

Climate change and livelihoods: perspectives from small-scale fishing communities in India

VENKATESH SALAGRAMA

This summary paper presents the outputs from a study undertaken by the author for the International Collective in Support of Fishworkers (ICSF) to highlight the perspectives of selected marine fishing communities in India on climate change and its implications on their lives and livelihoods. The paper highlights the weakening livelihood context in marine fisheries and how this has a direct bearing on the causes and consequences of climate change as well as on the capacity of the fishers to undertake appropriate adoptive/mitigating strategies. It summarizes the factors of climate change and variability that have a relevance to the marine fishers, their causes and consequences, and the strategies adopted by the fishers to deal with them. It emphasizes the importance of community-based consultative processes to develop and implement climate change adaptation and mitigation measures, and suggests some measures to improve the current policy and institutional responses to cope with climate change.

Keywords: climate change, natural disasters, small-scale fishers, livelihoods

A MAJOR LIMITATION IN the current engagement with climate change and its impacts on fisheries and fishing communities is that it is based mainly on technical studies while the perceptions and proposals of fishing communities have received scant attention. There is no specific focus on coasts or fisheries in the national and state-level action plans on climate change, with the result that fishers will not only be unable to benefit from the measures proposed, but will also increasingly find themselves further marginalized and more vulnerable to the impacts of, and the responses to, climate change.

The International Collective in Support of Fishworkers (ICSF), with financial support from Heinrich Böll Stiftung-India, undertook a study in 2011 with the aim to highlight the perspectives of fishing communities on climate change and its implications for their lives and livelihoods, and to highlight the importance of developing and implementing adaptation and mitigation measures through consultative processes to address their poverty and food-security issues.

Methodology of the study

The study began with a literature review focusing on different aspects of climate change of relevance to Indian coastal and fishing communities, which was discussed

Venkatesh Salagrama (vsalagrama@gmail.com) is a development consultant with over 20 years of experience in small-scale fisheries and livelihood issues in South Asia and Southeast Asia.

© Practical Action Publishing, 2013, www.practicalactionpublishing.org
doi: <http://dx.doi.org/10.3362/2046-1887.2013.004> ISSN: 2046-1879 (print) 2046-1887 (online)

at a scoping workshop conducted by ICSF (Lakshmi, 2011). Together, the literature review and the scoping workshop provided a range of key climate change factors of importance to Indian fisheries, which were used to develop a checklist of key climate change/variability issues to be explored during the field studies.

Fieldwork was undertaken in selected locations in four coastal states of India, two on the east coast (Andhra Pradesh and West Bengal) and two on the west coast (Maharashtra and Kerala). The choice of the states and the fieldwork locations was based upon specific criteria related to their socioeconomic and physical vulnerability to climate change based on: coastal vulnerability index (CVI); cyclone prone areas; quality of housing; levels of literacy; and other relevant climate change indicators such as the extension of the northern boundaries of oil sardine (INCCA, 2010).

Field visits of about 10 days each were undertaken to the four states and the fieldwork focused on obtaining a qualitative understanding of the issues related to climate change from the fishers' perspectives. Consequently, the methodology involved group discussions and detailed individual interactions. Special emphasis was placed on capturing the perspectives of women and other vulnerable groups. Besides physical observations of the landing sites and other locations, fishing trips were undertaken to gain first-hand experience of the issues.

Alongside the fishing communities, relevant institutional stakeholders in fisheries (government, research institutes, and NGOs) were contacted to obtain their perspectives on climate change as well as to assess the policy/institutional/research framework currently in place to deal with the issue. At the conclusion of each state visit a consultative workshop was organized, bringing together all relevant stakeholders to discuss, validate, and revise the state reports. The four state presentations were used as the basis for consolidation of the study report (Salagrama, 2012), a summary of which is presented in this paper.

Given the small geographical area covered and the relatively short time spent in each state, the conclusions of the study should be treated as provisional and as a first step towards more intensive and detailed studies. Although the broad trends described in the paper show remarkably similar overall patterns, it is necessary to point out that the specific examples and trends discussed here are not necessarily applicable right across the country or even in all four states covered by the study. For the purposes of this paper, all statements with qualifiers such as 'the fishers stated ...' or 'the fishers perceived ...' are dispensed with, and the statements are given as matters of fact, which again is a simplification, although based in fact.

