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Metrics for assessing adaptation, risk and resilience

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Adaptation Metrics for Agriculture, Water and Resilient Cities

Mohammed VI University, Benguerir, Morocco

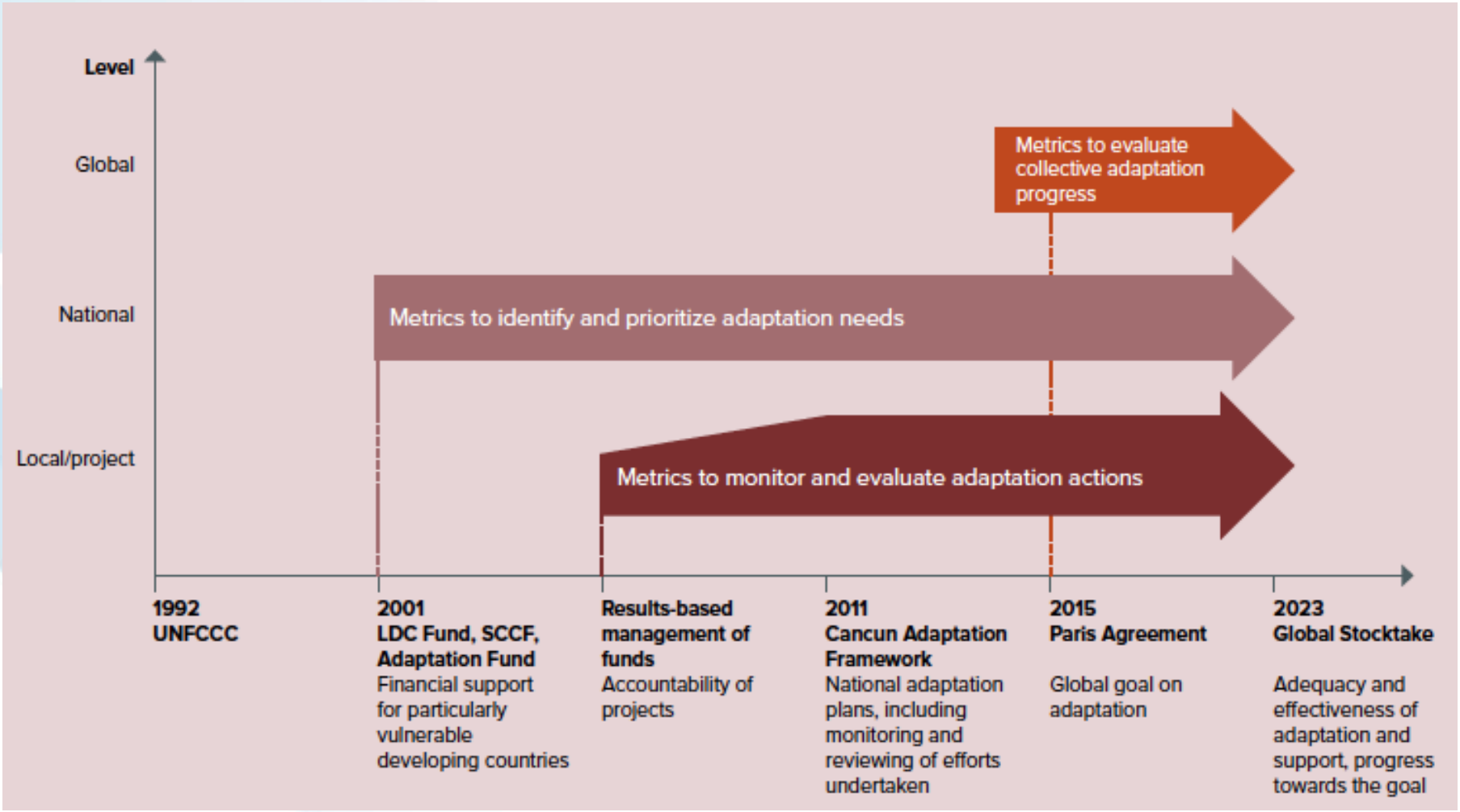
Adaptation metrics: what to measure?

- **Identifying need for adaptation: Vulnerability**
  Identify and compare **state** and needs: most vulnerable

- **Measuring and tracking inputs, output and process of implementing adaptive actions:**
  Input: e.g., spending on flood protection,
  Output: e.g., the number of early warning plans implemented,
  Process: running an inclusive risk management process

- **Measuring the effectiveness of adaptation - monitoring and evaluation: outcome**
  Measure progress and provide feedback on the effectiveness of actions, e.g. flood risk

