



Living with Changing Climate: Indian Sundarbans

Centre for Science & Environment



Adaptation for the adaptable?

- People of Sundarbans have been living in a difficult terrain reeling under absence of development
- So Why talk about adaptation now?
- Because global warming is causing irreversible changes in the nature systems that constitute Sundarbans
- So development now has become more of an urgency but it is more expensive, must take into consideration the additional climate burdens and has to be much more strategically focused

A Typical Sundarbans Saga

**Radhakanta Mahakal, 56, resident of
Brajaballavpur village, Patharpratima Block**



His father migrated from the adjoining district of Midnapore
Cultivated a small piece of land which was sufficient for the family
Subsequently, a large chunk of the land eroded away, Mahakal started fishing and collecting NTFP
After his daughter's marriage, only 0.26 hectares of land was left – not enough to his family of eight (2 sons, their wives, grandchildren)
Enrolled in MGNREGS, a govt. employment scheme. Procedural complications did not make it a viable alternative
Then came the Aila in 2009. Lost almost the entire land. Salinity was too high to farm
Sons migrated to work as daily wage labourers, they were not skilled or educated
Mahakal still looks after their families as his sons don't earn enough
Food insecurity is high and options non-existent.

Elements of the CRISIS

Climatic

- Rising sea levels – higher than global averages (Range: 5.7 – 10 mm/year between 2000 and 2004)
- Rising sea surface temperature – 0.5°C per decade
- Rise in Major Cyclones – 26 per cent
- Rise in salinity
- Erratic monsoons
- Unusual heat across different seasons

Socio-economic

- Increasing people, shrinking land – a 1000/sq km in a fragile ecosystem!!!
- Stark underdevelopment and poverty – 87 per cent with food insecurity, 44 per cent below poverty line
- Diminishing land-holdings - 0.08 hectares per capita
- Abysmal health care, education and transport infrastructure

Land: At the Heart of Crisis

- Total area eroded about 250 sq km since 1930 but the rate of loss has doubled over the past decade from approximately 2.85 sq km a year to **5.5 sq km per year**



Land Loss in 10 most vulnerable Island in eight years of the last decade

Sl. No.	Islands	2001 (In sq km)	2009 (In sq km)	Loss (In sq km)	% Loss
1	Dakshin Surrendernagar	44.336	42.015	2.324	5.23
2	Sagar	244.434	239.091	5.343	2.18
3	Namkhana	150.155	145.488	4.667	3.1
4	Moushuni	28.283	28.283	0.64	2.28
5	Ghoramara	5.339	4.564	0.774	14.52
6	Dalhousie	36.084	34.28	1.904	5.26
7	Dhanchi	67.101	62.201	4.9	7.3
8	Bulchery	26.915	23.287	3.628	13.45
9	Bhangaduanl	31.316	26.159	5.157	16.44
10	Jambudwip	6.242	4.979	1.263	20.19
Cumulative land loss for ten Islands				30.6	

