



Water at the heart of climate change

Global Centre for Adaptation- Water Adaptation Community Webinar

31st May, 2022

Dr. Aditi Mukherji IWMI

We are already in a 1.1 degree world & everyone has felt the impacts

Observed warming to date has been driven by greenhouse gas emissions, roughly a third of which has been masked by cooling from aerosol emissions

Contributions to global surface temperature increase based on two lines of evidence (panel a and b)





greenhouse gases changes





Four reasons why water is at heart of climate change

CC has affected all components of water cycle, including waterextremes All sectors of the economy and society has already felt these water impacts, some more than the others

Water is at heart of adaptation – people are adapting to either water related hazards, or using water to adapt (or both) Water is also implicated in mitigation – most mitigation (and carbon dioxide removal CDR) have water implications

Climate change has affected all components of water cycle, and all water use sectors in all regions, most societal/sectoral impacts are negative

Regional synthesis of assessed changes in water and consequent impacts



(a) Regional changes and impacts of selected variables

Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

Changes in global surface temperature relative to 1850-1900

a) Change in global surface temperature (decadal average) as monistructed (1-2000) and observed (1850-2020)



b) Change in global surface temperature (annual average) as observed and simulated using human & natural and only natural factors (both 1850-2020).



Hot extremes are increasing in almost all regions



a) Synthesis of assessment of observed change in **hot extremes** and confidence in human contribution to the observed changes in the world's regions

North GIC Europe America NWN NEN NEU RAR Asia WNA CNA ENA WCE | EEU **WSB** ESB RFE NCA **WCA ECA** MED TIB EAS Small Islands SAH CAR ARP SEA **SCA** SAS Central ... PAC America .. NSA WAF CAF NEAF NWS NAU 0 Small WSAF SEAF SAM NES Islands MDG CAU EAU SWS SES ESAF South Africa SAU America NZ Australasia ... SSA 0 Type of observed change since the 1950s

(IPCC AR6, Fig. SPM.3)

Type of observed change in hot extremes

Increase (41) Decrease (0) Low agreement in the type of change (2) Limited data and/or literature (2)

Confidence in human contribution

to the observed change

- ••• High
- •• Medium
- Low due to limited agreement
- Low due to limited evidence

Observed changes in heavy precipitation since 1950s



WGI SPM

Observed changes in droughts since 1950s



Projected changes in extremes are larger in frequency and intensity with every additional increment of global warming



Extreme precipitation over land: 10-year event

Frequency and intensity of an extreme precipitation event that occurred once in 10 years on average in a climate without human influence



Frequency and intensity of a drought event that occurred once in 10 years on average across drying regions in a climate without human influence





WGI SPM

Approximately 4 billion experience severe water scarcity for at least one month per year due to climatic and non-climatic factors (*medium confidence*)



Water scarcity: ratio of water demand to water supply

Severe water scarcity: water demand exceeds supply (ie: water scarcity is greater than 100%)



WGII Chapter 4

Water is central to adaptation ~60% of all adaptation is occurring in response to water related hazards

Water-related hazards and adaptations in response Water-related adaptation responses	Drough	Precipitatior variability and extremes	Heat related	Inland and riverine floods	Soil erosior and sedimer load change	n Ground- nt water availability e change	Poor water quality	Cryo- sphere change	Storms	Pests	Coastal hazards	General climate impacts	Other hazards	
Improved cultivars and agronomic practices Changes in cropping pattern and crop systems On farm irrigation and water management Water and soil moisture conservation Collective action, policies, institutions Migration and off-farm diversification Economic or financial incentives Training and capacity building Agro-forestry and forestry interventions Flood risk reduction measures Livestock and fishery-related							e e e e e e e e e e e e e e e e e e e							 Meta review of 1891 articles 359 articles on water-related adaptation that measures outcomes
Indigenous knowledge & local knowledge based adaptations Urban water management Energy related adaptations Water, sanitation and hygiene (WASH) related adaptations Any other (includes coping)	•••••	•	• • • Con	• • • fidence evidence	• • na • Low	• • • • • Medium	• na • • High	• na na	• na • na	na na •	na na na assessed	or no da	na na na ta	 Water related adaptation Water as hazard Water as response

WGII Chapter 4



Water for a food-secure world



Water related adaptation is happening in every sector, and particularly in agriculture as agriculture is the largest consumptive water use sector

Quantity of evidence on current water-related adaptation responses



WGII Chapter 4



Water for a food-secure world



Documented cases of water related adaptation is happening in all regions, and more so in Africa and Asia where there is high dependence on climate exposed livelihoods like agriculture



Observed water-related adaptation responses that measure outcomes

- Most water adaptations in Global South is in agriculture
- Most water adaptation in
 Global North is in urban sector

WGII Chapter 4



Water for a food-secure world



Observed water-related adaptation responses with positive outcomes

(a) Map depicting 319 case studies of current water related adaptation responses with documented beneficial outcomes of adaptation



(b) Fraction of top six adaptation responses to total responses

Adaptation response categories (n = number of case studies)

Improved cultivars and agronomic practices (n=128) Changes in cropping pattern and crop systems (n=133) Migration and off-farm diversification (n=84) Water and soil moisture conservation (n=100) On-farm irrigation and water management (n=109) Collective action, policies, institutions (n=88) Indigenous knowledge & local knowledge based adaptations (n=39) Economic/financial incentives (n=49) Agro-forestry and forestry interventions (n=53) Urban water management (n=19) Flood risk reduction measures (n=31) Livestock and fishery related (n=59) Training and capacity building (n=55) Remaining categories



Top six response categories per region as fraction of total responses

In the Global South, benefits of adaptation are economic and livelihoods related 12 responses

In the Global North, benefits of adaptation also includes better outcomes for theenvironment

(c) Beneficial outcomes of adaptation per region across five dimensions. Innerlines correspond to the top six adaptation response categories from previous panel.



WGII Chapter 4

Adaptation becomes less effective with more warming

- Water-related adaptation is most effective up to 1.5°C and effectiveness decreases with increasing warming
- Residual impacts remain, especially at higher levels of warming

WGII Chapter 4

Water-related adaptation responses

Improved cultivars & agronomic practices Changes in cropping pattern & crop systems On farm irrigation & water management Water & soil moisture conservation Collective action, policies, institutions Migration & off-farm diversification Economic or financial incentives Training & capacity building Agro-forestry & forestry interventions Livestock & fishery-related Indigenous knowledge & local knowledge based adaptations Water, sanitation & hygiene (WASH) related adaptations Multiple agricultural options

Strength of evidence / effectiveness / residual risk

High Medium Low

Incon- not observed or clusive insufficient evidence



Future

Assessment under different levels of global warming (+°C)





Water for a food-secure world



Many Mitigation (reducing emissions) and Carbon Dioxide Removals (CDR) approaches and technologies can have large trade-offs with water and food security

"Many mitigation measures (including CDR approaches and technologies) have considerable water footprint (*high confidence*), which must be managed in socially and politically acceptable ways to reduce the water intensity of mitigation while increasing synergies with sustainable development (*medium evidence, high agreement*)" WGII Chapter 4

Examples include:

- Afforestation and reforestation
- Bio-energy crops





Water for a food-secure world



International Water Management Institute



Thank you