Introduction to climate change and climate projections in South and South East Asia

Practitioner's and policy-makers exchange on climate change adaptation in agriculture

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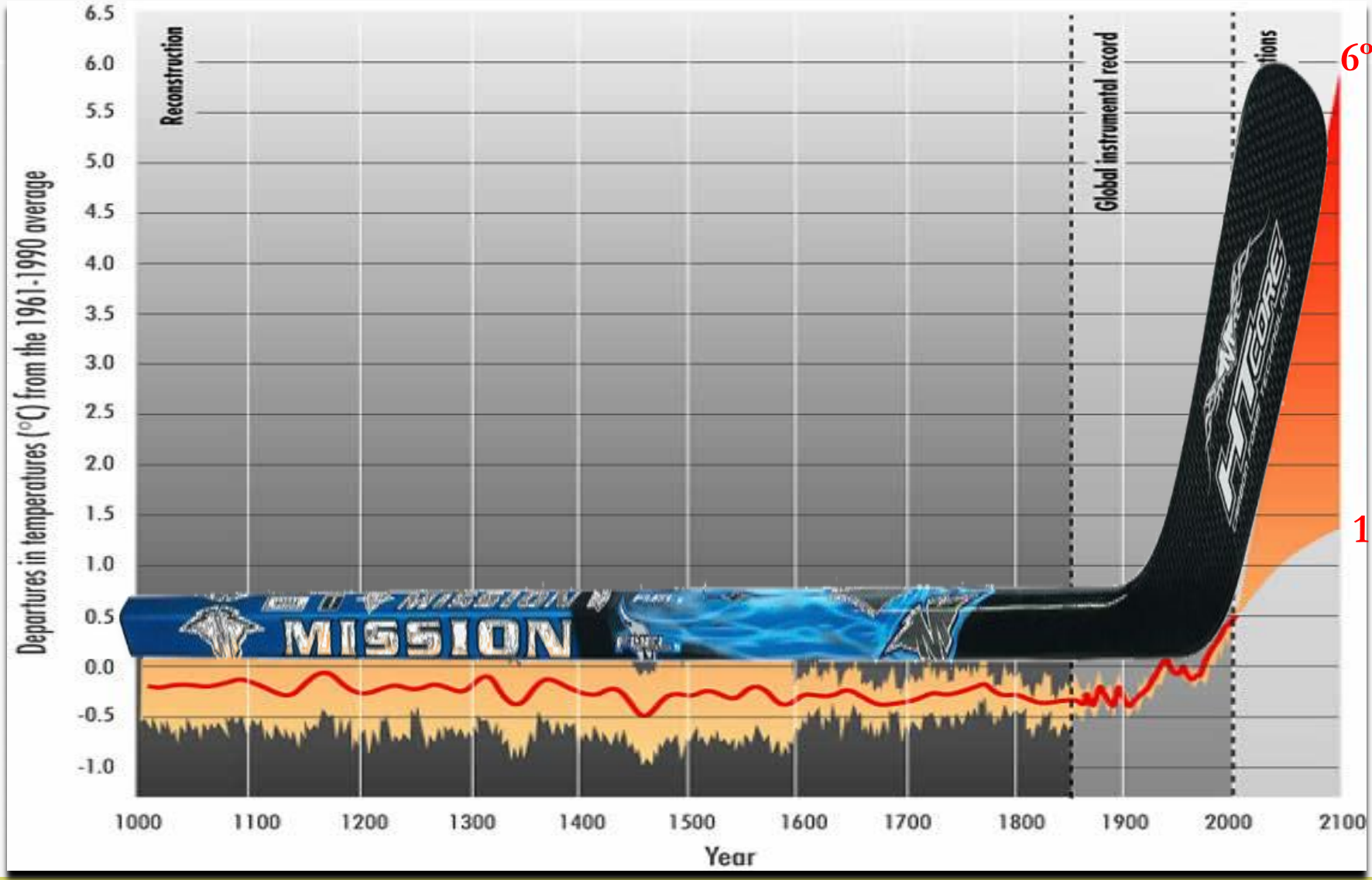
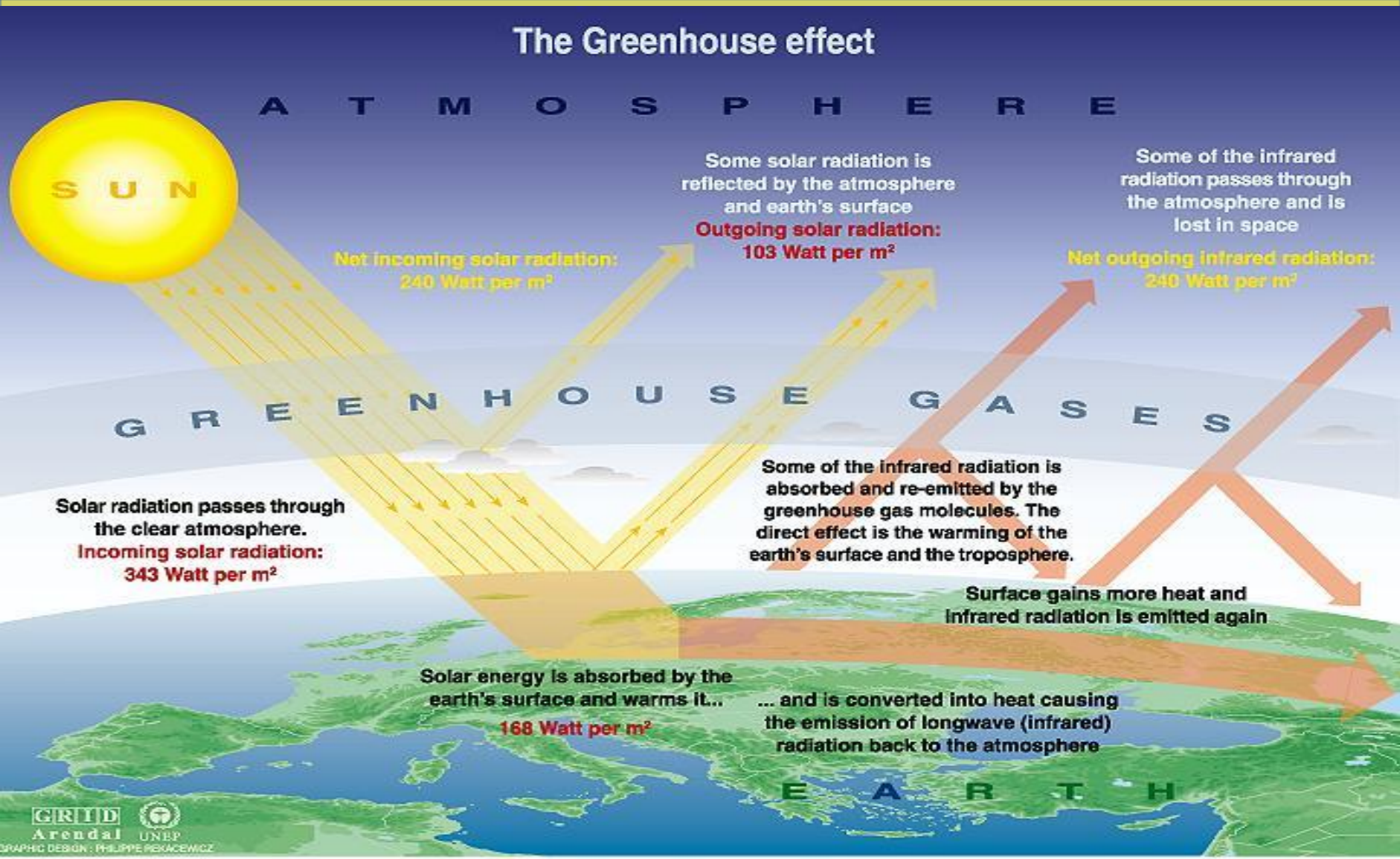
30 August 2010
Bangkok, Thailand

1. The Basics

What is global warming, and why are we concerned about it?

FACT #1: Our grandchildren will live in a world that is at least 2° C warmer than 1990





Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

The main greenhouse gases

Greenhouse gases	Chemical formula	Pre-industrial concentration	Concentration in 1994	Atmospheric lifetime (years)***	Anthropogenic sources	Global warming potential (GWP)
Carbon-dioxide	CO_2	280 ppmv	358 ppmv	50-200	Fossil fuel combustion Land use conversion Cement production	1
Methane	CH_4	700 ppbv	1720 ppmv	12-17	Fossil fuels Rice paddies Waste dumps Livestock	21 **
Nitrous oxide	N_2O	275 ppbv	312 ppmv	120-150	Fertilizer industrial processes combustion	310
CFCs	CFC-12	0	503 pptv	102	Liquid coolants. Foams	125-152
HCFCs	HCFC-22	0	105 pptv	13	Liquid coolants	125
Perfluoromethane	CF_4	0	1 10 pptv	50 000	Production of aluminium	6 500
Sulphur hexafluoride	SF_6	0	72 pptv	1 000	Production of magnesium	23 900

Note : pptv= 1 part per trillion by volume; ppbv= 1 part per billion by volume, ppmv = 1 part per million by volume

* GWP for 100 year time horizon. ** Includes indirect effects of troposphericozone production and stratospheric water vapour production. *** On page 15 of the IPCC SAR. No single lifetime for CO can be defined because of the different rates of uptake by different sink processes.

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Source: IPCC radiative forcing report ; Climate change 1995, The science of climate change, contribution of working groupe 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge press university, 1996.

