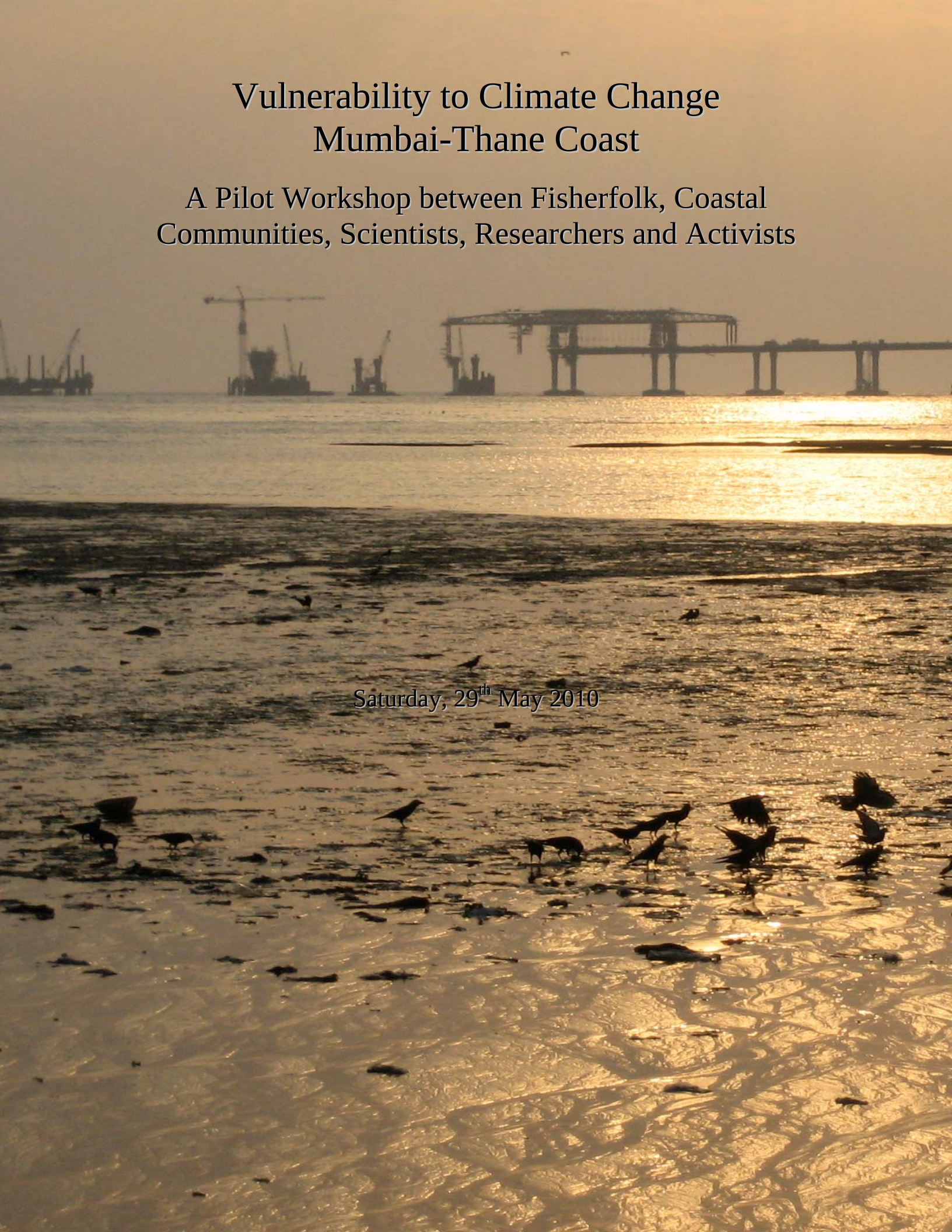
Vulnerability to Climate Change
Mumbai-Thane Coast

A Pilot Workshop between Fisherfolk, Coastal Communities, Scientists, Researchers and Activists



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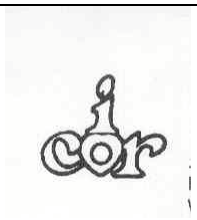
Vulnerability to Climate Change:Mumbai-Thane Coast:

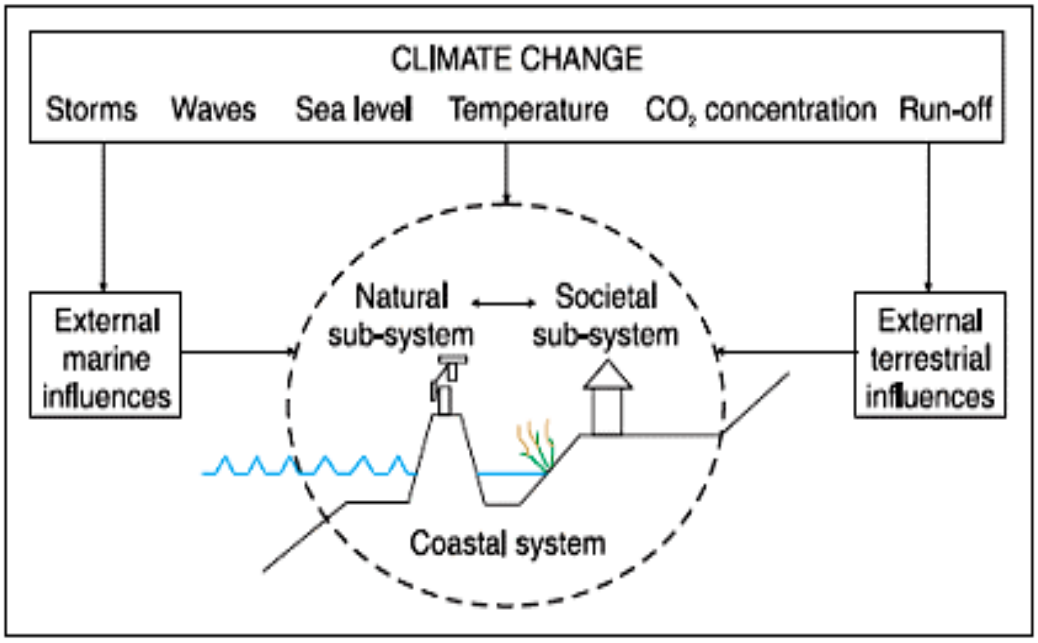
A Pilot Workshop
organised by

CEC Centre for Education & Documentation 3 Suleman Chambers 4 Battery Street Mumbai 400 001	 Institute for Community Organisations & Research St Pius College Campus Aarey Road Goregaon Easy Mumbai 400 063

