Understanding Uncertainty: Views from Kachchh, Mumbai, and Sundarbans



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INTRODUCTION

Understanding Uncertainty in the Context of Climate Change

espite the climate change deniers, there has been incontrovertible scientific evidence to prove that anthropogenic activity has indeed triggered serious changes in the earth's climate with farreaching implications. According to IPCC 5th Assessment report (2014), South Asian countries are already experiencing the impacts of climate change in the form of altered precipitation patterns, high rate of sea level rise, and extreme temperatures, all of which threaten the lives, livelihoods, health and wellbeing of about one-fourth of human population that lives in this region.

While there is overwhelming scientific evidence establishing a causal link between anthropogenic activity and climate change, there is a degree of uncertainty on the precise impacts of this phenomenon on the environment and human society. The uncertainty induced by climate change poses a threat to the ecology, human settlements, biodiversity and economy. Greater uncertainty makes the prediction of extreme climate events like droughts, floods and extreme temperatures tougher which in turn causes problems for preparation against such contingencies. This is why, climate change related uncertainty has become a great challenge to be addressed by planners, policy-makers and at-risk communities.

One of the greatest ironies, nay travesties of this climate change associated uncertainty is that people who are least responsible for this problem bear a disproportionate burden of its adverse impacts. Communities exposed to the adverse impacts of climate change are generally composed of poor and marginalized people who have the smallest carbon footprint, yet because their livelihoods predominantly depend upon natural resources, they tend to lose out the most due to the uncertainty caused by climate change.



This issue of Southasiadisasters.net is titled "Understanding Uncertainty: Views from Kachchh, Mumbai, and Sundarbans" and focuses on the theme of climate related uncertainty. This issue draws heavily from the work of the Research Council of Norway (RCN) funded project 'Climate Change, Uncertainty and Transformation'. This project spawned three round tables recently held at Gandhinagar, Mumbai, and understand Kolkata to the perspectives of various stakeholders such policy makers, as administrators, climate scientists, activists and community leaders on

climate related uncertainty. This issue is replete with the insights of these stakeholders on how they understand, experience, interpret and are impacted by climate change related uncertainty.

These round tables drew heavily from the experience of the precariousness faced by at-risk communities in the Kachchh, Mumbai, and Sundarbans areas of India due to climate change related uncertainty. Among the key lessons emerging from this dialogue is that uncertainty for local communities is not just an inconvenience in the form of extended periods of erratic weather but an existential threat to their livelihoods. This uncertainty destroys the ecological resources such as mangroves which not only provide India's coastline with a protective cover but are also central to the livelihoods of such at-risk communities. Therefore, any solutions to the problem must be rooted in the local milieu of such communities and must take into account their perspectives.

Most importantly, this issue covers a wide range of themes that are central to the dialogue on climate change related uncertainty. For instance, themes as diverse as distress migration, focus on rural women's employment, the need for more participatory environmental risk assessments and the need for contextualization of solutions have been discussed here. It is hoped that through this issue, concrete action on climate change related uncertainty takes place in this country.

- Mihir R. Bhatt

Tackling Uncertainty in a Changing Climate: Lessons from Gujarat, Mumbai and the Sundarbans

rticles in this special issue A show how uncertainties are 'everywhere': It runs through policy and planning processes as well as every other aspect of people's daily lives. Climate change-related uncertainties are receiving particular attention. For example, there is increasing uncertainty about rainfall patterns in Kachchh and new concerns about floods, changes in storm frequency and intensity in the Sundarbans, and increasing floods in Mumbai. However, for people living in these areas, climate-related uncertainties are but one of many. Some of them are new – like the possibility of increasing floods in Kachchh – but in most other cases, climate change may merely exacerbate existing uncertainty around incomes and livelihoods,

ecosystems, or rapid social, economic or political changes.

While most people will have no choice but to live with such uncertainty, often at great cost, planners and policymakers have traditionally tried to isolate and reduce (and ideally eliminate) it. Climate change makes this aim increasingly unrealistic, given the high and increasing uncertainty in climate change model projections, let alone the impacts they will have at sub-national and local levels. Recent approaches have therefore tried to turn this around, recognising that uncertainty is unavoidable and focusing instead on the robustness, resilience and adaptive capacity to a wide range of possible future climates. This special issue shows how difficult this is in practice, not at least bridging the gap between the very different understandings of 'the above' actors (planners, policymakers and modellers), and the 'below' actors (people at local and community levels).

This special issue also highlights the possible strategies to overcome these challenges. One is to bring the voices from communities, typically excluded from formal processes, to the fore. Bose (this volume) documents efforts using an approach called photo voice. This involves providing people with cameras while facilitating linkages 'upwards' to bring their message to policy audiences, from the local panchayat and implementers through to policy makers, modellers and planners. The



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Long hours depleting fish catch, Sundarbans.

aim is to bring marginalised voices to those who have the power to make changes. So far the project has had state level round tables in Gandhinagar, Mumbai, and Kolkata; the final journey is to bring these voices to policy makers at the central level in Delhi.

A second important area is to better recognise and integrate local knowledge, skills and experiences. Duff (this volume) shows the importance of learning from vernacular architecture to make the built environment more adaptive to uncertain futures. The Kachchh and Sundarbans cases both show the importance of making better use of the wealth of dynamic local knowledge and experience that exists in both observing and tackling changes, including strategies to diversify livelihoods. And third, the case study by the Self-Employed Women Association, SEWA (Bhatnagar, this volume) shows the importance of supporting and strengthening local agency. While climate change worsens existing uncertainties around yields and returns, SEWA supports women groups to, for example, improve access to credits, seed banks, training, and insurance and advisory services.

Tackling climate change in a context of increasing uncertainty will require small and gradual changes, working within existing systems, while not losing sight of the need for deeper, structural and transformative changes. In the Sundarbans and Kachchh, example, for the immediate priority is the need to adapt livelihoods to increasing uncertainty, focusing on the factors that make people vulnerable (Ghosh, Srivastava and Mehta). To address this properly will mean going much further, however. In Kachchh, livelihood uncertainties, including climate-related ones, are underpinned by problems associated with rapid economic and industrial development and its impacts on fragile and increasingly threatened ecosystems, with highly unequal resource access, in particular land. Without tackling these underlying issues, responses to climate change will at best be short term 'sticking plasters'.

Similarly, floods in Mumbai are today mainly tackled as an issue of managing water flows, creating barriers to protect the population. However, current problems are better seen as symptoms of much deeper political and governance challenges, such as unregulated construction, lack of treatment of solid waste, lack of coherent urban planning, and the disappearance of natural buffers such as floodplains and mangroves (Adam, Parthasarathy, and Narayanan, this volume). Thus, unless these underlying or root causes are tackled, floods are going to continue to hit the poorest and most marginalised groups hardest: they live in the least protected areas, are the most exposed to water-borne diseases, have the least own capacity to cope and adapt, and the least support from the state. On top of this, they are subject to new uncertainties created through the rapidly expanding city, with fears of being relocated.

The examples above show that while challenges are considerable. At the same time, so are the possible opportunities: if the attention to climate change can provide entry points to more integrated urban planning, such as a focus on 'smart cities' in Mumbai (Adam, Parthasarathy, and Narayanan, this volume), it may give hope for better of vulnerability integration mapping and pro-poor adaptation interventions. Similarly, in Sundarbans and Kachchh (Ghosh; Srivastava and Mehta, this volume), forging alliances between those on the ground and policymakers may give new openings in policy processes.

> - Dr. Lars Otto Naess, Research Fellow, Institute of Development Studies, UK

CLIMATE CHANGE AND DRR

Bridging the Gaps in Uncertainty and Climate Change

n India, local people, planners and $\mathbf{I}_{ ext{policy makers regularly confront}}$ climatic shocks and stressors such as cyclones, floods, droughts, changing rainfall patterns and extreme temperatures. Yet, the knowledge about the scale and impacts of these changes remain deeply uncertain. This is particularly true at the local level, where climate related uncertainties combined with accelerated capitalist growth trajectories often exacerbate social and political inequities and the vulnerabilities of marginalised communities. While the uncertainty associated with climate change is often considered to be a 'super wicked problem' by scientists and policy makers, climate experts (policy makers and scientists) continue to draw on quantitative assessments, models and scenario

building to understand and capture uncertainty. These efforts, however, rarely take into account how local people - particularly those living at the margins - make sense of and cope with uncertainty. Often there is a wide gap between how uncertainty is understood and experienced from 'below' by the lived experiences of local people, how it is conceptualised and represented from 'above' by climate scientists and experts and how the 'middle' - civil society, NGOs, academics - can potentially function as brokers between the 'below' and 'above'.

The Research Council of Norway funded project 'Climate Change, Uncertainty and Transformation'¹ sought to bridge the diverse perspectives between the below, middle and above by organising three round tables in Gandhinagar, Mumbai and Kolkata in January 2018 bringing together perspectives and experiences of government officials, academics, practitioners and activists. These built on an earlier round table organised in Oslo in August 2017. The aim was to better understand the way climate change and uncertainty are experienced and understood by diverse stakeholders in order to explore ways to foster transformative, socially just and inclusive development in the context of growing climate change uncertainty.

