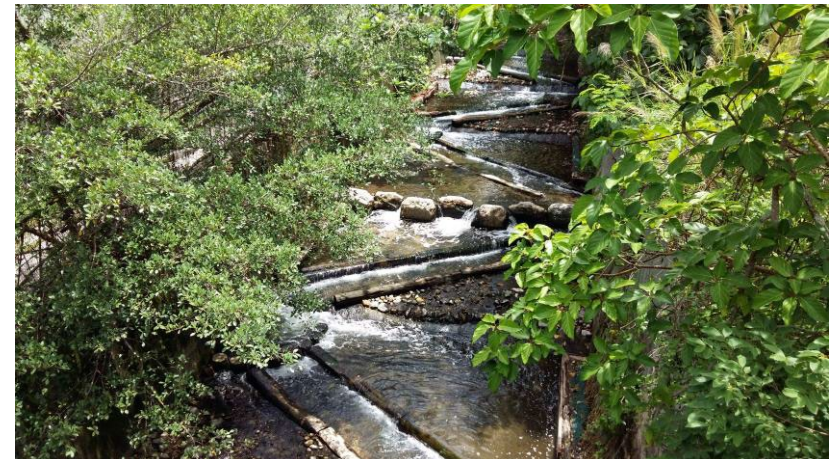
emphasises the need for a well-managed or restored ecosystem to be at the heart of any NbS

broader and more emphasis on applying solutions that not only use nature but are also inspired and supported by nature

Engineered solutions vs NbS

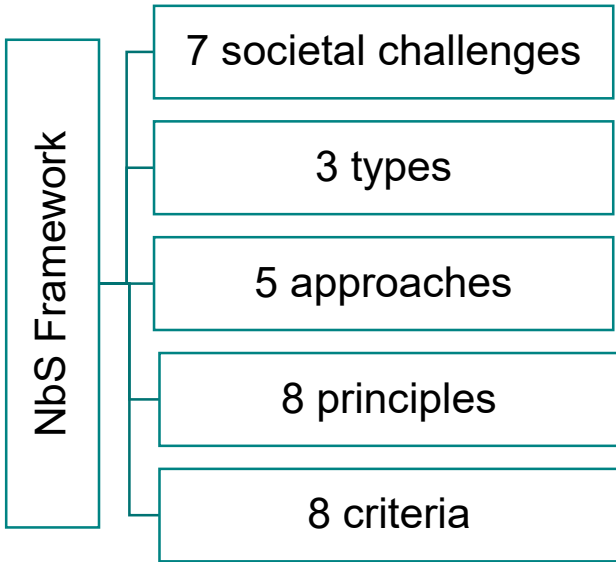


	Engineered Solutions	Nature-based Solutions
Advantages	<ul style="list-style-type: none">• Precise and targeted interventions• Can be implemented relatively quickly	<ul style="list-style-type: none">• Promotes biodiversity• Multiple benefits for human and nature simultaneously
Disadvantages	<ul style="list-style-type: none">• Can disrupt natural ecosystems• May have limited ecological benefits• Relies on finite resources	<ul style="list-style-type: none">• May need longer implementation time• Relies on natural processes(ie. less control)



NbS may complement / even replace engineered infrastructure

The NbS framework



Published in 2016



Nature-based Solutions to address global societal challenges

Editors: E Cohen-Shacham, G Walters, C Janzen, S Maginnis



Published in 2020



Guidance for using the IUCN Global Standard for Nature-based Solutions

A user-friendly framework for the verification, design and scaling up of Nature-based Solutions
First edition



INTERNATIONAL UNION FOR CONSERVATION OF NATURE



NbS to address global societal challenges



NbS Framework

7 societal challenges



Climate change mitigation and adaptation



Disaster risk reduction



Economic and social development



Human health



Food security



Water security

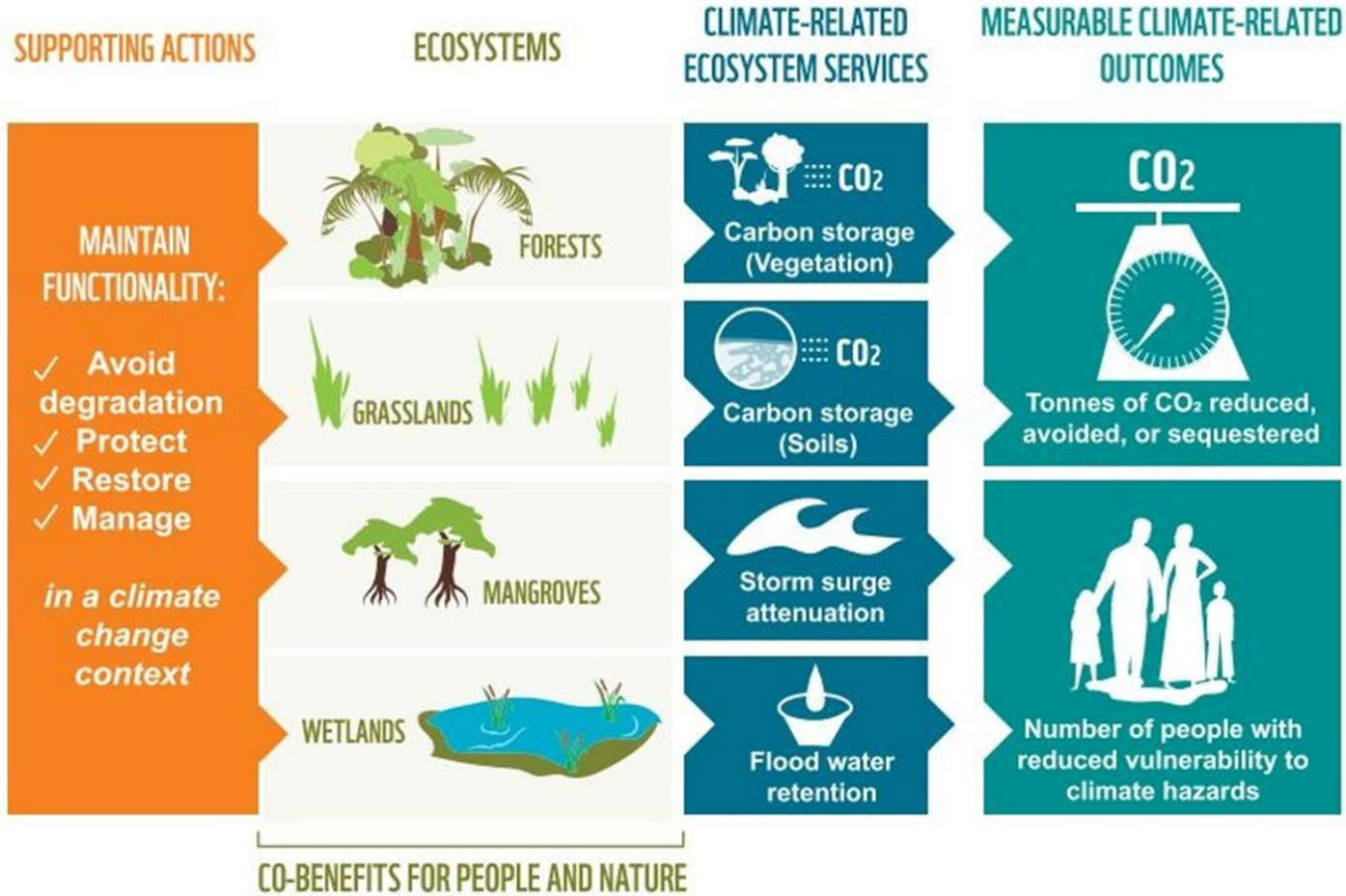


Environmental degradation and biodiversity loss

NbS to address global societal challenges



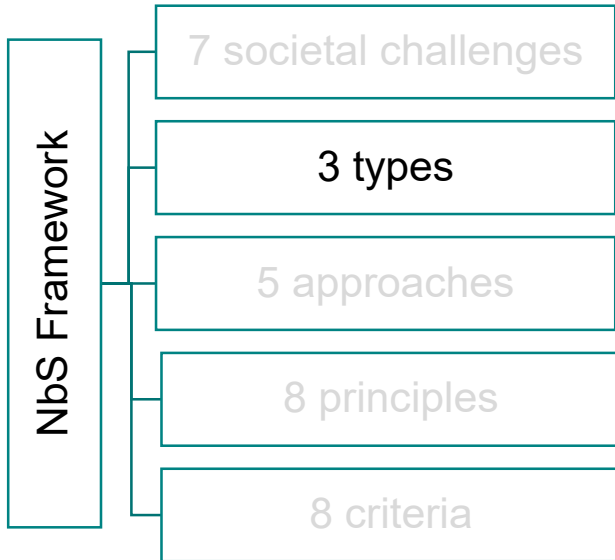
An illustration of NbS to climate change



An example of WWF's work in Hong Kong: Gei wai restoration and mangrove planting



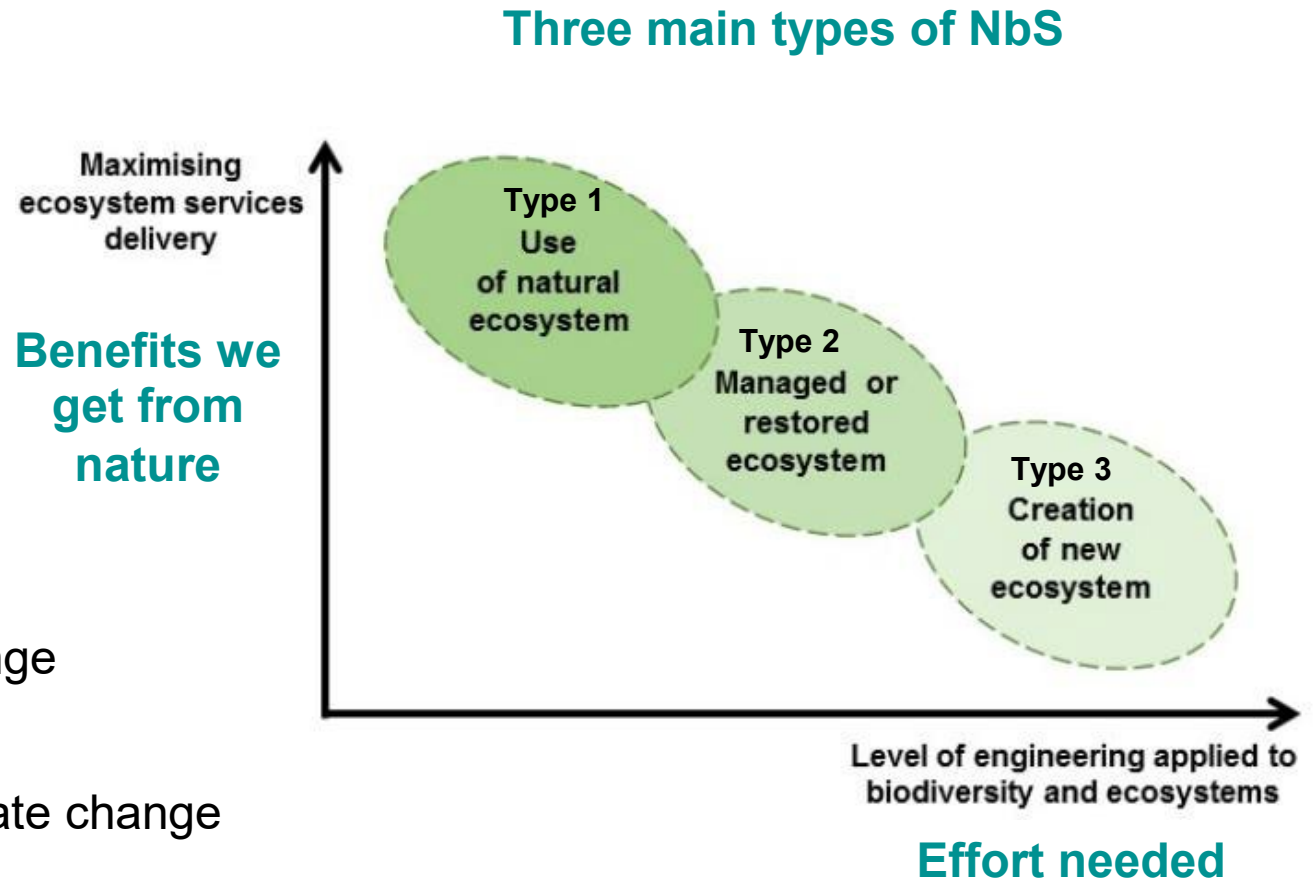
The three main types of NBS



Type 1. Use of natural ecosystem:
Protect intact forest to mitigate climate change

