DECCMA

POLICY BRIEF
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Climate change and the economic future of deltas in Africa and Asia

VOLTA, MAHANADI AND GANGES-BRAHMAPUTRA-MEGHNA

Climate change has the potential to reduce GDPper capita by 8.5 - 14.5% in the deltas, through impacts on infrastructures, agriculture and fisheries.

Traditional adaptation options, such as embankments and protection and restoration of mangroves, could only reduce these effects by up to 40-50%, thus minimising but not ruling out negative impacts.

1. Introduction

Deltas are especially vulnerable to climate change given their low-lying location and exposure to storm surges, coastal and river flooding, sea level rise and subsidence. These events are altering environmental conditions in the deltas, which translates into changes in the productivity of ecosystems and, ultimately, into impacts on livelihoods and human well-being.

This policy brief explores the economic implications of climate change for the three deltas of the DECCMA project: Volta (Ghana), Mahanadi (India) and Ganges-Brahmaputra-Meghna (GBM, Bangladesh and the Indian Bengal delta in India). It does this using a Delta Computable General Equilibrium (Delta-CGE) model that simulates how the economy might react to the impacts of climate change under three different economic baseline narratives. In this policy brief we summarise the findings for the Business as Usual scenario (BAU_SSP2 scenario) without climate change, with climate change, and with climate change and adaptation (see Arto et al., 2019).

2. Current economic context

Understanding the current economic context is essential in order to explore the economic future of deltas. However, studying discrete geographical regions within national economies, such as deltas, is often restricted by the availability of detailed data at that level. To overcome this, DECCMA has compiled relevant information available for the administrative regions within the delta from many different sources including as the economic accounts, census and national statistics on employment, trade, agriculture and forestry and fishing (Cazcarro et al., 2018).

Contributions of the delta to national economies (%) and GDP per capita (USD)

DELTA	PROPORTION OF THE NATIONAL ECONOMY	GDP PER CAPITA IN THE DELTA
Volta Delta	4.4%	$1,050
Bangladesh GBM Delta	28.0%	$1,600
Mahanadi Delta	0.4%	$2,000
Indian Bengal Delta	1.1%	$2,350