FACT #2: Global Warming will lead to large-scale changes in risk patterns

Chnges in forest composition, extent, health & productivity

Variability in water supply, quality and distribution. More competition and cross-border conflicts over water resources

Erosion, inundation, salinisation, stress on mangroves, marshes, wetlands

PUBLIC HEALTH

AGRICULTURE

FORESTRY

WATER RESOURCES

COASTAL SYSTEMS

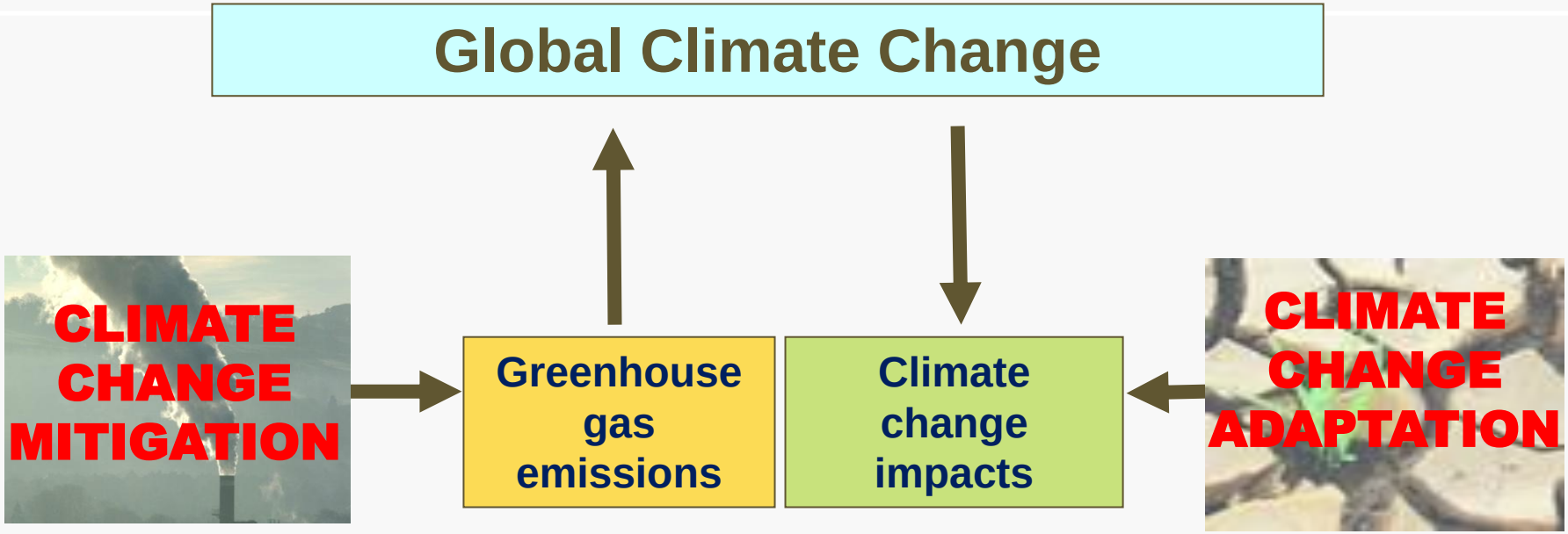
ECOSYSTEM SERVICES

Increasing incidents of infectious, water-borne and vector-borne diseases, heat stress & mortality, additional public health costs

Less predictability in crop yield, changing irrigation demand, growing risk of pest infestations

Loss of habitat, species and protective ecosystems, migratory shifts

FACT #3: There are basic strategies to tackle these risks



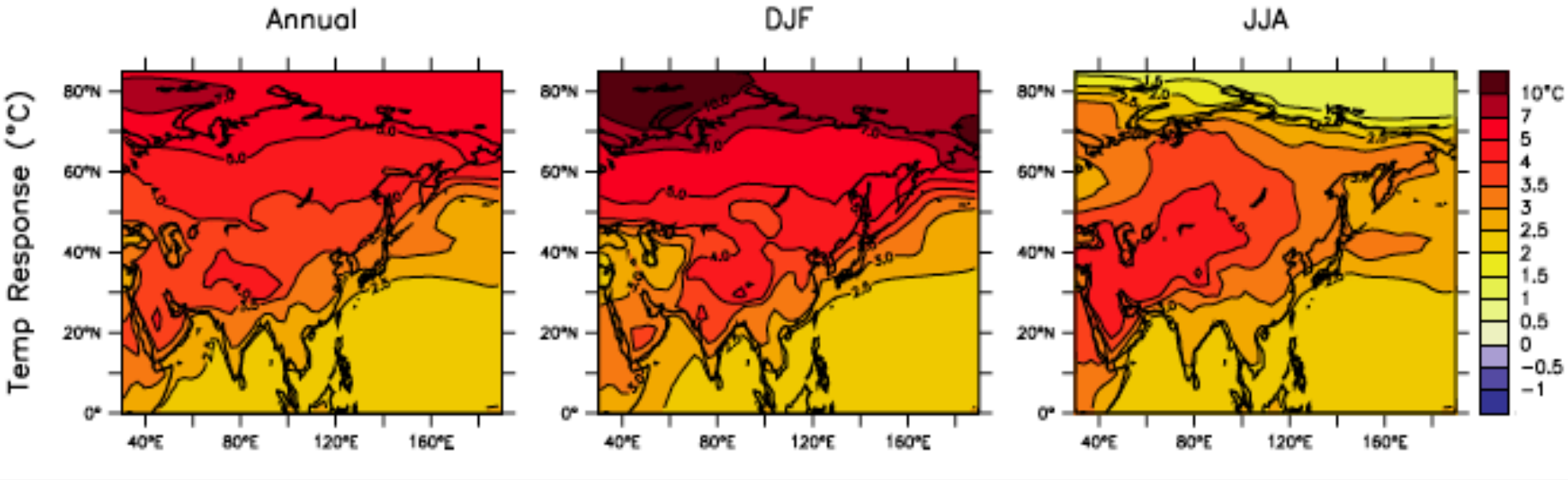
- Reduce magnitude of global warming
- Reduce greenhouse gas emissions
- Primary focus on energy, transport, land use

- Reduce vulnerability to CC impacts
- Reduce human and material losses
- Primary focus on climate-sensitive sectors and economic activities

2. Changes and Effects

What are the expected impacts of Climate Change in South and Southeast Asia?

Temperature

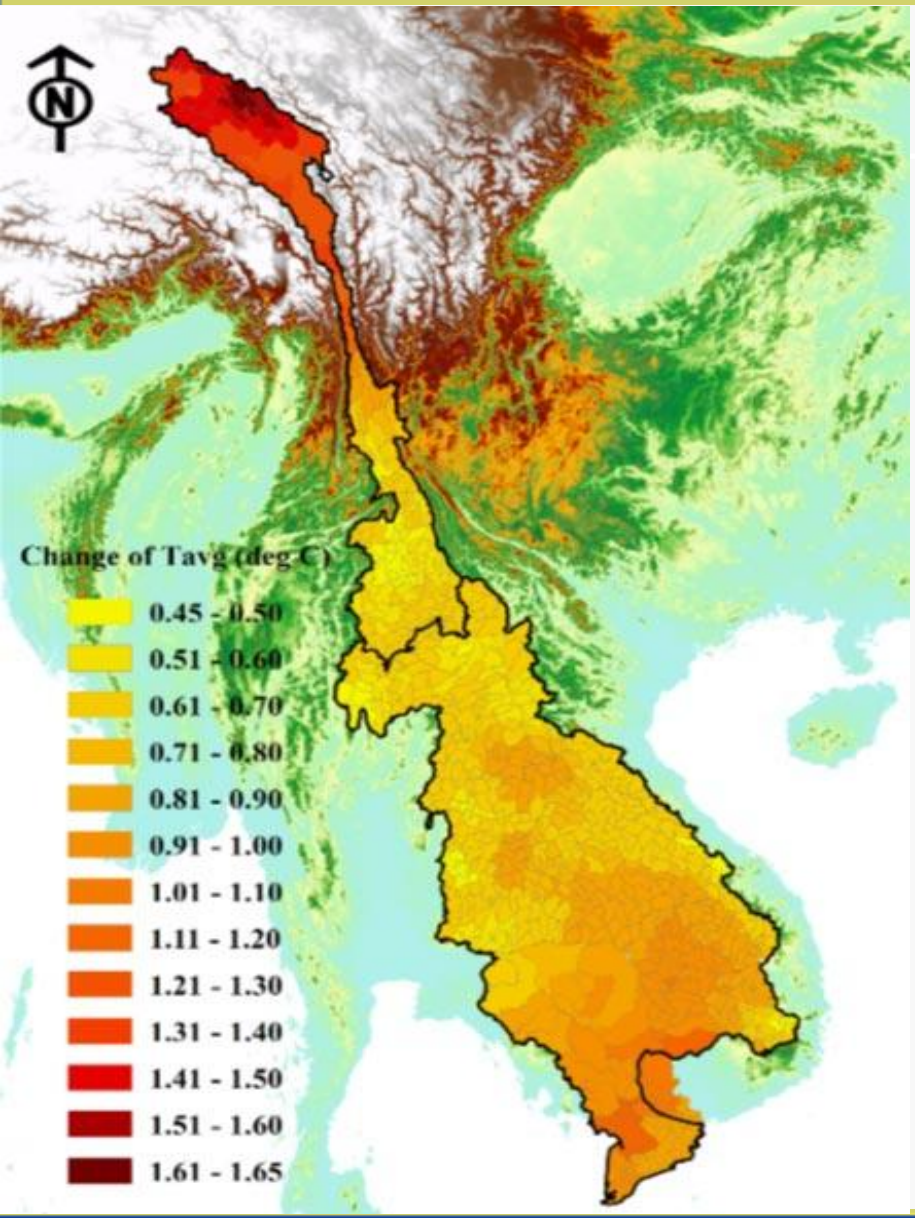


Temperature changes over continental Asia from the MMD-A1B simulations: Temperature change between 1980-1999 and 2080-2099 (averaged over 21 models)

- Regional warming range for SE Asia: 2 - 6 ºC; S Asia: 1.5 - 5 ºC
- Likely annual mean warming over land regions: ~3º C (by 2050); ~5º C (by 2080)
- Relative warming greater in winter than in summer
- Incidence of heat waves and days with extreme temperatures will increase

Sources: IPCC (2007) [WGI, Ch. 11, p. 883; WGII Ch. 10, p. 479]