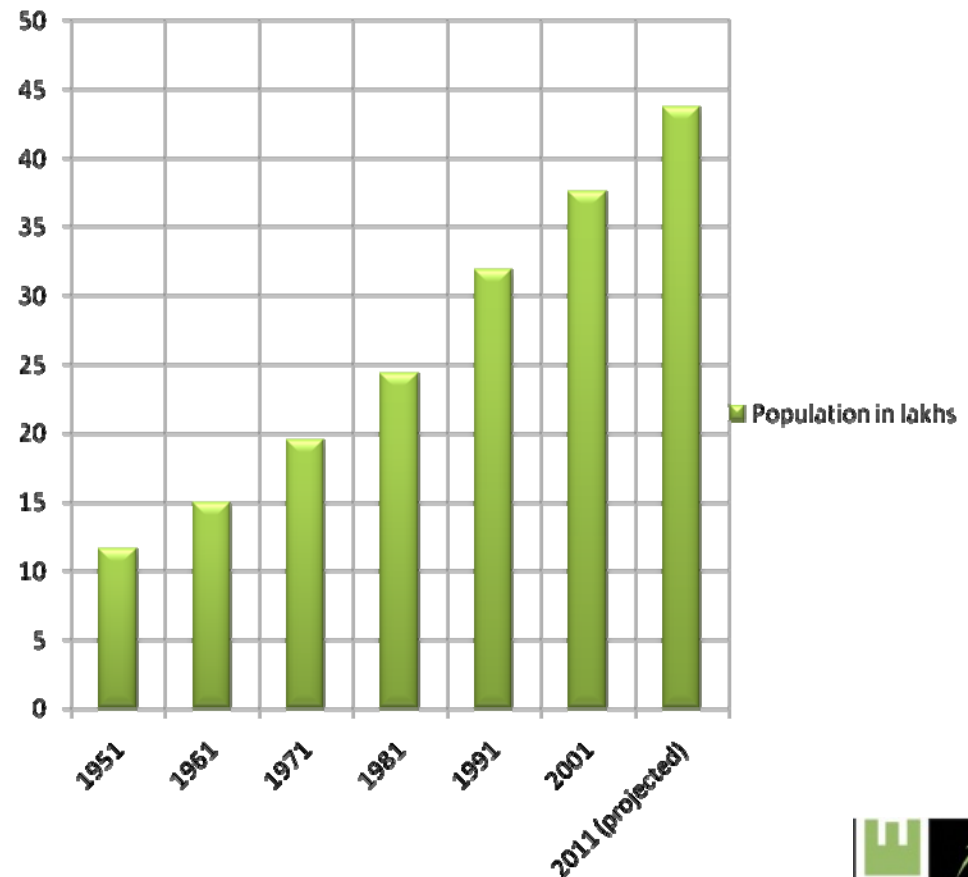
Note: Cumulative land loss in ten most erosion prone Islands: 30.6 sq km. This amounts to 69 per cent of net land loss, which is 44.042 sq km in the entire Sundarbans.

Source: S Hazra, K Samanta, A Mukhopadhyay and A Akhand 2010, 'Temporal Change Detection (2001-2008) Study of Sundarban', School of Oceanographic Studies, Jadavpur University

Not enough to live on

Population density in Indian Sundarbans is over 900 per sq km already (2001 census) which is expected to be well over a 1000 people a sq km now. This is far greater than the national average for rural areas. Almost the entire population depend on the natural resource based livelihood patterns.

Fig. Population Increase in Sundarban



Changes in the Land use patterns and land cover classes in Sunderbans between 2001 and 2009

Source: Hazra, S, Samanta K, Mukhopadhyay A & Akhand A., Temporal Change Detection (2001-2008) Study of Sundarban (2010), School of Oceanographic Studies, Jadavpur University

	Land use Land cover Classes	Year 2001 (in sq km)	Year 2009 (in sq km)
1	Dense Forest	1655.878	1651.3275
2	Degarded Forest	404.887	332.0008
3	Saline Banks	38.93	74.7965
4	Settlement with Vegetation	1226.334	1666.43
5	Agricultural Land	2149.615	1691.246
6	Agricultural Farm	603.603	649.1
7	Water Body	232.888	250.6531
8	Mudflats	23.897	12.6135
9	Sand	8.0835	8.7664
10	Reeclaimed land from forest	14.512	12.644
11	Swamp	14.847	20.41
	Total	6373.4745	6369.9878

Embankments: When solutions create problems



Men at work: Constructing a new embankment in Mousuni Island along the sea that was breached last year. It is an annual ritual in Sundarbans