Type 2. Manage/restore ecosystem:
Plant trees to restore forest to mitigate climate change

Type 3. Create new ecosystem:
Green roof to mitigate climate change



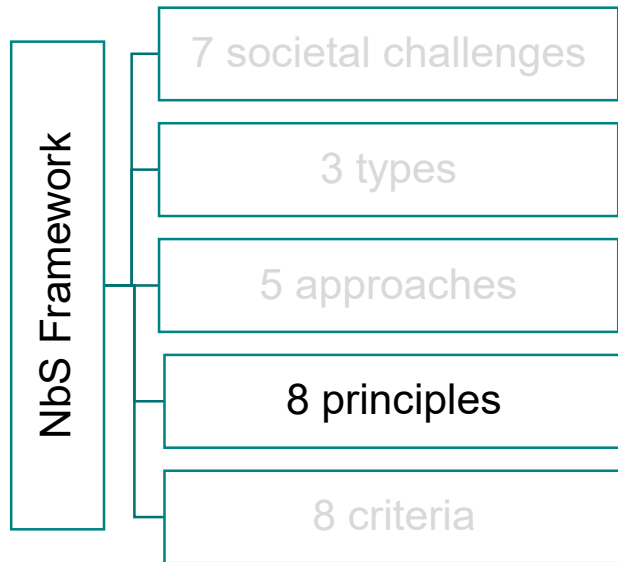
Source: adapted from Eggermont et al., 2015.

NbS is an umbrella concept of different ecosystem-based approaches



Category of NbS approaches	Examples
1. Ecosystem <u>protection</u> approaches AbC	Area-based conservation (AbC) approaches including protected area management
2. <u>Issue-specific</u> ecosystem-related approaches EbA EbM Eco-DRR CAS	Ecosystem-related adaptation (EbA) Ecosystem-based mitigation (EbM) Climate adaptation services Ecosystem-based disaster risk reduction (Eco DRR)
3. <u>Infrastructure</u>-related approaches GI NI	Natural infrastructure (NI) Green infrastructure (GI)
4. Ecosystem-based <u>management</u> approaches EbMgt	Integrated coastal zone management Integrated water resources management
5. Ecosystem <u>restoration</u> approaches ER EE FLR	Ecological restoration (ER) Ecological engineering (EE) Forest landscape restoration (FLR)

IUCN Resolution 069 – Principles for NbS



Principle 1	NbS <u>embrace nature conservation norms and principles.</u>
Principle 2	NbS can be implemented alone or in an integrated manner with other <u>solutions to societal challenges.</u>
Principle 3	NbS are determined by <u>site-specific natural and cultural contexts</u> (incl. traditional, local and scientific knowledge).
Principle 4	NbS produce <u>societal benefits</u> in a fair and equitable way in a manner that promotes transparency and broad participation.
Principle 5	NbS maintain <u>biological and cultural diversity</u> and the ability of ecosystems to evolve over time.
Principle 6	NbS are applied at a <u>landscape scale.</u>
Principle 7	NbS recognize and <u>address the trade-offs</u> between the production of a few immediate economic benefits for development, and future options for the production of the full range of ecosystem services.
Principle 8	NbS are an <u>integral part of the overall design</u> of policies, and measures or actions, to address a specific challenge.

From definitional principles to operational framework



Definitional / Conceptual framework

8 Principles:

1. Embrace **nature conservation**
2. Can be implemented **with other solutions** to societal challenges
3. Are determined by **site-specific natural and cultural context**
4. Produce societal benefits in a **fair and equitable way**
5. Maintain **biological and cultural diversity**
6. Are applied at a **landscape scale**
7. Recognise and address the **trade-offs** between immediate economic benefits for development, and future production of ecosystems services
8. Are an **integral** part of the overall design

2014-2016

Missing terms:

- **Adaptive management & governance**
- Effectiveness
- **Uncertainty**
- **Multi-stakeholder participation**
- **Temporal scale & Long-term stability**

2017-2018

Operational framework

8 Criteria (and 28 indicators):

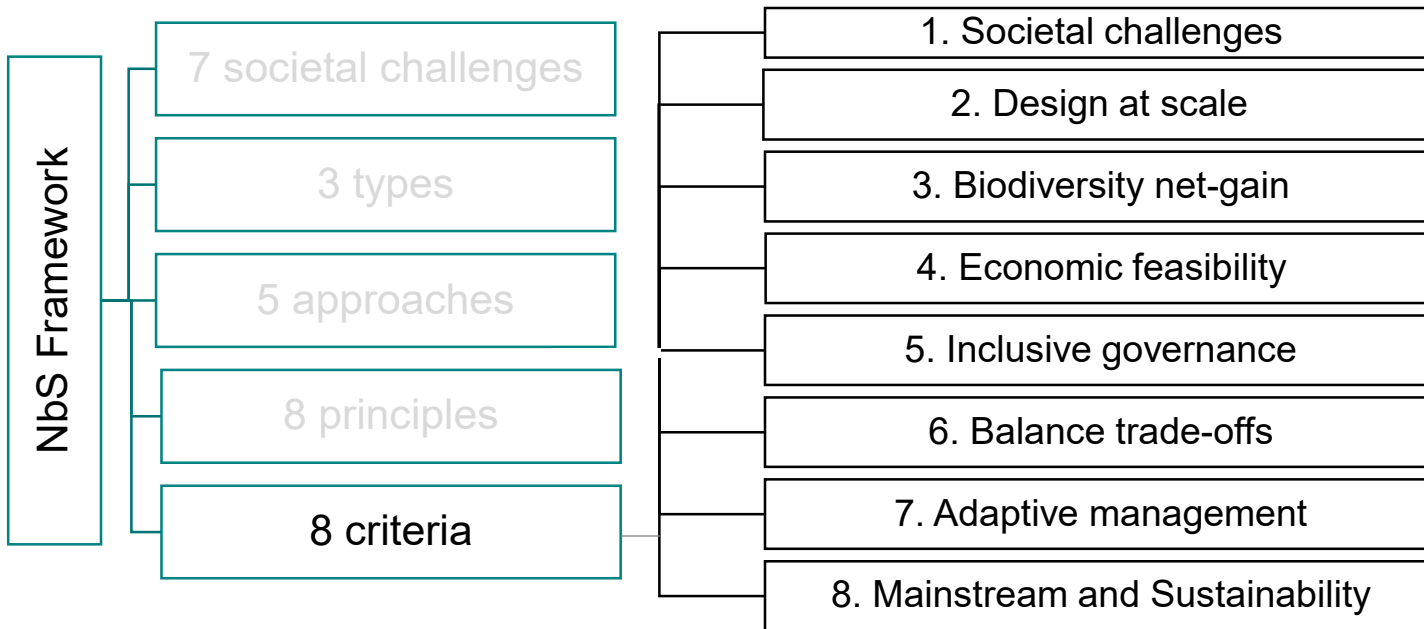
1. **Societal challenges**
2. **Design at scale**
3. **Biodiversity net-gain**
4. **Economic feasibility**
5. **Inclusive governance**
6. **Balance tradeoffs**
7. **Adaptive management**
8. **Mainstreaming and Sustainability**

2018-2020

& Global Consultation



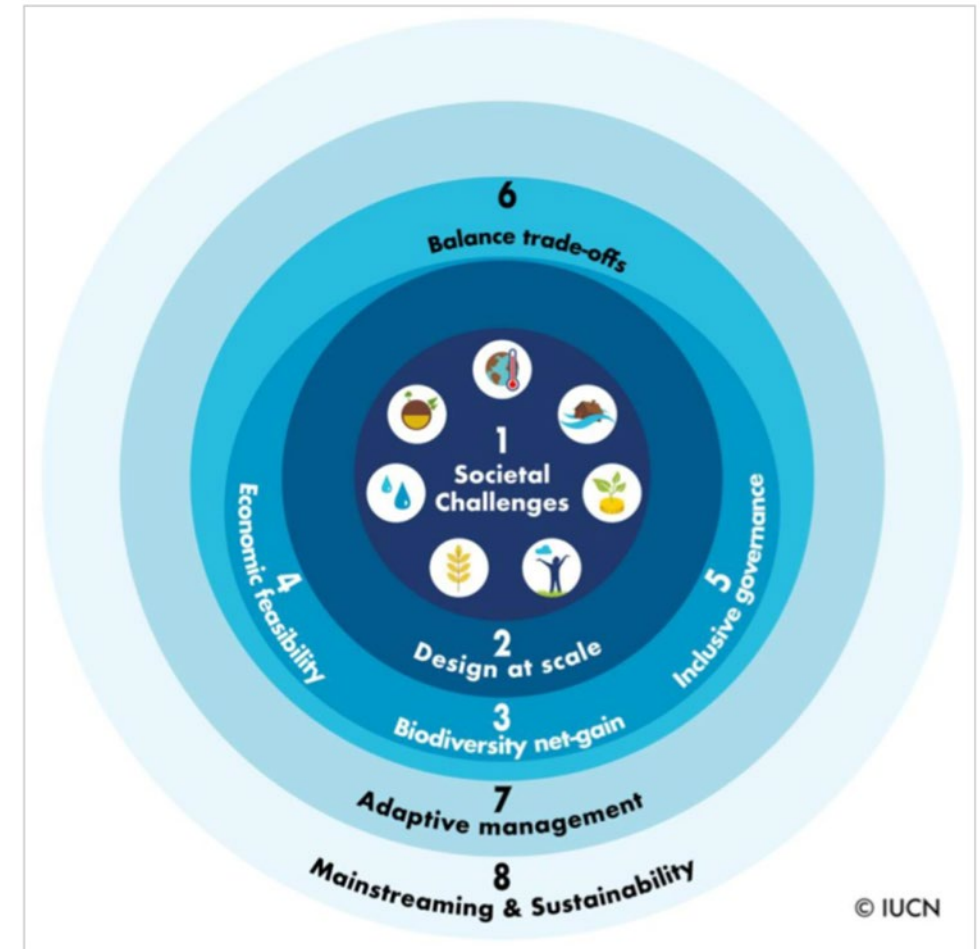
IUCN Global standard for NbS



Purpose:

- Set a common basis of understanding for NbS
- Provide a robust framework, to design, implement, assess, adapt and improve NbS

Audience: project managers, landscape planners, development practitioners, conservationists, policy makers, finance sector representatives (donors and investors), governments and planners.



