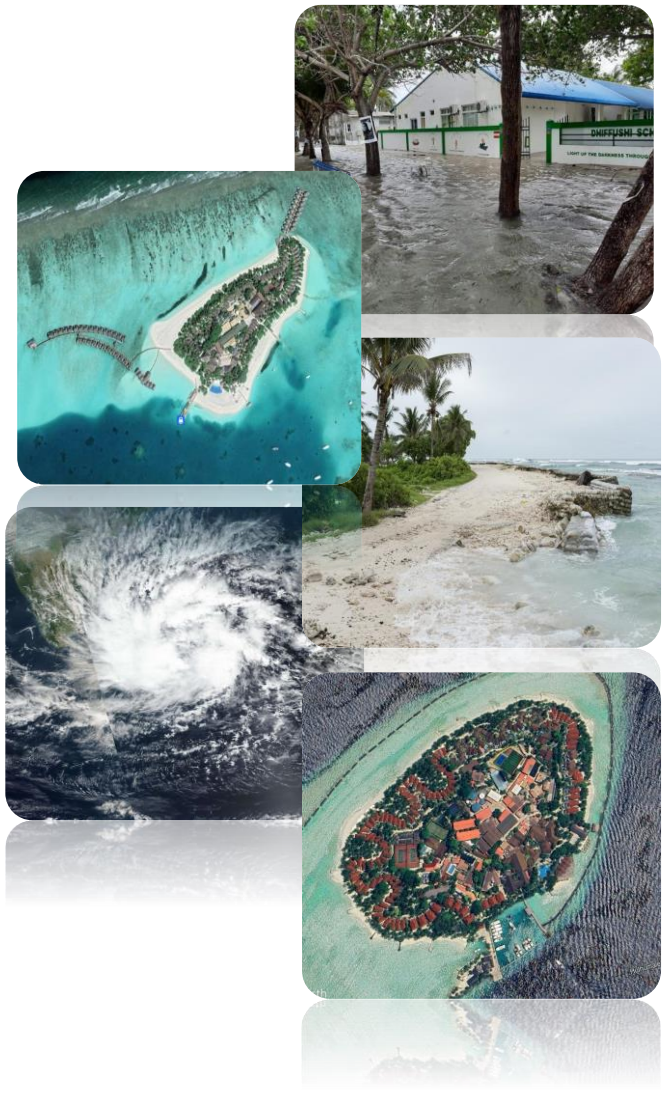


Key Findings

Maldives UN Joint Project funded by SDG Funds for SIDS

Strengthening National and Subnational Capacity for Sustainable Disaster Risk Reduction, Climate Change Adaptation and Mitigation in Maldives

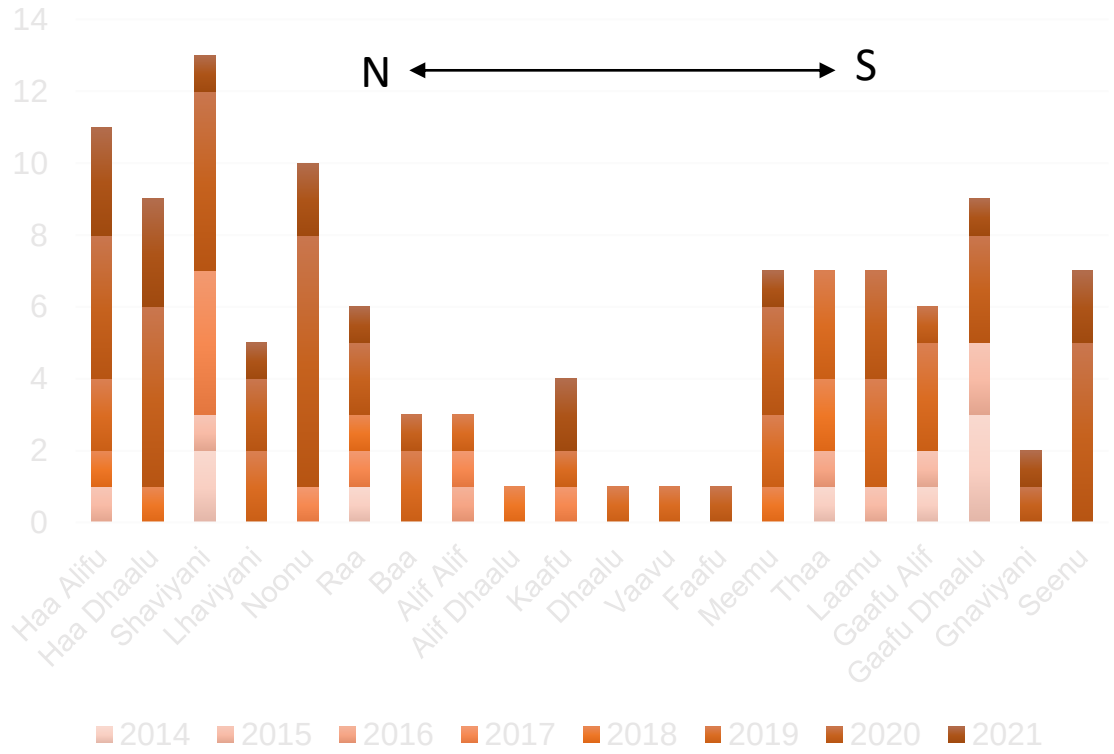
Capacity Building on National and Subnational Planning for Sustainable Disaster Risk Reduction, Climate Change Adaptation, and Mitigation

January 30, 2024

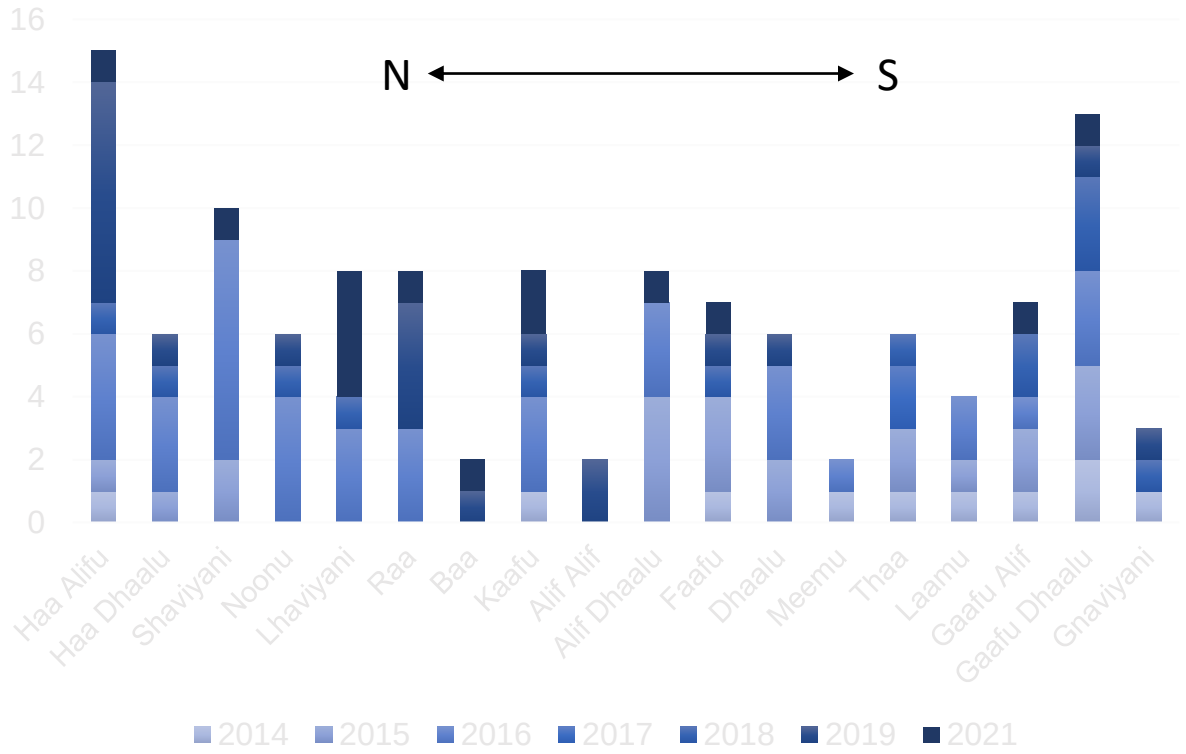
Prangya Paramita Gupta

Climate change and its relevance for Maldives

Number of cyclone/storm/surge in the Maldives during 2014 – 2021



Number of rainwater floods in the Maldives during 2014 – 2021



(Source: Disaster database, NDMA, Maldives)

Climate change and its relevance for Maldives

- Weather events are exacerbated by a changing climate - intensified storms, more frequent sea-surge events and longer dry periods leading to water shortages
- All of them are already detectable across both natural and human systems
- The country is vulnerable to coastal flooding due to the islands' low elevation; this vulnerability is worsened by climate change.
- **Projected changes** says that the wave climate superimposed on sea level rise will rapidly increase flooding in small islands
- A 5-10 cm additional sea level rise (expected for ~2030- 2050) will double flooding frequency in much of the Indian Ocean

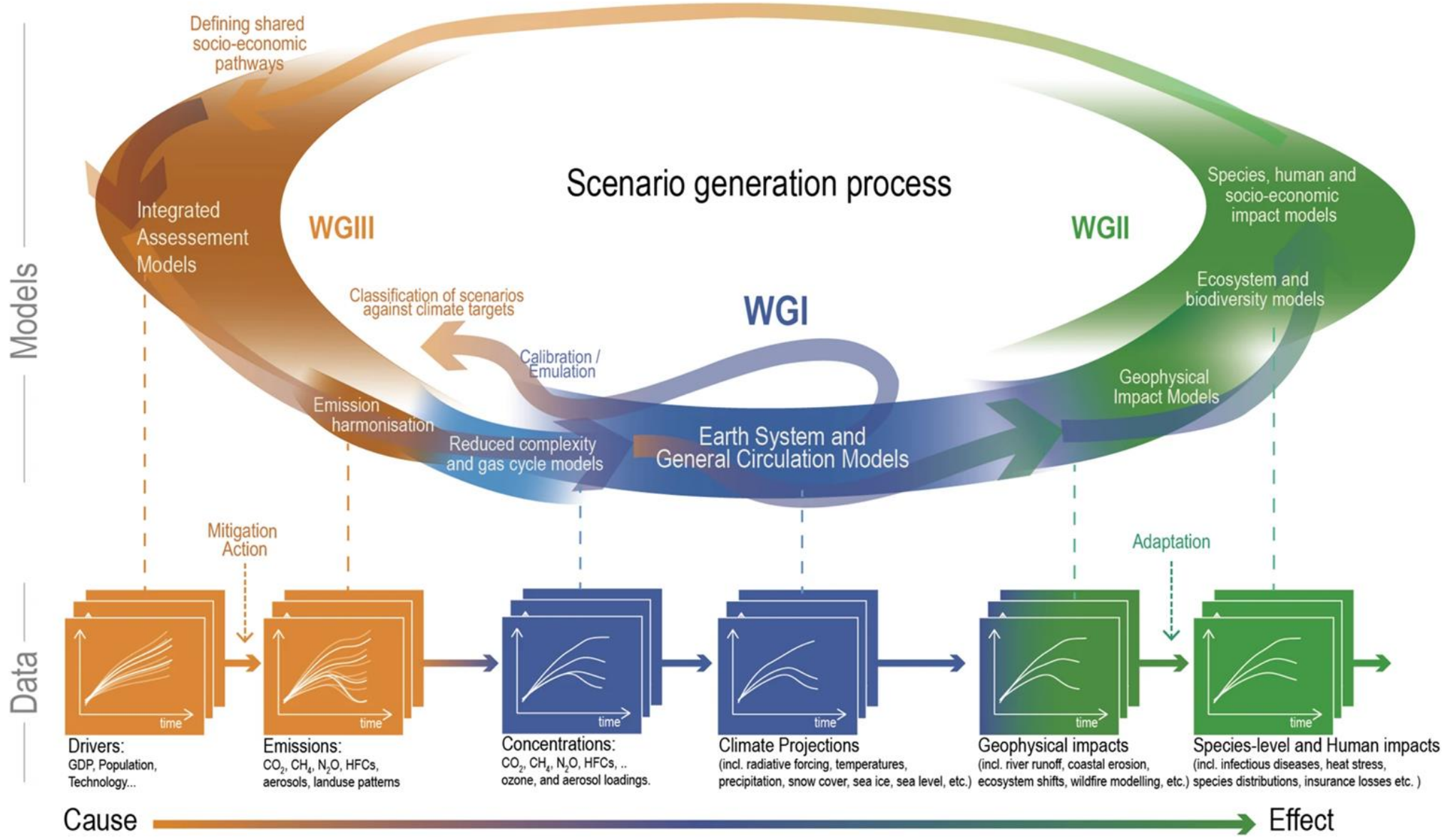
Overview

1. **How we did**

2. **What we did**

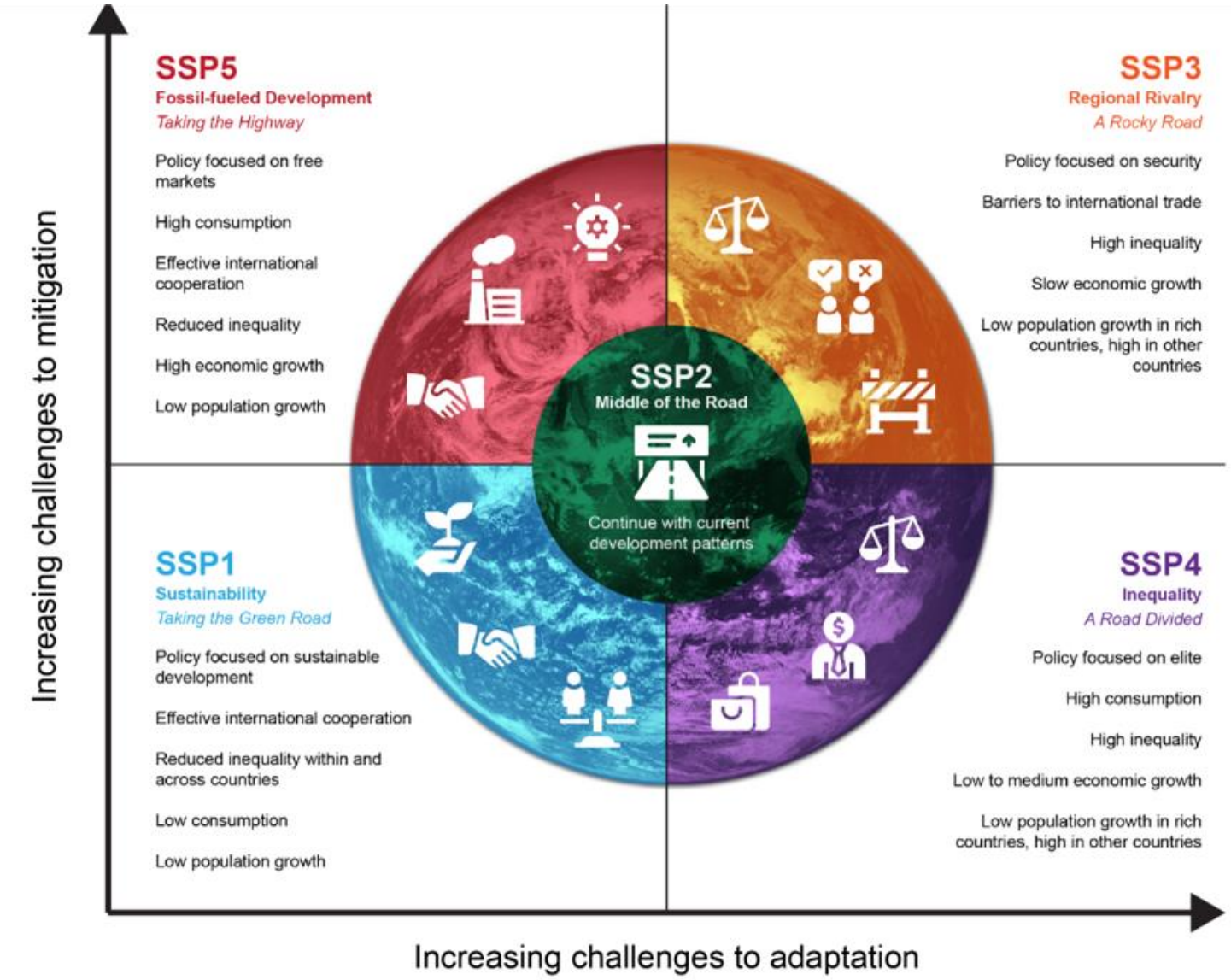
3. **What we can do with these information**

Risk analysis: Data and scenario



Source: Pirani et al. 2024

Risk analysis: Data and scenario



Downscaled climate projection data with 5 km spatial resolution received from Asia-Pacific Climate Change Adaptation Information Platform (AP-Plat)

Climate variables:

- Precipitation/ Rainfall
- Average temperature
- Surface wind
- Sea level rise

Time period:

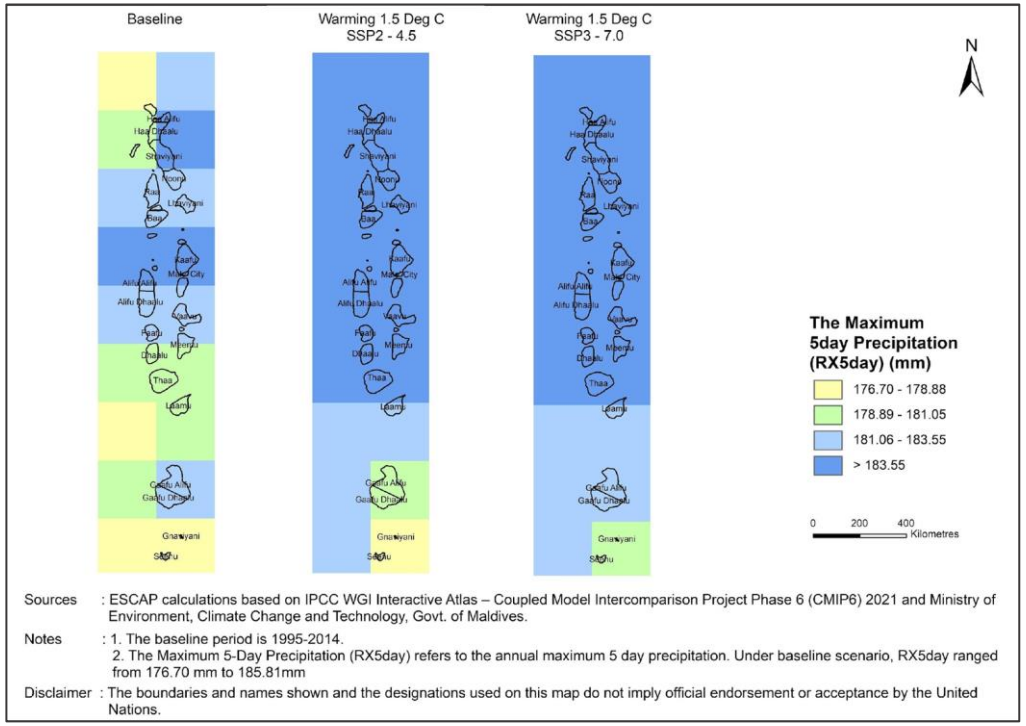
- 2021-2040
- 2041-2060

Climate scenario:

