



The DECCMA Scenario Framework: A Multi-Scale and Participatory Approach

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Summary

This work describes the overall scenario framework, methodology, and processes adopted for the development of scenarios in the DECCMA project across the multiple scales of interest (from local to global and short- to long-term) to explore the future migration and adaptation in three deltas in South Asia and West Africa: (i) the Ganges-Brahmaputra-Meghna (GBM) delta (Bangladesh/India), (ii) the Mahanadi delta (India), and (iii) the Volta delta (Ghana) (Fig. 1).

1. Introduction:

- Deltas are home for over 500 mill. people globally, & have been identified as some of the most vulnerable coastal environments (Nicholls et al. 2015; 2016).
- They are susceptible to multiple climatic (e.g., SLR, storm surges) and socio-economic (e.g., change in pop., GDP, subsidence) drivers, which operate at multiple scales (Fig. 2).
- They face long-term sustainability challenges, with threats on the well-being of people/health of ecosystems that support livelihood of large (often very poor) population.
- Holistic understanding is needed for devising robust policies under uncertain futures.
- Scenario analysis supports robust adaptation decision-making under uncertainty.
- This work presents the DECCMA scenario framework.

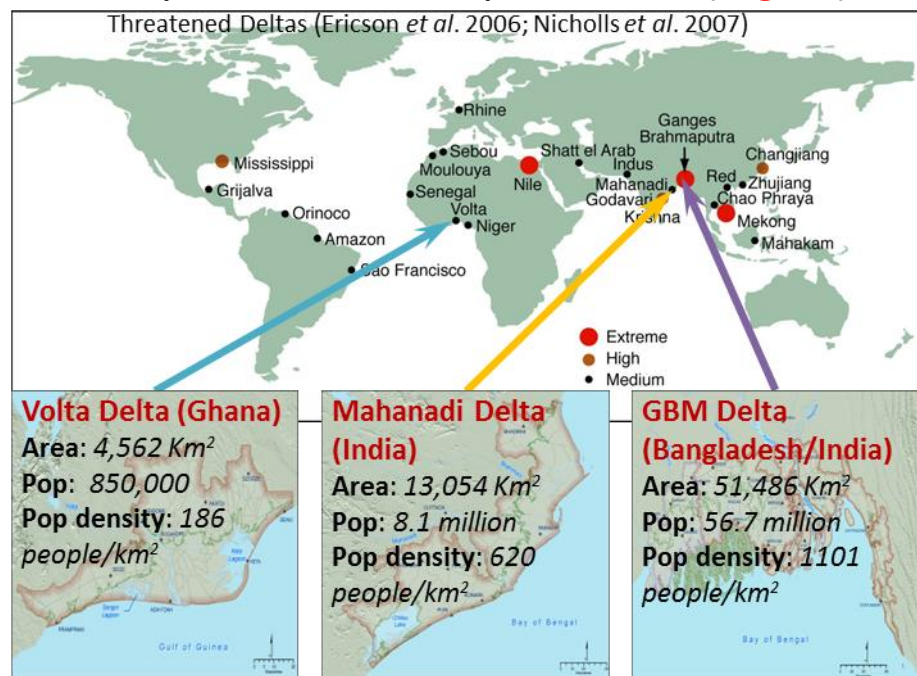


Fig. 1: DECCMA case study deltas.

2. Scenario Needs in DECCMA:

- Multi-scale (Fig. 2):
 - **Global:** climate change (e.g., SLR, temp.), socio-economic assumptions (e.g., pop & GDP for economic modelling)
 - **Regional:** (i) *catchment* e.g., river catchment modelling, (ii) *regional seas* e.g., fisheries modelling, (iii) *regional politics*, e.g., transboundary disputes
 - **National:** e.g., socio-economic factors for input-output modelling
 - **Delta:** e.g., future adaptation and migration policies
- Purpose:
 - Consistent futures at the delta scale, while linked to wider scales (global, catchment, regional seas, national),
 - Consistent futures across all deltas,
 - Consistency with other CARIIA projects (as much as possible),
 - Consistency with wider climate change, environmental change, and migration research.

