



## New Insights: Climate Change, Migration and Adaptation in the Mahanadi Delta



### What is the nature of climate change risk in the Mahanadi delta?

#### Water-related hazards pose the biggest threats

**Flooding** is the most common hazard in the Mahanadi delta, along with erosion and cyclones. Erosion occurs along some parts of the coastal stretch. Dhamnagar, Tihidi, Chandabali, Basudevpur, Marshaghai, Bhadrak and Baliakuda are high risk zones of all the three hazards.

**Coastal storm surges** during cyclones also cause inundation of low lying flat land in the northern part of delta.

Table 1 outlines the area of cropland that is under the risk of being affected by 100 year floods and coastal storm surges.

Table 1: Area of cropland likely to be affected by 100 year floods and coastal storm surges

Block (sub-district)	AREA OF CROPLAND	
	(a) Projected to be flooded in 100 year floods (in sq. km.)	(b) Projected to be flooded by coastal storm surges (in sq. km.)
Chandabali	418	421
Basudebpur	298	256
Mahakalpara	290	280
Rajnagar	251	263
Tihidi	212	176
Ersama	211	148
Pattamundai	206	152
Rajkanika		183

## Climate Impacts

### Runoff

The likelihood of higher rates of runoff in the Brahmani-Baitarani river basin poses increased **risk of floods in the Bhadrak and Kendrapara districts** (Figure 1).

### Evapotranspiration

Significant increase in evapotranspiration, particularly during low rainfall years, would **exacerbate the water scarcity in downstream delta districts**.

### What does changing water availability mean for economy and livelihoods?

The Mahanadi Delta has a smaller GDP per capita than the rest of India (approximately \$2000 per capita compared to a national average of \$3100). The main livelihood in the vulnerable blocks is agriculture, and direct loss in the agricultural sector would represent 27.3% of total GDP of the delta.

Land cover change also contributes to different levels of climate risk. There has been considerable increase in double and triple cropland (often enabled by irrigation) and some increases in aquaculture, wetlands and urban settlements. At the same time areas of single cropland, mangrove, and forest are declining. The percentage of earthen houses known as *Kuccha* is also high in this region.

The changing nature of land cover also affects flood risk by increasing vulnerability to flood exposure.



Figure 1: Mahanadi-Brahmani-Baitarani river basin with the study area district boundary

## Migration

### Migration is higher in areas at high risk of climate stresses

A survey of 1414 households in the delta shows that 22% have sent migrants. Migration is highest from the blocks categorised as having high or very high hazard exposure. People are thus migrating to find a safe place to stay, despite environmental reasons never being cited as the primary reason behind their movement.

### Migrants often have a common demographic profile

Migrants often have common demographic characteristics. The propensity to migrate is highest for males in the 21-30 years age group (Figure 2). People with secondary and tertiary education generally tend to migrate more than those with lower levels of education. However, the survey shows that migrants are mostly from agricultural households, where monthly income is low (less than \$30 or INR 2000) and household size is big (more than 6 members).

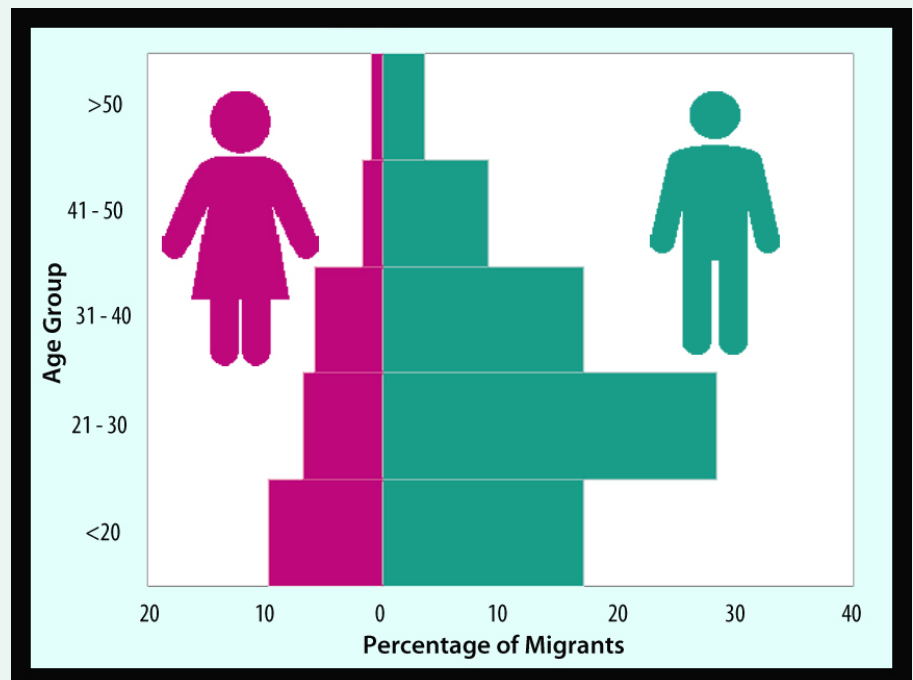


Figure 2: Age-sex pyramid of migrants from Mahanadi Delta

In case of female migrants, the decision to migrate is dependent on the household. They mostly move with their family. This finding is consistent with the Census Data 2011 which cites moving with family is the second most mentioned reason for female migration after marriage.

With greater limitations on mobility, the trapped populations in the delta tend to be the elderly and women.