- SSP2
- SSP3

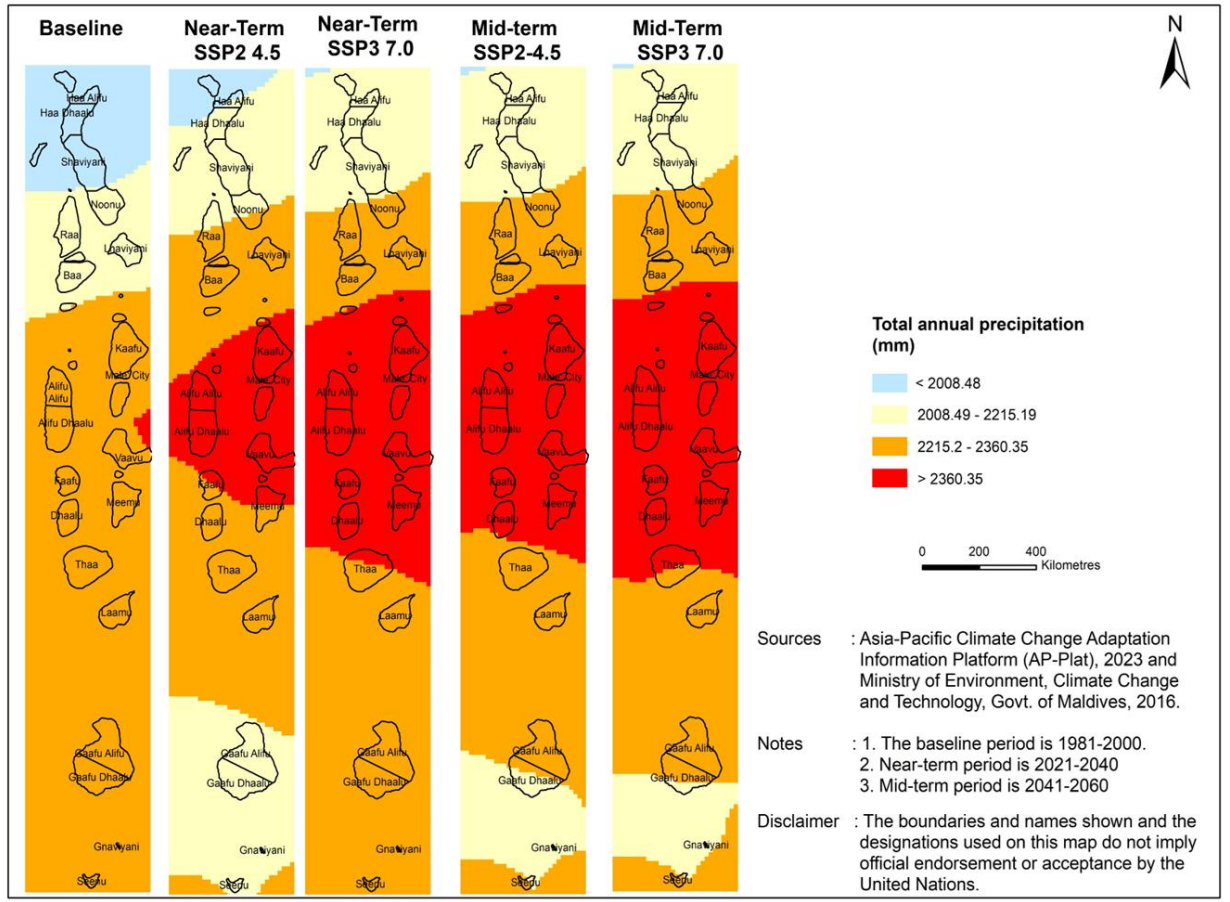
Source: climatedata.ca

Enhanced granularity in data

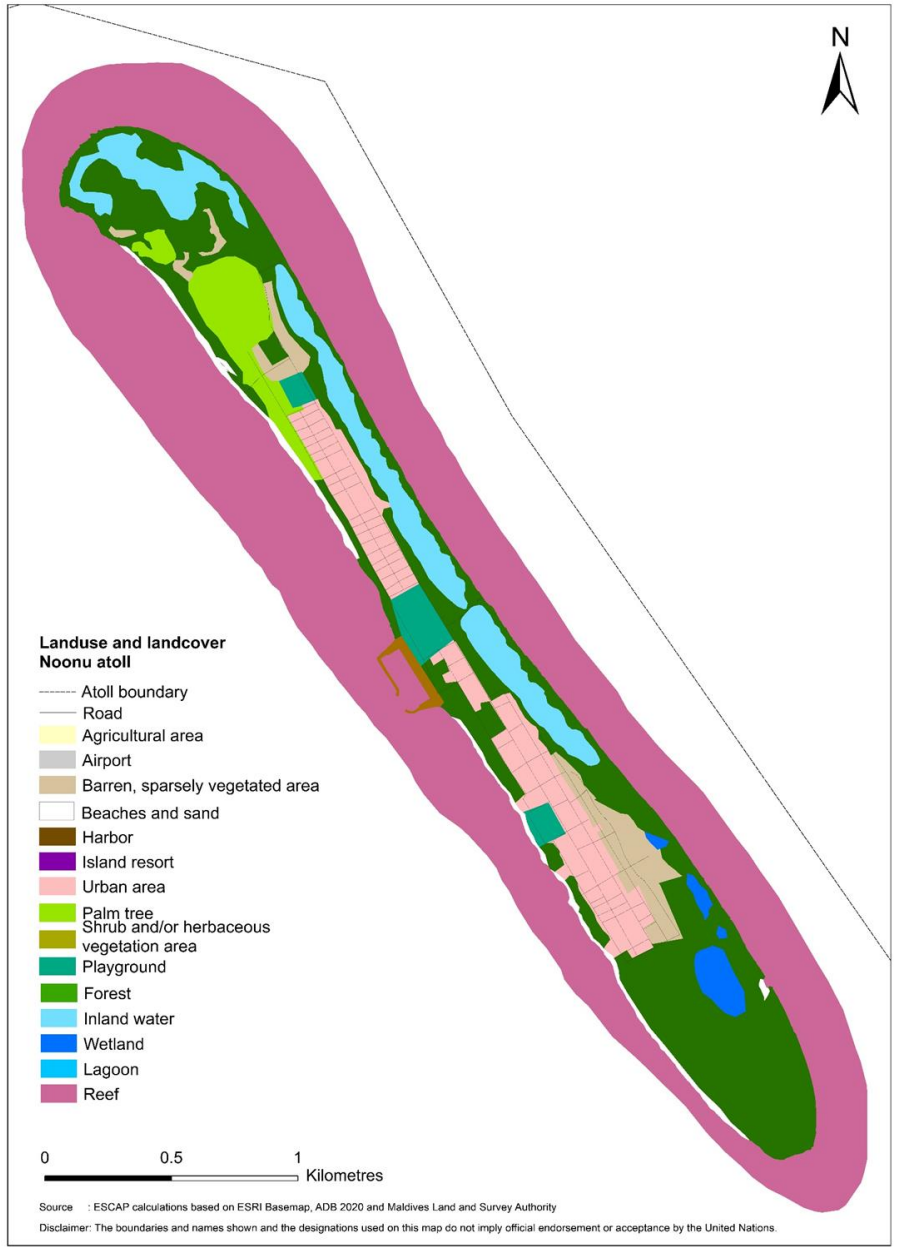


100 x 100 km

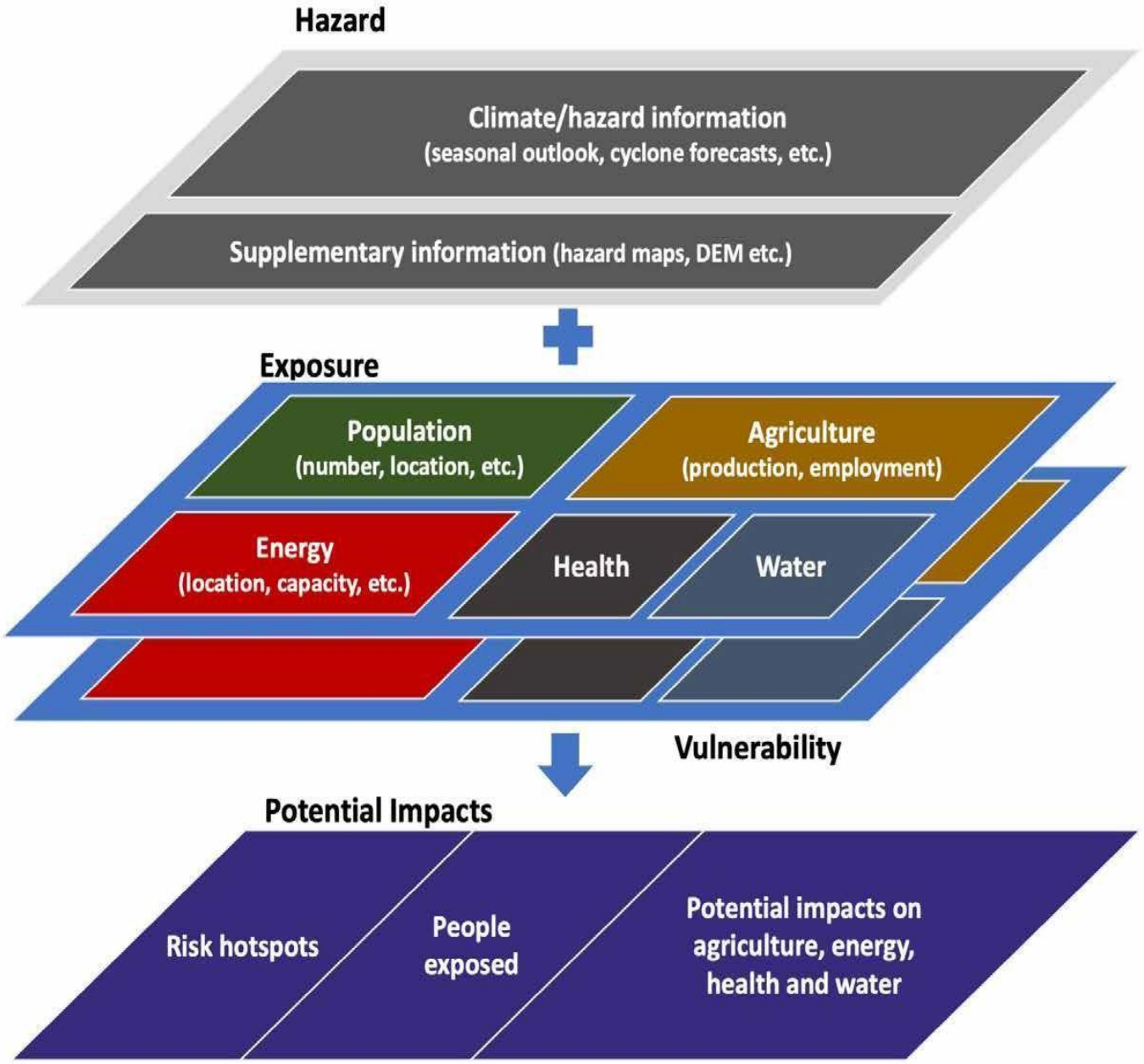
5 x 5 km



Landuse/ landcover maps



Risk analysis: methodology



Hazards:

- Flood (increased precipitation)
- Drought (increased temperature)
- Cyclone (increased wind speed)
- Sea level rise (sea surface anomaly)

Sectors:

- Total Population
- Female population
- Landuse and land cover
- Transport and energy
- Critical infrastructure
- Healthcare infrastructure
- Education infrastructure

Overview

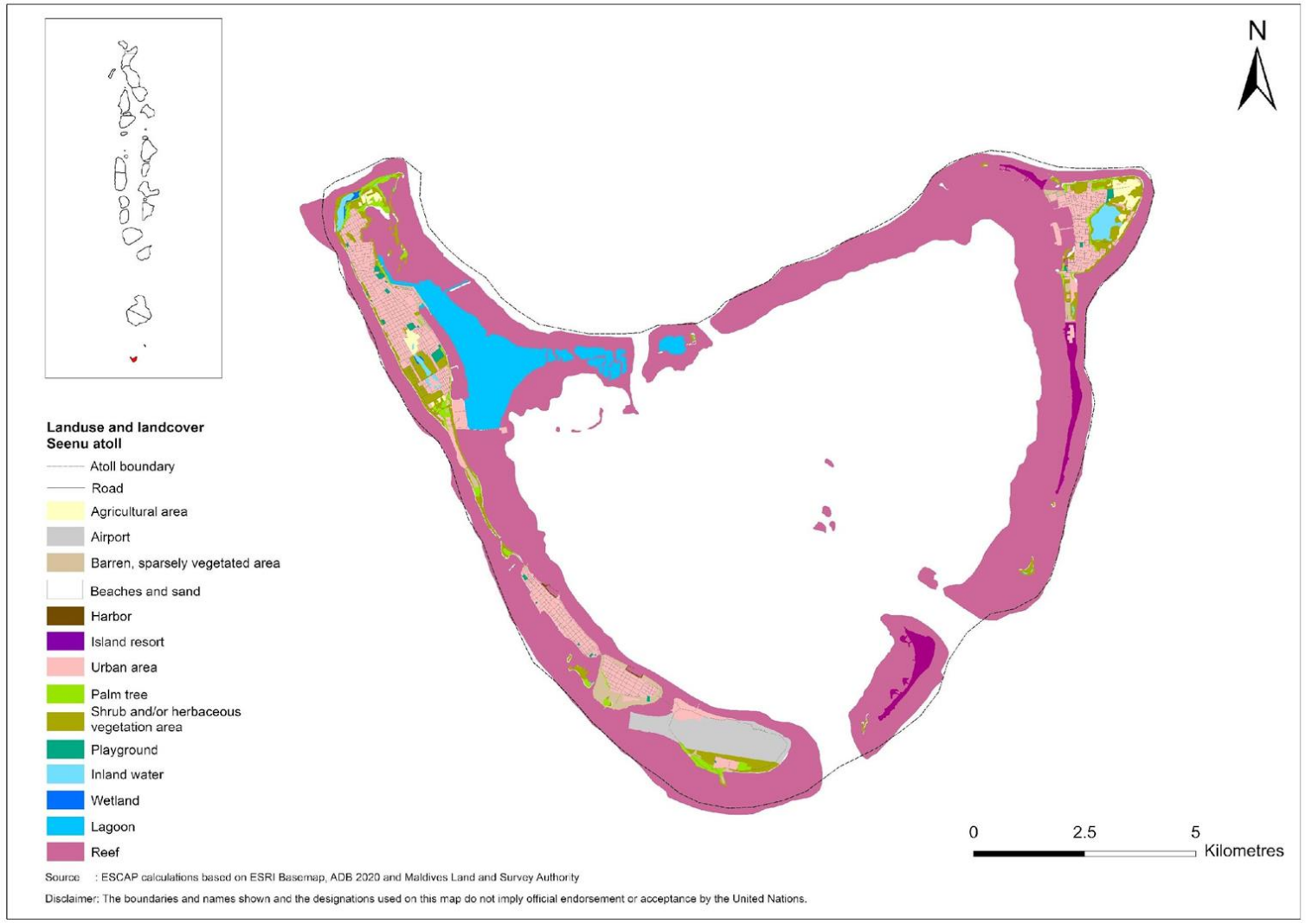
1. How we did

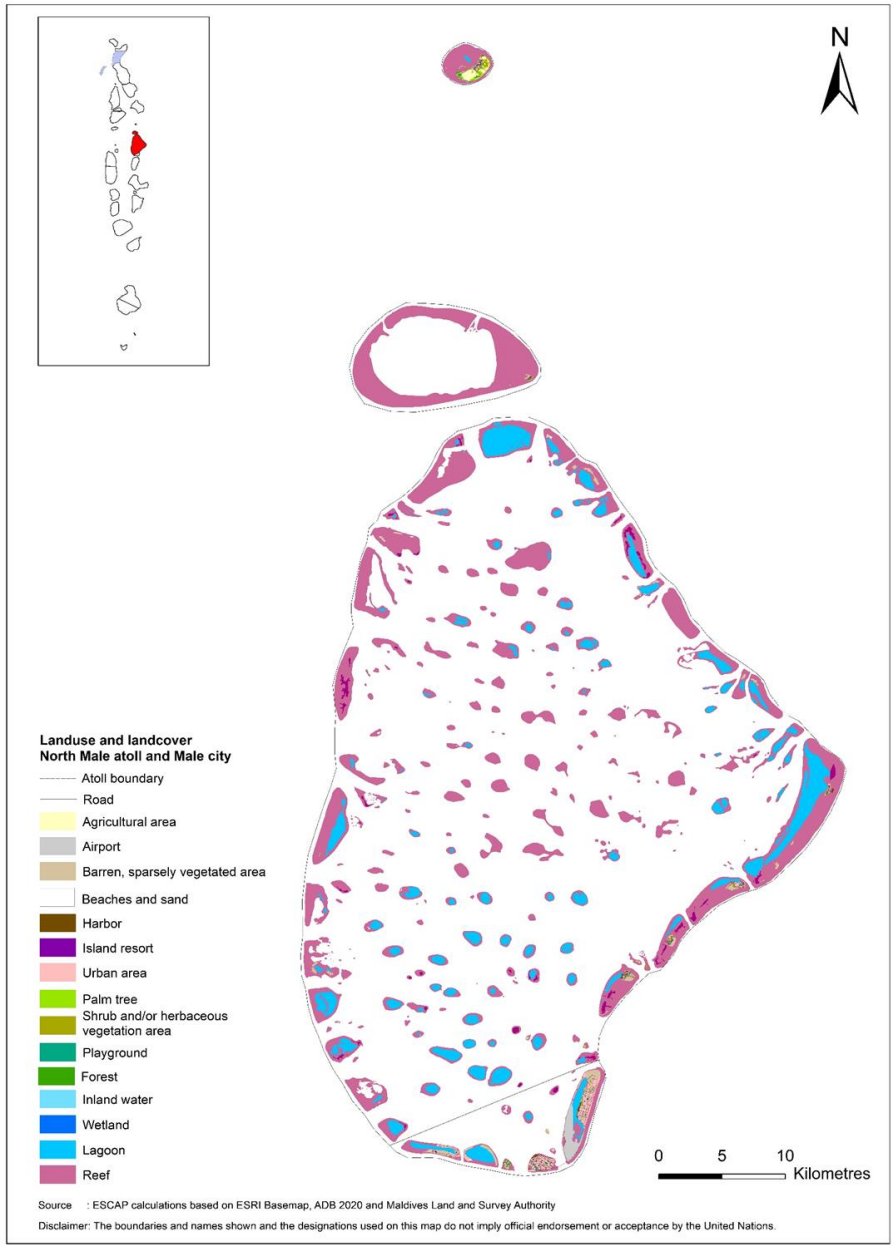
2. What we did

3. What we can do with these information

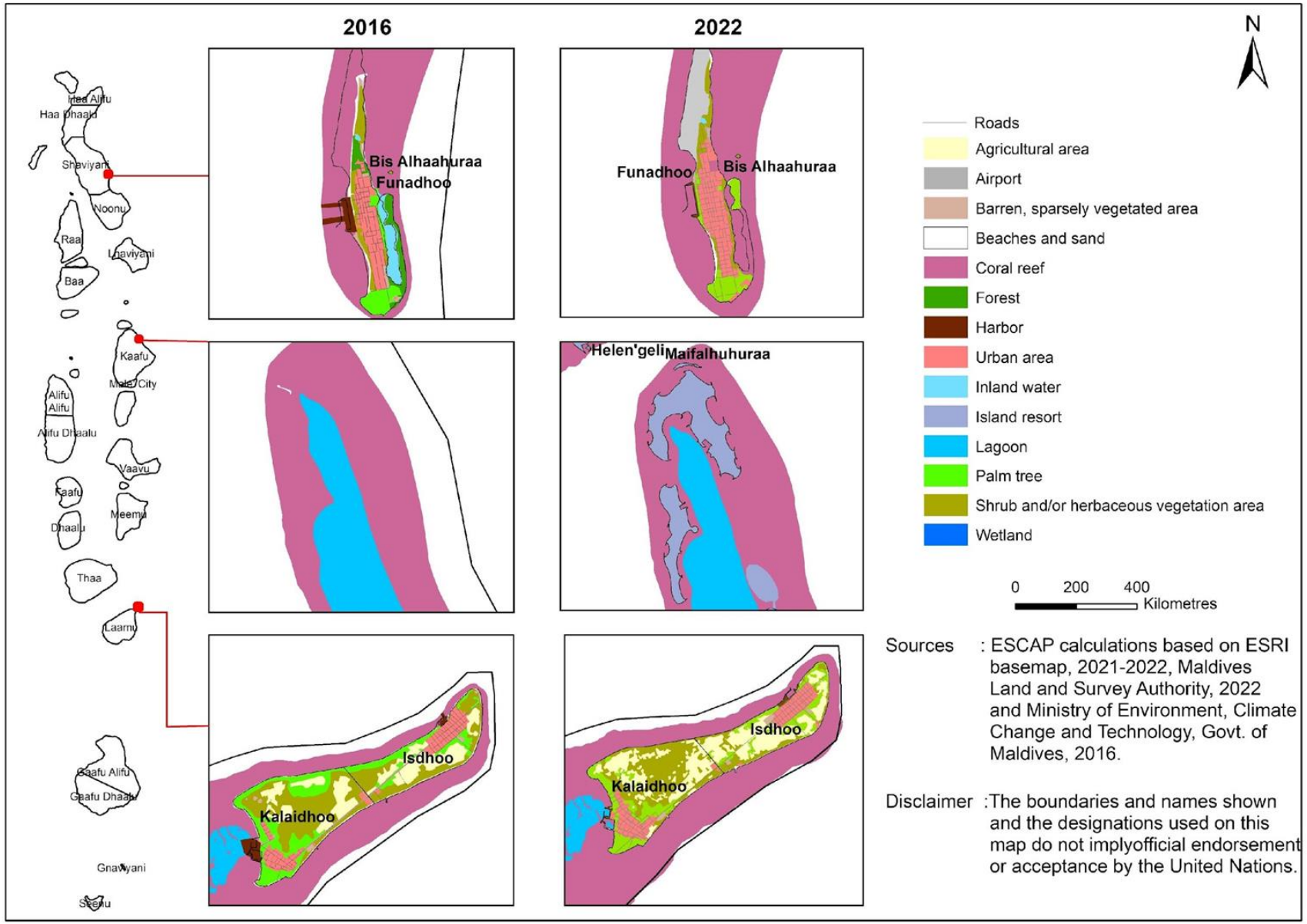
Updated landuse maps

- The landuse and land cover has been updated for the entire country using high resolution satellite images of 2021-2022





