



## Climate Change, Migration and Food Security: Evidence from Indian Sundarbans

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**ABSTRACT:** Climate change has attracted substantial attention in recent years as vital global challenges of the people. The frequency and intensity of severe weather events are increasing especially in coastal areas such as Sundarbans. The basic objective of this study is to assess the impact of climate change on migration and to understand the adaptation needs of the migrants. This paper have identified three factors of migration namely environmental, economic and social factors. Environmental factors are most important drivers of migration in this area: 86.67% of households have migrated, compelled by climate change directly or indirectly. The decline in purchasing power and the lack of other developmental choices in the face of climate variability are a serious threat to the economic viability of population. This study has tried to analyze problem specific and region specific vulnerability, which would be more precious for policymaker to prescribe policies based on ground level fact/truth.

**Keywords:** Climate Change, Migration, Food security, Vulnerability and Adaptation

### I. INTRODUCTION

Climate change is an imperative issue facing the world today. Climate change affects nature and human being. It results to droughts, flood, crop failures, ecosystem imbalances, more frequent weather-related disasters and melting ice caps causing downstream problem and sea level rise. Climate change induced sea level rise predictions of IPCC 2007 are being revised with refined research methodologies worldwide. The average mean sea level was  $1.8 \pm 0.5$  mm/year between 1961 and 2003, and doubled between 1993 and 2003 – rising by  $3.1 \pm 0.5$  mm/ year (IPCC Technical Paper-VI, 2008) [1]. The Climate Change Vulnerability Index (CCVI) 2011 rates 16 countries out of 170 countries in the World as ‘*extremely risky*’ in regard to climate change impacts. India is ranked 2<sup>nd</sup> after Bangladesh in terms of such risk [2]. According to Dr. N. Das, sea level rise by 130 m since the last glacial maximum 18,000 years ago has inundated over 250,000 sq. km of land in the west coast of India. He has also claimed that the upper limit of 88 cm is an underestimate, and sea level rise could be much higher. Sea level would rise to one meter by 2100 AD. One meter rise of sea level will inundate about 1,220 sq. km land in the state of West-Bengal (N. Das, 2008).

The northern most part of the east coast of India, where the Ganges and the Brahmaputra have created the largest delta of the world, which is unfortunately above sea level and most vulnerable. Bulk of this Ganges-Brahmaputra deltaic system (Sundarbans) is situated in Bangladesh, and the rest in the Indian state of West-Bengal. Environmental impact like sea-level rise is so severe in this area that creates displacement of resident on islands for many generations and making them homeless and destitute. A lot of migration has been induced by climate change related extreme weather events and sea level rise in Indian Sundarbans. Sea levels are rising faster than global average and extreme events such as tidal surges and severe cyclonic storms are becoming more frequent. In Indian Sundarbans, four islands namely Bedford, Lohachara, Kabasgadi and Suparibhanga have been submerged nearly 6,000 families became homeless and turned into environmental migrants. In future, this area will be the hardest hit by climate change and many people will be forced to leave their homes temporarily or permanently. Based on the current habitation and density over 70,000 people will be rendered homeless in next 13 years due to rising seas in Sundarban and by 2020 more than 30,000 people will be displaced in Sagar Island (Hazra, 2002). Food insecurity is another important problem in this area.

The decline in food security, slowing down of human capital generation and the lack of other developmental choices in the face of climate variability is a serious threat to the economic viability of the population in the Sundarbans. In this perspective, the purpose of this paper is to test the hypothesis that climate change acts as a push factors on rural migration and food security.

## II. LITERATURE REVIEW

How does the climate change affect the rural migration and food security? The relationship between climate change and rural migration is very controversial issue of modern research. Some studies suggest that more people have been displaced by natural hazards in recent years than previously. Cyclone Aila in 2009 displaced 2.3 million people in India and almost 850,000 in Bangladesh (Michelle Yonetani, 2011), while floods in 2012 displaced about 1.5 million people in the state of Assam (Bhattacharyya et al., 2012). A study by Dasgupta et al. (2007) shows that continued growth of greenhouse gas emissions and associated global warming could well promote sea level rise 1m-3m in this century, which will displace hundreds of millions of people in the developing countries. In West Bengal, if present sea level rise trend (0.5826m) continues 2099.807 sq. km wetland areas will be submerged and lots of people will be rendered homeless in the next 100 years (Dwivedi, 2005). In another study, Hazra et al. (2002) shows that the annual erosion changes in shoreline has been estimated to be 4.54 m per annum in pre 1995 scenario, which increased manifold to be 18.75 m per annum in 1999.

