EAFm Capacity Plus
Module 3: Climate Change Adaptation

EAFm Capacity Plus training
Yangon, Myanmar- August 2019

Module objectives

- Learn…
- Recognize…
- Describe…..
- Discuss…

Structure of Presentation

- Introduction
- Weather, Climate, and what causes our climate to change
- Review: Disasters, Extreme Events and Climate Change Adaptation
- Impacts of Climate Change on aquatic environments
- Impacts of Climate Change on fisheries and aquaculture
- Climate Change Adaptation principles and approaches
- Options for supporting fisheries and aquaculture in a changing climate
- Conclusions

Weather, Climate, and what causes our climate to change

The difference between the climate and the weather?

- Weather – atmospheric conditions over a short period of time

- Climate - how the atmosphere behaves over long periods of time.

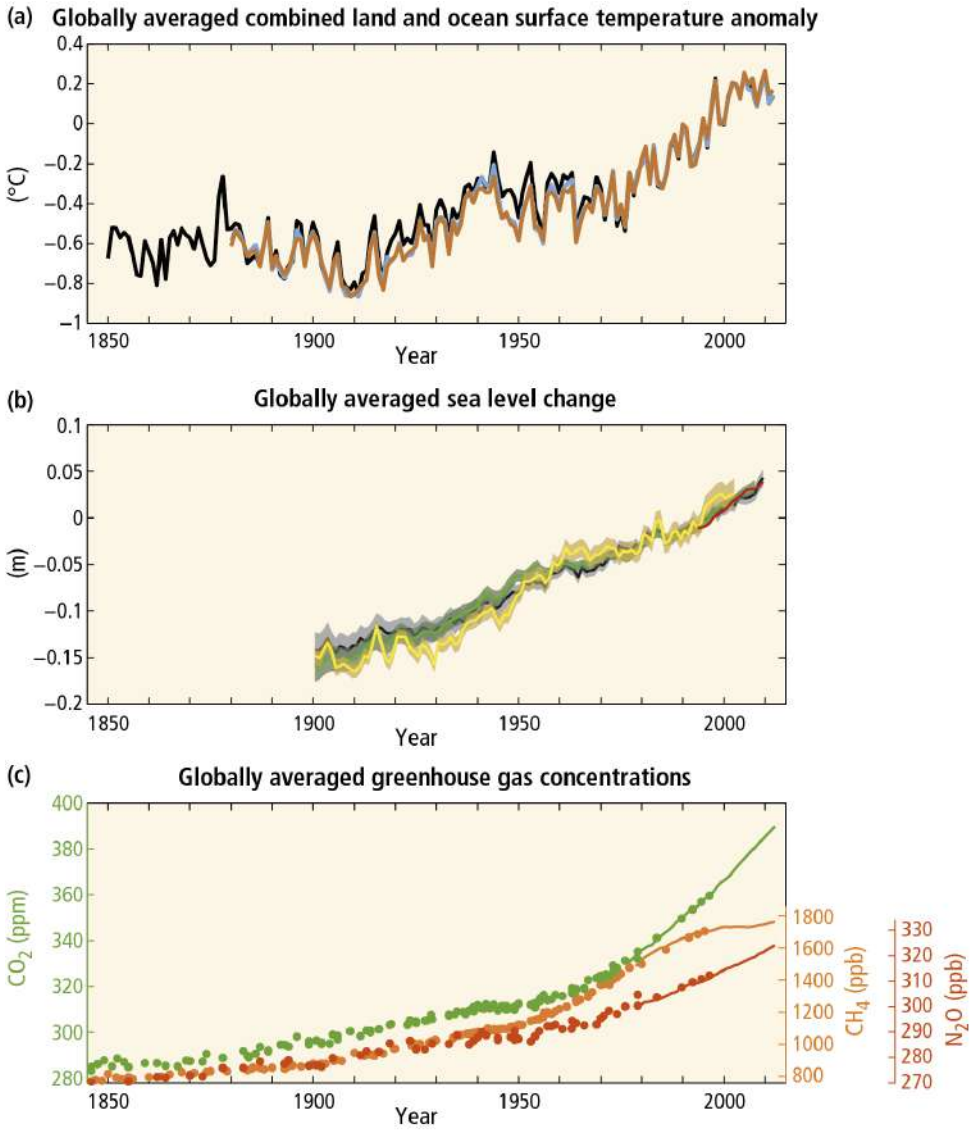
- Climate is like your character.
- Weather is like you mood.

‘Climate is what you expect’

‘Weather is what you get’

Is Climate Change real?

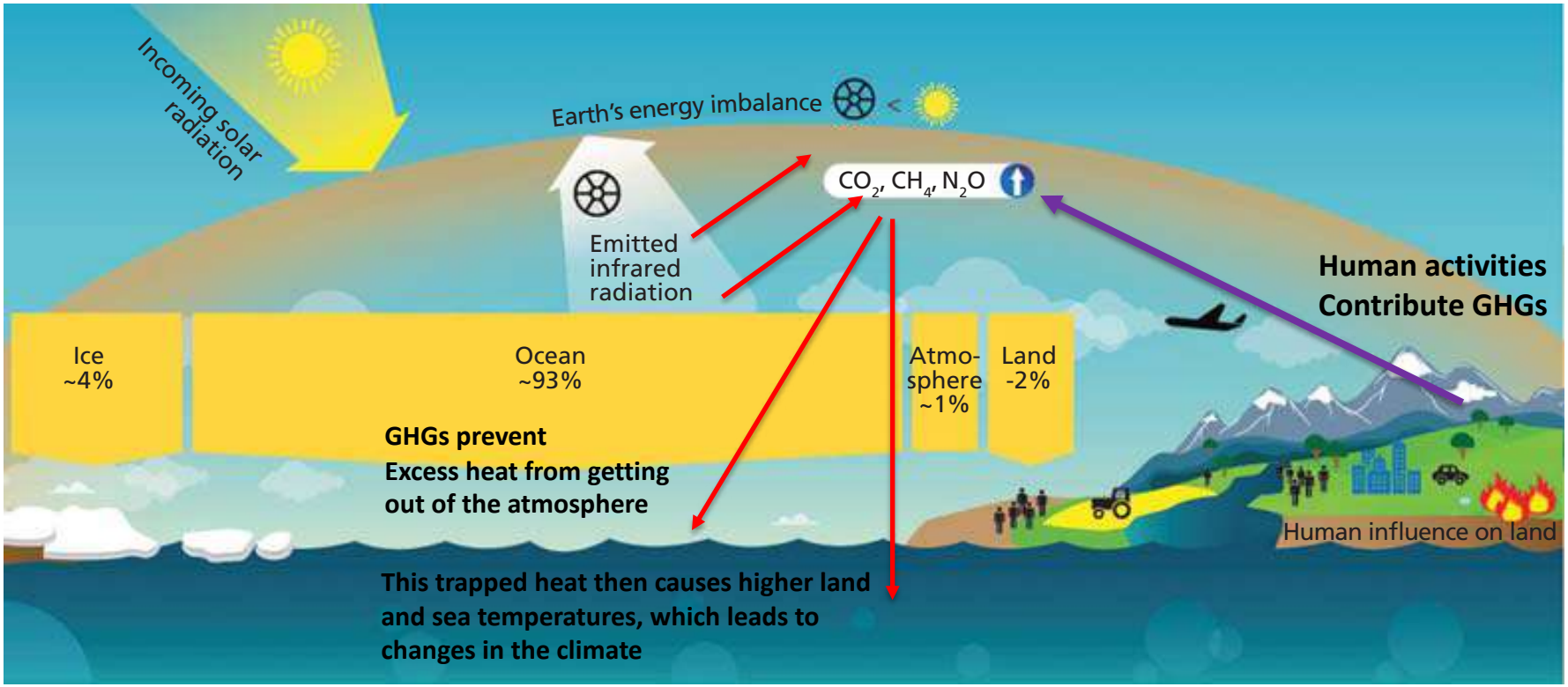
- Evidence for the warming of the Earth's climate.
  - The atmosphere and the oceans have warmed,
  - amounts of snow and ice have diminished and…
  - sea levels have risen.
    - 1901 - 2010, global mean sea level rose by 0.19 m.
- Still some people remain unconvinced.



