

# AUDITING CLIMATE CHANGE ADAPTATION

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AUDITOR GENERAL'S OFFICE



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Adaptation examples and Audit cases of water sector





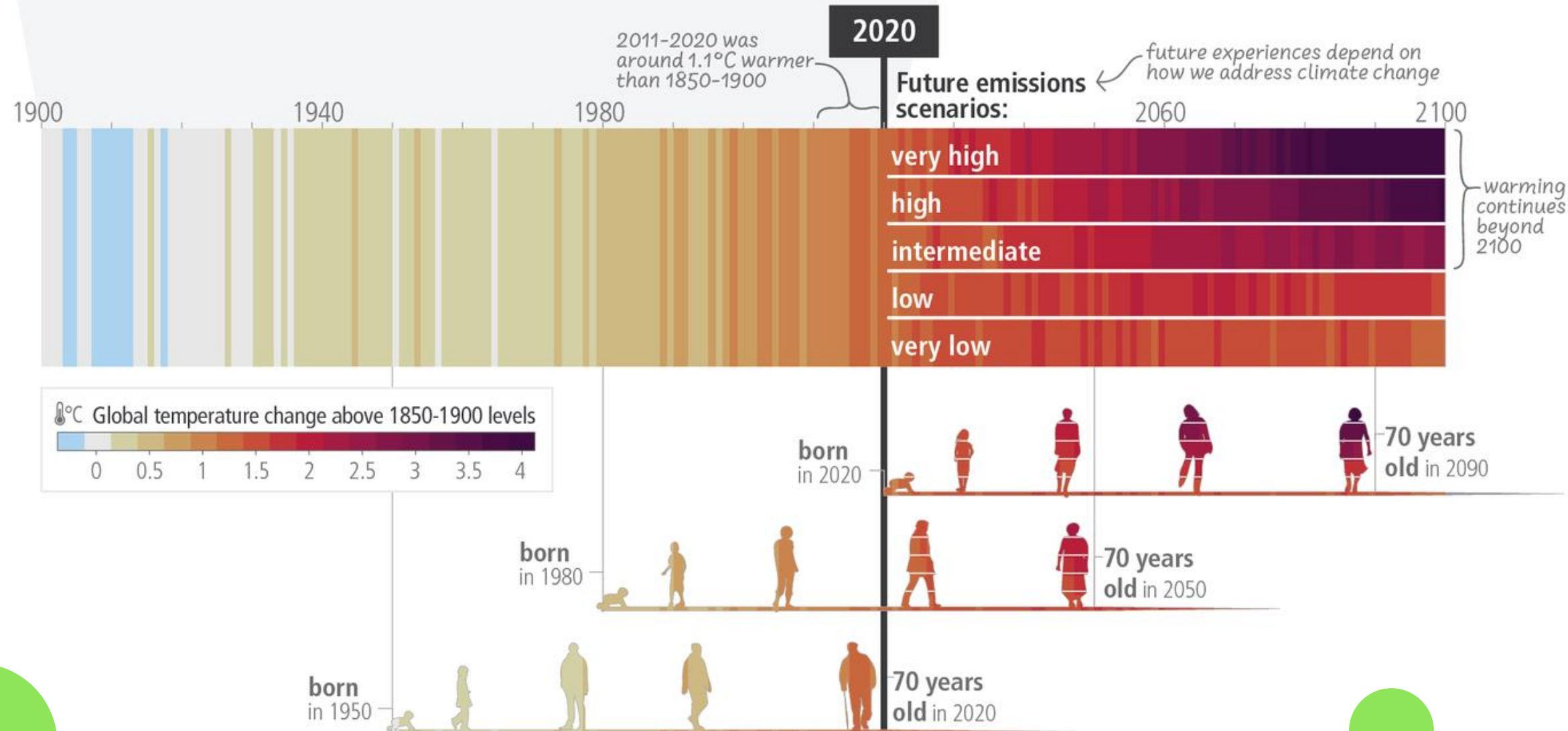
# CLIMATE CHANGE

- Human activities, especially burning fossil fuels (like coal, oil, and gas), release greenhouse gases (GHGs) such as carbon dioxide (CO<sub>2</sub>) into the atmosphere (Greenhouse Gas emissions)
- These gases trap heat from the sun, causing the Earth's temperature to rise
- This effect is also known as Global Warming



# RISING TEMPERATURE

c) The extent to which current and future generations will experience a hotter and different world depends on choices now and in the near-term



- Since the late 1800s, the Earth's temperature has risen by about 1.1°C.
- This warming is mainly caused by human activities, not natural events



# IMPACTS OF CLIMATE CHANGE

Climate change is leading to increased frequency and intensity of droughts, water scarcity, severe fires, rising sea levels, flooding, melting polar ice, catastrophic storms and declining biodiversity.



# WARMING OCEANS

- The oceans have warmed significantly since the 1970s, and most of the heat trapped in the climate system is going into the oceans.
- 25% of all marine biodiversity are dependant on coral reefs and they covers less than 1% of the ocean floor.
- Ocean warming causes coral bleaching resulting in significant coral mortality





# CORAL BLEACHING

Have you ever wondered how a coral becomes bleached?

## HEALTHY CORAL

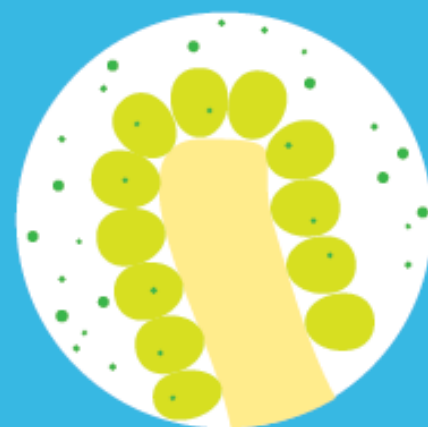
**1** Coral and algae depend on each other to survive.



Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral's primary food source and give them their color.

## STRESSED CORAL

**2** If stressed, algae leaves the coral.



When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral's tissue.

## BLEACHED CORAL

**3** Coral is left bleached and vulnerable.



Without the algae, the coral loses its major source of food, turns white or very pale, and is more susceptible to disease.

## WHAT CAUSES CORAL BLEACHING?



### Change in ocean temperature

Increased ocean temperature caused by climate change is the leading cause of coral bleaching.



### Runoff and pollution

Storm generated precipitation can rapidly dilute ocean water and runoff can carry pollutants — these can bleach near-shore corals.



### Overexposure to sunlight

When temperatures are high, high solar irradiance contributes to bleaching in shallow-water corals.



### Extreme low tides

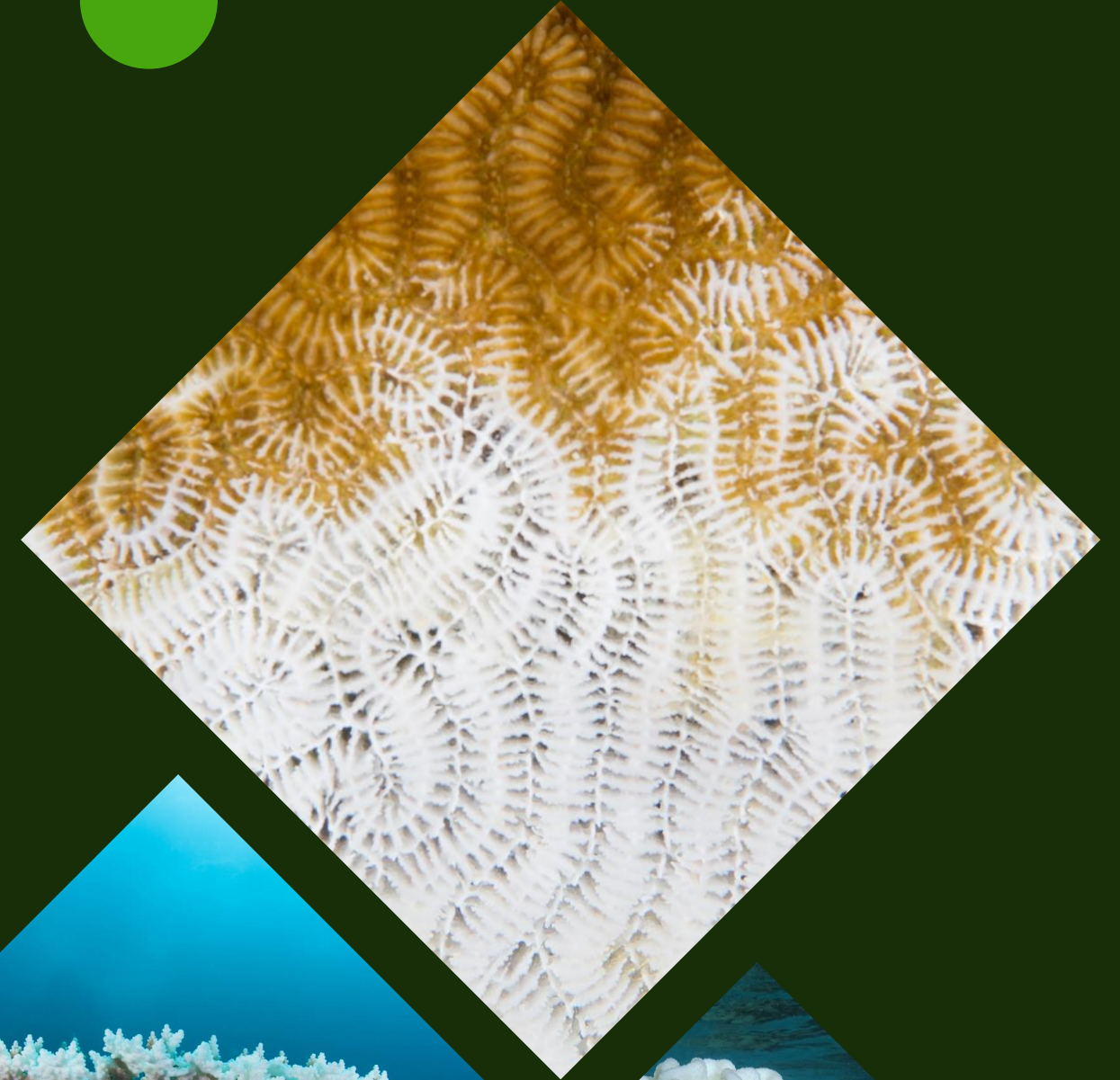
Exposure to the air during extreme low tides can cause bleaching in shallow corals.