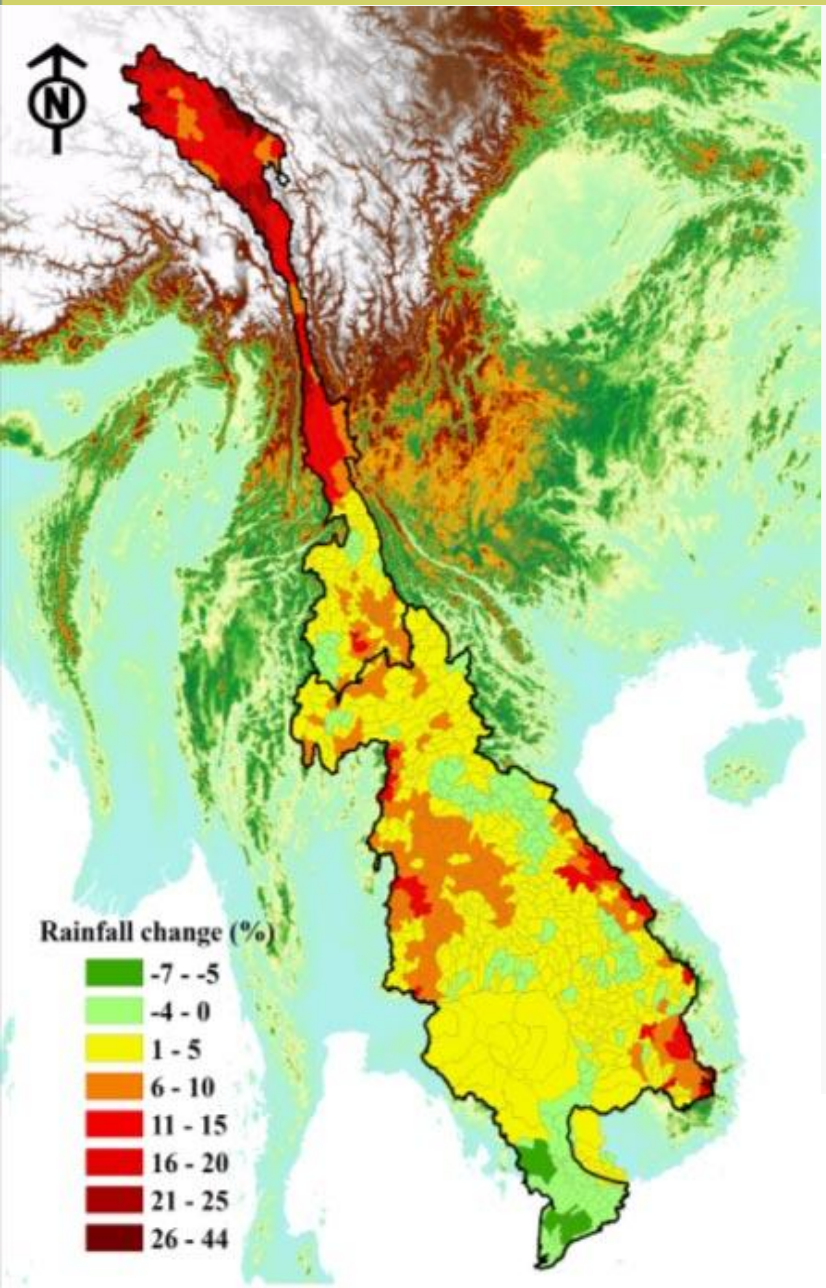
Temperature (cont.)



Change projections for mean annual temperature (ºC) during 2010–2050, compared to 1985–2000

(Source: MRC, 2009)

Rainfall



- **Drier winters, wetter summers**
- **Greater variations in river flow: Higher in winter, lower in summer**

Low water Mekong, early 2010

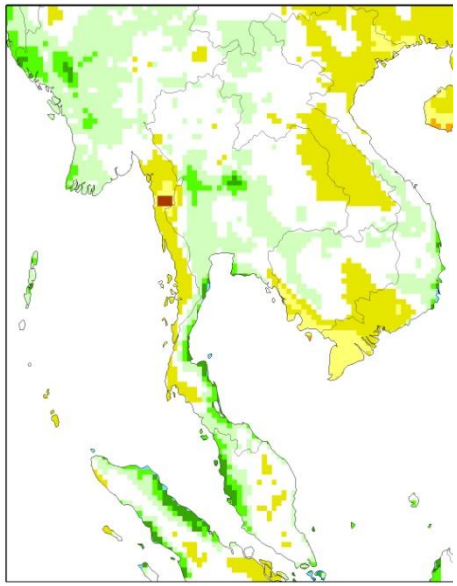
Change projections for rainfall increase/decrease in %) during 2010–2050, compared to 1985–2000

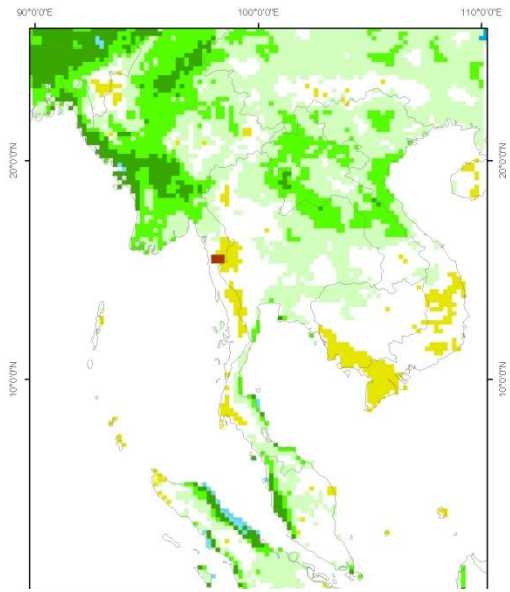
(Source: MRC, 2009)

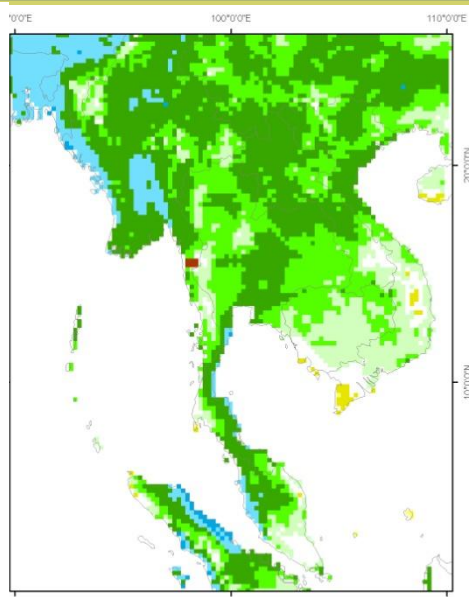
Increases in Rainfall

Change in Annual Rainfall (%)