What is important to note is that biophysical aspects are fairly well documented but none of the studies were carried out to determine what can be alternative development pathway for this unique ecosystem and vulnerability in the Indian Sundarbans. Limited evidence is not being able to assess the impact of climate change on migration and food security with high level of confidence. In contrast with the studies discussed above, the primary objective of this study is to assess the impact of climate change on rural migration and to understand the adaptation needs of the migrants in the Indian Sundarbans. So, this paper has tried to assess the causes of rural migration and to analyze problem specific and region specific vulnerability.

## III. DATA AND METHODOLOGY

This study has included both secondary and primary data. Primary data is collected using stratified sampling techniques, pre designed questionnaires and focus group discussion.

Migrant households are surveyed from mainland and different islands during 1960 to 2014 and got settled in six villages of Sagar Island such as Boatkhali (BOT), Beguakhali (BEG), Gangasagar (GAN), Manshadeep (MAN), Kamalpur (KAM) and South-Haradhanpur (SHA). Finally, we prepared sample questionnaires and applied to 300 affected households.

To assess the vulnerability, a village vulnerability index (VVI) is constructed based on LIFE approach parameters (Ghosh and Roy, 2006). In the index, four focus indicators are 'LIV' represents livelihood patterns, 'INT' stand for institutional presence, 'FST' means food security and 'EMP' implies empowerment. Finally, eight variables under four focus indicators have selected, which are consistent with Sustainable Development Goals (SDGs).

## IV. RESULTS AND DISCUSSION

### A. Migration

Rural migration is primarily *internal migration*- people moving within a district, state or nation. Rural migration is mainly two types' namely *permanent migration* and *temporary migration*. About 70.67% of the households are permanent migrants. They have migrated from one village/block to another with the intention of settling permanently within a state. Permanent migrants are divided into two groups – reactive migrants and proactive migrants.

(i) **Reactive migrants** are those that migrate as a reaction to life and livelihood threatening developments and events. About 65% of the migrants in total migrants are reactive migrants. They came from different nearby islands/blocks/villages and living in make shift houses in Sagar Island permanently.

(ii) **Proactive migrants** are those that anticipate the mentioned developments/events well in advance of their occurrence and plan out their migration in steps. Cost of damages of the proactive migrants of ₹1.78 million/family is lower than the reactive migrants of ₹1.83 million/family (Roy and Guha, 2013). Proactive migrants have shifted their all moveable assets even sometimes transferred their house kits such as asbestos/tin, door, window etc. before inundation. Reactive migrants lost all the assets even some families lost their family members. Temporarily migrants (29.33%) are primarily shifted at the time of severe cyclones and coastal flooding for 15-30 days and get back there after. After cyclone 'Aila' lots of people have also migrated to various cities in searching of jobs due to lack of job opportunity in Sundarbans. They are mainly seasonal migrants: they are working in different cities and came back to Sundarbans at the time of rice cultivation.

Most of seasonal migrants are in the nature of inter-state migration (75.86%) who are working in the state of Kerala, Gujarat, Telangana and other states. They are mainly working as a construction labourers. Some of the people (24.14%) are working within the state of West Bengal. About 16% of the workers are working in Kolkata as daily wage labourers and few of them are working as non-farm skilled workers. The majority (77.27%) of the seasonal migrants belonged to age group 17-30 years. It is implied that young generation are highly interested to work as skilled and semi-skilled workers in the non-farm sectors due to greater job opportunities and higher relative wage in different states. It was noticed that almost all seasonal migrants (95.45%) are male members. A small number of female members (4.55%) are interested for inter-state migration due to social customs and lack of safety.

#### B. Causes of Migration

The causes of rural migration are of two types namely push factors and pull factors. Push factors such as climate change, civil wars, political and religious oppression etc. are those which force people to move from their own land.

Pull factors such as better job and education opportunities, social security, religious freedom etc. encourage people to move towards new/target place. Indian Sundarbans is extremely vulnerable not only economic point of view but also environmental point of view. The extent of vulnerability has been increasing over time due to its geographical location. Lots of people have migrated from their own habitat permanently or temporarily for last few decades. This paper has identified three factors of migration namely environmental, economic and social factors.

(i) **Environmental factors:** Environmental factors are basically *push factors* such as inundation of islands, coastal flooding, coastal erosion and severe cyclones etc, which force a person to migrate to other places. Most important driver of migration in this area is environmental factors: 86.67% of households have migrated due to major environmental factors out of which 61% only environmental factors, 17% environmental and economic factors, 2% environmental and social factors; 6.67% environmental, economic and social factors (Table 1).