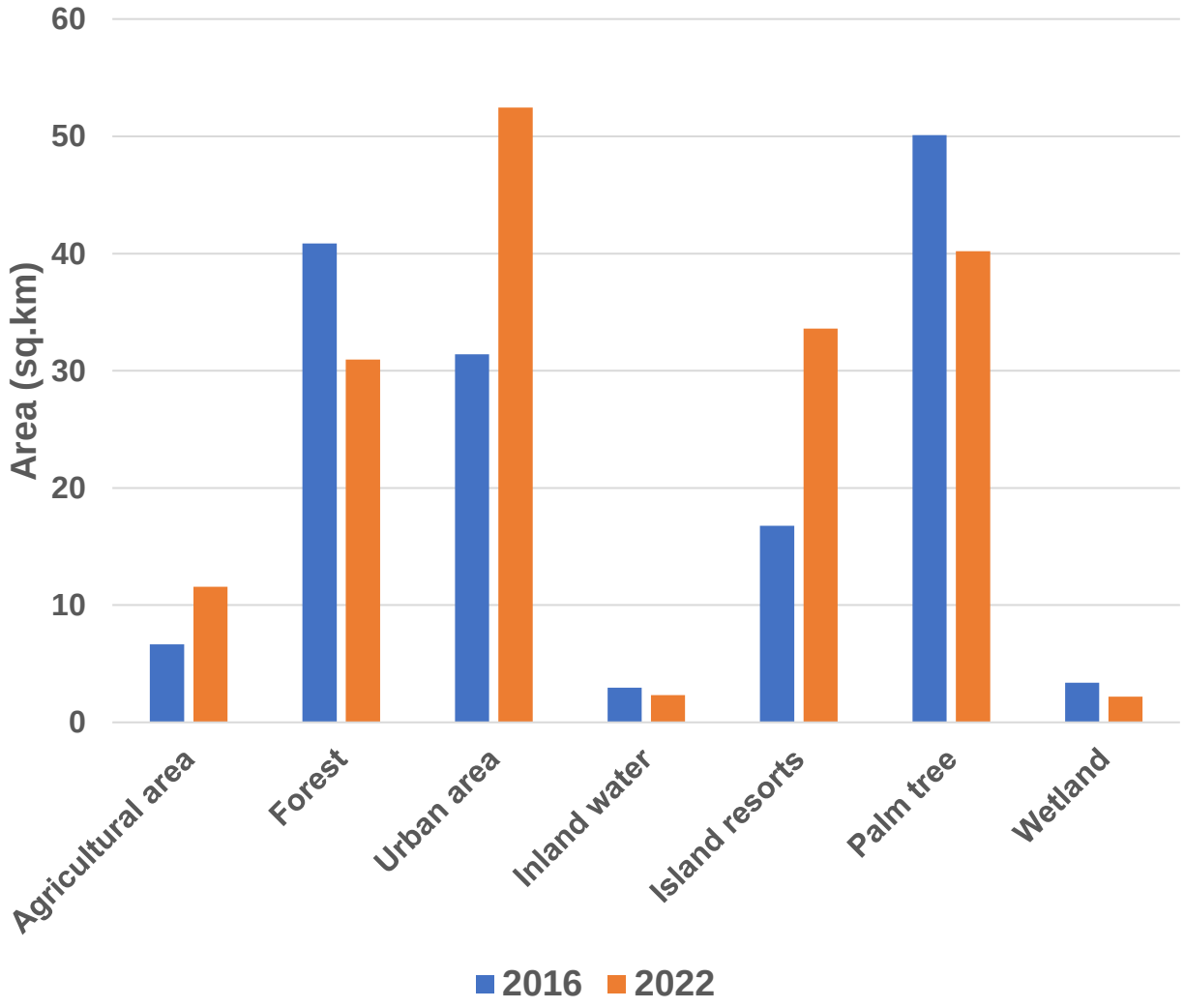
Updated landuse maps



- Landuse maps are updated based on the 2016 maps produced as part of ADB led Multi-hazard risk assessment project.
- The landuse and land cover has changed since then in many islands. E.g.
  - Urban and agricultural areas have expanded.
  - New resort islands are developed.
  - Reef areas are reclaimed for landuse development
  - Uninhabited islands are converted Island resort and agricultural lands.

Updated landuse maps

Land use/ Land cover category	Area in 2016 (sq.km)	Area in 2022 (sq.km)	% Change
Agricultural area	6.65	11.58	74.13 ↑
Forest	40.86	30.96	24.22 ↓
Urban area	31.40	52.45	67.03 ↑
Inland water	2.97	2.33	21.54 ↓
Island resorts	16.77	33.60	100.35 ↑
Palm tree	50.10	40.21	19.74 ↓
Wetland	3.39	2.19	35.39 ↓

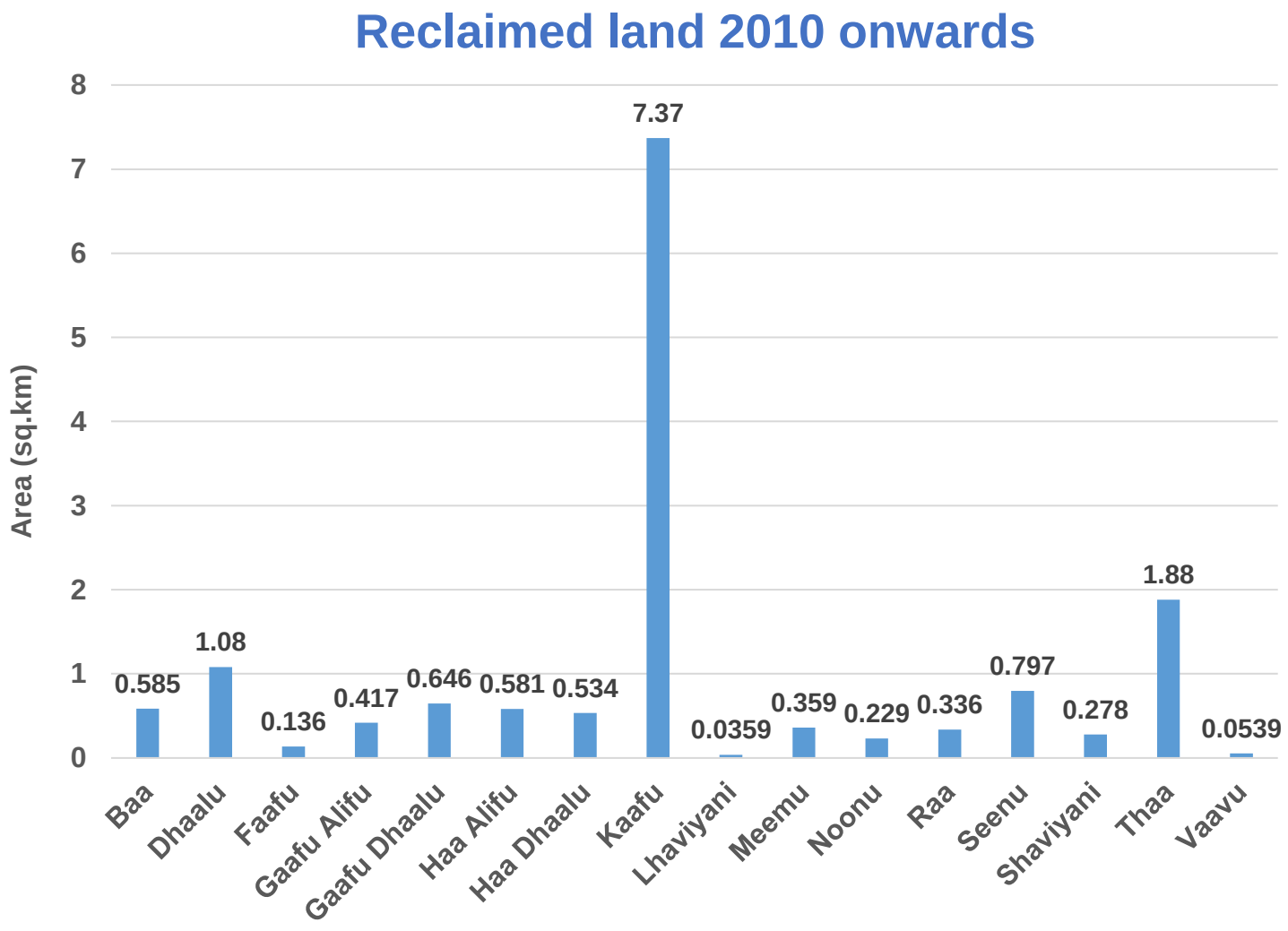


Updated landuse maps: reclaimed lands

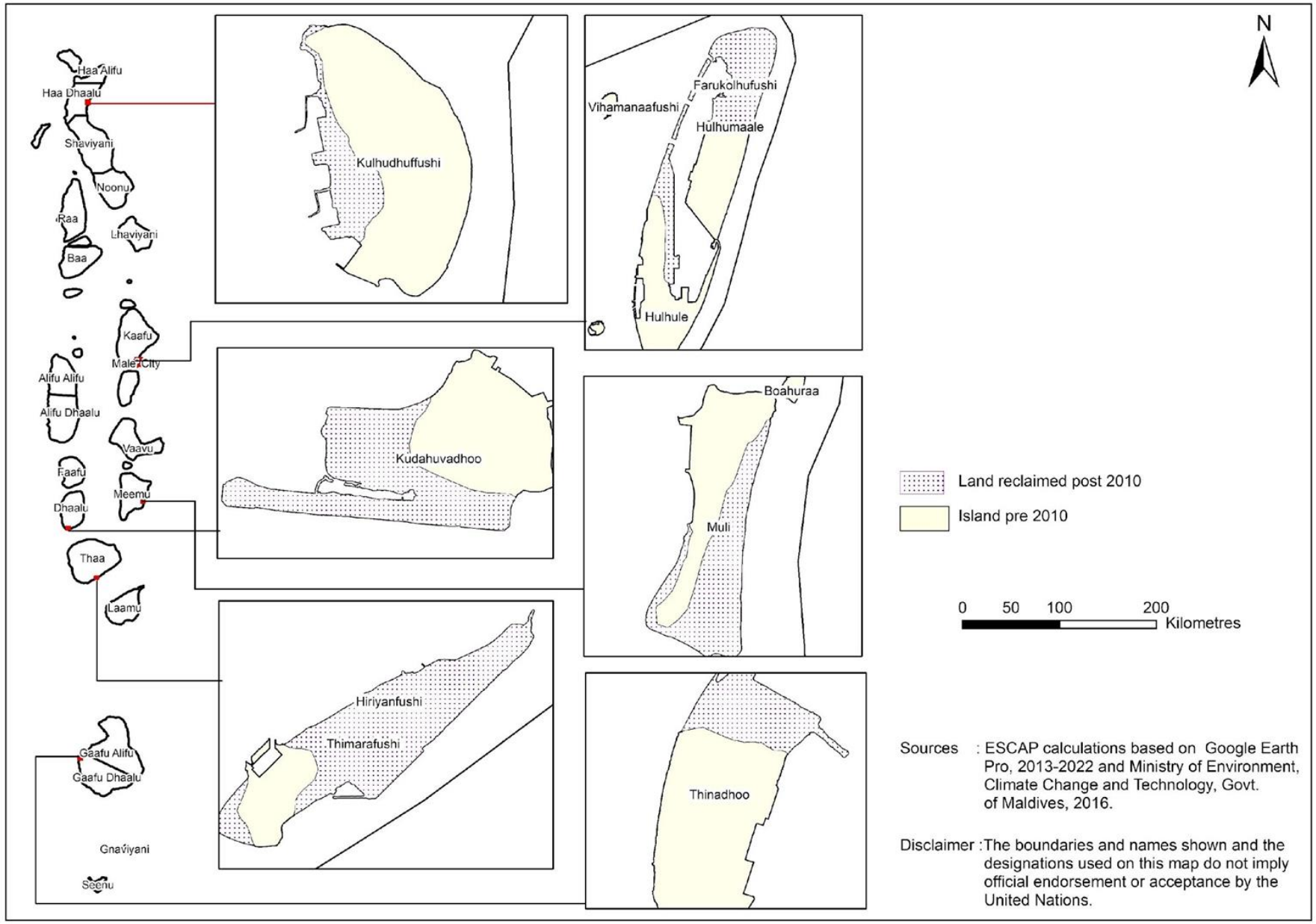
- Reclaimed lands were identified using high resolution satellite images of two time periods - 2010 and 2022.

- Around 15.38 sq.km area has been reclaimed post 2010.

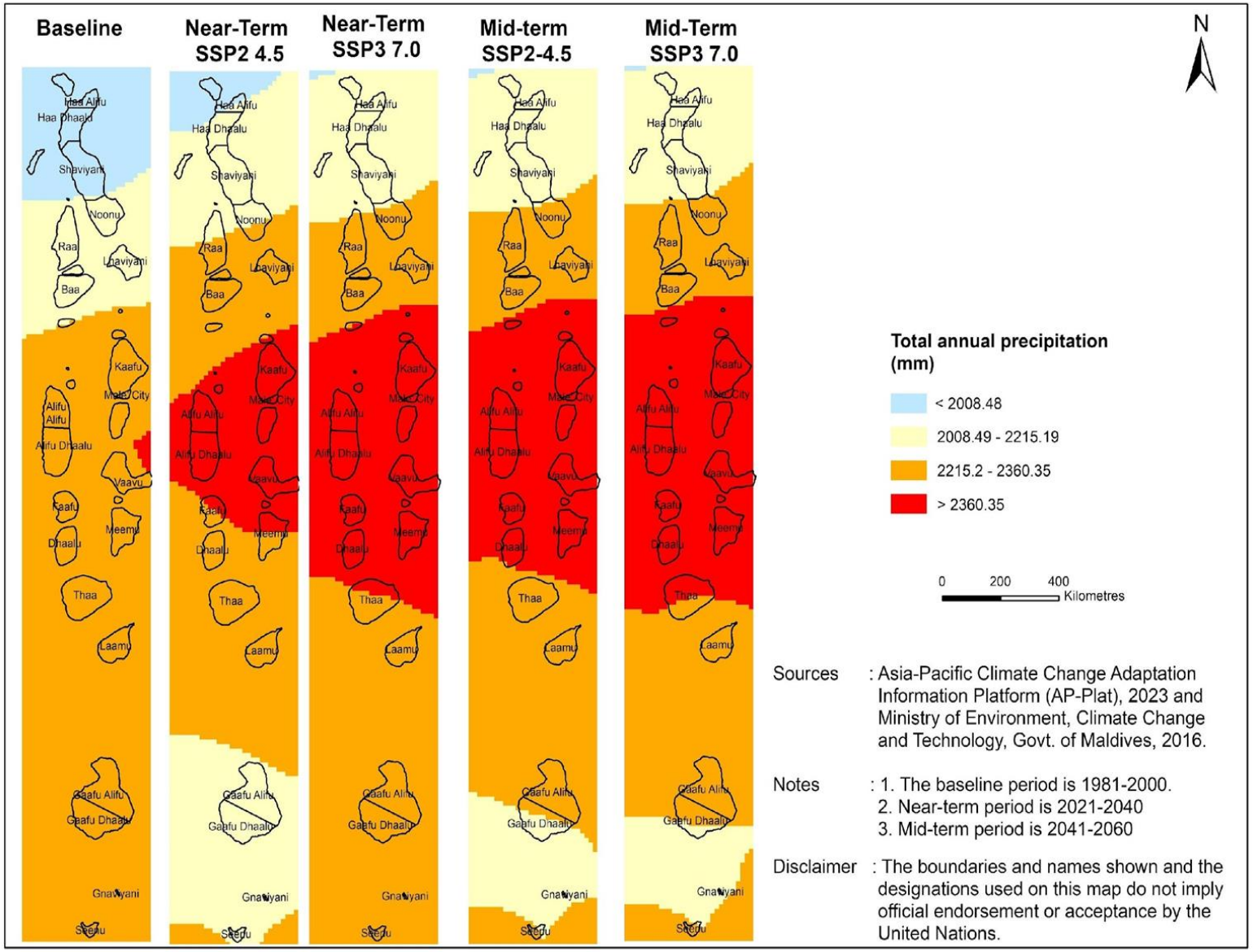
- **Kaafu atoll tops the list in land reclamation by 2022.**



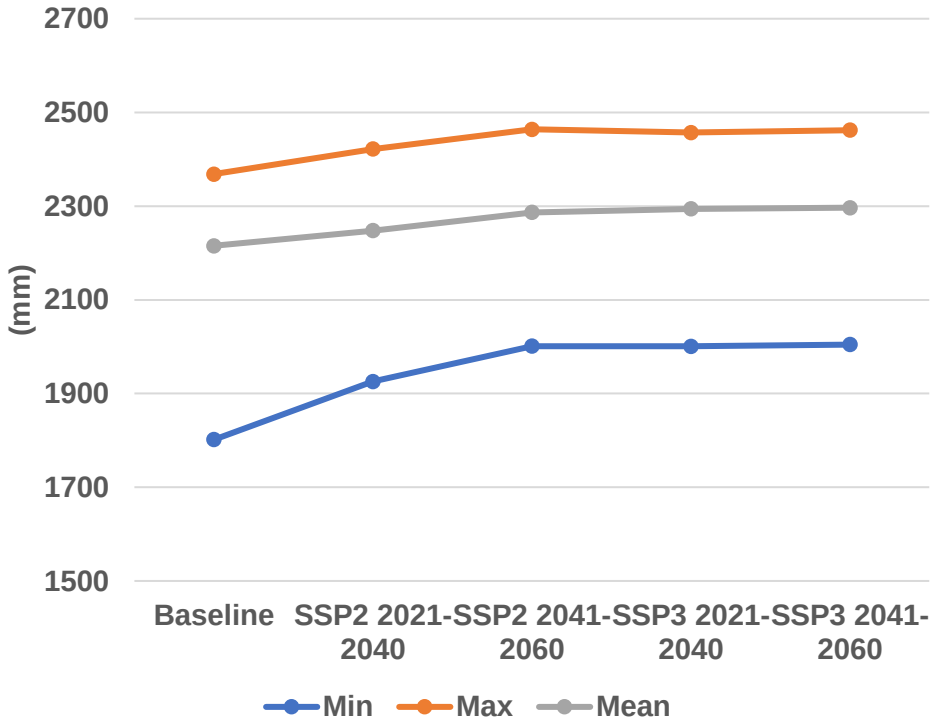
Updated landuse maps: reclaimed lands



Hazard trend – Precipitation



Projected total annual precipitation (mm)