NOAA's Coral Reef Conservation Program  
<http://coralreef.noaa.gov/>

# OCEAN ACIDIFICATION

- Carbon dioxide (CO<sub>2</sub>) from human activities is making the oceans more acidic, which is harmful to marine life.
- Due to the change in the water chemistry, the reef recovery and growth rates are reduced.
- This increases risks on coral reefs



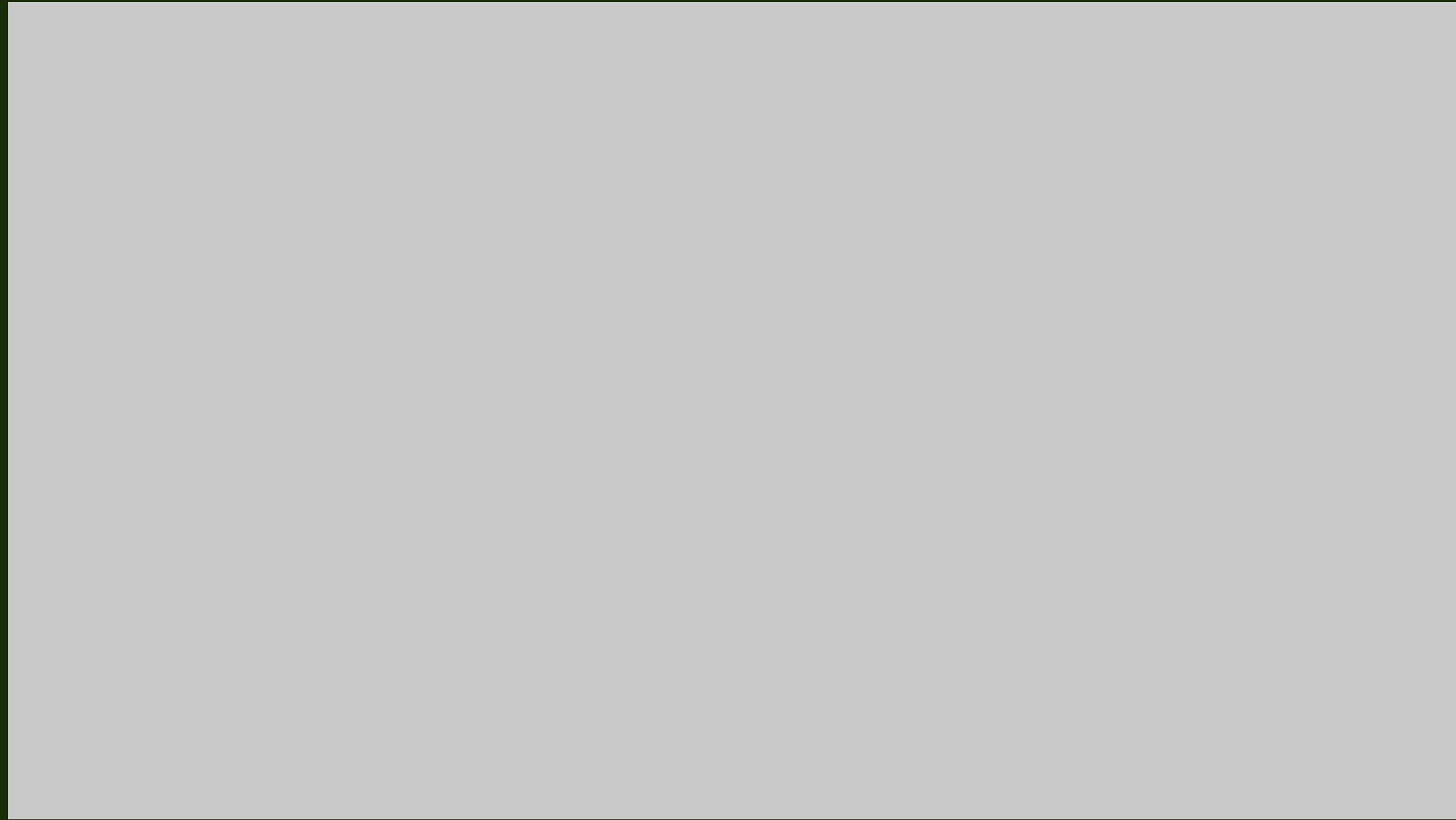


# MELTING ICE AND SEA LEVEL RISE

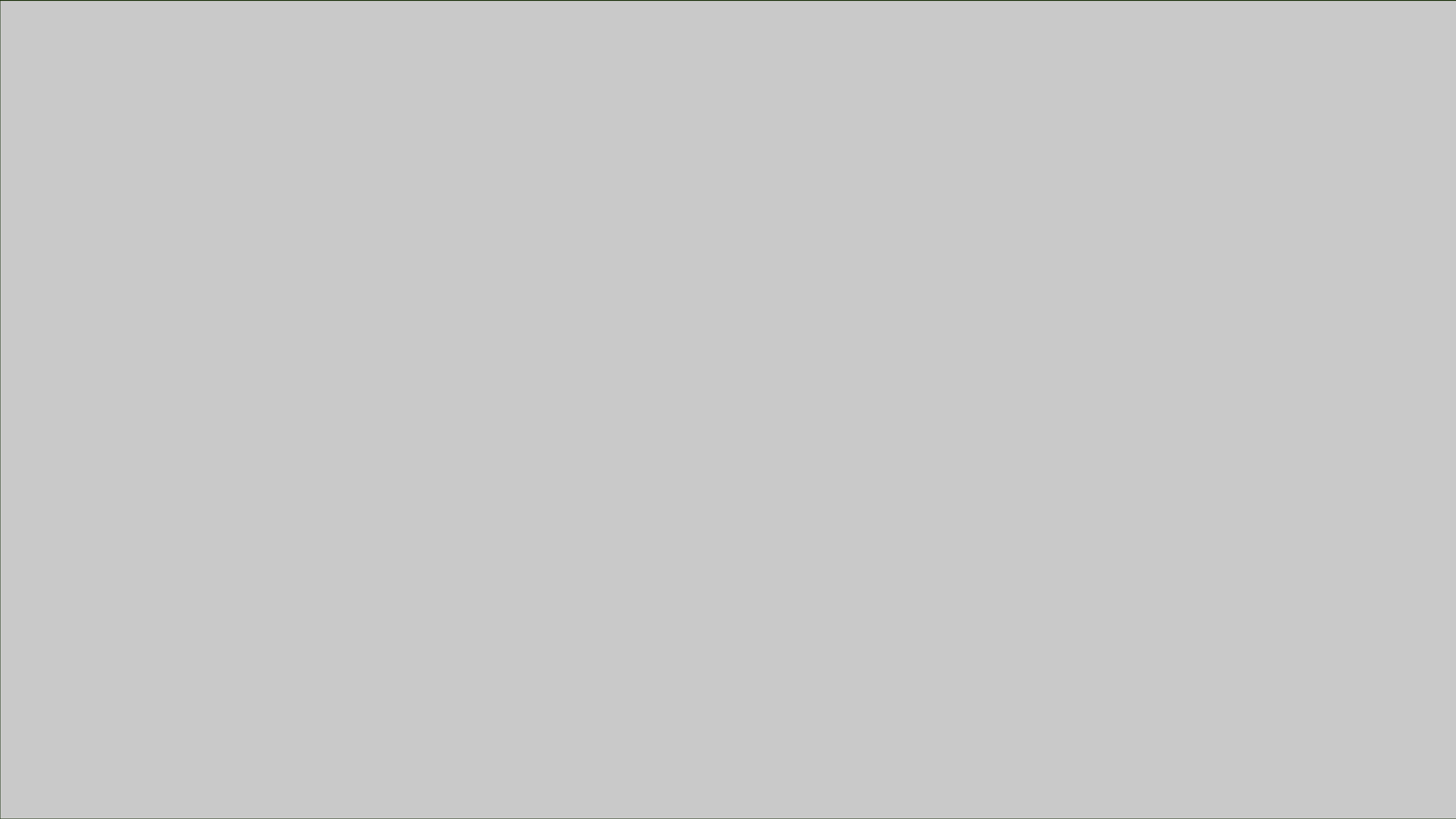
- Glaciers around the world are shrinking, and Arctic sea ice is disappearing.
- Global sea levels have been rising over the past century, with the rate of rise increasing in recent decades



# INCREASED EROSION AND INUNDATION







# EXTREME WEATHER EVENTS

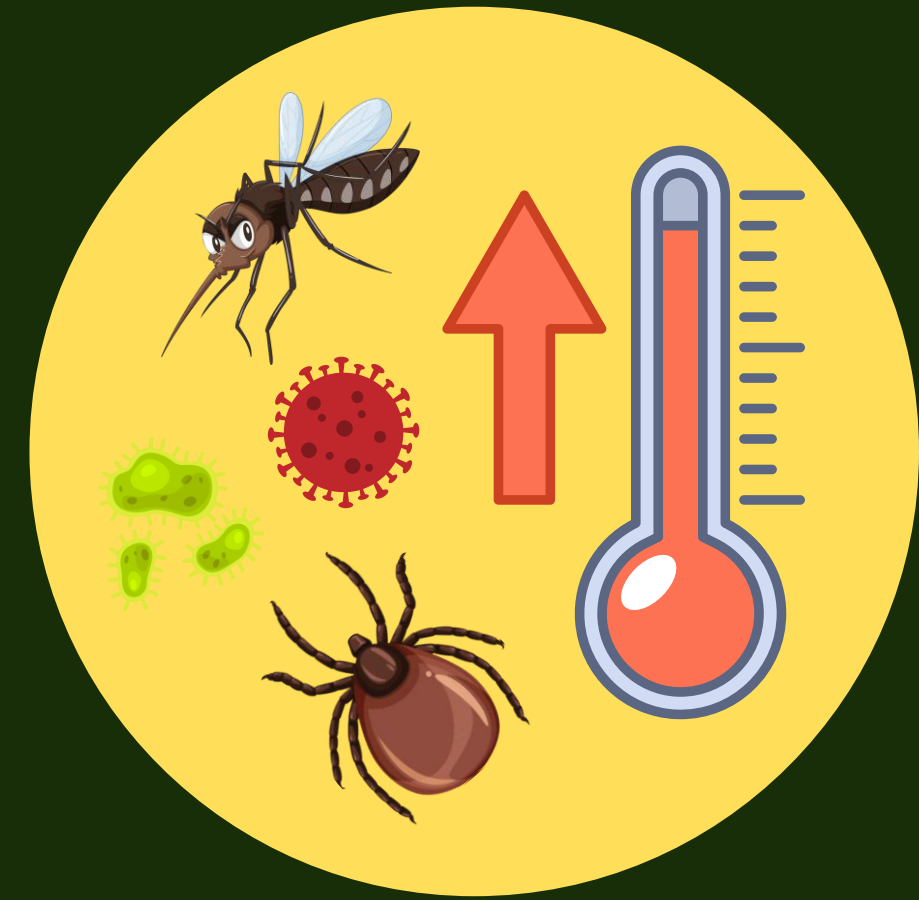
- Climate change is already making weather events more extreme around the world.
- This includes more frequent and intense heatwaves, heavy rainfall, droughts, and powerful storms.
- Hot extremes, including heatwaves, have become more common and intense since the 1950s. At the same time, cold extremes are becoming less frequent and severe