8 criteria, 28 indicators



Back to Hong Kong

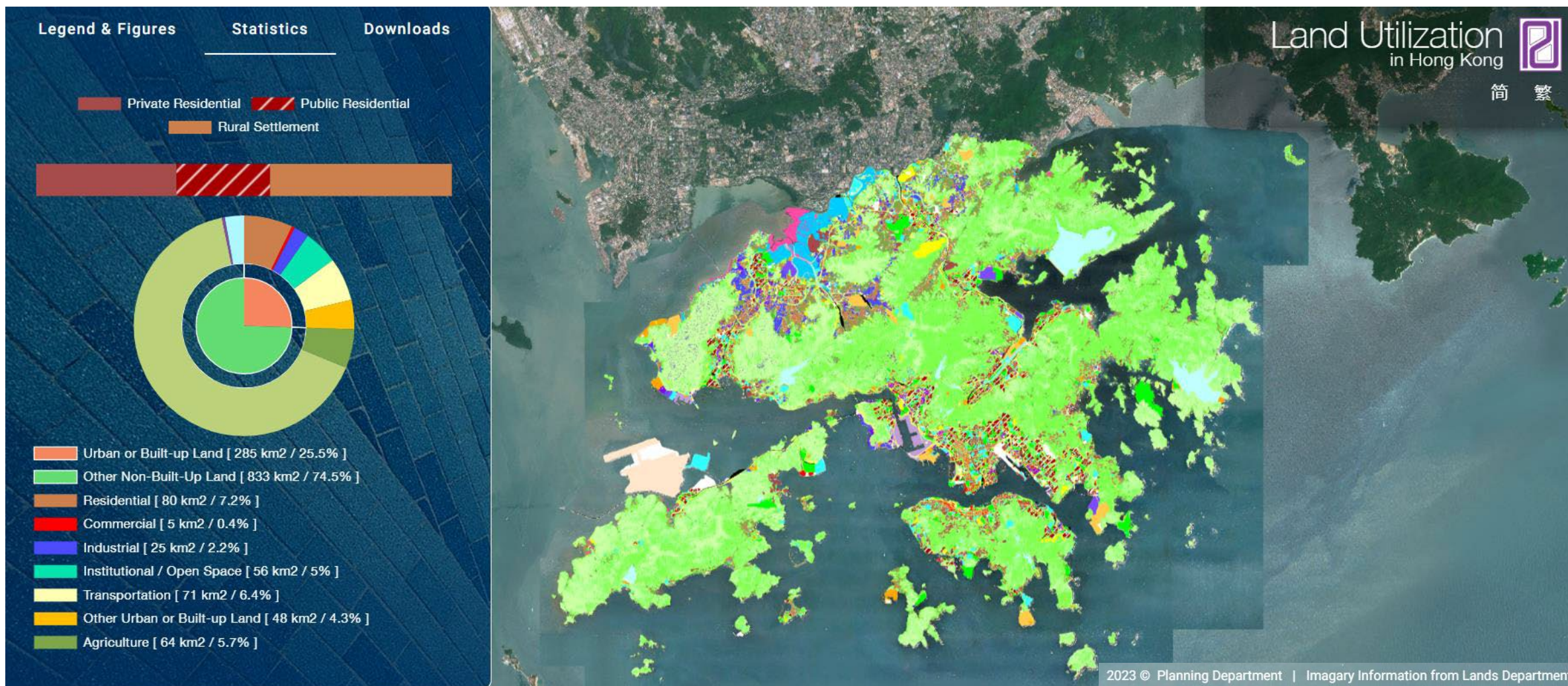
- What challenges we are facing?
- How NbS can help?

Nature in Hong Kong



25.5% Hong Kong land is urban/ built-up land, 74.5% is non-built-up land

About 85% of our population are living within 3km from a country park and 90% within 400m from a park



Habitat diversity in Hong Kong



Hong Kong is rich in biodiversity

Why?

- Tropical location
- Large variety of environmental conditions due to steep topography



Woodlands



Shrublands



Grasslands



Mangroves



Seagrass Beds



Marshes



Rocky Shores



Soft Shores



Coral Communities



Streams and Rivers



Urban Blue-Green Areas

Species diversity in Hong Kong



- 3 300 species of vascular plants
- 55 species of terrestrial mammals
- 570+ species of birds
- 194 species of freshwater fish
- 90 species of reptiles
- 25 species of amphibians
- 245 species of butterflies
- 131 species of dragonflies



Ting Kok Tree Climbing Crab



Hong Kong Bent-winged Firefly



Hong Kong Paradise Fish



Hong Kong Oyster



Mountain Crab



Hong Kong Cascade Frog



Hong Kong Azalea



Hong Kong Clubtail



Hong Kong Camellia



Hong Kong Newt

Just newly described in 2023



Tripedalia maipoensis

Biodiversity loss in Hong Kong



Wetland loss

Lowland habitats are particularly vulnerable to loss and degradation

TABLE 1 Change in the extent of wetland in Hong Kong between 1999 and 2020

Wetland type	Area in 1999 (ha) ^a	Area in 2020 (ha) ^b	Net change	% change
Reservoirs	2,477	2,480	3	0.1
Aquaculture ponds	1,790	1,590	-200	-11.2
Drainage channels	423	720	297	70.2
Rivers/streams/creeks	393	460	67	17.0
Wet agricultural land	2,786	290	-2,496	-89.6
Marshland (5% of this area is brackish)	2,101	1,100	-1,001	-47.6
Total	9,970	6,640	-3,330	-33.4

^aData retrieved from LC (2000).

^bData retrieved from AFCDD (2020).

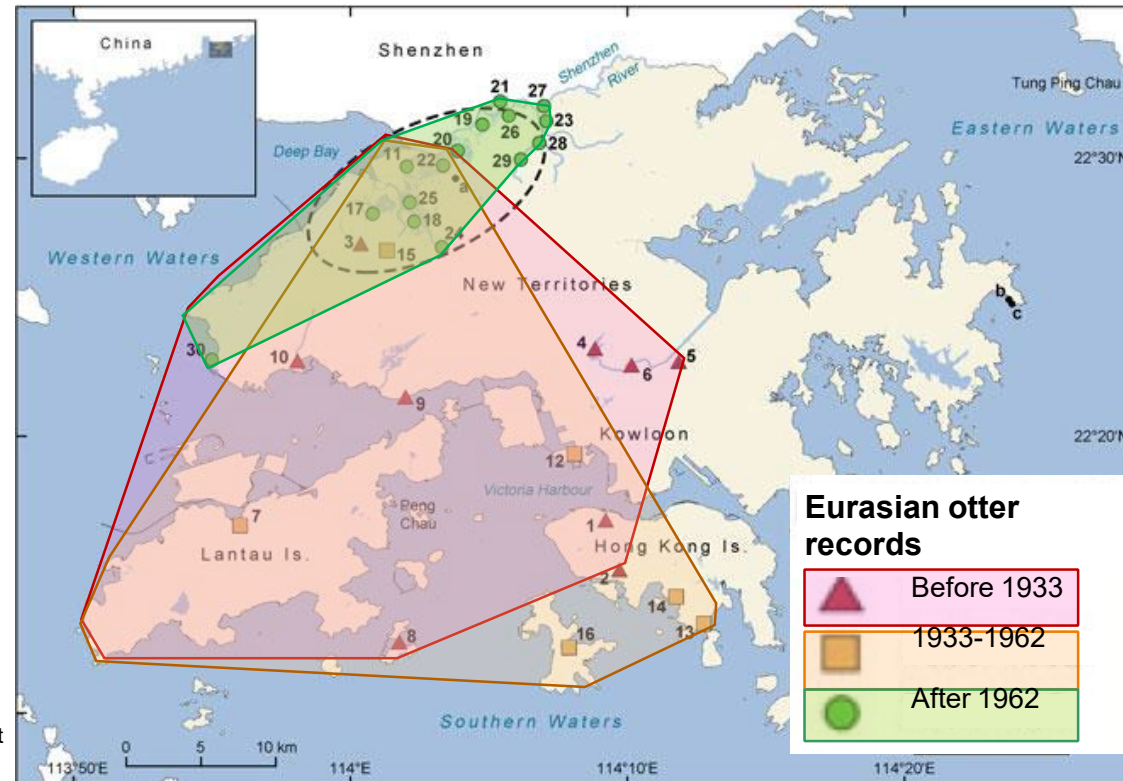
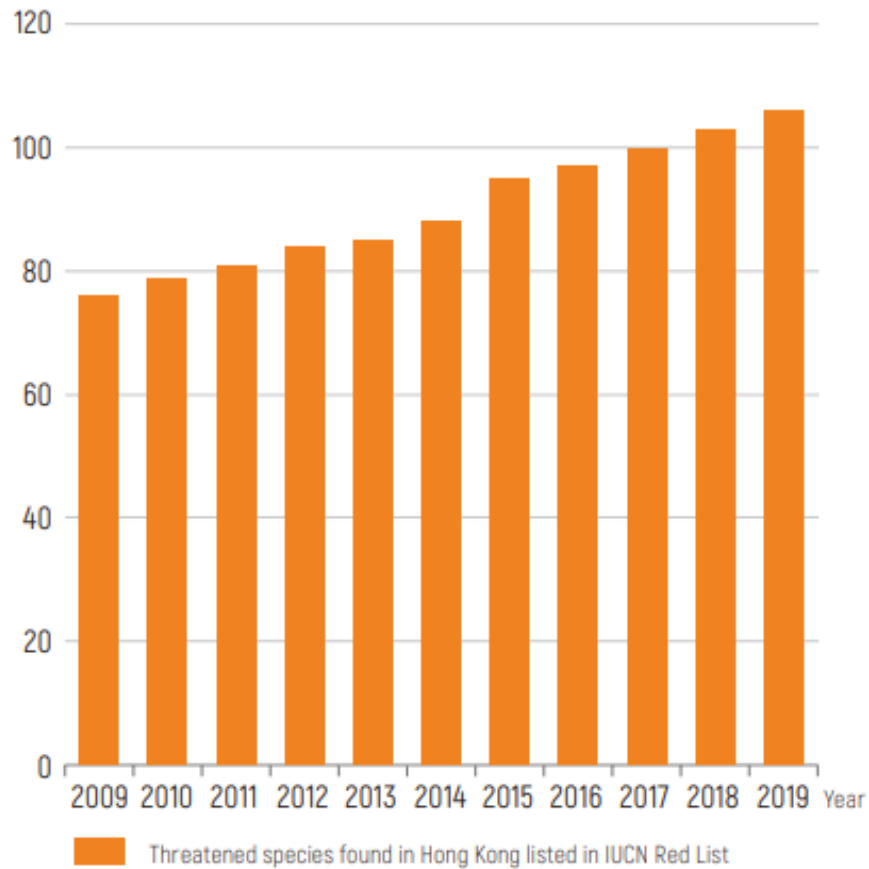
Biodiversity loss in Hong Kong