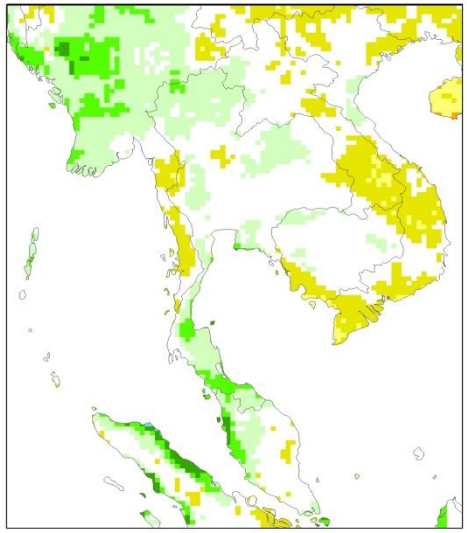
A2 Scenario ►

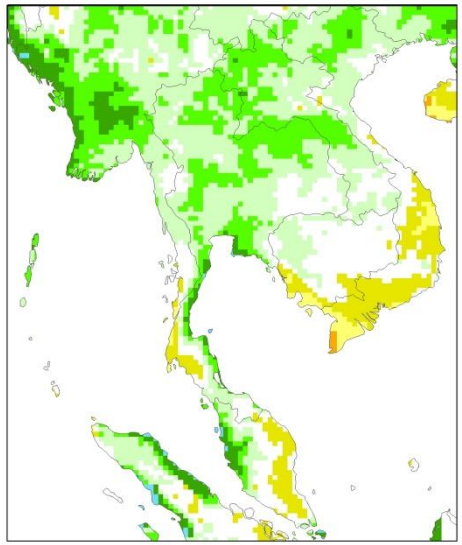


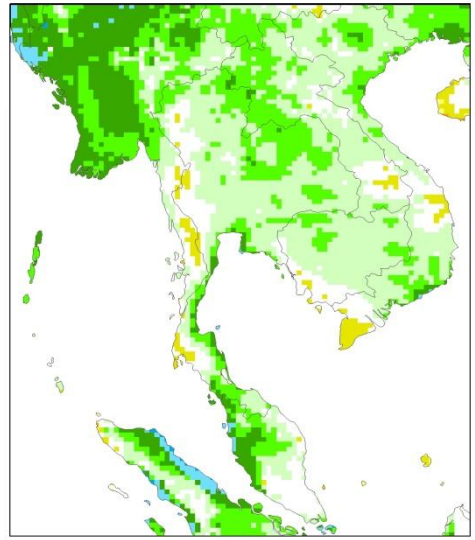


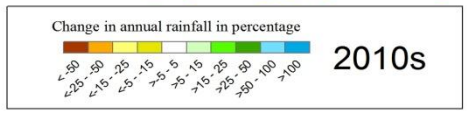


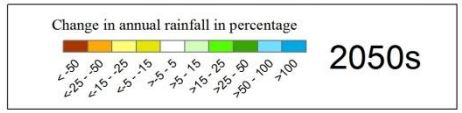
B2 Scenario ►

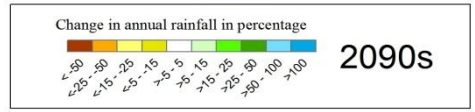






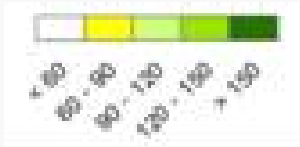






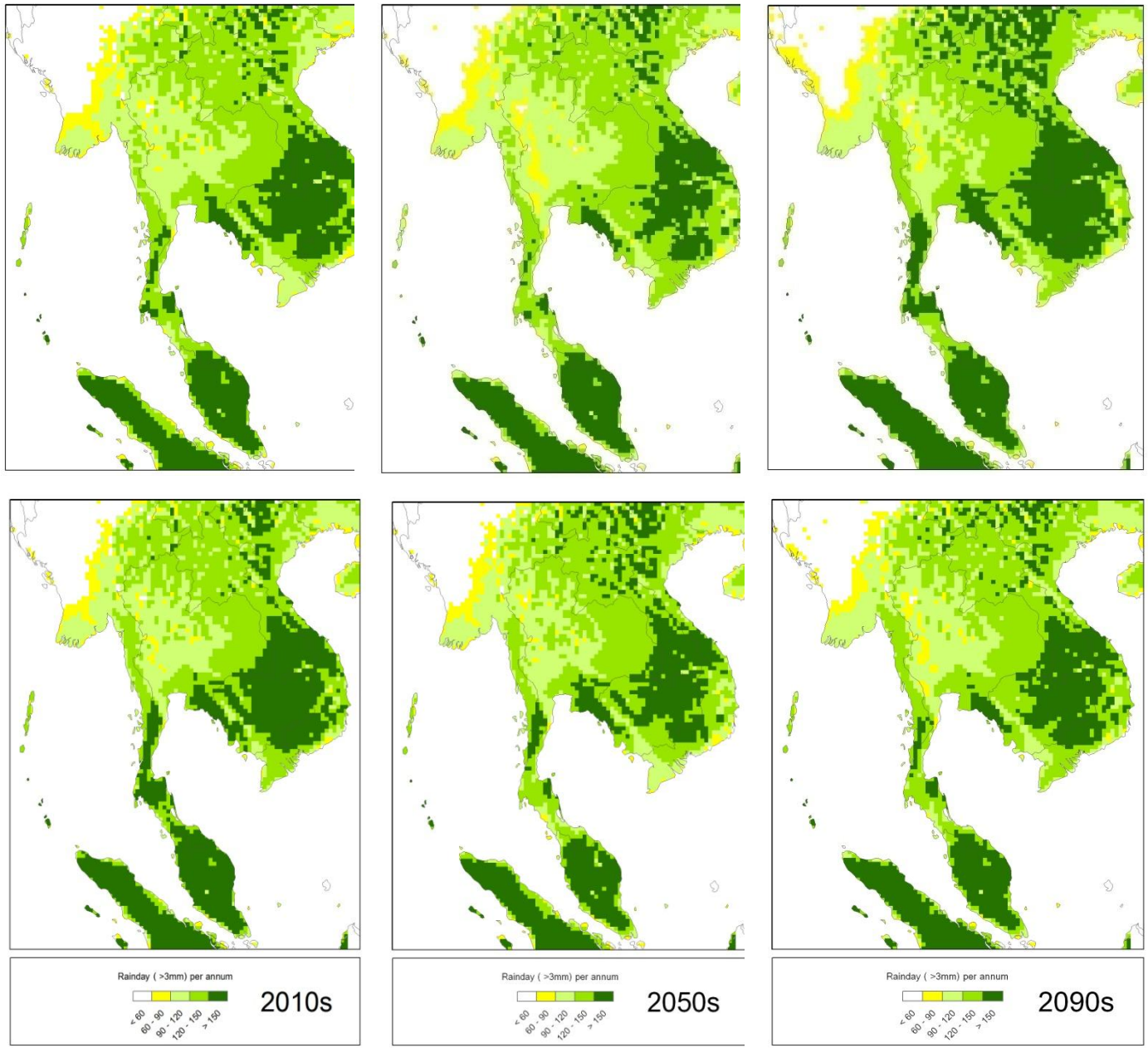
BUT: Equal or fewer rainy days!

Rain Days (>3mm)

