Indo-Global
Social Service Society

CHANGING CLIMATE

Impact on the livelihoods of the communities living along the coastal tract of Odisha, Andhra Pradesh & West Bengal

Contents

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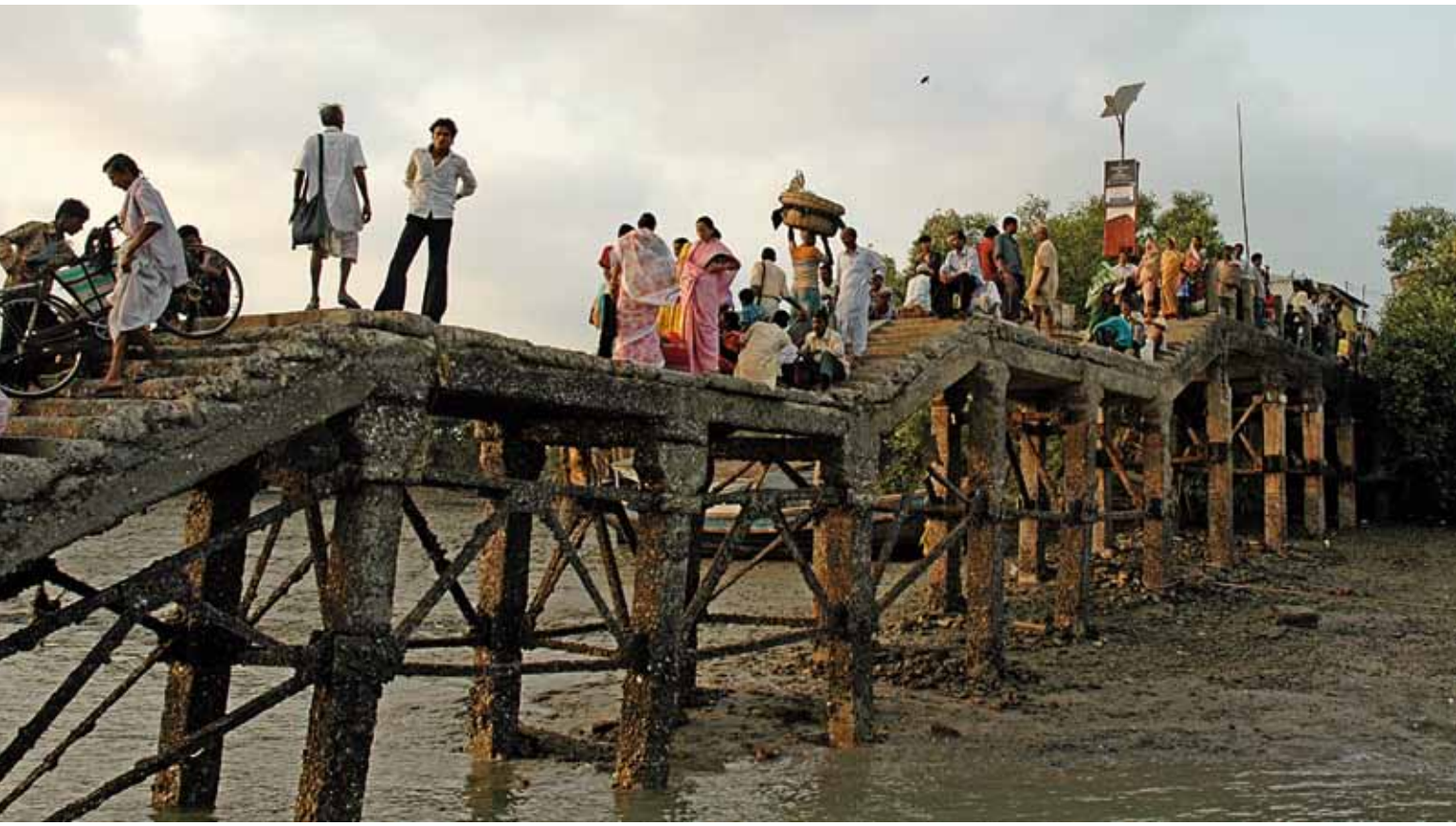


Foreword

The most vulnerable groups in Indian society are the rural and tribal poor as they largely depend on natural resources for their livelihood sustaining primarily on agriculture, livestock, fisheries and forestry. Unfortunately, all these resources have for a long time been under great threat due to various human activities like over exploitation, deforestation, urbanization, excessive use of fossil fuel, population growth, chemical intensive farming etc. which in turn has aggravated the vulnerability of these communities.

According to UNDP Human Development Report 2006, climate change "now poses what may be an unparalleled threat to human development". Its lead author, Kevin Watkins goes on to say that this "climate change is not an issue for 50 years down the road; it is an issue for today." He also warned that crop yield could fall by a third or more in some regions as whatever effects rain and moisture content in soil will also impact poverty.

Broad consequences include:

- Agriculture and rural development which will bear the brunt of climate change.
- Extreme poverty and malnutrition will increase as water insecurity increases.
- More extreme weather patterns will increase the risk of floods and droughts.
- Shrinking glaciers and rising sea levels will reduce access to fresh water (UNDP Human Development Report 2006).

Obviously, these climate change impacts vary strongly in their extent and form around the country, resulting in a wide variation in vulnerability depending on different agro-climatic locations, people's perceptions, their adaptive capacities and opportunities, prevalent socio-economic conditions, environmental factors, political (Local, State, National and International) motivations etc.

Therefore, to cope with the risks, a concerted effort in intervening on the issue will have to be specially adapted to suit the different situations. While adaptation to environmental change is not new, as all living beings have an inherent capacity to adapt to different climatic and environmental changes for survival, human induced changes pose a new challenge as these are potentially more serious and occur within very short spans of time.Keeping all these factors in mind, IGSSS commissioned an action research study on Climate Change which was conducted by Mr. Sanjay Khatua under its People's Empowerment for Accessing Rights to Livelihood (PEARL) programme.

The main objectives behind the study were:

- To understand the dynamics of 'climate change' and livelihood.
- To understand the perceived and felt 'changes' at community level and assess the impact (relating to major occupational groups and the livelihood resource base).
- To understand the adaptation (how individuals, groups and natural systems prepare for and respond to changes in climate or changes in their environment) and coping up mechanisms developed (at community level through self initiative and/or extension support).
- To develop understanding regarding the opportunities and possibilities.

We really appreciate the untiring efforts made by Sanjay in putting this report together.
IGSSS is also thankful to DHARA, Bhubaneswar/ Rajanagar and Ramnagar in Kendrapada district, Odisha, especially Ananda Swain of DHARA for his support for desk studies and partially accompanying the field appraisal; Society for Participatory Action& Reflection (SPAR), Kolkata, mainly their field staff at Patharpratima and Digambarpur Angikar, Patharpratima, South 24 Parganas, West Bengal; BRIGHT, Tuni, East Godavari, Andhra Pradesh, particularly T. Ravikiran for accompanying the field appraisal at East Godavari coast, and the community members at a number of villages and sea beaches along the coastal tract of Kendrapada & Jagatsinghpur coast in Odisha, Patharpratima block in 24 Parganas, West Bengal and Tuni, Kakinada and Kataremukona Mandal coast in East Godavari district, Andhra Pradesh.

K.C.SAHU
HEAD LIVELIHOOD

CONCEPT NOTE

RATIONALE
(on the basis of the observations that emerged out of the appraisal)

Livelihood and the resource bases are affected because of the direct and indirect impact of the changing climate and host of other contributing factors:

- Repeated failure and production loss in traditional land based farming due to host of factors such as erratic rainfall (late arrival, early cessation, uneven distribution, etc),increase in small intensity storms (triggered by increase in sea surface temperature, among other things), inundation by sea (apart from rough sea behaviour, there are host of human centric factors- malfunction of sluice gates, breach in weak saline embankments/no embankments; non responsive line departments, etc.) has rendered it highly undependable in the coastal tract, triggering low investment in land, migration, etc.

- Cost of agricultural operation has increased for number of factors; the one contributed by the changing climate is the rainfall fluctuation, necessitating farming operations to be completed within limited period (use of tractor and labour, pump irrigation) and use of chemical inputs to maintain the level of production.

- Another important livelihood sector, fishing (here focus on fishing in the river mouth region and the offshore region) is badly affected due to the changing climate and host of other contributing factors – fish breeding is affected due to surface temperature rise as well as the heavy nets of the big trawlers sweeping the sea floor; movement of economically important fish to the river mouth and offshore region; over exploitation resulting in substantial decrease in economically important species; reduction in fishing days due to rough sea behaviour/ increase in low intensity storms (coast specific); prolonged government ban on fishing in breeding season/nestling of Olive Ridley turtles(coast specific) and other factors. Small scale traditional fishing community finds it difficult to earn livelihood as the family is dependent on a single source of income ie - fishing.

- Livelihood resources are also negatively affected due to host of factors, some triggered by the changing climate- increase in soil salinity, increase in ground water salinity; offshore and mouth region heavily depleted by fish resources, and so on.

- Housing and habitations are increasingly vulnerable to sea, tidal aggression and bank erosion.

- While there are number of predictions having significant bearing to the coastal livelihood (sea level rise, increase in precipitation,extreme weather conditions,the experts corroborate the observation made at the community level (rise in sea surface temperature affecting fish breeding and triggering rough sea condition and low scale storm etc).