# ECOSYSTEM AND BIODIVERSITY

- Climate change has created conditions ecosystems have never experienced previously.
- Due to warmer temperatures, vectors (disease spreaders) are moving to new places and exposing wildlife and humans to new threats
- Many species are shifting to cooler areas and changing the timing of key life events (breeding, migration).
- Some species are unable to adapt to rising temperatures, this causes death and even extinction



# ECOSYSTEM AND BIODIVERSITY

- Changes in species behavior are causing mismatches in natural relationships.
- Predators may not finding enough prey
- Insects may not find the plants they rely on (reduced pollination).
- This leads to increased competition and the spread of non-native species





# ECOSYSTEMS AND BIODIVERSITY

- 80% of the world's remaining biodiversity is on Indigenous lands
- Changes in these ecosystems are significantly affecting food security, health, livelihoods, and cultural practices.
- Further these impacts are also affecting biodiversity based economic activities that support food security (agriculture and fisheries)





# HEALTH AND WELLBEING

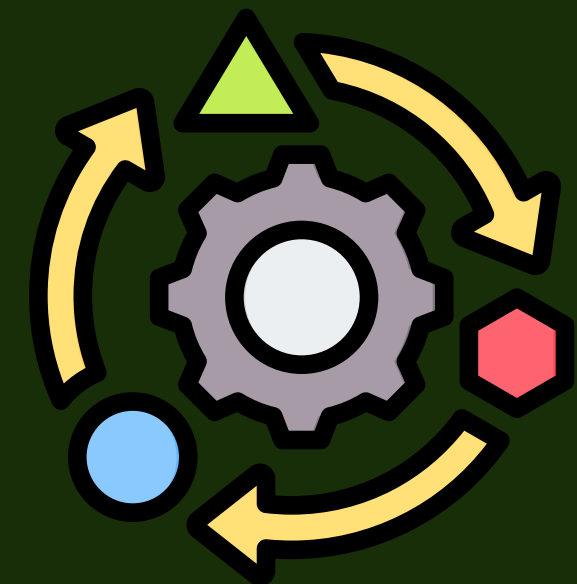
- Climate change has harmed physical and mental health, making inclusive development more difficult.
- The most vulnerable groups impacted include women, children, the elderly, Indigenous People, low-income households, and marginalized communities
- Rising temperatures, heatwaves and extreme weather events have led to higher rates of illness and death.
- Climate related food safety risks, malnutrition and water borne diseases (due to flooding) have also increased globally





# CLIMATE CHANGE ADAPTATION

- The impacts of climate change is projected to get worse under current climate scenarios
- Even with the efforts of reducing the emissions globally countries and communities need to invest in mechanism to reduce the impact of climate change
- These efforts are called **Climate Change Adaptation**. It is the process of adjusting to actual or expected climate and its effects



# ADAPTATION AND AUDITORS

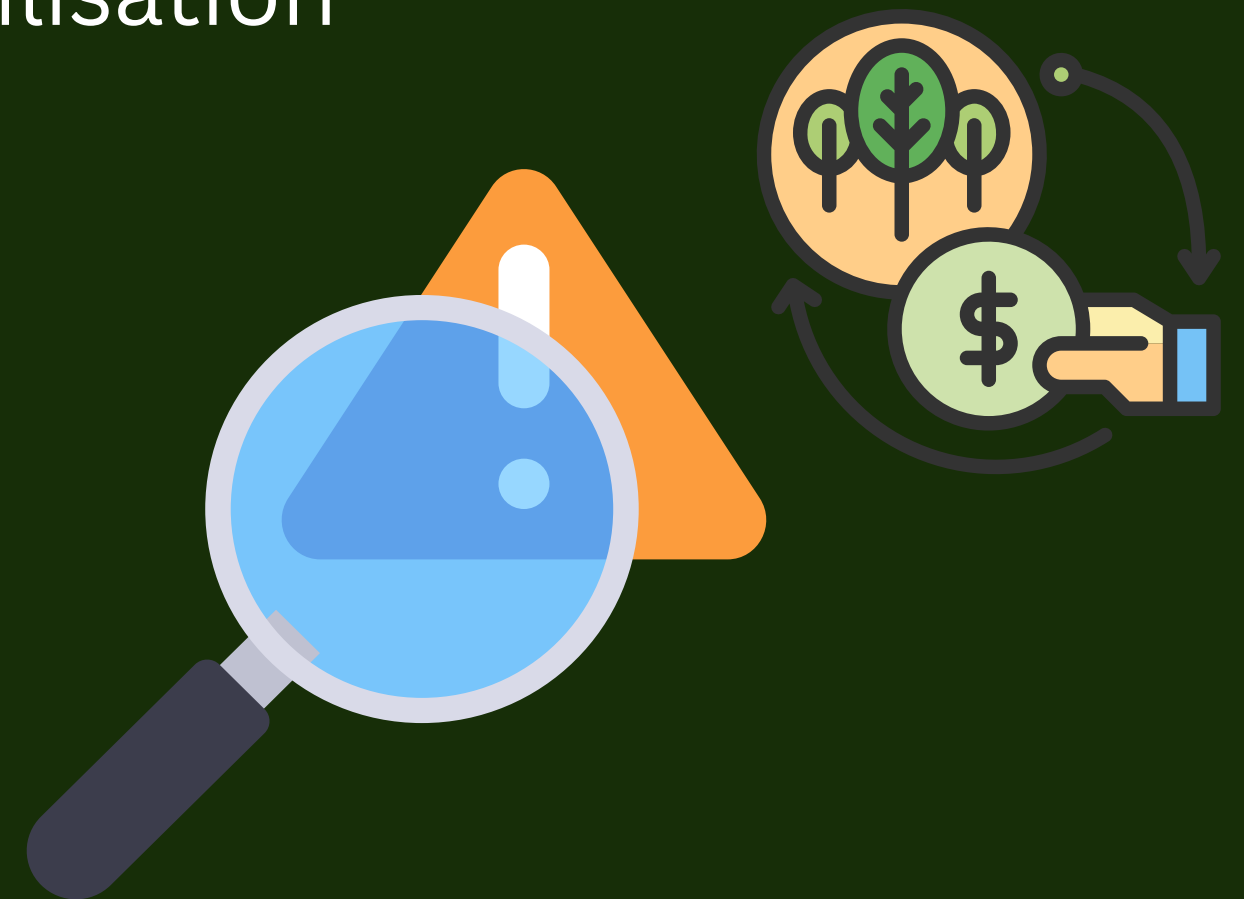
- Countries worldwide have recognized climate change as a major issue affecting people, the planet, and prosperity.
- They have pledged to various international agreements to address climate change
- Due to these commitments and to secure a liveable environment to its citizens, the governments have initiated a lot of work in climate adaptation





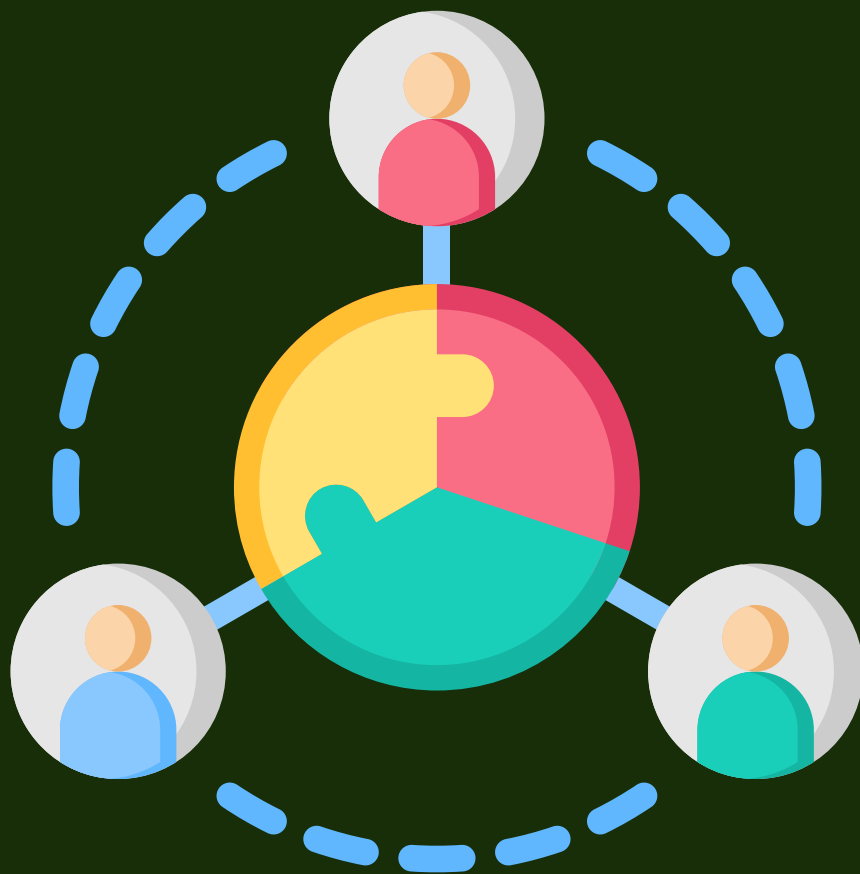
# ADAPTATION AND AUDITORS

- These interventions require tremendous amounts of financial and other resources
- The effectiveness of this spending and appropriate utilisation of the resources are important for taxpayers
- SAI auditors have a role to hold governments accountable for effective and efficient implementation of policies and public spending on climate change



# AUDITORS CONTRIBUTION TO ADAPTATION

- **Conduct Comprehensive Audits on Climate Change:**  
Perform specific financial, performance, and compliance audits related to climate change



- **Engage with Stakeholders and Communicate Findings:**  
Actively engage with key stakeholders, including government agencies, NGOs



# AUDITORS CONTRIBUTION TO ADAPTATION

- **Incorporate Climate Change into Regular Audits:** Integrate climate change as a key focus area in the annual audit plans



- **Enhance Climate Audit Capacity and Conduct Follow-up Audits:** Strengthen the audit office's capacity to assess climate-related risks and performance by investing in training, expertise, and tools. Conduct follow-up audits to track the implementation of recommendations and evaluate the progress of climate change initiatives.