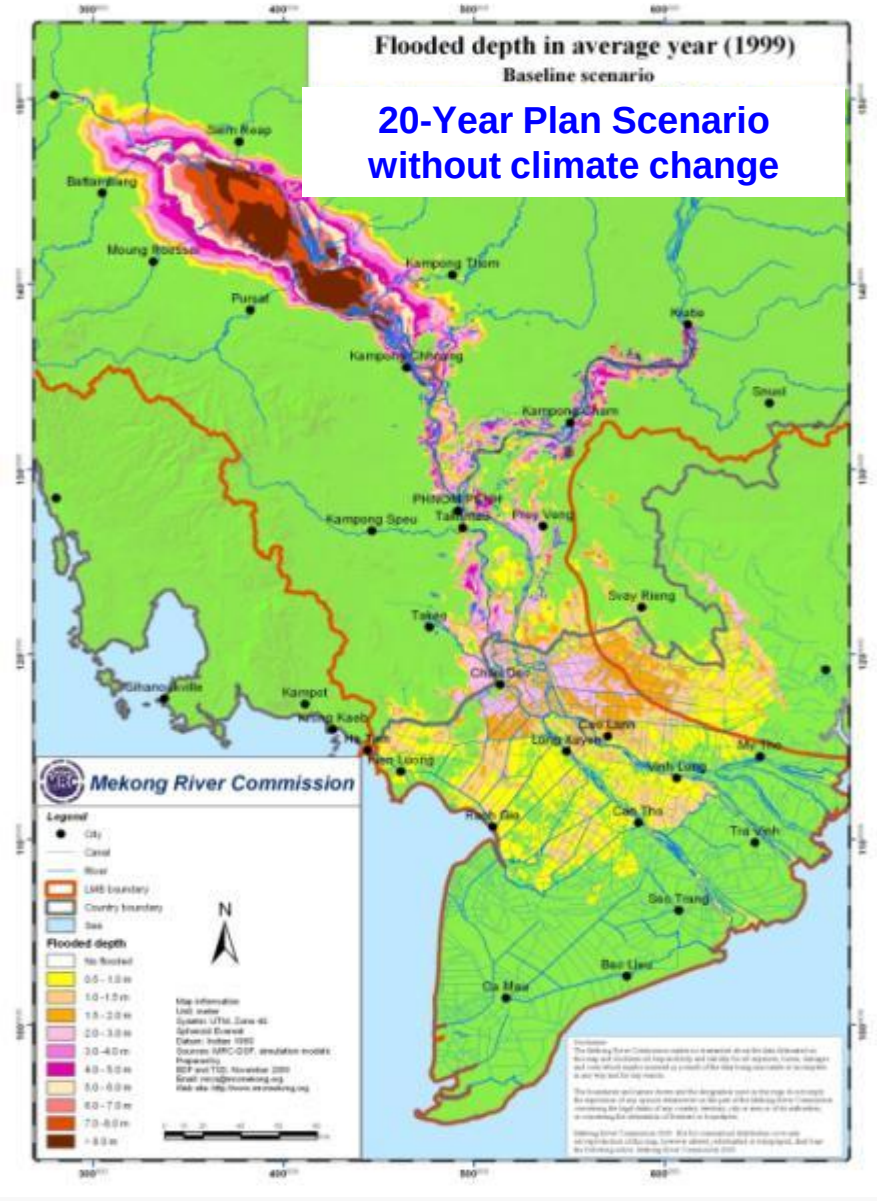


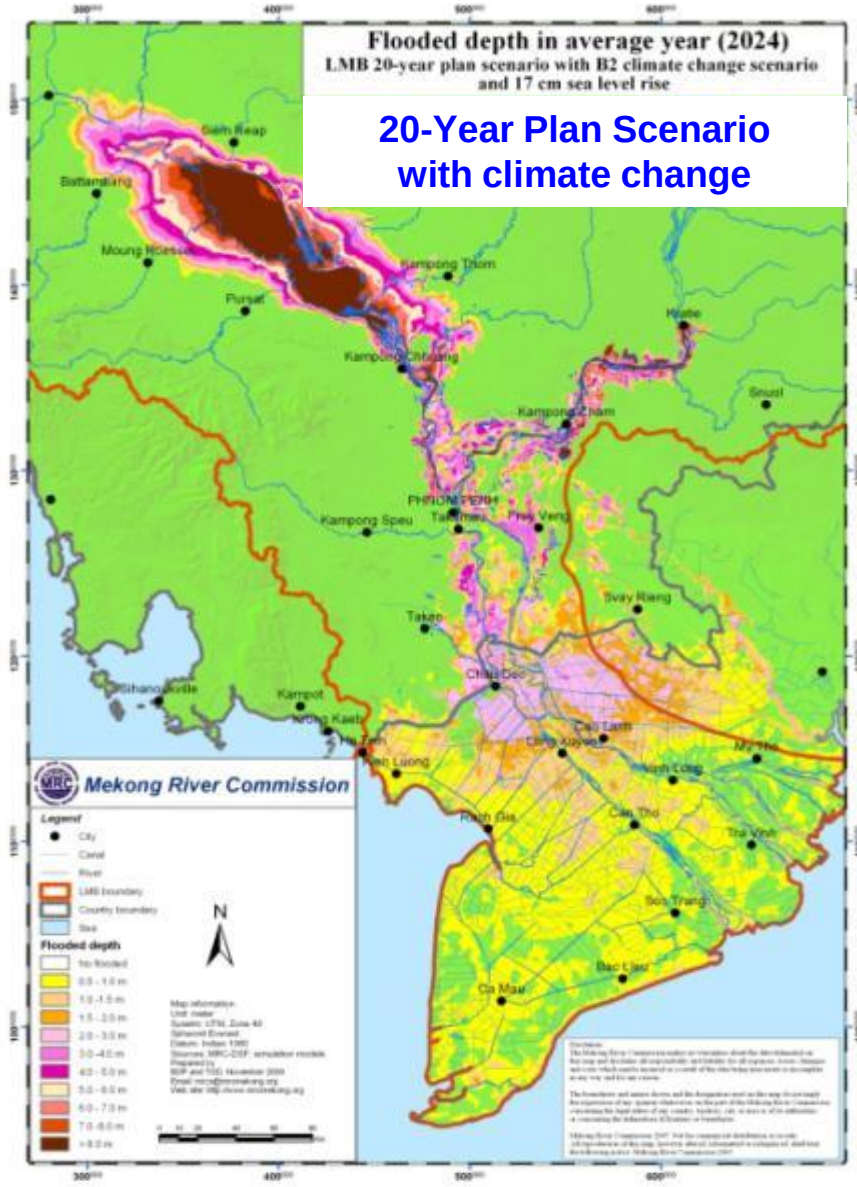
A2 Scenario ►

B2 Scenario ►



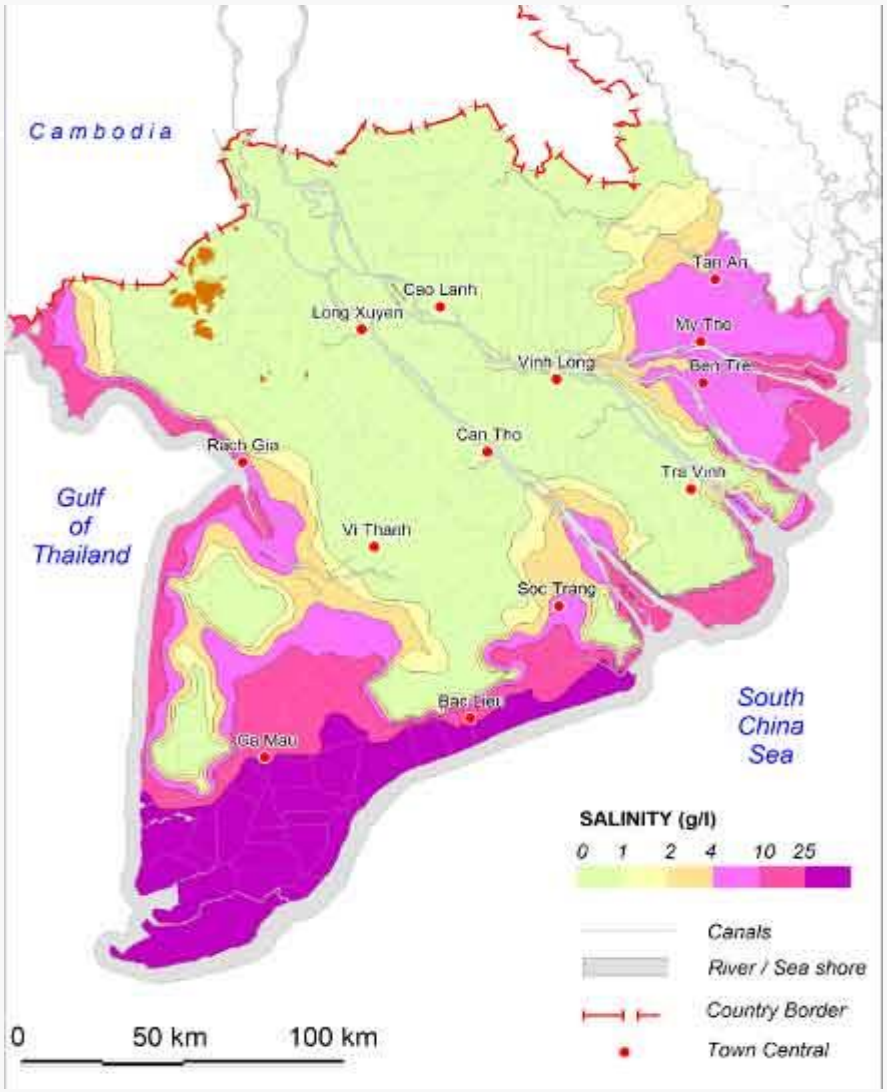
Flooding patterns



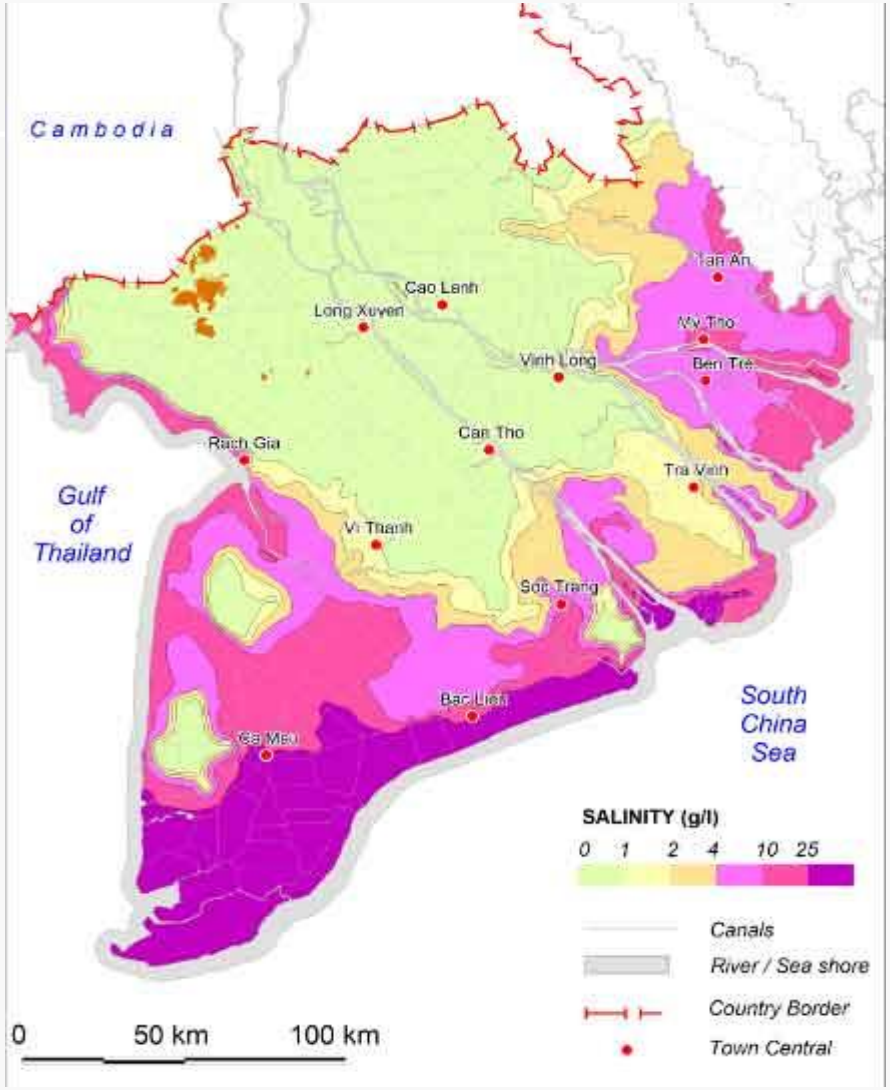


Climate Change impacts on flooded areas In the lower Mekong basin (MRC, 2010)

Soil & groundwater salinity



50 cm sea level rise



100 cm sea level rise

Tropical Storms

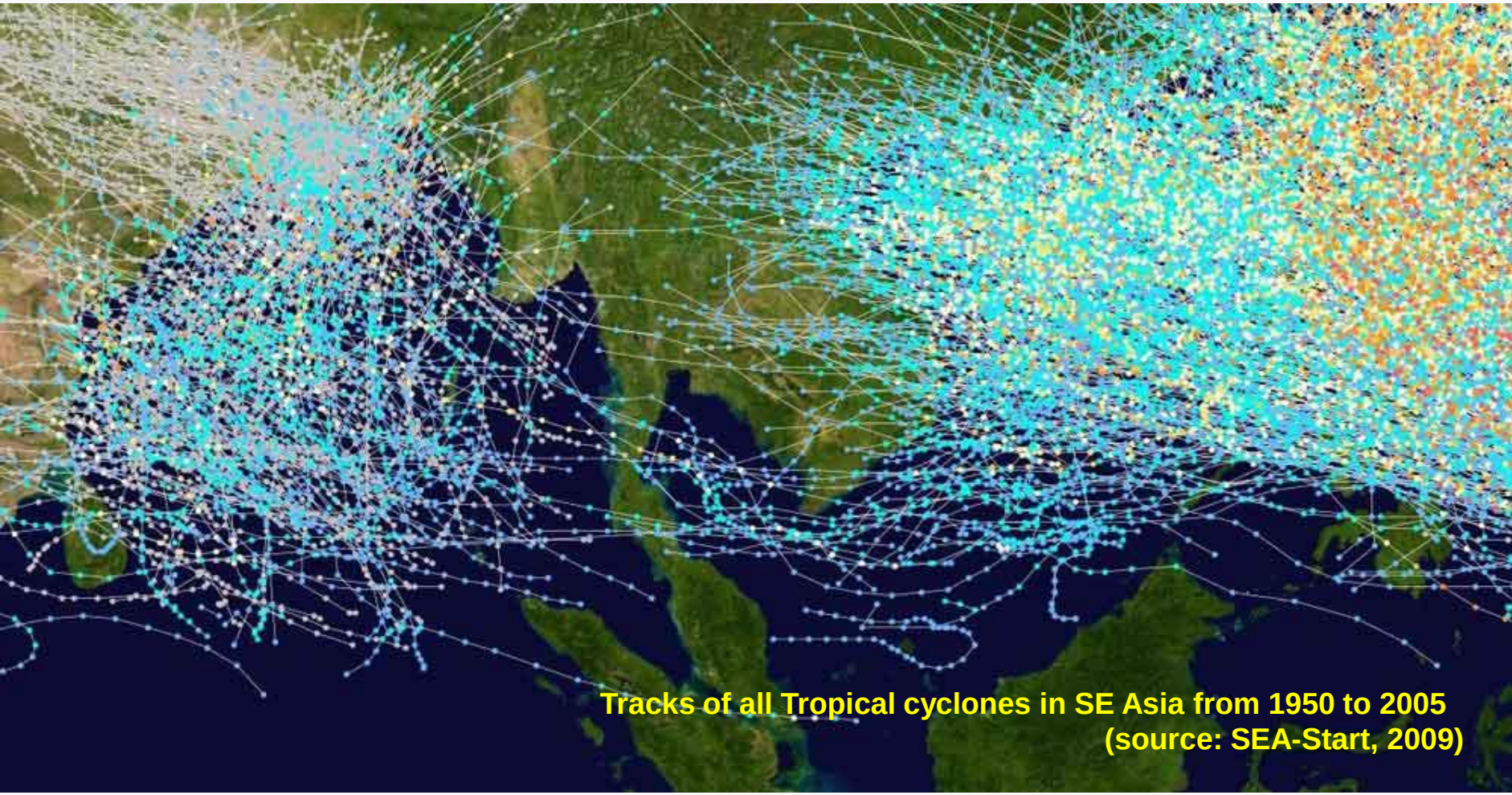
Pathway of tropical storm 'Ketsana' September 2009