This programme is supported by INECC - Indian Network for Ethics on Climate Change as part of its larger effort to facilitate grassroots engagement on vulnerability of different eco-regions to the impacts of climate change to communities already at risk and vulnerable to other forces, local, regional and global.

INECC is a network of individuals and organization representatives, who are concerned with the Climate Change issue, particularly with reference to the Indian situation. The network has been in operation since 1996. INECC believes that Climate change is a part of a large environmental crisis and addresses the basic issue of ecologically destructive development processes that have been globally pursued.

NOTES & READINGS



- **Coasts are already experiencing the adverse consequences of hazards related to Climate and sea-level**
- **Coast will be exposed to increasing risk including coastal erosion in the coming decades**
- **Increased human pressure on coasts migration, land use, development will make matters worse**
- **Due to lower adaptive capacity developing countries will have a bigger problem**
- **Cost of adaptation are much less than cost of inaction**
- **Sea level rise is now long term and it conflicts with present day human development patterns and trends.**

These are the main points made by the IPCC working group II in Chapter 6 on Coastal and Low Lying Areas. The report concludes:

- Climate change and sea-level rise increase the challenge of achieving sustainable development in coastal areas, with the most serious impediments in developing countries, in part due to their lower adaptive capacity. Long-term sea-level rise projections mean that risks will grow for many generations unless there is a substantial and ongoing investment in adaptation. Hence,
- Increased effort to move from reactive to more proactive responses in coastal management.
- Strengthening integrated multidisciplinary and participatory approaches
- retrospective analyses of coastal disasters
- Technological developments most especially in softer technologies associated with monitoring
- predictive modelling and broad-scale assessment and assessment of coastal management actions, both present and past
- **Traditional practices can be an important component of the coastal management tool-kit.**
- Finally, any response to climate change has to address the other non- climate drivers of coastal change in terms of understanding potential impacts and responses, as they will interact with climate change. As recognised in earlier IPCC assessments and the Millennium Ecosystem and LOICZ, these other drivers generally exacerbate the impacts of climate change

The complete report is available on : http://www.ipcc.ch/publications_and_data/ar4/wg2/en/contents.html . The next page contains the executive summary of this Chapter.

Impacts, Adaption and Vulnerability Coastal Systems and Low-Lying Areas

The Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) made six major points in its chapter on Coastal Systems and Low Lying Areas

I. Coasts are experiencing the adverse consequences of hazards related to climate and sea level (very high confidence).	Coasts are highly vulnerable to extreme events, such as storms, which impose substantial costs on coastal societies. Annually, about 120 million people are exposed to tropical cyclone hazards, which killed 250,000 people from 1980 to 2000. Through the 20th century, global rise of sea level contributed to increased coastal inundation, erosion and ecosystem losses, but with considerable local and regional variation due to other factors. Late 20th century effects of rising temperature include loss of sea ice, thawing of permafrost and associated coastal retreat, and more frequent coral bleaching and mortality].
II Coasts will be exposed to increasing risks, including coastal erosion, over coming decades due to climate change and sea-level rise (very high confidence)	Anticipated climate-related changes include: an accelerated rise in sea level of up to 0.6 m or more by 2100; a further rise in sea surface temperatures by up to 3°C; an intensification of tropical and extra-tropical cyclones; larger extreme waves and storm surges; altered precipitation/run-off; and ocean acidification. These phenomena will vary considerably at regional and local scales, but the impacts are virtually certain to be overwhelmingly negative. Corals are vulnerable to thermal stress and have low adaptive capacity. Increases in sea surface temperature of about 1 to 3°C are projected to result in more frequent coral bleaching events and widespread mortality, unless there is thermal adaptation or acclimatisation by corals. Coastal wetland ecosystems, such as saltmarshes and mangroves, are especially threatened where they are sediment-starved or constrained on their landward margin. Degradation of coastal ecosystems, especially wetlands and coral reefs, has serious implications for the well-being of societies dependent on the coastal ecosystems for goods and services. Increased flooding and the degradation of freshwater, fisheries and other resources could impact hundreds of millions of people, and socio-economic costs on coasts will escalate as a result of climate change.
III. The impact of climate change on coasts is exacerbated by increasing human-induced pressures (very high confidence).	Utilisation of the coast increased dramatically during the 20th century and this trend is virtually certain to continue through the 21st century. Under the SRES scenarios, the coastal population could grow from 1.2 billion people (in 1990) to 1.8 to 5.2 billion people by the 2080s, depending on assumptions about migration]. Increasing numbers of people and assets at risk at the coast are subject to additional stresses due to land-use and hydrological changes in catchments, including dams that reduce sediment supply to the coast. Populated deltas (especially Asian megadeltas), low-lying coastal urban areas and atolls are key societal hotspots of coastal vulnerability, occurring where the stresses on natural systems coincide with low human adaptive capacity and high exposure]. Regionally, South, South-east and East Asia, Africa and small islands are most vulnerable]. Climate change therefore reinforces the desirability of managing coasts in an integrated manner.