IPCC AR5, 2014.

What is causing the earth's warming?

Flow and storage of energy in the Earth's climate system



Source: Reid, 2016.

- Increases in the atmospheric concentration of carbon dioxide (CO2) and other greenhouse gases.
- CO2 levels have increased by 40 % since pre-industrial times,
- It is extremely likely that human influence has been the dominant cause.
- A result of fossil fuel Emissions & land use change.

I. Myanmar's Climate (Climatology)

II. Is Myanmar's Climate Already Changing?

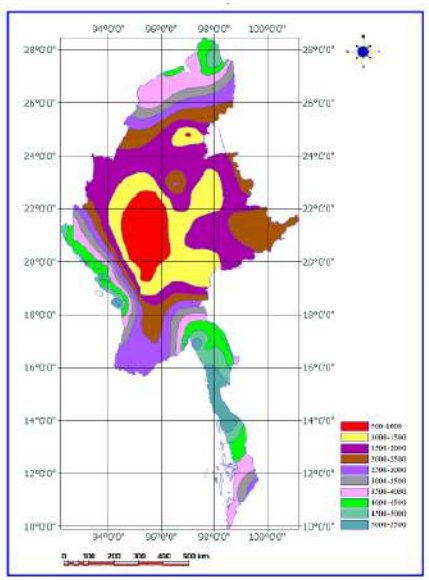
Climate (or 'Climatology') of Myanmar (30 year average)

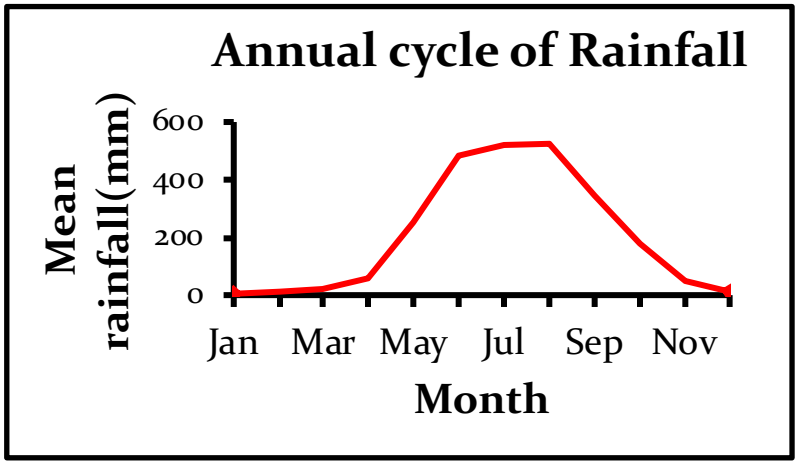
Zin Mie Mie Sein:
Please add/change as you wish. Our goal with this slide is just to remind them what Myanmar's climate is So they could better understand the fact that it is indeed changing.

Hence the proposal to use simple examples: i) Temperature; ii) Annual Rainfall; and then maybe we just add iii) monsoon and ENSO as examples of climate variability;

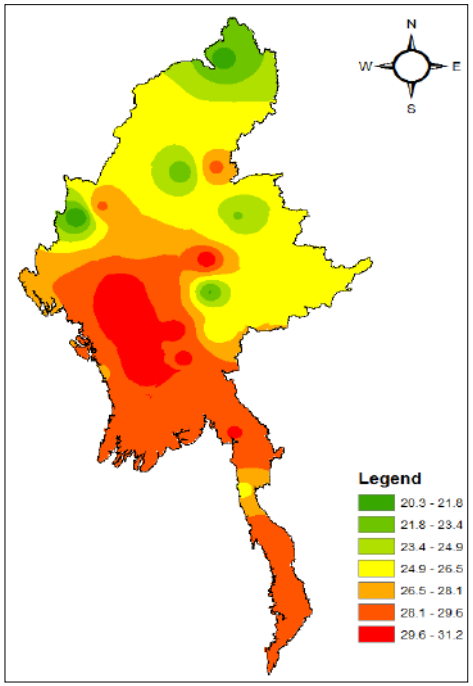
- we need to try to make them understand in Myanmar language that with CC comes along increased climate variability :-)

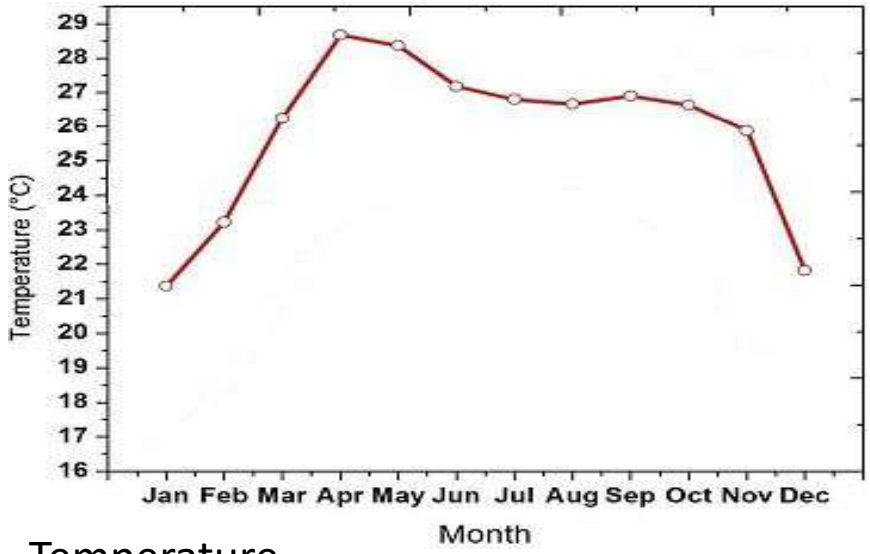
- I'll try to add simple examples for CV tomorrow/today.





Rainfall





Temperature

Climate Change in Myanmar

- Myanmar is highly vulnerable to climate change:
- Some studies have identified Myanmar as the 2nd most vulnerable country in the world, in terms of **vulnerability from extreme weather events related to climate change.**

- Slides that follows summarise the findings of WWF-US - WWF Myanmar & UN-Habitat Myanmar, 2017 Report

- Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingen, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. 2017. *Assessing Climate Risk in Myanmar: Summary for Policymakers and Planners.* New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar, UN- Habitat Myanmar.

Is Myanmar's climate already changing?

- Between 1981 - 2010,
  - average temperatures increased by 0.25°C.
  - Happening faster inland than in coastal areas,
  - Annual total rainfall increased slightly
  - Higher rate in coastal areas.
  - Research suggests summer monsoon season has become shorter by approximately one week, on average.