- The above brings home few important realizations: i) the changing and changed climatic characteristics are for long term and

the communities have to accept it as the reality of the time; ii) livelihood resource base has been taken as granted for long ; that they will not be depleted so easily, and now they need restraint in utilization, nurturing and management; iii) the livelihood practices, which might have functioned well in the past with the climate and the need prevalent then, need to be recalibrated to the changing climate and the socio-economic realities of the present times - the transition might not be easy for all sections of the occupational groups; iv) the marginal families might not be able to earn livelihood sustainably, matching to the present needs and aspirations, depending on depleted resources and increasing number of uncertainties without innovations and expanding the livelihood options; v) the policies and programs also need to consider the micro realities arising out of the impact of the changing climate and devise ways to address the issues effectively; vi) community participation in decision and management of the livelihood resources and addressing the emerging issues in the coastal region still remains negligible; vii) the increasing population of educated and semi educated youth lack critical awareness of the livelihood issues in perspective of the changing climate and alternative ways to live sustainably matching to the present socio-economic needs.

APPROACH

- Considering the plight of the coastal communities arising out of the present changing climate scenario, 'bottom-up' approach to adaptation is suggested- the 'present' being the starting point for adaptation 'in progress' to effectively address the future scenarios.

- Incorporation/improvisation of the selected adaptation practices in place among different communities with proven results (people have been coping with climate variability and extremes). The idea is that helping people to respond to existing climate variability, and learning how they have coped with it in the past, will help initiate responses to climate change scenario, now and in future.

- Sustained exploration of the expert findings and policy engagements to find ways and means to

prepare communities to successfully adapt to the future scenarios. Going by the projections, the impact of the future climate changes will probably be beyond the present capacities of the marginal communities to adapt effectively, hence 'climate change' needs to find special consideration within the development agenda at the micro level.

- Through strategic adaptation processes (focused on sustainable development/ improving upon the quality of livelihood in the given situation) make coastal families/ communities part of the macro mitigation process.

- Making the coastal communities and governance system responsive to the emerging issues arising out of the changing climate.

- Since engaging with climate change issues at the community level is relatively new and the replicable models are few and far between, instead of going for implementation, it would be pragmatic to develop different replicable models - taking the community experience into consideration - relating to expanding livelihood options, resource revival and management, alternative use of typical coastal resources- brackish soil, saline water, sand dunes, tidal creeks and swamps, mangroves, etc; alternative ways to enhance productivity within the given situation; alternative energy, agricultural inputs etc.

- View climate change related concern and realisations as an opportunity to recalibrate the livelihood practices, resource use and management matching the present realities.

POTENTIAL ACTION POINTS

- Expansion of livelihood options of the communities affected by the changing climate.

- Multipurpose use of typical coastal resources- brackish, soil, water, sand, creeks, etc.

- Sustainable increase of productivity of the limited land resources in the given situation.

- Capacity building/demonstration/piloting around alternative energy, low carbon farming and other proven models of sustainable/ multipurpose use of typical coastal resources.

- Documentation of adaptation practices and opportunities in the coastal region.

- Critical understanding of the line departments operational in the coastal areas; role and accountability, policies, etc and building capacity of the communities around these (for example including piloting of the participation of coastal communities in sluice management).

- Understanding and engaging with state policies relating to climate change, coastal vulnerabilities, compensation and social securities.

- Understanding the aspirations and dynamics of the youth from the coastal communities, especially the semi-educated and piloting capacity building around the alternatives.

BACKGROUND

Going by the experience of communities in different ecosystems, 'Climate change' is no more a matter of speculation or projection. Communities across diverse ecosystem experience change in the pattern of rainfall and temperature, to a large extent different than what they experienced couple of decades back. There are also a number of corresponding changes in the activities and resources the communities depend upon to make a living. The good work so far done in the areas of food and livelihood security, etc in order to improve the quality of living are being seriously challenged by the emerging phenomena of climate change.

In recent times, climate change related adaptation and mitigation have been one of the hot issues of engagement at local, national and international levels. Most of it is focused on stabilizing or regulating the levels of emission of the green house gases (GHG). In the din of the emission regulation and high profile negotiations, the voice of the marginal communities who have been struggling to cope with the 'changes' in the local climate have to a large extent been sidelined.

Like other ecosystems, the coastal ecosystem is also challenged by the recent changes in the climate and because of its typical geo-location specific features, the challenges for the coastal areas are rather critical. A number of regions at the eastern coast of India have been vulnerable to climatic hazards since long and have been violently impacted. The recent increase in frequency and intensity of low-pressure phenomena, sea surge, etc are attributed to climate change. Due to typical geographical features (low land, tidal creeks, proximity to sea and river mouths), relatively limited livelihood options (constrained by the typical ecological characteristics- tidal rivers, problem of salinity, lack of irrigation & communication and climate sensitive livelihood practices) and the imminent climate change related problems (sea level rise, increase in sea surface temperature, increase in low pressure phenomena, cyclone, etc), the coastal tract stands apart in the background of complex impact of the climate change.

In this context, one participatory appraisal was commissioned by IGSSS, New Delhi in order to gain insight to the impact on the livelihood of the communities living along the coastal tract of Odisha, West Bengal and Andhra Pradesh.

OBJECTIVES

- To develop understanding of the community perception relating to the changing climate and its impact on the livelihood (practices).
- To develop an understanding regarding the contributing factors other than the changing climate to the impact on livelihood (including infrastructure, programmes, and policies).
- To develop an understanding regarding coping mechanisms/adaptation in context of the impact on the livelihood.
- Develop a concept note for the potential action research.

METHODOLOGY AND SCOPE

- The rapid appraisal involved field work of about 12 days- in Rajanagar, Mahakalpada and Erasama blocks, respectively in Cuttack, Jagatsinghpur districts of Odisha; Payakaraopetta Kakinada and Katarenukona Mandal coast in East Godavari district of Andhra Pradesh; and Patharpratima block (Sunderbans) in 24 Parganas district in West Bengal.
- The rapid appraisals involved transect, FGD, person to person interview and case studies.
- Desk study included analysis of news paper clippings and rapid browsing of net.

Limitations

- In consideration of the time and resources available, the study focused on collecting trends, perceptions and expert observations from secondary sources.

KEY OBSERVATIONS FROM THE APPRAISAL

THE EASTERN COAST OF INDIA

- The east coast of India, extending from the international border of India and Bangladesh in the northeast to Kanyakumari in the south, is 2,545 km long. It covers 21 districts in the states of West Bengal, Odisha, Andhra Pradesh and Tamil Nadu and has a population of approximately 128 million. Four states and one Union Territory (U.T.), viz. West Bengal (157 km), Odisha (476 km), Andhra Pradesh (974 km) Tamil Nadu and Pondicherry U.T. (938 km) share the eastern coastline.
- A large portion of the population along the coastline is dependent on multiple products and services available in their ecological niches - agriculture, fishing, animal husbandry, and collection of Non Timber Forest Produce(NTFP) materials from the mangroves forest and other coastal vegetations, horticultural plantations coastal natural resource based craft.
- The livelihood options of the communities living along the coastal tract are in general limited owing to the geo-climatological features of the region – river mouth area crisscrossed with a number of tidal creeks, limited rain-fed farm lands, saline /brackish marshy lands, recurrent flooding and oceanic disturbances.
- Contrary to the popular perception (higher literacy rate, being politically active), the costal districts have considerable percentage of families 'living below poverty line'. The data presented below shows it clearly :

EXTENT OF RURAL FAMILIES BELOW THE POVERTY LINE IN COASTAL DISTRICTS OF ORISSA

District	Total rural families	% of BPL families in rural area
Balasore	167974	72
Bhadrak	215185	64
Kendrapada	219436	60
Jagatsinghpur	172300	54
Puri	236721	69
Ganjam	478899	61

Source: Journal of environmental research and development , vol.7 no 1A, JULY- September 2012

PERCEIVED IMPACT INDUCED BY THE CHANGE IN THE LOCAL WEATHER/CLIMATE CHANGE

Increasing cases of intrusion of sea and shore erosion along Orissa coast

- There is sharp increase in the number of low pressure areas in the Bay of Bengal. For example, during 2005, the Bay of Bengal witnessed 10 low-pressure phenomena, six of which were in the post-monsoon period of October- December. Increased incidence of low pressure- play havoc in numerous scattered micro regions along the coast including intrusion of sea, damaging crop and other livelihood resources and causing saline water logging. News reports portray complexity of this issue.

For instance, breaches in saline embankments, especially during August, September and October, are regularly reported in Mahakalapada (Chakada Gagua, Kharinasi, Jambu) and Rajanagar blocks (Baunsagadi-Satabhaya) in Kendrapada district, Odisha. The problem is further accentuated due to weak saline embankments. For example, going by the news report, breaches and weak embankment are often reported at following places in Kendrapada district, Odisha:

- The 25km Talachua-Rangani embankment in Rajanagar block.
- 32 km long saline embankment along Hansua river Rajanagar.
- Saline embankment in Chakada Gagua, Radia Kansara, Baulakani and Baradanga, Suniti, Jambu, Kharinasi region, Mahakalpada block.
- Satabhaya cluster of villages along Bay of Bengal in Rajanagar block have been in the news for about four decades due to intrusion of sea to landmass. Most of the agricultural land of Satabhaya and Kahnupur villages have already been engulfed by the sea. The sea, which was about 3 kilometers away from the famous Panchubarahi temple in Satabhaya village, is at present only few meters away.
- Damage of houses due to intrusion of high tidal waves have often been reported in Kharanasi, Batighar, Jamboo/ Kansarbadadandua- region in Mahakalapada block and Satabhaya Kanhupur region in Rajanagar Block

The case study from Rajanagar mirrors the situation that many pockets along Odisha coast face - damage of crops, houses and embankments due to intrusion of sea water. The locations which are often reported include:

- Chandabali & Basudevpur Blocks, Bhadrak district suffer repeated loss of paddy crop due to intrusion of sea water and increasing soil salinity since mid seventies. While areas in Chandabali block include Dhamara, Kaithakola, Dosinga, Karanjamala, Bansada, etc, areas in Basudevpur block include Chudamani, Iram, Adhuan, Nuagaon, Sudarsanpur, Kumarpur, Jagannathpur, Artung, Krushnapur, Bideipur, Balimunda. Large areas of Tihidi and Dhamangar blocks are also affected.
- Baliapal block, Remuna block and Sadar block, Balasore district- inundation of large amount of paddy land; damage to houses due to inundation of sea water and high tide.
- Region near Devi river mouth, Jagatsinghpur - gale wind drives the sea water to paddy fields, due to the low pressure there is flooding by high tides of 3m high, breaching the saline embankment in several places since last 15 years.
- Sea becoming violent along the Astarang coast, Puri district over the last 2-3 decades. At some places sea has intruded more than 2 kilometers inland making villages shift number of times. Hundreds of acres of farm land, village ponds, and vast grazing lands in many villages have gone into the sea.