All the round tables were rooted in the context of their specific sites. The Oslo meeting addressed overarching contextual issues whereas the other sessions built on the challenges and



Kanmervillage as seen from Kanmer hill, Kachchh, Gujarat.

contexts of the specific sites. All the round tables began with a powerful photo voice presentation highlighting the precariousness of local people to climate change related uncertainties (e.g. erosion of lands in the Sundarbans due to sea level rise or the changing nature of rainfall and droughts and their impacts on livelihoods in Kachchh) and how they make sense of, live with and adapt to them. These uncertainties are further compounded by wider socio economic changes (e.g. port development in Urban/ Mumbai) which often destroy key ecological resources such as mangroves which both protect the vulnerable coastline and are also key to the livelihoods and wellbeing of the local communities.

The following key lessons emerged from the round tables:

- It is important to challenge the dominant positivist understanding of uncertainty that dominates science and policy making. Uncertainty will be understood differently at different levels (above, middle and below) and multi-sectoral and interdisciplinary ways are required to understand its impacts and manifestations. Social science aspects concerning socio-political pathways, gender dynamics and site specific vulnerabilities of different social groups and how these interact with climate related uncertainties need to be included in mainstream debates.
- It is important for policy makers to embrace uncertainty in decision making. While they feel this might paralyse decision making, it is important to find optimal ways to communicate uncertainty across the above,

middle and below in order to promote pro-poor adaptation and long-term development planning. Better training and education on the limits and opportunities with models can improve decision making

- There are still significant data gaps in understanding climate change impacts across the sites. Data gaps also exist regarding local people's coping strategies and understandings. Official responses to climate change have not built on local level knowledge and experiences. There is no one size fits all and further research is required to understand ground level realities. Advances in attribution science will be important to improve disaster management. Environmental and social impact assessments that feed into decision making processes need to become more participatory less exclusionary. and Transparency and accountability to all stakeholders, especially marginalised people who lack voice, are key. Currently, these processes are often closed and opaque.
- The so called 'smart' approaches need to pay more attention to long term ecological issues (e.g. flood proofing in Mumbai) and incorporate climate risk

The Research Council of Norway funded project 'Climate change, uncertainty and transformation' sought to bridge the diverse perspectives between the below, middle and above by organising three round tables in Gandhinagar, Mumbai and Kolkata. assessments. They also need to put the needs and interests of marginalised citizens upfront, rather than exclude them.

- Despite much advance in state level climate change policies and action plans, much more could be done to improve propoor adaptation and the strengthening of local ecosystems and biodiversity. Various forms of knowledge and experiences, including scientific, technical, administrative, and every day practices need to come together to plan for alternatives. The state should facilitate dialogues between policymakers across scales and sectors, academics, NGOs, CBOs as well as local communities.
- More support is also required to enhance the resilience of local communities to disasters and climatic events such as heatwayes and floods. Interventions need to focus on strengthening livelihoods, local experimentation with accessible technologies (in housing and shelter, water, energy), resource conservation and community empowerment.
- A clear pathway for transformation based on knowing the 'certainty of uncertainty' needs to be charted and shared with diverse stakeholders
- Bridging asymmetries of power and stakeholders, policy makers, and citizens is a prime concern.
 Good case studies of successes and failures can be deployed to develop better transformation strategies.

- Dr. Lyla Mehta, Institute of Development Studies, UK and Norwegian University of Life Sciences, Norway

1 https://www.ids.ac.uk/project/climate-change-uncertainty-and-tranformation

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CLIMATE CHANGE IMPACTS

Climate Change Uncertainty in Dryland Kachchh, Gujarat

n a summer evening in June Oⁿ a summer creater of 2016, I met Bau*bhai*, a farmer in Rapar taluka, whose family has been farming for generations. As we talked about the changes in havaman (term used for weather in Gujarati), he told me how agriculture was becoming difficult with irregular seasonal cycles and changes in temperature. He lamented that winters are becoming warmer and we get heavy spells of rains during monsoons, only God knows what is happening! Baubhai was among the many people I met during my visits to Kachchh (also spelled as Kutch) who are witnessing the effects of climate change uncertainties, often vocalised through the impact on livelihoods.

Climate uncertainty refers to the inability to predict the scale, intensity and impact of climate change on human and natural environments. Within climate science, it is often treated as a 'super wicked' problem that needs to be tamed or controlled but for people who are at the forefront of climate change, uncertainty has always been a part and parcel of their lives. As part of the Research Council of Norway funded project Climate Change, Uncertainty and *Transformation*¹, we are investigating these perspectives to arrive at more inclusive and socially just adaptation responses.

Nowhere are the impacts of climate change felt more acutely than in the marginal environments (such as the drylands) which are home to ecologically sensitive ecosystems, and vulnerable populations that rely



on these systems. Drylands constitute about 40 percent of the earth's land surface and support 38 percent of the human population². Drylands are highly variable ecosystems characterised by low, erratic rainfall. Pastoralism, agro-pastoralism and rain-fed agriculture are dominant livelihoods of these regions. Despite being highly dynamic ecosystems, drylands are extremely vulnerable to climate change impacts. With changes in the hydrological cycle, it is suggested that climate change will increase aridity and lead to greater strain on water resources in these region thus affecting the lives and livelihoods of the resource dependent populations.

In dryland Kachchh, droughts and poor rainfall are a defining part of the ecological landscape of the region. Located in the north-western part of Gujarat, about 51 percent of the area in Kachchh is covered by saline deserts (Greater and Little Rann of Kachchh). A dynamic ecosystem, Kachchh is highly vulnerable to climate change impacts. In addition to the increase in erratic patterns of rainfall, Kachchh is also witnessing sea level rise and coastal erosion leading to higher incidence of salinity ingress and invasion of *prosopis juliflora* (invasive weed). These will have long term effects on the ecology and livelihoods of this region.

Uncertainty has been a part of life in this semi-arid region whereby people have historically lived with ecological changes related to rainfall and droughts. They have relied on indigenous knowledge systems and diverse coping strategies such as changes in cropping patterns, livelihoods diversification, and migration to cope with these changes. However, what they are not attuned to is the erratic and

 $1\ http://www.ids.ac.uk/project/climate-change-uncertainty-and-tranformation$

2 https://www.unibas.ch/en/News-Events/News/Uni-Research/The-Impact-of-Climate-Change-on-Drylands.html (Accessed 20 March 2018).

unpredictable nature of these changes such as high incidence of freak events like flash floods, rapid changes in seasonal cycles. The sheer frequency of these events is limiting their ability to cope with these rapid changes. While farmers are struggling with depleting groundwater tables, salinity ingress and uncertain rainfall patterns, pastoralists are facing the pressures due to loss of grazing lands and increased incidence of livestock diseases due to warmer temperatures.

The effects of ecological uncertainty are further amplified by changes in the political economy of this rapidly industrialising district. The diversification options are few especially as capital-led development is increasing the vulnerability of the rural populations due to intense pressure on land and water resources. For example, rapid industrialisation along the coastline has reduced the access of pastoralists and fishers harming their livelihoods, thus making them more vulnerable to climate shocks.

Though climate change concerns are increasingly being mainstreamed in policy making in Gujarat through various projects , the top down *modus operandi* tends to make local level impacts fairly 'invisible' in the policy discourses. For more inclusive development, it is essential that local level perspectives on resource uses and rights, adaptation, and livelihoods are mainstreamed into climate adaptation measures in the state.

- Dr. Shilpi Srivastava, Research Fellow, Institute of Development Studies, UK

POLICY SUPPORT

Taking the Voices of the Community into the Realm of Policy Making



Round Table on Bridging the Divide on Disaster Risk, Climate Change and Uncertainty: Engaging with Transdisciplinary Perspectives, January 19, 2018, Gandhinagar, Gujarat.

More often than not raising a voice is not enough by itself. For instance, it is imperative for vulnerable communities that live on the margins of society's consciousness to not only raise their voices but also to make them heard to the people whose decisions determine their exposure to risks and their daily struggles to adapt to the ever changing environment.

The Research Council of Norway funded project 'Climate Change, Uncertainty and Transformation', realizing the importance of these factors, used a participatory action research technique called photo voice. The method follows the model of 'voice' proposed by Lundy, et al. in 2007, which describes four key components that enable participants to raise their voice for the betterment of their challenges.

The first component is 'space,' which refers to participants' opportunities to express their views regarding climate change. Site wise facilitation



in the remote villages in Kachchh, the fishers in Mumbai and in the rapidly sinking and eroding islands of the Sundarbans played a key role in supporting communities to collectively express their views, by providing them cameras and facilitating linkages with target audiences. The second component is 'voice' in terms of articulating their views through photographs within and outside the community. The third component is 'audience,' which refers to the target audience (the local panchayat and the local implementers), who support implementation of the communities' demands and who can link groups to the higher ups—the policy makers, the modelers and planners. The fourth component of the model is 'influence,' where participants influence how local decision makers work on mutually agreed actions to address identified problems.