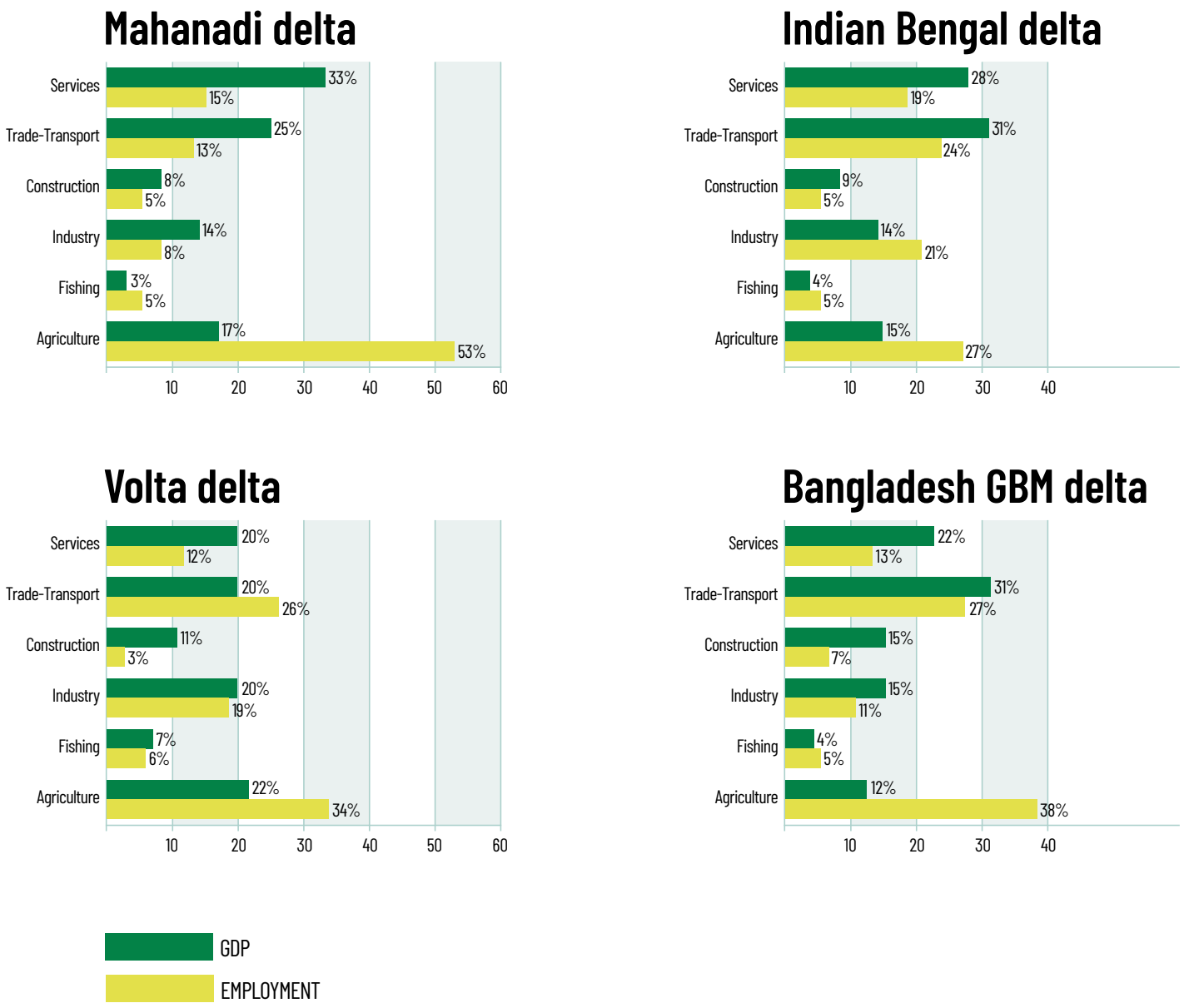
The tertiary sector is the main source of income in these deltas (Figure 1). In the Asian deltas the contribution of the services, trade and transportation sectors represents more than half of the total GDP of the economy; in the Volta, while lower, they still contribute around 40%. However, the contribution of the primary sector remains significant, ranging between 16% and 29%. In the Bangladesh GBM the construction sector is relatively high compared to the other delta areas (15%), while manufacturing activities in the Volta account for almost 20%.

In terms of employment, however, the role of the primary sector in the economy is much greater than in terms of GDP. The share of the employment engaged in the primary sector ranges from 32% in the Indian Bengal Delta to 58% in the Mahanadi. This difference is the consequence of the low productivity of an agricultural sector, in which subsistence production dominates, compared to other economic activities.

Figure 1.

DISTRIBUTION OF GDP AND EMPLOYMENT BY SECTOR AND DELTA IN 2011

Source: Cazcarro et al., 2018.



Climate change is already impacting the economies of the deltas. For example, the increase in the frequency and magnitude of extreme events is damaging the human-built environment, and the change in environmental conditions is reducing crop productivity. However, the future economic impact of climate change is unknown and will depend, among other factors, on future environmental and socio-economic conditions and on the degree and effectiveness of adaptation. Thus, in order to better understand the economic future of deltas it is necessary to make some assumptions, or scenarios.

3. Future scenarios for the deltas

The scenarios of DECCMA are based on the new global scenario framework developed for the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) (see Kebede et al., 2018).

CLIMATE PERSPECTIVE

From the climate perspective, DECCMA focuses on the scenario with the strongest climate signal, which shows the highest concentration of greenhouse gases in the late 21st century (the so-called Representative Concentration Pathway 8.5). This scenario represents a worst-case in terms of projected temperature increases and it is used as an input for the biophysical models used in DECCMA to estimate the effects of climate change on different variables such as crop yields, fish catches or damages in infrastructures.