INDICATORS OF CHANGING 'CLIMATE': COMMUNITY EXPERIENCE /PERCEPTION

- Increase in occurrence of low pressure during summer and monsoon period (May to October).
- Increase in incidence of rough sea condition; sea aggression – high wave, high tides, sea surge to inland areas.
- Continuous dry period of about 6 to 7 months; no spring rain; comparatively higher temperature throughout the year.
- Decrease in winter days & intensity of cold as well.
- Longer period of effect of high tide during full moon/new moon period.
- Summer comes early and stays longer with relatively high temperature (about six months); decrease in summer rainfall.
- Irregular/unusual/delayed rain fall, heavy pouring of rain within short period, decrease in rainy days, and increase in low pressure.

SALINE WATER INTRUSION AND IMPACT ON THE FARMING COMMUNITIES, A CASE FROM RAJNAGAR, KENDRAPADA DISTRICT

Praharajpur village, Bramhansahi Gram Panchayat, Rajanagar Block, district Kendrapada is one of the many villages which is affected by saline water intrusion at regular intervals.

The geographical landmarks of the village include: Barunei river mouth, Bay of Bengal and Mangroves forest in the east; river Hansina and agriculture land in the west; agricultural land in the north; and river Hansina in the west.

The village is part of the mangroves ecosystem (Bhitarakaniaka region) characterized by soil salinity, brackish water, lack of irrigation, limited dependence on mangroves for fuel, fodder and building material. The dependence on mangroves has drastically been reduced due to substantial depletion of the Mangroves. The impact is evident in poor housing conditions (repeated cyclones/storms are other contributing factors).

Praharajpur has about 115 families with about 300 acres of land. Main occupations include cultivation of Khariff paddy, livestock rearing, captive pond fish culture and wage earning. Most of the landowning families are marginal farmers harvesting about 25 quintals of paddy per family in years of normal weather condition and small amount of pulses 50 - 100 kg.

RECOUNTING OF THE EXTREME WEATHER EVENTS

<table>
<tr><td>Major Cyclones</td><td>1971, 1982, 1992, 1999</td><td rowspan="3">• Crop (paddy) loss since 1992 (1992 – 100%, 1999 – 100%, 2007 – 50%, 2008 – 50%, 2009 – 25%)
• When sea water enters, surface water bodie sturn saline making it difficult for the Rabi crop. Pre-monsoon saline water intrusion increases soil salinity that reduces growth and production of paddy. Sea water intrusion during growing stage of paddy has chain impacts - decrease in yield, straw becomes useless for thatching and fodder, triggering distress sale of livestock.
• Impact of soil salinity remains for one year – decreased yield during that period.
• Shortage of thatching material (paddy straw) puts pressure on mangroves ; people collect Hentala leaves for thatching and face harassment from forest personnel.
• Increased cases of Migration/wage earning.</td></tr>
<tr><td>Sea surge/water entering into agricultural land due to low pressure</td><td>•2009 (3 times), 2008 (2 times), 2007 (3 times)</td></tr>
<tr><td>Longer/high tidal effect during full moon/new moon times</td><td>• Jagar Amabasya, Baruni Amabasya, Chitalagi Amabasya, Dipabali Amabasya, Kumar Purnima, Kartik Purnima, Indu Purnima. Highest tides in Kumar Purnima & Dipabali Amabasya. Sea becomes rough and water swells when wind speed touches 20kms</td></tr>
<tr><td></td><td>• Village level Paddy production (115 family – 300 acre) in normal year – 3000 quintal</td><td>Sample calculation: Loss of paddy (village level) due to saline water intrusion:
Year Loss in qtl. Loss in Rs.
(as per present local price)
1992 3000 24,00,000
1999 3000 24,00,000
2007 1500 12,00,000
2008 1500 12,00,000
2009 750 6,00,000
5 times in 17 years 78,00,000</td></tr>
</table>

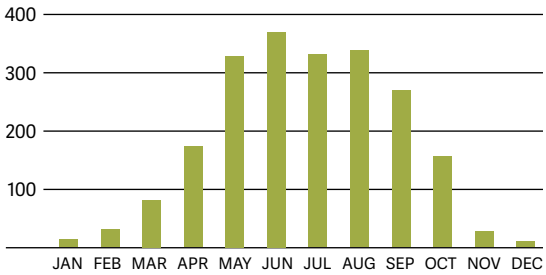
Coping with the situation: does not involve any long term approach; coping include: purchase food material, going for wage earning/migration, selling of livestock, incurring loan, skipping annual thatching of houses, selling trees, purchasing seed from market, etc.

- Number of villages in Erasama, Kujanga, Balikuda and Tirtol blocks in Jagatsinghpur district face similar problem as narrated above. The mouth of local rivulets Khaprakhal, Gaiguhal and Pitapari threatens large areas in Gobindpur, Gadharishpur, Goda, Ambiki, Dhinkia, Nuagan, Gadkujang, Padmapur, Kunjakothi of the above blocks. Large amount of land have been (around 44,473 ha) inundated by saline water and sand casting (about 8,646 ha).
- Puri and Konark- In 2008 July, sea crossed over 300 meters and reached the marine drive road that connects Puri and Konark - two towns of tourist importance. About 2 and half meters from the side of the road was washed away by the sea posing danger of complete breaching of the road. Of late, several pockets at the Ganjam coast have been facing similar problems frequently.

Ref: Indian Express August 29th, 2000/ August 25th, 2009/ May 24th, 2009/ April 16th, 2009/ October 26th, 2008/ August 23rd, 2008/ June 16th, 2008/ June 16th, 2008/ September 10th, 2005/ September 19th, 2005/September 21st, 2005/August 23rd,1997,Asian Age./ July 2nd, 2000 Sambad/January 25th, 2000, October 29th, 2003, September 19th, 2005 / November 10th, 2009, June 14th,2004

- Between 1877-1990, 964 cyclone crossed the eastern coast, of that 422 struck Odisha(Indian Meteorological department). Around 100000 hectares of agricultural land are inundated every year damaging the standing crop and also suffers from high levels of salination (Annual Survey of Indian Agriculture, Hindu, 2002-03). The condition is aggravated by frequent breach in saline embankments, weak condition of the saline embankments and defunct sluice gates.

Orissa: No. of climatic Hazards (1970-2007)



Seasonal peaks shifting from June- August to April –October
Source: workshop presentation: Panda Dr. GK, Department of Geography, Utkal University, Climate Change, Coastal Vulnerability & Policy Choices

ODISHA: TOP 10 DISASTERS BASED ON NO. OF DEATHS (1971-2007)

Sl.no	Year	Death	Hazard
1	1999	9924	Cyclone
2	1971	5307	Cyclone
3	1998	2042	Heat waves
4	2007	351	Lightning
5	2005	303	Lightning
6	2004	298	Lightning
7	2006	283	Lightning
8	2001	270	Lightning
9	2003	262	Lightning
10	2005	235	Heat waves

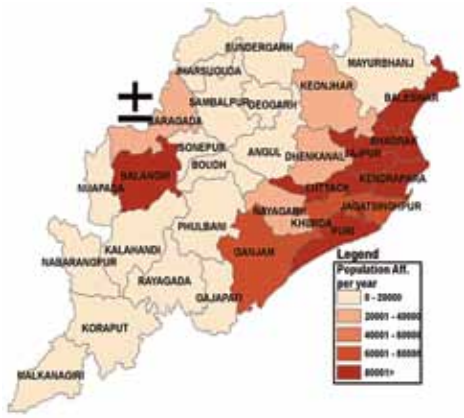
EASTERN COAST: EXTENT OF COAST EROSION

Sl no	State/UT	Length of coast (KM)	Length of coast affected by sea erosion (km)
1	Andhra Pradesh	973.70	9.19
2	Andaman & Nicobar islands	1962.00	N.A.
3	Goa, Daman & Diu	160.50	10.5
4	Gujarat	1214.70	36.40
5	Karnataka	280.00	249.56
6	Kerala	569.70	480.00
7	Lakshadweep Islands	132.00	132.00
8	Maharashtra	652.60	263.00
9	Odisha	476.40	107.55
10	Pondicherry	30.60	6.40
11	Tamil Nadu	906.90	36.15
12	West Bengal	157.50	49.00
	Total	**7516.60**	**1379.75**

Source: Coastal erosion & protection- a national perspective/workshop on coastal protection measures- 5th/6th November 2004

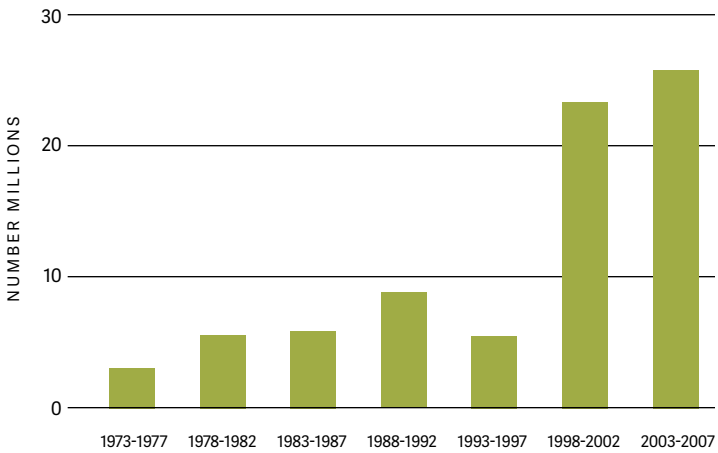
CLIMATIC HAZARDS IN ODISHA: POPULATION AFFECTED

Annually >1 lakh people are affected from coastal districts
Flood & Cyclone accounts for 93 % of population affected



Source: Workshop presentation: Panda Dr. GK, Department of Geography, Utkal University, Climate Change, Coastal Vulnerability & Policy Choices/2012

ODISHA: PEOPLE AFFECTED BY CLIMATIC HAZARDS- 1973-2007



SEASHORE EROSION

Seashore erosion is one of the emerging problems due to aggressive sea behavior, increased low-pressure phenomena and manmade factors. According to a 2011 assessment by the Institute of Ocean Management at Chennai's Anna University, more than a third of Odisha's coastline is prone to erosion, and eight percent is vulnerable to severe erosion, including Gahirmatha beach, which is the world's second largest nesting ground for the endangered Olive Ridley sea turtle.