# COASTAL ADAPTATION

- There are many ways coastal communities choose climate adaptation. These include
  - Hard engineering
  - Accommodation and advancement
  - Migration
  - Ecosystem-based adaptation
- Hard engineering coastal protections are interventions which have been used traditionally and continue to be used to adapt to erosion and other ocean-based impacts on the shoreline

- These include:



Sea Wall



Break Water



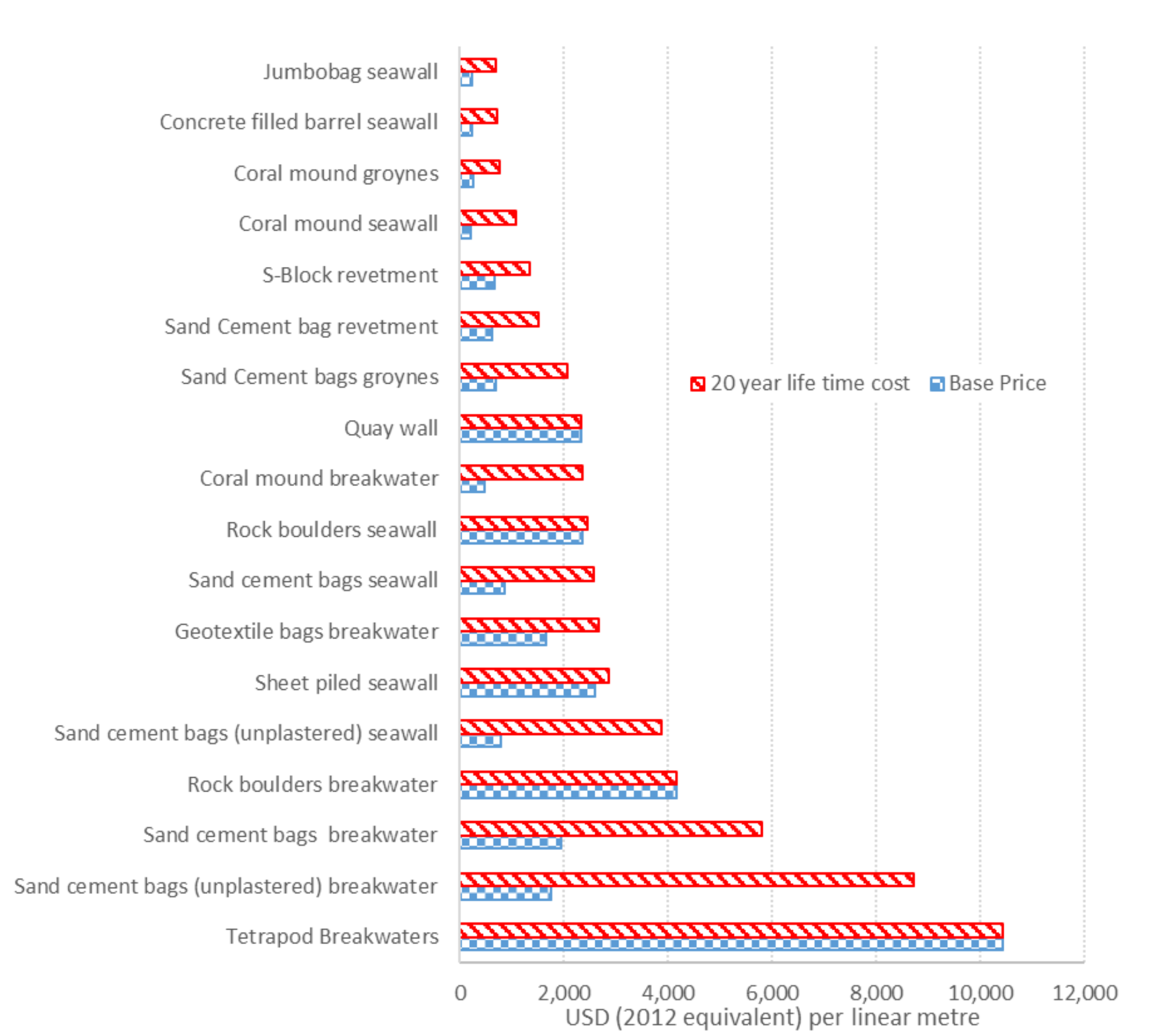
Revetment



Groyne



# COASTAL ADAPTATION



# COASTAL ADAPTATION

- Advantage of these methods is that they are age old technologies which has been tried and tested
- However if they are not properly designed, it can shift erosion elsewhere
- A poor design can also increase erosion of the site putting people at more risk
- These interventions are resource intensive (manpower, finance)





# COASTAL ADAPTATION

- Accommodation and advancement:
  - Beach nourishment and reclamation
  - Raised dwellings
- Migration:
  - Relocation and resettlement
  - Managed retreat
- Ecosystem based adaptation:
  - Maintaining vegetation belt
  - Rejuvenating mangrove and coral reef ecosystems





# AUDIT EXAMPLE

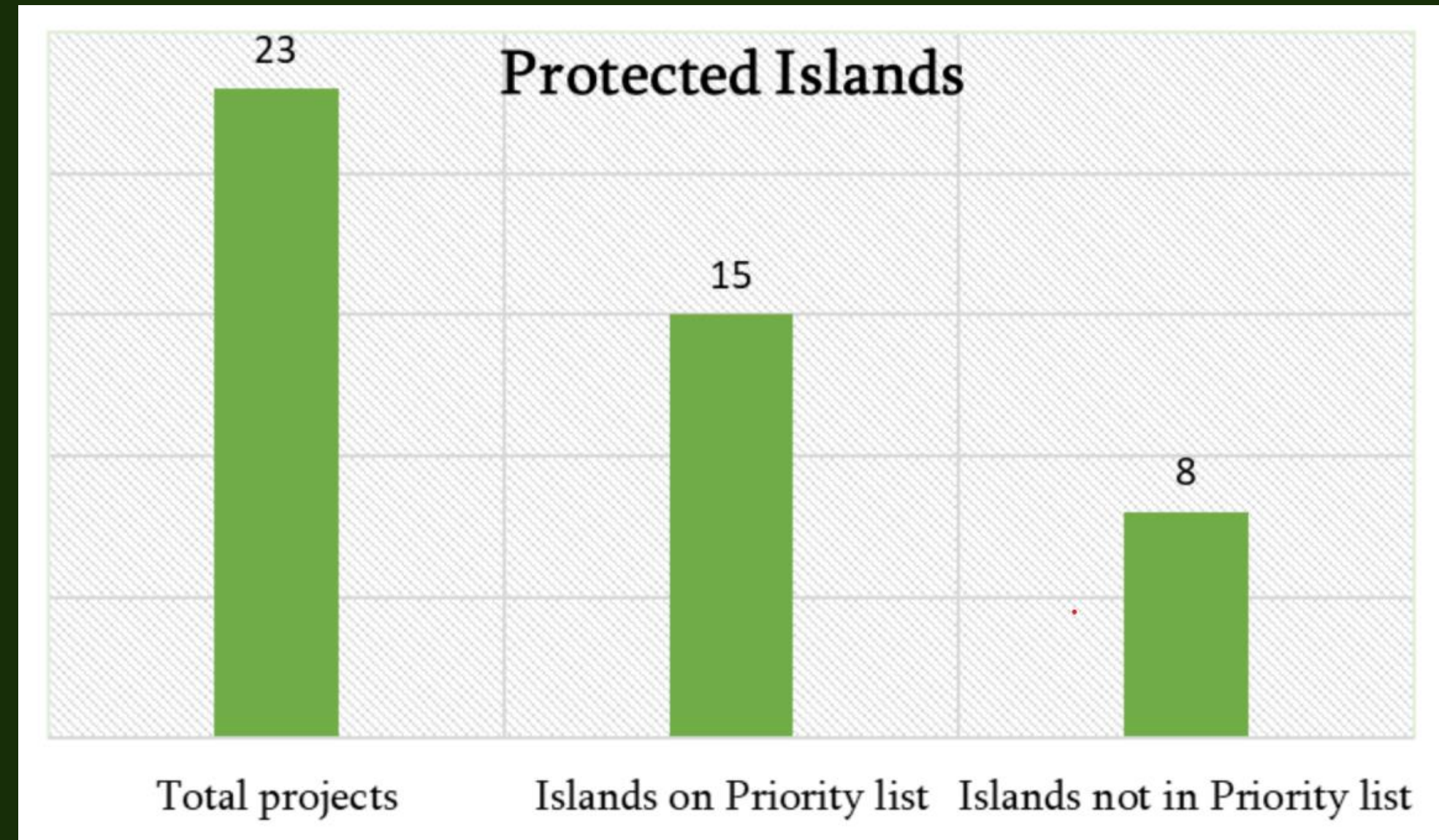
- Audit: Effectiveness and sustainability of response to coastal erosion.
- Main Audit Questions:
  - Does the existing framework have a mechanism to identify and respond to coastal problems?
  - Have the human and financial resources been utilised to achieve intended targets?
  - Are the coastal protection programs achieving its intended benefits?