For the third and fourth component, the project held a series of round tables in Ahmedabad, Mumbai and Kolkata to reach the views of the communities' perception of climate change to a varied group of key stakeholders - academia, policy makers and civil society. It was interesting to note that the stakeholders discussed the perceptions of the communities while putting forth their own views. In some cases the views matched and in some others the views differed. But the crucial gain was that the project was able to bring in the voices of the community into the public arena. The project plans to take the deliberations from the state round tables on the communities perceptions to the central policy makers through a national round table planned in the later part of 2018.

- Shibaji Bose, Consultant, Future Health System (FHS), India

DRR AND URBAN PLANNING

Climate Change, Uncertainty and Urban Development: The Case of Mumbai

Anthropogenic communication of the second se impacts, patterns and trends remain characterised by uncertainty. Models and scenarios are imperfect, and methodologies and tools are unable to entirely capture the complexity of rapidly evolving climate and weather changes across different scales. Studies predict that extreme events are likely to increase further in the Mumbai metropolitan region. As a coastal city, Mumbai already faces risks from storm surges, sea level rise, and coastal erosion. In future, the region is expected to witness more intense rainfall events, increase in wet spells, and further

exposure to the risks of cyclonic storms along the west coast. Oceanic warming and El Nino driven effects make the monsoon increasingly variable, uncertain and unpredictable.

Adding to the climatic uncertainty is poor quality urban governance, high levels of social, political, and economic inequality, and insufficient and deteriorating urban infrastructure. In combination, they tend to exacerbate risks and vulnerability for all residents, with disproportionate effects on the poor. The lack of equitable economic growth, and persistent environmental degradation and encroachment on the commons result in severe loss of livelihoods especially in the informal and resource dependent sectors. The crisis of livelihoods, constant threats of eviction, housing problems, and ineffective disaster governance add to the woes of uncertainty for the region and its population. Against this backdrop, top down urban development models and planning trajectories encourage rapid and haphazard development that do not address the causes and consequences of growing uncertainties. As a result, significant opportunities for a positive transformation are lost.



Flooding at Moregaon after closure of pumping station gate.

The imagination of transformative urban development and planning is, however, constrained by an inability to consider the large informal sector and the high level of dependence on the natural resources for livelihoods. In addition, ecological systems that act as a natural defence against flooding, sea level rise, and other hazards remain side-lined in most planning approaches. They are also constrained bv а narrow understanding of economic development, which undervalues the role of the environment in vulnerability reduction and disaster risk management.

The Research Council of Norway sponsored project 'Climate Change, Uncertainty and Transformation' seeks new pathways of understanding and responding to climate change uncertainty among different sectors and actors in Mumbai. Among the range of disaster risks that affect Mumbai, chronic monsoonal flooding is the most common hazard. The city is also ranked consistently among the most vulnerable cities in the world prone to climate change impacts and disasters. Uncertainty is considerably enhanced for the large population sections that are subject to poor living conditions, live in marginal environments, are economically excluded and uncared for by state agencies.

Narratives from the field reveal that state agencies are either not very responsive, or are prone to narrow technical, rather than socially inclusive flood management solutions. Our research, discussions, and a round table with stakeholders suggest that uncertainty needs to be firmly addressed and incorporated into urban and disaster governance processes. Going beyond the ideas of resilience and adaptation, the research underscores the imperative of a larger process of transformation that can better understand and interpret the nature of uncertainty

in multiple realms (ecological, livelihood, and knowledge), and the perception of uncertainty by diverse actors (experts, lay people, activists, academics, and bureaucrats). Transformative urban governance is envisaged as a process that can modify and mobilize institutions and agencies across sectors and scales to better grasp the interplay of water related uncertainties with Mumbai's political economy, governance, and institutional dynamics. Ultimately, this process should lead to a considerable reduction in the multiple risks and uncertainties that the most vulnerable people face. The need for co-produced hybrid forms of knowledge, plural perspectives and multiple response options in this process cannot be overemphasized.

- D. Parthasarathy, Convener, Climate Studies Inter-disciplinary Programme; and Professor, Department of Humanities, and Social Sciences, Indian Institute of Technology Bombay, India

Based on research inputs from Hans Nicolai Adam, NC Narayanan, Alankar, Synne Movik, Lyla Mehta, Mihir Bhatt, and Shibaji Bose.

CLIMATE CHANGE AND DRR

Climate Change and Uncertainty in Delta Areas

limate change and its consequences are expansive and all encompassing, and the South Asia region is one of the worst hit regions of the world. According to IPCC 5th Assessment report, South Asian countries are already experiencing the impacts of climate change in the form of altered precipitation patterns, high rate of sea level rise, and extreme temperatures, all of which threaten the region's life, livelihood, health and wellbeing. Within the context of regions' socio-cultural and political dynamics, and rapid urbanizations, these extreme climatic events will likely be very disruptive and India is one of the classic examples of such challenges.

As per the statistics provided by National Disaster Management Authority, Government of India, 40 million hectares of India's total land mass is prone to cyclone, tsunamis and river erosion. 7516 kms of highly populated coastline are at a greater risk especially the river basins of north and north-eastern states affecting more than 30 million people on average each year. As per the IPCC 5th assessment report (2014) and a series of studies done by Indian Meteorological Department (IMD), 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. Similarly, IPCC 4th assessment report (2007) pointed to the alarming rate of the melting and eventual disappearance of Himalayan glaciers. The combination of sea level rise and melting glaciers poses a greater risk of flooding in the coastal plains in which the rural areas and cities are equally vulnerable. In addition to frequent flooding there is a

projection of 15% increase in intense flooding in the coastal regions by IMD. The region of Bay of Bengal alone has a 20% increase in cyclonic events due to sea level rise and increasing sea surface temperature.

Often neglected in the discourse on climate change at the national level is its impact on the poorest and most vulnerable in society; those who are least responsible for it. Changes in extreme weather events and the spread of climate sensitive vector borne diseases are increasingly affecting the morbidity and mortality in the region. Access to resources to deal with climate change impacts is sensitive to societal intersections like ethnicity, gender, class and other identities, making the economically disadvantaged even more vulnerable. Hence, poor people, members of minority groups, women, children, elderly, people with chronic diseases and disabilities, those residing in vulnerable deltaic areas in India with a high prevalence of climate-related diseases, and workers exposed to extreme heat or increased weather variability become the most vulnerable to the adverse impacts of climate change.



In terms of health as an indicator, frequent flooding in last two decades has significantly impacted the health of the Indian population in two ways. First, there are direct impacts at the time of disaster in terms of mortality, increasing water borne diseases, mental trauma and destroying health infrastructures. The second and longer term impacts are in terms of depleting significant social determinants of health like livelihood, shelter and social conditions. Together these impacts are creating a vicious cycle starting of depleting agricultural products, hampering market availability, loss of household assets and indebtedness, migration and malnutrition and related morbidities. According to World Banks' 2009 report, India has 70% (aged between 6 months to 5 years) malnourished children as well as 55% malnourished women and 25% malnourished men.

Even though the effects of climate change across the region and across social and environmental systems are likely to be uneven depending upon already existing structural vulnerabilities, it is very likely that impoverished regions will bear a disproportionate burden of these changes due to their structural inequalities as well as the limited capacity of their populations to adapt and respond to climate change. Therefore, efforts to respond, mitigate, or adapt to climate change will need to address issues of equity and social justice, innovative approaches - cooperative responses and new forms of governance.

- Upasona Ghosh, Indian Institute of Health Management

Research (IIHMR), Kolkata, India

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WOMEN AND CLIMATE CHANGE

Women, Livelihoods and Climate Related Risks



While other farmers struggled with challenging climate conditions and their crop was infested with worms; I could reap a good cotton harvest thanks to being taught by SEWA's Farmer Field School how to prepare organic fertilizer. Application of this fertilizer in my field has mitigated the worm infestation and enhanced the quality and quantity of my yield. Today farmers from neighbouring villages are also commissioning preparation of this *Panchamrut....*"

- Umayaben Rajubhai Rathod (Kalyanpur Village-Surendranagar District) For over 4 decades, the Self Employed Women's Association (SEWA) has been working with its rural members to help them improve their livelihood through various initiatives in technical training, microfinance, market linkages and natural resource management, across a number of trades.

As a large number of SEWA's rural members hail from the agricultural sector, the thrust has been to understand and work around the nexus between women, agriculture, water and climate. Women are the backbone of marginal farmer

households in India with their efforts being critical to the well-being of the household the farm. and Comprehending this SEWA's agriculture model emphasizes on developing the farm as an enterprise; shifting the focus from mere subsistence to viability and profitability; propagating solutions to mitigate climate related risks; and ensuring adequate supply of water even in arid zones to suffice the domestic and farming needs of the women.

With global warming badly hitting the agriculture sector – farmers are losing entire crops to unseasonal rains and droughts; fields are being rendered unproductive due to pesticides and bad cropping patterns; soil health and plant health are rapidly deteriorating; and erratic water supply is adversely affecting the irrigation pattern.