- Satabhaya cluster of hamlets of Rajanagar block of Kendrapada district in Odisha has been in the news for over last three decades for the aggressive intrusion of sea into the land mass lapping up of land, houses and trees. According to revenue department, during 1930 settlement, Satabhaya region covered an area of 320 square km. But in 2000, the region has been reduced to 155 square km.

› **Podampeta village** on the coast near to Behampur in Ganjam district of Odisha inhabited by marine fisherman community has been facing severe sea erosion for the past few years. As the village is situated close to Rushikulya river mouth, danger of erosion has increased further for its inhabitants. In 2007, around 20 houses of the village were washed away by the sea.

Some other villages on Ganjam coast that face menace of sea erosion are Bada Arjyapalli, Sana Arjyapalli, Badakaturu, Sanakaturu, and Kandara Arjyapalli. Sea water enters villages during high tides accompanied by gale wind. The erosion in these areas was quite high in 2007 and 2008. It was substantially reduced in 2009 but again became more aggressive during 2012.

Photo courtesy: The Hindu, September 1, 2011/ http://www.thehindu.com/todays-paper/tp-national/tp-otherstates/sea-erosion-podampeta-villagers-in-grip-of-fear/article2416858.ece

- Recently it is happening all over the Odisha coast, especially in Rajanagar , Astaranga, Puri and Ganjam coasts. The fishing village Podampeta at Ganjam coast, Odisha is already submerged in the sea where as Garampeta village is just awaiting complete submergence.

Ineffective saline embankments

- Odisha has about 1517.67 kms of saline embankments covering eight districts. Presently they are maintained by water Resources Department. These embankments are the lifelines of the people living in the villages along the coast. People have no participation in the management of these embankments, the adjoining areas are often used by different stakeholders like prawn gheri owners, migrant workers, fisher folks who do not have long term stake.
- Going by the news paper reports, weak saline embankments and mal functioning or nonexistent sluice gates have been among the major contributing factors that further aggravate the flooding situation as well as intrusion of saline water. Some samples from Odisha coast, from the news paper review:

- 28 saline embankments measuring 278.5 km in Rajanagar block in Kendrapada district, are in weak condition and unable to prevent saline water entering agricultural lands even during minor tidal effect.
- Right embankment of Devi River is open, through which tidal waves enter and adversely affects large parts of Astaranga block of Puri district.
- 135 kms saline embankments and 200kms of gheribandhs in Erasama, Kujanga and Balikuda blocks in Jagatsinghpur district have weakened ever since the super cyclone in 1999. Some of the saline embankments made in 1960 have become so weak that saline water enters agricultural field during the high tide.
- The situation is no different in large parts of the coastal Mahakalapada block in Kendrapada district.
- 60 sluice gates in Mahakalpada & Rajanagar block are on the verge of damage. Similarly, out of 150 sluice gates under Erasama saline division in Jagatsinghpur, nearly 50 gates do not function.
- Sea water engulfed 1600 acre of agricultutral lands and damaged standing crops due to 140 meter long beach in Kharanasi Gram Panchayat, Mahakalapada block, Kendrapada district.

Ref: Sambad: 24.10.09/27.10.09/21.10.00/09.07.02/Ind Exp- 30.05.97/17.05.03/28.08.01/ 23.03.00/ 20.08.03/21.06.04/29.09.05

WATER LOGGING

- Increased case of water logging induced by increase in number of low pressure accompanied with heavy rainfall and the problem of discharge owing to manmade obstructions – roads, gheries and choking of the natural drainage system,

LOSS OF PADDY DUE TO INTRUSION OF SALINE WATER: FROM NEWS PAPER CLIPPINGS

Village/GP affected	Extent of crop/land affected	Time/period
Gagua GP, Mahakalpada block	5000 acres paddy crop	October, 2000
Gobardhanpur, Balishripatna, Kusaei, Kirajodi, Kaduagada villages under Bramahanisahi GP, Rajnagar Block	5000 acres paddy crop	August, 2001
Talachua & Rangini GP, Rajnagar Block	16,000 villagers and their land affected	May, 2003
Kharanasi GP, Mahakalpada block	1600 acres paddy crop	August, 2003
Ramanagar GP, Mahakalpada block	1000 acres paddy crop	August, 2003
Baulakani, Ramnagar, Kharanasi GP, Mahakalpada Block	4000 acres paddy crop	August, 2003
Satyabhaya, Kanpur village/ Satyabhaya GP/ Rajnagar Block	Most of the paddy land of the villages	August, 2004
Kharanasi, Batighar, Jamboo villages of Mahakalpada block & Kansarbadadandua village of Rajnagar block	Cultivable lands are under two ft. sea water	June, 2004
Rajapatna, Jotiprasad, Mukundapalli, Khasmunda, Baghamari, Pravati, Ahirajpur, Saneipur and other villages under Talachua & Rangini GP, Rajanagar Block	10 seaside villagers are marooned and 1000 acres of agricultural land under knee-deep water.	September, 2005
Akhadasali area, Mahakalpada Block	Sea mouth is only 2 km away from the area; all agri. land become saline due to sea water ingress in the land.	July, 2005
Mangalpur, Balipal, Deulipada, Barakanda, Badihi, Goruha, Suniti, Rajgarh, Alailo, Badakul, Karanja, Ameipal-GP; Mahakalpada Block	Half the year the whole area submerged in saline water.	June, 2005

› About 3 decades back the sea at **Pentha village** in Rajanagar block in Kendrapada district was about 3 kilometers away but at present just about 50 meters away from the habitation. In the past two years alone, huge waves have destroyed two 7-metre high (23-feet) embankments and eroded 20 hectares (49 acres) of farmland.

Extreme weather, tidal surges and the increasing salt contamination of the land is making agriculture even harder.

Photo courtesy: http://www.sagarsandesh.com/crisis/work-on-geo-tube-sea-wall-project-to-begin-soon/

siltation of river mouth, etc has been reported from different parts of the coastal area.

For instance, a number of regions in coastal Odisha are often reported in newspapers for water logging; they include areas in Naugaon, Erasama (about 44% cultivated land in about 15 Panchayats in Erasama block get waterlogged every year) and Balikuda blocks in Jagatsinghpur district. Similarly, areas adjoining Chilika lake - Kanas, Bramhagiri of Puri district are often in news for water logging mainly due to obstruction of river mouth, weed growth in Daya, Bhargavi & Luna rivers which drain to Chilika lake.
Ref: Sambad : 20.09 2005/11.10.98/29.09.00/ 04.80.01/ 17.09.01/Indian Exp: 16.06.04.