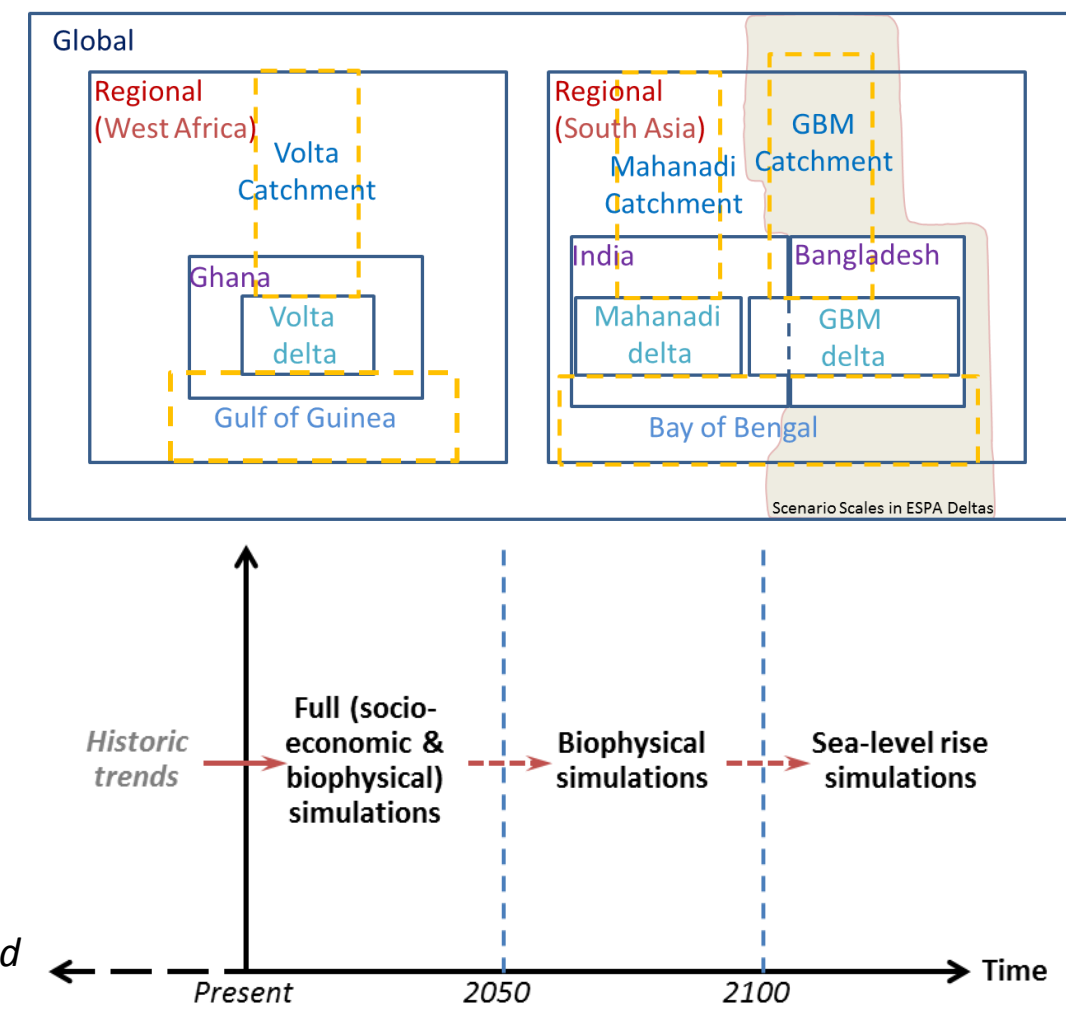


Fig. 2: Schematic illustration of the spatial and temporal scale needs in DECCMA.

3. The Scenario Framework:

- Developed building on the ESPA Delta project's experience (Allan and Barbour 2015).
- Comprises a multi-scale hybrid approach for producing appropriate and consistent exogenous and endogenous scenarios to analyse each delta.
- Includes and combines expert-based and participatory approaches as appropriate (Fig. 3):
 - Considers the global RCP/SSP scenario narratives, the regional (catchment, coastal seas, land use/cover and political conditions) and national scale scenario projections as boundary conditions.
 - Stakeholder engagement for developing more specific delta-scale scenario narratives (storylines) and quantification of the narratives for modelling.
- Facilitates consistency of the modelling process across various scales/components, and the three deltas
- Provides an improved specification of the role of scenarios to analyse the future state of adaptation and migration in the three deltas.