The tertiary sector is the main source of income of the delta. In terms of employment, the role of the primary sector is much greater than in terms of GDP.

ECONOMIC SPHERE

In the economic sphere, the scenario framework follows three alternative baseline narratives up to 2050 inspired by Shared Socioeconomic Pathways (SSP) of the IPCC: one of these (the SSP3) presents a world of Fragmentation/Regional Rivalry, another (SSP5) presents Conventional/Fossil fuel-driven Development. A third (SSP2) is known as Middle of the Road scenario or Business as Usual. These socioeconomic scenarios are highly important to explore the economic future of deltas, the level of exposure of economic activities, and the impacts of different adaptive capacity and vulnerability.

The Business as Usual (BAU_SSP2) is used as reference scenario in DECCMA (see Figure 2 for spatial distribution of the GDP per capita in 2010 and the future projections in 2050 under this BAU_SSP2). According to this scenario, the GDP per capita would grow notably in the three deltas. In particular, real GDP per capita would multiply by the following factors:

- 3.9 in the Mahanadi Delta,
- 6.3 in the Indian Bengal Delta
- 4.2 in the Volta Delta
- 3.6 in the Bangladesh GBM

The expected increase in the GDP per capita would not evenly distributed across the different districts of the deltas. The maps show a generalised increase in the GDP per capita in all the districts, which could potentially increase their adaptive capacity. However, the increase is expected to be higher in the Indian deltas and in the urban areas of the deltas, which could trigger rural-to-urban migration affecting living conditions in cities.

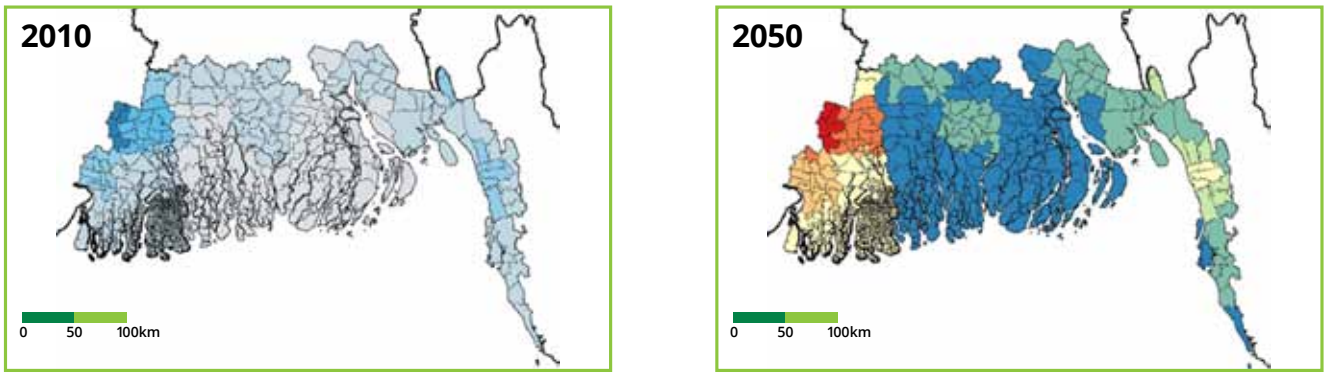
GDP per capita will more than double in all four deltas between 2010 and 2050.

Figure 2.