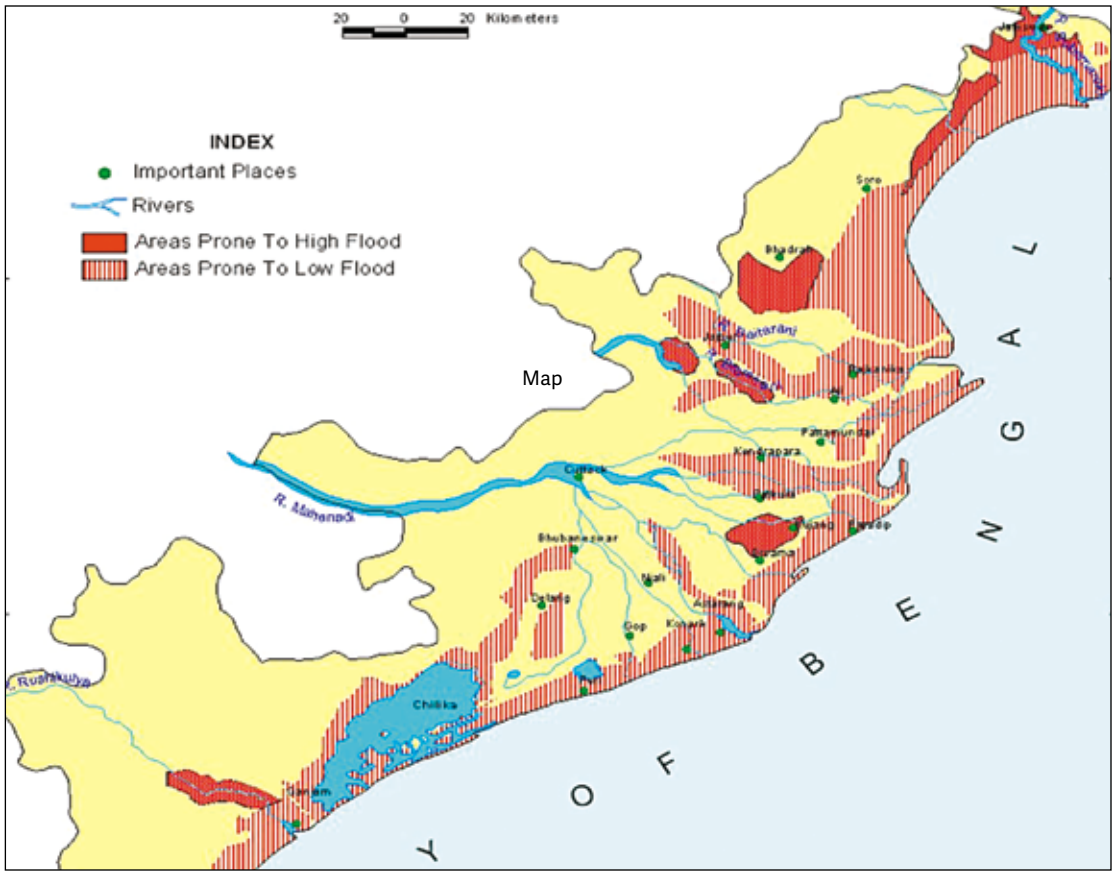
INCREASED INCIDENCE OF FLOODS

Various studies state that Odisha, from 1955 to 2008, has experienced 28 years of flood, 19 years of drought and seven years of cyclone along with the Super Cyclone in 1999. Interestingly, flood and drought are experienced in the same year due to a huge change in the pattern of rainfall. Number of coastal regions are regularly reported for flooding; for instance, flood caused by backwater of Luna river of Delang in Puri district, Jaleswar, Baliapada, Basta and Bhogarai blocks of Balasore district affected by Subarnarekha and Budhabalanga - some parts are flooded repeatedly in the same year; Dhamnagar, Tihidi, Chandabali blocks of Bhadrak district due to Baitarani and Kapali ; Tirtol, Biridi, Kujanga, Balikuda, Naugaon and Jagatsinghpur blocks of Jagatsinghpur district due to Devi, Mahanadi, Paika and Chitrotpala waters; Marshaghai, Mahakalpada, Patkura, Garadpur and Mahakapada blocks of Kendrapada district due to Chitrotpala and Luna rivers.

Ref: Indian Express: 02.08.06/25.08.06/04.09.06/ 09.09.06/20.08.06/07.07.07/09.07.07/26.09.07/24.09.07,

SBD-12.08.07/22.08.07/ 26.09.07

AREAS PRONE TO FLOOD: ODISHA



IMPACT ON OCCUPATIONS

Fishing: experience & perception from fishing communities across the coast

Overall increase in the temperature throughout the year, long dry seasons and sea surface temperature rise- as observed by the communities living along the coast as well as the experts- adversely affect the fish breeding and movement; trigger rough sea conditions. This has made the livelihood of the small scale fishing families vulnerable. Of course, there are host of other contributing factors other than the changing climate, such as overfishing, pollution, decrease in the inflow of water to the sea of the rivers, etc.

REDUCTION IN FISH CATCH

- Reduction in fish catch is reported across the coastal tract of Odisha, forcing fishing families to migrate to other areas- sometimes out of state or diversify to other livelihood options. For example, 290 Nolia fishing families of Markandi (25 km from Berhampur town in Ganjam district of Odisha) find it difficult to earn livelihood based on fishing due to severe depletion of fish from the offshore region. Income per day has reduced from Rs.50 – 90 to Rs. 20. So, many families are migrating to Maharashtra, Goa and Kerala. Women sit idle because of non availability of fish to prepare dry-fish.
- Presented below are interesting insights shared by the fishermen across the Odisha and Andhra coast visited during the appraisal.

FISH AND THE CHANGE IN THEIR HABITAT

A perceptible shift was observed in geographic distribution of the warm water fish species. Elevated temperature range (0.37ºC–0.67ºC) and alteration in the pattern of monsoon proved a major factor for shifting the breeding period of Indian major crops from June to March in fish hatcheries of West Bengal and Orissa. Ex-situ experiment carried out indicated a rising trend in the specific growth rate of Labeo rohita with increasing temperature between 29ºC and 34ºC.

Though there were wide monthly fluctuations in the number of spawners, grouping the number of spawners into two major seasons, i.e., warm (April to September) and cool (October to March) seasons showed a clear pattern in the shift of the spawning season. Whereas 35.3% of the spawners occurred during the warm months in 1980, the number of spawners gradually reduced and only 5% of the spawners occurred during the same season in 2004. In 1980, it was observed that 64.7% of the spawners occurred during October- March, whereas as high as 95% of the spawners occurred during the same season in 2004. In other words, the number of spawners reduced in summer and shifted towards cooler months.

Analysis of historical weather data showed that during April – September, the annual average sea surface temperature (SST) off Chennai coast increased from 29.07°C during 1981-85 to 29.38°C by 2001-04; and from 27.86°C to 28.01°C during October-March. There was good correlation between SST and spawning activity of the two species of threadfin breams. The occurrence of spawners (percent of spawners in the annual total number of spawners) of N. japonicus linearly decreased with increasing temperature during April – September, and increased positively during October – March. It appears that SST between 28º C and 29º C may be the optimum and when the SST exceeds 29º C, the fish shift the spawning activity to seasons when the temperature is around the preferred optima.
(**Source net:** DARE/ICAR ANNUAL REPORT 2008–2009)

THE FISH AND THE FISHERS :
MULTIPLE CHALLENGES INCLUDING THE CLIMATE CHANGE

Bundu Masen and about 60 other families from Pakarayapeta near Tuni in East Godavari district have been seasonally migrating to Gachakayapara, Katrenukona Mandal, East Godavari district since last 10 years. Usually, they come in September, after Ganesh chaturthi and stay up to March. Reason: Severe depletion of fish in their area in the offshore region. However, they do not fish for free here, they give Rs. 5 per income of Rs.100 – local fishermen hold auction for the sellers who come with tray on motorbikes and deduct the commission. They are not allowed to market of their own.

'Sea is getting warmer- if sea is cool no fish and if sea is hot no fish' ,observed Bundu. Incidences of sudden big waves are increasing.

Economically important fish are drastically decreasing mainly because of human pressure - fish lay egg in depressions in sea bed. The net of trawlers sweep the sea bed and cover the egg with sand, and the eggs get spoiled, added Bundu.

In coastal Jambu village of Mahaklapada block of Kendrapada district, more than 1000 families depend on fishing in the tidal creeks and offshore regions. Radhu Gain of the Fishery ghat hamlet is one of them, who uses his row boat. Recently he purchased six goats as earning livelihood from fishing is becoming difficult due to multiple factors- change in the climate, over exploitation by the trawlers, reduction in the flow in the river and the double ban, during the breeding period in April to May and from October to February, during nestling of the Olive Ridley turtles.

Fishing is closely linked with the weather – with the easterly wind blowing, mainly during rainy season, fish go back to the sea, and fish catch falls to 50%. Moreover, this is the period of depression. Sea becomes rough with southerly wind- rough sea phenomena; no difference in fish but problem for fishermen to negotiate. With southerly wind, jelly fish will come from the sea and stick to net; they are poisonous, especially red jelly fish. Number of depression has increased, especially during months of July and August. Strong north wind blowing towards sea would make river comparatively cold and fish would like to stay close to mouth as it is warmer, fishers find it difficult to go to fish due to high waves. Fishing days has reduced to one third, observed Radhu Gain.

Dharmeya, 92 , Venkatanagaram village, Keshvaram Panchayat, Payakaraopetta Mandal , East Godaveri.

Fish catch has reduced, especially for the traditional fishermen; he attributes it to manmade reasons. Then the net and mesh size was different, no one used to catch mother fish (during breeding season).Fishing used to depend on muscle, now mostly on machines.

At present overall production has come down, specific species –hilsa, pomfret have decreased substantially, mostly due to catching of the mother fish. In summer, the fish used to come to backwaters to lay egg, now they are not spared there.

However, according to Dharmeya, the seas have become calmer - the height of wave has come down. They go for fishing throughout the year, except April –May 15th, when it is officially restricted. They have one day off in a week in rotation with neighbouring villages.

Sea water has always been 'finger warm'. During rain they come down from the open boat to sea water to keep themselves warm, shared Dharmeya.

Bullokareya, also from Venkatanagaram village, Keshavarm Panchayat, Payakaraopetta mandal. Bullokareya uses traditional boat and use mesh size of 1 – 1.5". Commercially important Konam fish is available between December-March (also Kanakarta), more catch when light breeze blows- sales 300/400 Rs./ Kg. They also catch soara and tuna fish which sale in the local market.

From March to June, Maga (whisker fish) and small Konam are available. This happens to be the cyclone and depression time – sometimes about three times in a week. Fish caught in May is filled with eggs. May to August more prawns are available.

Nowadays, they have machines. So even if they make loss they cover up the next day. They can go to 100 kilometers in a day – starting at one a.m. in the night and come that very same day or stay up to three days.

From September to December there is no certainty in the type of fish caught, usually the diversity is high during post rainy season. In a year, altogether, they do not go to sea for three months due to cyclone and other reasons; nowadays prior information is available through TV. Sometimes they study the height of the wave and if it is more than 10' at a distance; then he shared that they do not venture to the sea.

He agreed with 92 year old Dharmeya that the incidence of rough weather has decreased. Number of people going for fishing is decreasing; younger people prefer to work for factories. Some fishers seasonally migrate to other areas for good catch. Ring nets and Sona trawlers are new. For overboard boat Rs. 30,000 income per month is the bench mark- Rs. 15,000 for expenses and oil. Maintenance is quite high; so some fishers (like him) continue with traditional boat and net, Bullokareya added.