General context of fisheries in India

Before discussing the specific climate change issues from the fishers' perspective, it is necessary to understand the prevailing livelihood context in the marine fisheries in India, which has a direct bearing on the causes and consequences of climate change as well as on the adaptive/mitigating strategies adopted by the fishers. (This section is drawn from Salagrama and Koriya, 2007, and Salagrama, 2009.)

The level of socioeconomic development in the marine fishing communities in India is considered to be weak compared with other coastal dwellers, making them 'outliers' in the overall development processes. While the fishing communities in the west coast states show a much better level of socioeconomic development, their counterparts on the east coast are much poorer, more vulnerable, and less integrated into the mainstream. Even in more developed states such as Maharashtra, access to basic services such as literacy, health, sanitation, and decent and safe housing is low among fishing communities, which limits their choice of livelihood options.

Since the 1990s, small-scale households in India have seen incomes from fishing fluctuate wildly, with the fishers on the east coast particularly hard hit by uncertain incomes. Although the modernization process – begun in the 1950s – contributed to improving small-scale fishers' access to technologies, resources, markets, and incomes in the beginning, the inherent contradictions in the process led not only to a failure to bring the small-scale fishers out of their poverty, but actually made them more vulnerable to emerging threats such as climate change. The crisis in the sector is the outcome of a range of factors, which can be summarized, *inter alia*, as:

- overcapacity and capital-intensive fishing practices;
- uncertain fish catches and decline of several commercial species that contributed to much of the fishers' incomes;
- competition and conflicts for fishing grounds and fishery resources at sea, also affecting the traditional interrelationships among the fishers on the coast;
- growing costs of production as a result of increasing investments in productive assets and their operations;
- rising levels of indebtedness (largely to informal sources), with cost of credit accounting for a sizeable proportion of the earnings;
- greater competition faced by women of fishing communities in accessing fish and markets, especially for higher-value fish; and
- long and uncertain market supply chains, consisting of several trader-intermediaries who determine market access to the producers through credit linkages, preservation and transport systems, and market information.

In the face of the crisis, support from the government to fisheries, particularly to small-scale artisanal fisheries, has remained paltry and hardly commensurate with the scale of support that is actually required. More alarmingly, the economic potential of opening up the coastal space for industrial development has come to receive high policy priority, and the state has been taking an active role in developing vast stretches of coastal commons for industrialization, frequently alienating the fishers from their living spaces and livelihoods. At yet another level, the enforcement of several conservation policies and their implementation have led to further marginalization and even criminalization of some traditional activities.

Thus, for the fishers, the crisis is an outcome of processes within the sector and, increasingly, one of competition with more powerful outside forces, backed by the state and its legal systems. The situation is exacerbated by the relative absence of strong institutional mechanisms among the fishers, hindering their ability to take collective actions or to put forth their responses in a meaningful manner.

The fishers' responses to the crisis show a contradictory trend between the east and the west coasts. On the west coast, despite the various constraints faced by the sector, fisheries are still a paying proposition, and here the response has been to undertake more intensive fishing operations. On the east coast, while a similar trend is observed in some fisheries, the low levels of surpluses and savings at the household level discourage fresh and additional investments beyond a particular limit, which forces the fishers to look beyond fisheries to meet their livelihood needs (Bhaskara Sarma and Salagrama, 2007). Thus, the diversification effort in these states also involves moving into non-fisheries and non-traditional activities both within and beyond the local areas.

Thus, in marine fisheries, climate change is just one more layer (or a final nail in the coffin) in a complex web of factors affecting fisheries and fishing communities. Fishers have been experiencing its impacts since before the term acquired popular currency, which makes it difficult to differentiate climate change issues from the wider processes affecting fisheries.

In this context, two points need to be made to understand the fishers' responses to climate change. First, that the marine fishers in India had been having serious enough problems of their own even before climate change came to be recognized as an issue. Second, in their more immediate need to ensure a reasonable livelihood, they could hardly bother – or afford – to take actions to improve a long-term global condition such as climate change.