Demand for adaptation metrics



Moehner, 2018

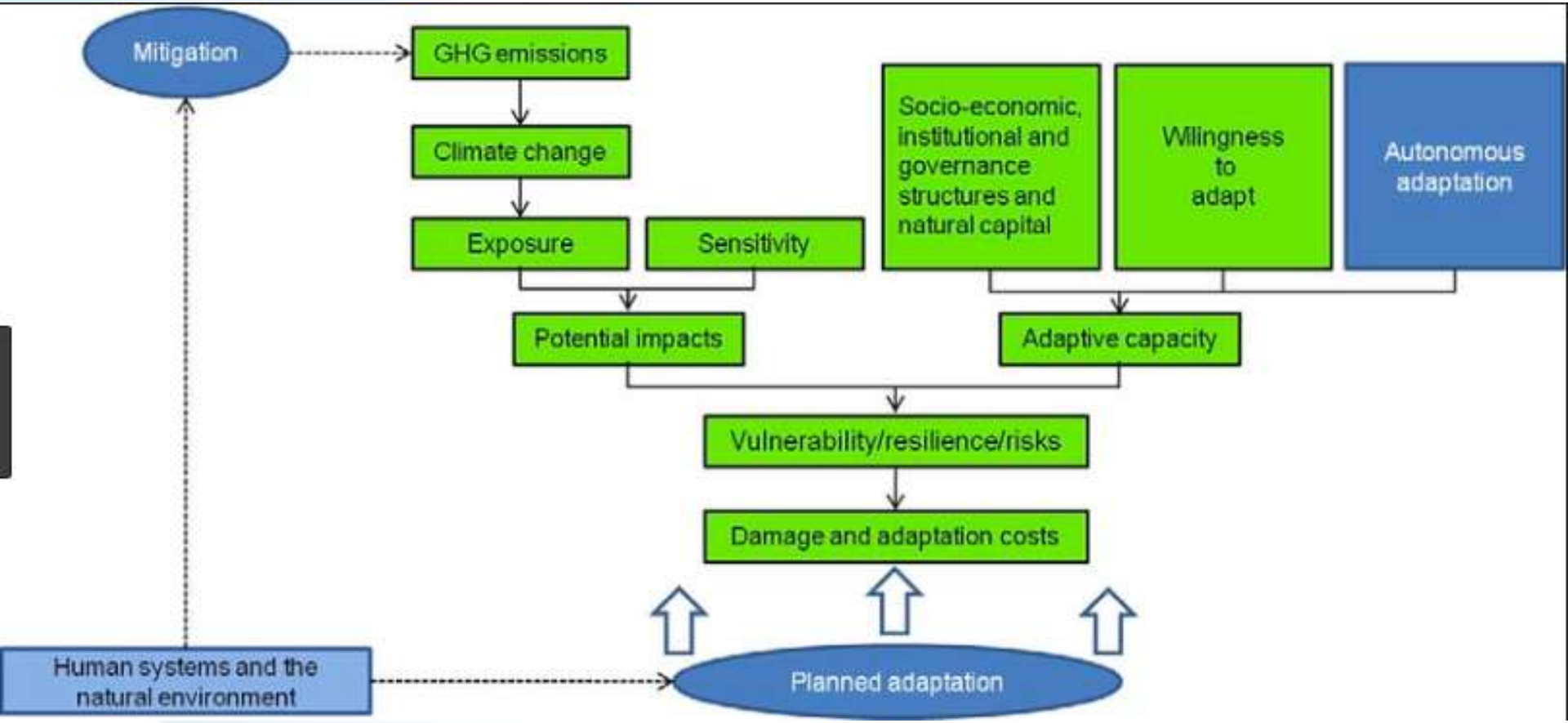
Uptake in NDCs

Table 2. Examples of quantitative targets and goals included in the adaptation component of the communicated intended nationally determined contributions (UNFCCC, 2016c p. 68).

Sector/area	National example
Water	• Ensure full access to drinking water by 2025 • Increase water storage capacity from 596 m^3 to 3,997 m^3 in 2015–2030 • Increase desalination capacity by 50% from 2015 by 2025
Agriculture	• Convert 1 million ha of grain fields into fruit plantations to protect against erosion • Increase the amount of irrigated land to 3.14 million ha • Reduce post-harvest crop losses to 1% through treatment and storage
Ecosystems and biodiversity	• Protect 20% of marine environments by 2020 • Regenerate 40% of degraded forests and rangelands • Establish 150,000 ha of protected marine areas
Forestry	• Increase forest coverage to 20% by 2025 • Maintain 27% forest coverage • Achieve 0% deforestation rate by 2030
Disaster risk reduction	• Ensure that all buildings are prepared for extreme events by 2030 • Reduce the number of the most vulnerable municipalities by at least 50% • Relocate 30,000 households
Energy	• Ensure that hydropower generation remains at the same level regardless of climate change impacts • Increase the proportion of renewable energy to 79–81% by 2030
Other	• Ensure that 100% of the national territory is covered by climate change adaptation plans by 2030 • Reduce moderate poverty to 13.4% by 2030 and eradicate extreme poverty by 2025