Ms. Rajamma, Venkatanagaram village, keshavarm Panchayat , Payakaraopetta Mandal, East Godavari

Rajamma buys fish worth Rs.500-1000 everyday. After buying, she cleans, grades and sales locally with minimum 20% profit margin. Ice man comes to the shore with ice loaded on to his moped, women have to pay him even if they do not need ice, 1 kg costs Rs. 20.

During her husband's time, there was more production but less price– now production has decreased but income is more due to higher price– for example they used to buy 80 Kanakarta fishes just for Rs 80 but now the same cost Rs.1000.

Well ring pindis (small round platforms) were provided by NGOs post Tsunami in 2004 for drying fish; however, they are not convenient so not used. The casuarinas plantation was done by the forest department, Rajamm shared.

Ban makes the fishing community vulnerable

State government imposes sixmonths (November-May) fishing ban to protect the Olive Ridley. The areas reported under ban as accounted in newspapers include Gahiramatha marine sanctuary - Agaranasi to Dhamara, Puri coast and Devi river mouth to Keluli mouth. During the period, trawler and boat men are directed not to fish within 20 km of the coast.

Government bans fishing in the sea from November 1st to May 31st within 20 km radius of Gahirmatha marine sanctuary every year to protect Olive Ridley. It deprives 25,000 marine fishermen from fishing.

State government promised financial help for doing alternative works during ban period. Government also promised to provide mechanized boat for fishing beyond 20 km from coast. But promises were not fulfilled. As a result suicidal cases from fishermen families are reported. (20.3.2009/IE). The enforced ban on marine fishing has triggered human resource exodus in several seaside villages of this coastal district, severely impeding one of the major economic activities of the region.

Increase in sea surface temperature, incidence of rough sea and impact on fishing

(FGD at Sundaripal village, Brahmanasahi Gram panchayat, Rajnagarblock, Kendrapada district, Odisha)

Sundaripal is about 1.5 kilometers from the Barunei river mouth (Hasina river) and the Bay of Bengal.

The village is close to a patch of old mangroves and new plantation of mangroves, as well. The habitation is dominated by Bengali families. Very small percentage of families have agricultural land up to 1 acre. Paddy growing, fishing in the river mouth regions and wage earning are the major occupations. Very marginal farming families harvest about 5 quintal of paddy and about 12,000 INR from fishing.

Experience of the change in climate

- Increased low pressure phenomenon during summer and monsoon period (May to October).
- Increased incident of rough sea condition.
- Increased temperature and humidity.
- Decreased winter days & intensity.
- Increased cases of sea aggression (high tides, sea surging/ingression to inland areas).
- Longer/high tidal effect during full moon/new moon times increased.
- Increased sea surface temperature.
- Salinity level of backwater increased.

Marine/ inter tidal fishing in Odisha

According to the Department of Fisheries (DOF), 2002, the total number of fishers in the state of Odisha is just over 1million. The total marine fishing population is about a third of a million, which, when compared to the total population of the state, is not very large. This explains the relatively low priority given to marine fisheries as a livelihood option - there are about 86, 000 active marine fishers in the state. One important feature

Major Cyclones	1971, 1982, 1992, 1999 2009	Impact: • Fishing days reduced from 22 days in a month to 8 days at present • Per day catch reduced from 40 kg to 5 kg • No Hilsa fish available • Migration /wage earning increases • Younger generation lost interest in fishing, so migrate to metro cities **Loss due to saline water intrusion** • Crop (paddy) loss since 1992 (1992 – 100%, 1999 – 100%, 2007 – 50%, 2008 – 50%, 2009 – 25%) • No rabi crop – Rabi crop hampers due to salinity of surface water irrigation sources (jora, nala, pond) • Loss of culture fish/prawn, major source of cash income
Sea surge to inland areas	2009 (3 times), 2008 (2 times), 2007 (3 times) - Frequency of sea remaining rough has increased (with slightest Pubaei paban- easterly wind)	

of marine fisheries in Orissa is the in-migration of fishing craft from Andhra Pradesh during certain periods of the year. Fishers from areas north of Kakinada in Andhra Pradesh migrate annually to Puri, Konark, Astaranga and Paradeep.

The shallow northern coast extending northward from Rajanagar in Jagatsinghpur district to Kistania in Balasore district. This area has a broad shelf, gradual slope and greater tidal effect, with muddy and calm waters, and is characterized by tidal flats and extensive river deltas.

The southern coast extending southward from Paradeep in Jagatsinghpur district to Pattisonapur in Ganjam district, which is narrower, with broad sandy beaches and open surf-beaten shores. In the southern zone, the waters from Bahutia estuary to the mouth of Chilika lake are considered to be the deepest region with a rocky bottom. The coastal waters from the mouth of this lake to Dhamra, although comparatively shallow, are rich in demersal and pelagic fish. The offshore region from Dhamra to the mouth of the Subarnarekha is much shallower and has commercial pelagic fisheries. Coastal variations from the southern to

the northern zone determine the fishing systems and post-harvest disposal of catches. A majority of small-scale fishing activities in the northern zone take place in the intertidal zone (which could extend up to 5–6 km from the shore) or shallow waters and are focused mostly on demersal species, whereas the southern zone specializes in open-sea-based, often pelagic-dominated fisheries.

Total marine population	322772	
Well-off	30000	10%
Marginal to poor	100000-133000	30-40%
Very poor	133000-166000	40-50%
Destitute	33000	

Source: Salagrama Venkatesh/Trends in poverty and livelihood in coastal fishing communities of Orissa State, India/Integrated Coastal Management Kakinada, Andhra Pradesh, India

EXPERIENCE AND PERCEPTION FROM PATHARPROTIMA BLOCK (SUNDERBANS)24 PARGANAS, WEST BENGAL

The main livelihood activities in the village include collection of fish seedlings from the tidal creeks (mainly river mouth region) and fishing in the tidal creeks along with agriculture, wage earning and rearing domestic animals.

Collection of fish seedlings affected

Collection of fish seedlings from the tidal creeks in the region has been one of the major economic activities for many families. November to February is the peak season for collection of fish seedlings, Bagda, locally known as meen. Collection in January is the highest, apparently due to cold but the price of seedlings is higher in non-peak season.

About 10 years back, one person would collect average 3000 seedlings per day, now they catch 1000 (sales @ Rs. 200). Owing to the sharp decrease in catch, men at present prefer to go to work in brick kilns and potato go downs in the region. Now mostly women from about 50 families go for collection.

Reasons for decrease in the catch are complex. There are specific pockets of fishing and collection of fish seedlings as well, which is disturbed due to various manmade reasons - siltation of the creeks, decreased flow of water in the internal creeks due to blockade at different places – road, embankment, etc and pollution.

Partly it is attributed to the change in the 'climate'. "Temperature of water in the tidal creeks is increasing", observed the community members. Indicators include: people, who go for fishing or collection of fish seedlings feel uncomfortable to stay in water continuously for more than 2/3 hours; they used to drink water from the creeks till December, now the water becomes too saline by November and the body itches if one stays longer inside the creeks (ga' galu hae).

Bhaktipada Bar of Kamadevnagar of Patharpratima block, shares similar observations. Indigenous fishing, one of the major livelihood activities in the area is impacted by the change in the weather. Increase in the surface temperature of the water in the tidal creeks and the mouth region and increase in the level of salinity are perceived as major reason, shares Bhaktipada. The local people used to take bath in the creeks till January, at present it is hardly possible up to kalipuja in November due to increase in the level of salinity. Prolonged dry spell increase the surface temperature. Certain fish species, such as Pomfret and Chandana (similar to Hilsa) have become rare as they do not come to river mouth region due to increase in surface temperature and increase of the level of salinity, adds Bhaktipada. Rising surface temperature plays foul with the regeneration process; seeds of species such as parse, bagda, sele, tengda, bhetkii, which usually seed in the months between February- April are spoiled because of the increased temperature, claims Bhaktipada. To cope with the decreasing volume of catch fishermen use net of lesser mesh size, which further aggravates the situation. In order to discourage catching fish less than 500 grams, recently government has issued circulars directing use of particular mesh size, informed Bhaktipada. Number of species such as Pomfret have become extinct or have drastically reduced.

Frequent saline water intrusion

Cases of saline water intrusion has increased during high tide (bhara katal), over the past years the water during bhara katal has increased at least by 2ft. The saline embankments are weak and

VOLUME OF CATCH FOR AN INDIGENOUS BOAT AND NET TEAM, OVER THE LAST 10 YEARS- BHAKTIPADA BAR

Season	Before 6-10 years	At present
Summer(Khairi, Topesi,Amedi Similikanta	3-4 quintal	2 quintal
Rain (Hilsa, Modekanta, Bhola	12 quintal	3-4 quintal
Winter	7-8 quintal	4 quintal

inadequate in many points making the crop land as well as the protected habitation area vulnerable.

Betel vines affected due to rise in the temperature

As shared by the betel leaf farmer Harekrishana Das of Krishnapur village in the Patharprotima block 3 types of betel leaves are cultivated- Bangla, Mitha and Hybrid. Betel leaves are very sensitive to temperature - the size of leaves usually decrease in summer. The temperature over the years has increased- the increase of mosquitoes inside the vine is one of the indicators. So now for about five months, in place of 12 leaves per plant, they get 8 leaves. To compensate, use of fertilizer and cultivation of hybrids have increased. Hybrids are not affected or less affected due to longer dry months with relatively higher temperature, shared Harekrishana.

Bhaktipada Bar of Kamadevnagar also agrees with the long dry months and sharp rise in temperature. After long summer, when it suddenly rains, betel plants die due to intense humid heat (vapsa), observes Bhaktipada. There has been no winter rains for last few years, he adds.