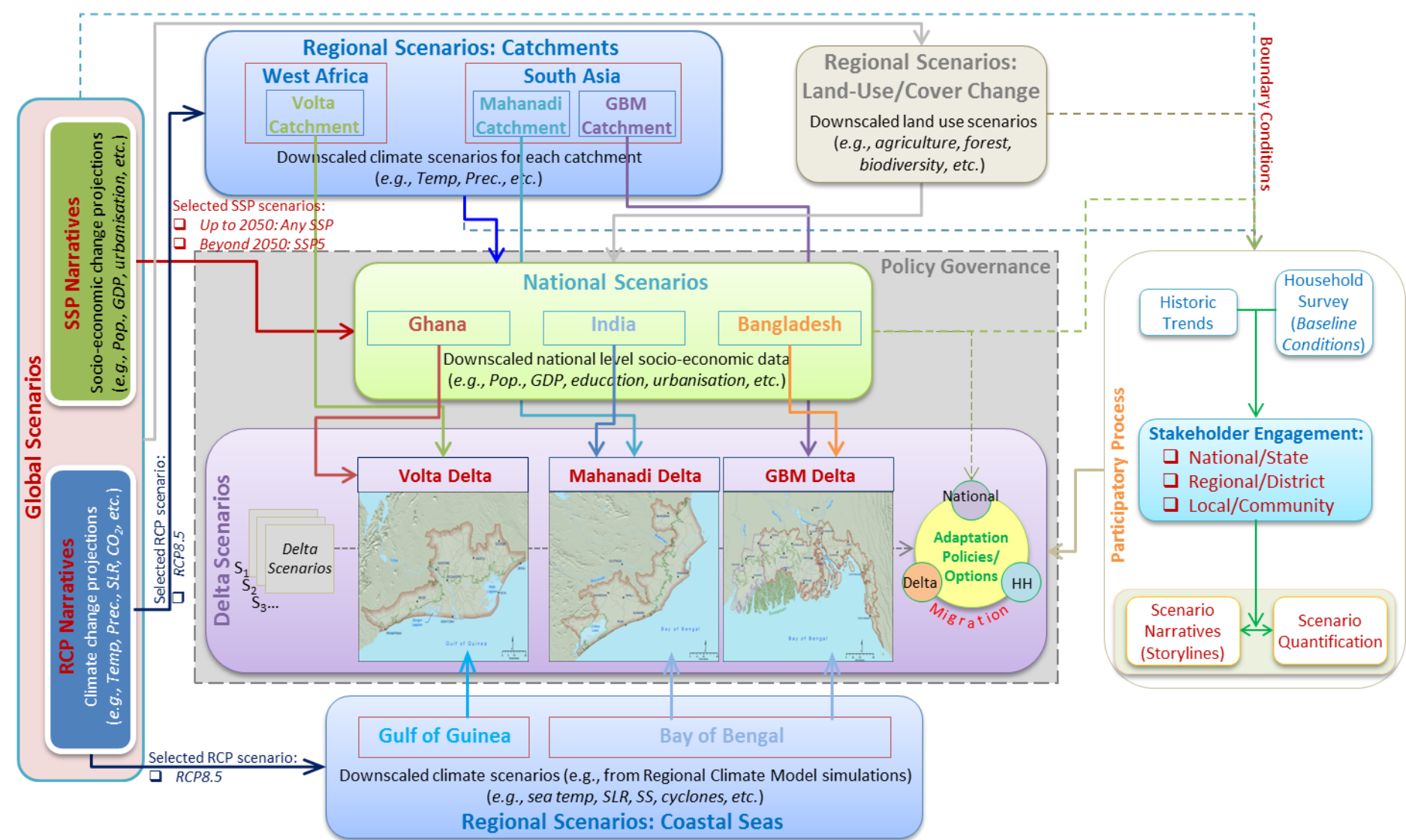


Fig. 3: The scenario framework.

4. Global Scenarios:

- The RCP/SSP is the state-of-the-art scenario framework (developed for the IPCC AR5).
- There are four RCP (climatic change) and five SSP (socio-economic change) scenarios: providing 20 possible combinations.
- In DECCMA:
 - RCP8.5 is selected to consider the strongest (a 'high-end') climate signal.
 - In terms of SSPs:
 - Up to 2050: SSP2 and two variances of SSP3 are selected to inform the participatory scenario development process
 - Beyond 2050: SSP5 is selected for the long-term biophysical assessment as it is consistent with RCP8.5
- The Figs. 4 and 5 show example RCP and SSP projections for selected c. and se. drivers.