Moehner, 2018

1. Assessing climate vulnerability



EEA 2011

Assessing climate vulnerability for water resources

Table 2 Indicators used to represent *Global Impact Factors* for the CVI value for Mongolia

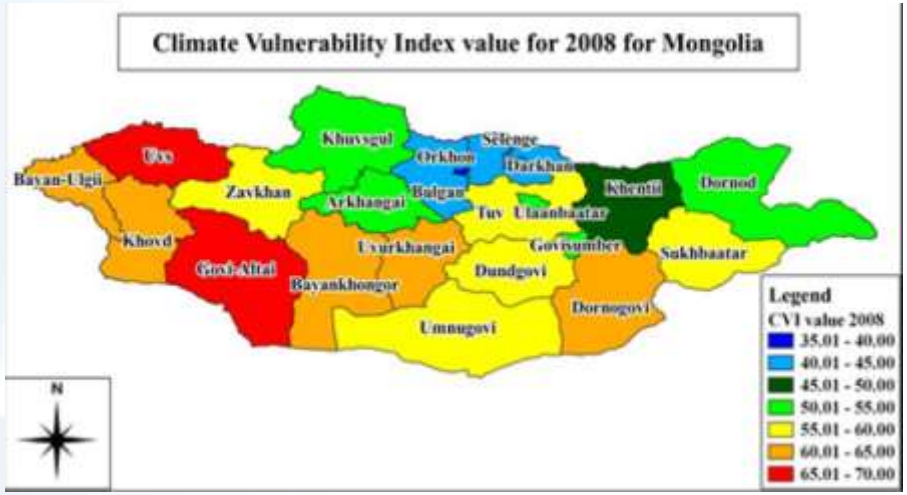
Global Impact Factors (GIFs)	Data used for each indicator	Source data
Geospatial variability (G)	• Isolation from the capital city (food sources) • Human population density • Range in altitude (slope)	• Dist from capital, Mong Rd Atlas 2004 • Statistical yearbook 2008 • Topog Map NASA SRTM 90m DEM data
Resource quantification (R)	• Ave annual precip (mm) * • Total water res per capita (M^3) *	• Statistical yearbook 2008 • Water census 2007, MNET /HDR, 2011
Accessibility and property rights (A)	• Useable water resource per capita (cubic metre) * • Domestic water use (litre per day) *	• Water census 2007, MNET cited in Mongolia HDR, 2011 • Stats yearbook 2008, Basandorj (2011)
Capacity of people and institutions (C)	• Under 5 mortality rate (per 1000 live births) • Tot sch children as % of school age cohort * • GDP per capita (1000 togrogs) *	• The MDGs Implementation, 2009 • National Statistical office, 2008 • Statistical yearbook 2008
Utilisation and econ efficiency (U)	• Econ return on ag water use (togrog) * • Econ return on ind water use (togrog) * • Econ return on mun water use (togrog) *	• Statistical yearbook 2008 • Statistical yearbook 2008 • Statistical yearbook 2008
Ecological integrity maintenance (E)	• Forest area (hectare) * • Pasture-damaged land (in percentages) • Livestock density • Road network (km)	• FAO (2007),Darkhan gov • MNET, 09 Mong HDR, 2011 • National Stats office, 2008 • Mongolian Road Atlas, 2004

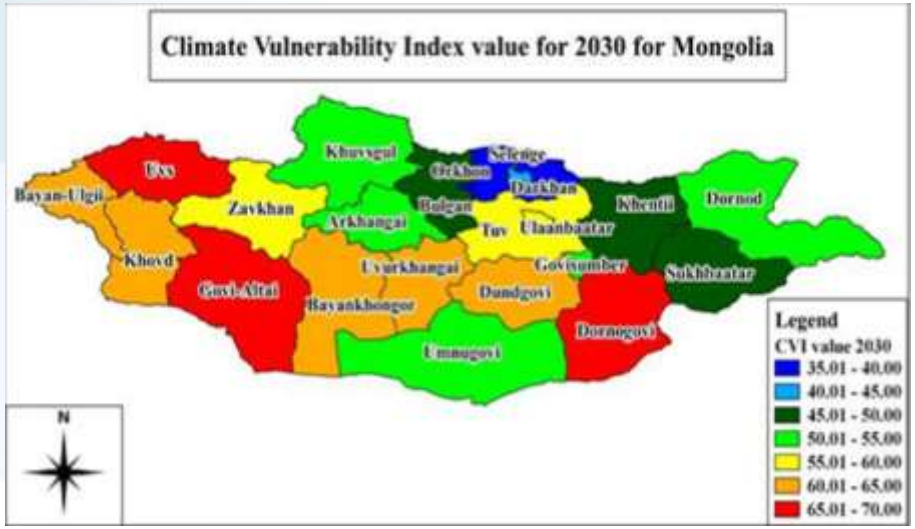
Note: Indicators marked with * must be inverted to reflect negative impacts. For example, high rainfall will reduce water vulnerability by increasing water resources and availability, but the high livestock density will increase vulnerability. This means the score for rainfall must be inverted to reflect its impact on the overall CVI score, since high CVI means high vulnerability.