Damage	Total
People dead	92
People missing	19
People injured	199
Houses collapsed	6376
Houses flooded	173611
Schools damaged	503

Revised Death toll:

Lao 16, Vietnam 163, Cambodia 17

- **Possible increases in tropical cyclone intensity and wind-related damages**
- **Storm surge heights amplified by stronger winds (+sea-level rise)**

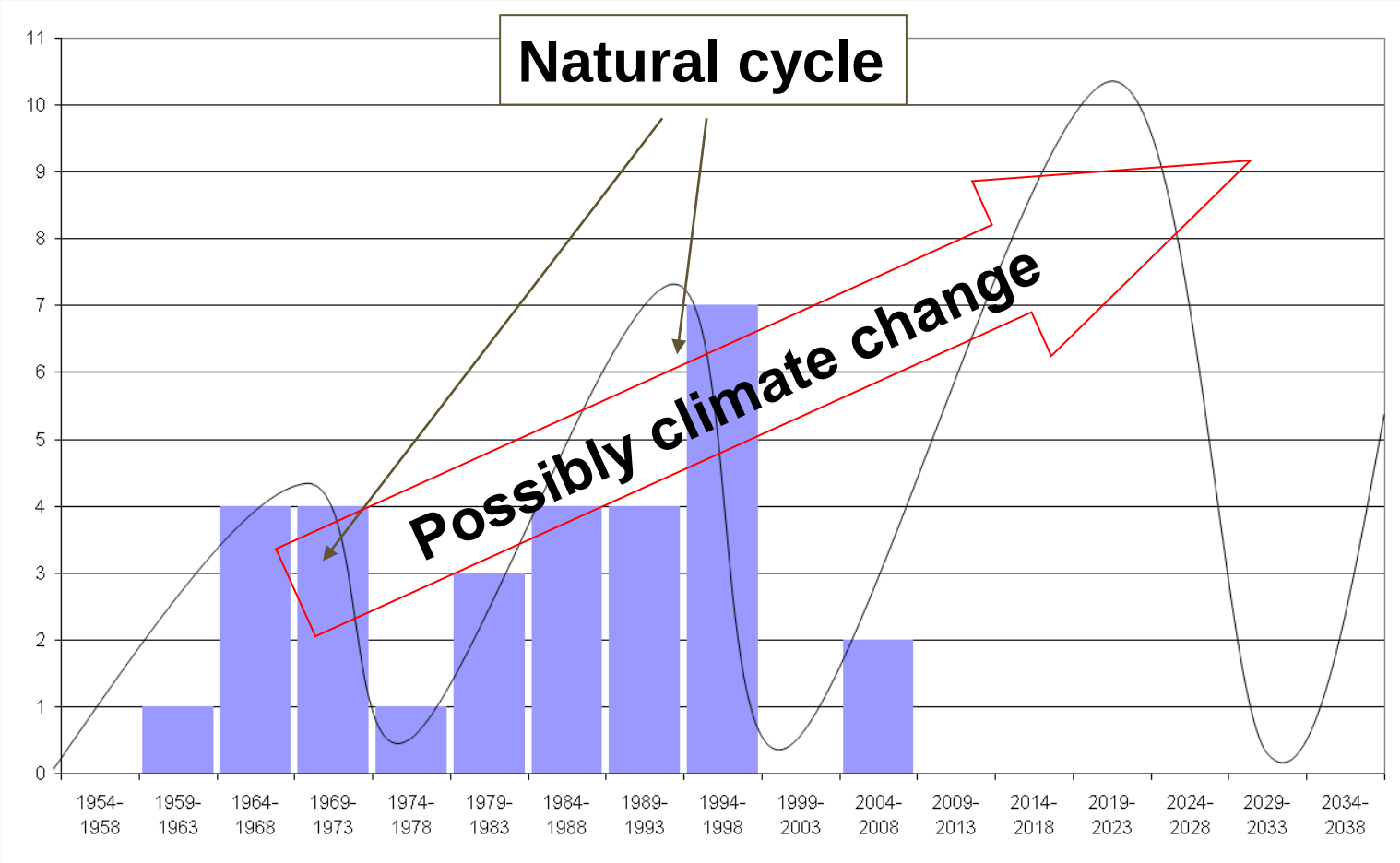


- **Possible shift in tropical cyclone tracks**

Trends of typhoon-class storms in South Vietnam

(Khanh Hua, Ninh Thuan, Binh Thuan, Ba Ria-Vung Tao, Ben Tre, Tra Vinh, and Minh Hai (Ca Mau)