Key climate-change factors affecting fisheries

In this section, a summary of the key changes relating to each climate-change/variability issue is provided from the fishers' perspectives.

Sea-level rise

Sea-level rise is considered to be an important manifestation of global warming. In field interactions, sea-level rise did not come up as an issue in any of the study villages; a 2-mm increase in sea level is rather difficult to perceive unless one is particularly watching for it (Vivekanandan, 2011). The fishers do, however, perceive other manifestations of the sea-level rise, which include changed patterns in waves, currents, and bottom pressure in the nearshore regions. Recent work by the Central Marine Fisheries Research Institute (CMFRI) in Maharashtra has indicated that some 75 coastal villages are vulnerable to inundation due to a projected 1-m rise in sea level, expected to happen over 20–50 years (V.V. Singh, personal communication to the author during fieldwork).

Sea-surface temperature

While the fishers are unable to perceive a rise in sea temperature *as a result of climate change*, a rise in sea temperature itself has been noted by them – both at the surface and even more so at the bottom – and is attributed to intensive drilling, industrial

discharges, chemical effluents, and urban wastes. The heat generated by these activities is so much greater than the natural global-warming process that the latter remains mostly hidden.

One impact of rising sea-surface temperature relates to changing fish composition in their catches. The small-scale gillnet fishers of Andhra Pradesh have reported that the depth of the surface gillnets, which was 4 fathoms (approx. 7 m) in the 1980s, has now gone up to 9 fathoms (approx. 16 m); the fishers contend that the pelagic species have descended to the lower layers from the surface as a result of variation in surface-water temperature. Another, more widely noticed, example is the spread of sardine along the east coast of India where it was only a minor catch until the 1990s.

Sea-surface salinity

Sea-level rise could lead to incursion of seawater into the coastal and upstream areas, making groundwater more saline, harming freshwater fisheries, aquaculture and agriculture, and limiting industrial and domestic water uses. There is much anecdotal evidence of increased salinity in the nearshore waters, in the creeks and rivers, and in the groundwater in certain locations. However, according to the fishers, the critical factor which contributes to the increased salinization of the coastal areas could also be the dramatic reduction in freshwater flows from upstream. With weakened flows from upstream, the seawater intrudes higher up in the creeks and rivers, and stays longer in the absence of a strong push from above.

Wind patterns

According to the fishers, there have been significant changes in intensity and directional stability of winds over the last 20 years. A critical change which has implications for fishing activities relates to the uncertainties in the direction of wind flows. Three broad trends are discernible:

- The seasonal wind patterns have changed; winds that should arrive at particular seasons do not appear on time, leading to a disturbance in fishing.
- The stability of wind flows in particular directions is very uncertain; wind flows in a particular direction for a short duration before it changes and flows in a different direction.
- Some unusual winds have gained strength, while favourable winds have become sluggish.

Overall wind velocities have reportedly decreased, especially in the nearshore waters, with impacts on the currents, upwelling, fish movements, navigation, and fishing effort – especially as the small-scale fisheries on the east coast of India still partly depend on sails (or sail-cum-engines).

Seasonality and seasonal patterns

The fishers are as dependent on the monsoons as the farming communities, because of their impacts on coastal waters and fish breeding. Increasingly, the monsoons

have become quite irregular; even when they arrive on time, they seem less consistent in their behaviour. For the fishers, staggered monsoons playing hide-and-seek and staying on much longer than usual have become routine. In Andhra Pradesh, reduction in intensity and duration of the south-east and east-south-east day winds during summer has been reported by the fishers to have affected the arrival of small pelagic shoals.

Unseasonal events – heavy rains during the peak summer, high temperatures during September–October – are on the rise, with an impact on the behaviour, breeding, and migratory patterns of fish. In culture fisheries, this leads to mass mortalities, stunted growth, and spread of diseases in culture operations.

Rainfall

There have been some critical trends in rainfall patterns from year to year and within each year. Heavy downpours in certain years are followed by near-drought conditions in the following years, both equally disastrous for fishing and related activities. Even within a year, rainfall is not spread evenly through a season; the entire annual rainfall occurs within a very short period, creating problems both immediate (swamping) and long-term (reduced upwelling). Thus, even while the total annual rainfall may remain constant, its uneven distribution throughout the season means a severe upset of fishing and other activities.