How much will temperatures increase in the future?

- **In the 2020s**….
  - National average temperatures are projected to rise by 0.7°C–1.1°C compared from the 1980–2005 base period.
  - Wet season temperature increases are projected to be smaller than warm and cool season changes.

- **By the 2050s…**.
  - Warming trends may accelerate, raising average temperatures by 1.3°C–2.7°C, relative to the base period.
  - temperatures in inland areas are projected to increase more than coastal ones.
  - The Eastern and Northern Hilly regions may see the most dramatic warming, with hot season average temperatures projected to rise by up to 3°C.

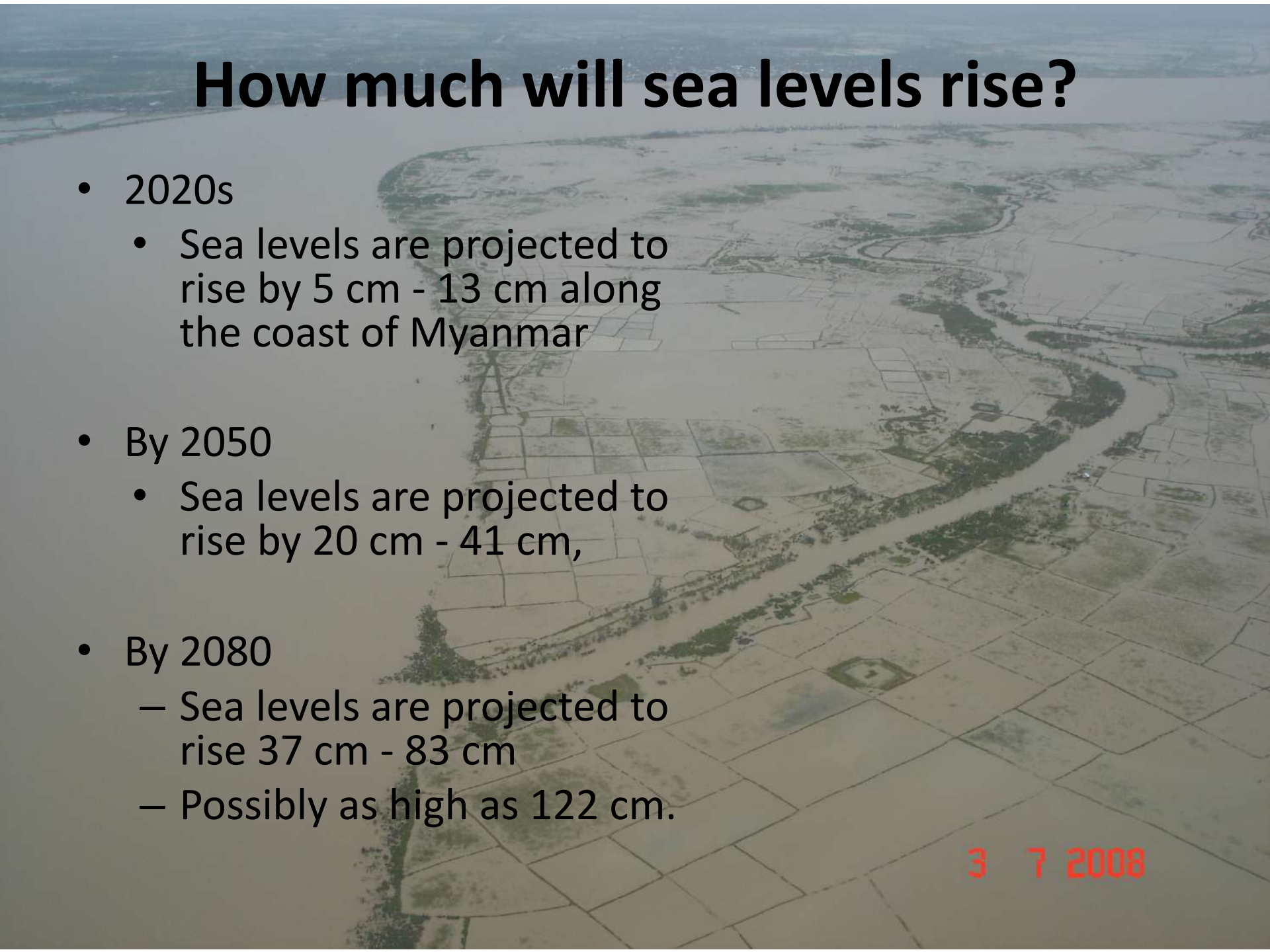
How will rainfall patterns change in the future?

- **During 2020s**
  - Total rainfall projected to increase (compared with 1980–2005 baseline.
  - Changes likely to increase wet season flooding in some regions.

- **By 2050,**
  - Total rainfall projected to increase further.
  - Rainfall during the hot season more likely to increase than decrease,
  - Cool season projected changes are less clear.

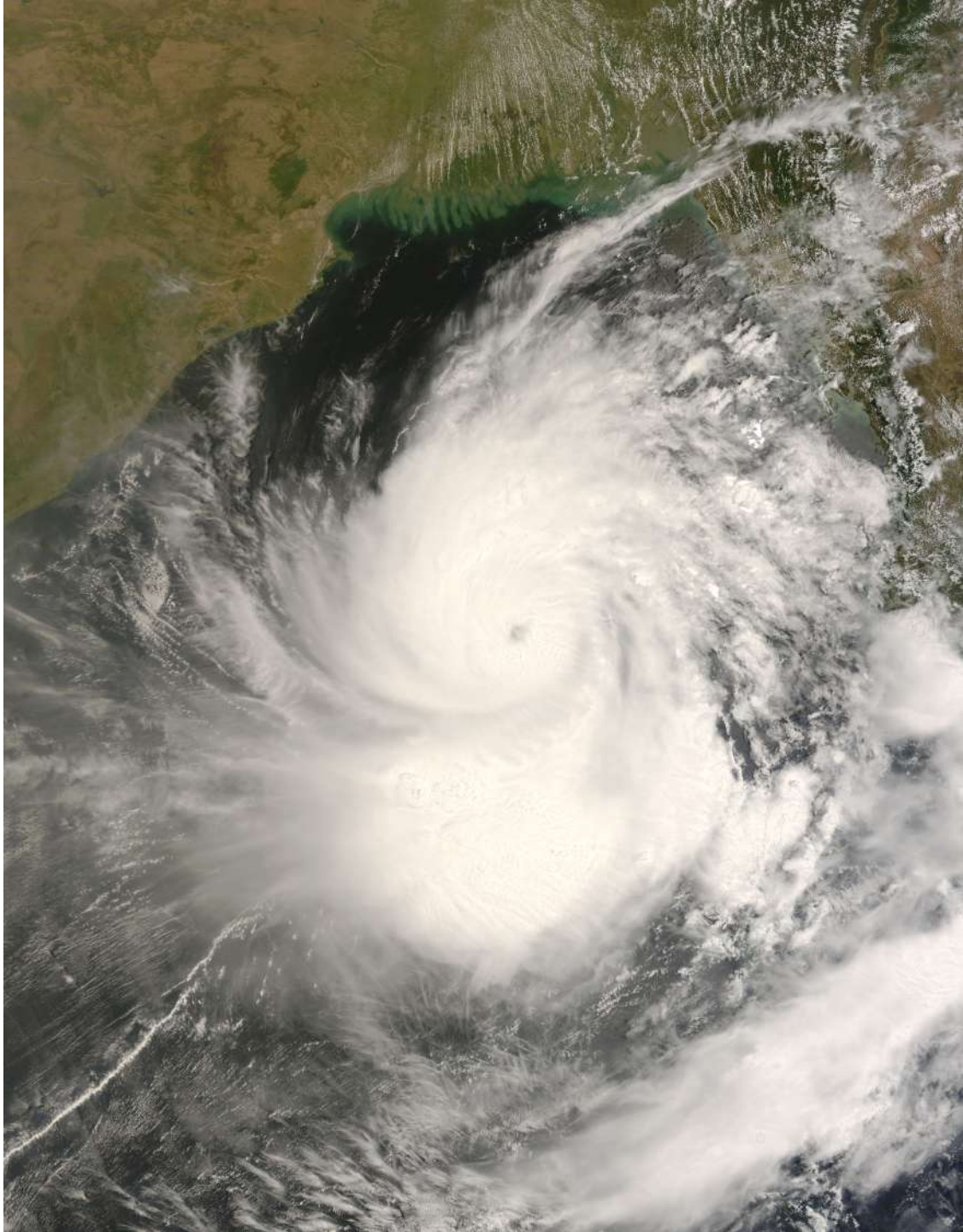
How much will sea levels rise?

