

Applying the Global RCP–SSP–SPA Scenario Framework to Coastal Deltas:

A Multi-Scale and Participatory Approach

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Abstract

Applying the latest global RCP-SSP-SPA scenario framework of the IPCC AR5 at a sub-national scale requires a multi-scale integrated scenario approach that combines expert-based and participatory methods. Here, we present a generic scenario framework based on such an approach developed and applied within the DECCMA project to explore migration and adaptation in three contrasting coastal 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 million people globally, and have been identified as some of the most vulnerable coastal environments (Ericson et al. 2006; Syvitski et al. 2009).
- They are susceptible to multiple climatic (e.g., sea-level rise, storm surges) and socioeconomic (e.g., population and GDP growth) drivers, which operate at multiple scales.
- They face long-term sustainability challenges, with threats on the well-being of people and health of ecosystems that support livelihoods of large (often poor) populations.
- Holistic understanding is needed for devising robust adaptation policies under uncertain futures.
- □ Scenario analysis supports robust decision-making under uncertainty.
- □ This paper presents the overall scenario framework, methods and processes adopted for development of scenarios in DECCMA and example scenarios across the multiple scales of interest (global to local, and short- to long-term).



4. RCP Scenarios: Temperature, Precipitation and SLR Projections



2. The Global RCP–SSP–SPA Scenario Framework:

- □ State-of-the-art scenario framework developed for the IPCC AR5 (*Fig. 2*).
- Provides a foundation for improved integrated assessment of climate change impacts and adaptation/mitigation policies
- Applying this global framework at sub-national scale requires:
 - A multi-scale integrated scenario approach, and
 - Combining expert-based and participatory methods
- □ Such an approach is developed and applied in DECCMA to explore migration and adaptation at the three contrasting coastal deltas (see *Fig. 3*).





RCPs

- **RCPs:** Representative Concentration Pathways Climate
- SSPs: Shared Socio-economic Pathways Socio-economics SPAs: Shared climate Policy Assumptions – Policy choices

3. The Integrated Scenario Framework:

- □ The generic and DECCMA-specific integrated scenario frameworks are shown in *Fig.* 4.
- Developed building on the ESPA Deltas project experience (Allan and Barbour 2015; Nicholls et al. 2016).
- 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:
 - Considers the global RCP/SSP scenario narratives, the regional (catchment, coastal seas, and political conditions) and national scale projections as boundary conditions.
 - Stakeholder engagement for developing delta specific adaptation policy trajectories and identification of appropriate national adaptation interventions for modelling.
- □ Facilitates consistency of the modelling process across various scales/components, and

- Bay of Bengal:
 - Mid-century: 18 33 cm
 - End-century: 49 100 cm

Fig. 4: Climate change scenarios (a) global mean temperature change and sea-level rise (IPCC AR5), and (b) delta scale change in temperature and precipitati

National level historic trends (left) and scenario projections (right) of socio-econom

5. SSP Scenarios: *Population, Urban Share and GDP Projections*

- Scenario data at: national (Ghana (G), Bangladesh (B), India (I), & delta (Volta (V), Mahanadi (M), GBM (Gb)) levels.
 - *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)

Fig. 6: Delta scale scenario projections of population and GDP in each delta (Sources: Jones and O'Neill

- GDP:
 - 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);



1400 🗌

1200 - - B



- Population (millions):
- 2050: 1.3–2.1 (V); 8.6–12.6 (M); 66.6–93.7 (Gb)
- 2100: 1.3–3.6 (V); 6.7–16.7 (M); 42.5–113.0 (Gb)
- *GDP* (*billion UD*\$2005/year):
 - 2050: 6–18 (V); 80–280 (M); 540–1050 (Gb)
 - 2100: 24–105 (V); 183–868 (M); 1300–2740 (<u>Gb</u>)

SSPs

the three deltas.

(Note differences in the y-axes across 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: An integrated scenario framework based on a multi-scale and participatory approach (left). The framework is applied and demonstrated within the DECCMA project (right), showing the various scales of interest and broad workflow for applying the global RCP–SSP–SPA scenario framework at sub-national scale, such as coastal deltas.





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