IV. Adaptation for the coasts of developing countries will be more challenging than for coasts of developed countries, due to constraints on adaptive capacity (high confidence).	While physical exposure can significantly influence vulnerability for both human populations and natural systems, a lack of adaptive capacity is often the most important factor that creates a hotspot of human vulnerability. Adaptive capacity is largely dependent upon development status. Developing nations may have the political or societal will to protect or relocate people who live in low-lying coastal zones, but without the necessary financial and other resources/capacities, their vulnerability is much greater than that of a developed nation in an identical coastal setting. Vulnerability will also vary between developing countries, while developed countries are not insulated from the adverse consequences of extreme events.
V. Adaptation costs for vulnerable coasts are much less than the costs of inaction (high confidence)	Adaptation costs for climate change are much lower than damage costs without adaptation for most developed coasts, even considering only property losses and human deaths. As post-event impacts on coastal businesses, people, housing, public and private social institutions, natural resources, and the environment generally go unrecognised in disaster cost accounting, the full benefits of adaptation are even larger]. Without adaptation, the high-end sea-level rise scenarios, combined with other climate changes (e.g., increased storm intensity), are as likely as not to render some islands and low-lying areas unviable by 2100, so effective adaptation is urgently required.
VI. The unavoidability of sea-level rise, even in the longer-term, frequently conflicts with present-day human development patterns and trends (high confidence)	Sea-level rise has substantial inertia and will continue beyond 2100 for many centuries. Irreversible breakdown of the West Antarctica and/or Greenland ice sheets, if triggered by rising temperatures, would make this long-term rise significantly larger, ultimately questioning the viability of many coastal settlements across the globe. The issue is reinforced by the increasing human use of the coastal zone. Settlement patterns also have substantial inertia, and this issue presents a challenge for long-term coastal spatial planning. Stabilisation of climate could reduce the risks of ice sheet breakdown, and reduce but not stop sea-level rise due to thermal expansion. **Hence, it is now more apparent than it was in the TAR that the most appropriate response to sea-level rise for coastal areas is a combination of adaptation to deal with the inevitable rise, and mitigation to limit the long-term rise to a manageable level .**

VULNERABILITY

Vulnerability is defined as the susceptibility to stresses or hazards, and the capacity (or lack, thereof) to prepare, cope and recover from such hazards. Human vulnerability, in particular, is a condition resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard. Human vulnerability includes the vulnerability of social and economic systems, health status, physical infrastructure and environmental assets It is the concept that explains why a community is more or less at risk to a given hazard.

VULNERABILITY
- is the degree to which a system is affected by adverse effects of climate change
- is a function of
- **direct impacts on the system**
- **sensitivity of the system**
- **adaptive capacity of the system**

However, neither vulnerability alone nor hazard alone determines the occurrence of a disaster. A hazard, by itself, is simply a potentially damaging event or physical disturbance and it is the combination of hazard and vulnerability that disaster occurs. (Mitchell, J. K. (eds.) (1999). *Crucibles of Hazard: Megacities and Disasters in Transition*. Tokyo: UN University Press. As quoted in Mumbai after 26/7 Deluge: Some Issues and Concerns in Regional Planning . R. B. Bhagat1, Mohua Guha and Aparajita Chattopadhyay - www.cicred.org

What is Vulnerability to Climate Change?

THE IPCC DEFINITION: "The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. The term 'vulnerability' may therefore refer to the vulnerable system itself, e.g., low-lying islands or coastal cities; the impact to this system, e.g., flooding of coastal cities and agricultural lands or forced migration; or the mechanism causing these impacts, e.g., disintegration of the West Antarctic ice sheet. (IPCC – http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch19s19-1-2.html)

Direct impacts - System exposure to crises, stresses and shocks

First, there is the direct impact due to rise in sea level and increase in sea temperatures that may inundate low lying areas or result in depletion of fish stock. Sea level rise will have multiple impacts. It will inundate coastal settlements, aggravate flood situations, erode beaches, further impacting settlements, and will leave vast swathes of land and water sources saline. The net result will be the displacement of people from these densely populated areas.

Sensitivity of the system

Second, there are other changes brought about by dumping of industrial waste or reduction of mangrove cover the coast line which have already has an adverse impact on the lives and livelihoods of local communities; in which case, climate change will exacerbate the existing vulnerability.
Beyond actual inundation, rising sea levels will also put millions of people at greater risk of flooding. This will displace a large number of people and result in rapid urbanisation (as already seen in some parts of Gujarat and Maharashtra), straining resources and putting more pressure on civic amenities. Increased sea water percolation may further reduce freshwater supplies.

Adaptive capacity
Focus on perturbations alone (environmental, socioeconomic, technological) was insufficient for understanding the responses of, and impacts on, systems (social groups, ecosystems, places) exposed to

such perturbations. The ability of the system to attenuate stresses or cope with the consequences is critical. We need a clearer understanding of coping strategies or mechanisms, of who and what are at risk, from what. Which are the specific stresses and perturbations which have higher risk and major impacts. This includes the consequences and attendant risks of slow (or poor) system recovery.

This perspective suggests that the most vulnerable individuals, groups, classes and regions or places are those that: experience the most exposure to perturbations or stresses; are the most sensitive to perturbations or stresses (i.e. most likely to suffer from exposure); and have the weakest capacity to respond and ability to recover.

Within this extended vulnerability framework, there is formal recognition that macroforces - broad-scale environmental and human systems within which the local system resides - come together to affect the local system and, simultaneously, influence the pressures that act upon it. Different pressures across scales come together in various sequences to create unique "bundles" of stress that affect local systems. A major hypothesis holds that when stresses or perturbations emanating from the environment coalesce with those arising from society, significant consequences can result. For example, economic depression reduces society's capability to develop or maintain pre-emptive coping measures to reduce the impacts of drought, such that the co-occurrence of drought and economic depression synergistically enlarges the vulnerability of the system. The risks resulting from such vulnerabilities emerge from multiple sources and at different scales. These risks cascade through interacting human and environmental systems to create adverse consequences".(**The vulnerability of global cities to climate hazards,** Alex De Sherbinin, Andrew Schiller And Alex Pulsipher, Environment and Urbanization, Vol 21, Number I, April, 2009-Sage, New Delhi).