# AUDIT EXAMPLE - MAIN FINDINGS

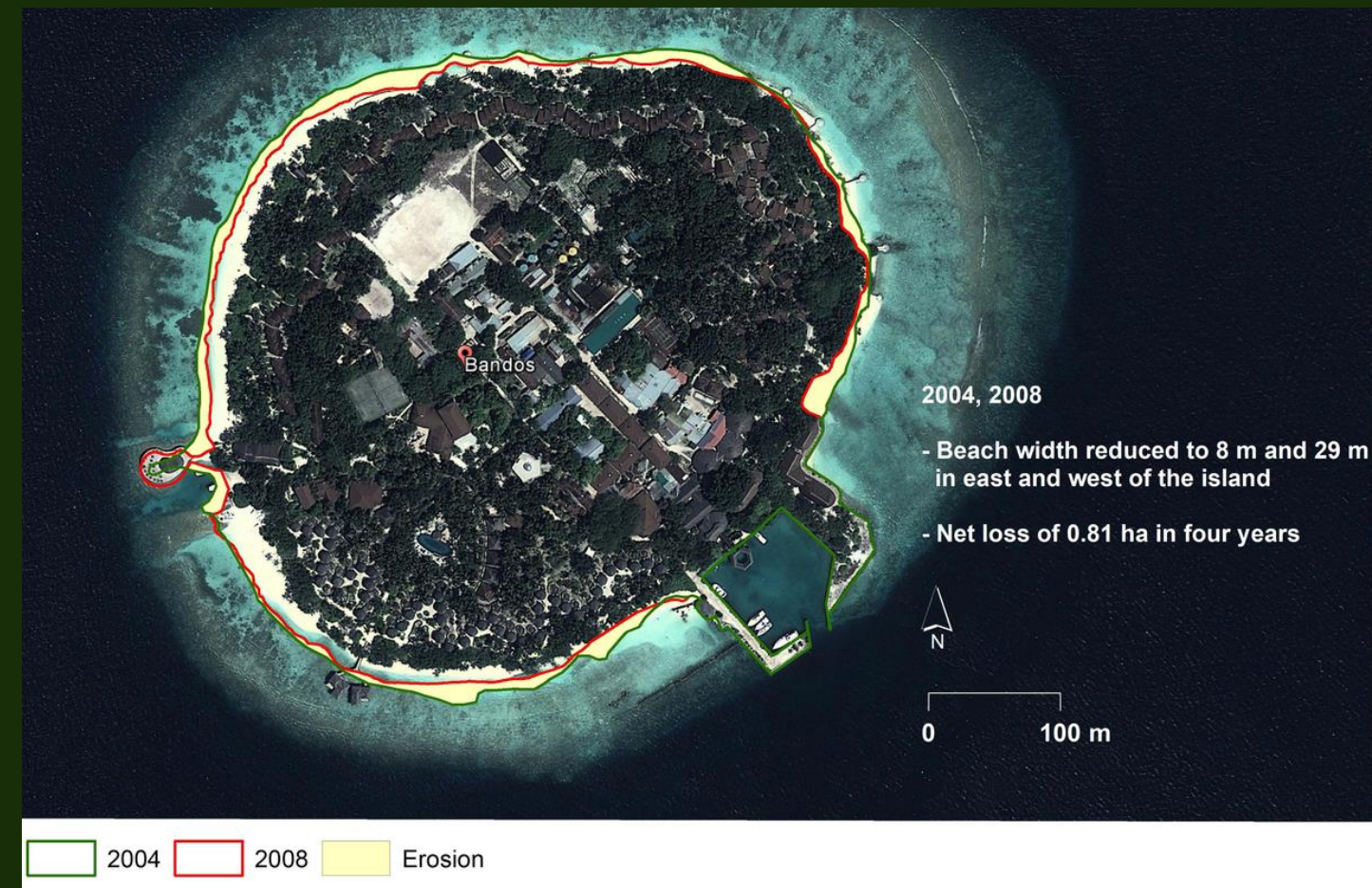
- 115 islands out of 188 reported erosion but no proper mechanism to measure land loss of islands
- Gaps in priority and implementation
- Inadequate human and technical resource





# AUDIT EXAMPLE - MAIN FINDINGS

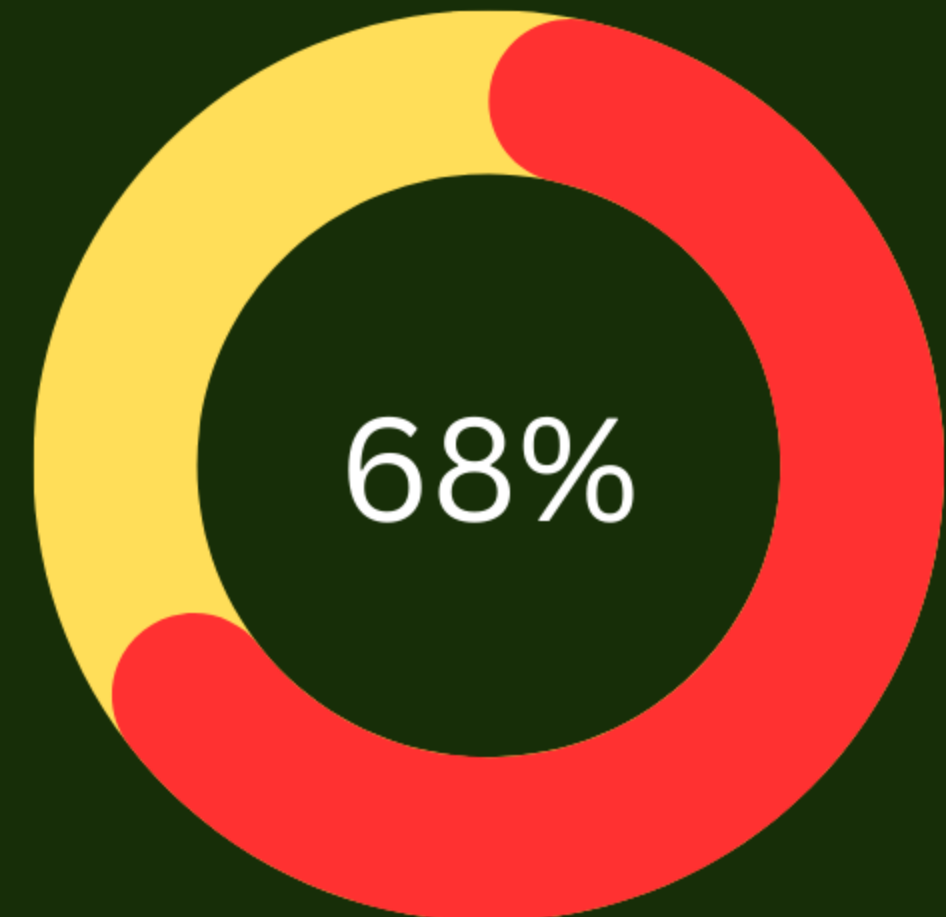
- Weak legislative framework
- Weak project planning and design resulting in scope variations
- There are some cases of maladaptation but generally interventions are effective





# AUDIT EXAMPLE - MAIN FINDINGS

- Case Study : Geobag coastal protection
  - Incorrect material supply specification due to poor planning
  - The geobags were not ultra violet resistant and therefore the geobags were torn due to sunlight
  - Government had to remove the bags and reorder new bags which took time and required more funding
  - The total cost of the project was 1,090,169 USD and the government had to spend an additional 749,633 USD to complete the project



# AUDIT EXAMPLE - RECOMMENDATIONS

- In coordination with the island councils (local government) formulate and implement a mechanism for erosion risk monitoring
- Ensure that government interventions are implemented based on risk and priority
- Enhance the existing technical capacity of the relevant staff of the Ministry of Environment and Environmental Protection Agency
- Publish guidelines on climate resilient coastal protection development
- Carry out adequate research in project planning phase and implement the projects in an environmentally friendly manner
- Ensure environmental monitoring is conducted in coastal protection projects





# FISHERIES SECTOR DIVERSIFICATION

## Auditing in the Blue Economy



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A Presentation by SAI Maldives

# WATER ADAPTATION

Water Production

Improving transport

Enhancing storage

Recycling and reusing

Green Infrastructure





# AUDIT EXAMPLE

- Audit: Dry period water supply
- Context:
  - The Maldives have two seasons (dry and wet monsoon)
  - Every year multiple islands undergo water scarcity during the dry periods significantly affecting the island communities.
- Audit questions:
  - Is the dry period water provision carried out in the most economic, efficient and sustainable way?
  - Are the water infrastructure developed in the islands effective?



# AUDIT EXAMPLE - MAIN FINDINGS

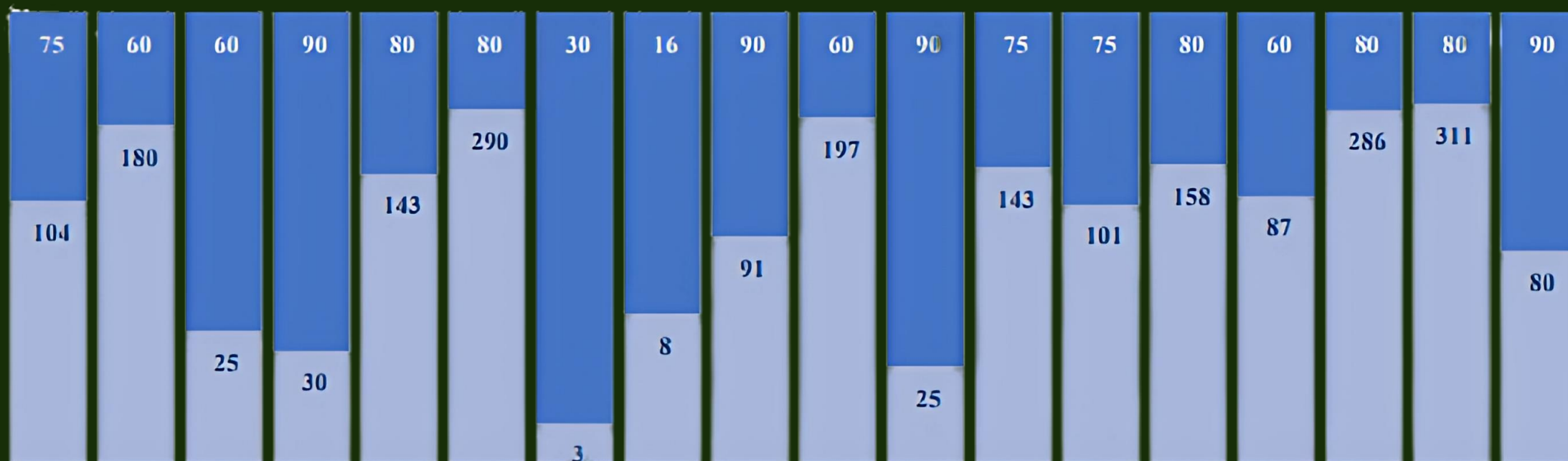
- The number of island undergoing water scarcity has not improved over the years and government spends significant portion of public funds each year for the exercise
- The emergency water supply is not contracted in the most cost effective manner
- Delay in supplying emergency water
- Supply water quality has been assured