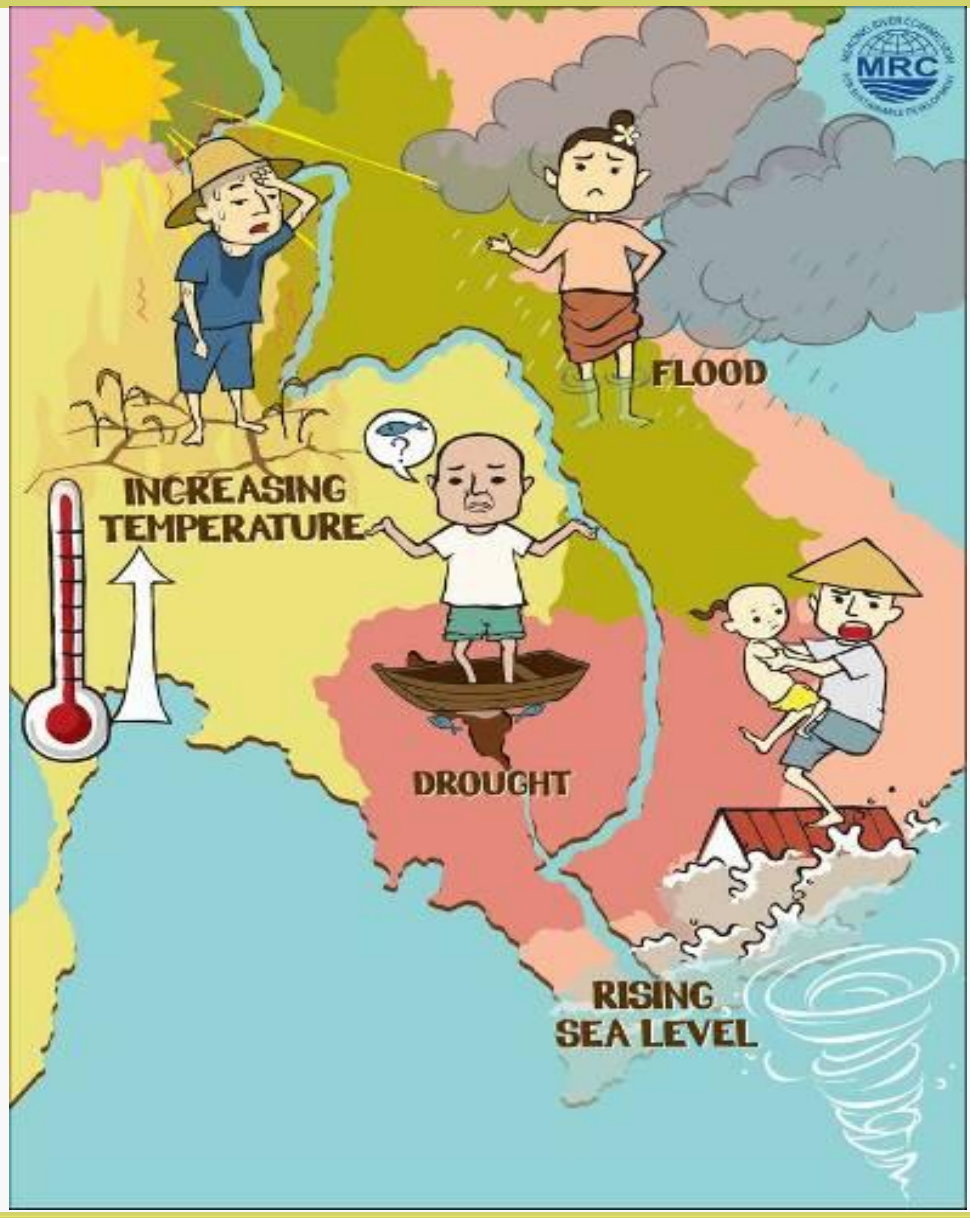
5-year sums

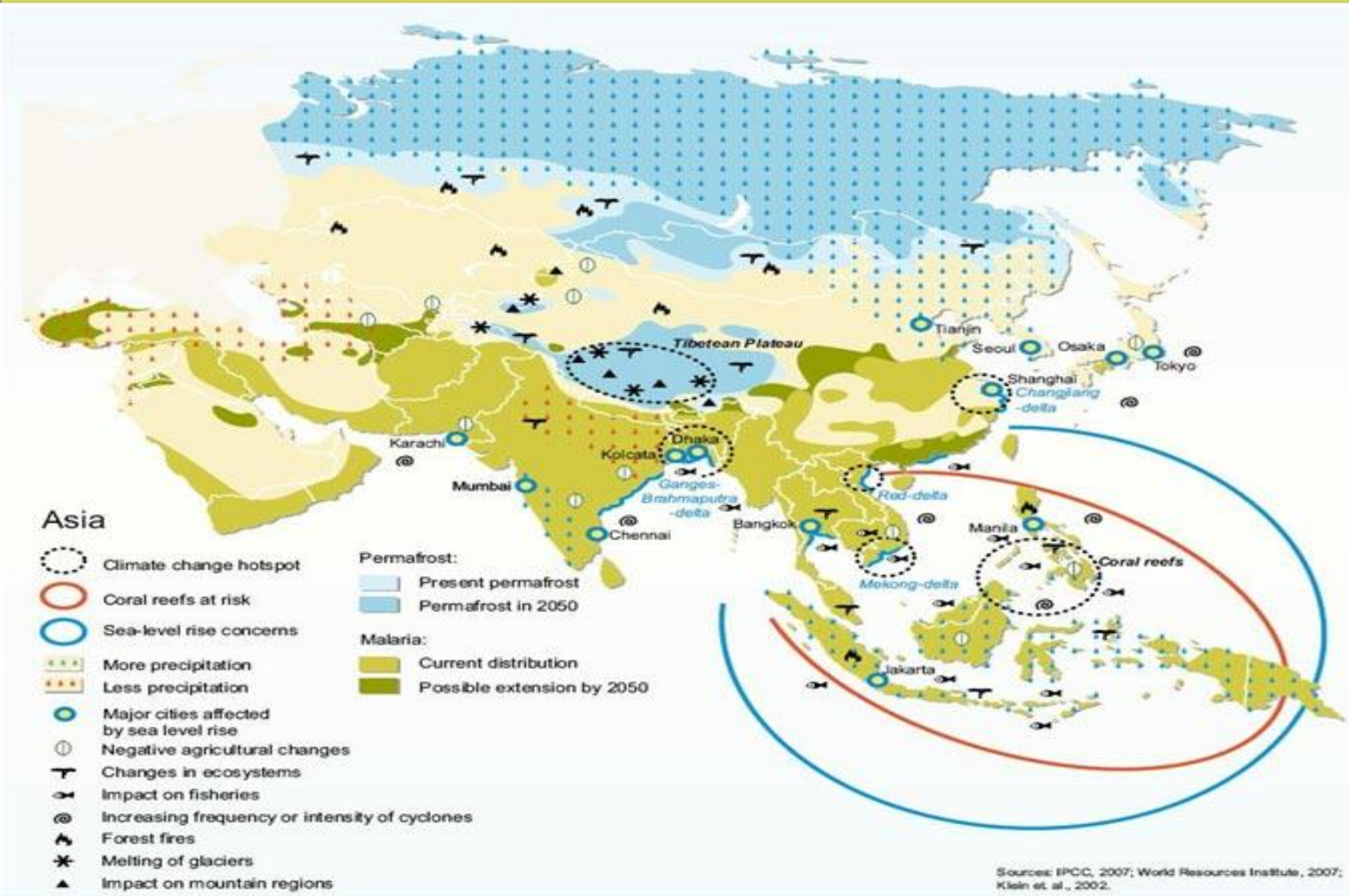


Source: SEA START, 2009

- Trend towards stronger storms

In summary…


MRC
FLOOD
INCREASING TEMPERATURE
DROUGHT
RISING SEA LEVEL


Asia
Climate change hotspot
Coral reefs at risk
Sea-level rise concerns
More precipitation
Less precipitation
Major cities affected by sea level rise
Negative agricultural changes
Changes in ecosystems
Impact on fisheries
Increasing frequency or intensity of cyclones
Forest fires
Melting of glaciers
Impact on mountain regions
Permafrost:
Present permafrost
Permafrost in 2050
Malaria:
Current distribution
Possible extension by 2050
Tibetean Plateau
Tianjin
Seoul
Osaka
Tokyo
Shanghai
Changjiang -delta
Karachi
Dhaka
Kolcata
Mumbai
Ganges-Brahmaputra -delta
Red-delta
Bangkok
Chennai
Manila
Coral reefs
Mekong-delta
Jakarta
Sources: IPCC, 2007; World Resources Institute, 2007; Klein et. al., 2002.

3. Risk, Hazards, and Vulnerabilities

How do climate change impacts affect people's security and livelihoods?

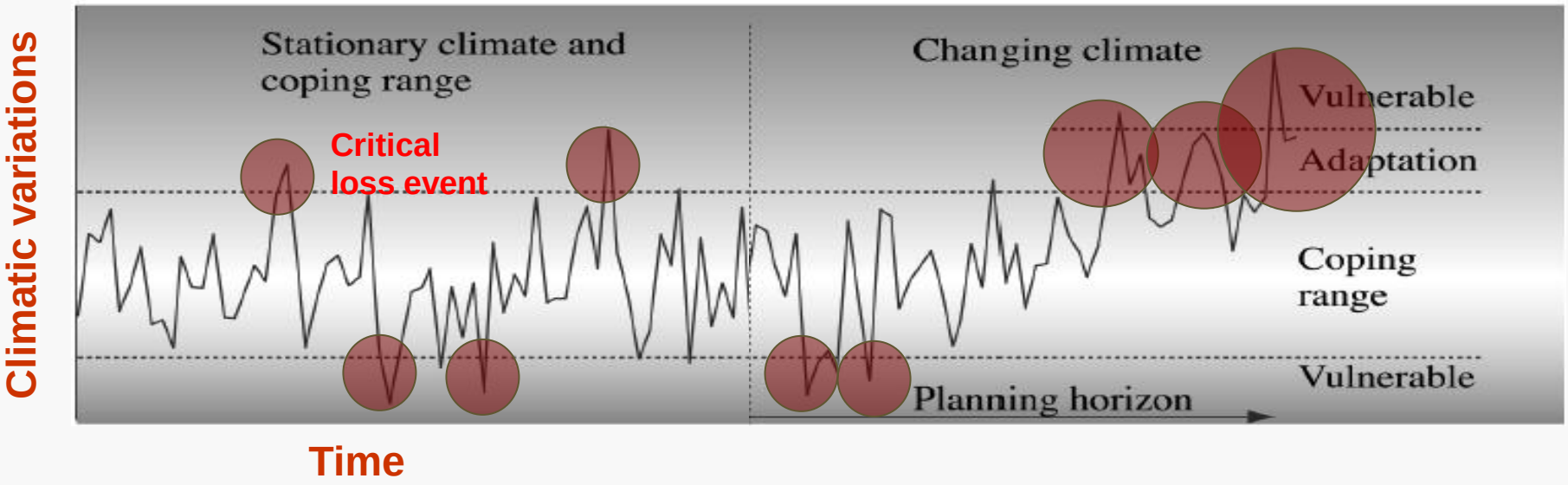
DEFINITIONS: 'RISK', 'HAZARD', 'VULNERABILITY'

- **RISK** is the **probability of harmful consequences**, or expected losses (e.g. deaths, injuries, property, economic activity disrupted or environment damaged) resulting from interactions between hazards and vulnerable conditions.

- **HAZARDS** are natural or man-made **processes or phenomena** that may result in a damaging event. They can be amplified by human activities, such as e.g. environmental degradation, urbanisation, and global warming.

- **VULNERABILITY** is a condition resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a particular hazard (= **the degree of expected damage** from a hazard)

How do people's vulnerabilities evolve in a changing climate?



Which factors can increase or decrease the vulnerability of livelihoods?

Human Capital:

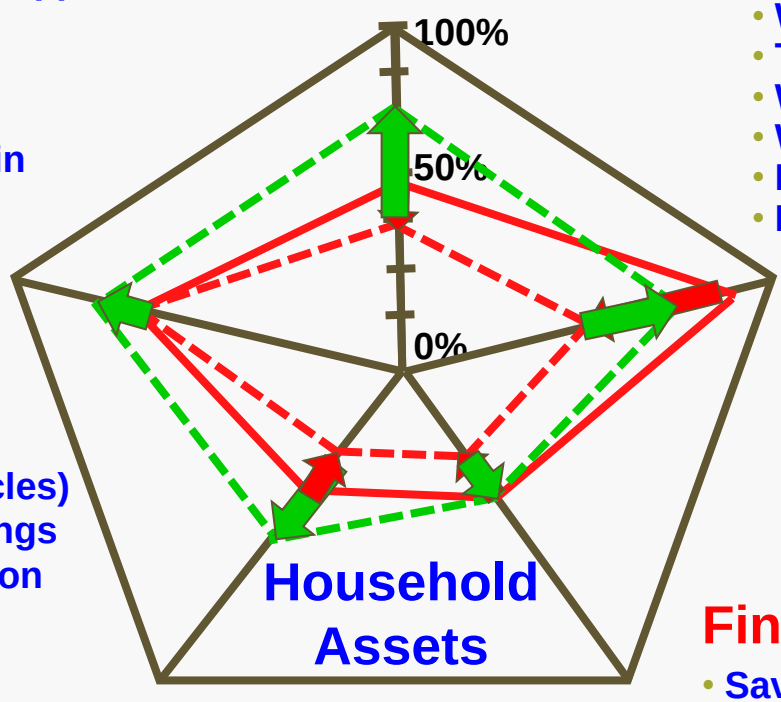
- Health
- Nutrition
- Education
- Knowledge and skills
- Capacity to work and adapt

Social Capital:

- Networks and connections (patronage, kinship, neighbourhoods)
- Relations of trust and mutual support
- Formal and informal groups
- Common rules and sanctions
- Collective representation
- Mechanisms for participation in decision-making
- Leadership

Natural Capital:

- Land and produce
- Water & aquatic resources
- Trees and forest products
- Wildlife
- Wild foods & fibres
- Biodiversity
- Environmental services



Physical Capital:

- Infrastructure
  - transport (roads, vehicles)
  - secure shelter & buildings
  - water supply & sanitation
  - energy
  - communications
- Tools and techology
  - tools and equipment for production
  - seed, fertiliser, pesticides
  - traditional technology

Financial Capital:

- Savings
- Credit/debt (formal, informal)
- Remittances
- Pensions
- Wages

How can we analyze vulnerability?