Hazard trend– Precipitation

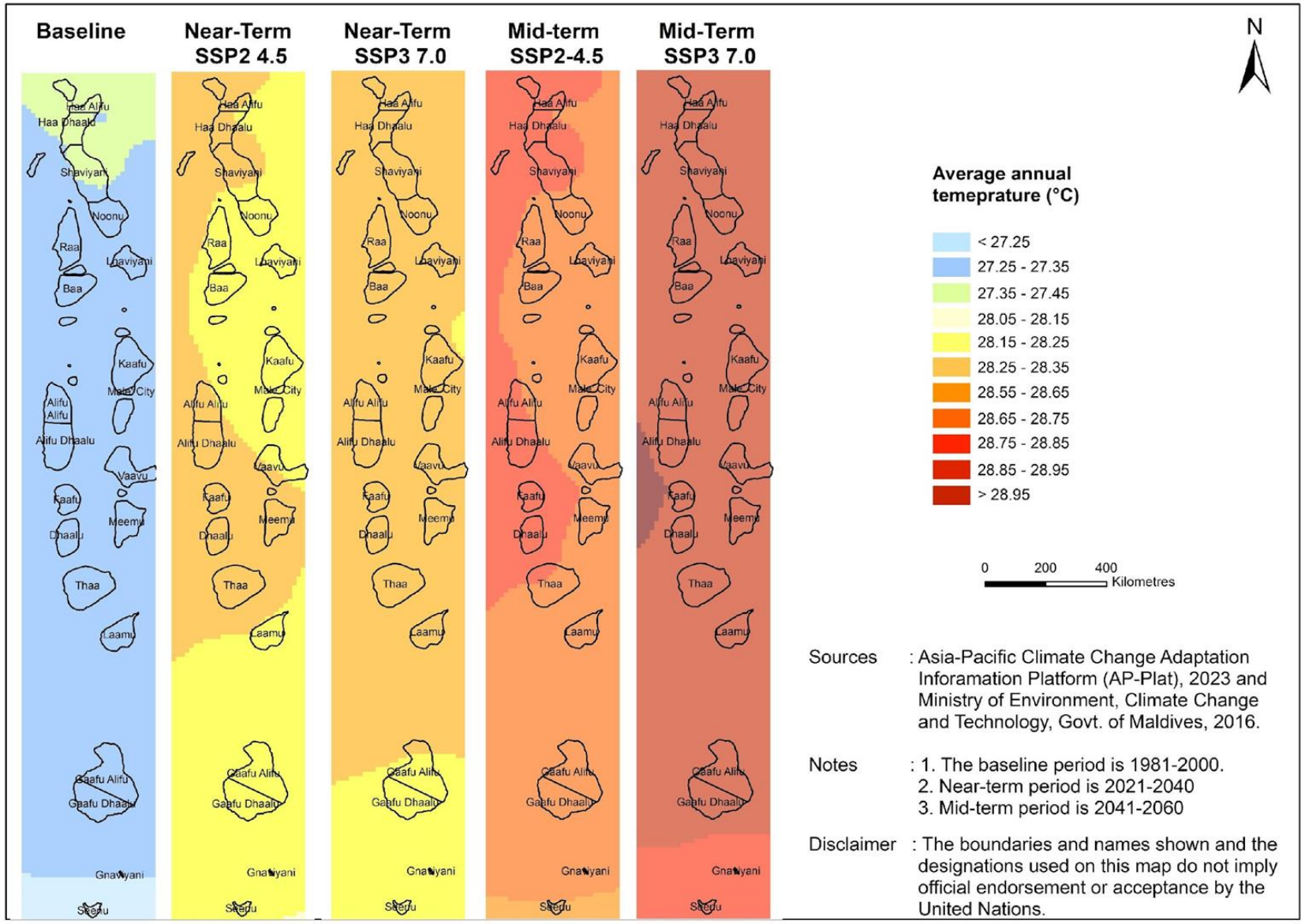
- Rainfall is likely to increase across the country compared to baseline period. Central atolls - **Kaafu, Alifu Alifu, Alifu Dhaalu, Vaavu, Faafu, Dhaalu and Meemu** are likely to receive maximum rainfall across all scenario and timelines.

- More of atolls/ islands are likely to receive highest rainfall in the worst-case scenarios (SSP3) than business-as-usual scenarios (SSP2).

- Many of the flood prone islands are likely to face occurrence of similar events in both near and mid-term scenario.

- Some of the central atolls are likely to receive **up to 100mm increase** in average annual rainfall from the baseline period.

Hazard trend - Temperature

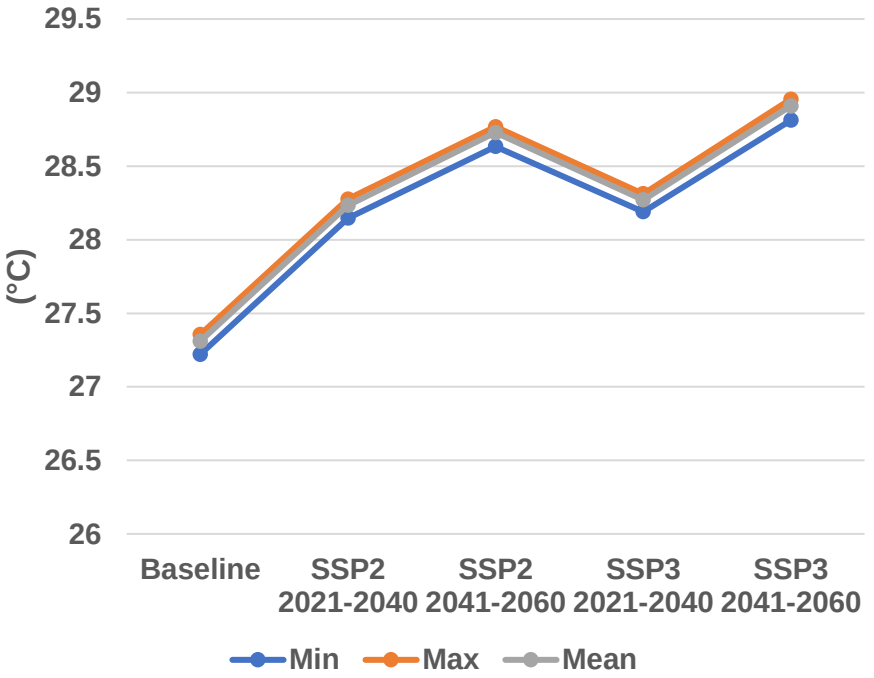


Sources : Asia-Pacific Climate Change Adaptation Inforamation Platform (AP-Plat), 2023 and Ministry of Environment, Climate Change and Technology, Govt. of Maldives, 2016.

Notes : 1. The baseline period is 1981-2000.
2. Near-term period is 2021-2040
3. Mid-term period is 2041-2060

Disclaimer : The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

Projected annual average temperature (°C)



Risk analysis: Hazard – Temperature

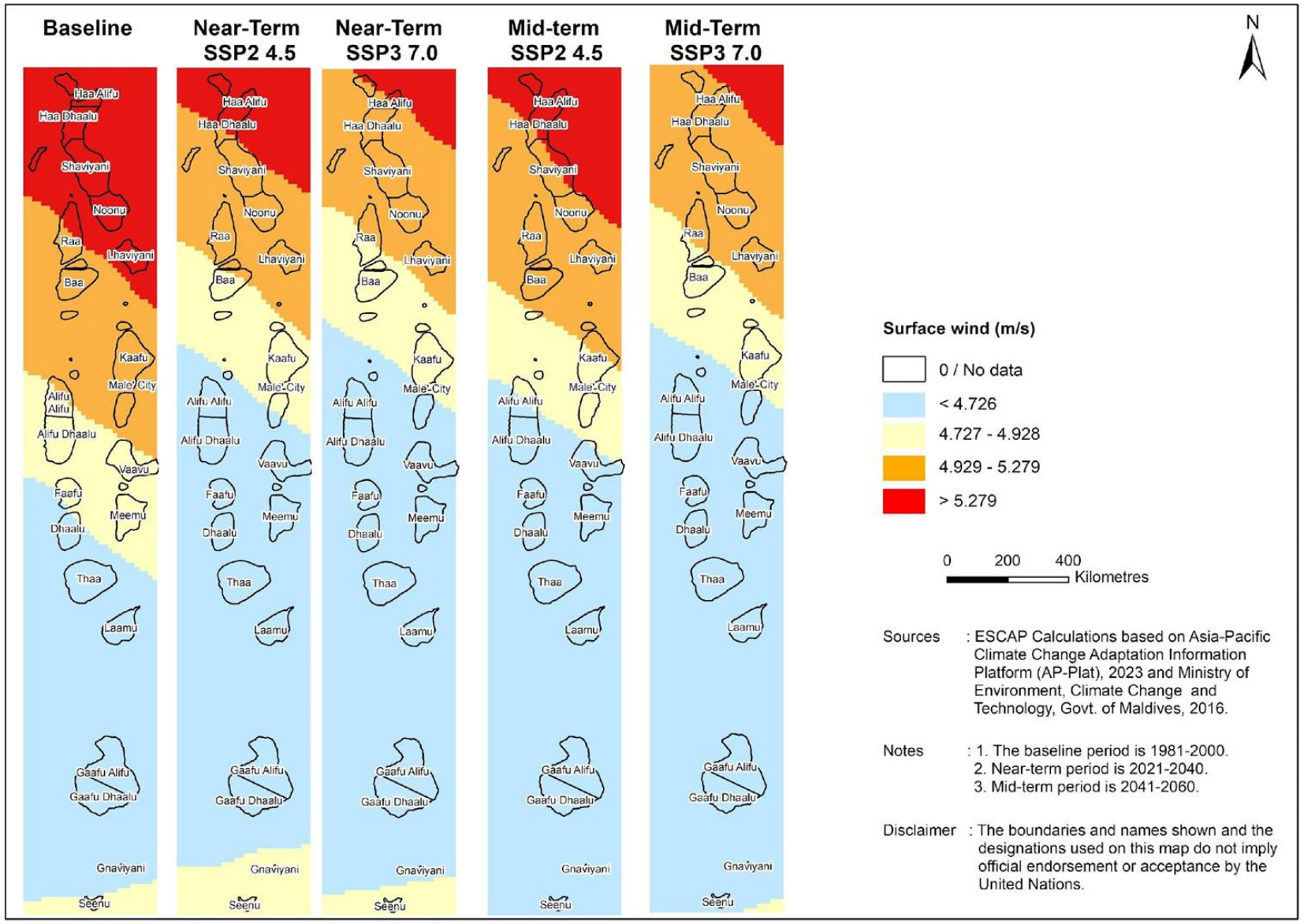
- The average annual temperature shows an increasing trend across the country under all the climate change scenarios.

- It is likely to increase more in the northern and central atolls - **Haa Alifu, Haa Dhaalu, Alifu Alifu, Alifu Dhaalu, Faafu, Vaavu and Thaa.**

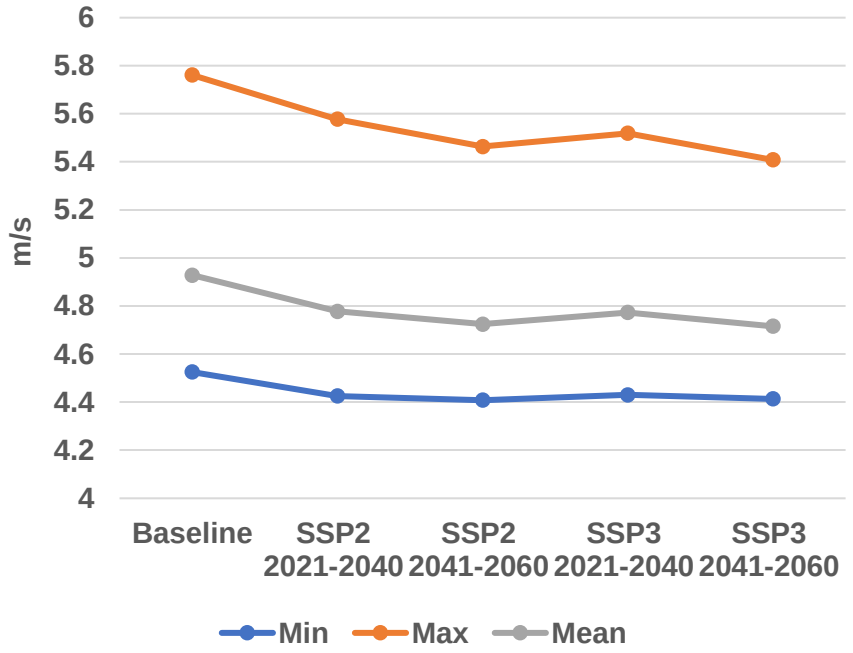
- In some of the atolls the increase in average temperature **may go up to 1.6 °C** from the baseline period under the **business-as-usual scenario** (SSP2 4.5) by 2040.

- Under **worst-case scenario** (SSP3) the average annual temperature may increase up to **1.7 °C** in all the atolls except Seenu and Gnaviyani by the end of 2060.

Risk analysis: Hazard – Surface wind



Projected seasonal average surface wind (m/s)



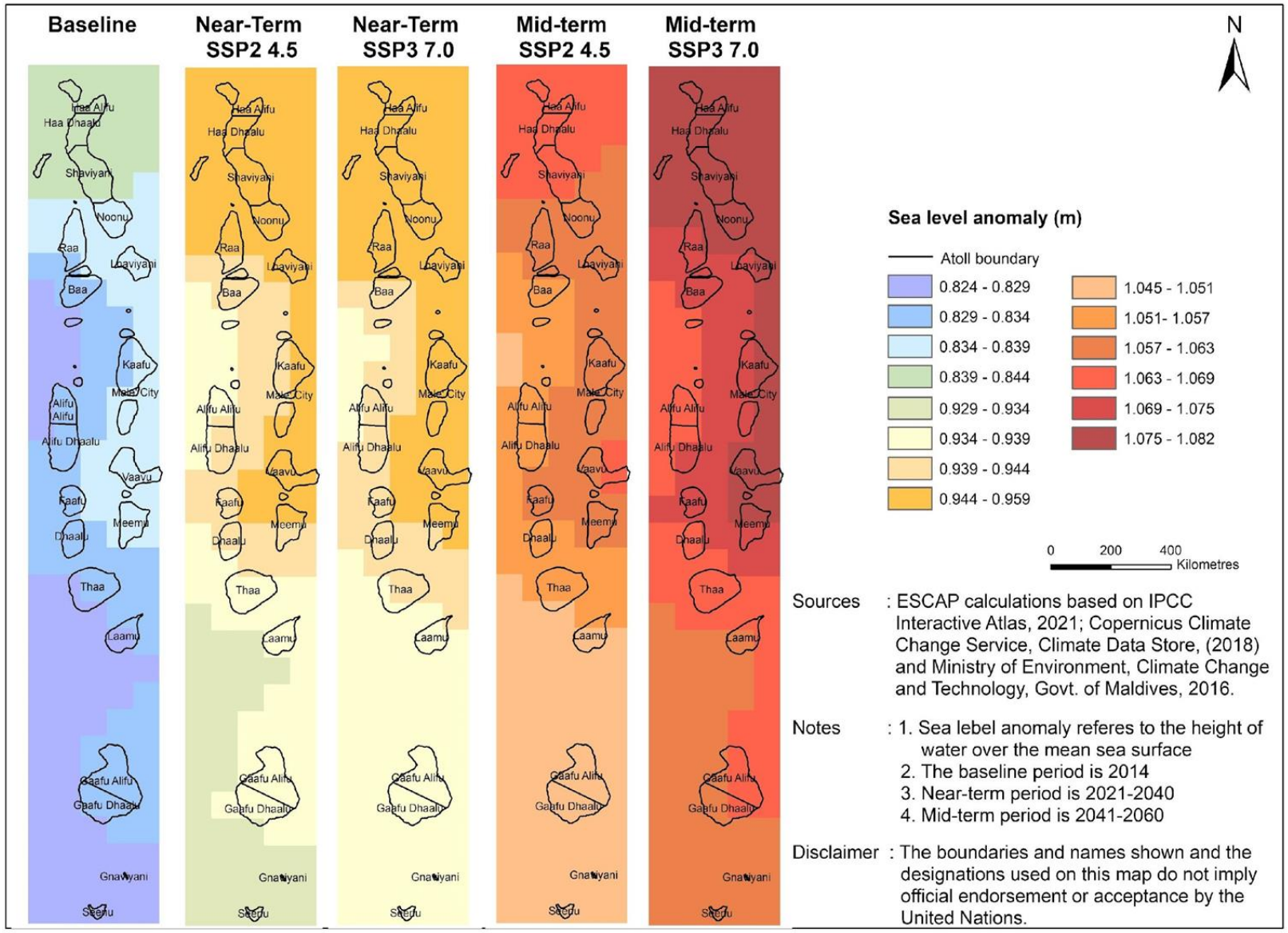
Hazard trend – Surface wind

- The future trends in seasonal surface wind (May to October) follows the baseline trends across all the scenario and time period however the **wind speed is likely to decrease** in both near and mid-term period.

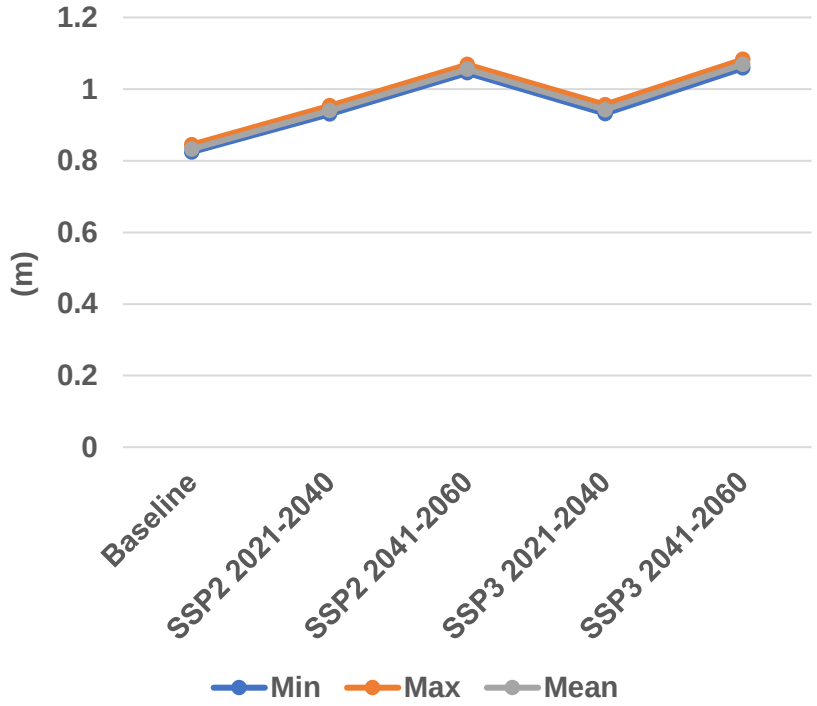
- The highest wind speed is observed across the northern atolls namely **Haa Alifu, Haa Dhaalu, Shaviyani, Noonu, Lahviyani, Kaafu, Raa and Baa.**

- The northern atolls with existing risk of cyclone and storm like events, have highest likelihood of similar events in future. However, southern and central atolls are likely to have the baseline like situation.

Hazard trend - Sea Level Rise



Sea level anomaly (m)



Hazard trend – Sea level rise

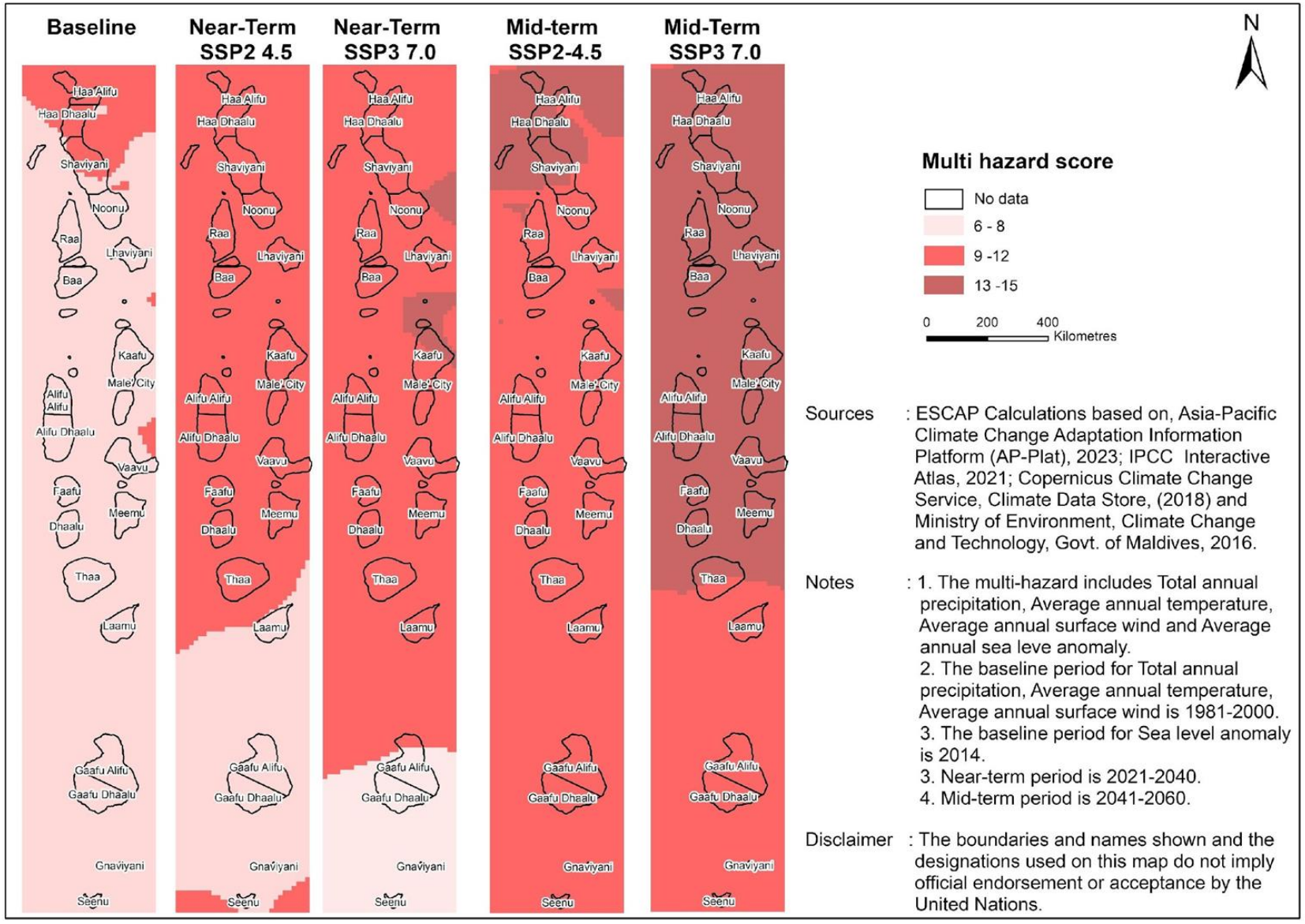
- The increase in the sea level is likely to occur across the country compared to the level of 2014 in all the climate projection scenarios.