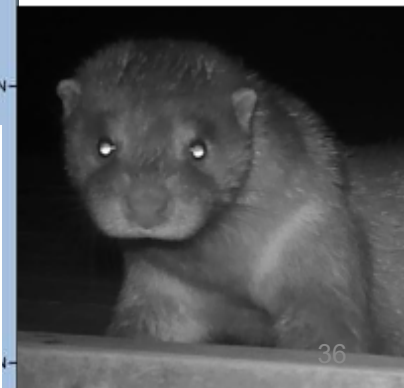
Threatened species increased by almost 40% to 106 species in 10 years in Hong Kong

Pheasant-tailed Jacana used to breed in Hong Kong but breeding population has been driven to local extinction

Number of threatened species



Eurasian otter is now the most threatened mammal in Hong Kong

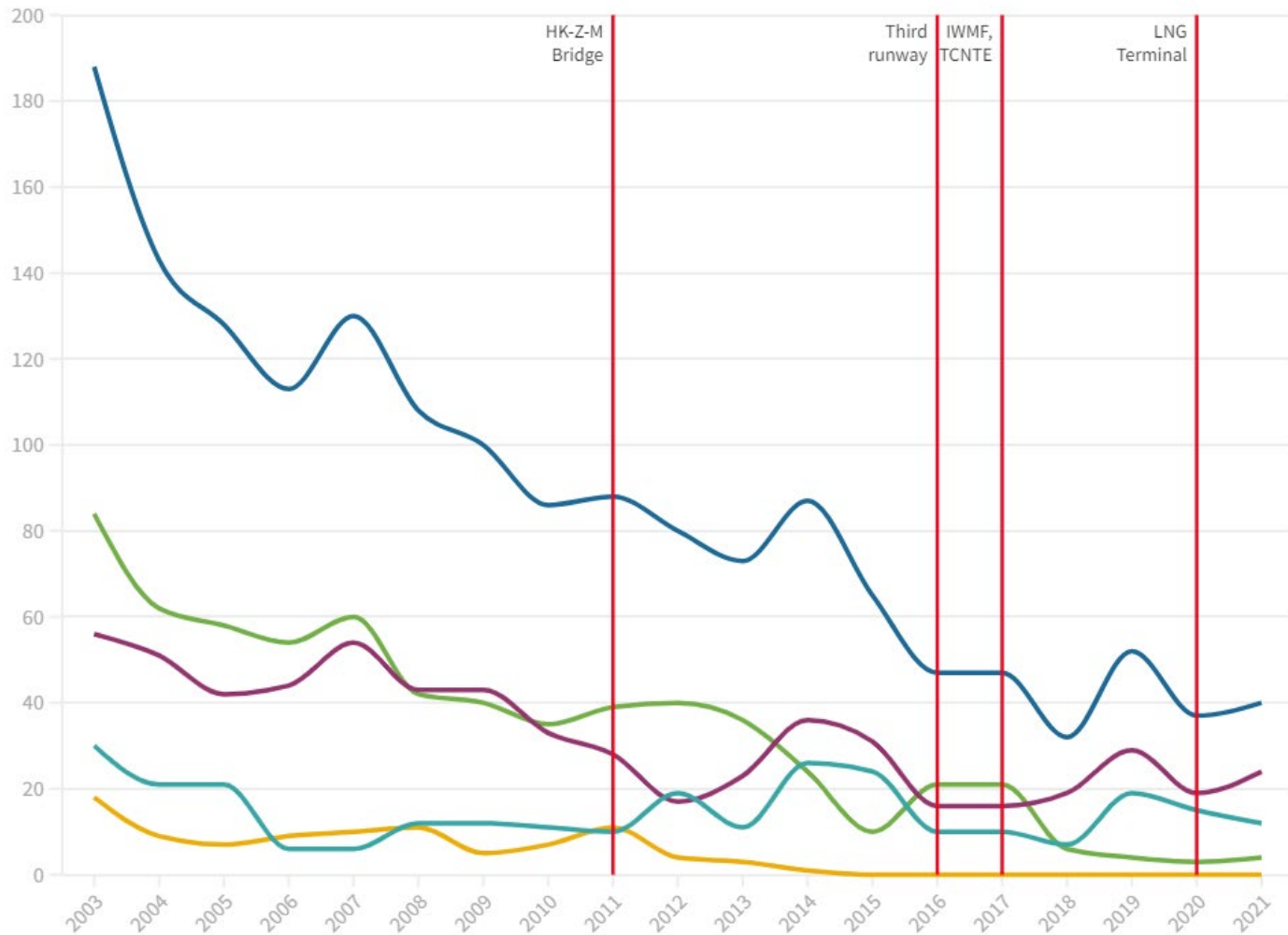


Biodiversity loss in Hong Kong



Declining trend of Chinese White Dolphin in Hong Kong

■ Total ■ NE Lantau ■ NW Lantau ■ W Lantau ■ SW Lantau



Hong Kong has the second-highest per-capita seafood consumption in Asia, and is the world's eighth-largest seafood consumer

“Records show that, decades ago, Hong Kong had such high yields of seafood that it supported 90% of local demand. Today, at least 90% of the seafood we eat has to be imported as our waters are so overfished they can no longer support the local appetite.”

Giant yellow croaker (Chinese Bahaba), taken in 1993 in Castle Peak Bay.

In Western Hong Kong there used to be a fishery for this species but the species is almost extinct today because of overfishing and lack of management.

The species only occurs in Hong Kong and Mainland China.