In the urban context the vulnerability becomes more evident of a certain section of people and these involve large numbers. The questions to ask are:

- Who lives or works where infrastructure like drains, drinking water, sewage, could reduce the risk/impact of climate change
- Who lives or works where there is direct impact of climate change like floods, landslides,
- Whose houses provide less protection for their family and possessions
- Who is not capable of taking short term measures like moving family, belongings, money, utensils, beddings etc just before the flood or disaster hits? What kind of knowledge, fore warning,
- Who is least capable to cope with impacts on health, injury, death?
- Who is least capable of dealing with loss of property, income
- Who has least cover of insurance, and most likely to get no or inadequate compensation from governments

OUR COASTS & CITIES

Coasts	Cities
More than 600 million people (or 10 percent of the global population) reside in coastal zones of less than 10 metres elevation,	Less than two percent of the global population resided in "megacities" of 10 million or more inhabitants about 25 years ago. Today the proportion exceeds four percent, and by 2015 it will top 50 percent, when megacities are likely to house 400 million people.77 million people, reside in megacities in coastal area
Indian coastline extends to about 5700 kms on mainland and to about 7500 kms including two groups of islands. An India country study by the Tata Energy Research Institute and the Ministry of Environment and Forests published in 1995 projected that a 1 metre sea level rise could put as many as 7.1 million people -- including all coastal fishing communities whose livelihood is directly linked to the ocean -- at risk of displacement	The 2001 Census established that almost one-third of India's population, i.e., an estimated 285 million people live in urban areas. By 2020, half of the country's population is expected to be city-based. In some states, the percentage is much higher than the national average. Of the 285 million urban dwellers in India, over a third – i.e., 108 million – live in 35 million-plus cities.
Western coastline has a wide continental shelf having an area of about 0.31 million km 2 which is marked by backwaters and mud flats.. Mangroves are located all along estuarine areas, deltas, tidal creeks, mud flats, salt marshes and extend to about 6740 km 2 (about 7% of world's mangrove areas). Major estuarine areas located along the Indian coasts extend to about 2.6 million hectares	States like Tamil Nadu and Maharashtra have 43.86 and 42.40 percent respectively of their population living in cities and towns. In actual numbers, Maharashtra, India's most urbanized state has an urban population base of 41 million.
The coastal states of Maharashtra, Goa and Gujarat face a grave risk from sea level rise, which could flood land (including agricultural land), and cause damage to coastal infrastructure and other property. Goa will be the worst hit, losing a large percentage of its total land area, including many of its famous beaches and tourist infrastructure.	Every city is marked by the informal settlements where the poor are forced to live without access to basic services like water and sanitation. City administrations are unable to check the flow of poor people into the city and have failed to provide them affordable housing. As a result, in some cities like Mumbai, for instance, half of the population (49 percent according to Census 2001) lives in slums. During any climatic hazards like flooding, the most vulnerable are the residents of these squatter settlements, many of which are located in low-lying areas.
A one metre rise in sea level will adversely affect 7 per cent of the population in Goa, and cause damages to the tune of Rs 8,100 crore.. In the state of Maharashtra, over 13 lakh people are at risk.	The cost of damages for Mumbai, the business capital of India, is estimated to be Rs 2,28,700 crore. Mumbai's northern suburbs like Versova Beach and other populated areas along tidal mud flats and creeks are vulnerable to land loss and increased flooding due to sea level rise.

The fact that so many people reside in megacities near coastlines, and that these cities continue to grow, underscores the importance of assessing the vulnerability of such cities to various natural hazards. Recent incidents have highlighted the vulnerability of cities, in particular, to climate hazards and different environmental shocks.

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[Text adapted from (Full text available at www.doccentre.net or www.inecc.net

1. Asian Development Bank 1994, *Climate Change in Asia: India Country Report*, Manila, p 77
Tata Energy Research Institute 2002, India specific impacts of climate change, h*ttp://www.teriin.org/climate/impacts.htm*, as viewed on July 2, 2002

2.Impacts of Climate Change in Western and Central India, Centre for Science and Environment, New Delhi, 2000
http://old.cseindia.org/programme/geg/pdf/western.pdf

2. Fishing in Troubled Waters: The Impact of Climate Change on Fishing Communities By Lalitha Sridhar India Resource Center, October 24, 2002
http://www.indiatogether.org/opinions/lalisri/ls1202.htm

Development & Vulnerability

The Vulnerability of the Coastal Regions to Climate Change sits on top of, and is exacerbated by vulnerabilities created by other human activities. of other non-climate change related anthropogenic activity. The irony is that it is the same activity, as is responsible for climate change. So Climate Change as an effect share its creator with other destructive practices. These practices are more pre-dominant in the coastal regions, or in estuaries, where urban development and other hyper human activity takes place.

Which way Dahanu?

Dahanu's dreams of rushing into the neoliberal economy

Whether the battle for ecological equity inevitably compromises opportunities for economic development is a question the communities of Dahanu have grappled with for over a decade. While there may be no simple answer, Dahanu's communities live in a paradoxical reality. Even as the environmental movement has sheltered them from the hazards of unregulated industrialisation, it has been unable to provide an alternative viable reality, while restricting many of the benefits of the modern economy.

Home to a predominantly large adivasi community of Warlis forming 64.84% of the total population of 3,31,829 lakh (Census 2001), Dahanu also has a large fishing and farming community. With a total of 174 villages and only one municipal area, the main source of livelihood is agriculture and its allied activities.The environmental regime, along with civil society action, was able to prevent the setting up of a large industry that would have destroyed the coast and its communities.