Impact on seasonal crops: chilli cultivation badly affected

Chili cultivation used to be a good source of cash income in the region. An investment of Rs. 4000 used to generate net income of Rs. 8000. Apart from the income, the crop residue– lanka pala supplemented the fuel need of the family. Decrease in chilli cultivation has triggered the increase in migration.

The reason for the decrease in chili is attributed to brief winter and sudden increase in temperature. Due to rise in temperature chili turns white (thasara).

Due to the same reason, production of brinjal, one of the major income generating crops like chilli is also hampered. Brinjal, which used to be harvested till April, at present comes to an end by February due to sudden rise in temperature. For the same reason, there is substantial decrease in the cultivation of til (seasame– used to take care of oil need of the family); leaves turn copper due to heat, shared the community members. Many farmers have discontinued the cultivation of sugar cane for the reason of temperature rise.

Farmers of Krishanapur observed that pollination of crops and vegetables are negatively affected due to intense heat. Mango production is affected due to lack of spring rain and intense heat.

Community members of Rakhalpur of Sridhar Nagar panchayat agreed to the observation relating to the change in weather and its negative impact. Cultivation of chilli (commercial cultivation started in 1977 and widely done after 1990), water melon and pumpkin have been discontinued since last four-five years because of multiple triggers - brief winter, sudden increase in temperature, longer dry spell of months together (requiring frequent irrigation, more pest and diseases like patramoda). Other contributing factors included not blowing of south wind during flowering time in March (instead get north-west wind). Intense Kuasa (fog) also adds to the problem, it continues till end of April intermittently; reportedly Kuasa contain salinity, which used to be sweet. Because of this, as the villagers alleged, summer paddy is affected with Jhalsa disease.

Impact on the practice of paddy cultivation

Broadcasting method of paddy cultivation has become a thing of past, observed Bhaktipada Bar of Kamdevnagar in Patharprotima block. At present paddy cultivation is done only through transplanting; broadcasting has been abandoned due to irregular summer rain, the kalbaisakhi towards the 2nd week of May in 4-5 days interval. Summer rain was also helping to raise seedlings early for the lowlands, observed Bhaktipada.

For paddy cultivation, water is needed up to end of October. Paddy is harvested during the period of 15th November to 15th December. Now in most of the years, rain stops around mid September; in most years, even the autumn paddy requires irrigation. After that there is about seven to eight months of dry period.

Fluctuation of rainfall also has been a major reason for discontinuing with number of traditional varieties.

However, Dudhersar is one traditional variety, which people continue to cultivate because of comparatively good price and the straw is preferred for thatching, observed Bhaktipada.

Impact on Honey and Crab collection

Paschim Dwarikapur is a habitation of about 50 years, mostly of Munda and Sabar tribes from the

THE INHABITANTS HAVE INTERESTING INSIGHT REGARDING FLOWERING OF THE MANGROVE SPECIES, THE BEE- HIVES AND THE QUALITY OF HONEY.

Mangroves species	Flowering period	Insight relating to bee - hives	Insight relating to the quality of honey
Bani	Baisakha to Jaistha	Hives also found in the village periphery	Honey reddish colour, thin
Gama (guan)	Baisakha to Asadha	-do-	
Sundari	Falgun to Chaitra/ Baisakha		
Ail	Baisakha to Jaistha		
Bhara/Garjan	Phalguna to Chaitra		wheatish, thick and tasty
Chapal	Round the year		
Khalasi (kharasi)	Phalgun to Chaitra		
Baghda/Hentala	Phalgun to Chaitra		

bordering areas of Orissa/ West Bengal. Honey and crab collection from the mangroves have been main source of their livelihood, as they do not have any agricultural land. They usually go to Luthian and Susuni chada areas in the Sunderbans in groups, camp there for about a week and forage for beehives and crabs.

They do not have an exact idea regarding the reason, but they claim that the size of the bee hives and number of the bee hives have decreased over the years (some attribute this to fluctuation in rainfall and longer dry spells). This could be due to decrease in the volume of flowers. So the production has decreased by 50% over the last 10 years.

They used to get 5kg per hive (32Rs/kg) now they get 2.5 kg per hive (60Rs/kg)-sold to forest department at Sibganga/Bhagabatpur. Wax is also sold at the same price.

They also claim that the regeneration of crab has been affected due to brief winter and long summer. Winter is the peak season for catching crabs, the volume of catch substantially decreases in summer. Crabs lay eggs at the bottom of water during magh-phalgun (February- March), which is affected due to the rise in the temperature.

They used to catch 100 pieces of crab per day and sold 20 piece for Rs 5, now they get 20 piece(2.5kg) and sell at Rs 40-100/kg). The rate varies as per the size of the crabs

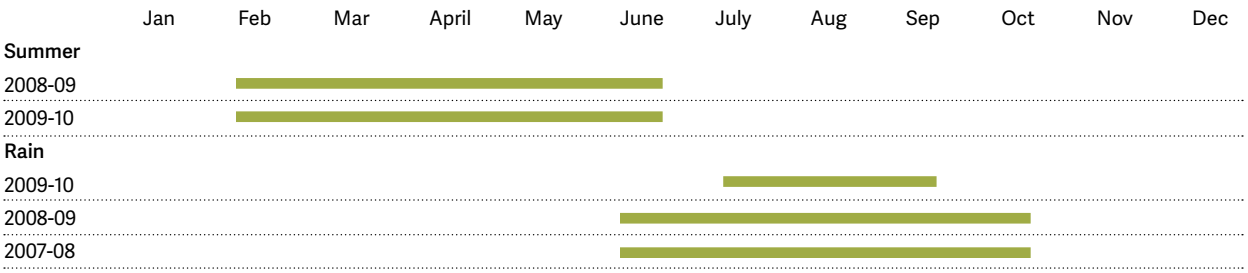
Size of the crab	Price
200g	90Rs/kg
300g	150Rs/kg
400g	200Rs/kg
500g+	250 + Rs./kg

Fluctuation in the seasons, uneven distribution of rain, kalabaishakhi & extreme weather (from FGD at different villages, as shared above in Patharpratima block)

Spring rain is very crucial for growth of fodder and mango crop. Jadi barse magher sese dhanya se raja dhanya se desh- (hail the king and the kingdom where it rains in month of February/ March), one of the community members shared a local saying emphasizing the importance of the spring rain. Winter used to linger till Chaitra sesh (March) - the spell of cold in Chaitra was known as Chaitra Kamdi (chaitra's bite indicating the last phase of winter) now people switch on fan by end January.

The community representatives present in the group discussion in the SPAR office observed that at present people experience only three seasons - rain, winter and summer, which has emerged as the longest season. Long dry periods and rise in the temperature have adverse impact on vegetable cultivation in the region, especially chilli and watermelon.

Distribution of rain has been very uneven



and irregular since last 10 years. Rain comes late, around mid July and stops around mid-September. No rain after mid September affects volume of paddy production; quantity of Apustidhan (half filled paddy) increases. Similarly, winter comes late around mid December and leaves early, by mid January. In 2009-10, winter was exceptionally longer after a gap of about 10 years, when winter continued till mid February, shared the community members of Rakhalpur of Sridhar Nagar panchayat.

In recent times, months of 'no rain' have become about 8 months. Kal Baisakhi (rain in May) has become rare since last 15 years. It used to be common around May when rain accompanied with wind would come in the afternoon in spell of about 10 days. It used to be very useful for trees with fodder and replenishing water in the ponds. It also helps leaching out salinity in the soil and help raise paddy seedlings (make stronger) for low lands. Delayed rain and fluctuation should actually result in decrease in production of paddy, the main crop, but to a large extent it did not happen. To maintain (and increase) the level of production people have mostly switched over to improved HB varieties and increased use of fertilizer and pesticides, which has almost tripled over the past 15 years.

Extreme weather phenomena (Rakhalpur of Sridhar Nagar panchayat)

- **Lightning:** Over the last 5 years, have reported around 70-80 human deaths. During 2009-10, 18 cases of compensation. In case of death of earning member,the family gets Rs. 10,000.
- **Low pressure:** 30-35 times per year, since last five-six years, increasing trend since 1995.
- Flooding because of breach in the embankment (Breach or surpassing if low pressure during bhara katal).

The synergistic impact and coping practices

- Migration is a recent trend (following discontinuation of cash generating chili , bitter gourd and water melons).
- Most families have switched over to ploughing through power-tiller.
- Because of intense summer, irrigation need has increased- indicator: to irrigate 1 bigha, it used to take 10 pumping hours, but now it takes 14 hours. Water scarcity for irrigation is emerging as a major problem- ponds get dry by March (water accessed at depth of 8-12 feet) despite of comparatively better water management- direct to field through long distribution pipes.

WHAT KIND OF WEATHER WOULD YOU PREFER ?

- South wind in summer (instead of north/west wind)
- Rain from mid June with continuous rain in the months of July/August and intermittent rain till November and winter and summer rains as well.
- Winter from mid November to Mid February

- Summer paddy cultivation is done mainly through pond irrigation- Sreedharnagar panchayat does not have bore-well based irrigation (which is increasing in Durbachati panchayat). Aman irrigation decreasing water level in the ponds.
- Use of diesel has been manifold– 250 litres per machine.
- Due to temperature increase, farmer's stock higher level of water in the field.
- From Sridharnagar Panchayat about 1000 persons have migrated– about 70% of them are youth.

Coping practices

- In order to maintain the volume of crop production people apply increased quantity of fertilizer.
- Changing to wage labour and increase in migration.
- Rain harvesting through land shaping - farm pond-to increase inland irrigation and water recharging.