- The rise high around the northern and eastern part of the central atolls and relatively low towards the southern atolls.

- The highest rise is likely to heppen in **Haa Alifu, Haa Dhaalu, Shaviyani, Noonu, Lahviyani, Kaafu, Vaavu, and Meemu.**

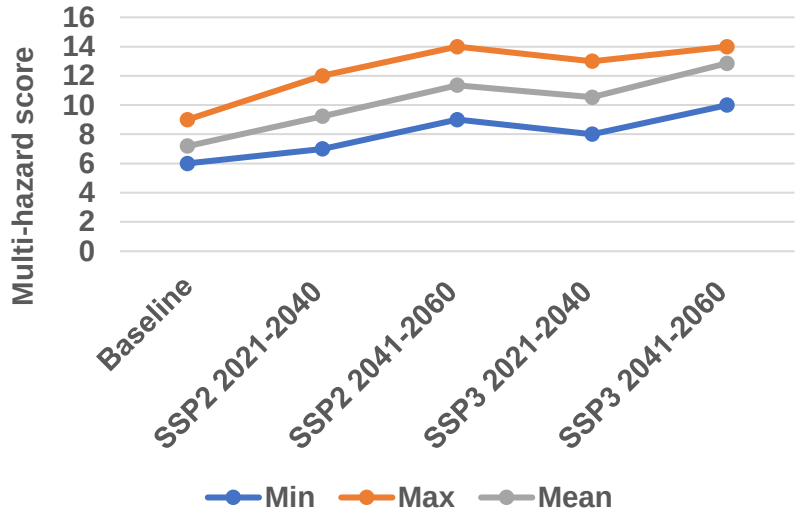
- The northern and central atolls may experience increase in sea level up to 0.95 m by 2040 and up to 1.08m under worst case scenario (SSP3).

Trend - Multi-hazard (precipitation, temperature, surface wind and sea level rise

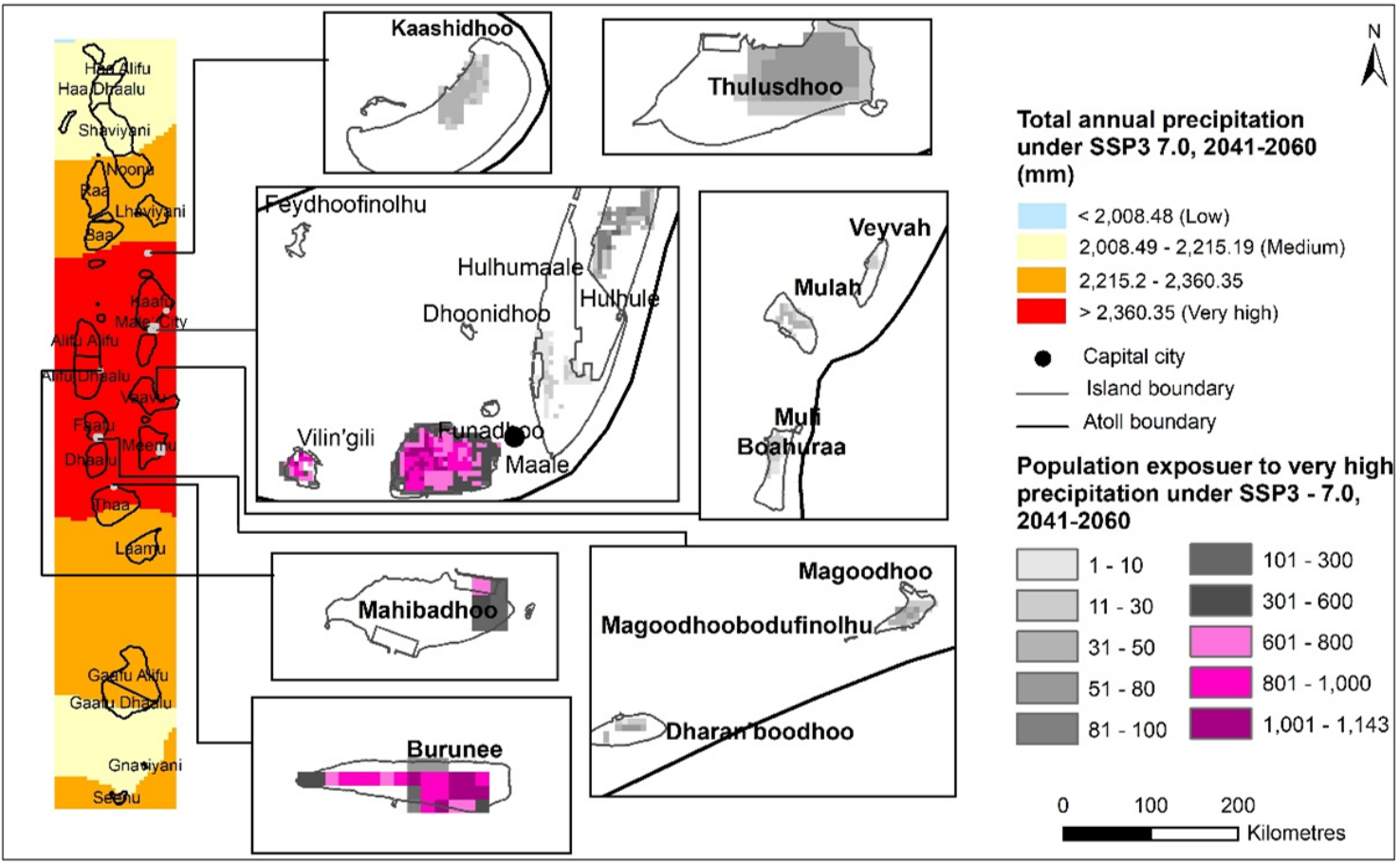


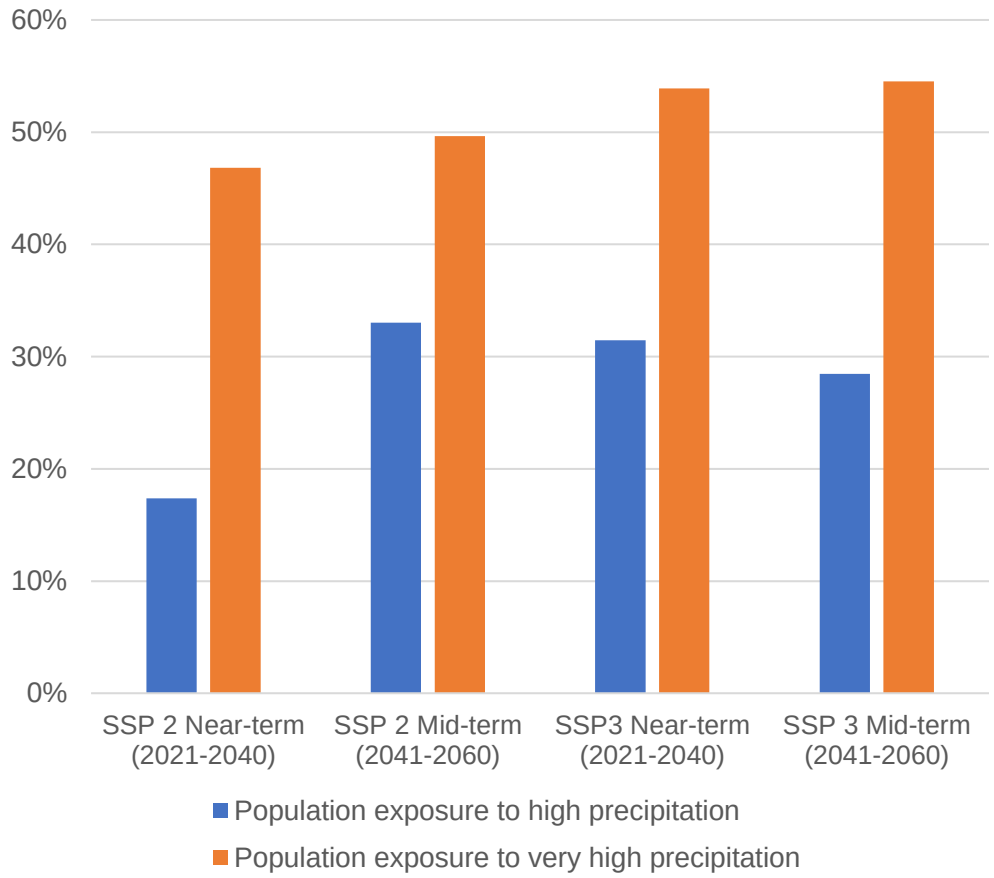
- There is increasing trend of multi-hazard likely across the country from baseline to the mid-term worst-case scenario (SSP3).
- Northern, central atolls namely - **Haa Alifu, Haa Dhaalu, Shaviyani, Noonu, Lahviyani, Baa, Alifu Alifu, Alifu Dhaalu, Kaafu, Faafu, Dhaalu, Thaa, Vaavu, and Meemu** may experience more intense multi-hazards than the rest.

Projected multi-hazard score



Exposure – Population



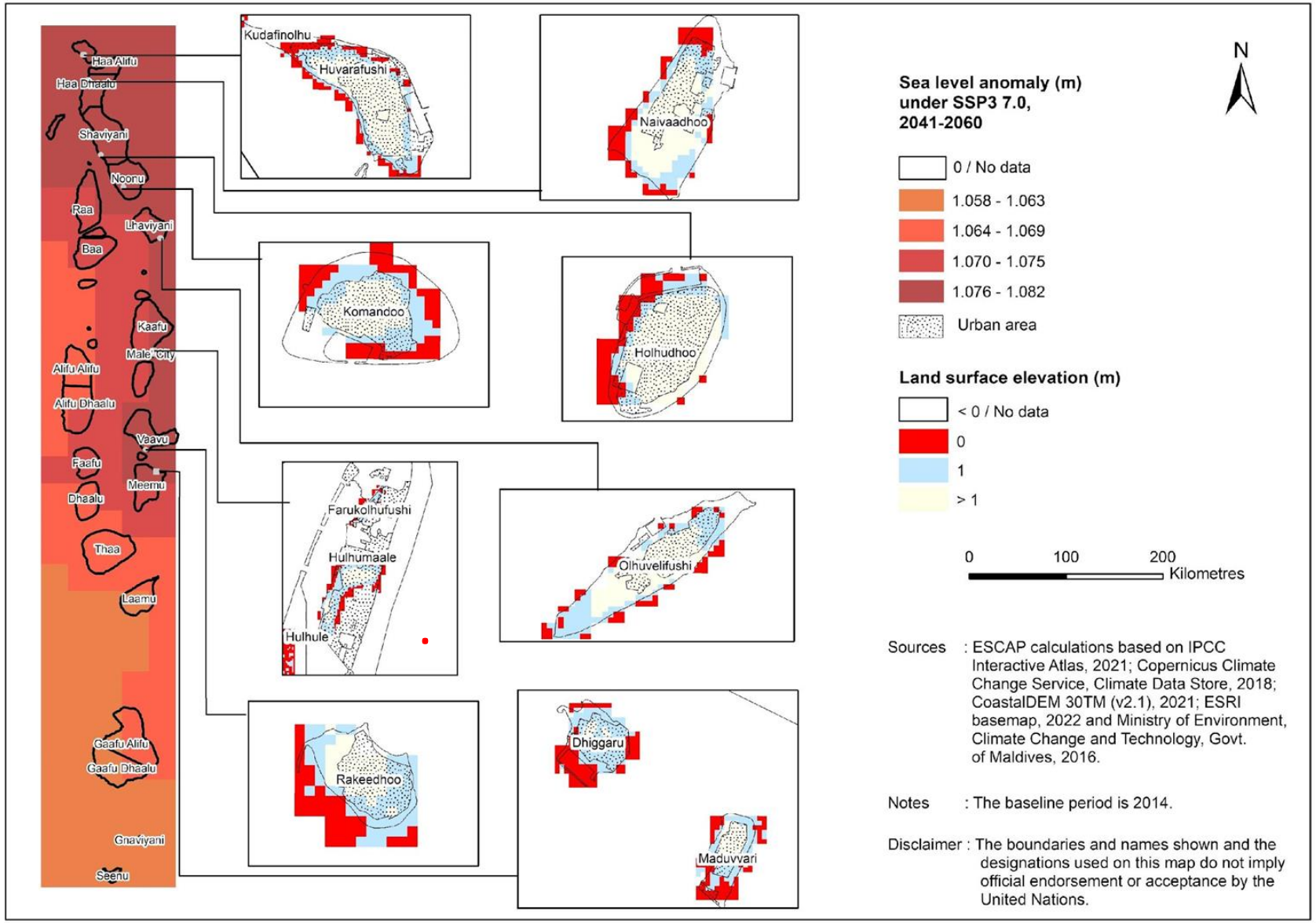


- Around **50%** **of the total population** of Maldives is likely to be exposed to **high precipitation** under business-as-usual (SSP2) scenario and around **55%** under worst-case scenario (SSP3) by 2060.

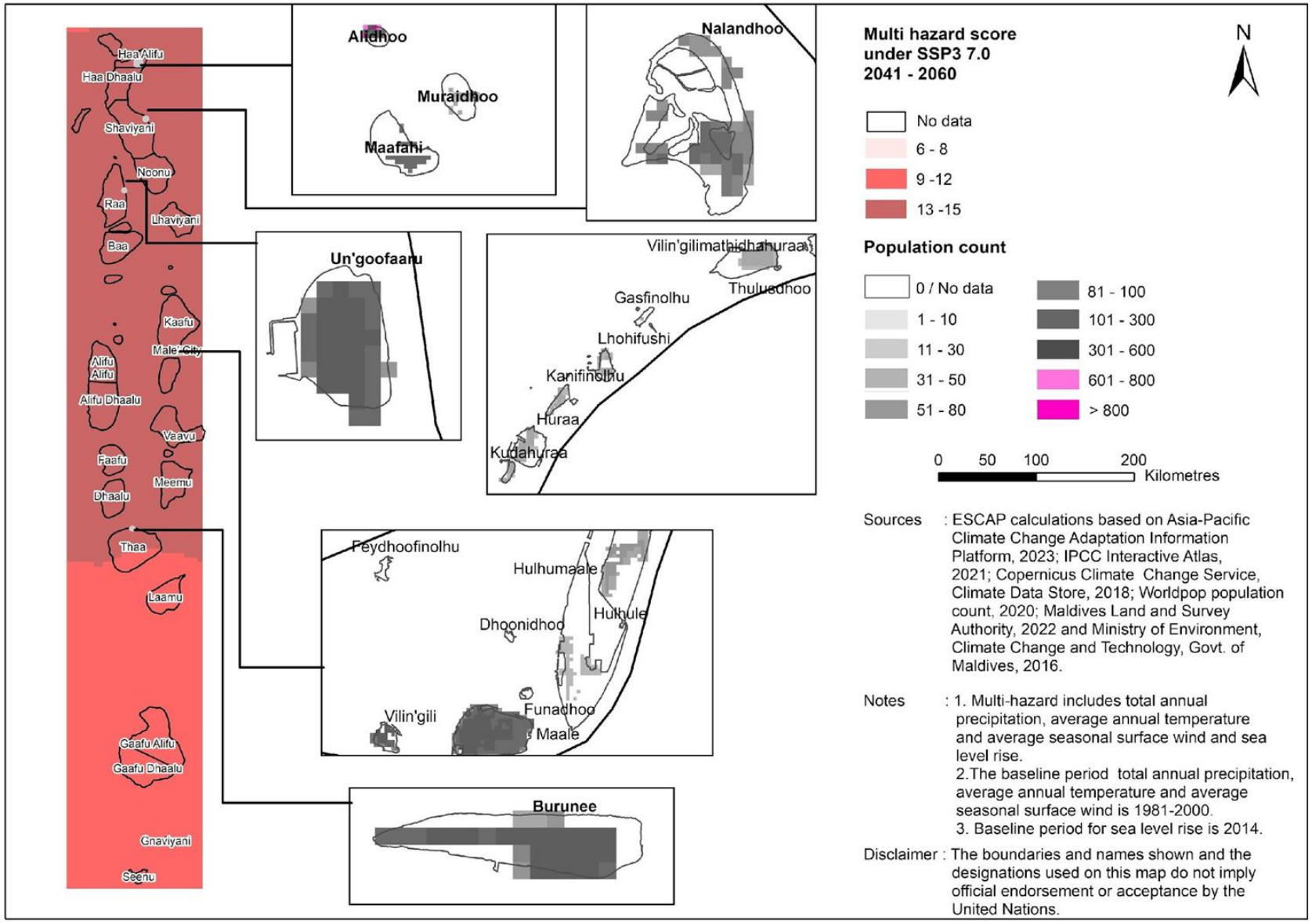
Exposure – Population

- Around **19% of the total population** are likely to be exposed to up to **1.6 °C increase** in annual average temperature.