- 2020s
  - Sea levels are projected to rise by 5 cm - 13 cm along the coast of Myanmar
- By 2050
  - Sea levels are projected to rise by 20 cm - 41 cm,
- By 2080
  - Sea levels are projected to rise 37 cm - 83 cm
  - Possibly as high as 122 cm.



Will more cyclones reach Myanmar?

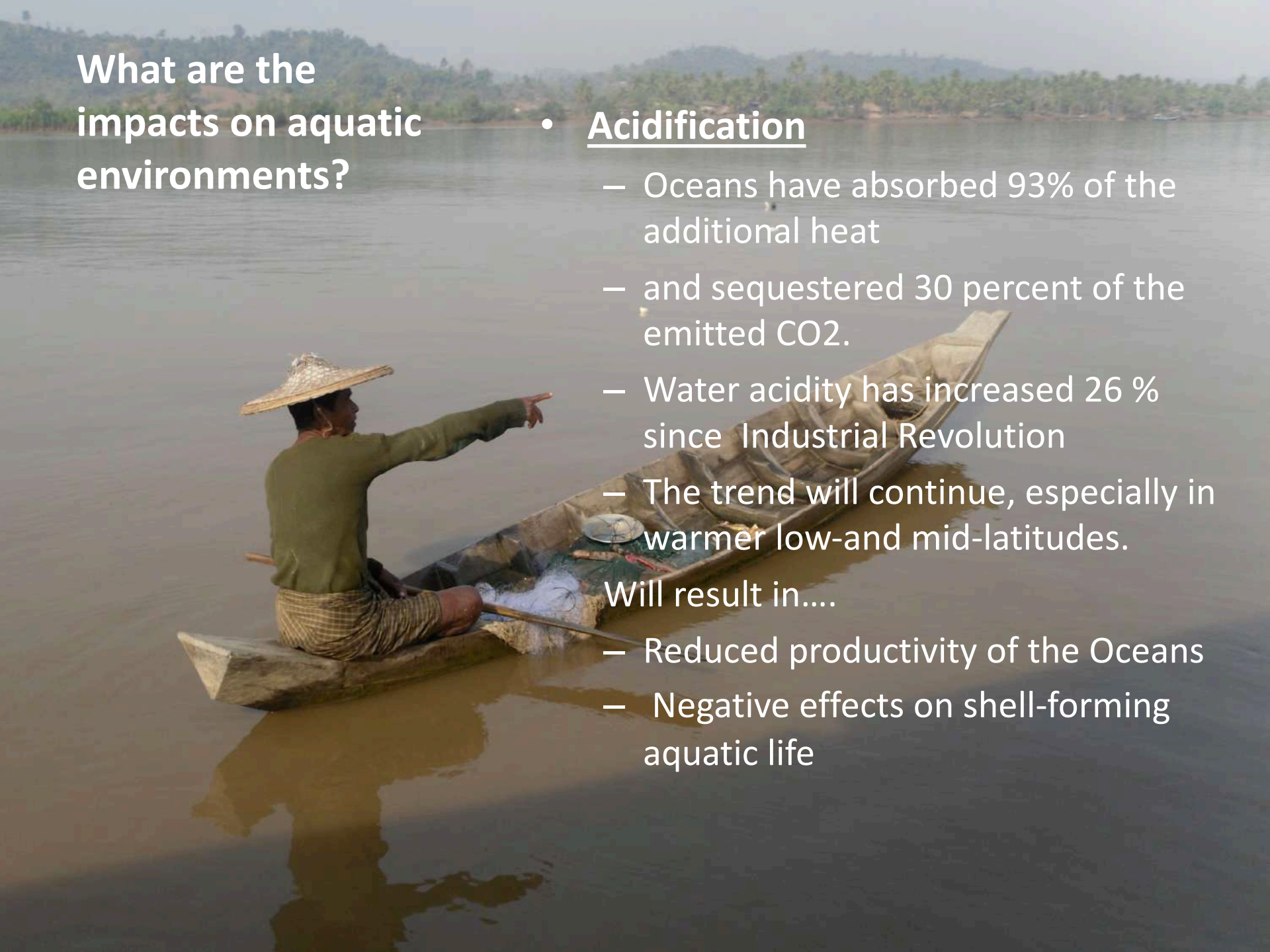
- Ave. 10 tropical cyclones form in the Bay of Bengal each year.
- < 10% make landfall in Myanmar
- **Since 1990**,
  - the total number of tropical cyclones reaching Myanmar has increased,
  - There has been a rise in tropical cyclone events occurring just before the monsoon season,
  - while those occurring after the monsoon season have decreased.



Is the monsoon season shifting?

- Summer monsoon: 75- 90% of Myanmar's total annual rainfall.
- Normal onset date - June 1,
- August is the wettest month, followed by July.
- A study by Lwin (2002)
  - the duration of the monsoon season has shortened
    - **late onset and early withdrawal.**
  - Annual rainfall, monsoon rainfall, and monsoon strength have decreased,
  - The number of **drought years** has declined.

What are the impacts on aquatic environments?