5. Regional Scenarios:

- **Catchments:**
 - Considers three catchments: the Volta, Mahanadi, and GBM catchments
 - Downscaled climate scenarios (e.g., from RCM simulations of daily prec. and temp. data for INCA model)
 - Regional land use/cover change (e.g., SSP-based projections, Popp et al. 2016; Fig. 6)
- **Coastal seas:**
 - Gulf of Guinea and Bay of Bengal
 - Downscaled climate scenarios (e.g., from RCM simulations)

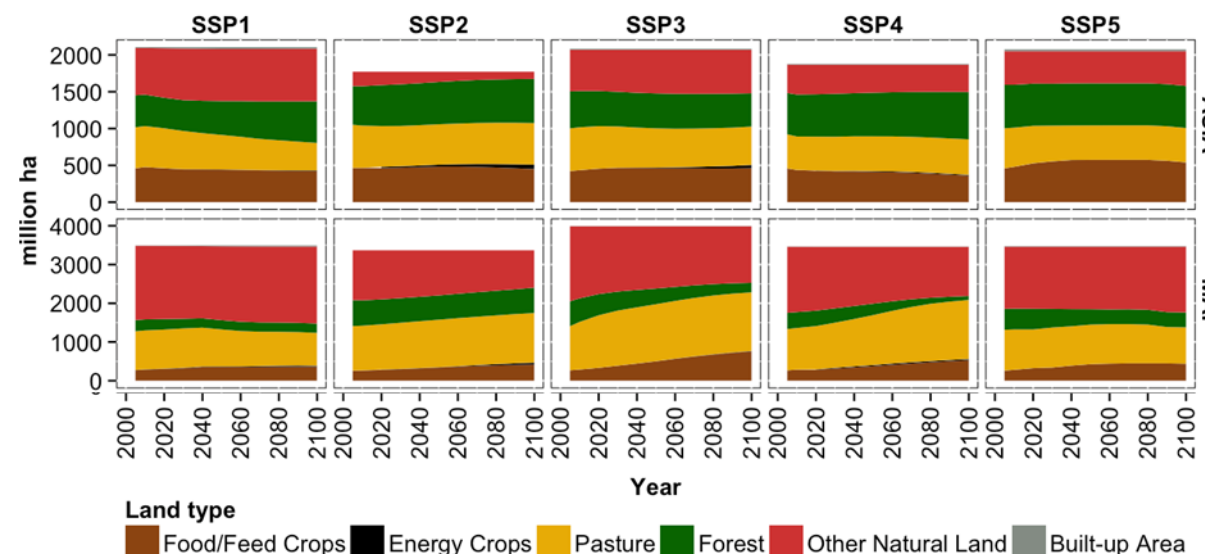


Fig. 6: Regional land use dynamics in ASIA (except Middle East, Japan, Former Soviet Union states) and MAF (Middle East + Africa) under the five SSP and baseline climate scenarios (Source: Popp et al. 2016).

7. Delta Scenarios and the Participatory Process:

- Aims to develop consistent scenarios across the three deltas.
- Involves various stakeholders at multiple scales: national/state, regional/district, local/community.
- Integrates historic data with baseline condition (based on household survey data).
- The three key stages of the participatory process include:
 - Setting boundary (wider scale) conditions and identifying scenario elements
 - Narrative co-production and agreement
 - Quantification of narratives for modelling

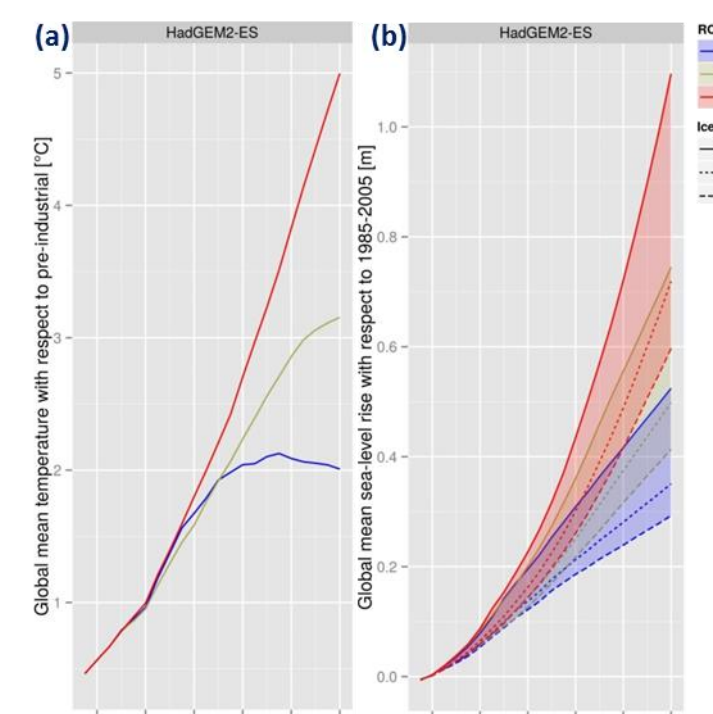


Fig. 4: Projections of global mean (a) temp. & (b) sea-level rise under three RCP scenarios for the HadGEM2-ES model (Source: Brown et al. 2015).