### Migration is rural-urban, and typically seasonal

Major cities and states are the destination for many migrants. Migrants are moving to other parts of Odisha such as Bhubaneswar, Puri, and Paradip. Bhubaneswar is the capital city of Odisha and the state's economic and educational centre. Other cities in Odisha, like Puri - famous for religious tourism, and Paradip - a port city on the Mahanadi River also attract migrants. Some migrants from the Mahanadi delta travel to urban areas further afield, such as neighbouring West Bengal, Karnataka, Tamil Nadu, and Gujarat.

62% of migrants are seasonal, migrating there once or twice a year, returning home for the agricultural season.

### Migration occurs to capitalise on economic opportunities

Migration is strongly linked with the economy and also has both direct and indirect effects on economic growth. Economic reasons are the primary cause of migration for the vast majority of migrants. Based on analysis from the household survey, the average per capita income from non-migrant households is lower (US\$101) than that of migrant households (\$157). It is thus reasonable to assume that the combination of opportunities for employment and the low returns from natural resource-based livelihoods (agriculture and fishing) is the single most important determinant of migrants in this delta.

After economics, the second most frequently mentioned reason for migration is education, with 19% of respondents reporting that the migrant left to pursue a degree or obtain training.

### Migration has consequences for social inequality

Migration changes the population structure. A major challenge of migration is the replication of income inequality often seen in urban areas, with some households earning much more than others. The majority of migrant-sending households are female-headed, i.e. the men are the ones migrating, leaving women behind. This can create additional burdens on labour and responsibility, as well as the social consequences of a spatially-divided family.

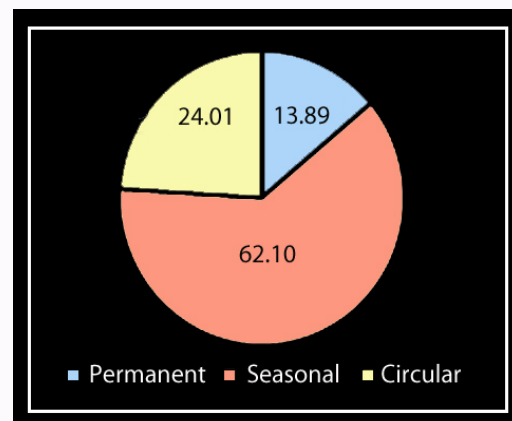


Figure 3: Nature of migration from Mahanadi Delta



## Adaptation

### There is evidence of adaptation taking place in the Mahanadi

Adaptations taking place in the delta relate to vulnerability reduction, disaster risk reduction, and building social-ecological resilience. Natural resource-based livelihoods are supported by the introduction of climate-tolerant crops, diversification, water resource management (for example floating gardens and irrigation) and skill development (for example in plumbing). Disaster risk reduction takes the form of training, capacity building, preparedness and awareness and is a well-recognised adaptation option. Social-ecological resilience is enhanced by conservation and regeneration of mangroves by the community (as an autonomous adaptation) and by the state (as a planned adaptation). Structural interventions such as embankments also exist.



## Some adaptations are deemed successful

The impact of these adaptations is reflected in improved agricultural productivity, food security, efficient management of water resources and enhanced income. However, based on workshops with government and non-government stakeholders at state and district level, there are different perspectives on which are most successful. Training, climate-tolerant crops, assistance from government and NGOs, and structural protection measures were seen to be effective, with loans, cutting down trees and the use of mixed farming methods deemed less successful.

## Female-headed households are unable to practice some adaptations

Whilst male-headed households exhibited 21 different types of adaptations, some options were not used by female-headed households. These include using new farming/fishing tools, receiving training on farming/fishing methods, and fishing new breeds. This suggests that training activities are not gender-sensitive with the effect that men are benefiting more than women; and that there is limited ability to purchase new equipment. Additionally these activities are among those advocated as the most successful adaptations.

## Policies could better support gender-sensitive adaptation

Analysis of policies of relevance to the environmental sphere highlights a lack of gender sensitivity and the absence of objectives to achieve gender equality objectives. As a result of this, even imperfect policy implementation can reinforce social inequality. The sex-disaggregated findings on migration and adaptation within the survey can inform the design of forthcoming policies, such as the Odisha Climate Change Action Plan 2018-23.

## Migration and adaptation

### Migration is a successful adaptation

Migration is deemed successful by more than 60% of people, taking into account benefits for the migrant themselves and the family left behind. 21% of current non-migrant households expressed the intention to migrate in the future, which would increase the proportion of migrant-sending households in the delta to around 38%.

A stellar example of adaptation enabling migration is evidenced from Kendrapara district. Training is provided to the young people on skills such as plumbing. They are migrating to Gulf countries and sending remittances. This is strengthening the local economy and also an example how skill development can facilitate successful migration of men.

### Successful adaptation can reduce migration

When adaptation is successful it can reduce the propensity to migration. Conservation and regeneration of mangroves reduces the impact of cyclones on lives and livelihoods, thereby reducing migration. Healthy mangrove ecosystems also increase returns on agriculture and fishing.

## Policy recommendations

1. Assessing the Mahanadi delta region as a unit of planning and implementation offers opportunities to enable coherent policy responses to reduce the risk of climate change to populations by supporting gender-sensitive adaptations.
2. A variety of types of adaptations should be used to reduce climate change risk. These include -
  - **structural interventions** - embankments and raised concrete houses;
  - **livelihood-based adaptations** - climate-tolerant crops and sustainable rice intensification;
  - **ecosystem-based adaptation** - mangrove restoration to provide a buffer against coastal storm surgesInformation on the nature of climate risk helps to ensure the most appropriate adaptations are used in the most appropriate places.
3. To encourage migration as an adaptation, targeting trapped populations with skill development can improve their migration capability to enable choice.



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