To combat this SEWA imbibes a community-driven approach integrating agriculture and technology to enable farmers to become the drivers of sustainable agriculture by initiatives like:

- Organizing farmers into Farmer Groups to facilitate timely access to credit
- Seed banks, plant clinics and agricultural tools and equipment libraries (22,500 + farmers benefitted)
- Training 24,917+ farmers in soil health and vermicompost preparation
- Customized products like rainfall insurance and agriadvisory services to 8584+ farmers
- Energy initiatives like biogas plants (152 set up), solar pumps for irrigation, solar lanterns (to 15,000+ rural households) and cooking stoves (for 6000+ women)

- The rural retail value chain (RUDI) to enable farmers to sell their agri produce at fair prices without having to travel long distances thereby positively impacting 40,000+ households
- The Women, Water and Work Campaign to improve agriculture productivity and increase resilience to weather shocks (covering 4,60,000 women across 1500 villages)
- Delivering capacity building trainings to develop a sturdy cadre of grassroots Master Trainers who through Farmer Field Schools cascade their learning/s to a larger farmer audience (6,455 farmers)
- Digitizing 23,660 rural women across 2200 villages to ease their drudgery.

The journey of making the rural women accept and adapt to climate resilient agricultural practices and technological innovations has been challenging but the results have been heartening in terms of – substantial increase in the quality and quantity of yield, strengthened livelihoods, fulfilment of nutrition requirement of a greater number of households, retention of soil nutrients, tech savvy farmer women, smart agricultural practices, climate preparedness, hike in agricultural revenue, a well set supply chain, sturdy cropping patterns, etc.

Vanitaben Kudecha from Anjar Village - Surendranagar District, shares - "Earlier I used to practice salt farming, but with the water canal being set up in our village I thought of starting cotton farming - but had no idea about it. But thanks to the various training programs conducted by SEWA's Farmer Field Schools I learnt scientific agro practices, cotton farming, soil testing, seed multiplication and production and organic farming techniques. Applying these has ensured doubling of yield, with input of lesser efforts, time and money ... "

SEWA believes that women are the best agents to engineer change and address new aspects of development in a society. With Indian agriculture getting feminized a holistic approach interweaving climate resilient practices and water solutions enables women to work towards the economic and social security of their families. **– Smita Bhatnagar**, Manager, SEWA, Gujarat, India

CLIMATE CHANGE AND PUBLIC HEALTH

Climate Change and the Challenge to Public Health in India

ntroduction Climate

Climate change leads to uncertainty in weather patterns. The manifestations of climate change are wide ranging in India due to the size and geographical diversity of the country. Depending on the location and vulnerability, regions of India are getting affected by rising sea levels, heat waves, sudden storms, erratic rainfall, droughts and salinization of water, to name a few. These phenomena are destroying homes and upsetting livelihoods. Such climate change induced uncertainty poses a challenge to securing the health of people. How is their health and wellbeing compromised on the face of such uncertainty? Is the challenge insurmountable?

Promotion of people's health is at the core of public health. The discipline adopts a macro-societal perspective. It seeks to prevent disease and promote health and wellbeing. Collective gains underscore public health victories. Success stories in public health are about deaths averted and lives saved. The count is not in ones or twos. Rather, it is in thousands and millions. The discipline has evolved over time. It is multidisciplinary with representation from medicine, nursing, natural sciences and the social sciences. In recent years, there has been an emphasis on the participation of people in health promotion and monitoring of healthcare services. The discipline recognizes the power of the people and seeks to leverage it to attain its goals. It is acutely empathetic to the plight of the disadvantaged and the marginalized. Equity has guided policy and practice in public health since the 1990s. The discipline has been a forerunner in ethics with principles such as beneficence, nonharm (non-maleficence), autonomy and confidentiality underpinning it.

Challenge to Public Health in India

Climate change poses a threat to securing people's health in India and the world. Temperature rise leads to spread of diseases such as malaria and diarrhea to hitherto cooler areas. Extreme weather events cause injuries, disabilities and deaths. Storms damage/destroy healthcare facilities. In the Indian Sundarbans, islands have shrunk in size due to the land being washed away by the waters of the Bay of Bengal. Public health outposts that provide care to the local population have been damaged. The increased disease burden and damaged infrastructure add to the country's existing public health challenges. India shoulders a dual burden of communicable and non-communicable diseases. Ill health and death due to diseases such as malaria and tuberculosis are common in the country. As are illhealth and death caused by lifestyle

diseases such as diabetes. The public health care infrastructure is deficient in India. The challenge posed by climate change thus adds to the burden on the country and compounds it.

Another point needs to be mentioned here. Climate change affects social determinants of health such as shelter and livelihood. It upsets the very conditions in which people live and work. Decreased crop yields increase food insecurity. The traditional sources of foods are affected, compromising people's health and nutrition. Cyclones and floods make the homeless vulnerable.

Public Health in Uncertain Times

The history of public health is replete with challenges. It is also testimony to the successful overcoming of challenges and drawing lessons from them. The successful eradication of small pox is an example in this regard. More recently, making India polio free has been an acclaimed public health success. It is held that the size, diversity and complexity of India makes it an interesting test case. If a public health challenge can be successfully tackled in the country, then it holds a mirror to the rest of the world.

Climate change poses a grave challenge to securing the health and wellbeing of people. It militates against the very rationale of the discipline of public health. Whether the challenge can be overcome depends on whether а transformative approach can be adopted to secure people's health. Challenges are not new to public health. Equity and ethics are well founded in the discipline. Influential voices in public health have already begun to join forces against the common threat. The 2015 report by The Rockefeller Foundation - Lancet Commission on Planetary Health explicitly states that 'environmental threats to human health and human civilisation will be characterised by surprise and uncertainty'. It calls for action to be taken at global, national and sub national levels 'before irreversible changes in key Earth systems occur'.

Can the discipline of public health once again rise to the occasion? Can it restrict the multifaceted effects of climate change on people's health and on the social determinants of health? The discipline has successfully overcome challenges in the past. Only time will tell if this too shall pass. — – Manasee Mishra, IIHMR University, India



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URBAN HEALTH AND CLIMATE CHANGE

Urban Health Focus in Climate Resilience

In a rapidly urbanising India, the Litrural to urban population ratio has already reached to 70:30. Urbanisation influences the economy, development, demography, climate change, social cohesion as well as urban health. Urban health is defined as "Health status and health concerns of the population in an urban area"¹. Urban health is based on core healthy cities principles of equity, intersectoral cooperation, community involvement and sustainability². Climate change has been recognised as the greatest threat to human health in 21st Century³. Urban health is a new arena, adding climate agenda in urban health and health agenda in climate change is the need of the hour.

Climate change can impact urban health in a variety of ways, viz. direct exposure, intra-domestic – occupation environment, changing microbes – vectors-contamination pathways, changes in ecologyhydrology-agriculture and socio economic- demographic transitions. It is measured as discomfort, disease, disability and death.

"What is not good for the climate is not good for human health as well", explains safe climate limits. Considering temporal and spatial variability of climate and health trends, every city needs to develop its action plan towards climate and health resilience and regularly update it. Health Resilience is a dynamic process whereby people bounce back to health, revive health status and go on with their lives after an emergency. The following measure highlight some of the ways to identify and address the impacts of climate change on urban health.

Urban Observatory:

A) Health and climate surveillance: Is important to understand human reaction and tolerance to climate change. There is much information on climate change but not much on health changes due to climate change. Every city needs to build its capacity to avail standardized health data, review health and climate data regularly for evidence based planning. The same is an advocacy tool as policy makers, administrators and community will listen if its properly vetted.

- **B)** Intersectoral convergence: Health and climate resilience is a matter of engineering, enforcement and education. All departments of urban systems need to have a cross boundary agenda.
- C) Technology: Use of technology shall improve efficiency of the resilience activity for real time data mining, storage, organisation, analysis, interpretation, dissemination and storage.
- D) Capacity building: To fix climate and urban health resilience requires investment in human beings along with tech magic⁴. It requires experts from planning, engineering, health, policy, law, management but most of all it needs people who are able to understand cross cutting areas.
- E) Academic support: Academic support by collaborating with academic institutions / centre is valuable. For evidence based interventions learners and researchers are to be different from the doers and together they can create a knowledge and experience for effective urban, health and climate resilience.

Urban Community Lab:

A) Community is the answer: Community education, skill building and participation are major contributors to the resilience building process. Community preparedness is a behavioural aspect and action beyond mass media for day to day resilience is required.