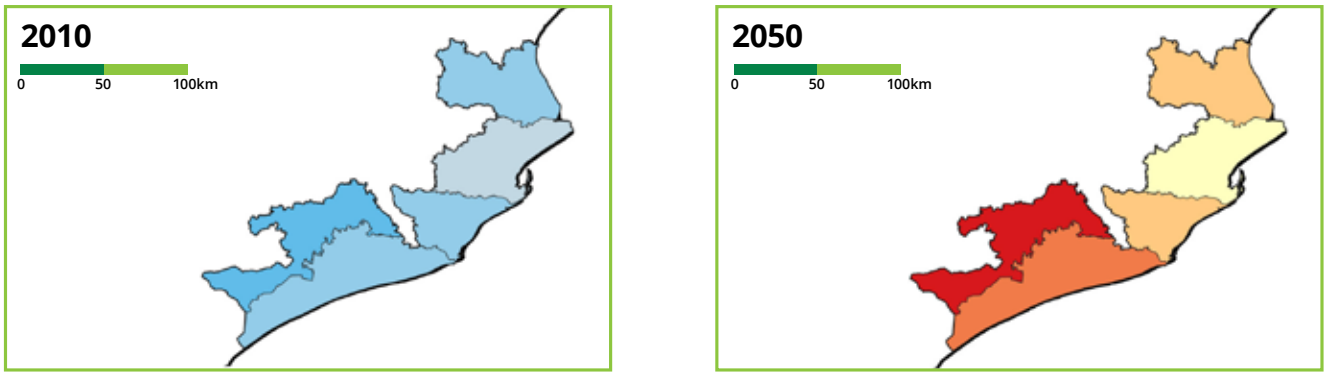
SPATIAL DISTRIBUTION OF THE GDP PER CAPITA OF THE DELTAS IN 2010 AND 2050 (USD per capita in power purchasing parities, constant prices of 2010)

Source: Own elaboration from Murakami & Yamagata (2016).