Source: Byambaa, 2012

Sullivan and Byambaa, 2013

Measuring needs
Vulnerability assessment



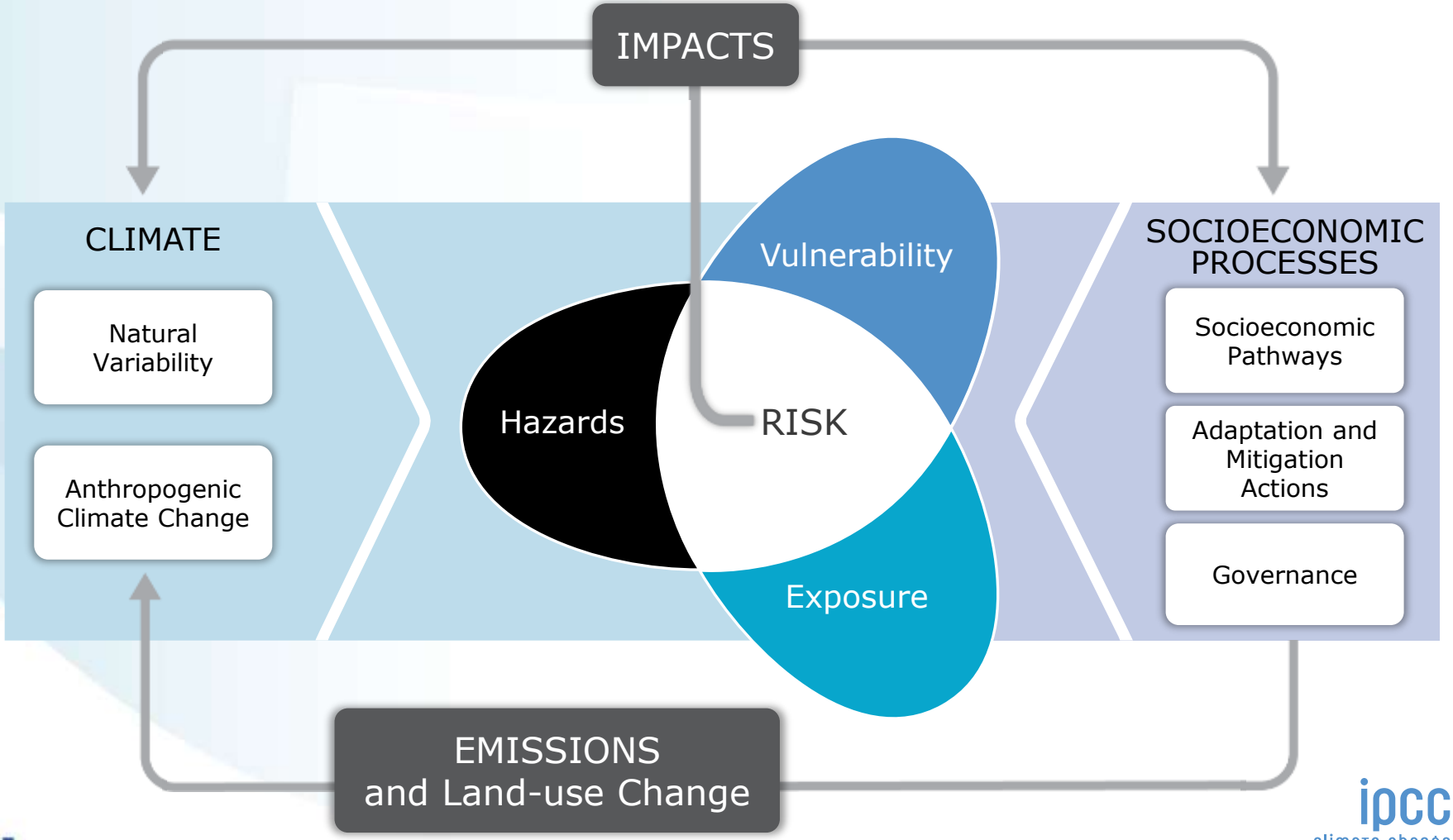


Sullivan and Byambaa, 2013

Status

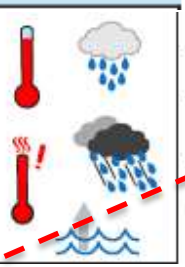
- Focussed on need, rather than outcome and impact
- Construction of V Index not straightforward
- Comparisons across regions and countries difficult