- **B)** Urban museum: A Museum displaying visuals for learning about city, its vulnerability, service system, health system, climate trend and modulation, ecology and its impact shall be the attraction for urban community.
- C) Social media platform: Interactive web portal to inform, to learn, solve the queries, updates and relay forecast with SOPs.
- **D)** Institutionalisation: Institutionalizing community empowerment and enhancing inter personal communication capacity of grassroots level
- stakeholders will also improve health outcomes in a changing climate scenario.E) Child friendly city: Educate and Empower. Involve children and
- Empower, Involve children and youngsters to ensure that every child has access to opportunity, care, protection and rights.
- F) Promoting individual Health and climate resilience:
 - Holistic approach towards individual tolerance and immunity by education, immunisation, nutrition and following "Rituchakra" guidelines for seasonal lifestyle modification.
 - Compliance to guidelines of environment actions e.g. water conservation, green cover, sanitation, public transport, etc.
 - Action as per SOPs of disaster, climate and health forecasts.
- Dr. Vikas Kishor Desai, Technical Director Urban Health and Climate Resilience Centre of Excellence, Surat, Gujarat, India

- 2 Healthy cities. Urban planning, evaluation phase V, (2009-2013) WHO regional office for Europe
- 3 Tackling climate change: the greatest opportunity for global health – The Lancet 2015
- 4 Social change is in danger from Technology, Kentaro Toyama, 2015

¹ Oxford online Dictionary

SOLAR ENERGY

Development and Climate Change Mitigation



10 MW grid connected Canal Top Solar Power Plant in Vadodara by Government of Gujarat.

Climate change is the bitterest truth of the 21st century. Economic development through abuse of natural resources has led to irreversible changes to earth's systems including damages to the atmospheric concentration of gases. The uncontrolled use of fossil fuels, manufacturing of cement and land use change are the major reasons of green house gas (GHG) emissions which have caused climate change since last one century.

The efforts made to limit further emissions of GHG are known as mitigation. Also efforts made to capture and store atmospheric carbon is part of climate change mitigation efforts.

Energy generation is a major contributor of GHG, which is the reason behind global warming. Therefore in recent times promotion of use of non-conventional sources of energy through use of solar and wind resources are promoted world over. Also in the United Nations Sustainable Development Goals, published in 2015, it is given high importance. Access to energy to every citizen is a high priority of the Government, at the same time through structured policies and programmes renewable energy is being promoted for long-term ecological sustainability as well.

The Government of India has decided to establish 175 GW of

renewable energy by 2022 under visionary leadership of Prime Minister of India Shri Narendra Modi. Out of 175 GW, 100 GW will be from solar, 60 from Wind energy and the rest 15GW will be from biomass, waste to energy and small hydroelectric power stations. Thus, India is playing a centre stage role in renewable energy development the world over. India has also been instrumental in establishing International Solar Alliance (ISA) under the United Nations with help of tropical countries getting very high solar irradiation. The ISA is ensuring Energy Security in under developed African and Asian countries through maximising cost effective solar technology. Out of 100

GW of installed capacity through use of solar energy 40% will be from Rooftop installations, also installations of solar based pump sets in Agriculture is promoted with an idea to conserve water resources by ensuring uninterrupted power supply.

Gujarat has been the leading Indian state to promote renewable energy through strong government policy and infrastructure support. Gujarat's Solar Policy of 2009 was instrumental in scaling up of Solar Power installed capacity from KW scale to MW scale and now it has reached to GW scale in India. The solar power policy of Gujarat was revised in 2015 to promote net metering across the state with an emphasis to rooftop based installations. Gujarat has also promoted Wind energy since the last 2 decades, the recent version of Wind Power policy of 2016 is instrumental in adding to the installed capacity of wind energy which has reached to more than 5500 MW by Jan. 2018.

Also Gujarat is promoting waste to energy projects through a Policy announced in 2016. Municipal Corporations along with the private developers are working hard to resolve the issues of disposal of Municipal Solid waste through waste to energy projects in PPP mode in the State. The innovation of Solar Park, Canal top Solar, hybrid structural design for wind tower are some of the outstanding initiatives of Gujarat in the field of climate change mitigation. Gujarat's development story started with 315 MW of installed capacity of power in 1960-61 to todays 27058 MW,

however the present capacity comprises more than 25% from renewable resources with a vision to make it 40% of installed capacity by 2030.

There is still a long way to go in order to achieve climate change mitigation. In the present scenario, only the energy sector is focused on this pursuit as evidenced by development towards mitigation action, but alternatives to cement along with the large scale carbon capture and storage are also required. Technology and scale of economy can help to fulfil the promise of keeping the rise of global temperatures below 2°C by the end of the 21st century as committed in the Paris Agreement.

-Shwetal Shah, Technical Advisor, Climate Change Department, Government of Gujarat, India

CLIMATE CHANGE INITIATIVES

GUIDE's Initiatives for Climate Change Adaptation and Mitigation

Kachch, an arid district, entirely falls under desert biogeographical zone of India (Desert 3A). The district experiences many geomorphic and climatic events in past as showed by many evidences. About 62 per cent of the district

population resides in rural areas. The majority of rural population belongs to poor and marginal communities and is dependent on natural resources for their livelihood. The major occupations of the rural people of the district are dryland farming,



Milkfish culture following cage method.

animal husbandry, fishing, artisan and daily wage labour. The poor and marginal communities are facing severe threats from ongoing climatic changes and are also prone to the uncertainty of climate change as projected in the near future. Major implications are weather variability; crop season shifting, temperature alterations and precipitation patterns leadings to degradation of the natural ecosystem, land degradation and desertification, which subsequently affects agriculture productivity. Thus, concrete measures are to be undertaken for adaptation of rural poor and marginal communities of the district to mitigate the climatic vulnerability. In view of this, Gujarat Institute of Desert Ecology (GUIDE) has been striving to address many of these issues and challenges. Some of the initiatives undertaken by

GUIDE are i) reclamation of some of the areas in Rann of Kachchh, ii) restoration of degraded grasslands in Banni, iii) promotion of alternate livelihood options through pisciculture and sea-weed cultivation, and iv) climate proofing through watershed development programme.

GUIDE initiated the Rann Reclamation Programme during the year 2001 with an aim of making some of the 'bet' (islands) in Greater Rann of Kachchh (GRK) habitable and suitable for defence personnel to perform their duties. The conditions in selected islands were improved through an integrated approach including land development, water resource conservation, and vegetation establishment. Similarly, GUIDE also carried out action based programmes to restore degraded grasslands in Banni region. The project aimed at pasture land development, improved grass productivity, enhanced fodder availability and increased milk productivity. The attempt also addressed migration issues of nomadic communities. This project was undertaken during 1996-2011. The key player was Gujarat Ecology Commission and Department of Forest and Environment, Government of Gujarat (GoG), Gandhinagar. A District Level Committee (DLC), constituted by the GoG under the Chairmanship of District Collector, Kachchh, oversaw the project activities. The detailed guidelines for execution of the project were framed and approved by the DLC. Through these initiatives the local populace has been empowered to undertake grassplot development bv addressing the challenges of inherent salinity, and also ensuring fodder supply for their livestock.

In addition, as a climate proofing exercise, integrated watershed development programs were also



Some glimpses of watershed development programme undertaken by GUIDE.

undertaken by GUIDE. The major problems of the area include climatic constraints, poor soil fertility, soil erosion, poor vegetative cover, poor ground surface and water availability, soil and water salinity resulting into land degradation and subsequent productivity degradation. The integrated project aims at improving the land status through various soils, water and other site specific amendments. This has improved the land as well as the socioeconomic status of the villagers.

The project had both ecological and sociological dimensions. Of late, the GUIDE team has also initiated another integrated programme, wherein both adaptation strategy and mitigation options are being looked at. Polyculture activities are initiated to increase adaptive capacity of coastal populace and seaweed culturing activities are initiated to provide livelihood options and as a means of sequestering carbon, as one of the mitigation options. Lates calcarifer (Bloch), i.e. Giant Sea Perch or Asian Seabass is an important food fish and is being cultured currently. Approximately 6,000 fingerlings were initially stocked in different HAPA nets in Gujarat coast. Fish seeds were acclimatized, and regular

grading was done to avoid cannibalism, competition among the individuals for feed and space. Artificial feeds mixed with cooked trash fish was used for fingerlings. Regarding the sea-weed culture, floating rafts (3×3 m² bamboo frame with polypropylene ropes) is being used to suspend seaweed about 50 cm below the water surface.

The seedlings are inserted to the ropes and all rafts are connected and anchored. Initially four rafts were installed to study the feasibility of the chosen site. Each family is maintaining 06 cages during trials carried out by GUIDE. Even if one or two non-working members of a family are involved in polyculture, this technique is estimated to generate a minimum income of Rs. 1.5 - 3.0 Lakhs annually from fish culture (2-5 families) while seaweed would generate an income of Rs. 13,000-15,000 per month per family. All these initiatives would not only help in restoring the degraded lands in the arid region, but would also help in ameliorating the hardships of native people by providing them with alternative livelihood options.

> - Dr. V. Vijay Kumar and Dr. Anjankumar Prusty, Gujarat Institute of Desert Ecology, Bhuj, Gujarat, India

Architecture Design and Addressing Climate Change Uncertainty

The act of building is a L fundamental expression of confidence in the future. Place and the ready access to useful materials are the essential elements of the process of Architecture. Across the length and breadth of India we can see how multiple and varied landscapes have produced a huge variety of built solutions to human needs. These so-called vernacular traditions, primarily in rural areas, are the tangible embodiment of generations of skill in the use of materials and in the response to the forces of nature. The efficient use of local materials created sustainable forms of passive architecture that could be adapted as the needs of society changed over generations.