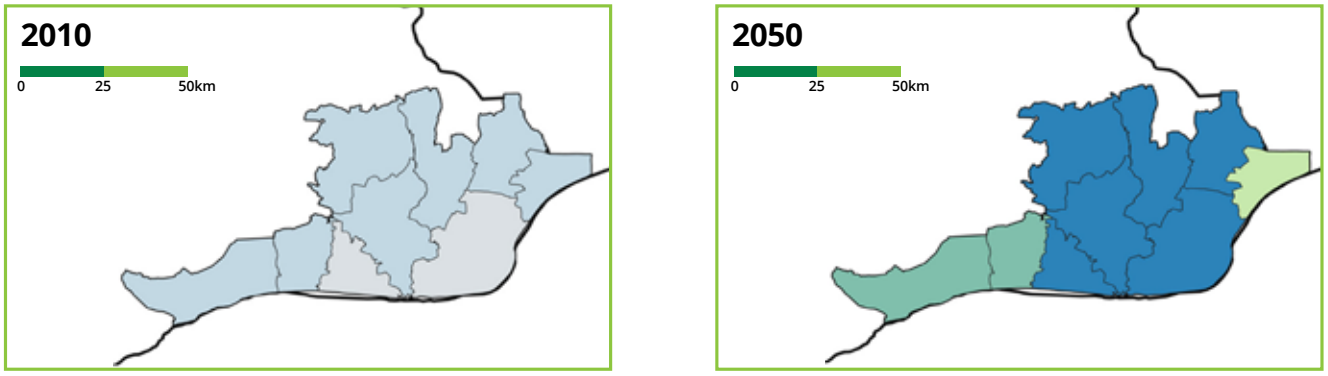
GBM delta

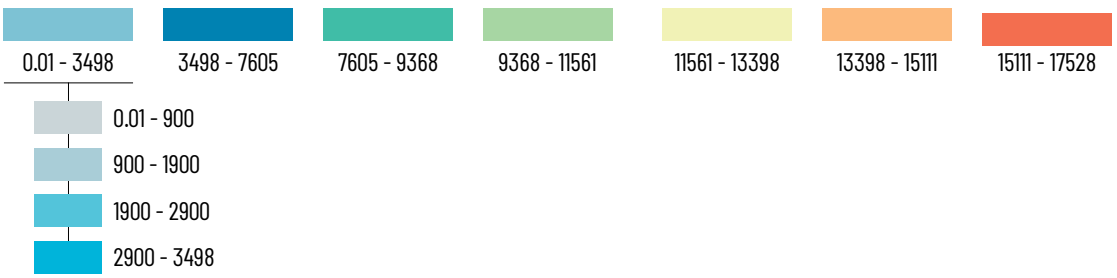


Mahanadi delta



Volta delta





4. The economic impacts of climate change in deltas

A Delta Computable General Equilibrium (Delta CGE) model was developed, which stimulates how the economy might react to the impacts of climate change under the three different economic baseline narratives. In particular, the impacts analysed include shocks on agriculture (losses in terms of land availability and crop yield), fisheries and infrastructure, with and without current adaptation options. We summarise the findings for the Business as Usual scenario (BAU_SSP2 scenario) with the type of adaptation options people and institutions apply in deltas nowadays.

Figure 3 shows the evolution of the GDP per capita in the deltas under three different trajectories. The black line represents the expected trajectory of the GDP per capita in the absence of climate change (BAU_SSP2). Under this scenario the GDP per capita is expected to increase by factors of 4 to 7 (this range increases under different scenarios and higher spatial disaggregation), depending on the delta. By 2050, the GDP per capita in the Mahanadi Delta would reach around 11,000 USD/cap, around 16,000 USD/cap in the Indian Bengal Delta, close to 8,000 USD/cap in the Bangladesh GBM Delta, and 6,000 USD/cap in the Volta Delta.

Climate change would push the GDP path downwards (red line in Figure 3). In the case of the Mahanadi Delta, the main shocks are found in infrastructure, representing about three times the losses in the agricultural and fisheries sectors. The cumulative losses due to climate change up to 2050 represent around 12% of the GDP per capita of the delta with respect to the BAU, of which 9 percent points would correspond to damages in infrastructures and 3 percent points to losses in the agriculture sector. In the Indian Bengal Delta, by 2050, climate change would reduce the GDP per capita by 15.5%; damages in infrastructure would generate losses equivalent to 7% of the GDP per capita, losses driven by the impacts of climate change in the agricultural sector would affect about 8% of the GDP and fisheries around 0.33%.

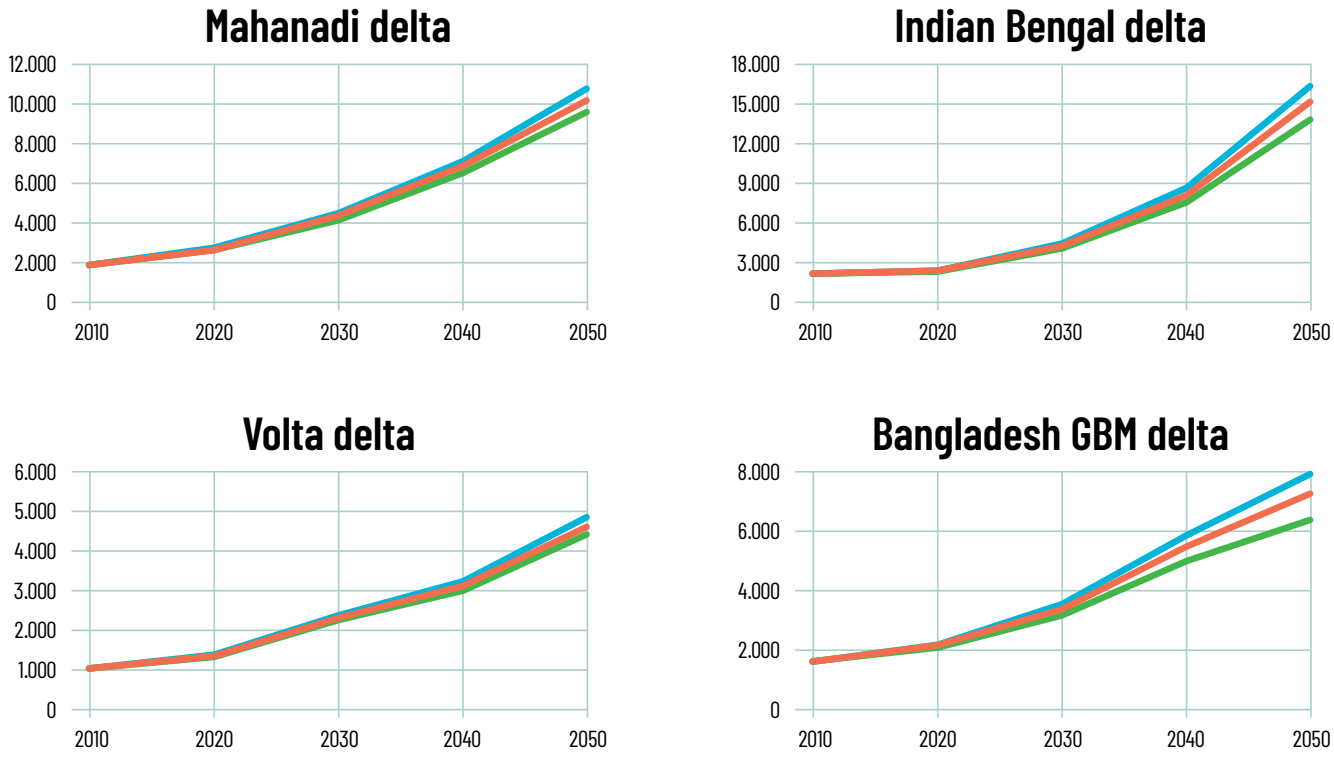
Cumulative losses due to climate change up to 2050 represent around 12% of the GDP per capita of the delta. Adaptation options could reduce losses.