2. IPCC's Climate risk concept



IPCC AR5 climate risk management approach: outcome

Africa

Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future, with drought stress exacerbated in drought-prone regions of Africa (*high confidence*) [22.3-4]	• Reducing non-climate stressors on water resources • Strengthening institutional capacities for demand management, groundwater assessment, integrated water-wastewater planning, and integrated land and water governance • Sustainable urban development		Present Near term (2030 – 2040) Long term (2080 – 2100) 2°C 4°C	Very low – Medium – Very high

Risk:
Potential impacts

Scope for risk management

Adaptation infeasible:
Limits

IPCC AR5 climate risk management approach: outcome

Africa

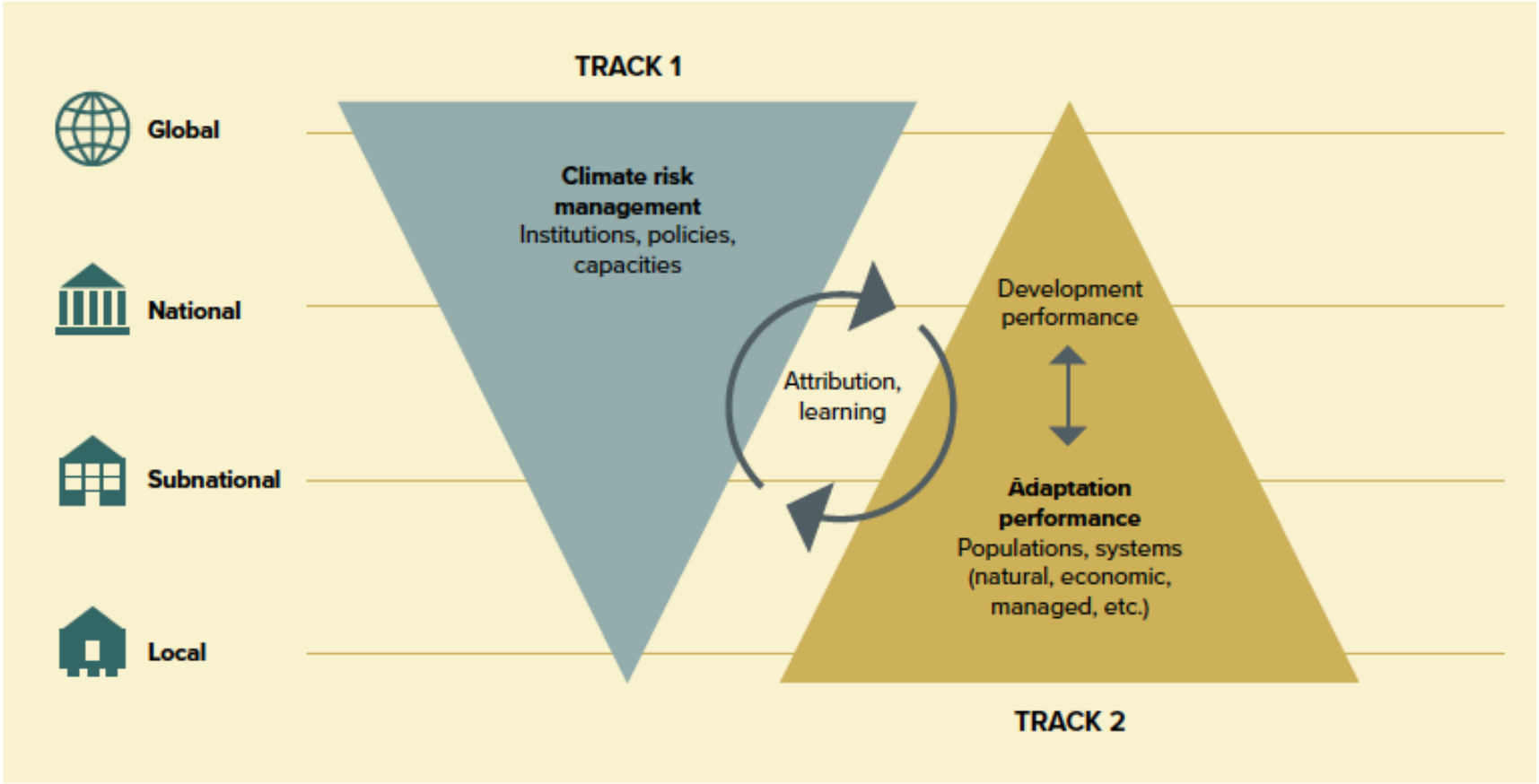
Key risk	Adaptation issues & prospects	Climatic drivers	Timeframe	Risk & potential for adaptation
Reduced crop productivity associated with heat and drought stress, with strong adverse effects on regional, national, and household livelihood and food security, also given increased pest and disease damage and flood impacts on food system infrastructure (*high confidence*) [22.3-4]	• Technological adaptation responses (e.g., stress-tolerant crop varieties, irrigation, enhanced observation systems) • Enhancing smallholder access to credit and other critical production resources; Diversifying livelihoods • Strengthening institutions at local, national, and regional levels to support agriculture (including early warning systems) and gender-oriented policy • Agronomic adaptation responses (e.g., agroforestry, conservation agriculture)		Present Near term (2030 – 2040) Long term (2080 – 2100) 2°C 4°C	Very low · Medium · Very high