Urban development in Hong Kong



Northern Metropolis Development Strategy released in 2021



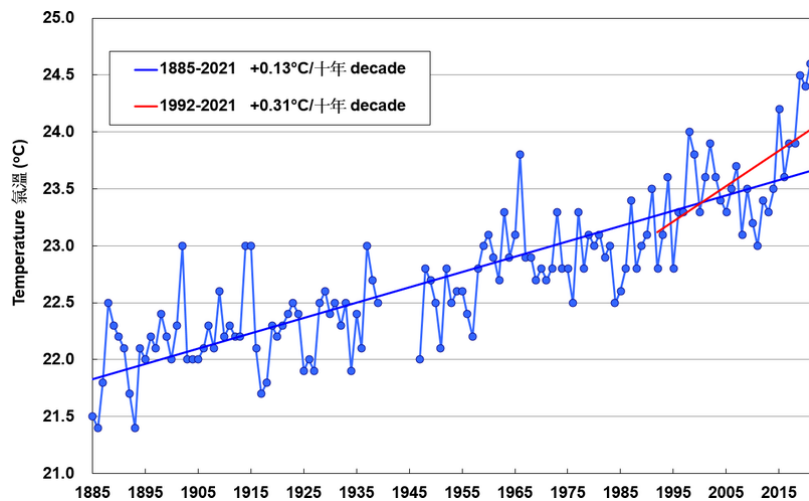
Current population
~ 960k

Expected population
2.5 million

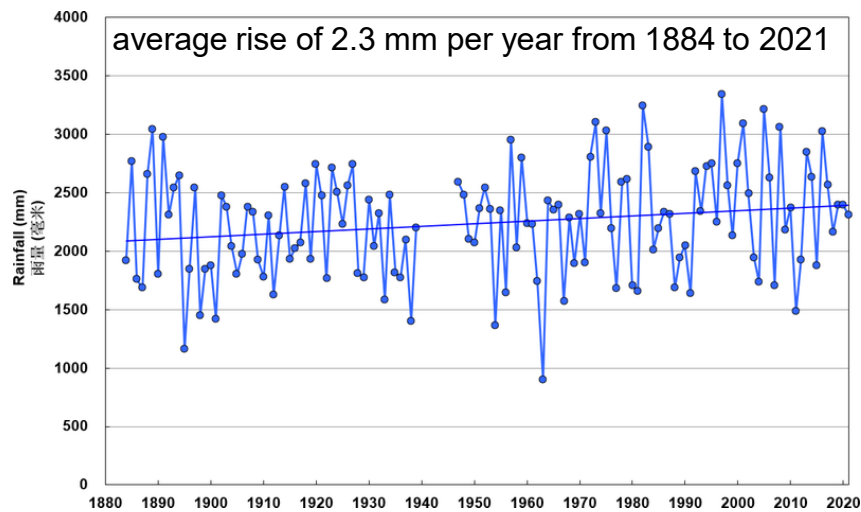
Climate change in Hong Kong



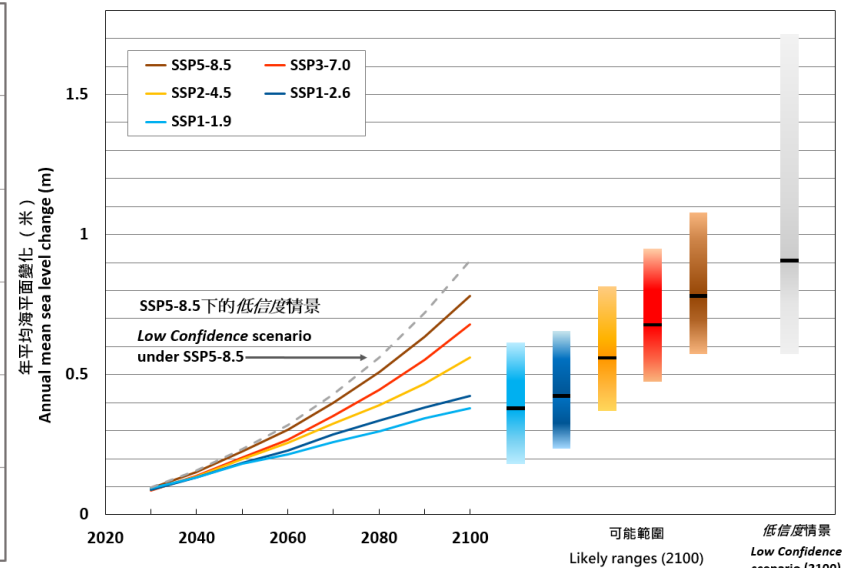
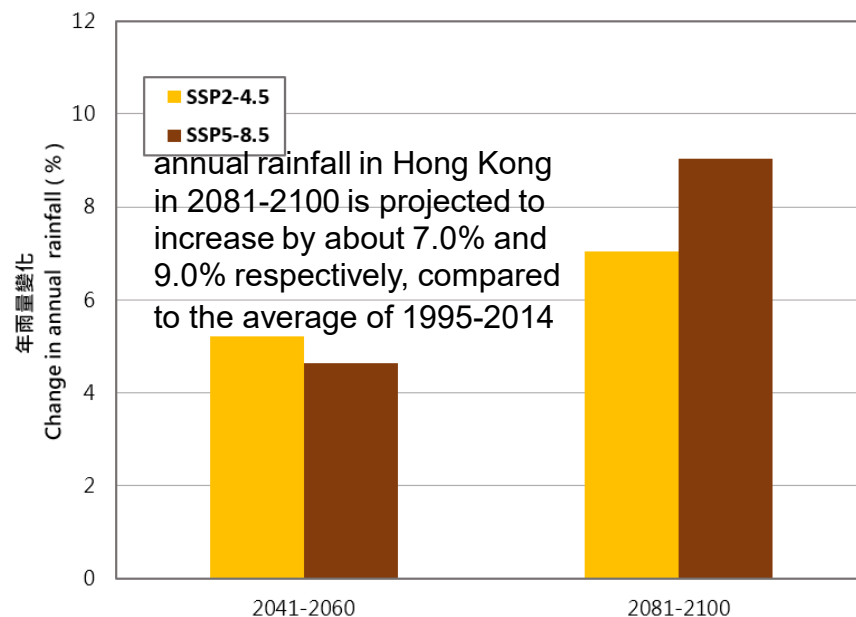
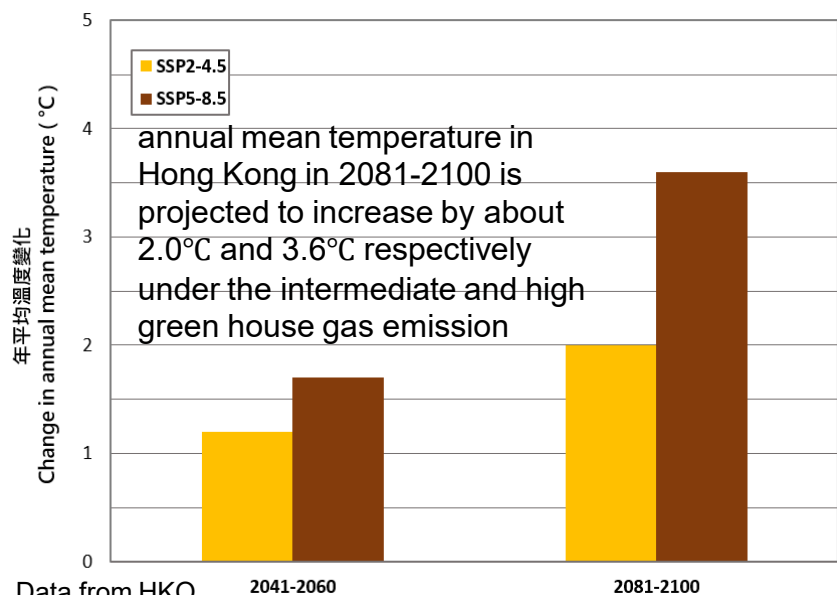
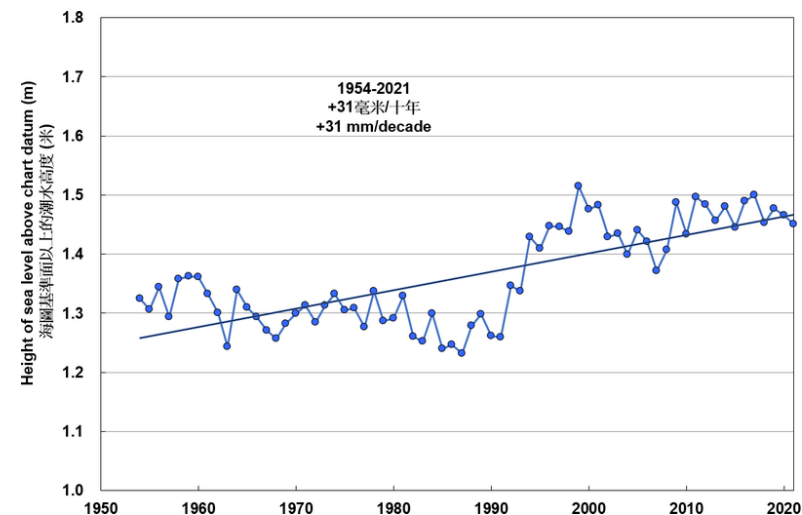
Temperature increase



Rainfall increase



Sea level rise



COASTAL RISK SCREENING TOOL

COMPARISON: LONG-TERM SEA LEVEL OUTCOMES

Climate and energy choices this decade will influence how high sea levels rise for hundreds of years. Adjust the sliders below to compare the outcomes of different warming scenarios. Which legacy will we choose?

[DETAILS AND LIMITATIONS](#)

[3D Visuals](#) [Report](#) [Scientific Paper](#)

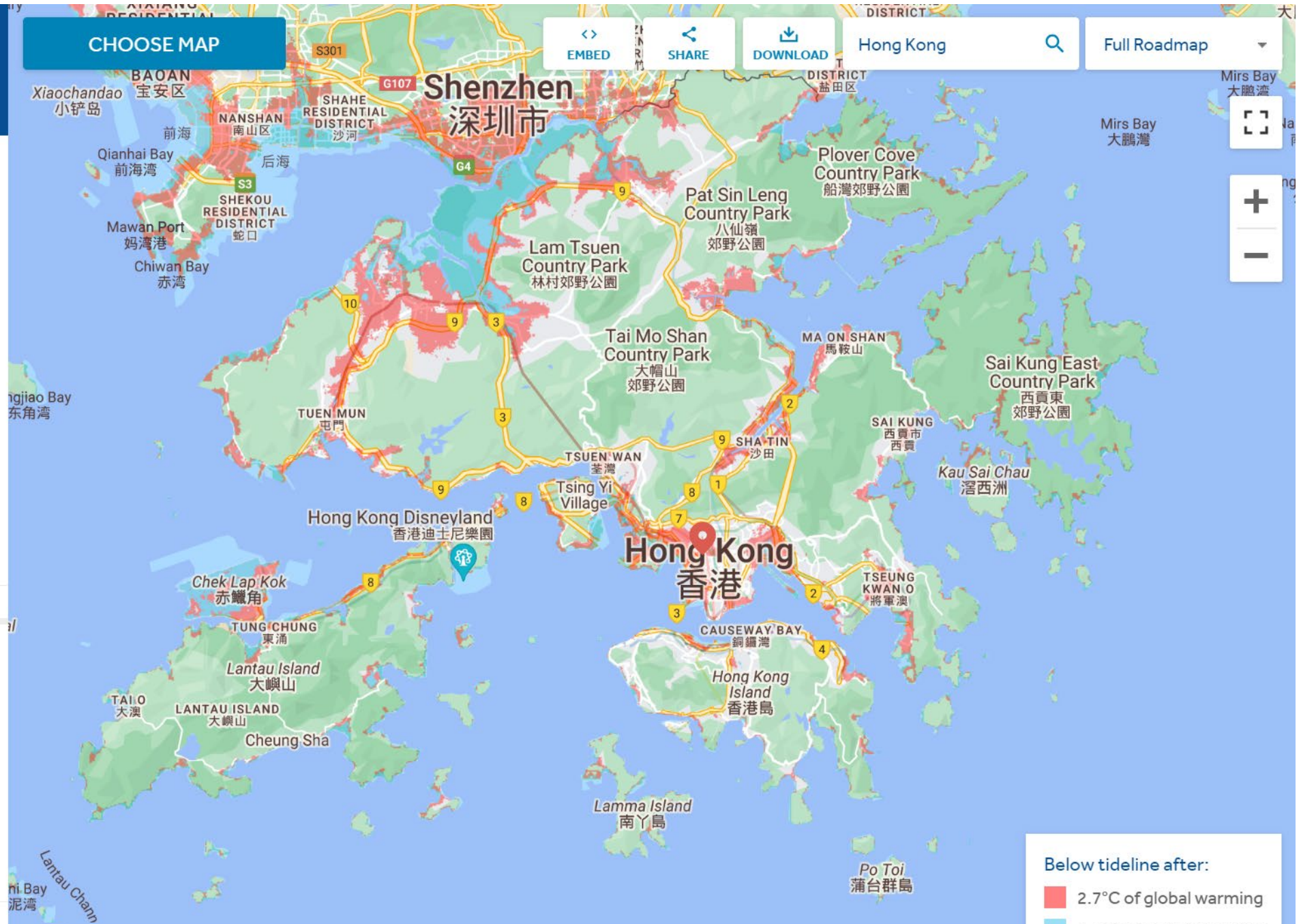
GLOBAL WARMING SCENARIOS TO COMPARE

+1.5°C vs. +2.7°C



Celsius Fahrenheit

[Video Tutorial](#)



Below tideline after:

- 2.7°C of global warming
- 1.5°C of global warming

HongKong International Airport

Present



4°C scenario (40 mters sea level rise)