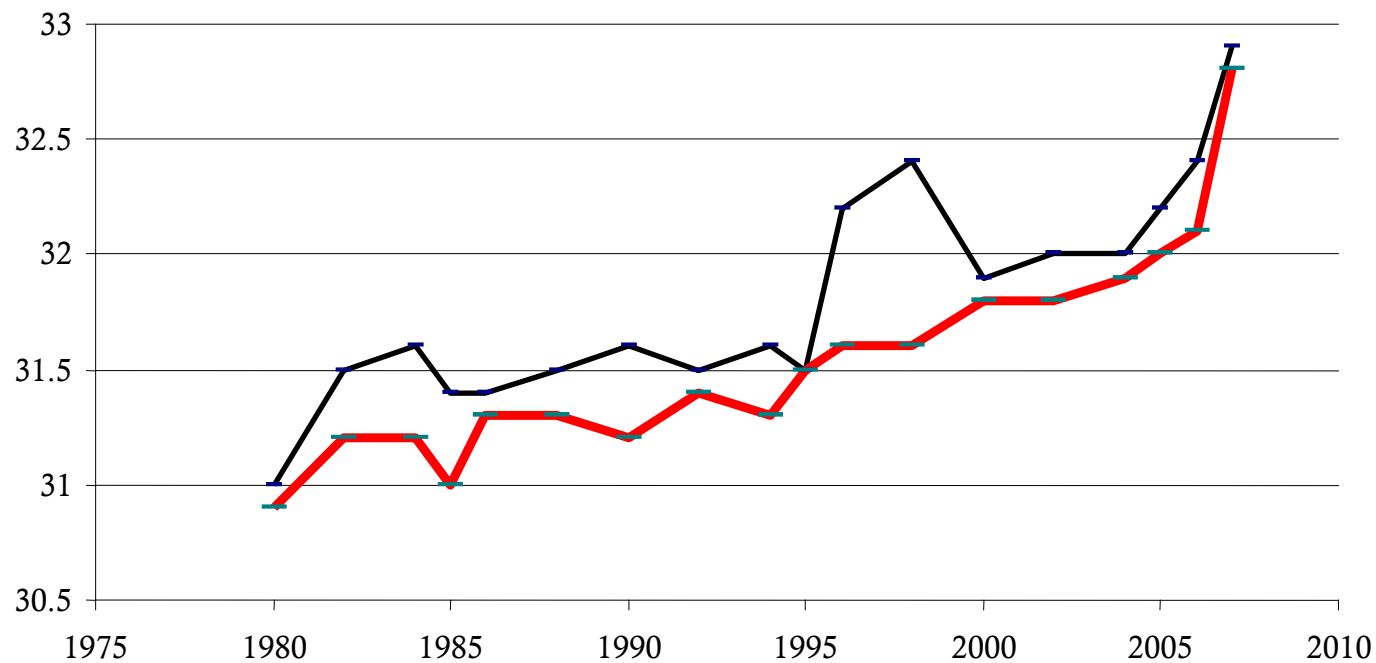
- Aggravated erosions in many places
- Heightened flood risks and increased soil salinity in many places
- Contributed to sea level rise through subsidence and increasing the height of river bed
- But they are essential nonetheless for human settlement



What the Poor Face then?



- **Rise in Sea surface temperature (SST) in Indian Sundarbans at the rate 0.5°C per decade**; against globally observed SST warming rate of 0.06°C per decade.
- Secondary impacts: Additional sea level rise because of thermal expansion, affects aquatic life – particularly fish distribution