Adaptation infeasible: Limits

Status

- Currently expert-based at regional scales
- Impact and risk analysis not yet brought together with scope for adaptation/risk management
- Tracing scope for risk management over time?
- Climate risk attribution difficult

3. Mixed approach: Process + output Learning across scales



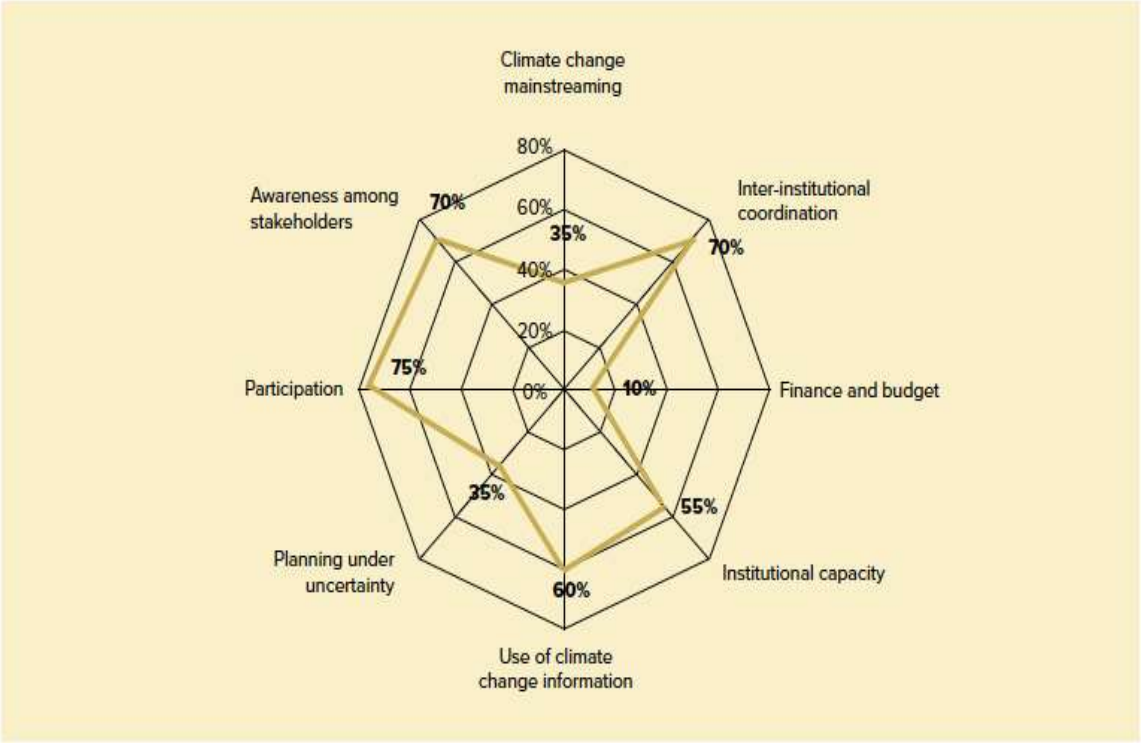
Tracking Adaptation Measuring Development (TAMD) framework

Brooks and Fisher, 2014

Process + output
Learning across scales

Institutional scorecard analysis

Figure 3. District of Guijá: institutional scorecard results (Artur et al., 2014, p. 33)