West Kowloon



Mai Po Nature Reserve

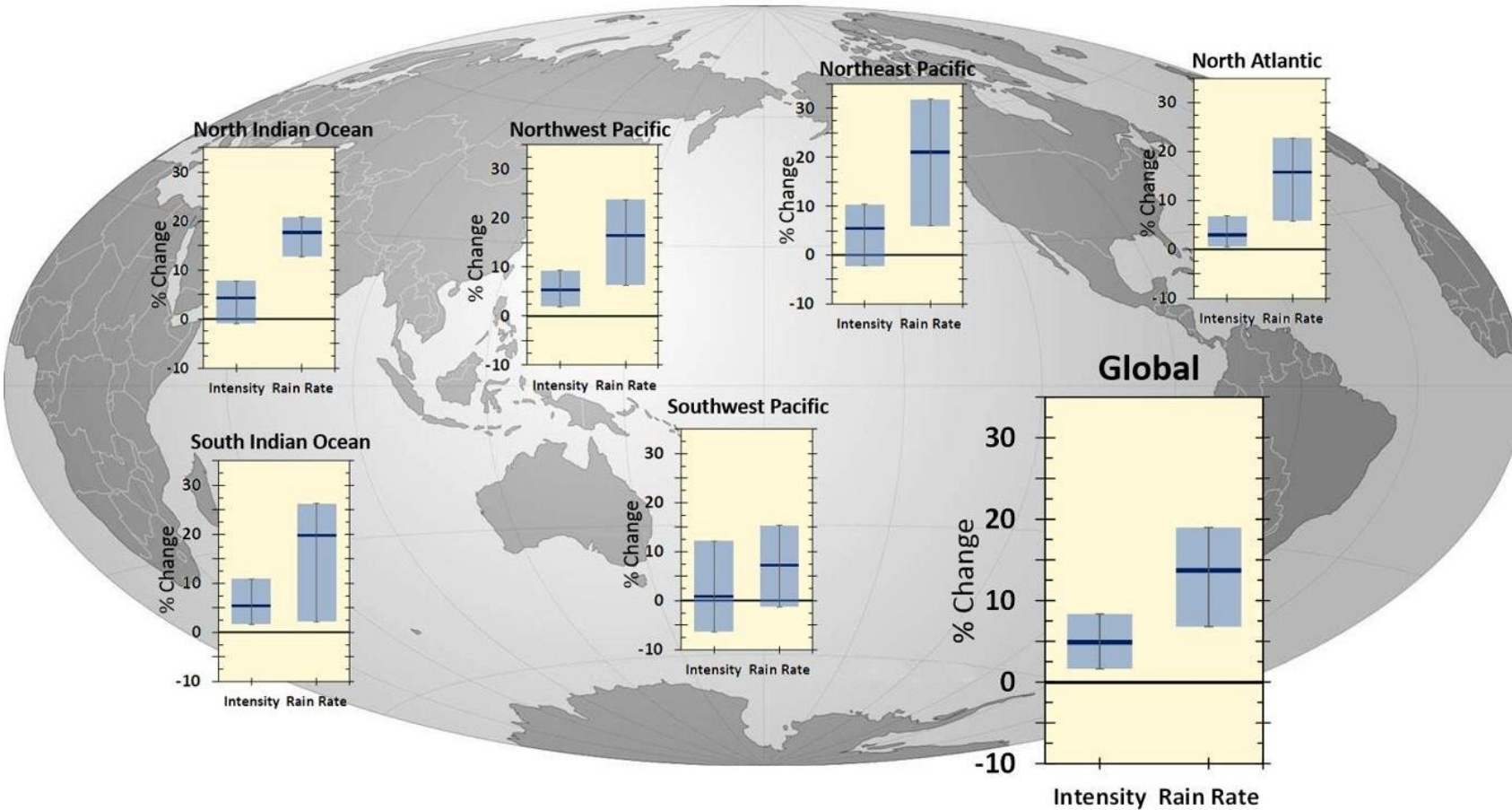


Data Source:
<https://choices.climatecentral.org/#15/22.2953/114.1706?compare=temperatures&carbon-end-yr=2100&scenario-a=warming-2&scenario-b=warming-4>

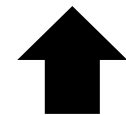
Climate change and disaster risk in Hong Kong



Tropical Cyclone Projections (2°C Global Warming)



- Most studies projected an increase in tropical cyclone intensity.
- The proportion of very intense tropical cyclones is expected to increase.
- Tropical cyclone related precipitation rate will increase in a warmer climate.

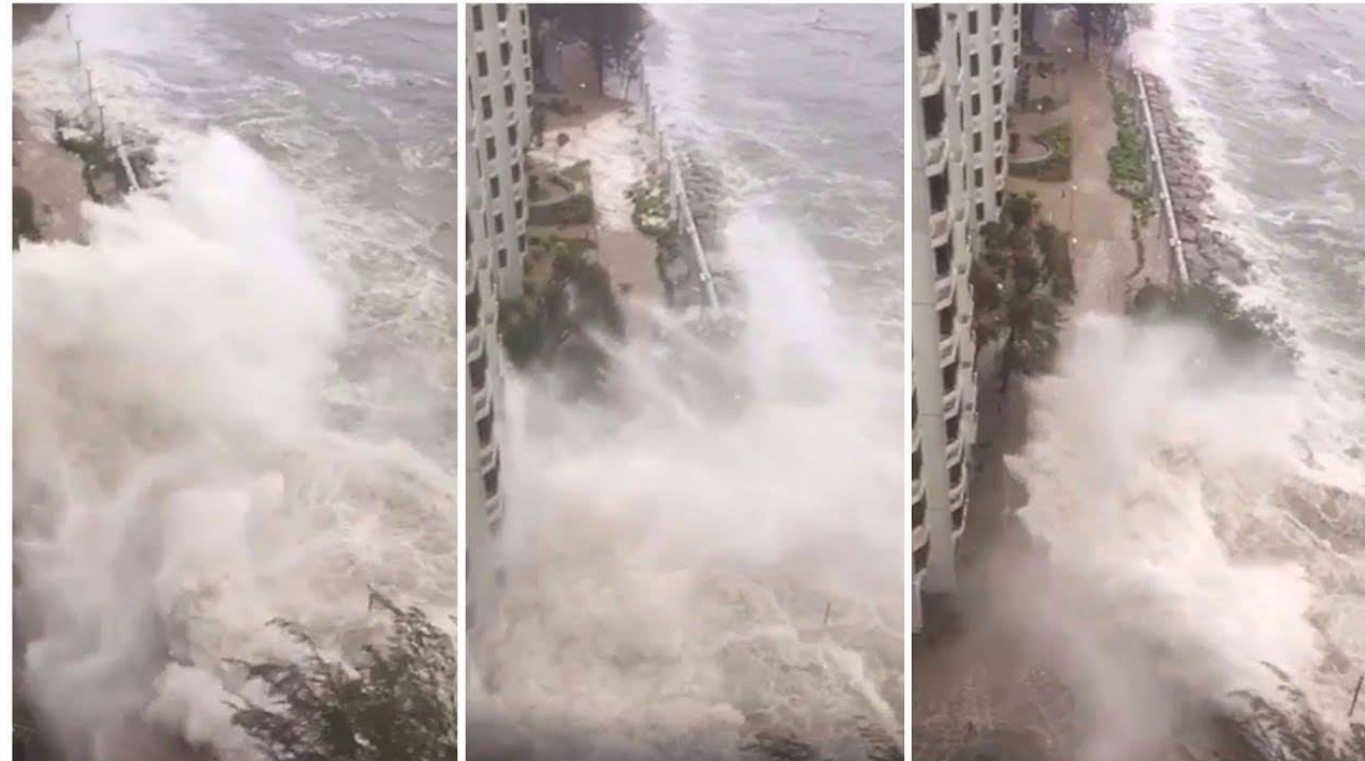
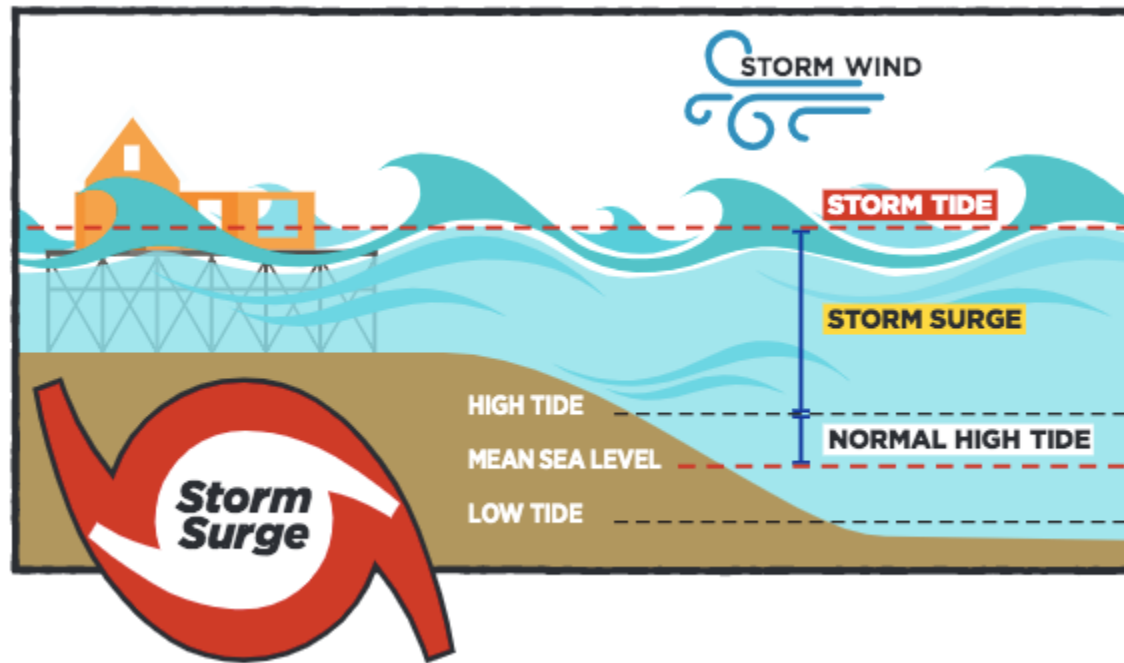


Tropical cyclone intensity (maximum sustained wind speed) and tropical cyclone related rainfall rates increase

Disaster risk in Hong Kong



- Storm surge risk will be exacerbated by future sea level rise and projected increase in tropical cyclone intensity.
- Increased impacts of storm surge and sea level rise on coastal structures and increased coastal inundation risk.



Human health issue in Hong Kong



Last month, the Chinese University of Hong Kong (CUHK) revealed the results of a government-commissioned study. The researchers interviewed 6,082 youth aged six to 17, as well as their parents, between 2019 and 2023.

The study found that 24.4 per cent of children and adolescents had experienced at least one mental health issue in the past year. Half of them were suffering from two or more mental illnesses at the same time. More than 8 per cent of secondary school students said they had thought about suicide.

- Over the next two academic years, HK\$60,000 will be given to schools and HK\$20,000 will be given to parent-teacher associations
- An Education Bureau circular has advised schools to make the well-being of students the priority

Connection of children to nature brings less distress, hyperactivity and behavioural problems - now measurable with a novel scale developed by HKU scientist

10 Jan 2019

Physical Health
People who spend more than **2 Hours** in nature per week can improve their health¹

- To strengthen the immune system^{2,3}
- To improve sleep quality⁴
- To reduce the likelihood of developing chronic diseases^{5,6}
- To lower the risk of developing dementia in old age⁷
- To reduce the likelihood of severe obesity⁸
- To reduce mortality rate⁹

General Public
People who visit the countryside every day can recognize **15%** more local species on average compared to those who rarely visit¹⁹

- To encourage pro-environmental behaviours¹⁷
- To enhance local sense of belonging and civic engagement¹⁸
- To enhance ecological literacy and knowledge¹⁹

Mental Health
Exercising in nature for at least **5 Minutes** at a time can effectively improve mood and boost self-confidence¹⁴

- To help relieve stress^{10,11,12,13}
- To reduce anxiety^{6,14,15}
- To boost self-confidence¹⁶

Physical and Mental Health
Daily exposure to nature for **3 Hours** can reduce the risk of myopia¹¹

- To benefit overall health¹⁰
- To reduce the likelihood of developing chronic diseases^{10,11}
- To help relieve stress¹²

Learning Abilities
By Integrating the environment into subject teaching, **98%** of teachers reported that their students' enthusiasm and engagement in learning have been significantly increased²²

- To improve academic performance^{20,21,22}
- To enhance thinking skills²²
- To increase learning motivation²¹
- To improve focus and self-discipline^{23,24,25}

Interpersonal Relationship
Participating in outdoor activities for about **1 Hour per week** can significantly boost children's self-confidence after 8 months of continuous engagement²⁴

- To promote family harmony²¹
- To help to establish a positive self-image and self-confidence²⁴

Environmental Awareness
Increased exposure to nature **Before Age 11** can help cultivate environmental awareness in later life²⁶

- To increase environmental awareness and encourage pro-environmental behaviours^{26,27}
- To enhance local sense of belonging and civic engagement²⁸