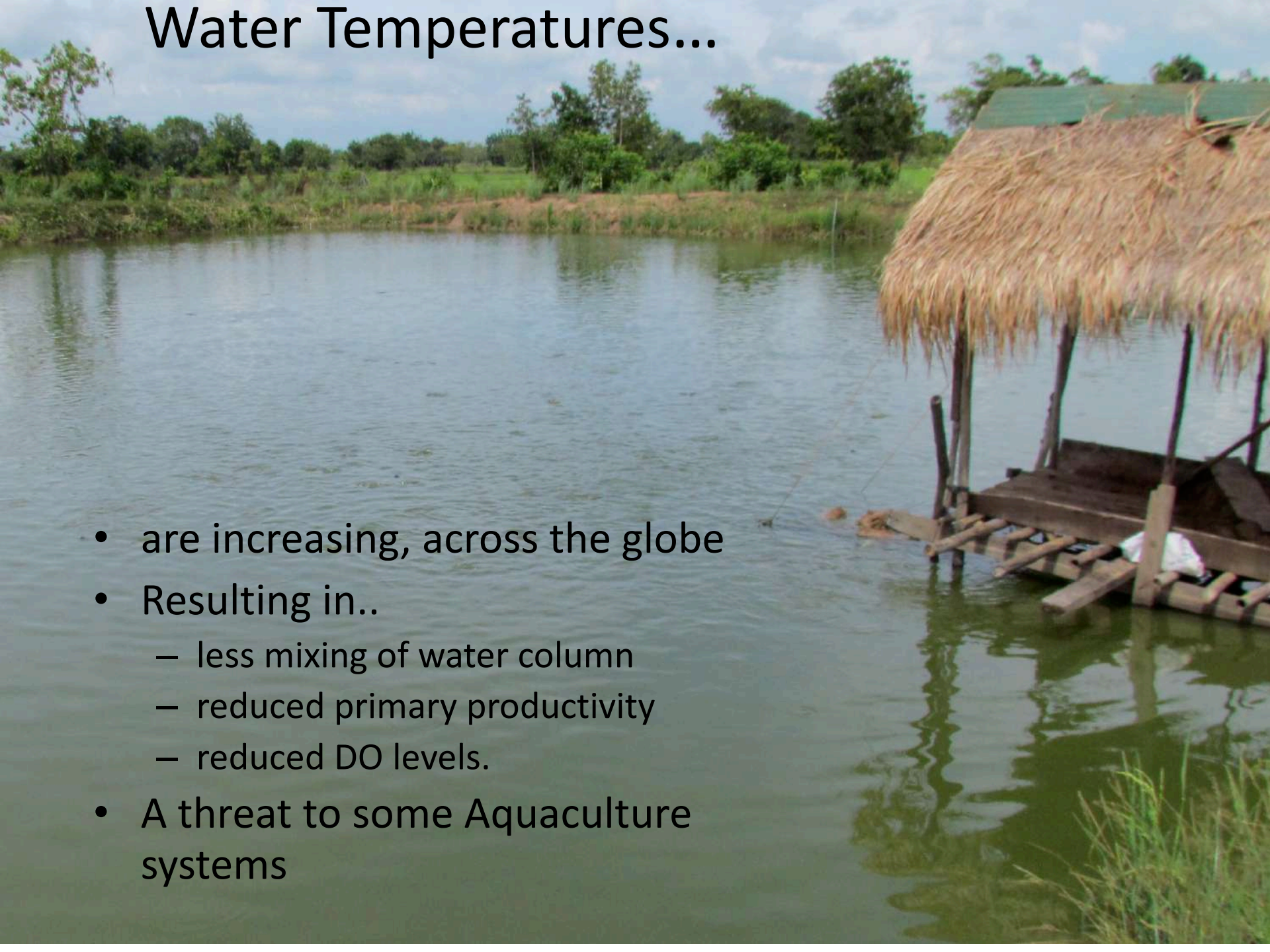


- **Acidification**
  - Oceans have absorbed 93% of the additional heat
  - and sequestered 30 percent of the emitted CO2.
  - Water acidity has increased 26 % since Industrial Revolution
  - The trend will continue, especially in warmer low-and mid-latitudes.

Will result in….

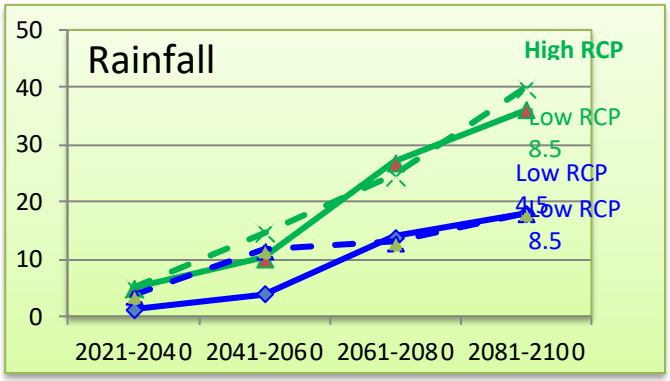
  - Reduced productivity of the Oceans
  - Negative effects on shell-forming aquatic life

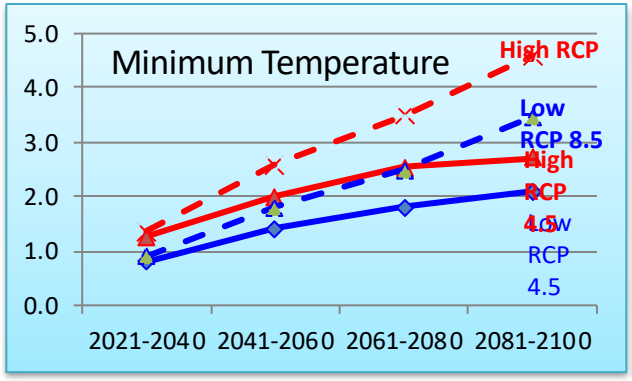
Water Temperatures…

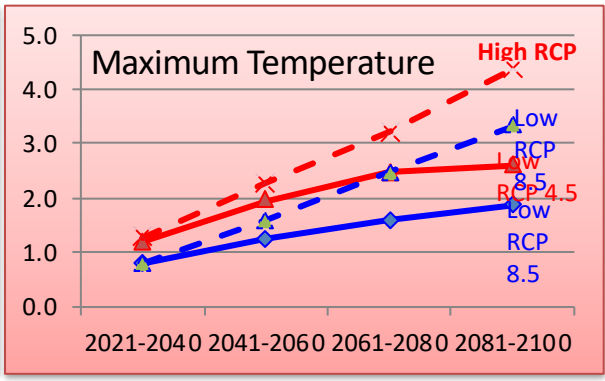


- are increasing, across the globe
- Resulting in..
  - less mixing of water column
  - reduced primary productivity
  - reduced DO levels.
- A threat to some Aquaculture systems

On-going Work: Updating of Climate Change Projections for MYANMAR by DMH







Source: DMH

GCM	MODELLING CENTER
BCC-CSM1.1	Beijing Climate Center, China Meteorological Administration
CanESM2	Canadian Centre for Climate Modelling and Analysis
CCSM4	NCAR (National Center for Atmospheric Research) Boulder, CO, USA
CSIRO-Mk3.6.0	Commonwealth Scientific and Industrial Research Organisation
HadGEM2-AO	NIMR (National Institute of Meteorological Research, Seoul, South Korea)
MIROC5	Atmosphere and Ocean Research Institute (The University of Tokyo), Japan
MRI-CGCM3	Meteorological Research Institute, Japan

Projections for all states and regions

Review: Disasters, Extreme Events and Climate Change

From the DRM module, we learned that:

DRR and CCA SHARE COMMON OBJECTIVES:

Common concern with climate-related risks and hazards

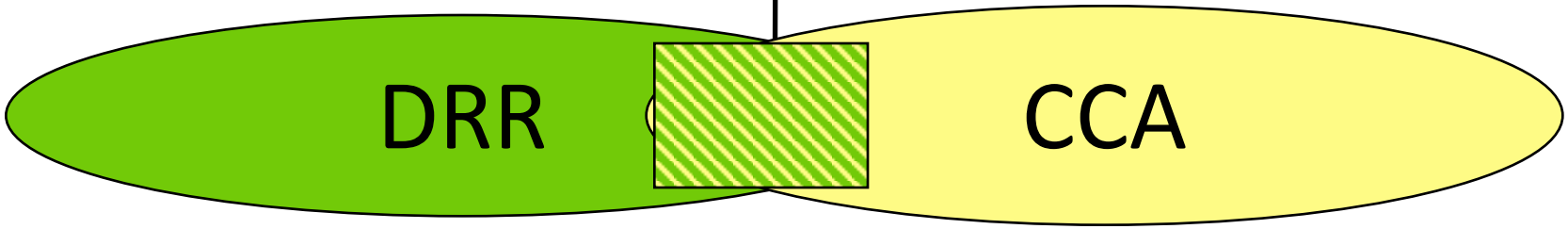
Cross-sectoral perspective

Poverty reduction and sustainable Natural Resources Management

Increase of resilience and building response capacity

Addressing similar drivers of vulnerability

Capacity-building and awareness-raising



Disaster Risk Reduction, Climate Change Adaptation and Sustainable Development

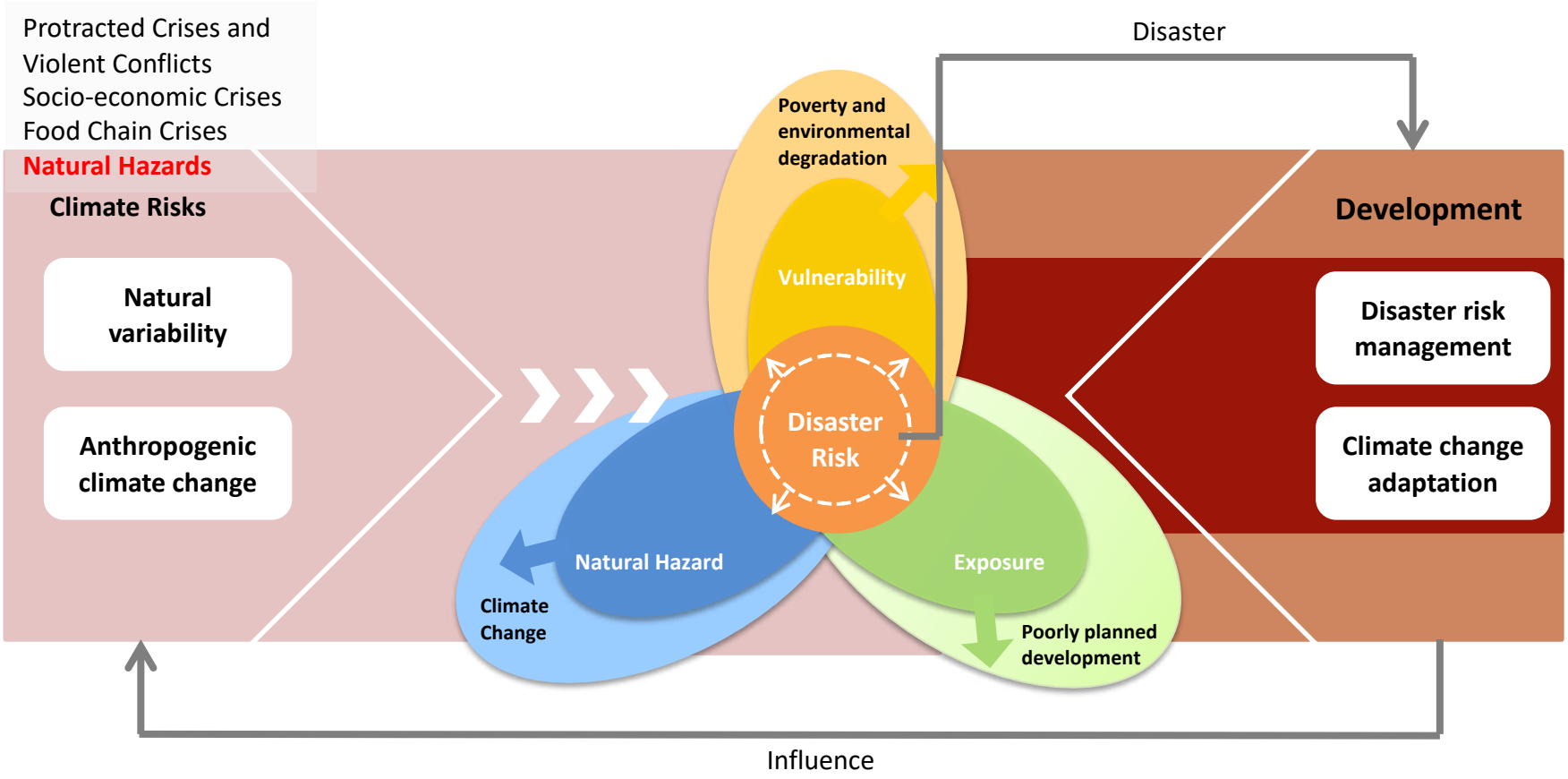
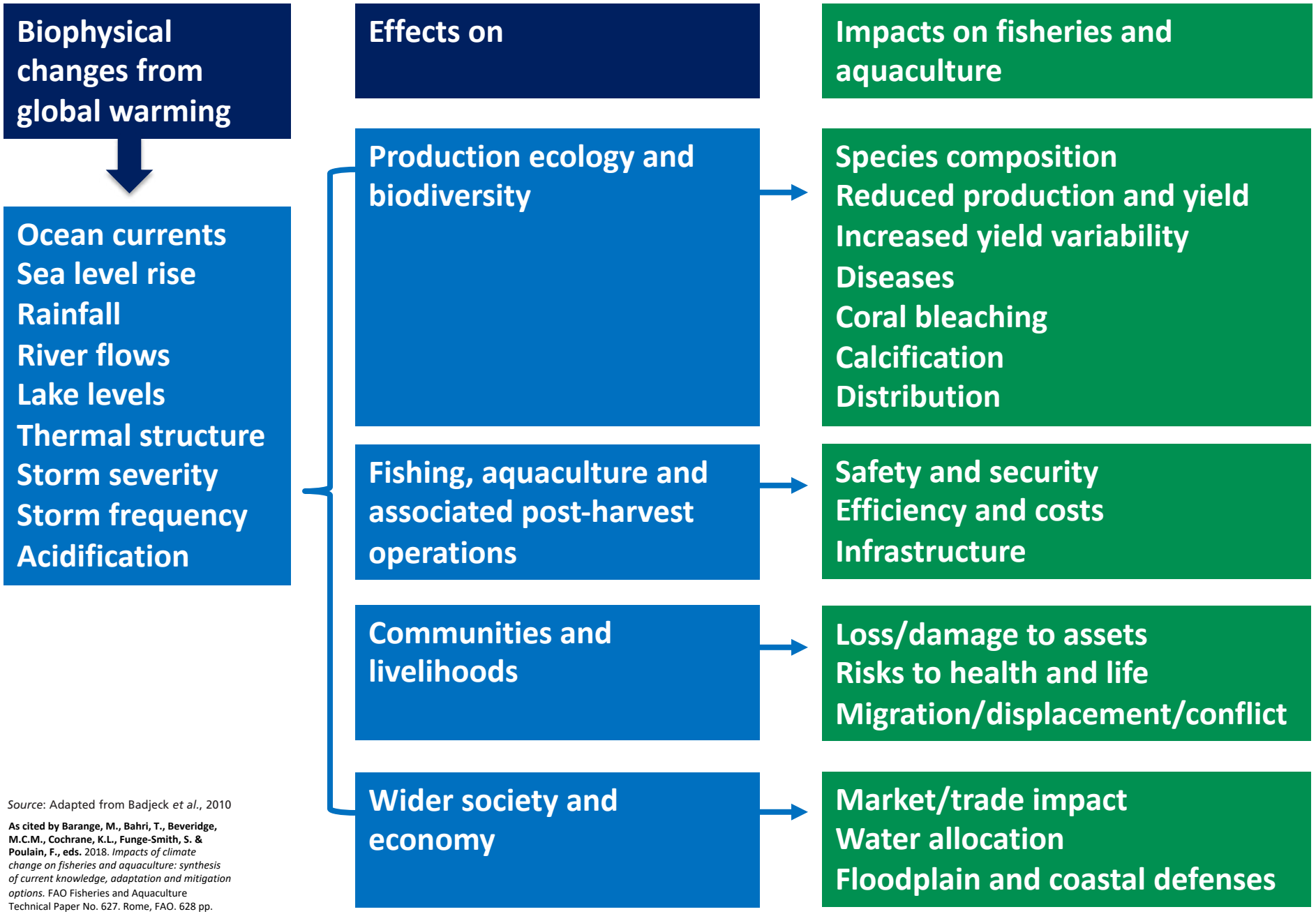