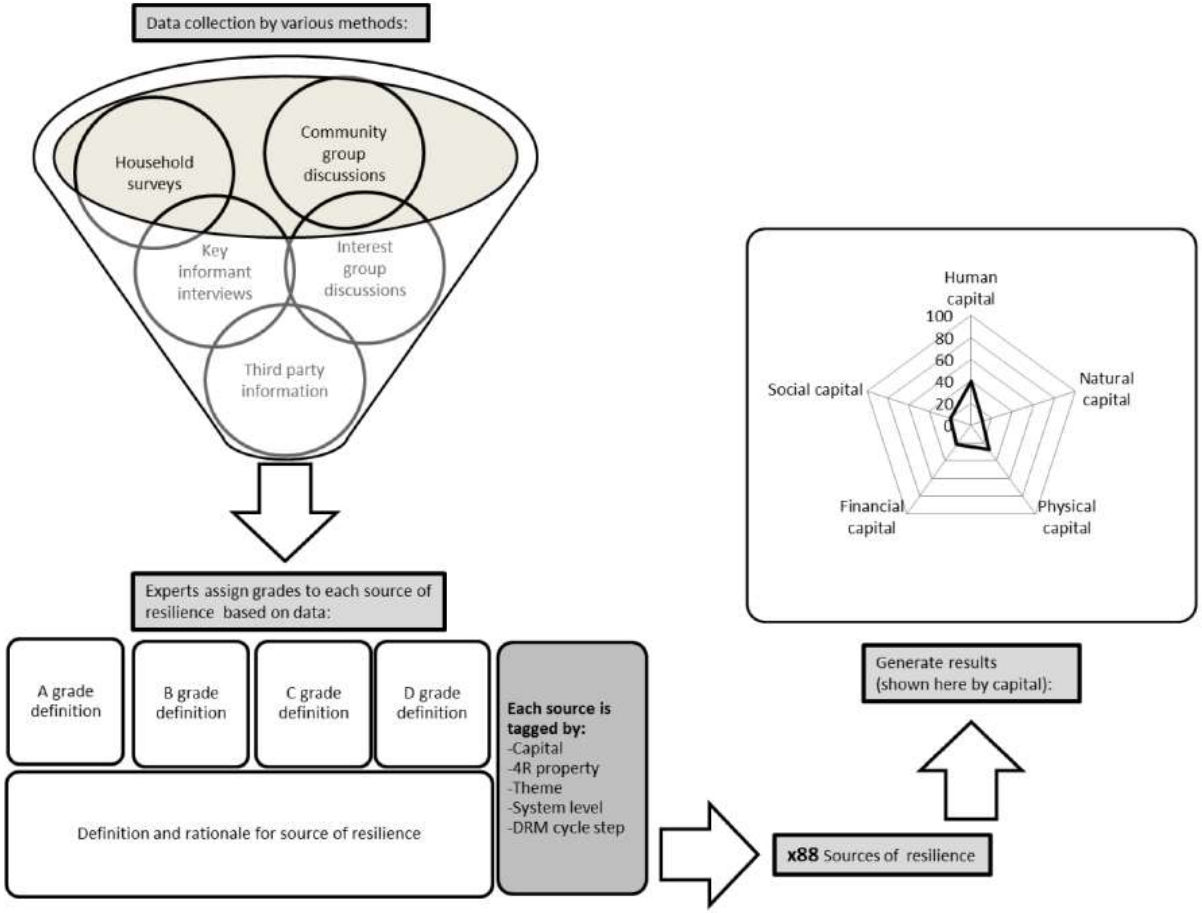
Source: Governo de Guijá (2014)

Table 1. Dimensions of climate risk management

Dimensions of climate risk management
Integration of climate into planning
Institutional coordination for integration
Budgeting and finance for climate integration
Institutional knowledge and capacity
Use of climate information
Planning under uncertainty using appropriate methodologies
Participation of relevant stakeholders in national planning
Awareness among stakeholders

Fisher and Anderson, 2018

Measuring capacity: The Flood Resilience Measurement Tool (Flood Resilience Alliance)