- **Around 14% of the urban area with 0-1m elevation are under risk of 1 m increase in sea level under future climate scenario**



Exposure – Female population

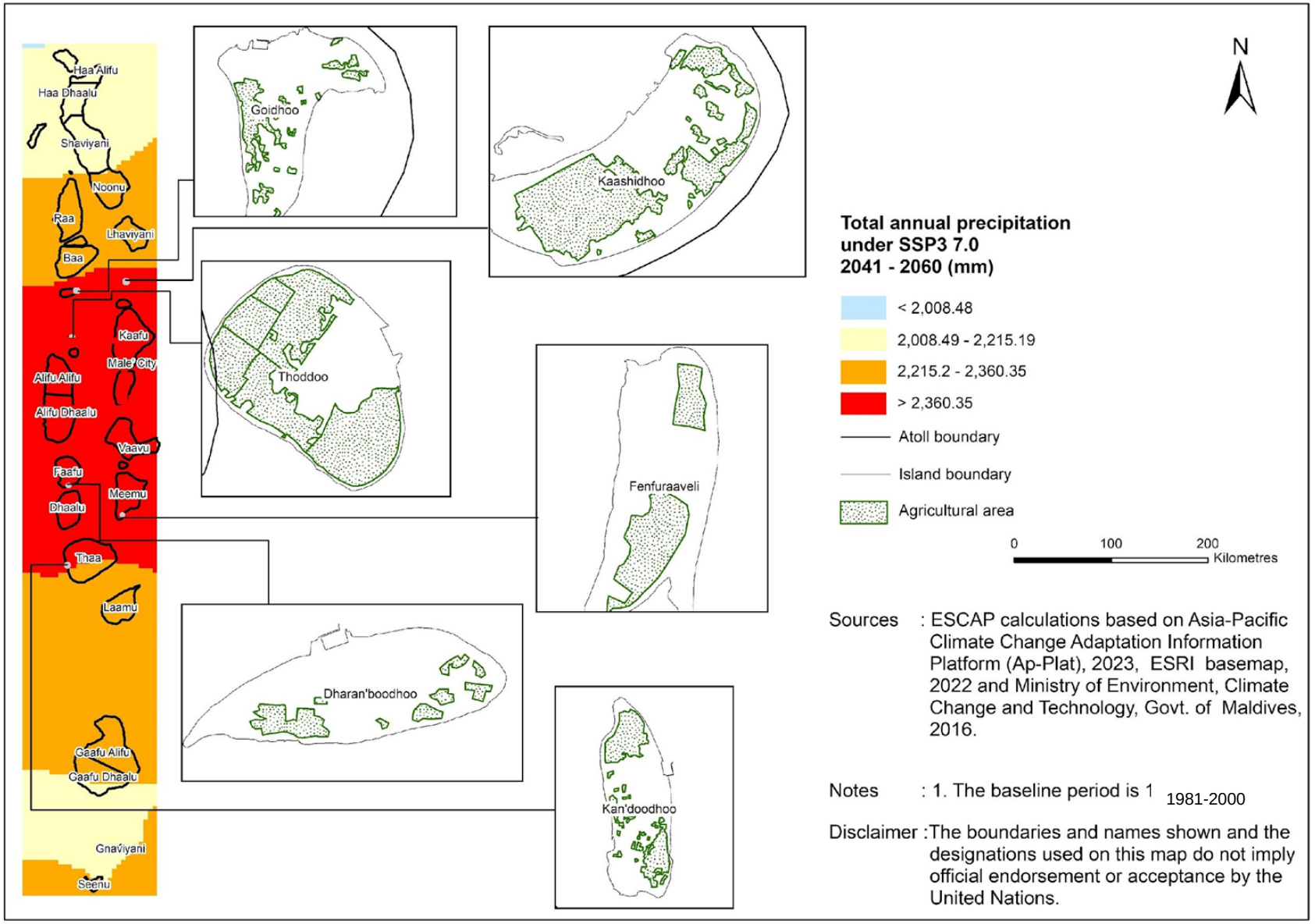


- **Up to 99%** of female population are likely to be affected by **multi-hazard** by 2060 under worst-case scenario
- **55% of female population are exposed to high precipitation and 16% to the 1m increase in sea level** under worst-case scenario

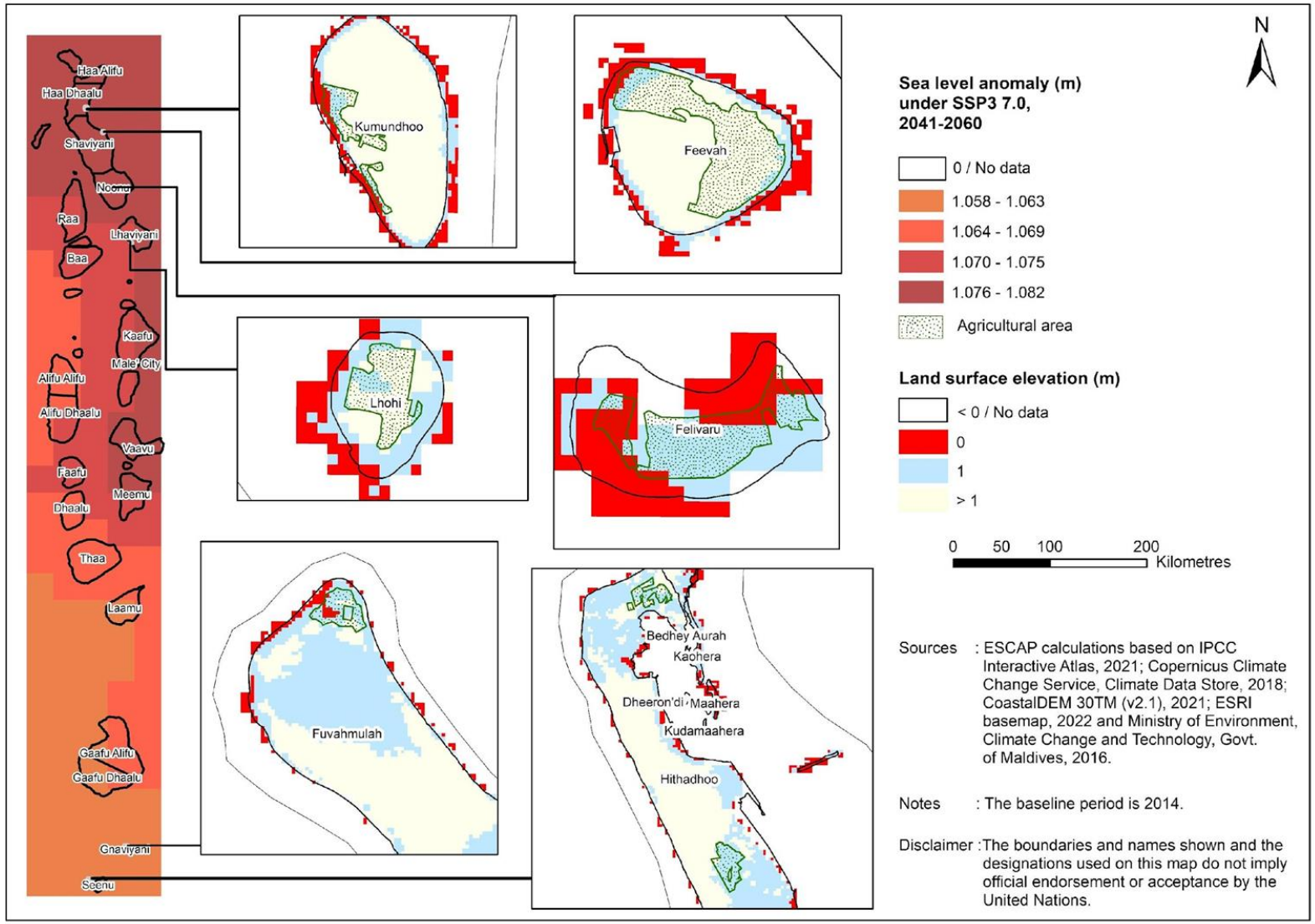
Exposure – Agriculture

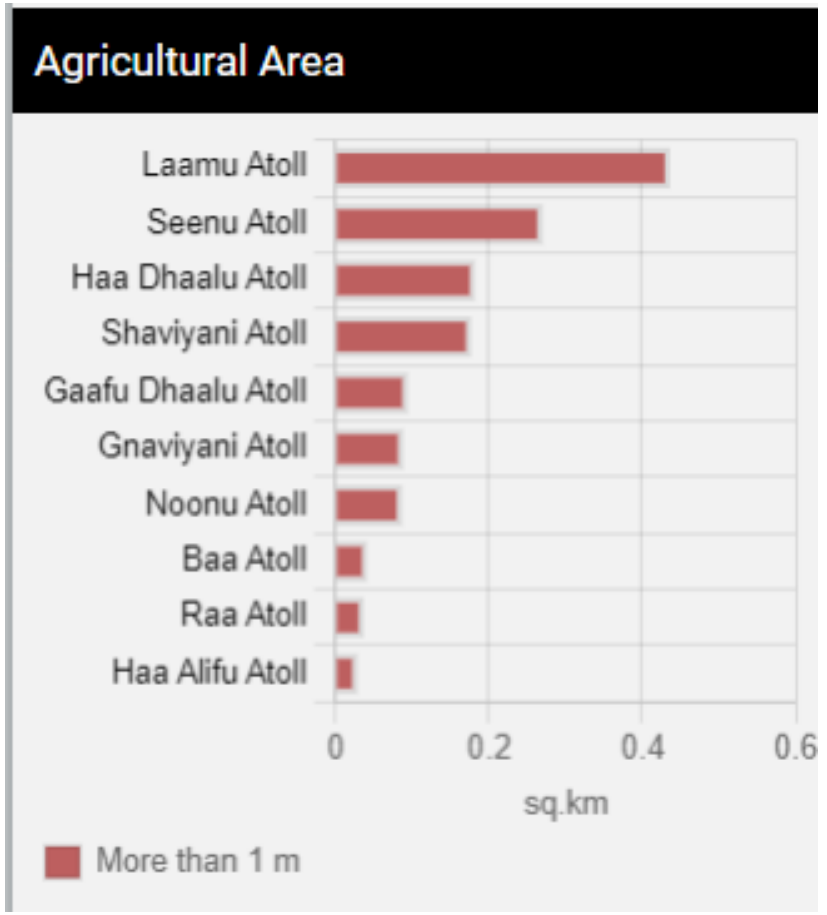
- Up to **26%** of the agricultural lands in the country are likely to be exposed to intense precipitation under worst-case scenario (SSP3) by 2060.

- **86%** of the total agricultural land is exposed to up to 1.6 °C increase in average temperature.



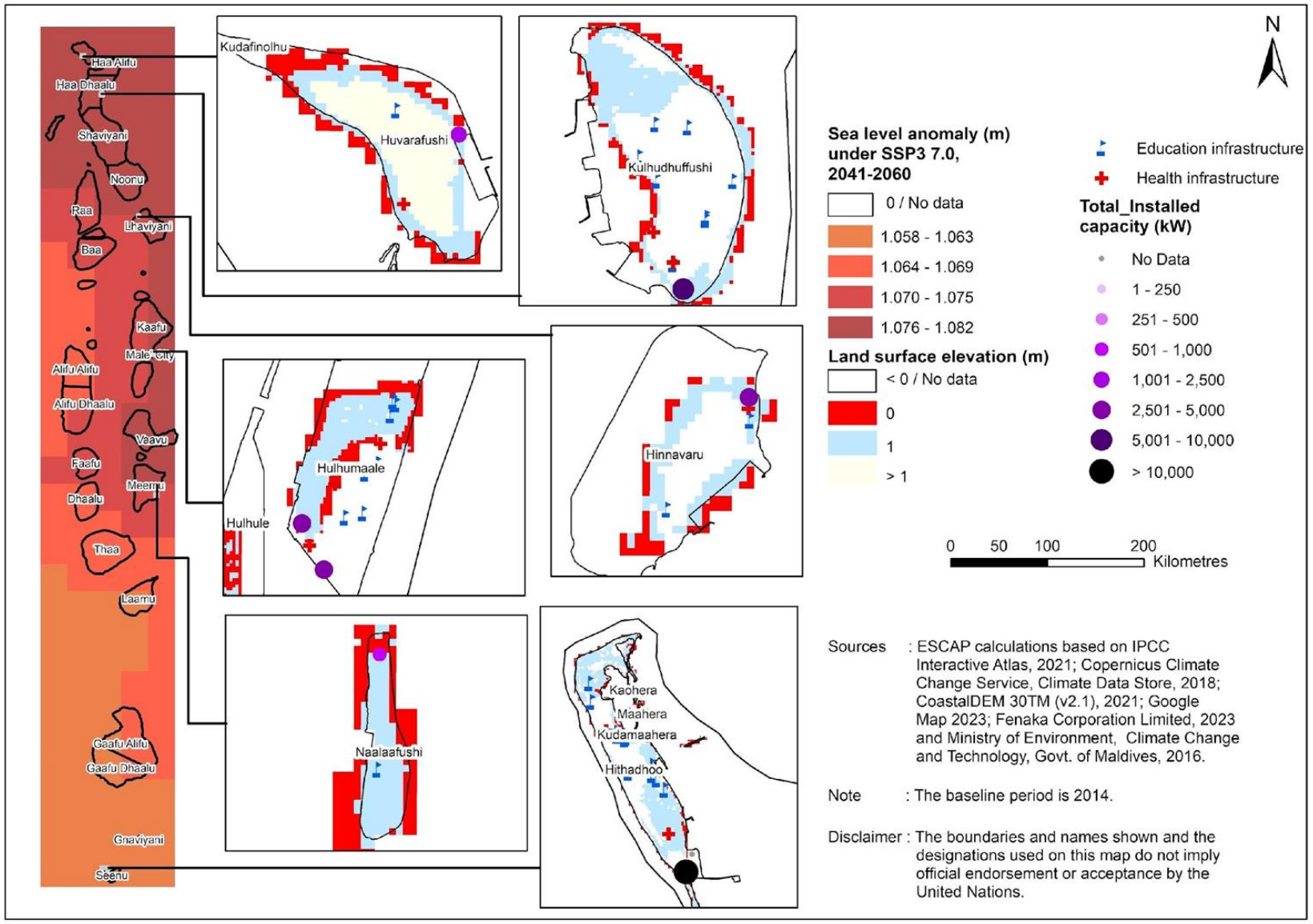
Exposure – Agriculture





13% of the agricultural areas with 0-1m elevation are under risk of 1m increase in sea level under future climate scenario by 2060 under SSP3 7.0 climate scenario.

Exposure – Energy infrastructure

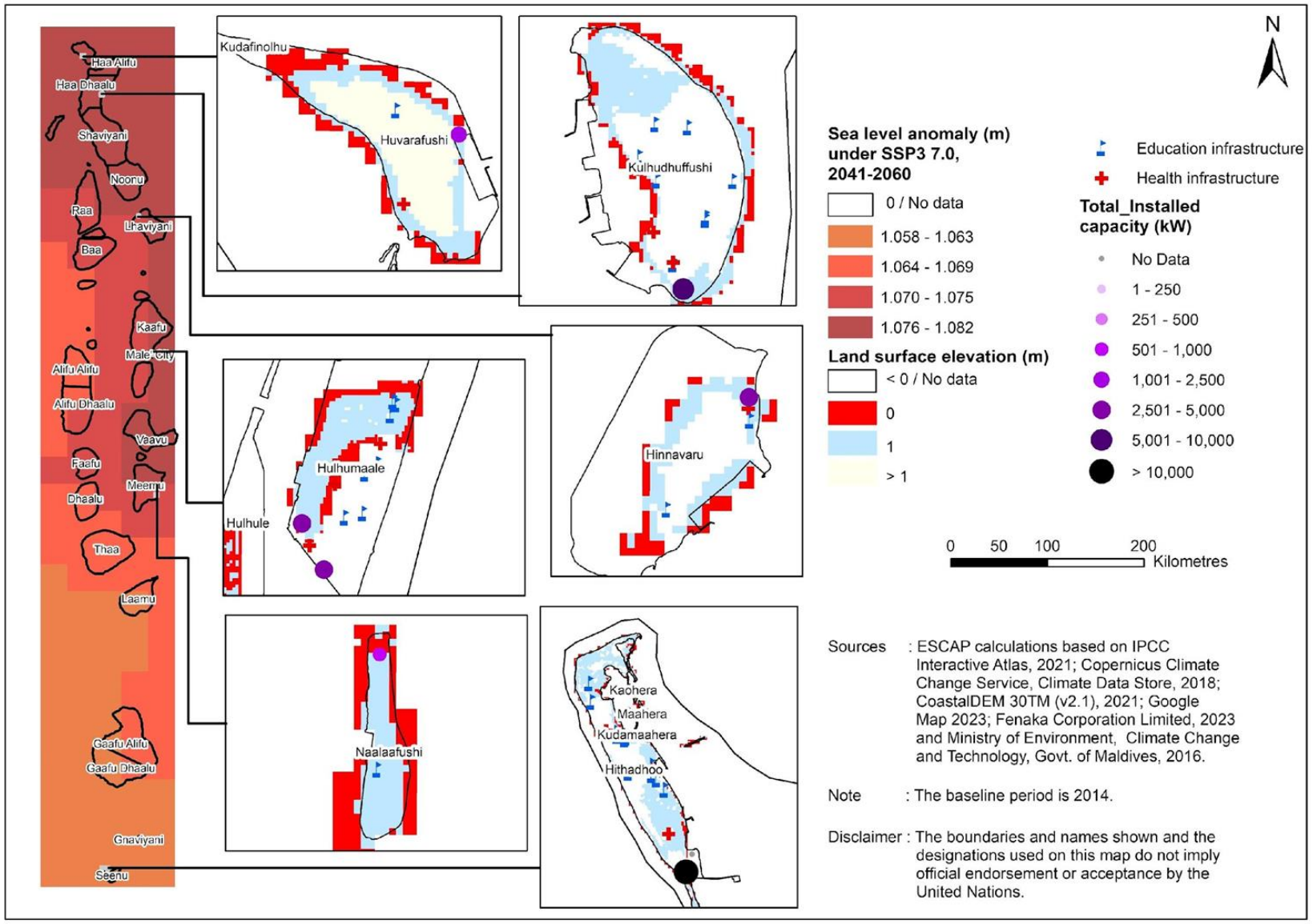


- Around **47%** of total energy capacity of the country is exposed to the highest increase in precipitation by 2060 under both SSP2 and SSP3 climate change scenarios.

- **22%** of the energy capacity are located at 0-1m elevation and are under risk of 1m increase in sea level under future climate scenario by 2060 under SSP3 7.0 climate scenario.

- **Seenu atoll (100%), Meemu atoll (62%), Faafu atoll (47%), Noonu atoll (40%) and Lahviyany atoll (39%) are likely to be most impacted due to sea level rise in terms of energy capacity.**

Exposure – Energy infrastructure



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- **22%** of the energy capacity are located at 0-1m elevation and are under risk of 1m increase in sea level under future climate scenario by 2060 under SSP3 7.0 climate scenario.

- **Seenu atoll (100%), Meemu atoll (62%), Faafu atoll (47%), Noonu atoll (40%) and Lahviyany atoll (39%) are likely to be most impacted due to sea level rise in terms of energy capacity.**

Risk matrix: Multi-hazard - Population

Baseline

Probability	Impact: Low	Impact: Medium	Impact: High
High			
Medium		Sh, HDh	HA
Low	B, Lh, Sh, AA, Dh, F, Gn, GA, V, M, ADh, HDh, N, GDh	L, Th, K	R, S, Male

SSP2 2021-2040

Probability	Impact: Low	Impact: Medium	Impact: High
High			
Medium	B, Lh, AA, Dh, F, V, M, Adh, N	Sh, Th, HDh, K	R, HA, Male
Low	Gn, GA, GDh	L	S

SSP3 2041-2060

Probability	Impact: Low	Impact: Medium	Impact: High
High	B, Lh, AA, Dh, F, V, M, Adh, N	SH, Th, HDh, K	R, HA, Male
Medium	GA, Th, GDh	L	S
Low			

Risk matrix: Multi-hazard - Agriculture

Baseline

Probability	Impact: Low	Impact: Medium	Impact: High
High			
Medium		HA	Sh, HDh
Low	Lh, R, Sh, Dh, F, Gn, M, ADh, HDh	B, S, GA, Th, N	AA, L, GDh, K