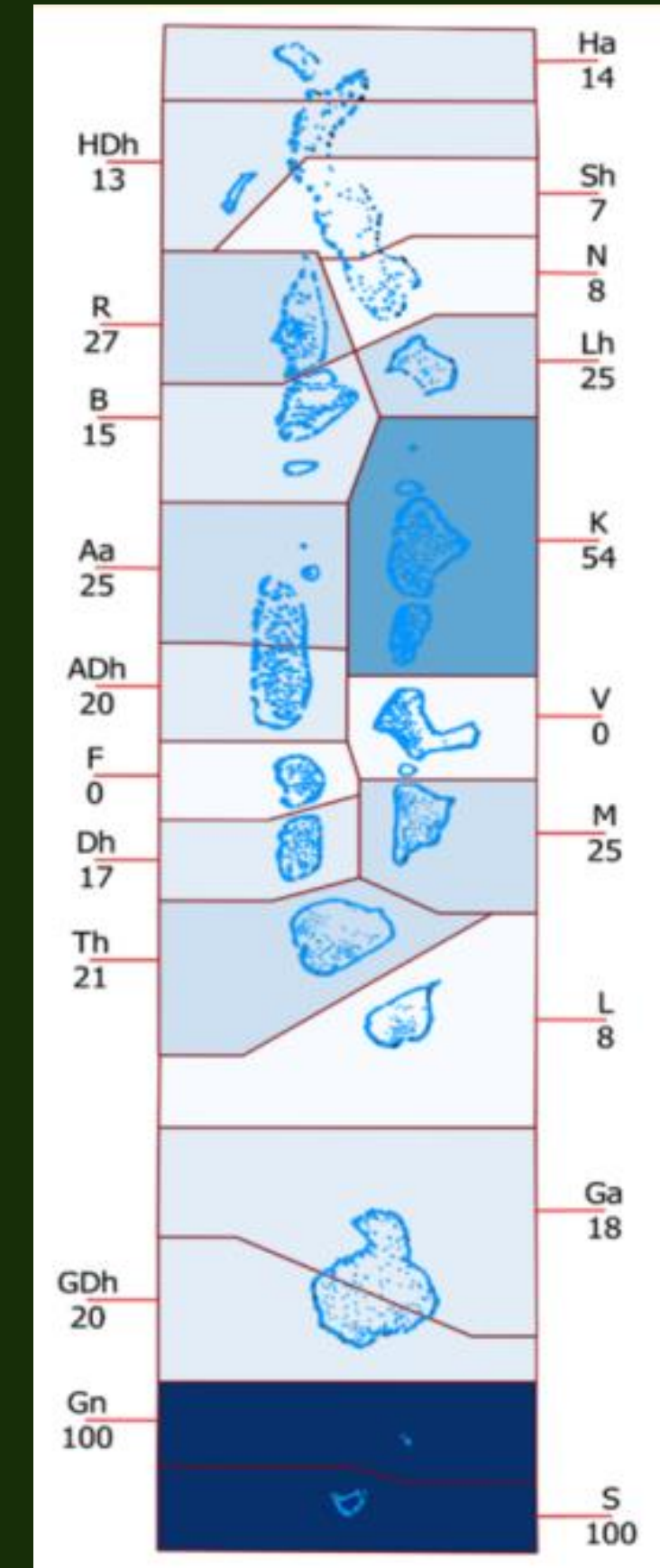
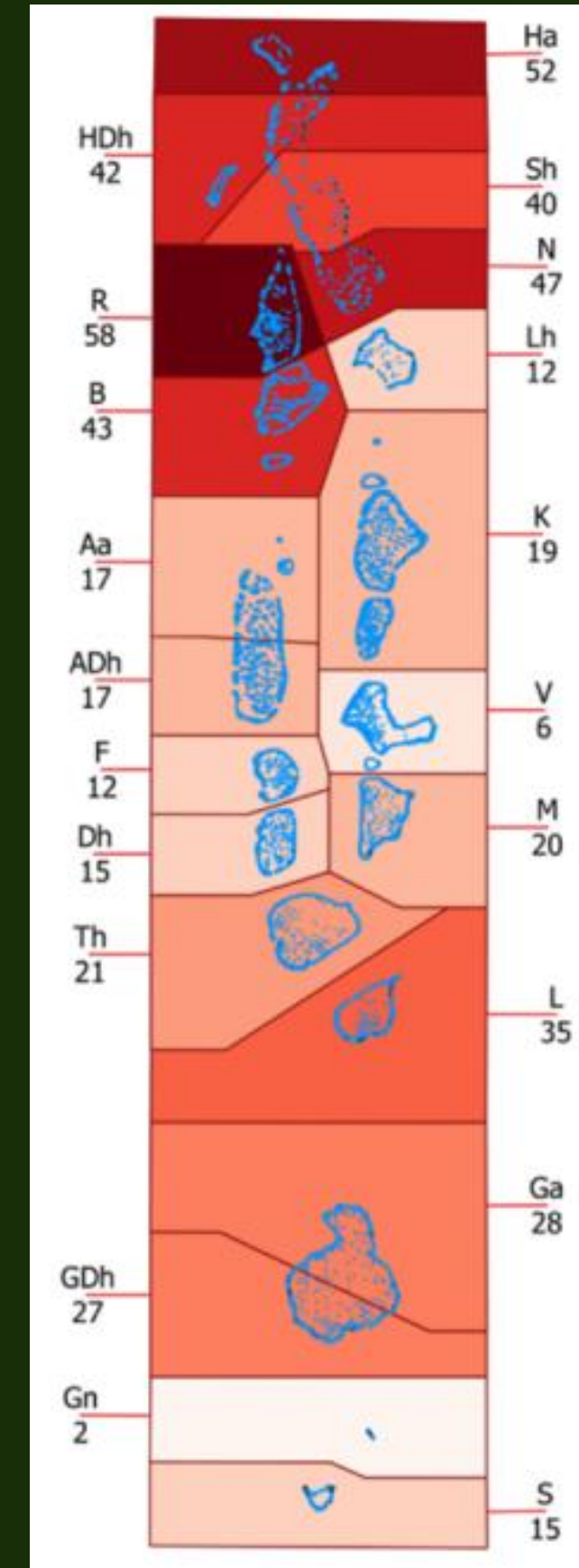
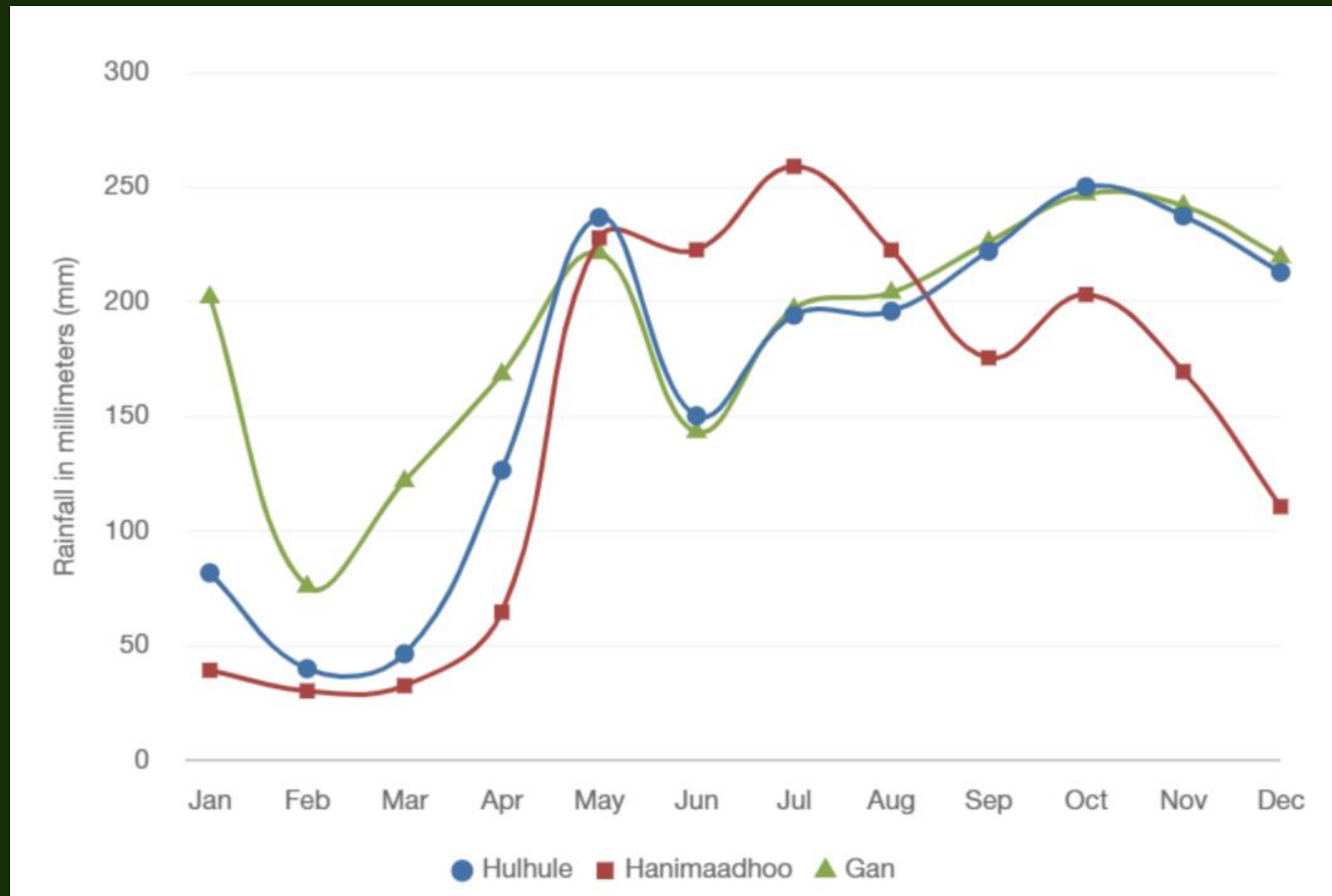
# AUDIT EXAMPLE - MAIN FINDINGS

- Poor project design resulting in lack of effectiveness for the rainwater harvesting systems
- Extended delays in project implementation
- The O&M of established infrastructure is not carried out properly