Children

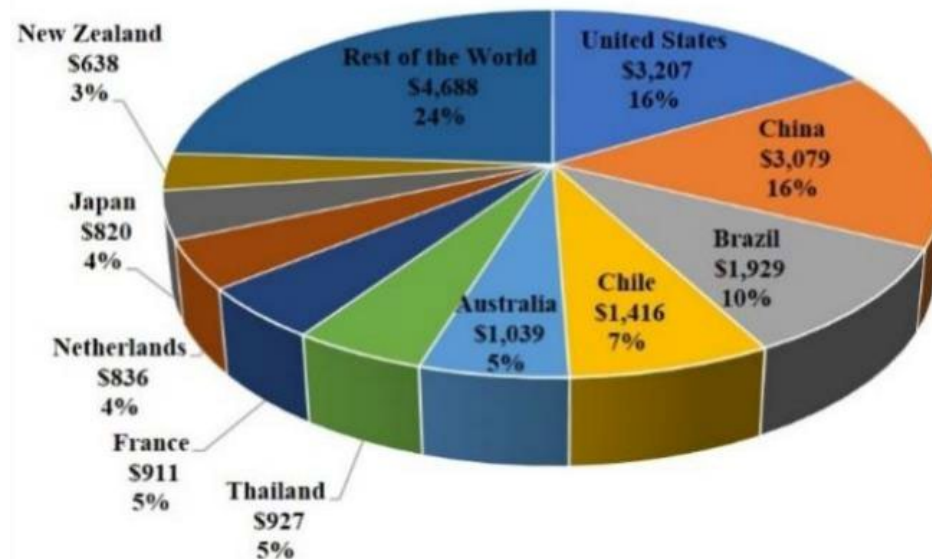
香港學童自然連結感研究及戶外環境教育推廣計劃
Hong Kong Nature Connectedness and Outdoor Environmental Education

Food security in Hong Kong



- Only 5.7% land in Hong Kong is agricultural land
- Around 95% food in Hong Kong is imported
- Hong Kong is one of the top markets in the world for food and beverages, processed, fresh, and frozen gourmet products. Hong Kong is the 6th largest export market for U.S. consumer-oriented agricultural products, by value
- Nomura's 2019 "Food Vulnerability Index" ranked Hong Kong as the world's 42nd most vulnerable place among 110 places

Hong Kong Imports of Consumer Oriented Agricultural Products 2019 (\$ Million)



Prepare for a food price surge

3 Possible Triggers

-  Weather-related shocks
-  Sharp USD depreciation
-  Oil price surge

Trade protectionism

High & hidden debt in frontier economies

Speculation & hoarding

3 Possible Amplifiers

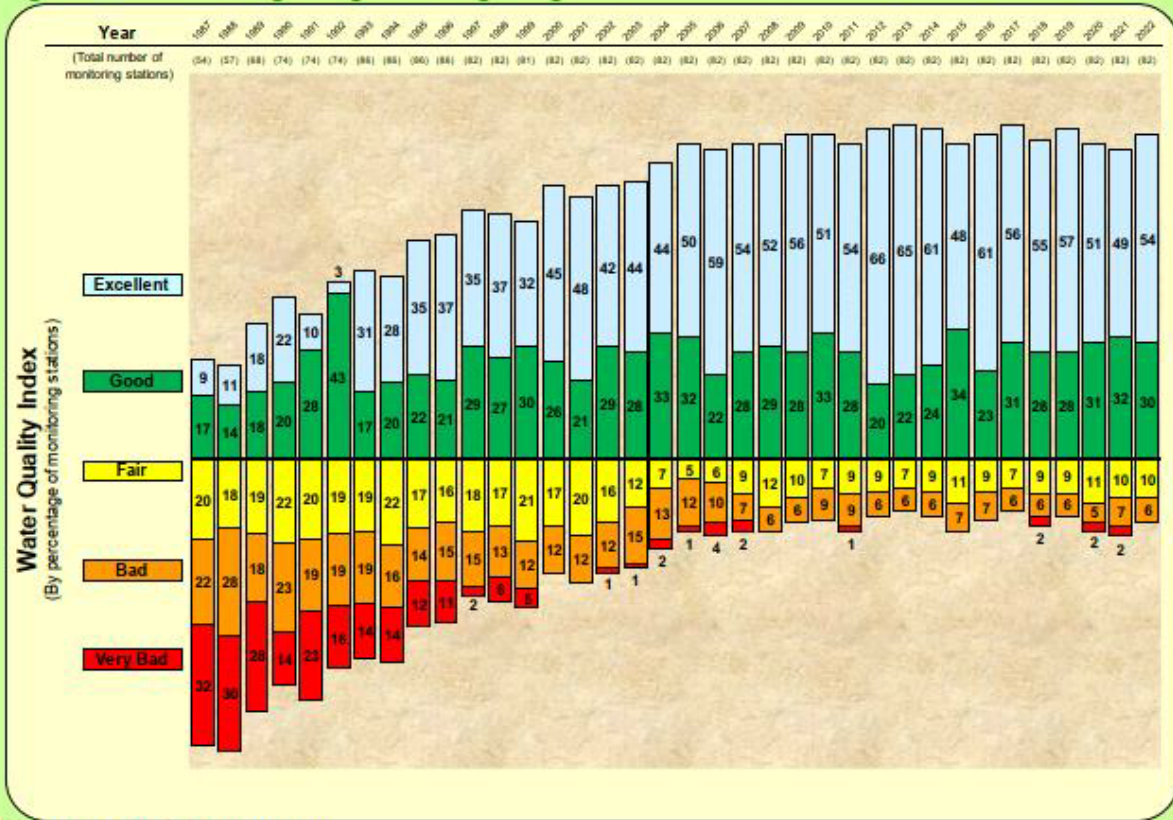


Water issue in Hong Kong



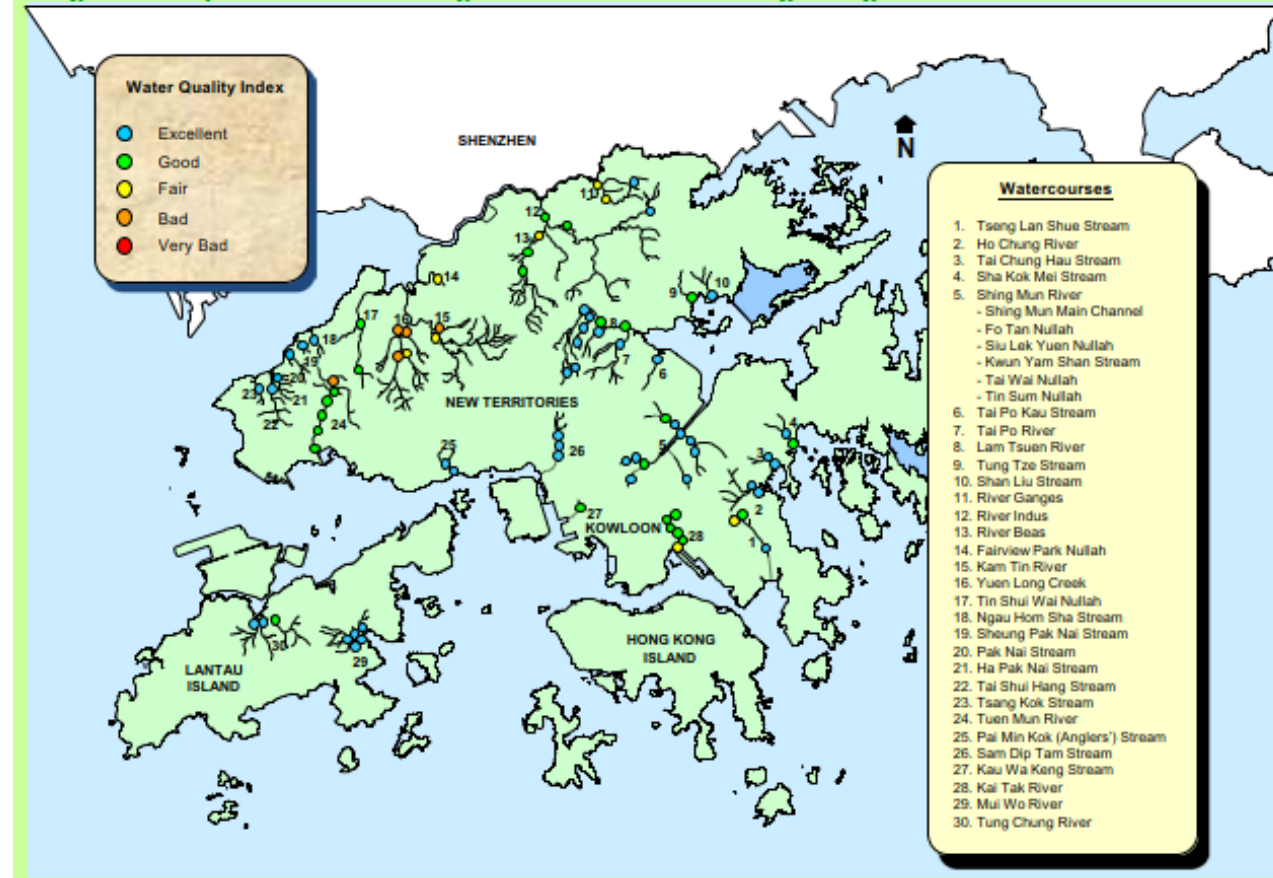
Unlike developing countries, water supply may not be a critical problem in Hong Kong but water pollution is still a threat