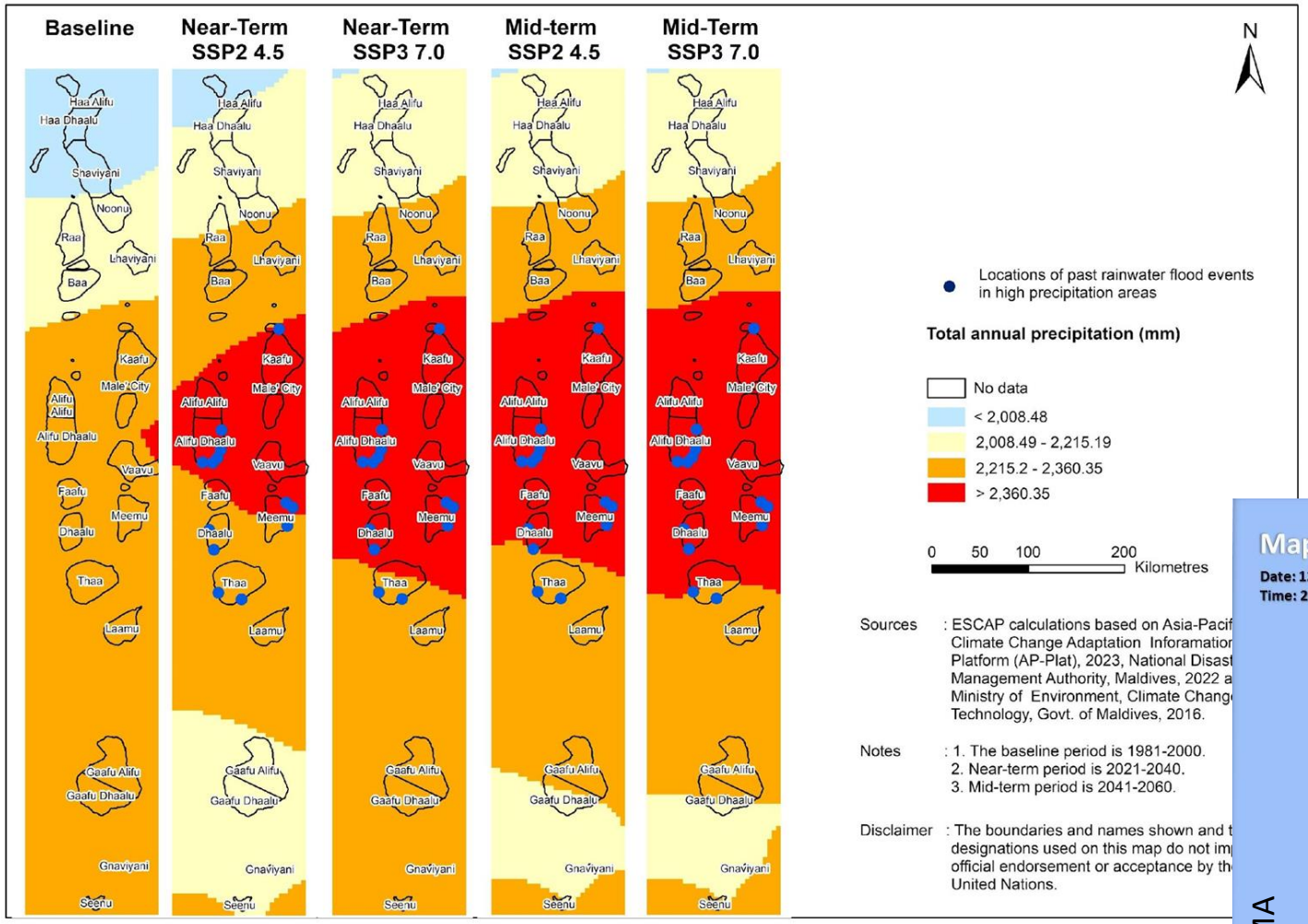
SSP2 2021-2040

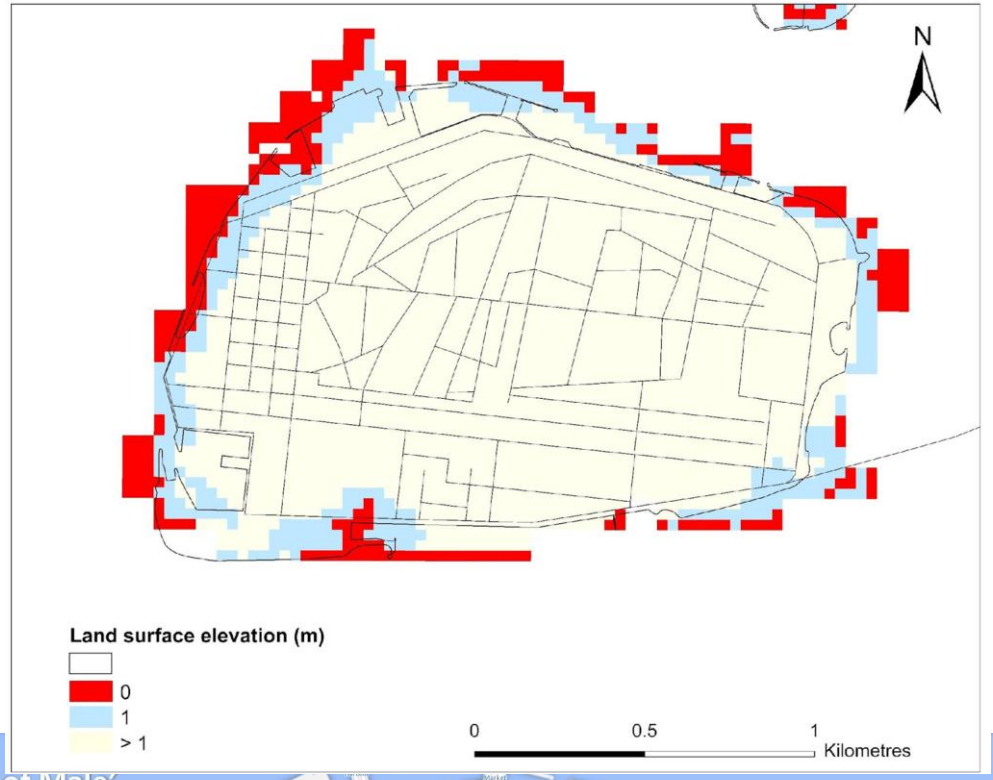
Probability	Impact: Low	Impact: Medium	Impact: High
High			
Medium	Lh, R, Dh, F, M, ADh, GDh	B, Th, HA, N	Sh, AA, HDh, K/Male
Low	Gn	S, GA	L, GDh

SSP3 2041-2060

Probability	Impact: Low	Impact: Medium	Impact: High
High	Lh, R, Dh, F, M, Adh	B, Th, HA, N	Sh, AA, HDh, K/Male
Medium	Gn, Th	S, GA	L, GDh
Low			