In recent times there has been a proliferation of new cost-effective materials which can be transported everywhere with speed and ease. As a result there is huge range of new building forms being constructed that bear little or no relation to their natural context and may not be at all efficient in terms of their response to the given climate as well comfort levels. as basic Consequently, the control of climate is being mechanized - either for cooling or heating – at a considerable cost, both capital and recurring. Unfortunately, the amount of energy being used to manufacture these new building materials as well as using them in construction is enormous and may also be contributing to the process of climate change. In addition the skills required for the use of traditional materials are being rendered obsolete at a rapid rate.

We understand climate change to be a complex process that is a global phenomenon. As the effects of climate change increase across India it is all the more important for architecture to be able to adapt to the changes occurring both seasonally as well as in the form of extreme conditions that are becoming more frequent.

The challenge for architecture today is to meet the growing demand for basic facilities in a cost effective manner. Architecture must respond and adapt to the environment and to climate as well as satisfying the immediate functional and cultural needs of the users. Buildings need to be climate adaptive across all functional types. The following fundamentals of vernacular architecture need to be incorporated into contemporary design solutions:

1 Use of natural ventilation and of thermal mass to optimize the

response of buildings to extremes in climate conditions. Use natural light where possible.

- Use natural light where possible.
 Local craftsmanship that can optimize the use of materials for specific site and functional conditions.
- Use of local materials that are appropriate to site conditions and climatic conditions leading to relevant forms of architecture.

For an adaptive architecture to be relevant to current and future needs of society it needs to engage both with vernacular traditions where appropriate as well as the relevant new technologies and materials that can improve the quality of the lives of the end users. Time is of the essence as the demand for all forms of basic shelter far outstrips the capacity to provide for it. ■

- Arthur Duff, Area Chair, CEPT, Ahmedabad, Gujarat, India



"Contemporary technology optimising the use of bamboo as a structural element". Demonstrated in the shamiana at Kamla Sadan Bodakdev, Ahmedabad, designed by Deepak Arora.

IMPLEMENTING PARIS AGREEMENT IN INDIA

Climate Change Initiatives in Gujarat: Towards Transformation

India is committed to implement the Paris Agreement with all its vitality and resources. For India, climate change is a sustainable development challenge and Paris Agreement is a commitment to its own citizen. As a result, many states in India have taken numerous steps to reduce emissions and improve as well as scale-up successful adaptation. Gujarat is leading the way among the different states of India to implement innovative climate change initiatives.

The following are key areas in Climate Change that the various departments of the government of Gujarat are implementing.

A. Climate Change Department:

- Installation of Solar Roof Top System
- Subsidy to students of Smart city/ Solar City /Carbon resilient City for purchase of (low speed and high speed) battery operated two wheelers vehicles.
- Installation of Solar Water Heating Systems at Government hostels and Residential Schools
- Provide super efficient Fans and LED Tube light in Schools and Hostels of the State.
- Promoting Waste to Energy and Solid Waste Management
- Small Grants Programme for Promotion of Small Projects and Research on Climate change.
- Climate change, Renewable Energy, and Gobar Gas Plant

B. Agriculture and Cooperation Department:

- Scheme for Farm Ponds for Water storage in Gujarat State
- Scheme for Water Harvesting
- Scheme for Distilling of Village Ponds
- Integrated watershed development programme in tribal area.

C. Energy and Petrochemicals Department:

- Assistance to state PSEs for providing solar based non electrified areas of the state
- Assistance to Gujarat Urja Vikas Nigam Limited for implementing the scheme of solar agriculture pump sets
- Capital contribution to Gujarat Power Corporation Limited for establishment of solar park in the state
- Assistance to Sardar Patel Renewable Energy Research Institute.
- Assistance for Energy Conservation
- D.Forest and Environment Department:
- Biodiversity conservation and rural livelihood improvement project
- National Afforestation programme
- Soil and moisture conservation and afforestation in denuded forest area
- Gujarat Forestry Development
- Action plan for creation of
- Kachchh biosphere reserve
- Community forestry scheme
- Grass Development Project
- Vrux Kheti Yojana
- Intensification Forest Management
- Vermicompost Scheme
- Action Plan for Creation of Taskforce and Mangrove Plantation
- Bamboo Forest Management
- Scheduled Castes Sub Plan Scheme for Fruit Plantations
- Integrated Development of Destinations
- High Level Cleanliness at Yatradhams/ Drinking Water/ Smart Spritual Destination/ Solar

Rooftop/ BoV/ Energy Eff. Light at Yattradham

E. Industry and Mines Department:

- Integrated Development of Destinations
- High Level Cleanliness at Yatradhams/ Drinking Water/ Smart Spritual Destination/ Solar Rooftop/ BoV/ Energy Eff. Light at Yattradham

F. Urban Development and Urban Housing Department:

- UDP-Urban Development Mission - Smart City
- Grant in aid to Municipal Corporation for Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

G. Kachchh:

- Installation for Wind Energy
- Climate Change Adaptation for Natural Resource Dependent Communities in Kachchh, Gujarat. The project aims to enhance the adaptive capacity of natural resource dependent communities (Agriculture, Coastal Fishing and Pastoral communities) to climate change in targeted villages of Kachchh district, Gujarat.

The next step in this endeavor is robust implementation of the aforementioned projects and programmes. It is important to reimagine and reformulate existing adaptation policies to address the need of the most vulnerable communities of Gujarat. There is also a need for stronger linkages and greater policy coherence among SDGs, NDCs and SFDRR to help the state in transforming its economy to a green and clean one. ■

-GUIDE and AIDMI Teams

POLICY BRIEF

Addressing Climate Change Uncertainty in Dryland Kachchh, India

The semi-arid district of Kachchh in Gujarat, India is known for its erratic rainfall, water scarcity, and droughts. Climate change has intensified extreme temperature and rainfall patterns and also led to changes to the long coastline. These are affecting not only the lives and livelihoods of local people, but also threatening the vibrant ecosystem of Kachchh. While locals are pushed to the limits of coping, government interventions are driven by top-down measures. Strategies geared towards adapting to these changes need to be grounded in local experiences if they are to address the many uncertainties brought about by climate change alongside other rapid socioeconomic changes in Kachchh.

Climate Change in Kachchh Kachchh is the largest district in

✓ Kachchh is the largest district in India, located in the state of Gujarat. The semi-arid district has a dynamic ecosystem, ranging from wetlands to grasslands, deserts, and a long coast with lush mangrove forests. Apart from its ecological diversity, Kachchh is also known for its cultural diversity and syncretism.

Water scarcity and droughts have always been a part of life in Kachchh and local people have used their own knowledge to cope with the uncertainties that these bring. Such local experience, however, rarely finds its way into policy interventions concerning dryland management and climate adaptation and mitigation. Since 2001, Kachchh has witnessed rapid industrial growth in the form of port development, special economic zones, and mining. These have rapidly transformed the district's ecology, especially the coast, and also undermined local people's rights to common property resources and local lands.

Climate uncertainty refers to the inability to predict the scale, intensity, and impact of climate change on human and natural environments. The project *Climate Change*, *Uncertainty* and *Transformation* seeks to bring together existing policy and scientific discourses of climate uncertainty





with local knowledge systems and response strategies in order to make climate science more relevant. This should help decision makers draw on a wider range of options to address climate change issues.

Research was conducted in Kanmer, located in Rapar taluka (sub-district) bordering the Little Rann of Kachchh, and the coastal village of Jakhau in Abdasa taluka. These locations represent the district's key ecosystems (coastal, wetland, and dryland) and livelihoods (agriculture, animal husbandry, and fishing).

Livelihoods in the Face of Climate Change

It is estimated that coastal areas such as the Gulf of Kachchh are likely to be the worst hit by climate change as agricultural lands have become susceptible to inundation and salinity, and cyclones and storm surges are likely to become more frequent. Rainfall in Kachchh has become more unpredictable with an increase in intense periods of rainfall and floods. While droughts have always been a part of life in Kachchh, floods have not.

Reduction in fodder and fuel availability, increased salinity ingress (freshwater aquifers turning salty), and depleting forest and groundwater resources have made livelihoods more precarious and vulnerable to shocks. The negative impacts of *prosopis juliflora* (an invasive weed), changing drought patterns, a high burden of livestock and crop diseases due to increased temperatures, and poor water

quality have affected the major livelihoods—agriculture, animal husbandry, and fishing. For local people, coping responses include changes in cropping patterns (for farmers) and moving out of traditional occupations to adopt casual jobs (for fishers and herders).

Understanding Climate Change

For several generations, local people have deployed traditional knowledge such as observing seawater currents, animal and bird behaviour as well as planetary positions in the sky to predict seasonal patterns. Scientists found these predictions to be quite accurate up to 2005, but in the last decade these predictions have become less reliable.

While policymakers and nongovernmental organisations concur that climate-related uncertainties have become acute in Kachchh, government interventions need to be more proactive. While government has undertaken many programmes concerning mitigation and adaptation, they have tended to be top-down and seldom reflect the ecological and social diversity of this district.

Industrialisation has Intensified Climate Change Impacts

The accelerated pace of industrial development in Kachchh is having a significant impact on local livelihoods. Following the 2001 earthquake, industrial zones and ports were set up to 'develop' this remote district. These have brought about changes in land use, biodiversity, and resource distribution that have intensified the impacts of climate change.