However, a decade later, the residents of many fishing villages are struggling to live off the natural resources. Ganesh Tandel, fisherman and resident of Dhakti Dahanu, a fishing village near Vadhavan states, "We were definitely relieved when the port was canceled, since we would have lost our livelihoods and been displaced. However, if you look at our community today, it is becoming increasingly difficult for us to sustain ourselves and most of the younger generation is opting for jobs outside Dahanu."

Saltpans and Rise in sea levels

The government of Maharashtra have long been eyeing Mumbai's saltpans under the pretext of undertaking low-cost housing projects to relocate the city's slum-dwellers and upgrade infrastructural facilities. Saltpans are lands along the coast that were hollowed out to process salt; in Mumbai they are spread over approximately 5,378 acres.

The move has triggered a heated debate among environmentalists, citizens' groups and those concerned with urban planning. The civic body's plans for the last few stretches of saltpans would spell disaster for Mumbai, say citizens' groups and environmentalists. The latter argue that a major portion of the land is covered by Coastal Regulatory Zone (CRZ) guidelines, and that these lands cannot be used for development. Besides, saltpans form part of the fragile ecosystem that supports thousands of species of animals, birds and fish.
Environmentalists also claim that saltpans, with their thick mangrove trees, are Mumbai's last defence against flooding. "The saltpans are eco-sensitive zones that act as natural buffers against ocean flooding… They absorb the rush of water from the sea," says the Bombay Natural History Society (BNHS)

The next five years are going to be crucial, say experts, as rising sea levels threaten the city. One of the biggest challenges for the state forest ministry will be to save the saltpans and mangrove lands in and around Mumbai. It will also have to put an end to the large-scale destruction of mangroves along the city's coastline, failing which millions of lives will be affected. (infochangeindia.org)

The fishing community continues to benefit from the restrictions of the Notification. However, the bigger challenge is to create sustainable and economically viable alternatives in a rapidly changing economy and a constantly evolving community. - **How Dahanu epitomises the environment vs development debate** by Michelle Chawla, InfoChange News & Features, April 2009

Dredging of sand for increasing construction

The historic Panvel (or Ulve) creek gets special mention in the Bombay Gazette records. Centuries ago the creek used to have pearls on its sandy bed and was a focal point of trade and commerce with Persia. Today, the creek is mined for a different kind of treasure—its dark sand—and this could soon transform the creek into an ugly, black canal.

The dark sand dredged is used in construction activity, say environmental activists. Miners have been dredging the creek for years together and storing the sand on dry docks on both sides of the creek, which is considered a Coastal Regulation Zone. The sand is reportedly sold to builders in and around Navi Mumbai. The 7-km-long creek passes through Taloja, Panvel and Ulve, before entering the sea at Belapur.

A senior official with the Thane collectorate said that the administration has been vigilant in the area after receiving complaints about the illegal activity. “We have penalised 214 trucks and recovered penalties worth Rs 24.63 lakh from offenders carrying unauthorised excavated sand last year,’’ the official said.

But residents say the illegal activity continues with the help of local godfathers. “The creek has been exploited to the hilt as the transportation costs are at a minimum, but a great ecological damage has been done over the years,’’ said P B Menon, a resident who lives near the creek. Swati Park residents have undertaken a signature campaign to stop the illegal activity and even filed a PIL on the issue. “We feel the creek will become another Mithi river in a few years’ time. That is when Navi Mumbai will see more floods,’’ Menon said.

Activists say that more than sand mining, it is the dumping of debris on both sides of the creek that is slowly killing the creek. “Truckloads of debris are being carried along the creek and pucca roads are being made to dump the debris on the banks. On both sides of the creek, there are huge mounds of sand as high as two-storey buildings which is periodically dredged from the creek,’’ Menon said. (http://timesofindia.indiatimes.com)

Public Interest Litigations (PILs) in the Bombay High Courty on the Dredging:
The PILs have complained about dredging and dumping at Panvel (or Ulwe) creek and the Savitri river in Mahad. Another PIL alleges illegal sand dredging at Alibaug. Miners’ footprint on waterways under fire. Times of India, 13th March 2010.

The report of Shyam R Asolekar, head of IIT-B’s Centre for Environmental Science and Engineering at the behest of high court said
-“present status of destruction of habitats of fishermen and fishes due to prevailing rampant sand dredging and mining”
- need for environmental audit of rivers, estuaries and their ecosystems, studying the biodiversity and dependence of fishermen and coastal communities on the water bodies, looking into the destruction caused by dredging and mining and taking stock of the resources of the sand mining sector.
- the verdant Panvel creek is being destroyed on both banks through reclamation and dumping.
Prof Asolekar called for “recovery and recycling of construction quality sand from debris’’.

Disasters Coming…

The list of most polluted industrial clusters in the country, which were announced on Thursday, figures five in and around the city. Domivli, Navi Mumbai, Tarapur, Chembur and Pimpri-Chinchwad are names that appear in the top 50 most polluted areas out of the 88 areas identified by the Union environment and forest ministry.

The areas have reached their top level in terms of air, water and land pollution. And, the worst is that all the five clusters have reached critical levels of pollution, which has forced the Centre to put on hold expansion in these areas.

Chembur, which ranks 46 in the list, with a comprehensive environment pollution index (CEPI) of 69.19 has chemical industries, a power plant and refineries that have severely affected marine life in Mahul creek.

At the Mahul creek, the worst-hit have been the fishermen. About a decade ago, Waman Koli, a fisherman from Mahul, used to net over 300kg fish every day at the Mahul creek but today the average daily catch is around 50kg. The contamination of water at Mahul has forced Koli to rethink his occupation to earn his livelihood. Koli now doubles up as a guide to bird watchers who visit Mahul creek supplement his income.