The GDP per capita of the Bangladesh GBM Delta would suffer the highest impact across the deltas analysed, with a reduction of 19.5%. The impacts of climate change in the agricultural sector would represent 12% of the GDP per capita and damages in infrastructures 7.5%. The impacts of climate change in the Volta Delta would be lower than in the other deltas (9% of the GDP per capita). In this case, most of the losses would concentrate in the agriculture sector (6.5% GDP per capita) and in the infrastructure (1.5%). The expected losses on fisheries in the Volta Delta are the most important across all studied deltas (around 1% of the GDP per capita).

Figure 3.

GDP per capita in the Business as Usual Scenario (BAU_SSP2), Business as Usual Scenario plus climate change (BAU_SSP2_CC), and Business as Usual Scenario plus climate change and adaption (BAU_SSP2_CC_adapt)

Source: Own elaboration.



GDP PER CAPITA IN 2050 BY SCENARIO (1000 USD)

	MAHANADI		INDIAN BENGAL DELTA		VOLTA		GBM BANGLADESH	
Year	2010	2050	2010	2050	2010	2050	2010	2050
BAU_SSP2	2.0	10.7	2.3	16.2	1.1	4.9	1.6	7.9
BAU_SSP2_CC	2.0	9.5	2.3	13.7	1.1	4.4	1.6	6.3
BAU_SSP2_CC_adapt	2.0	10.2	2.3	15.0	1.1	4.6	1.6	7.2

Authors

Iñaki Arto[1], Ignacio Cazcarro[1,2], Anil Markandya[1], Somnath Hazra[3], Rabindra Nath Bhattacharya[3], Prince Osei-Wusu Adjei[4], Katharine Vincent[5]

1 Basque Centre for Climate Change (BC3), Bilbao, Spain
2 Aragonese Agency for Research and Development (ARAID), Zaragoza, Spain.
3 School of Oceanographic Studies, Jadavpur University, Kolkata, India
4 Department of Geography and Rural Development, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
5 Kulima Integrated Development Solutions (Pty) Ltd, South Africa

For more information

Iñaki Arto: inaki.arto@bc3research.org • DECCMA website: www.deccma.com

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