**Table 1: Factors of Migration (in %).**

<b>Single Effect</b>	<b>Environmental factors</b>	<b>61</b>
	<b>Economic factors</b>	<b>8.33</b>
	<b>Social factors</b>	<b>3.67</b>
<b>Combined Effect</b>	<b>Environmental, Economic &amp; Social factors</b>	<b>6.67</b>
	<b>Environmental &amp; Economic factors</b>	<b>17</b>
	<b>Economic &amp; Social factors</b>	<b>1.33</b>
	<b>Environmental &amp; Social factors</b>	<b>2</b>

**Table 2: Village Vulnerability Index (VVI).**

<b>Indicators (in %)</b>		<b>BOT</b>	<b>BEG</b>	<b>GAN</b>	<b>MAN</b>	<b>SHA</b>	<b>KAM</b>	<b>Mean</b>
<b>LIV</b>	No. of unskilled daily wage labourers	75	85	85	70	45	88	<b>75</b>
<b>INT</b>	Nearest primary school > 1 km	20	23.3	13.5	53	80	10	<b>33</b>
	Nearest Secondary/ H.S school > 2 km	97	60	32.7	100	95	30	<b>69</b>
<b>FST</b>	Cultivated land area < 1.5 acres	98	96	98	100	80	100	<b>95</b>
	Shortage of two square meals per day	62	57	47	38	33	26	<b>44</b>
<b>EMP</b>	Unhealthy dwelling	55	65	34.6	23.1	0	0	<b>30</b>
	Scarcity of clean drinking water	27	35	67.3	38.5	100	70	<b>56</b>
	Lack of basic health facilities	24	35.6	27	38.5	5	40	<b>28</b>

**(ii) Economic factors:** Economic factors are mainly *pull factors* such as better jobs, economic benefits; land and house provided by Government etc., which encourage a person to migrate. Second important driver of migration is economic factors of 33.33% households of which 8.33% only economic factors and 1.33% jointly economic and social factors.

**(iii) Social factors:** Social factors are a combination of *pull and push factors* such as political benefits and pressure, help from relatives, religious affinity etc. Finally, 3.67 percent households migrated by only social factors out of 13.33% households.

#### C. Food Security

Food insecurity is an important problem in Sundarbans. About 44% of the households are not getting two square meals every day. Climate change is a key factor of food insecurity. Cultivated land area has been decreasing due to coastal erosion, inundation of islands and high soil salinity. A significant amount of crops has lost every year due to severe cyclones, embankment failure and heavy rainfall in the harvesting time. Food security is threatened due to declining land mass, low average productivity, huge crop loss and growing population pressure. The decline in food security and the lack of other developmental choices in the face of climate variability is a serious threat to the economic viability of population.

#### D. Vulnerability Assessment

A village vulnerability index (VVI) is constructed based on LIFE approach to assess vulnerability at micro level. The index has been carried out based on the responses of the households in this area. Here, we assume that any change 10% and above is indicative of high vulnerability and less than 10 percent of low vulnerability.

Table 2 shows that all the villages in Sagar Block are extremely vulnerable with respect to food security (FST) and livelihood (LIV). It was observed that food security problem is more severe for reactive migrants than that of proactive migrants. Secondary/H.S education system is highly vulnerable than primary education system in terms of distance. Scarcity of clean drinking water is another serious problem in this area. Nearly 30% of the households in this area are living unhealthy dwelling. However, this index is very useful for policymakers to take appropriate development plans in micro and macro levels, since this index shows the degree of vulnerability both area specific as well as problem specific.

## V. CONCLUSION

The main objective of this study was to assess the impact of climate change on migration. The result indicated that climate change has a negative impact on migration in Indian Sundarbans. The study could identify three factors of migration such as environment, economic and social factors, out of which 86.67% of households was found to be due to major environmental factors. Climate change is also an important driver of food insecurity due to declining land mass, low average productivity, huge crop loss, growing population pressure and lack of job opportunity. The economic viability of population is threatened due to the decline in food security and the lack of other developmental choices in the face of climate variability. Government is unable to solve all the problems at the same time due to financial, environmental and social constraints. To solve this problem, this study tried to construct a village vulnerability index which is area specific as well as problem specific. This will enable the government to remove mal adaptation and take up true adaptation strategy instead.

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