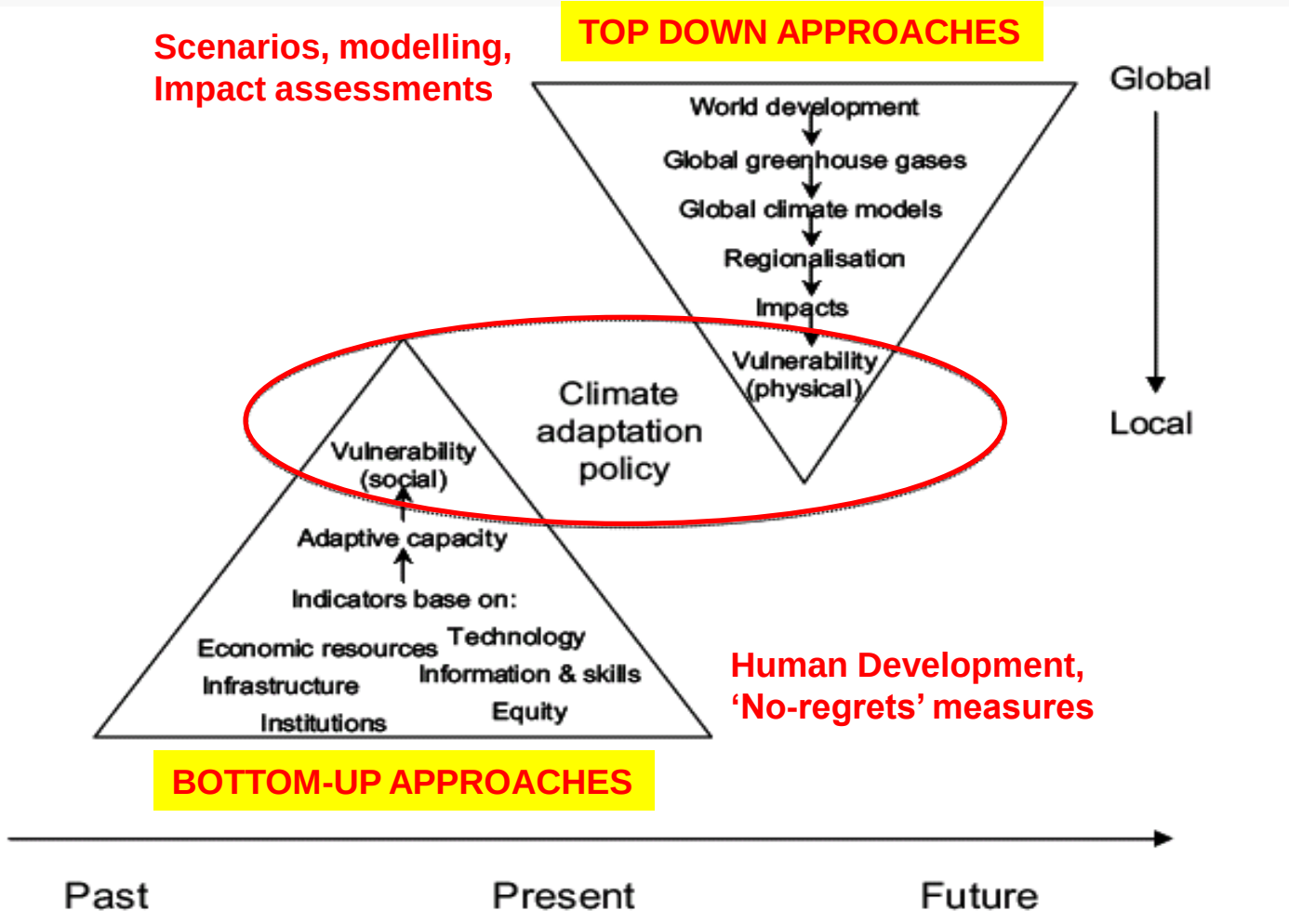
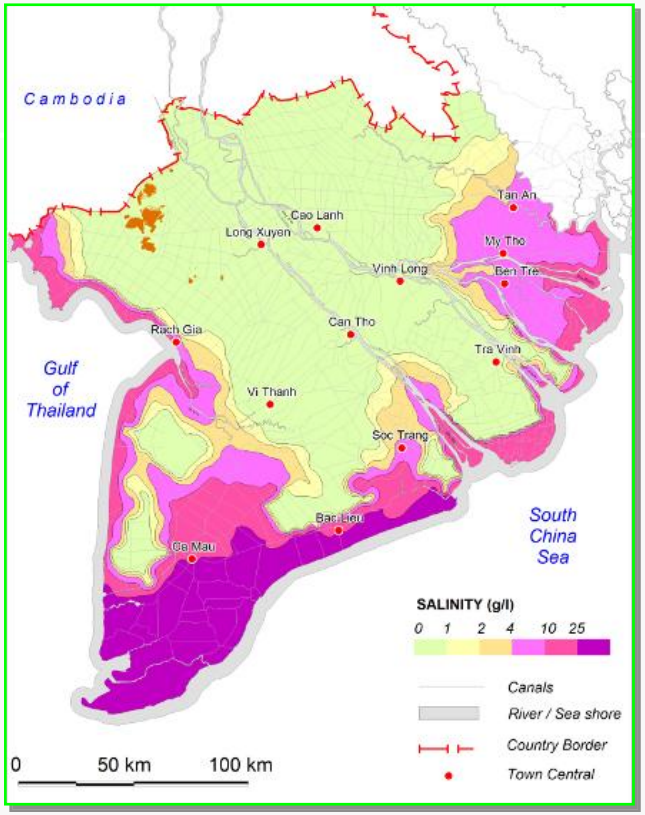
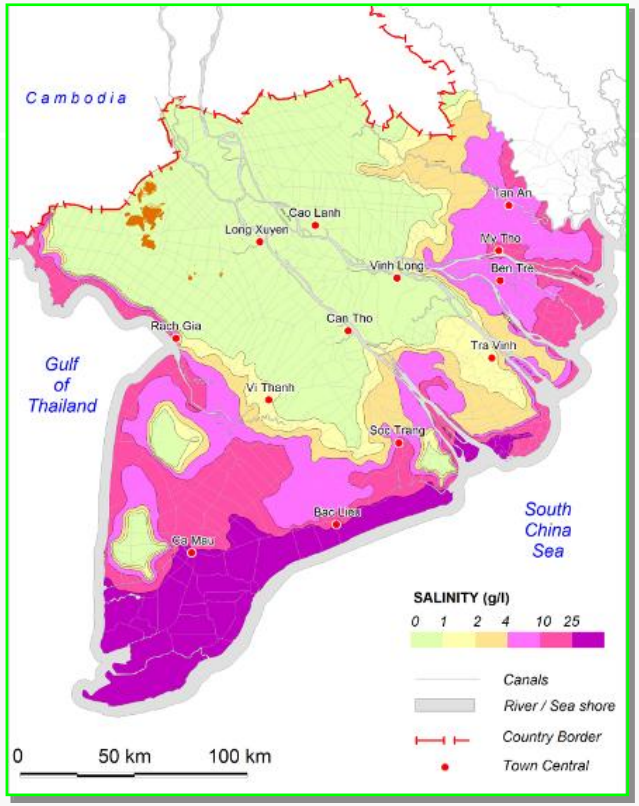


Figure 3.1. "Top-down" and "bottom-up" approaches used to inform adaptation to climate change (from Dessai and Hulme 2004).

TOP DOWN ANALYSIS



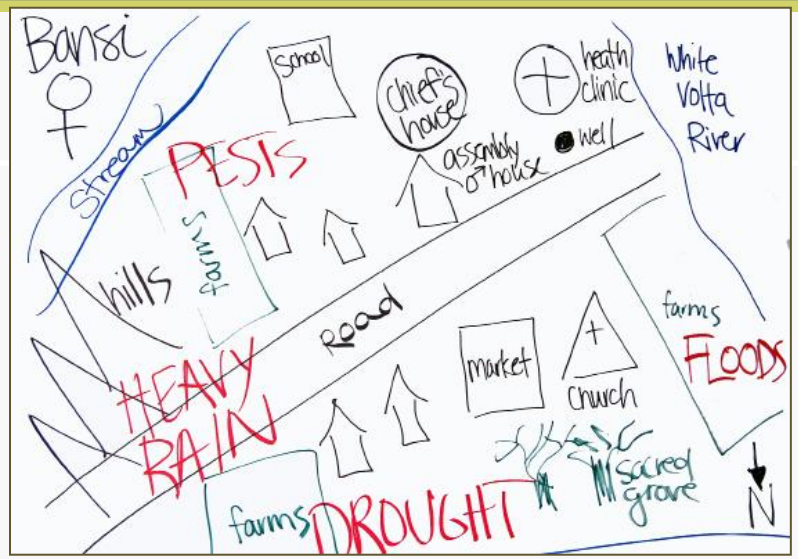
50 cm sea level rise



100 cm sea level rise

- **Understanding how hazards are evolving**
- **Understanding trends in the extent, distribution and productivity of natural resources**
- **Understanding hazard exposure**

BOTTOM UP ANALYSIS



Bansi ♀ ♂	human disease	animal disease	drought	floods	erratic rain
animals	2	3	3	3	1
food reserves	3	3	2	3	3
well-fed ♀ + children	3	3	3	2	2
Kids going to school (clothes, shoes)	3	2	2	3	1
♀ engaged in income gen	3	2	1	2	2

Communal Climate Risk Assessment (CARE, 2009)

- **Understanding people's vulnerability context**
- **Understanding which livelihood assets are at risk**
- **Understanding which adaptation measures are already being used and which ones work**
- **Understanding how vulnerability can be reduced**

IN SUMMARY:

- Autonomous efforts of farmers to cope with the change will not be sufficient. The changes people experience are too big, and they are happening too quickly

- Climate Change is not an isolated risk. It acts as a 'threat multiplier', increasing a large number of threats to the livelihood assets of farmers

- Understanding people's vulnerabilities should be the starting point for adaptation planning

Thank you!