The marine life at Mahul has ceased to exist due to the pollution from the nearby industries.

"The pollution has not only killed all the fish but also also threatens to destroy the creek," Koli said.

The industrial pollution along with vehicular pollution and pollution due to continuous construction activity in Mumbai can prove to be disastrous for the city. "Mumbai is one of the most densely populated cities in the world and pollution in the surrounding areas has very high impact on general health of people," Debi Goenka of Conservation Action Trust, said. "It is surprising that government is still allowing expansion of industrial units such as Tata Power plant, which was allowed to add one more unit."

Chembur residents, who have chemical factories and refineries as their neighbours, have been complaining about the pollution for a long time. Frequent breathing problems that the residents have to bear are being ignored by the authorities.

The effects of pollution due to the industries at Tarapur have also adversely affected the ground water resources in the region. "There is no way the pollution control board can check the levels of pollution with the acute crunch of effective machinery to monitor the industries," Goenka said.

The chemical industries are the most disastrous as chemicals from different factories mix and form another chemical. "This is something even more serious as no one knows its effects on the soil, ground water and the water bodies in which it is released. All these violations are going unchecked as the state government agencies are least bothered," (www.dnaindia.com)

http://infochangeindia.org/Environment/The-paradox-of-environmentalism/People-vs-environmentalists.html

The Deluge that was..

The year 2005 was a crude reminder to urban planners of the crisis that urban India faces. Within a span of few months, three major metros in the country – Mumbai, Bangalore and Chennai were laid low by unexpectedly heavy rains. The worst hit was India's commercial capital, Mumbai, where after a downpour of 944 mm in 18 hours on July 26, 2005, the city came to a complete standstill for the next 48 hours. A common thread runs through the crisis that immobilized all these cities. It illustrates the crisis of urban planning in India.

An inquiry into the handling of the 26/7 floods, conducted by the National Institute of Disaster Management (NIDM) at the request of the Union Home Ministry has revealed the negligence and gross lack of awareness on part of the authorities supposed to manage disasters under the detailed plan prepared for the city. This report has blamed the absence of a sustainable model of urban planning, where the planning processes have been replaced by short-term opportunistic decisions that destroy natural environmental safeguards and neglect the needs of the majority of city dwellers.

It is very important to note that the built up areas in the city have increased manifold engulfing the open spaces, hills, mangroves, wetlands and the natural drainages provided by Mithi and Dahisar rivers, and a disaster like July 26 might occur again. Although a rainfall of approximately 100 cm in just few hours as a result of cloudburst was unprecedented, the biggest question, however, is how to reach people at the moment of crisis like this and keep the transport network and means of communication functional in the city. Among other elements, disaster preparedness and managements plans are vital components of an adaptation strategy. But to design these, we need a better understanding of which people and systems are vulnerable to such hazards; also what makes them vulnerable,

The complex processes of urbanization along with the rapid expansion of urban population have changed the traits of natural hazards and cities have now become 'crucibles of risk'. Sometimes, even the location of cities place them at greater risk from climate hazards such as cyclones, flooding, etc. These events underscore the vulnerability to natural hazards faced by the urban people, in general, and the poor, in particular, especially those living in sub-standard housing in the most vulnerable locations

Source: Mumbai after 26/7 Deluge: Some Issues and Concerns in Regional Planning R. B. Bhagat1, Mohua Guha and Aparajita Chattopadhyay. (http://www.cicred.org)- Pix courtesy: www.treehugger.com

Fish, Fishing Communities and Fishing Habitat

The UN WRI's (World Resources Index) 1998 figures peg the Indian Ocean sector as the most densely populated coastal region in the world, with 135 persons per square kilometer. Large populations along these coastlines depend on fishing for their livelihood and nutrition. In Southern India's Gulf of Mannar Biosphere Reserve, 200,000 people -- a third of the population -- earn their living directly from the sea.

According to R.Ramesh, R.Purvaja and S.Ramachandran, scientists at the Institute for Ocean Management, Anna University, Chennai, greenhouse gas emissions are depleting the ozone layer to the extent that we have 7 percent more UV radiation now than we did less than 10 years ago. A study by Dr. Herman Cesar, Institute of Environmental Studies, Free University, The Netherlands, revealed that between February to June in 1998, surface water temperatures in the Indian Ocean was reportedly 4 to 6 degrees centigrade above normal for an extended period of time. Fish catches worldwide plummeted in 1998 due to the El Nino Southern Oscillation which, exacerbated by global warming, lasted for over 18 months. Fishmeal production fell by 10 million tons -- about 10 percent of the global fish catch -- and entire species such as horse mackerel, mackerel and hake were acutely scarce. –
(Fishing in Troubled Waters: The Impact of Climate Change on Fishing Communities By Lalitha Sridhar India Resource Center, October 24, 2002
http://www.indiatogether.org/opinions/lalisri/ls1202.htm

Habitat in Danger

Fishing Habitat in danger due to Industrialization, pollution, sky-rocketing prices of diesel, and declining catches . Displacement from the coast, construction of seawalls, erosion and sand mining are altering the coast's contours and affecting the social, economic and cultural environment of fishworker communities.

Scientists warn that the fishing industry in India faces a crisis, caused by overfishing. Around 4,000 trawlers prowl the coast off Maharashtra, their metallic jaws scraping the bottom of the seabed anddestroying marine habitat. Couple that with effluents discharged into the sea by thousands of industrial units and it is no surprise that the quality and quantity of catch has hit an all-time low. Times of India, Mumbai, 6 Apr 2009 -

Livelihood effected

That rapid climate change is impacting food security has been apparent for several years.
Climate change has a direct and terrible effect on the livelihood of coastal fishworkers. They rate amongst the poorest of the poor but their concerns are completely marginalized Although they may not understand global warming and greenhouse emissions, their traditional knowledge of the oceans, fine-tuned over centuries, should be providing key insights. But artisanal fishworkers have become victims of development instead of being participants to the process. (www.corpwatch.org)

Trawlers on the Prowl?