Figure 1: The inter-linkages between the core concepts of SREX (Adapted from IPCC SREX report)

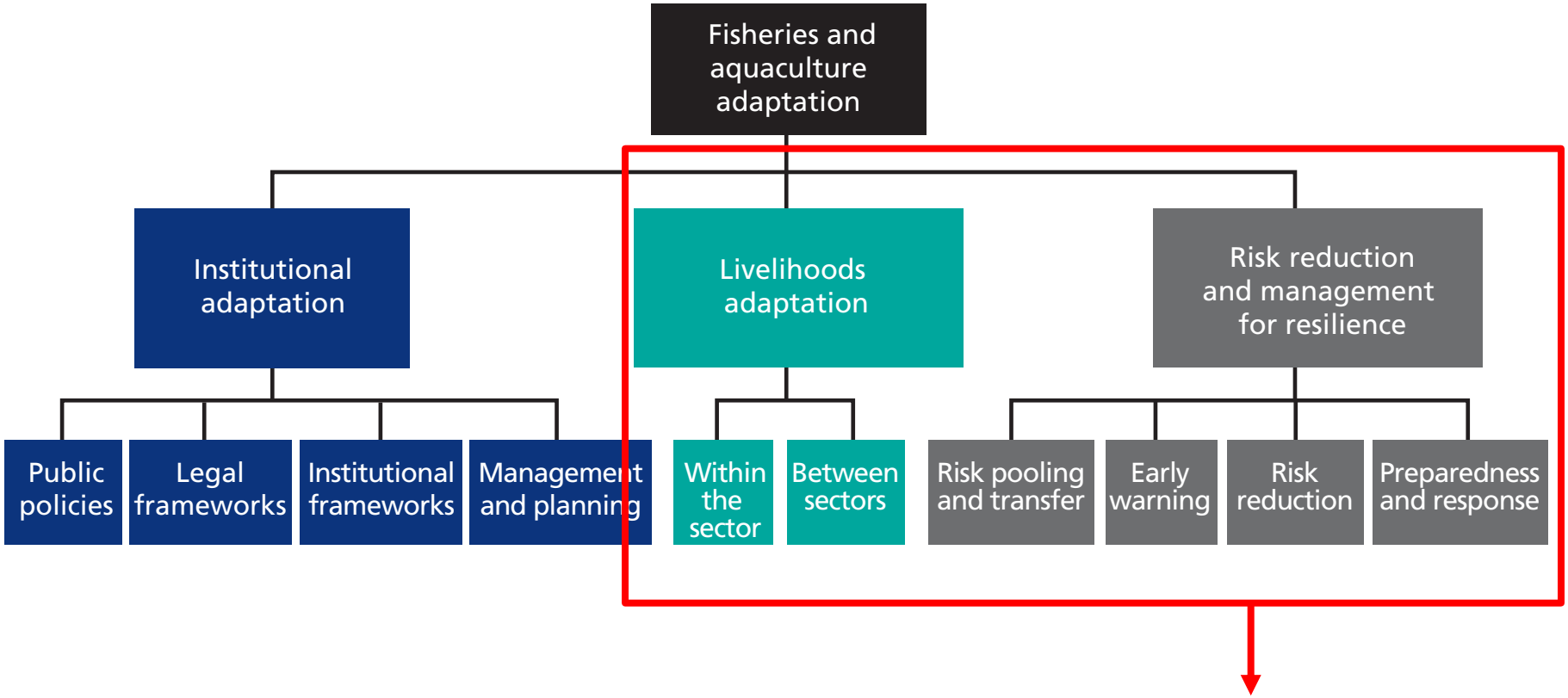
Climate Change impact pathways in fisheries and aquaculture



Source: Adapted from Badjeck *et al.*, 2010

As cited by Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S. & Poulain, F., eds. 2018. *Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options.* FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp.

Categories of Adaptation Activities



Link to DRM module

Shared concerns:

Climate-related risks and hazards

Natural resource management

Cross-sectoral livelihoods approach

Poverty Reduction/

Sustainable development

Source: Barange, M., Bahri, T., Beveridge, M.C.M., Cochrane, K.L., Funge-Smith, S. & Poulain, F., eds. 2018. *Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options.* FAO Fisheries and Aquaculture Technical Paper No. 627. Rome, FAO. 628 pp.

Supporting Myanmar's fisheries & aquaculture in a changing climate.

CCA for Upland fisheries

- To protect stream environments, forest cover should be retained or recovered.
- Protection of the small valley catchments to reduce the effects of flash flooding.
- Streams should be improved to preserve alternate shallow, fast-flowing areas to increase dissolved oxygen levels; and deeper pools in which fish can rest.
- Low weirs can also be used to retain water in some areas.
- Varied riparian habitat areas along the stream course will provide refuge areas and allow for diverse species to co-exist.
- The organized trapping of invasive species may also be necessary.

CCA for Major River systems

- For migratory white fish, - improving access to spawning grounds and habitats in the breeding areas.

- May require the seasonal dismantling of structures in the tributaries that prevent the movement of white fish species,
  - E.g. small-scale hydro or irrigation installations.

- Dry seasonal protection of stocks in deep pool areas should be promoted

- Artificial propagation of high value / rare species in hatcheries and the subsequent release of juveniles into river systems can maintain viable fish populations.
  - Eg. Giant Mekong catfish (*Pangasionodon gigas*) in Thailand

CCA for Lowland Wetlands

- Black fish species, (snakehead, catfish etc.) are robust species that maybe more resistant to the changing climatic conditions.

- Steps can still be taken to ensure that wetland biodiversity remains intact and their contribution to productivity remains high.

- The single most important management intervention for these fish species is the creation and management of dry season refuge areas, from which they can repopulate the flood plains each wet season.

CCA for Reservoir fisheries

- Create new environments that may suit certain indigenous or exotic fish species.

- Fish catches from these ‘new’ environments could contribute significantly to local food security and livelihoods.