# AUDIT EXAMPLE - MAIN FINDINGS

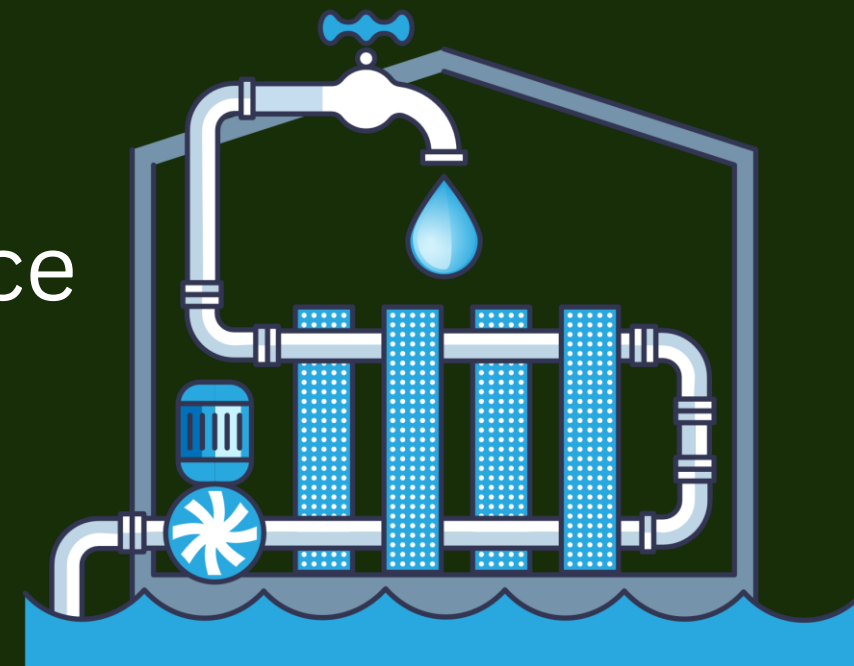
- Gaps between need and implementation
- Water infrastructure contracted for all islands





# AUDIT EXAMPLE - RECOMMENDATIONS

- Improve the efficiency of the existing projects on water infrastructure to attain long terms solution to the issue.
- Revisit the existing model of emergency water supply to increase the cost effectiveness of the process
- Ensure that government interventions are implemented based on risk and priority
- Enhance the monitoring of the project progress in the implementation phase
- Local governments to ensure that the operation and maintenance of the water infrastructure are carried out accordingly



# AUDIT EXAMPLE

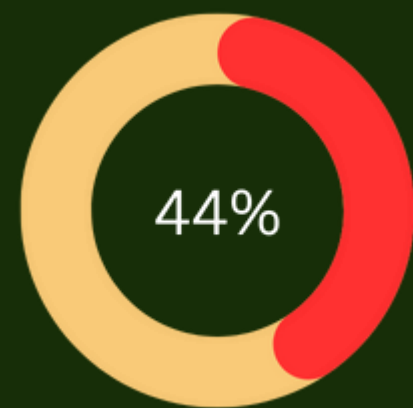
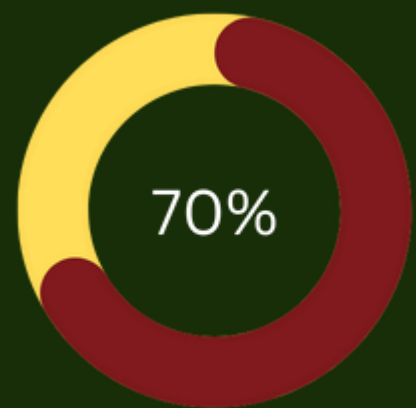
- Audit: Fuvahmulah city water and sanitation project
- Context:
  - Fuvahmulah is one of the most populace islands of the country
  - Government initiated a project to provide water supply and sanitation services in order to ensure water safety for the community and the conservation of the islands groundwater lens
  - The project includes the development of island water and sewerage infrastructure connected at household level
  - After the completion of the civil works, there were huge issues with the systems. Most significant being the malfunction of sewerage infrastructure causing major leakages and requiring manual removal





# AUDIT EXAMPLE - AUDIT FINDINGS

- Additional cost incurred for the project to rectify the issues.  
Planned cost was 18,331,486 USD  
However with variations and rectifications 22,049,044 USD was spent
- The needs for physical removal of sewerage across the island had negative social and environmental impacts
- The water network also had leaks which caused significant losses to the operation.



**79 million  
litres wasted**



# AUDIT EXAMPLE - AUDIT FINDINGS

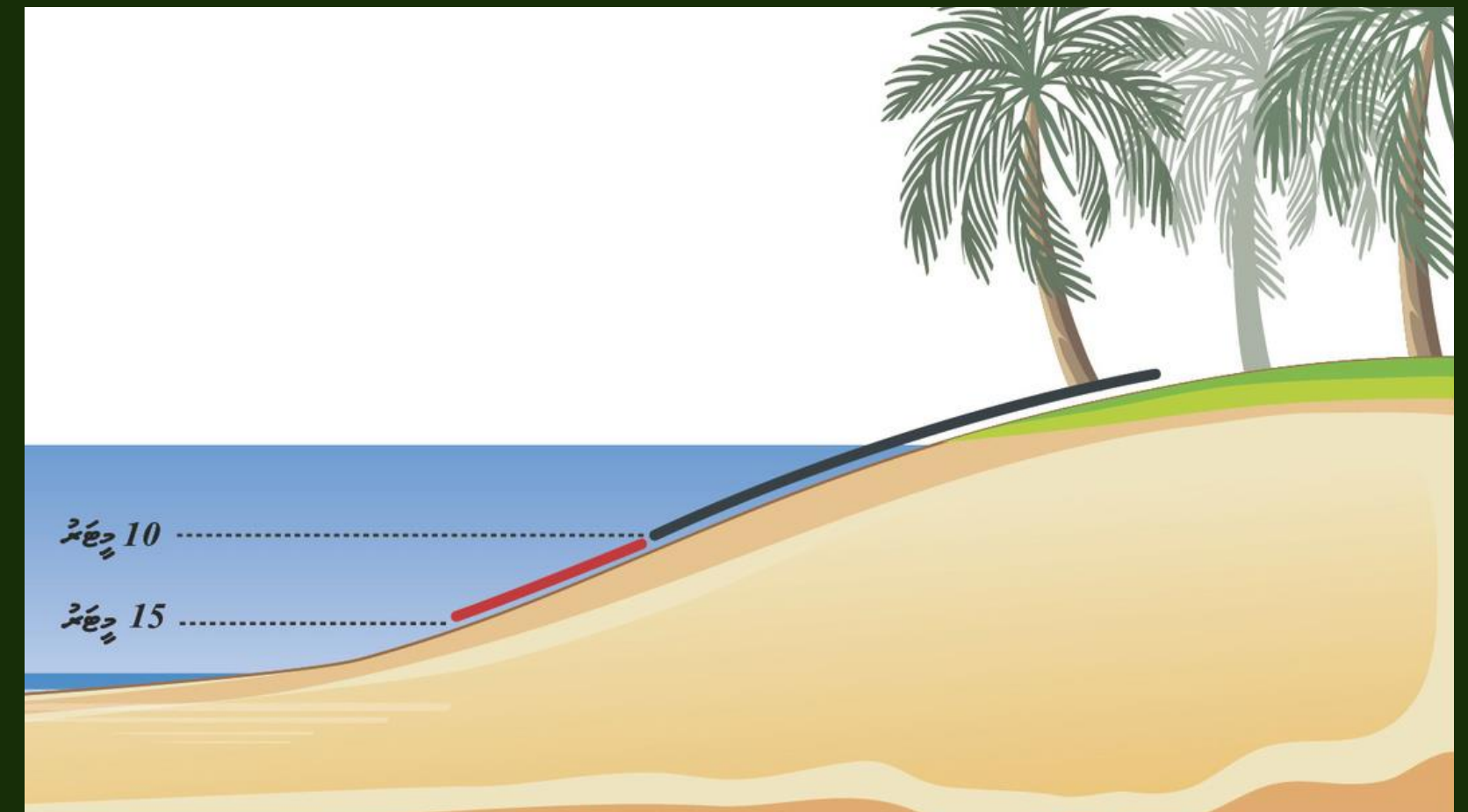
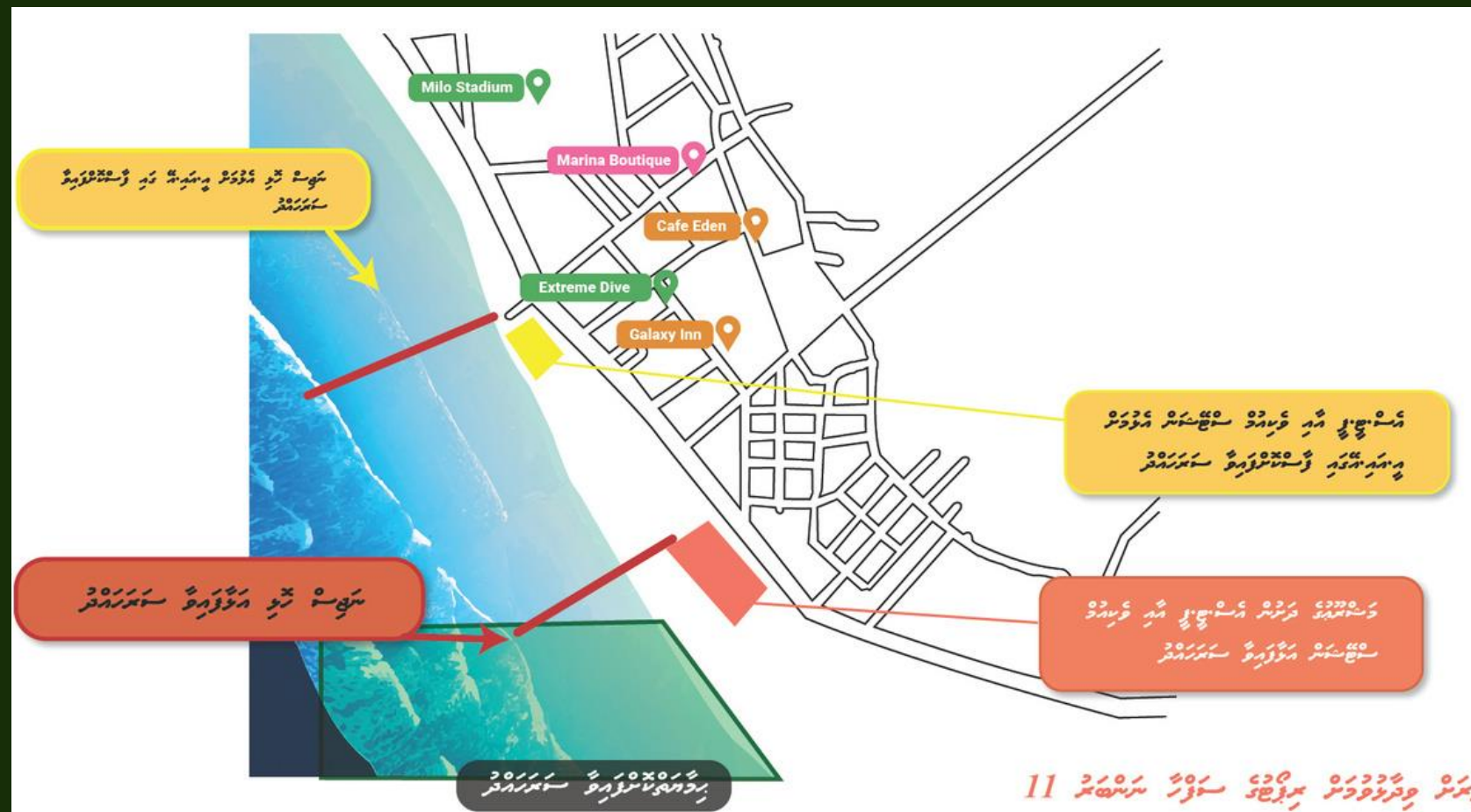
- The design of the project has not been properly vetted as a conditional approval was provided by the regulator and it was not ensured whether the proposed changes were incorporated prior to construction phase
- Although the project employed the services of a supervision consultant, some of the works were not verified and unauthorized personals have been involved in the quality assurance process.
- The quality of material used was subpar and the shortcomings on the quality assurance during the project design and implementation phase are key root causes for the projects issues.