Around 4,000 trawlers prowl the coast off Maharashtra, their metallic jaws scraping the bottom of the seabed and destroying marine habitat. Couple that with effluents discharged into the sea by thousands
of industrial units and it is no surprise that the quality and quantity of catch has hit an all-time low
.(Sea could become watery grave for fishing' .The Times of India, Mumbai, 06 Apr 2009)

We know..

"We have developed a sixth sense to predict the ferocity of monsoon and the level of high tides. So, our fishermen normally move beyond that line of high tide. But we are also finding that our sea creeks, like the Versova creek, are getting narrower due to reclamation activity in other areas. Squeezed out, the water has to find an outlet, affecting our community living and working in the coastal zone," explains Dr Gajendra Kisan Bhanji, Chairman, National Association of Fishermen.(Climate is Changing, But Mumbai is Not by Surekha Kadapa-Bose

Where are the Fish?

National Fishworkers' Forum's complaint is that the Indian coastline is being destroyed in the race to attract investments. To appear industry friendly governments in the states are turning a blind eye to the dumping of wastes at river mouths and in the sea. Oil tankers are being cleaned close to the coast and structures are coming up where the natural contours of the coast should be preserved.

Every fisherman then caught at least 10 kilograms of fish. Now, this has fallen to just one kilogram," added another fisherman at the hearing.

So where has all the catch gone? Ask any fish-worker along India's 8,118 kilometre-long (including islands) coastline, the answers are similar - "Low catch... unpredictable rainfall". For communities from the Gujarat and Maharashtra coast, pollution is another such hurdle to income-generation. "Global warming, increase in temperatures has impacted all the activities of coastal people," added Vaithalingam. **(**Climate Change Leaves Fisherman at Sea By Papri Sri Raman, Womens Feature Service)

N D Koli of the Maharashtra Macchimaar Kruti Samiti says Goa is facing the twin onslaught of the shipping and tourism industries. Oil slicks from ships moving close to the coastline, and oil tankers getting washed in shallow waters against all existing regulations continue to pollute the seas. Huge mounds of dead fish and tar balls (caused by ship fuel) pile up on the beaches. As the tourism industry grabs land, and continues to develop resorts, destroying sand dunes and sinking wells along the coast, traditional livelihoods and coastal ecosystems are attack, drastically reducing the fish catch. (Fish workers on a long, lonely march by Rina Mukherji. Civil Society Magazine, 01 Jun 2008.)

Encroaching Sea

Rapid sea invasion along the Gujarat coast is forcing families of fishermen to abandon the sea and their homes. No local studies have been done in India to measure the precise impact of global warming. But, in the last decade, several factors contributed to the loss of coastal land due to sea level rise," says Murari Lal. "Arctic ice has melted three times faster than predicted by the IPCC in 2001. The sea level has risen twice more than projected by the climate models. Stronger surface winds and storms have resulted in higher waves, which reach further inland. Human interventions, such as the removal of mangroves, reclamation and construction along the coast, have also led to faster erosion of the coast."

"Local factors could also be responsible. Neo-tectonic activity - shifts in the level of the seabed - could also cause the sea level to rise. If there are disturbances in sediment budgeting along the coast, the amount of deposits from rivers, it could also affect the water level." Their study will determine which of these reasons is driving the changes along the coast.

The fish have gone further into the sea because of [industrial] pollution. And the water has come further in; so we have suffered. We can't go very far in our tiny boats. We used to get 400 to 600 fish in one night. Now we barely get a hundred," says Shantibhai Tandel, a small fisherman. He has shifted back six times and is now in his seventh house. "I want my kids to study. The only thing is we can't afford donations for their education or bribes to get them a job. If they are lucky, they will find a job, otherwise they will have to stay here, continue fishing and face the hardships." Sandwiched as they are between the sea and the saltpans, there is not much further they can retreat.

Many from the village have moved to other towns or to Dandi in the past eight years. But like Mahesh Hari Tandel, those who moved out for safety reasons still yearn for the sea. "My boat is still in Danti and I feel I have to go there every day," he says. "When my father was alive, we shifted our house four times. After he died, our house broke twice and then we moved here. After we lost the mangroves in the last 15 to 20 years, many people had to migrate to big port towns like Mumbai, Porbandar or Veraval in search of work. Earlier, we could survive by fishing close to the shore and in the mangroves."

The sea has been encroached. Large parts of it have been reclaimed. Mumbai's prime commercial real estate – Backbay Reclamation and Bandra-Kurla complex - are built on reclaimed land. Mangroves, the breeding ground for fish, have also been hacked to make way for swanky apartments and offices. Mumbai's 15 million inhabitants dump their sewage into the sea with minimal treatment. The water is also polluted by chemical plants, oil slicks and garbage. To top it all, the government plans to build more bridges and recreational boating. That just may be the last straw for fishermen.

"For one month, my father and brother have been sitting at home. There's no catch. In Vasai (northern suburb), people have sold their boats and are working as musicians in wedding bands. What will happen to us?" Sameer asks. "After the construction of the bridge started, fish don't come close to the shore. In the last five years, our family's income has dropped by 80 per cent." They sold their wooden boat (which needs nine people) and bought a smaller fibreglass one (which needs five people) which uses less fuel. "Now, we cut costs by employing less people, using less diesel, not going far out. Like farmers, we too are in debt. We take an advance from traders and have to sell at the price they dictate." (Mumbai's lost world: /www.dionnebunsha.com)

The villagers along the coast are not sure why the sea is advancing at such a voracious pace. Some fishermen guessed it might be "because there are more storms in the sea". One of the reasons could be a rise in sea level owing to global warming. They don't know what global warming means, but have become "environmental refugees"

(Gone with the waves by Dionne Bunsha, Frontline, Jul. 14-27, 2007.)