Intense groundwater extraction for industrial activities and the destruction of mangroves and related ecology have compounded the problem of salinity ingress, creating problems for agriculture and livestock. Industrial activities have reduced pastoralists' access to

Policy Implications

- 1. Support Pro-poor Adaptation: Marginal environments such as Kachchh require pro-poor adaptation interventions that are linked with social development strategies that are ultimately more inclusive and address the vulnerabilities of marginalised groups. These may range from increased public expenditure on social sectors (schools, hospitals, and basic services) and employment to implementation of labour laws in new industries, as well as strengthening and protecting local ecosystems and biodiversity.
- 2. Recognise and Incorporate Local Knowledge in Policy: Vital in ensuring coherent and effective response to climate change is the incorporation of local realities and understanding. Decision makers need to build on the existing knowledge systems and practices of local resource users.
- 3. Protect Resource Rights and Livelihoods: Sustained efforts (in law and policy) need to be made to protect the resource rights of poor communities as they provide a critical cushion to climate shocks. These rights must also be protected in the wake of industrialisation processes. Agro-pastoralist livelihoods which are more attuned to dryland dynamics should be supported and mainstreamed in adaptation interventions.
- 4. Promote Inclusive Development in the Drylands: Policymakers need to develop policies and strategies that are attuned to Kachchh's dryland dynamics and which support the needs of local farmers, fishers and pastoralists rather than those of powerful corporations and industrial actors. It is important that industrial development and economic growth in the district do not intensify social and gender inequalities. Focus must move to social and human development that is socially and gender just.

common grazing lands and are threatening the survival of indigenous *kharai* (swimming) camels. Many of Kachchh's traditional pastoralist groups such as the *Rabaris* and *Jats* are now having to give up pastoralism in favour of settled agriculture or migrant/casual labour.

Social Inequality Increases Vulnerability

Despite the accelerated pace of 'growth', access to education and basic services remain challenging. Social inequities of caste, class, religion, and gender persist and lead to poor social outcomes. For example, with wells turning saline and poor drinking water infrastructure, women and especially young girls who bear responsibility of fetching water for household chores have limited time and opportunity to learn and go to school.

Credits:

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Readers can find more information about the Climate Change, Uncertainty and Transformation project on the website: www.nmbu.no/en/

faculty/landsam/department/ noragric/research/our_projects/ projects/node/21234

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POLICY BRIEF

Transforming Urban Governance to Manage Uncertainty and Climate Change in Mumbai, India

Despite unprecedented wealth accumulation, coastal Mumbai suffers from a myriad of socioeconomic and ecological challenges as well as connected uncertainties. These include endemic flooding, shrinking of sensitive ecosystems, inequality, and marginalisation of natural resource-dependent communities, such as fishers. These are in addition to existing risks, including building collapse, fire hazards, infrastructure collapse, industrial accidents, and landslides. The spectre of climate change looms large and further complicates the situation. Urban governance mechanisms and strategies respond insufficiently to the growing threats the city faces. More needs to be done to manage and address these uncertainties through a strategic, adaptation-focused, and communicative urban governance framework that emphasises both reducing risk and strengthening social justice.

Governance and Uncertainty Governance in urban megacities in general, and in Mumbai particularly, is a notoriously complex exercise. The range of actors, scales of governance, multiplicity of institutions, pace of economic development, and emerging threats from environmental change create multiple layers of uncertainty. Uncertainty impedes the ability of local policymakers and governments to accurately predict or plan for future events and disasters (for example, an extreme weather event's intensity, scale or timing, such as the devastating Mithi deluge in 2005) and associated impacts, and attribute a single identifiable root cause (or

numeric value) to a situation or outcome. The fractured nature of governance, for instance, creates uncertainty and is a major obstacle towards effective development planning and disaster mitigation.

Social, Political, and Natural Causes of Flooding

Annual flooding is undeniably an important matter of concern for residents and public authorities, especially since the devastating Mithi River deluge of 2005 that claimed more than 1,000 lives. Extreme rainfall is often blamed for floods. However, it is only a proximate cause for their occurrence

and ongoing attempts to control the runoff have not yielded intended results. Despite a number of infrastructure interventions by authorities, such as retainer walls and pump stations, flooding remains chronic in Mumbai.

Existing approaches preferred by the Municipal Corporation of Greater Mumbai and the Mumbai Metropolitan Region Development Authority tend to side-line underlying causes that are as much political and social in nature as they are physical. For example, unregulated construction activities, untreated discharge of solid waste, ill-planned and uncoordinated urban planning, and disappearing floodplains and mangrove areas have aggravated the vulnerability of many areas by hindering absorption and outflow of water. The consequent flooding affects all sections of society. A greater burden is, however, borne by economically and socially weaker sections, who live in low-lying areas and in closer proximity to drainage channels. They experience ill health through increasing incidence of vector-borne diseases or exposure contaminated water, injuries, loss in earning days, and destruction of assets and property on a regular basis, with limited capacities to cope, and little state support.



Mumbai's famed Mithi river in a sorry state.

Livelihoods, Development, and Climate Change

City residents perceive climate change mainly in terms of more erratic and intense rainfall events, as well as increasingly frequent heatwaves. In addition, middle-class residents articulate it in terms of rising pollution and a deteriorating quality of the natural environment. Mumbai's oldest community, the Koli fishers, observe changes in wave strength, wind, tidal flows, ocean currents, and sea temperature. The altered patterns adversely affect their fish catch and add uncertainty to their livelihoods. Uncertainties around climate change impacts interweave with larger development trends in the city, including those stemming from global market integration and industrialisation. Koli fishers point out that big trawlers, pollution, and disappearing mangroves and coastal ecosystems have had a major impact on their livelihoods. Urbanisation swallows large tracts of fisher spaces, as in the case of the Jawaharlal Nehru Port development. Mangroves also form an important natural defence barrier against floods and coastal erosion, but remain threatened by land grabbing and conversion – despite protective legislation such as Coastal Regulation Zone norms. People living along the flood-prone Mithi River often support efforts for flood mitigation and mention the improved disaster responsiveness of the city. On the other hand, they harbour deep fears of being forced to relocate in the name of flood protection and being impoverished in the process, without adequate compensation. They also point out that while big builders gain access to land along the riverbanks, it is refused to them, highlighting unequal planning outcomes.

The Need for a Transformative Approach

Urban planners have slowly started to mainstream climate risks into development planning. At present,

Policy Implications

- 1. Clear coordination needs to be established between all agencies local, regional, and national involved in climate change, disaster mitigation, urban planning, and municipal governance.
- 2. Climate risks have to be mainstreamed consistently into urban, disaster management, and flood mitigation planning.
- 3. Protection of livelihood rights of resource-dependent communities, such as fishers, needs to be strengthened.
- 4. There should be more focus on pro-poor adaptation that enhances people's and the state's capacity to cope with future climatic changes, and reduces uncertainty. Mitigation alone is inadequate.
- 5. There needs to be strict implementation by public authorities of Coastal Regulation Zone norms and other protective legislation (e.g. wetland rules) for coastal ecosystems.
- 6. Short-term infrastructure fixes need to be supplemented by longterm social, economic, and ecological assessments and visions for the city, such as scenario planning exercises, that acknowledge livelihood rights and risk/uncertainty scenarios of all its residents.
- 7. Genuine streamlining of alternative views and knowledge into political processes should be pursued by strengthening the participation of NGOs, fishers, residential associations, and citizen scientists. Constitutional rights (specifically the 74th Amendment) that provide for the participatory planning and governance of municipal master plans need to be followed in letter and spirit.

the focus in Mumbai lies on mitigation activities that are focused on technology and infrastructure, exemplified by the central government's flagship scheme for urban modernisation, the Smart Cities Mission. Scientists, residential associations, and NGOs highlight the need for improved vulnerability mapping and pro-poor adaptation action to complement mitigation frameworks. Yet, their voices and for knowledge alternative development plans seldom translate into policy, despite the fact that, as the case of flooding illustrates; singular top-down approaches with short-term fixes do not work, and can be highly inequitable. A transformative approach towards urban planning that emphasises long-term goals, risk reduction, ecological contexts, and social justice outcomes is necessary. In part, this can be driven by changing urban governance paradigms towards a more plural and people-centric approach. 📕

Credits:

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Readers can find more information about the Climate Change, Uncertainty and Transformation project on the website: www.nmbu.no/en/faculty/landsam/ department/noragric/research/ our_projects projects/node/21234

Readers are encouraged to quote and reproduce material from the IDS Policy Briefing series. In return, IDS requests due acknowledgement and quotes to be referenced as above. **POLICY BRIEF**

Bringing Together Voices to Address Climate Change Uncertainty in the Indian Sundarbans

The majority of the five million people that live in the deltaic Indian Sundarbans face continuous uncertainties in relation to their shelter, livelihoods, and health. Climate change is one of the key factors aggravating this situation. While scientific evidence exists regarding climatic changes in the Sundarbans, scientists and experts often disagree about how the resulting key challenges should be addressed. The communities in the Sundarbans hold considerable knowledge about these uncertainties and their complex socioeconomic and ecological origins. However, this knowledge is often bypassed in planning and policy. It is vital that the communities' knowledge and that of experts and scientists be brought together to improve livelihood adaptation and disaster response, and promote more socially just and sustainable outcomes in this vulnerable coastal region of India.