# AUDIT EXAMPLE - AUDIT FINDINGS

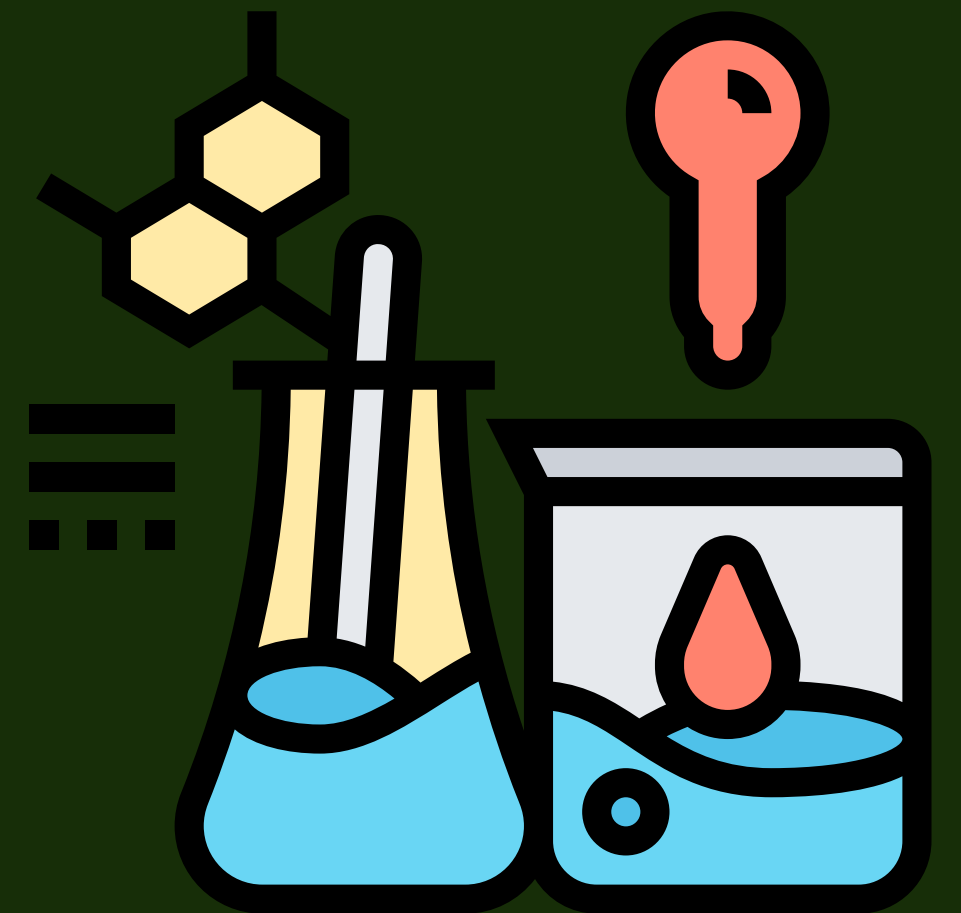
- The infrastructure was not laid in accordance to the approved Environmental Impact Assessment Report



- Environmental monitoring program has not been conducted
- Mitigation measures to reduce environmental impact has not been implemented

# AUDIT EXAMPLE - AUDIT FINDINGS

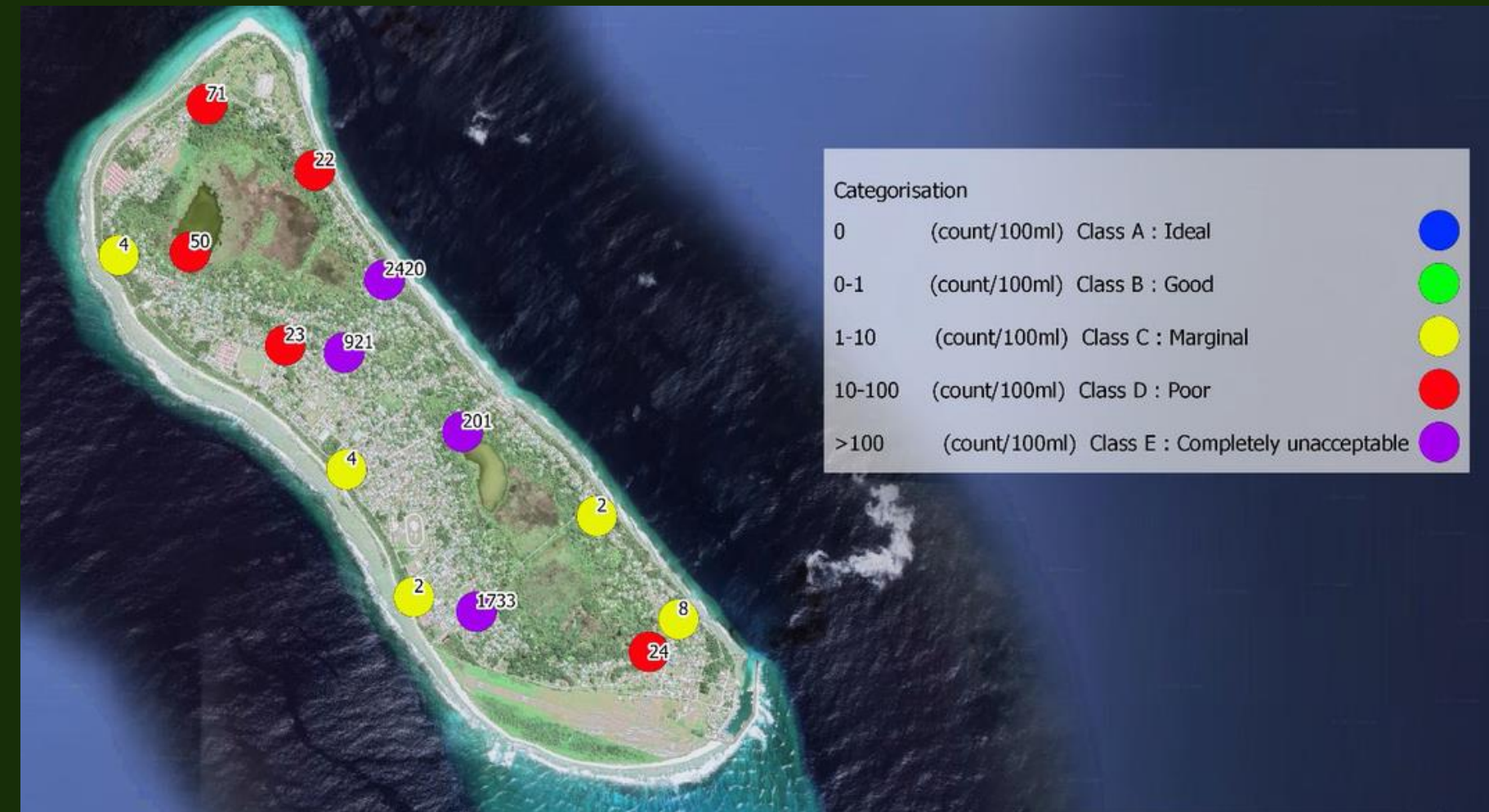
- Reverse Osmosis plant does not function as per the mentioned capacity (1500 cbm to be produced, can produce 532 cbm)
- Important water quality parameters are not regularly tested
- Supply water quality not up to standard (later rectified during audit process)
- Public acceptability of supply water was low, efforts of awareness was not effective
- Human and technical capacity for proper O&M not developed
- The system concept results in a loss of water from freshwater lens





# AUDIT EXAMPLE - AUDIT FINDINGS

- In contrast to the project objective, the quality of the groundwater lens has deteriorated after project implementation
- The system concept results in a loss of water from freshwater lens



# AUDIT EXAMPLE - RECOMMENDATIONS

- Ensure that the project outputs are as agreed as per project's objectives, signed contracts and specifications
- Implement the quality control mechanisms effectively
- Ensure compliance to environmental regulations including the environmental impact assessment and the operation and maintenance manual
- Foster collaborative approach in project implementation with adequate stakeholder input and ensure public acceptability of project outputs
- Undertake restoration efforts to rejuvenate the environmental resources negatively impacted under the current project





The image features a scenic view of a mountain range covered in dense green vegetation. A large, semi-transparent green circle is centered over the middle of the image. The words "THANK YOU" are written in a bold, white, sans-serif font across the center of this circle. In the top right corner, there are two smaller, solid green circles of different sizes. In the bottom left corner, there is a large green circle and a smaller one next to it, both semi-transparent. The overall color palette is dominated by various shades of green, with the white text providing a strong contrast.

**THANK YOU**