A: Best practice

B: Good standard, no immediate need for improvement

C: Deficiencies, room for visible improvement

D: Significantly below good standard, potential for imminent loss

Keating et al., 2017

Understanding Resilience
44 Sources evaluated with mixed methods approach

Household survey

Community discussion

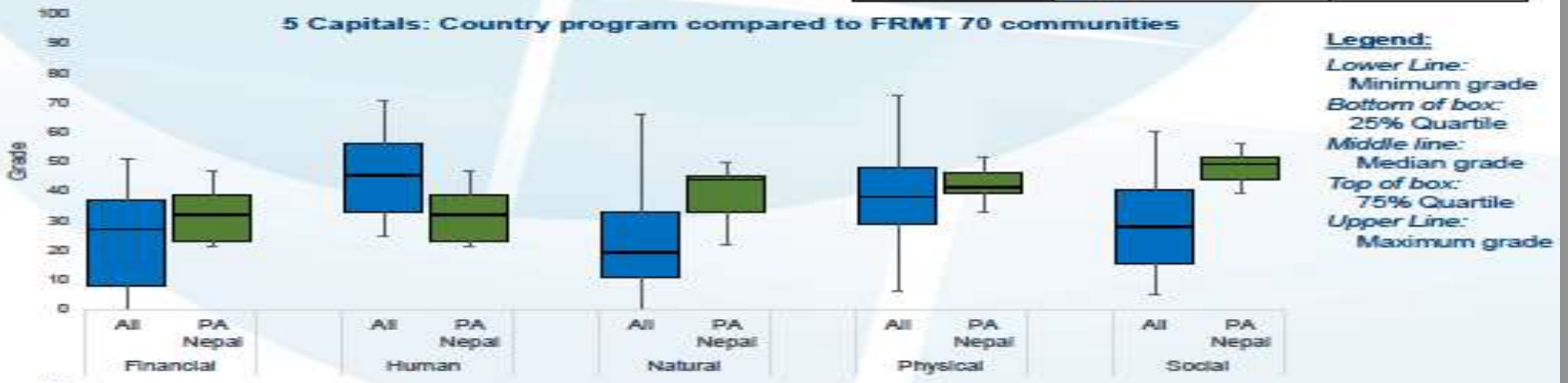
Key informant

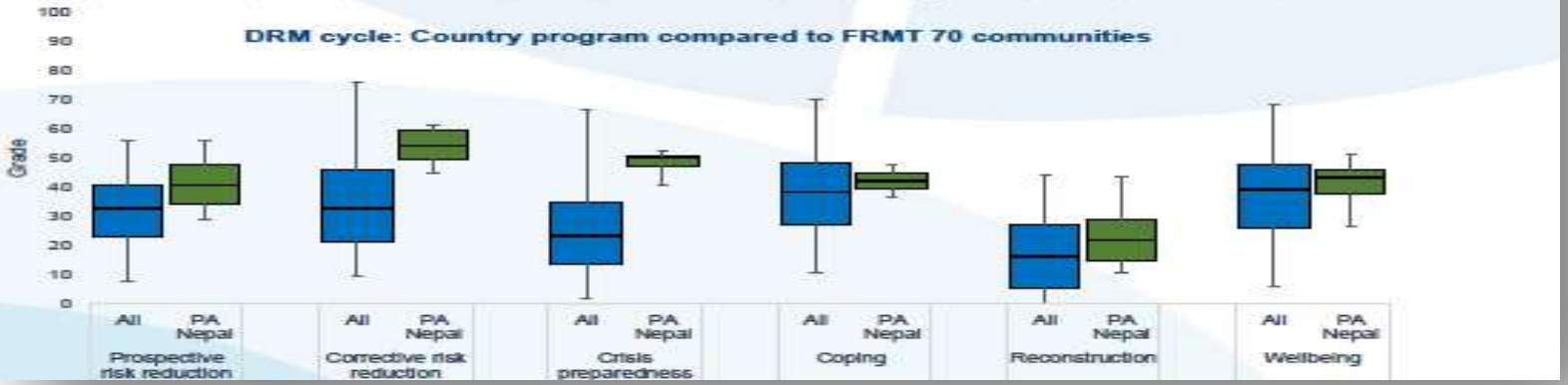
3rd party source

									3rd party source Question	3rd party source Allowed Answers
Communal social safety net	Does the local government have money available to help those harmed by flood emergencies?	emergencies 2 - The local government has a fund for flood emergencies but it is not set aside (funding is uncertain) 3 - The local government has no flood emergency fund 4 - I don't know	Does t… govern… money … those h… emerg…	flood emergency fund 4 - I don't know	…the local …rnment have money …ible to help those …d by flood …gencies?	has a fund for flood emergencies but it is not set aside (funding is uncertain) 3 - The local government has no flood emergency fund	…have money available to help those harmed by flood emergencies?	…The local government …s a fund set aside for …ood emergencies - The local government has a fund for flood emergencies but it is not set aside (funding is uncertain) 3 - The local government has no flood emergency fund	Provide statistics on local social safety nets for flood emergencies.	Free form
	If a flood occurs, our household can get money or supplies from the local government (or community org)	1 - Yes 2 - No 3 - I don't know	If a flood occurs, the households can get money or supplies from the local government (or community org)	1 - Yes 2 - No 3 - I don't know	If a flood occurs, the households can get money or supplies from the local government (or community org)	1 - Yes 2 - No 3 - I don't know	If a flood occurs, the households can get money or supplies from the local government (or community org)	1 - Yes 2 - No 3 - I don't know		
	If a flood occurs, this community has a way to share resources to help those in need.	1 - Yes 2 - No 3 - I don't know	If a flood occurs, this community has a way to share resources to help those in need.	1 - Yes 2 - No 3 - I don't know	If a flood occurs, this community has a way to share resources to help those in need.	1 - Yes 2 - No 3 - I don't know	If a flood occurs, this community has a way to share resources to help those in need.	1 - Yes 2 - No 3 - I don't know		

Tracking progress

Number of communities	10
Community with the highest average grade	Sankatti-Patabhar, Bardiya
Settlement type	Rural
Most common type of flood	Flash Flood
Proportion of very poor and poor people	69 %
Rate of female headed household	31 %
Average number of children compared to national standard	Same number of children than average
High school completion rate	35 %
Proportion of ethnic or religious minority groups	74 %
Most frequent-most severe flood (last 10 years)	Catastrophic





Status

- Strongly process-driven
- Quantitative-qualitative
- Focus on output rather than outcome

Final comments

- Water system (resources, flooding) strongly affected by climate change-directly and indirectly
- Adaptation occurring, but not well observed
- Measuring adaptation complex: work on metrics in flux
- Process-orientation important
- Climate risk management perspective promising combining qualitative and quantitative aspects