Climate Exiles

Three hours on this road from Baroda and you arrive at Danti - a fishing village just 12 km away from where Mahatma Gandhi led his famous Dandi Salt March. The car meanders through a dirt path into the village. And then, the unmistakable signs of climate change - nature's unforgiving backlash to human progress - start to show. Between the sea and a row of sea-flanked houses, which ends abruptly, there stands an 8-10 feet wall erected by the government. In the near distance, one can spot wells in the sea, brick-layered walls embedded deep in the sand; the flagpole of a temple.

These are remnants of a village called Moti Danti, now mostly drowned in the Arabian Sea. Hundreds of fishing families from this village have permanently migrated inland. They are among the swelling ranks of global "environmental migrants" or "climate exiles" - people who have to leave their habitats because of sudden or gradual alterations related to one of three impacts of climate change: sea-level rise, extreme weather events, and drought and water scarcity. The quintessential non-combatants in the climate war, they are the ones who have contributed least to global warming, but whose lives and livelihoods are most threatened by it.

Ganpat Bhai Tandel, who moved to Dandi with his family, is among them. Before moving, he says he rebuilt his house further inland five times. "I lost my boat, my income has reduced but at least there is satisfaction that the sea won't enter our home here." Still others have moved to the neighbouring areas of Billimora, Dungri, Kosamba and Lilapur. Further south along Gujarat's 1,600 km coastline, in Kaladra village, sea-level rise has eroded an entire road stretch and forced hundreds of villagers to rebuild their homes further inland.

IN WEST Bengal's ecological wonderland - the Sundarbans - devastating cyclones have pushed the Lohachara Island into the sea, displacing 7,000- 10,000 people permanently. In Orissa, which has experienced some of the worst coastal erosion in the country, entire villages have been swept away in a storm surge.
Yet, we are neither assisting nor protecting the millions of poor already vulnerable to climate change. The Government of India's National Action Plan on Climate Change (NAPCC), released more than a year ago, made no mention of environmental migrants or a plan to help them adapt to climate change.
Meanwhile, there are early but sure signs of the doomsday scenario unfolding across India.

(Meet A New Community Of The Displaced In India: Climate Refugees, Divya Gupta, Tehelka, 9 November, 2009http://www.tehelka.net)

Climate Refugee

Biplab Mondal, a migrant from Sagar island in the Sunderbans of West Bengal, now a resident of Delhi's Govindpuri slums, had a nightmare for 25 years. "Whenever I looked at the sea I thought it would march into our village," he recalls. So when he migrated to Delhi in 1992, to take up a daily wage job, he started saving to invest in a house that would be permanent.

After 17 years, Biplab's nightmare has turned into a reality. "My relatives informed me how the sea slowly submerged my home in Sagar. Now there is nothing to call home there," he says.

In 2009, he spent Rs 70,000 on an illegal hut in the Govindpuri slums. "My hut is illegal, but I am sure that it will not be submerged, ever."

Biplab's hut in Govindpuri is surrounded by the illegal settlements of many of his fellow villagers who have been forced to leave the island due to the invading sea. "In the last 30 years the sea submerged many islands in the Sunderbans. And many of us have migrated to Delhi, Kolkata and Mumbai," - **Richard Mahpatra. Infochange, April, 2010.** http://infochangeindia.org/Agenda/ Coastal-communities/Coastal-refugees.html

Vulnerability to Climate Change: Mumbai-Thane Coast
Pilot Workshop: 29th May 2010

Session I: Environment and Climate Change

Introduction **– Fr. Allwyn D'Silva,** ICOR,

Outline & Issues before the Workshop – **John D'Souza**, CED

Regional and local climate changes and factors affecting climate: trends, implications and vulnerabilities – **Dr. R. V. Sharma**; Dy. Director General, India Meteorological Department.

Session II: Climate Change: Impact on & Vulnerability of Fishing Communities

Impact of Climate change on fisheries and coastal land, vulnerability indicators **- Dr. V.V. Singh**; Central Marine Fisheries Research Institute, Mumbai.

The fishermen's view: **Neville D'Souza** – Gorai Macchimar Sahakari Sanstha Ltd
Pradeep Tapke- Vesava Macchimar Vivid Karyakari Sahakari Society Ltd.

Trends in fish catch and fish varieties around Mumbai. Long-term trends and causes of changes. Remedial measures: fishing regulation and practices. **- Dr. Sushanta Chakraborty**; Central Institute of Fisheries Education, Mumbai

Discussion

Facilitator: Rambhau Patil, Vice President, National Fisherworkers' Forum

Session III: Impact and Vulnerability of Coastal communities

Shore line changes in Manori and Gorai over the years, and maybe in some other coastal areas **- Dr. Madhavi Pikle;** Central Institute of Fisheries Education, Versova.

Vulnerability to climate change: Issues that we need to study and work on **- Prabhakar Nair** - Institute for Community Organisation and Research.

A perspective plan for the six villages of Dharavi Bet **- Fr. Elias Gonsalves** – Centre for Social Action,

Discussion: Non-fishing perspectives in the Coast:
(Nancy Gaikwad - Disha Kendra, **Abhishek Bharadwaj**: Alternative Realities; **Vijay Mhatre** - Dahanu Parisar Bachao Samiti**, Sheetal Tachpande/Meghna Dawar.** Conservation Action Trust.

Facilitator: Fr. Anthony Dias – Xavier Institute for Social Research

Session IV: The Way Forward

Alternatives: **Benson George**,
Centre for Human Ecology
Policy & People**: Fr. Allwyn D'Silva**

Discussion
On what we can do, ideas and plans:
John D'Souza to moderate

Workshop Presenter: **Raajen Singh**

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