Figure 3. Overall WQI gradings for Hong Kong's rivers, 1987-2022



Figures are rounded to the nearest integer

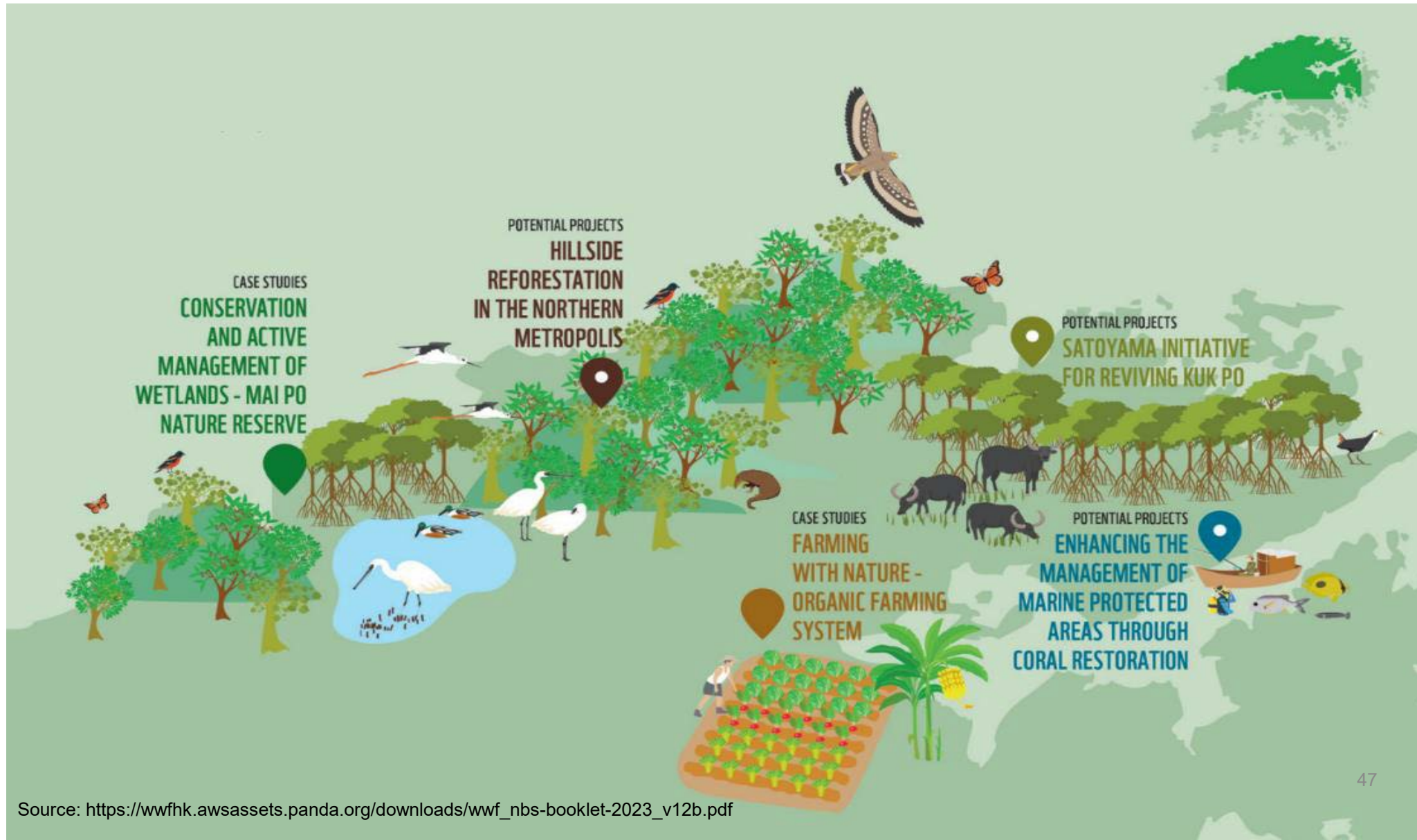
Figure 4. Map of river monitoring stations and their WQI gradings in 2022



Existing and potential NbS in Hong Kong



- Bilingual
- 2 case studies
- 3 potential projects
- Illustrate positive impacts of NbS
- Promote adoption of NbS in Hong Kong's Planning Standards and Guidelines



Source: https://wwfhk.awsassets.panda.org/downloads/wwf_nbs-booklet-2023_v12b.pdf

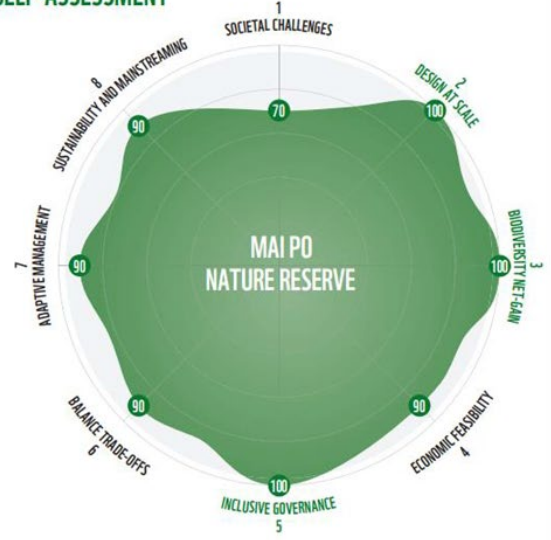
The 2 existing NbS case studies



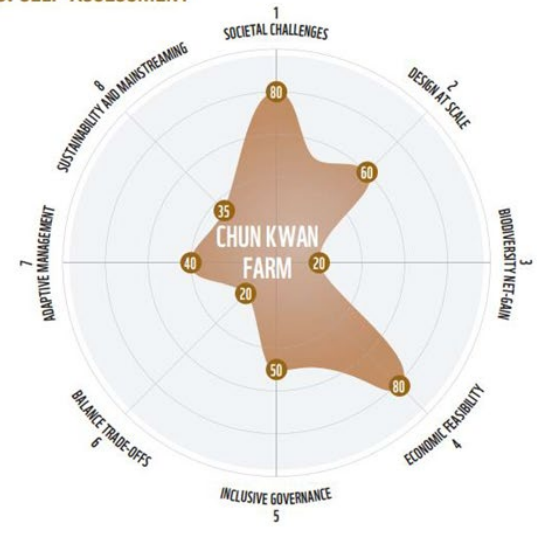
	Mai Po Nature Reserve	Organic farming
Nature of the NbS	Active management of wetland protected area	Certified organic farm
Biodiversity benefit	Wetland wildlife and ecosystem	Farmland organism and ecosystem
Climate change mitigation	Carbon sequestration	Carbon sequestration, Reduce carbon footprint due to import
Disaster risk reduction	Flood, storm surge	
Economic/ social benefit	Green job	Local economy
Human health benefit	Nature appreciation and education	Healthy food
Food security	Indirect support to fisheries	Diverse crops
Water security		Reduce watering demand

IUCN Global Standard for NbS Self-Assessment
 We take IUCN criteria as self assessment tool to calculate each intervention's % match against IUCN standards and checking whether the 2 interventions adhere to IUCN NbS Global Standard

IUCN GLOBAL STANDARD FOR NBS: SELF-ASSESSMENT










IUCN GLOBAL STANDARD FOR NBS: SELF-ASSESSMENT



The 3 potential NbS projects



	Mai Po Nature Reserve	Organic farming	Marine protected area enhancement by coral reef restoration	Hillside restoration in Northern Metropolis	Reviving Kuk Po
Nature of the NbS	Active management of wetland protected area	Certified organic farm	Coral reef restoration & marine protected area	Forest restoration	Sustainable livelihood in rural landscape
 Biodiversity benefit	Wetland wildlife and ecosystem	Farmland organism and ecosystem	Marine organism and ecosystem	Native forest plant and ecosystem	Wetland and farmland wildlife and ecosystem
 Climate change mitigation	Carbon sequestration	Carbon sequestration, Reduce carbon footprint due to import		Carbon sequestration	Carbon sequestration
 Disaster risk reduction	Flood, storm surge			Landslide, hill fire	Flood, storm surge
 Economic/ social benefit	Green job	Local economy	Green job	Green job, development in green infrastructure	Green job, income to local
 Human health benefit	Nature appreciation and education	Healthy food	Recreational activities	Recreational activities	Recreational activities
 Food security	Indirect support to fisheries	Diverse crops	Indirect support to fisheries	Indirect support to orchards	Rice and other crops
 Water security		Reduce watering demand		Irrigation water supply	

Developing sustainable metropolis with NbS



Part I: NbS Standard

Each criterion with brief guidance, indicators, case-study and informative graphic



Part II: Guidance

Detailed descriptions of rationale and requirements behind each criterion and indicator



Part III:

Self-Assessment

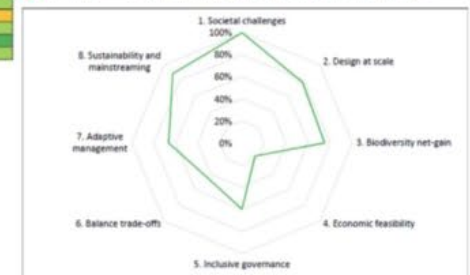
Excel sheet with each criterion and indicator, 4 assessment levels and guiding questions for assessment

Criterion 2: Design of NbS is informed by scale

Indicator No.	Indicator	Guiding questions	Use drop down menu to input how well intervention matches to indicator.	How well has the indicator been met?			
				Strong	Adequate	Partial	Insufficient
2.1	Design of NbS recognises and responds to the interactions between the economy, society and ecosystems	Are interactions identified between the economy, society and ecosystems? Does that include those within and surrounding the intervention area? Is the change in these interactions considered over time? Are potential knock-on impacts on and from other areas identified? Are these interactions used to design the intervention and decision making processes?	Adequate	Yes. The design of the NbS considers in detail the interactions between the economy, society and ecosystems within and surrounding the intervention area, given its potential knock-on impacts on and from other areas. These interactions are accounted for in the decision-making process throughout the intervention time scale.	The design of NbS recognises specific interactions between the economy, society and ecosystems, and is accounted for in the NbS decision-making processes, at least once during the intervention period.	The design of NbS recognises and	
2.2	Design of NbS integrated with other complementary interventions and seeks synergies across sectors	Are complementary interventions identified in and around the area? Is the design of the NbS integrated with relevant complementary interventions? Are synergies sought in project management, monitoring and outcomes? Are complementary interventions and synergies re-assessed throughout the intervention time scale?	Adequate	Yes. Synergies across sectors are thoroughly investigated, and all relevant complementary interventions are integrated within the design of the NbS. These are investigated and revisited at relevant points throughout the intervention time scale.	Synergies across sectors at investigated and the most relevant complementary interventions are integrated within the design of NbS. These are revisited at least once during the intervention period.		
2.3	Design of NbS incorporates risk identification and risk management beyond the intervention site	Have the drivers of internal and external risks been identified? Has scientific and local knowledge concerning those risks been taken into account? Does the design of the NbS take into account possible internal and external risks? Has a risk management plan been integrated into the design of the NbS? Will this risk management plan be revisited throughout the intervention time scale?	Adequate	Yes. The possible risks of undesirable changes and their drivers are identified, taking into account scientific and local knowledge. The management of these risks is integrated into the design of the NbS and revisited throughout the intervention time scale.	Most risks of undesirable change their drivers are identified, taking into account scientific and local knowledge. The management of these risks is integrated into the design of the NbS and revisited at least once during the intervention period.		

Criterion	Your Criterion Score	Maximum Criterion Score	FRUAL OUTPUT Your Criterion Usage
1. Societal challenges	9	9	1.0
2. Design at scale	7	9	0.8
3. Biodiversity net-gain	9	12	0.8
4. Economic feasibility	2	12	0.2
5. Inclusive governance	9	15	0.6
6. Balance trade-offs	4	9	0.4
7. Adaptive management	6	9	0.7
8. Sustainability and mainstreaming	8	9	0.9
Total			0.7

Key	Output
Strong	Intervention adheres to the IUCN Global Standard for NbS.
Adequate	
Partial	
Insufficient	
	Intervention does not adhere to the IUCN Global Standard for NbS.



WORLD WIDE FUND FOR NATURE (WWF)



Who we are

- WWF was founded in 1961
- WWF is in over 100 countries, on 5 continents
- Over 5 million supporters worldwide
- Over 5,000 staff worldwide

- WWF-Hong Kong was established in 1981, to deliver solutions for a living planet
- WWF-Hong Kong has over 35,000 individual financial supporters



Our mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by:

- conserving the world's biological diversity,
- ensuring that the use of renewable natural resources is sustainable, and
- promoting the reduction of pollution and wasteful consumption.

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WWF HONG KONG



What we do

WWF-Hong Kong manages conservation reserve, education centres and sustainability programmes in Hong Kong.

DISCOVER OUR WORK

For truly global conservation impact, we organise our work around these areas:



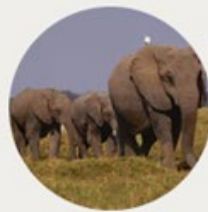
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