Climate Change and Uncertainties Cin Indian Sundarbans

Climate uncertainty refers to the inability to predict the scale, intensity, and impact of climate change on human and natural environments. The project Climate Uncertainty Change, and Transformation seeks to bring together existing policy and scientific discourses of climate uncertainty with local knowledge systems and response strategies in order to make climate science more relevant. This should help decision makers draw on a wider range of options to address climate change issues.

Research took place in two vulnerable hotspots: the sinking island of Ghoramara, located in Sagar block (sub-district) and erosion-prone Mousuni island in Namkhana block. It focused on challenges related to livelihoods, shelter, health, and food security in the context of climate change uncertainty.

Islanders in this region have had to contend with shocks such as cyclones and floods, and variations in its deltaic ecology as well as socioeconomic marginalisation since the first settlements were established in the colonial period. In recent years, scientific evidence shows that erratic climatic events (e.g. more intense rainfall, heat waves, and sea level rise) are becoming more frequent and pronounced. These manifestations of climate change have added to existing problems including frequent embankment breaching; loss of land, homesteads and other assets; and salinity ingress in agricultural land and sweet water ponds. All of these have led to the depletion of the traditional agro-fishing economy and strained the islanders' coping capacities.

As a result, households are forced to constantly change their livelihood patterns. For instance, agro fishing, wage labouring, or seasonal migration to other parts of West Bengal or other states in India.

Uncertainties are Amplified for the most Vulnerable

Vulnerable sections of the community are inevitably the worst off. For example, in Ghoramara, people are facing food insecurity along with loss of shelter and livelihood options. By contrast, islanders of Mousuni are confronted with inter-religious struggles due to problems around shelter in the face of recurrent embankment breaching and rapidly eroding lands. Conflicts between islanders who live in safe zones (away from embankment breaching and coastal erosion) are also becoming more acute.



Alongside this, adolescent boys are dropping out of school and migrating along with other male family members to find work, whereas young girls have to marry early in the mainland part of the Sundarbans to secure shelter and stable income.

Women across the Sundarbans largely engage in activities such as embroidery, and wage labouring to take part in the livelihood restoration process. They are also increasingly subject to domestic violence; and children experience a lack of care.

Short-term Disaster Response vs Long-term Transformative Response

Following the lessons learned after Cyclone Aila (2009), the state and local administrations are confident that large shocks can be managed through emergency responses. Yet, despite the consensus between scientists that concrete embankments are not a permanent solution to coastal erosion/storm-water surges, there is a dominant focus on concrete embankments in policymaking for the Sundarbans. Ground-level implementation of schemes severely lacks community knowledge and participation, such as in land acquisition for embankments, mangrove conservation, and compensation for crop loss due to natural calamities, as well as employment of rural youth under livelihood schemes. For example, after severe flood damage, the islanders of Ghoramara could not claim crop compensation as the affected agricultural land simply disappeared.

Long-term initiatives such as brackish water aquaculture, sack cultivation, and cultivation of salineresistant crops pushed by nongovernmental organisations (NGOs) and community-based organisations (CBOs) can make a huge difference to improve lives and

Policy Implications

- 1. Support convergence of knowledge: Vulnerable environments like the Sundarbans require pro-poor adaptation as well as the strengthening and protection of local ecosystems and biodiversity, especially mangroves. Various knowledge and experiences, including scientific, technical, administrative, and everyday practices need to come together to plan for alternatives.
- 2. Encourage bottom-up knowledge in policymaking: The state should facilitate spaces to enable sharing between policymakers and local-level policy implementers, NGOs, and CBOs as well as local communities' own experiences and responses.
- 3. Understand vulnerabilities and be open to iterative and multiple planning processes: Vulnerabilities to climatic uncertainties are differentially distributed within the Sundarbans as well as within communities. There is an urgent need to identify specific vulnerabilities, vulnerable groups and locations, and plan the programme accordingly.
- 4. Go beyond disaster response (capturing opportunities offered by disaster): Innovative initiatives such as aquaculture need to be supported and promoted in order to provide sustainable livelihoods alternatives.

livelihoods. Yet these are still to be scaled up to become accessible to the poorest members of the Sundarbans.

Lack of Coordination and Strategic

The uncoordinated and inconsistent

responses towards managing the

Sundarbans reflect a gap between

scientists, policymakers, NGOs, and

the islanders. NGOs (national and

international) find it difficult to

build bridges with policymakers due

to interference of political bias.

NGOs are well connected with CBOs,

and jointly implement development

programmes in the Sundarbans.

However, the implementation is

most often concentrated in particular

locations which results in a very

uneven spread of benefits. The

administrations, though well aware

of climatic impacts, fail to

communicate appropriate responses

to authorities at higher levels. The

community is, to some extent,

connected with each of these actors

but their voices are not fully

integrated into policymaking and

implementation.

block

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level

multiple challenges

Response

district-

Credits:

Upasona Ghosh and Shibaji Bose with inputs from Mihir Bhatt, Darley Jose Kjosavik, Lyla Mehta, Hans Nicolai Adam and Shilpi Srivastava and edited by Vivienne Benson. The opinions expressed are those of the authors and do not necessarily reflect the views of IDS. With thanks to the project team: IIHMR University, Gujarat Institute of Desert Ecology, All India Disaster Mitigation Institute, Indian Institute of Technology -Bombay, Centre for the Study of Developing Societies, University of Sussex, ESRC STEPS Centre, Institute of Development Studies, Norwegian Institute for Water Research, and the Norwegian University of Life Sciences. This research is supported by the Research Council of Norway.

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CAPACITY BUILDING

Communicating Uncertainty: Key Areas to Consider

espite the fact that there is D some perception among people across the globe that the living environment is surrounded by high risks in everyday life, skills of communication and information of risks is still not widespread among professionals. In the recent times, public administration across the globe is often seen to have come across complex critical situations the arising in wake of communicating uncertainty mainly in areas of environmental risks. Under such circumstances, there is a need that the scientific community, decision makers and the stakeholders work in cohesion to enhance the appropriateness for estimation of determining the extent of risk for managing uncertainty. It has been observed by researchers that although there has been a wide analysis of uncertainties but the actual representation of such analysis in documents has been found to be least documented and described which has lead decision makers to plan inadequate strategies at certain instances. Global reports published and shared on estimation of uncertainties have indicated that certain factors revolve around the science of risks communication and these includes Oualitative and Quantitative analysis, better understanding of risk information among users for stakeholders and timely communication of risk information to the community.

To understand uncertainty in a better way, it is necessary to know the reasons behind the variations of environmental determinants and the fact that these risks variations are not exempted for decision makers.



However, to deal with the aspect of communicating uncertainty, it is important to consider the environmental determinants – identification, management and communication of environmental risks. To go ahead with the subject of communicating uncertainty, a few observations on the following key areas have been drawn.

Adoption of scientific approach for communicating uncertainty: The approach for acquiring information of risks or raw data by the scientific professionals needs to be based on the application of latest scientific technique available which has been recognized as space technology.

Ideal measurement on risk probability/uncertainty: While the home of metadata for the environmental determinants or variations rests mostly with the scientific community at large, therefore it needs that the use of qualitative approach is recognized for presentation of risks assessment to the decision makers and community so as to avoid inconclusive communications. It has been found that the representation of risks uncertainty or probability in words instead of numbers in public is better comprehended and accepted.

Involvement of multi-sectoral and multi-stakeholders in uncertainty communication: Reliance on solely professionals risk without involvement of multi-sectoral and multi-stakeholder cannot be a comprehensive approach on communicating uncertainty. Therefore, studies on estimation of uncertainty have been found to recommend for adoption of multisectoral and multi-stakeholder approach in the decision making process.

Inclusion of uncertainty as component in scientific investigations: It is pertinent to mention that a large volume of scientific studies have been performed by scientific institutions across the world every year and are carried out by the scientific professionals wherein the component of risk communication or uncertainty levels found were seen to be not embedded in their studies/investigatory works. Intermediate/Risk/uncertainty findings have been recommended to be a part of the investigation/study from the outset and to be reflected in a manner that it is understandable the lay audience.

Participatory risk / uncertainty

communication: Another aspect of communicating uncertainty is the involvement of participatory uncertainty communication among various stakeholders so as to come out with joint solutions. While considering a crucial situation of public administration in communicating uncertainty, the challenge for the communicator is to involve-the audience, make the subject of uncertainty comprehensible and respect to audience related values to risk. The decision makers and the professionals associated in such situations need to be open for



changing opinions and to present uncertainties in a simple manner without jargon for audience acceptability.

Further, much of the literature published in uncertainty analysis emphasizes the confusion in which authorities find themselves whenever decisions concerning evaluation of new facility have to be undertaken and the possible environment risks. Hence, taking into account the fact that public information and references to the precautionary principle put in place by any authority can be effective if it is truly backed by public participation.

- Abhijnan T. Rajkhowa, Communication Expert, ASDMA, Assam

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