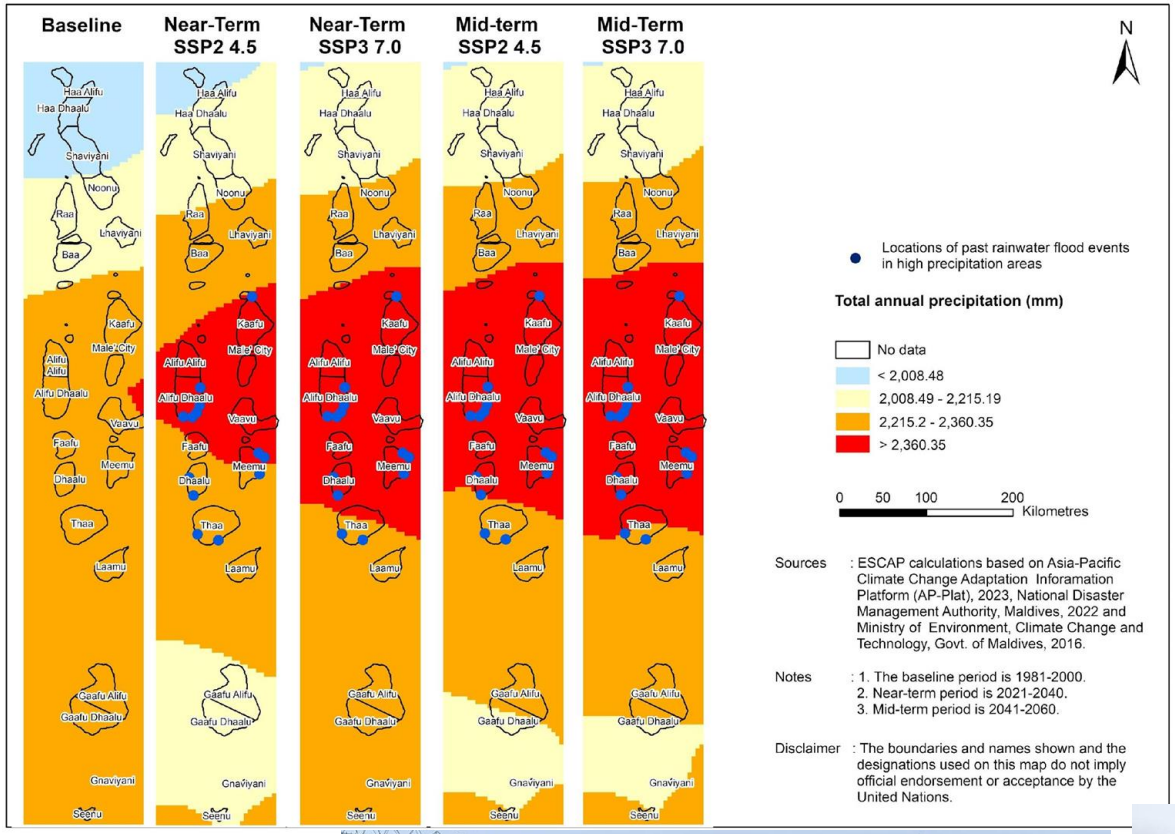
Flood scenario: Male – January 2024

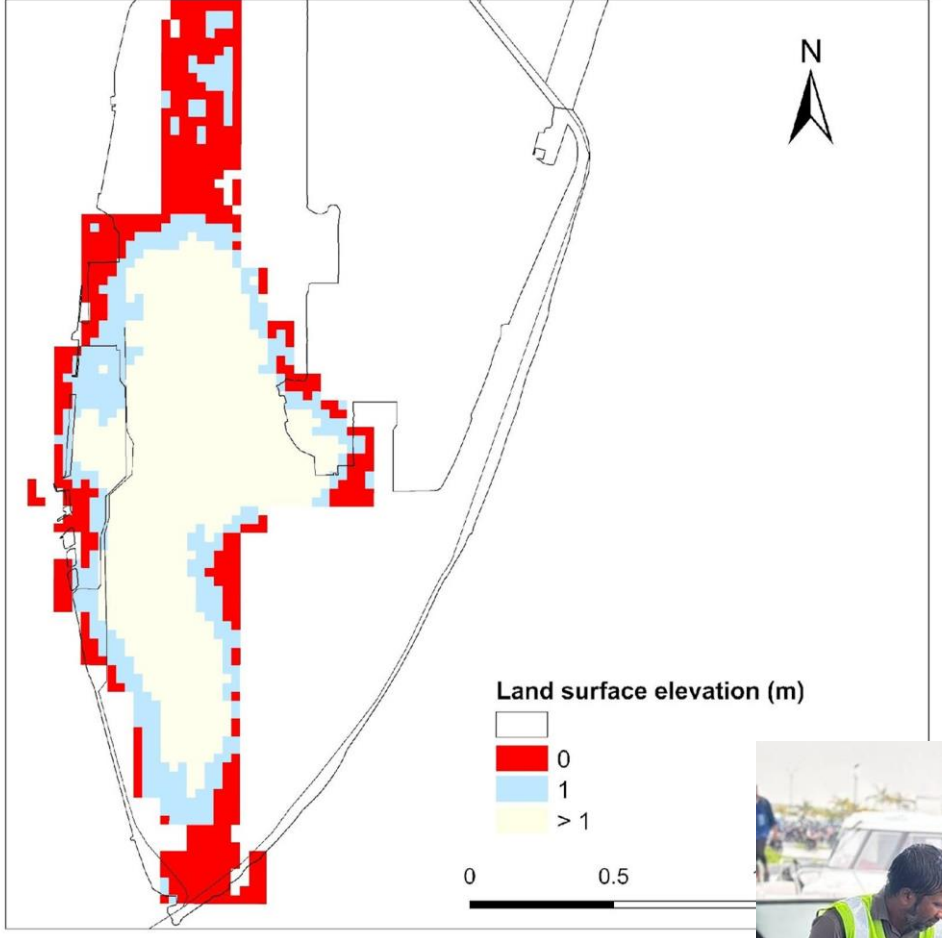




Source: NDMA

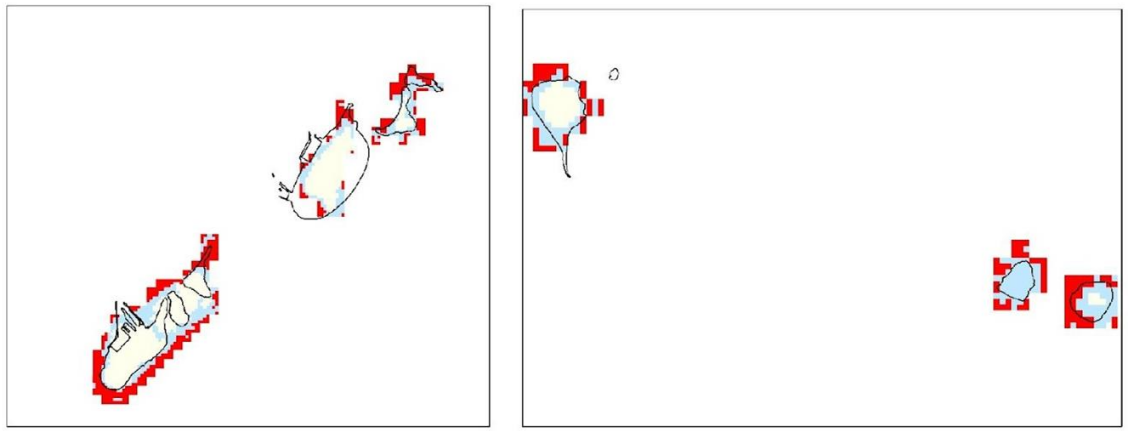
Flood scenario – Hulhule January 2024

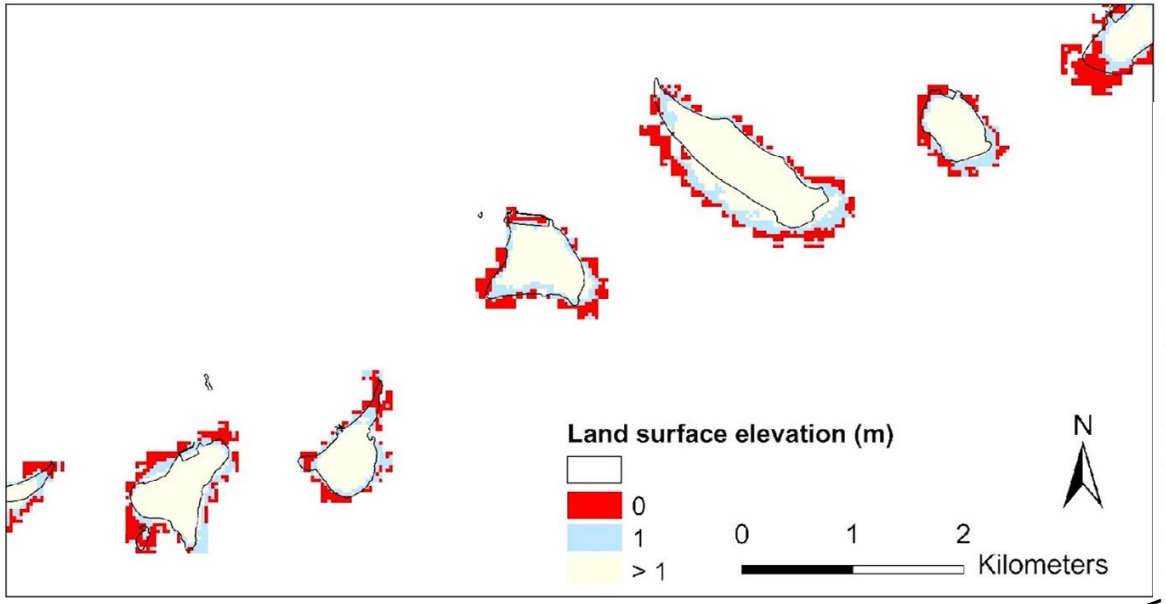


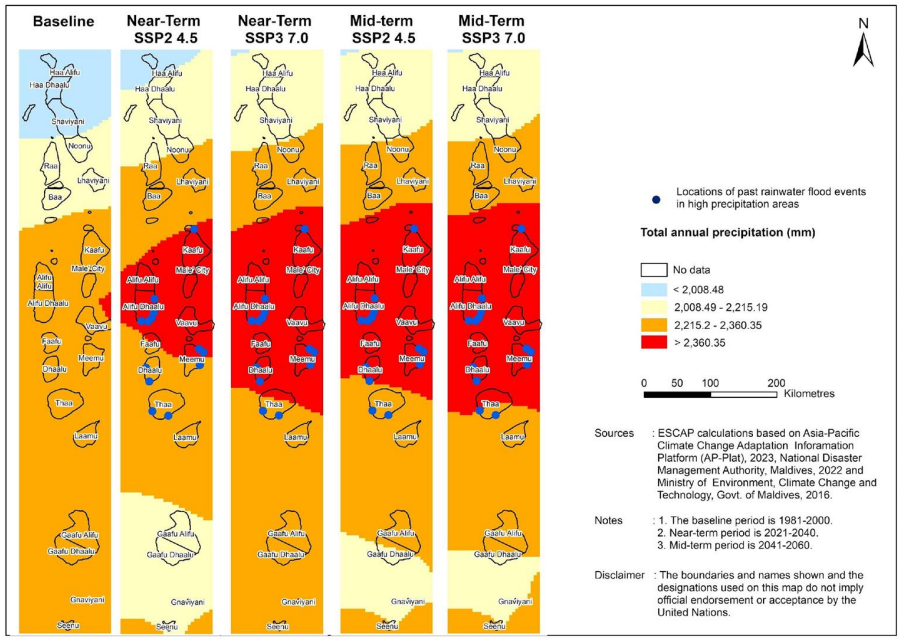


Source: MMS

Flood scenario – Thaa atoll January







Source: NDMA

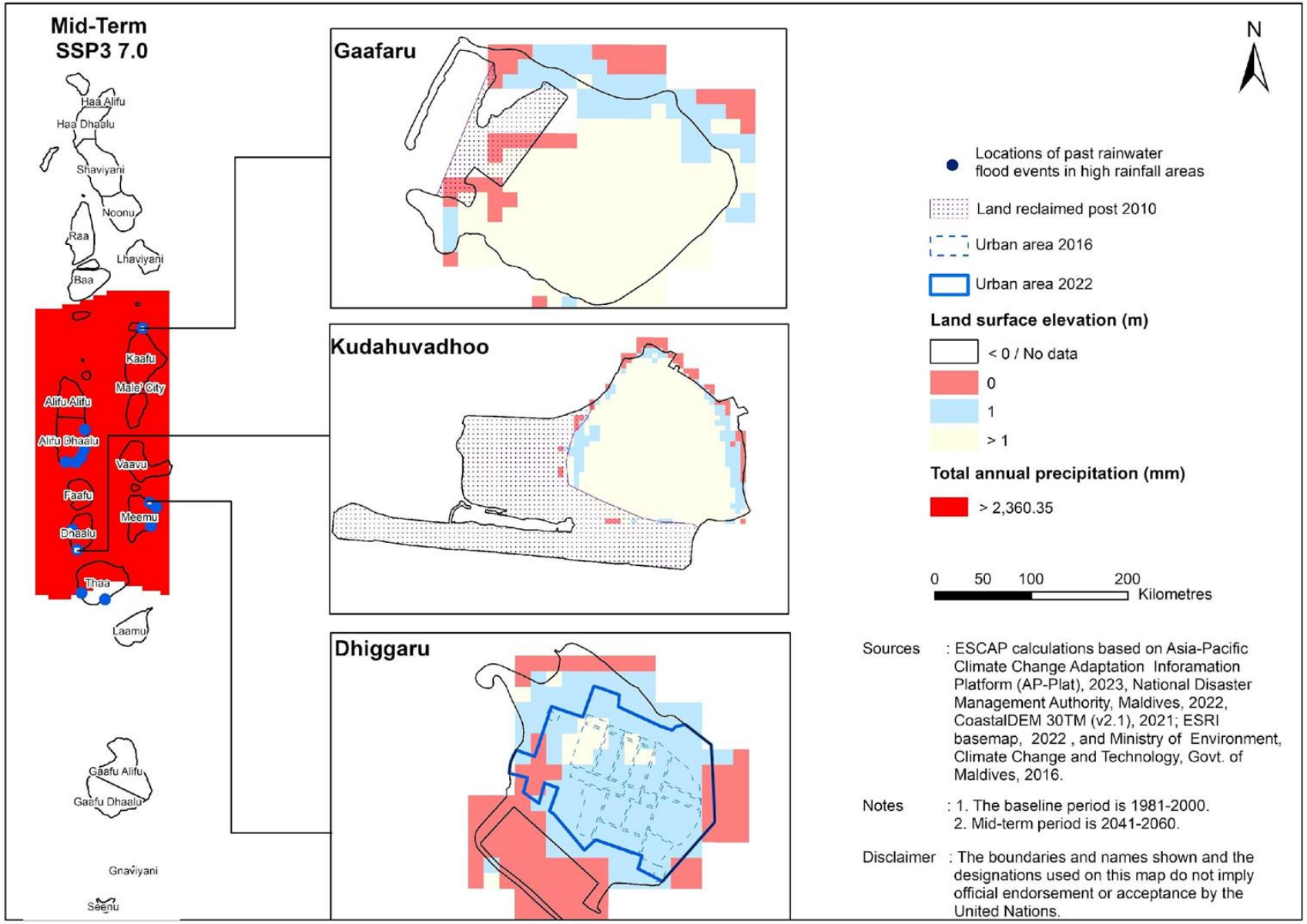
Overview

1. How we did

2. What we did

3. What we can do with these information

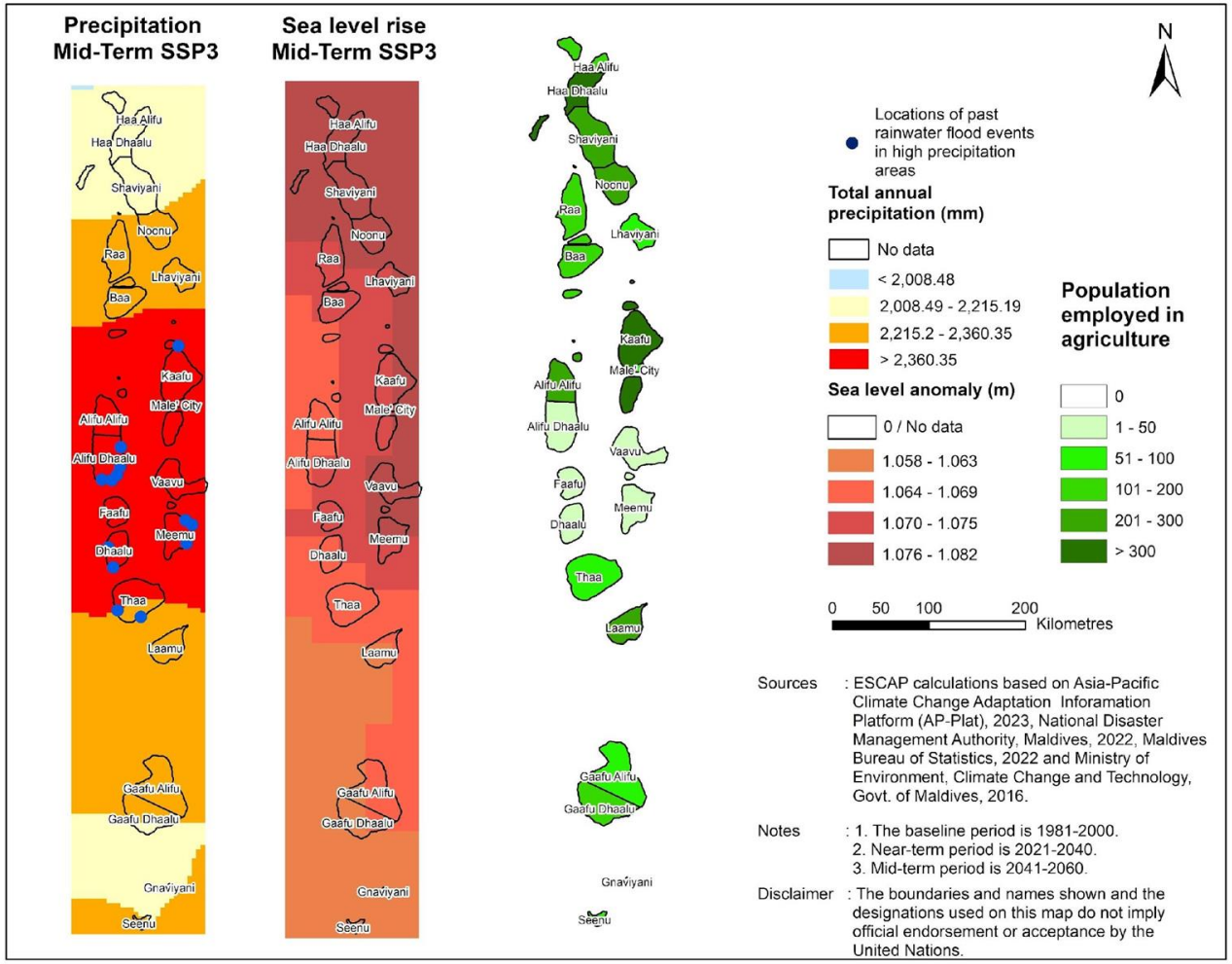
Risk informed development



Landuse planning in hazard prone areas

- Expansion of urban areas
- Climate smart agriculture
  - Expansion of agricultural areas
  - Planting resilient species.
- Land reclamation
- Infrastructure development and protect the existing

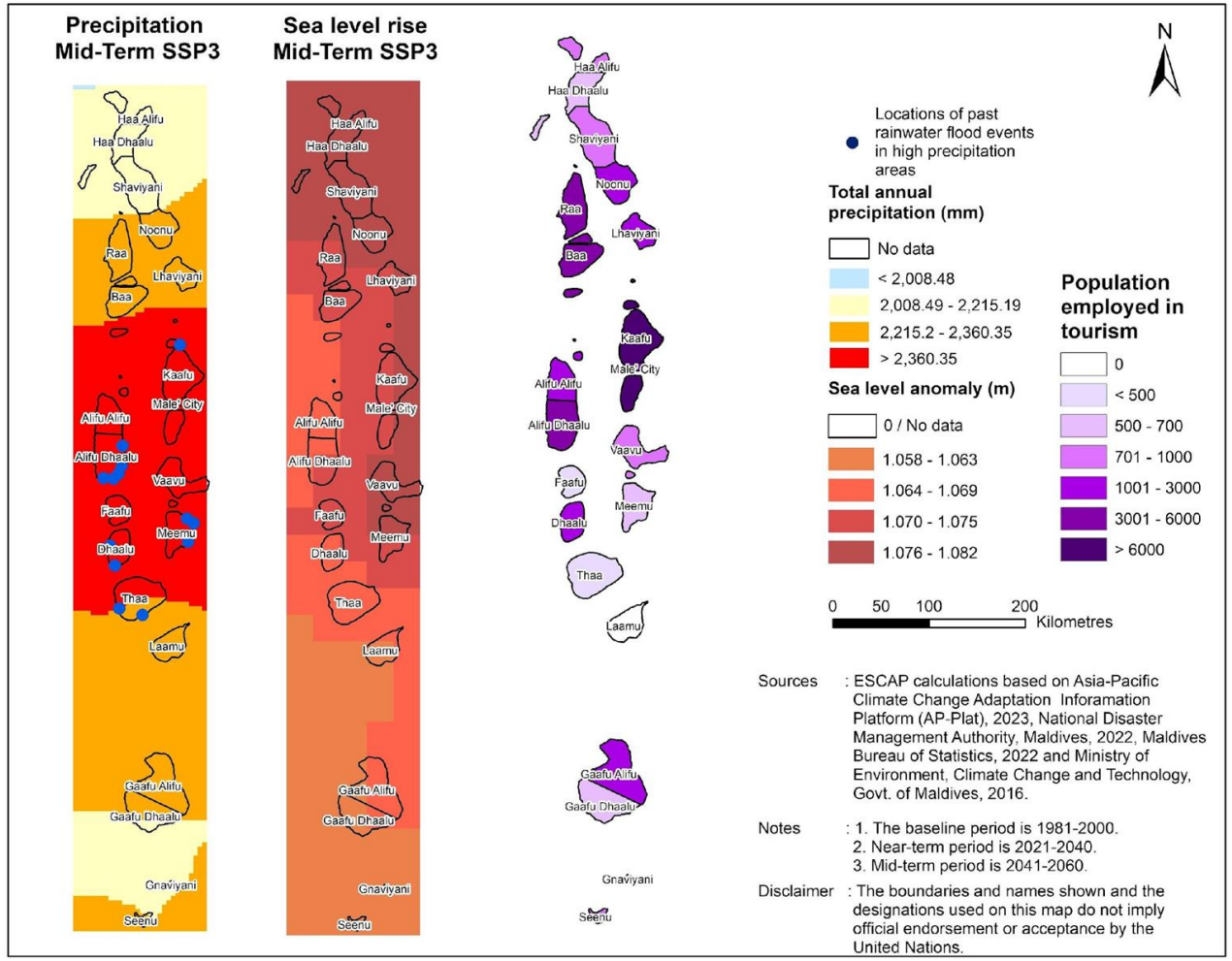
Prioritizing climate action and investment in adaptation



Sources : ESCAP calculations based on Asia-Pacific Climate Change Adaptation Inforamation Platform (AP-Plat), 2023, National Disaster Management Authority, Maldives, 2022, Maldives Bureau of Statistics, 2022 and Ministry of Environment, Climate Change and Technology, Govt. of Maldives, 2016.

Notes : 1. The baseline period is 1981-2000.
2. Near-term period is 2021-2040.
3. Mid-term period is 2041-2060.

Disclaimer : The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.



Sources : ESCAP calculations based on Asia-Pacific Climate Change Adaptation Inforamation Platform (AP-Plat), 2023, National Disaster Management Authority, Maldives, 2022, Maldives Bureau of Statistics, 2022 and Ministry of Environment, Climate Change and Technology, Govt. of Maldives, 2016.

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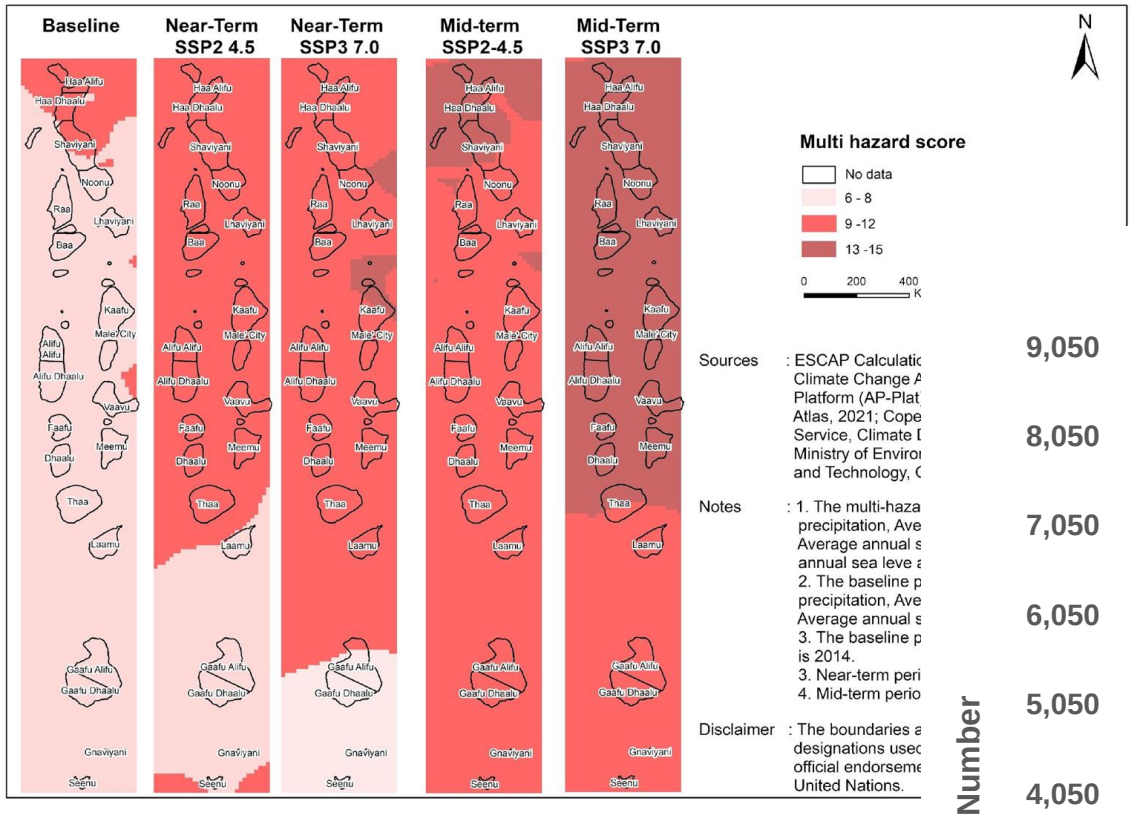
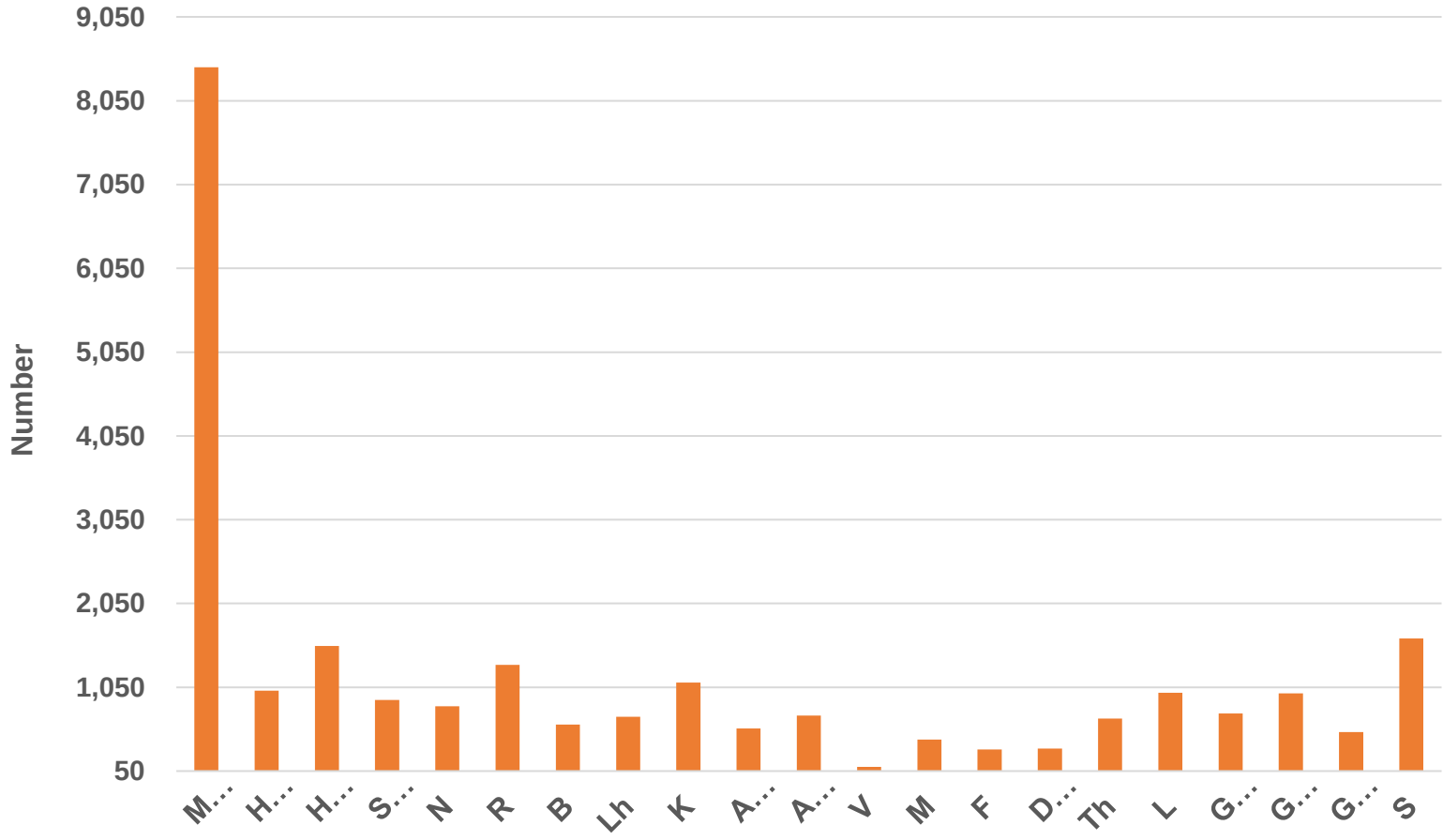
Inclusive social development



Identifying vulnerable population in the risk hotspot for inclusive development

Population with disabilities at the atoll level

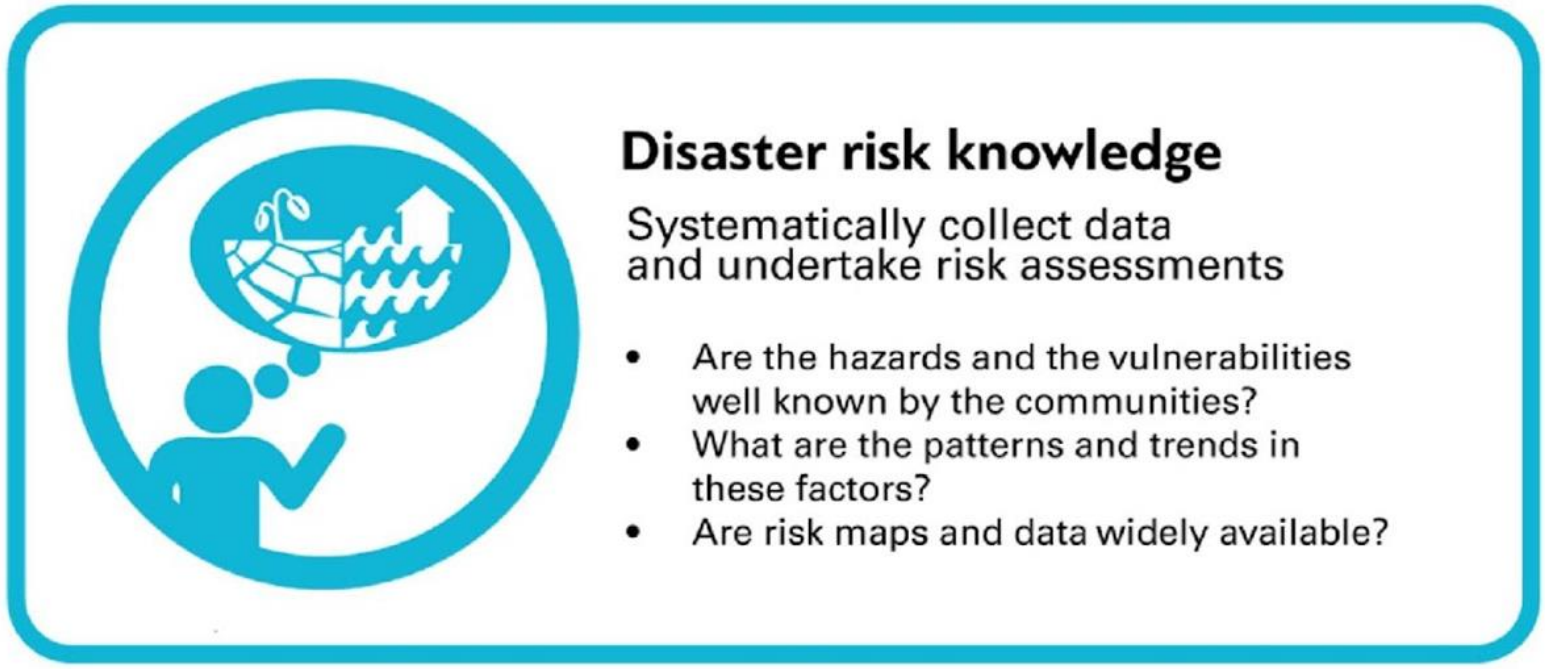


Develop risk informed and inclusive policy for disaster risk reduction

Contribution to EW4ALL, NAP and SDG

The overall goal of the JP is to anchor Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) at the heart of national and subnational development planning to address sustainability and leave no one behind elements of the Agenda 2030.

Pillar 1: EW4ALL



Source: ITU

Contribution to EW4ALL, SAP/NDC and SDG

Strategic Action Plan (SAP) 2019-2023 : *Jazeera Dhiriulhun*

Policy 1:
Strengthen adaptation actions and opportunities, and build climate-resilient infrastructure and communities to address current and future vulnerabilities

- **Strategy 1.2 (Action 1.2a)**
- **Strategy 1.3 (Action 1.3a, 1.3c)**
- **Strategy 1.4 (Action 1.4b, 1.3c)**

Policy 2:
Promote environmentally sound technologies and practices towards building sustainable climate resilient island communities

- **Strategy 2.3 (Action 2.3a)**

Policy 5:
Strengthening national level disaster management information, communication and coordination system

- **Strategy 5.1 (Action 5.1b)**

Contribution to EW4ALL, SAP/NDC and SDG

In NDCs announced by Government of Maldives in 2020-

- Strengthening adaptation actions and building climate resilience is considered as a high national priority.
- Special emphasis has been given on infrastructure resilience, early warning and DRR and DRM.
- Climate governance and capacity building has been identified as cross cutting issues

Contribution to EW4AL, NAP and SDG

Through the project interventions the adaptive capacity to climate-related hazards and natural disasters both nationally and subrationally is enhanced.

Targets: 13.1, 13.2 and 13.b; 11.5 and 11.b

Through project interventions enhanced community participation in CCA/CRR activities through capacity building of island communities and policy makers.

The national and subnational capacity of the government institutions are strengthened to make gender-sensitive, equity-based policy decisions.

Targets: 5.c and 11.b

Thank you!

Any Question ?

Acknowledgements:
Sanjay Srivastava, Chief, Disaster Risk Reduction, IDD, ESCAP
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