CLIMATE CHANGE PROJECTIONS (EXCERPTS)

INDIA'S SECOND NATIONAL COMMUNICATION TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE/AUGUST, 2008

The projections indicate that above 25˚N latitude, the maximum temperature may rise by 2-4˚C during the 2050s and in the northern region the increase in maximum temperature may exceed 4˚C. The minimum temperature in the 2050s is expected to rise by 4˚C all over India, with a further rise in temperature in the southern peninsula. At an all-India level, little change in monsoon rainfall is projected up to the 2050s. There is an overall decrease in the number of rainy days over a major part of the country. This decrease is greater in the western and central parts (by more than 15 days), while near the Himalayan foothills (Uttaranchal) and in the Northeast the number of rainy days may increase by 5-10 days. Increase in rainy day intensity by 1-4 mm/day is expected all over India, except for small areas in the northwest where rainfall intensities are expected to decrease by 1 mm/day.

The Indian Government's National Communications (NATCOM) report of 2004 identifies the following as the impacts of climate change most likely to affect India between now and 2100:

- Decreased snow cover will affect snow-fed and glacial systems such as the Ganges and Brahmaputra. 70 % of the summer flow of the Ganges comes from melt water.
- Erratic monsoons will affect India's rain fed agriculture, peninsular rivers, water and power supply,
- Wheat production will drop by 4-5 million tonnes, even with a rise in temperature of only 1ºC.
- Rising sea levels will cause displacement along one of the most densely populated coastlines in the world, also threatening freshwater sources and mangrove ecosystems.
- Floods will increase in frequency and intensity. This will heighten the vulnerability of people in the country's coastal, arid and semi-arid zones.
- Over 50 % of India's forests are likely to experience shift in forest types, adversely impacting associated biodiversity, regional climate dynamics and livelihood based on forest products.

REPORT OF SUB GROUP ON CLIMATE CHANGE, PLANNING COMMISSION, GOVERNMENT OF INDIA (OCTOBER 2011)

The recent assessment report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) has shown that climate change would have significant impact on myriad economic sectors and ecosystems. It is recognized that India has hardly any historical contribution to the problem. Yet, climate change is a huge challenge because India is deeply vulnerable to its adverse impacts. In countries like India where climate variability has always existed in several forms, climate change is likely to put further pressure on this variability

rendering several sectors more vulnerable.

In India, both climate and weather are dominated by the largest seasonal mode of precipitation in the world, due to the summer monsoon circulation. Over and above this seasonal mode, the precipitation variability has predominant inter-annual and intra-seasonal components, giving rise to extremes in seasonal anomalies resulting in large-scale droughts and floods and also short-period precipitation extremes in the form of heavy rainstorms or prolonged breaks on the synoptic scale. Further, the Indian climate is also marked by cold waves during winter in the north and heat waves during the pre-monsoon season over most parts of the country. Tropical cyclones, affecting the coastal regions through heavy rainfall, high wind speed and storm surges, often leave behind widespread destruction and loss of life, and constitute a major natural disaster associated with climatic extremes. These extremes have visible impact on human activities and therefore deserve to receive greater attention from all sections of the society.

The observed changes in India's climate reveal that an increase of -0.4degreeC in surface air temperature over the past century (1901-2000) has been noticed in India as against the globally observed increase of 0.76 degree C. However, there is no significant long term trend in monsoon rainfall or floods in the summer monsoon season at all India level. The total frequency of cyclonic storms forming over Bay of Bengal has also remained almost constant over 1887-1997. It is projected that, by the end of 21st century, rainfall in India may increase by 15-40% with high regional variability. Warming may be more pronounced over land areas with northern India experiencing maximum increase. The warming could be relatively greater in winter and post-monsoon seasons. The annual mean temperature could increase by 3˚C to 6˚C over the century.

The rise in sea level in the north Indian Ocean has been observed to be in the range of 1.06-1.75 millimeters per year in the past century. There is a threat of coastal inundation in some of the low lying coastal areas. On the other hand, the glaciers show a mixed behavior. While some of them are receding, some of them are growing.

As the glaciers retreat, they become more fragmented and the smaller glaciers are more sensitive to global warming. While some of the glacial recessions could be a part of natural cyclic process, the accelerated melting experienced by some of the glaciers as a result of the earth's warming may affect future water availability.

Increasing sea and river water temperature is likely to affect fish breeding, migration, and harvests. A rise in temperature as small as 1˚C could have important and rapid effects on the

mortality of fish and their geographical distributions, and hence climate change effects

could be very significant for fisheries. Oil sardine fisheries did not exist before 1976 in the northern latitudes and along the east coast as the resource was not available/and sea surface temperature (SST) were not congenial. With warming of sea surface, the oil sardine is able to find temperature to its preference especially in the northern latitudes and eastern longitudes, thereby extending the distributional boundaries and establishing fisheries in larger coastal areas.

Figure 6.6. *Relative vulnerability of coastal deltas as shown by the indicative population potentially displaced by current sea-level trends to 2050 (Extreme = >1 million; High = 1 million to 50,000; Medium = 50,000 to 5,000; following Ericson et al., 2006).*

CLIMATE CHANGE AND INDIA: IMPACTS, POLICY RESPONSES AND A FRAMEWORK FOR EU-INDIA COOPERATION (2007)

At the national level, increase of 0.4˚ C has been observed in surface air temperatures over the past century. A warming trend has been observed along the west coast, in central India, the interior peninsula, and north-eastern India. However, cooling trends have been observed in north-west India and parts of south India.

While the observed monsoon rainfall at the all-India level does not show any significant trend, regional monsoon variations have been recorded. A trend of increasing seasonal monsoon rainfall has been found along the west coast, northern Andhra Pradesh and north-western India (+10% to +12% of the normal over the 100 years) while a trend of decreasing monsoon seasonal rainfall has been observed over eastern Madhya Pradesh, north-eastern India, and some parts of Gujarat and Kerala (–6% to –8% of the normal over the 100 years).

Sea level rise has been observed to increase by 0.4–2 mm/year along the Gulf of Kutch and the coast of West Bengal. However, relative decrease along the Karnataka coast has also been observed.

Concentration of droughts is projected in Gujarat and Rajasthan, which are already drought prone, and in Odisha, which is currently flood prone.

Heavily populated regions such as coastal areas are exposed to climatic extremes and large falls in sown areas in arid and semi-arid zones, of which nearly two-thirds are drought-prone. Large areas in Rajasthan, Andhra Pradesh, Gujarat, and Maharashtra and comparatively small areas in Karnataka, Orissa, Madhya Pradesh, Tamil Nadu, Bihar, West Bengal, and Uttar Pradesh are frequented by drought. About 40 million hectares of land is flood-prone, including most of the river basins in the north and the north-eastern belt affecting about 30 million people on an average each year.

A mean sea level rise of 15–38 cm is projected along India's coast by the mid- 21st century and of 46–59 cm by 2100. India's NATCOM I assessed the vulnerability of coastal districts based on physical exposure to SLR, social exposure based on population affected, and economic impacts. In addition, a projected increase in the intensity of tropical cyclones by 15% poses a threat to the heavily populated coastal zones in the country (GoI, 2004).

ADAPTATIONS AND OPPORTUNITIES

Adaptation to climate change: varying definition

- Actions taken to help communities and ecosystems cope with changing climate conditions, such as the construction of flood walls to protect property from stronger storms and heavier precipitation, or the planting of agricultural crops and trees more suited to warmer temperature and drier soil conditions (website of the UNFCCC Secretariat).
- Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptations can be distinguished, including anticipatory and reactive adaptations, private and public adaptations and autonomous and planned adaptations (IPCC TAR, 2001 a).
- Adaptation is a process by which different strategies to moderate, cope with and take advantage of the consequences of climatic events are enhanced, developed, and implemented(UNDP, 2005).

The communities along the coastal tract have been addressing the climate variability and extremes through indigenous adaptation practices since long. The adaptation practices as well as the coastal ecosystem specific opportunities need to be explored and documented to help formulate strategies for sustainable development in the scenario of climate change. The appraisal process came across diverse adaptions and opportunities to make best out of the given situation – the pictorial sample is presented below.

Gainful use of saline/brackish water and tidal swamps- Palam region, Katrenukona Mandal, East Godavari district, AP-Mud crab farming without chemical inputs

Number of trees have capacity to survive and give multiple benefits on the coastal sands, edge of tidal creeks and in tidal water (from L to R- Gangireni, Casuarinas, Clearing nut, Cashew)

Coastal comunities need to broaden their livelihood options- rope making for fishing boats could be one; Kakinada coast, AP

Prosopis along tidal creeks could fullfil multiple needs if managed well (fuel, fencing, fodder) Gachakayapara, Katrenukona Mandal , East Godavari,AP

Brackish soil, sandy areas, open coasts, banks , tidal creeks and mud banks are potential sites for multipurpose plantation(socio-cultural need, sand binder, bank stabilization cyclone moderation)

Land shaping/rain water harvesting pond for multipurpose use- irrigation, pisci-culture in saline tract

Mud flats- potential site for mangroves plantation: multiple benefits

Successful mangroves plantation in a tidal creek in Nellore coast, AP which triggered increase in fish population : courtesy Dhara in collaboration with IRDWSI/Navjeevan

Livelihood security of the nature dependent marginal families : tough challenge

Shell processing , fish vending, dry fish making etc are just few examples of diverse coast specific livelihood options: needs documentation, innovation, improvisation and scaling up

Screwpine , great sand binder , also potential source for income generation (Courtesy: Dhara/Bhubaneswar-husbanding experiment)

Pongamea- multipurpose,grows well in coastal areas (Erasama, Jagatsighpur)

Nalia , Multipurpose grass that grows in tidal creeksmangroves eco system is also a source of livelihood for dalit craft families of Odisha coast (courtesy Dhara,bhubaneswar- husbanding experiment)

Strategic use of of new age appropriate technology: potential contribution to grow more in the given situation in low carbon enviroment

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