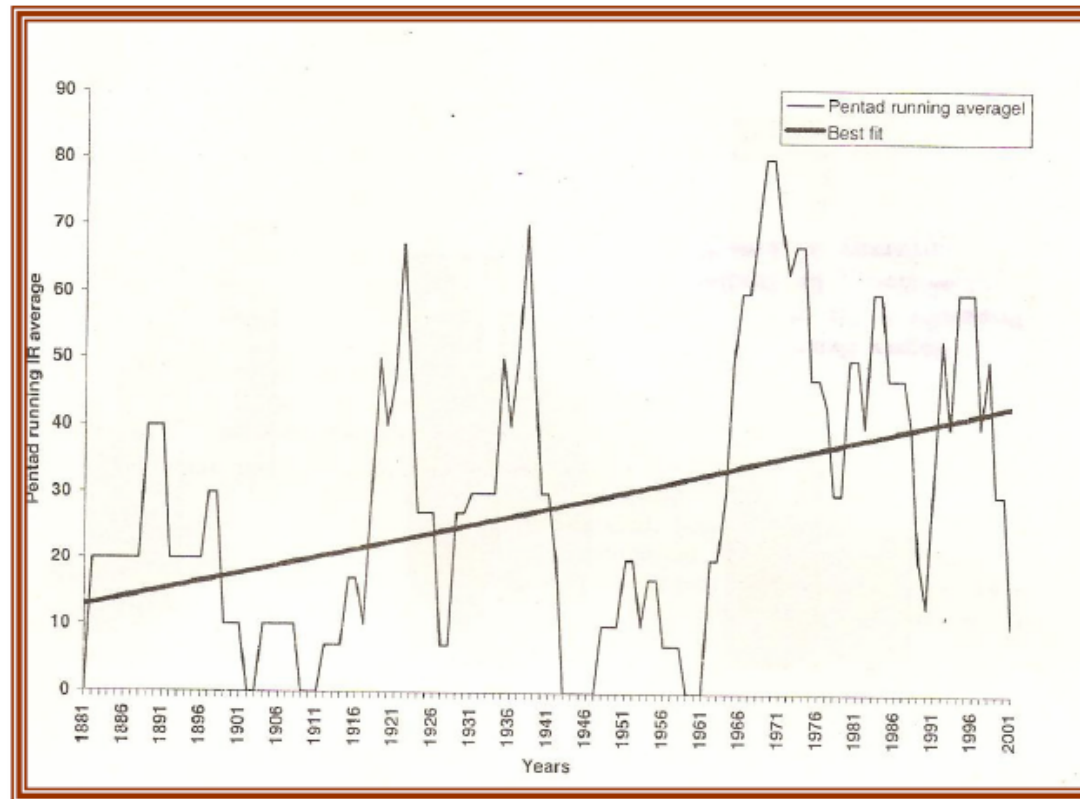


(Source: Mitra et al. 2009, 'Observed changes in water mass properties in the Indian Sunderbans (northwestern Bay of Bengal) during 1980-2007', *Current Science*, Vol. 97, Issue No 10, pp. 1445-1452.)



**More Severe cyclones which has risen by 26% over
past 120 years**

Secondary Impacts: Increase in soil salinity, higher tidal surges, damages to lives and livelihood



Source: Singh et al 2002, Mausam



- **Rise in Sea level** in the range of 5.37 - 12 mm/year, significantly higher than the **global average of 3.27 mm/year** between 1993 and 2010.

Secondary impacts: Soil salinity, risky seas for fisher-folk, higher risk of flooding and inundation, more acute erosion of land



- Monsoons longer but drier
- More intense when it rains
- Need more analysis

Secondary impacts: Agricultural yield heavily affected because of rainfall and temperature variation. Spawning of some fishes also affected because of the changes in temperature and humidity



Agriculture

- Too saline to cultivate
- Low paddy productivity (1.5-2 tonnes/hectare)
- Shrinking landmass
- Average land holdings very small (0.82 hectare)
- Inadequate irrigation
- Local farmers experiencing a drop in productivity in cash crops such as watermelon and chilly as well
- Farming is subsistence – even that is threatened now

Fishing

- Fish shifting from warm waters
- Fish losing spawning grounds because of erosion and coral bleaching
- Trash fish is increasing compared to commercially important fish
- Heavy metal (because of pollution) is increasing in the fish



Development Deficits



Rudimentary: Passenger boats are anything but safe, embankments are collapsing, roads don't lead anywhere

Infrastructure development was never a priority for the government. Now, in wake of climate change, the need is felt more acutely than ever before.

- About 44 per cent of the population live below the poverty line
- About 60 per cent of the households don't have access to clean drinking water
- About 87 per cent people live with some sort of food shortage – food insecurity is high
- About 47.55% households own no land – half (52.27%) of the workers in agriculture and fishing are daily wage labourers
- Only about 30 per cent of the families in live in *pucca* or partially *pucca* houses



Marginal Existence

- During 1992 and 2001, the number of marginal labour jumped from 49,429 to 4.15 lakh, an increase of almost 739% or over eight-folds
- However, the number of main workers in these 10 years remained almost constant, or hardly changed from about 15.27 lakh in 1991 to 15.30 lakh in 2001



Power

- The per capita electricity consumption is one-fourteenth of the national average. A majority of households doesn't have access to electricity
- Only 57 out of 1076 villages are fully connected
- Only 17 % households have grid connectivity
- Grid is being promoted despite its vulnerability to extreme weather events (that are common in Sundarbans) and “high cost of maintenance.”



Health



124,000 (12.4 lakh) people (or 1/3rd of the population) have no access to primary, institutionalised healthcare across

Only two days a week for four hours in most villages



Ideal doctor patient ratio is 1:1000, Indian average is 1:1792. For Sundarbans, well, it is...