6. National Scenarios:

- Three countries: Ghana (G), Bangladesh (B), India (I)
- SSP-based national projections of population, GDP, and urbanisation are obtained from IIASA SSP Public Database (<https://tntcat.iiasa.ac.at/SspDb>) (see Fig. 7):
 - **Population change:**
 - 2010 (million): 24.4 (G); 149 (B); 1,225 (I)
 - 2050 (%ch): 61–123 (G); 15–49 (B); 26–61 (I)
 - 2100 (%ch): 56–275 (G); -22–76 (B); -7–113 (I)
 - **Urban share (as % of population):**
 - 2010 (%): 52 (G); 28 (B); 30 (I)
 - 2050 (%ch): 8–28 (G); 10–39 (B); 7–37 (I)
 - 2100 (%ch): 13–42 (G); 21–62 (B); 16–61 (I)
 - **GDP change:**
 - 2010 (trillion UD\$2005/year): 0.04 (G); 0.22 (B); 3.70 (I)
 - 2050 (trillion UD\$2005/year): 0.23–0.74 (G); 0.91–33.7 (B); 18.9–46.5 (I);
 - 2100 (trillion UD\$2005/year): 0.74–4.39 (G); 0.93–12.2 (B); 36.9–144.6 (I);
- This projections will provide the national context for the delta-scale scenario development process.

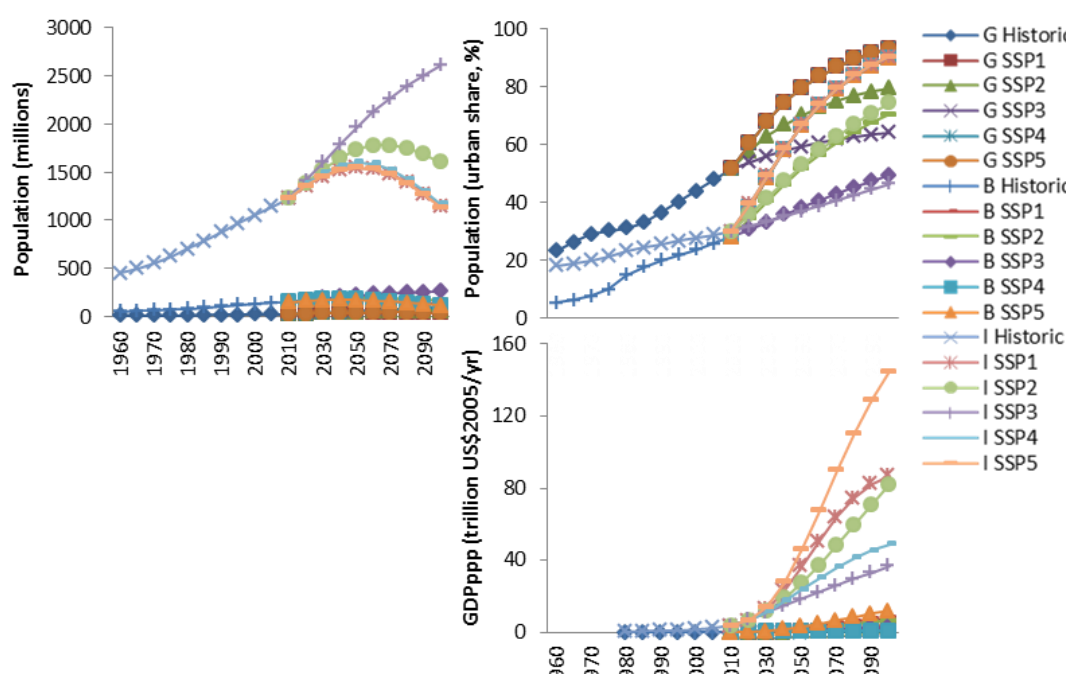


Fig. 7: National level historic trends and future projections of population, GDP and urbanization in Ghana, Bangladesh, and India (Source: IIASA SSP Public Database).

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