- Myanmar policy issues currently constrain fisheries development in reservoirs.

CCA for Coastal fisheries

- Replanting of mangrove forests can protect against
  - sea level rise
  - Storms
  - Erosion,
  - maintain fish biodiversity and production.

- Interference with natural tides and current patterns should be discouraged to ensure that mangrove areas remain healthy

- Special protection measures may be necessary for some sedentary estuarine animals such as molluscs.

CCA for Marine fisheries

- MPAs
  - Coral Reefs
    - Particularly important due to the stress on corals through acidification
  - Mud flats
    - Highly productive nursery and production areas.
    - Require protection

CCA and Invasive Species

- Many invasive aquatic species are
  - generalist
  - able to exploit a wide range of environments
- Climate change may create favourable conditions for invasives
- .This can increase pressure on indigenous stocks

CCA and Aquaculture- systems

- Offers more scope for adaptation to climate change than capture fisheries, due to
  - The diversity of production systems,
  - scales of production,
  - inherent manageability,
  - and control of environments,

- Super intensive systems may have greatest adaptive capacity due to the high level of investment and management.
  - Threats can be managed through advanced technology such as aeration although this may be costly

- The majority of aquaculture practiced in Myanmar is
  - extensive or semi-intensive
  - open to the elements with little contingency for managing climate change issues outside of a few simple preventative measures.

- To an extent, climate change threats can be managed through
  - changes to the intensity of the culture system,
  - the species raised,
  - and the use of inputs.

CCA and Aquaculture - Temperatures

- At higher elevations
  - Increasing temperatures may change sub-optimum areas (in terms of growth), more suitable for aquaculture.

- At lower elevations,
  - projected temperatures will be above optimum for many species
  - Adaptation may mean shifting from carp species to tilapias and catfish, which are generally more tolerant of high temperatures and low DO levels.
  - May have to adjust growing cycles and stocking densities to manage around expected high temperature periods.
  - Regular aeration of deeper ponds may be required to prevent stratification and sudden water column turnover;
  - Reduction in the use of low-quality fish feeds in favor of pelleted feeds, to maintain water quality.

CCA and Aquaculture- Water

- On-site water storage - reduce the risks of water shortages during dry season.
- Reuse of pond water will be an important strategy to reduce water use, and to mitigate the release of effluents to the environment.
- Strengthening of embankments to protect against flooding.
  - Flash flooding offers more of a challenge
- If flooding becomes unmanageable, then culture cycles would have to be adjusted so that fish harvests were timed to occur before high-risk periods.

CCA and Aquaculture- Water

- The creation of reservoirs will create new environments that can be used for cage aquaculture and possibly culture-based fisheries that will create new livelihood opportunities for some local people. However, only sheltered sites will be suitable as these systems are vulnerable to storms, which can damage infrastructure and result in loss of stocks.

- Finally, the creation of small on-farm ponds, can be viewed as an excellent local climate change adaptation strategy for a wide range of farming activities that are reliant on rainfall. This includes both the crop and livestock sectors

- These multi-use ponds will benefit small-scale aquaculture and allow the trapping of wild fish from the local capture fisheries, thereby helping rural households meet their food security requirements.

- Land use constraints

CCA & Shrimp aquaculture

- Many shrimp ponds are shallow which can result in
  - rapid changes in water salinity
  - increase stress levels in the shrimp
  - and make them more susceptible to disease, including WSSV.
- Conflict between shrimp farmers and rice farmers may increase it becomes more difficult to manage salt water.
- Integrated water management plans will need to be implemented in many areas to contain these types of conflicts.
- Efforts should be made to renovate derelict shrimp farms through
  - reconnection to the tidal system
  - the replanting of mangrove forest for protection and to encourage siltation.
- These areas may not return to mangroves without help.
- Climate-friendly systems, e.g., tiger shrimp/crab production in mangrove replanted areas of the delta, should be more widely promoted.

Conclusions- The Problem

- Myanmar's climate is changing
- Vulnerability of fishing communities will increase through..
  - rising sea levels affecting those living near the coastline
  - increasing temperatures
  - changing monsoon rainfall
- threatening agriculture productivity and human health.
- This will challenge
  - Livelihoods based on natural resources.
  - Viability of Fisheries and Aquaculture

Conclusions: The solutions

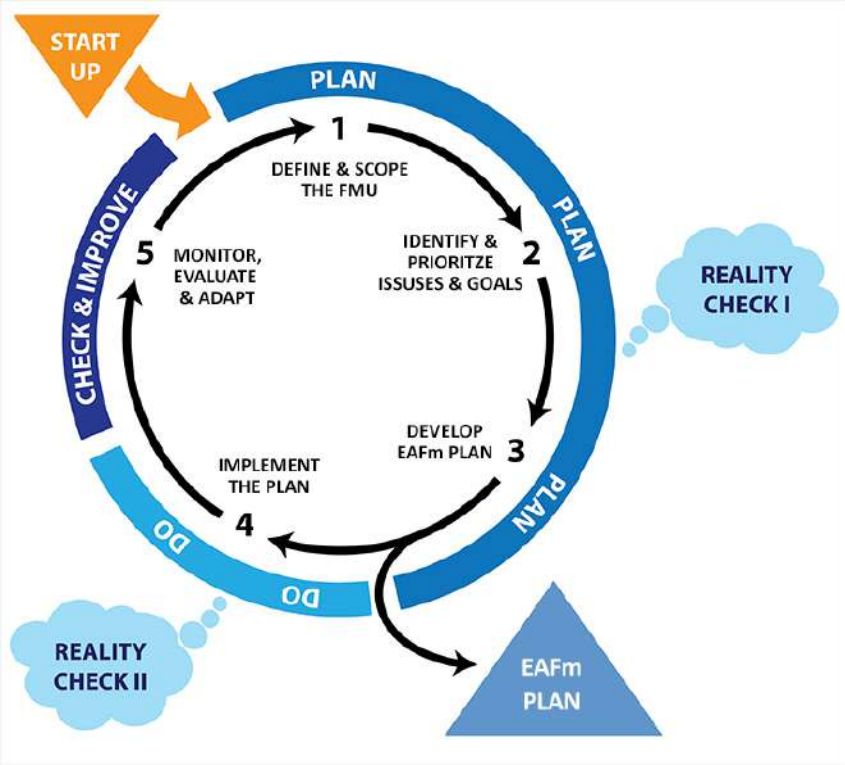
There are some climate change adaptation opportunities:

- Relatively High..
  - Upper river fisheries
  - Lowland Wetland fisheries
  - Estuarine fisheries
  - Aquaculture.
- Relatively Low for
  - Marine fisheries
  - Mainstream River fisheries

How can the EAFM support climate change adaptation efforts?

- Integrating Climate Change considerations into the EAFm planning process, can
  - Raise awareness of CC issues;
  - Ensure that fisheries & aquaculture productivity is made more climate-resilient.
  - Including local climate change mitigation practices

- Maintaining a balance between natural resource & human well-being, through good governance, will remain a principle objective as the climate changes.



Conclusions – Some Final words

- Despite the threats & uncertainty, fishing communities in Myanmar are resilient to extreme weather and changing seasons.
- There is an inherent traditional capacity to adapt and change practices based on the prevailing conditions of the time.
  - CCA management windows are open.
- Q. But will climate change push some communities into areas where their traditional management tricks and mechanisms no longer work?

Key messages

Discussion