Name of Blocks	Beds per 10,000 Pop	Doctors per lakh population	Doctor: Patient Ratio
Canning I	3.19	6.54	1:15290
Canning II	1.28	1.53	1:65359
Jaynagar I	2.1	3.2	1:39250
Jaynagar II	2.49	4.3	1:23255
Kultali	2.82	5.32	1:18796
Basanti	1.18	0.72	1:138000
Gosaba	1.39	2.24	1:44682
Mathurapur I	2.9	3.82	1:26178
Mathurapur II	4.48	5.46	1:18315
Kakdwip	4.85	10.45	1:9569
Sagar	4.42	4.85	1:20618
Namkhana	2.68	6.23	1:16051
Patharpratima	2.12	2.43	1:41152

Education: No Employability

- Absence of degree colleges, more specifically, technical institutes which would offer immediate jobs to students are absent
- Students in absence of such facilities (absence of electricity one of the major reasons behind non-availability of technical courses), drop out at secondary levels.
- This severely compromises their adaptive capacities by limiting their options, forcing them to be marginal workers



Dropping out for lack of options

Blocks	Upper Primary Drop Out Rate	Average population served (Upper Primary)	Area Served (Sq.Km) Upper Primary	Degree Colleges	Technical Institute	Households with education beyond class X
Canning I	39.31	16,308	12.52	1		16.6
Canning II	57.11	19,596	21.49			7.91
Jaynagar I	33.85	9,525	5.69	1		16.52
Jaynagar II	42.83	11,007	9.8			13.71
Kultali	52.95	12,532	20.41			9.02
Basanti	45.61	12,663	18.37		1	9.88
Gosaba	35.51	5,570	7.42	1		20.7
Mathurapur I	46.86	6,332	5.66			17.64
Mathurapur II	40.64	6,396	7.33	1	1	15.63
Kakdwip	43.26	6,136	6.4	1	1	15.82
Sagar	34.85	5,988	9.1			15.98
Namkhana	27.4	7,301	16.84	1	1	15.7
Patharpratima	44.33	7,034	11.82	1	1	16.26

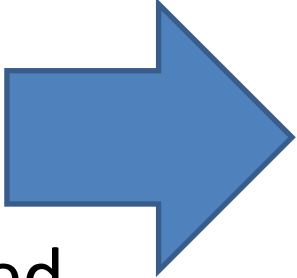
Source: Collated from data in: Anon 2009, 'District Human Development Report, South 24 Parganas', Development and Planning Department, Government of West Bengal

How to Enhance Adaptive Capacity?

- Foolproof Embankments – as much an engineering challenge as a social one
- Managing disasters efficiently – right from early warning, disaster shelters, communication systems to post disaster management
- Ensuring optimum utilisation of the region's productive capacity
- Ensuring alternate livelihoods



Ground Realities

- Absence of planning and institutional support
 - Climatic Changes
 - Absence of targeted strategies to address their culmination
 - Absence of Options
- 
- Increasing vulnerability of the poor
 - Reducing capacity to cope
 - Large scale out migration

As per a recent survey 75 per cent families had one or more members migrated out of their villages in search of



Elements of the Solution?

- **Lessons we learned:**
 - There is an urgent need for a comprehensive and well-researched development strategy that internalises present and future climate change impacts in each and every area of life, livelihood and infrastructure
 - The current development strategy has no climate change ‘additionality’ which must comprise the long-term plan
 - Need wider research and network between civil society on impacts and vulnerabilities
 - Global funds are needed to pay for the incremental development cost – but the local and national governments and the civil society must ensure that funds are well-directed and used efficiently to address the needs of the Sundarban



Saving people

- Sundarbans **cannot have more people**, there must be provision for alternative livelihood
- The most vulnerable – living in the embankments and along the banks – **need to be shifted out** urgently
- An effective **land and rehabilitation policy** that will facilitate the process
- **Regional development** plan that will help absorb additional people effectively
- Research on **new embankment technology** and design
- A disaster management system with clear protocols and responsibilities



Saving the Ecosystem

- Why save the ecosystem?
 - Because it is a natural buffer for cyclones and extreme weather events
 - Because it is a great carbon sink
 - According to a 2011 scientific paper, the forests of Sundarbans play a critical role as a carbon sink; trees and soils in forests can trap and store carbon dioxide (CO₂) from the atmosphere, a process known as carbon sequestration. Forests, when destroyed, lead to release of the stored carbon: tropical deforestation is reportedly responsible for about 20 per cent of the world's annual CO₂ emissions.
 - The biodiversity is precious and its sustenance determines better yields in agriculture, fishery and forest produce to better support about 4.5 million people who live here
 - Because survival of 4.5 million haplessly poor depend on it!!!



Easier said than done...

- Development planning never incorporated climate change in Sundarbans
- Has never kept a 'safety margins' nor helped enhancing the adaptive capacities of people
- The development failures kept exacerbating climate induced impacts – land management is the most stark example





Can the Sun Rise for the Sundarban?