Sudden and intense downpours are a rising phenomenon that fishers suggest leads to waterlogging, sudden flushing of large quantities of land pollutants into the sea (leading to mass kills), and damage to fish being dried on the beaches, wiping out the business investments of the women processors.

Natural disasters

For the fishers, especially those in Andhra Pradesh and Kerala, the tsunami of 2004 was a major indicator of climate change. Apart from the loss of lives and livelihood assets, the tsunami also left behind several long-lasting impacts and still remains a largely inexplicable and terrifying phenomenon to the fishers.

The fishers observed that there have been changes relating to the location, frequency, direction, and intensity of cyclones. Even the decline in the number of cyclones to hit the coast has implications on the fisheries because, contrary to the general perception of the cyclone as a destructive force, the fishers contend that it helps to churn the sea, ensures upwelling of nutrients from the deep and enables the rapid transport of plankton masses from one area to another. On the other hand, the few cyclones that did hit the coast during the last 15 years are considered to have been far more catastrophic than the previous ones. According to the fishers, they were not only more intense, but also covered a more extensive area further inshore than ever before.

Alongside such large-scale events as the tsunami and the cyclones, there is an impression that the nature and scope of disasters have also become more 'localized', and their implications are more diffuse. Freak waves, sudden swamping, unusual

surf crossing, overnight changes in river courses, sudden downpours, unpredictable upwelling, and planktonic blooms are some examples.

Waves and currents

In most places, it was seen that while there was an intensification of waves in one area there was reportedly a weakening of the wave action – smaller waves reaching a shorter distance – in the neighbourhood. The wave action in the coastal waters has become weaker as a result of weakening nearshore winds and increased siltation around river mouths. The cyclical pattern that characterized the movement of waves to the coast appears to be broken; according to the experienced fishers, rogue waves keep intruding into the cycle. There has been a reduction in wave height, frequency, and intensity. At the same time, wave action is much stronger in places where:

- beaches have been eroded and/or built over extensively;
- reclamation of land has taken place in the neighbourhood;
- natural barriers such as mangroves have declined; and
- new obstructions to water movement (such as harbours) have come up.

Currents in the nearshore waters have changed course for various reasons, some natural and many related to human actions. Offshore, water currents may have changed course in areas where oil rigs and shipping movements prevail.

Tidal action

Changes in tidal action are felt particularly in the estuarine regions, and evidence of both increase and decrease in tidal amplitude has been reported. Coastal constructions, siltation at the river mouths and along the creeks, and construction of tidal locks/bunds upstream have decreased tidal action in several areas. As a consequence, the backwaters and tidal pools receive less tidal waters, affecting the breeding and nursery grounds for several estuarine species in the creeks. Reduced tidal amplitude in the creeks also affects crab populations and aquaculture operations, makes the boats' passage through some creeks difficult, and the usage of some berthing places impossible.

Mud flows and turbidity

Mud flows from upstream, which carry soil and nutrients to the lower reaches of the rivers, have declined in all states mainly on account of reduced water flows. Reduced mud flows decrease the nutrient content in the coastal waters, with consequences for fish breeding and nursery grounds. However, turbidity has increased because of effluent discharges upstream as well as directly into the coastal/estuarine waters; construction activities on, or near, creeks and beaches; oil spills from rigs and passing ships; and intensive drilling activities on the sea bed. The turbid waters now consist of both suspended solids (which clog the nets and fish gills) and dissolved organic matter (poisoning the waters and leading to mass mortalities of small fish).

Shoreline changes

Erosion, which is reported to affect 23 per cent of the shoreline along the Indian mainland (Vivekanandan, 2011), is a major threat faced by many fishing communities in all four states. Many villages no longer have a beach in which to berth the boats, land and trade the catches, dry the fish, and mend the nets. Even as many houses have been lost to the sea, space available for housing itself has been reduced in erosion-prone areas.

With erosion of the coast, the shoreline does not slope gently into the sea, allowing the tides and waves to play out their energies before reaching the beach; it now drops abruptly into the sea, causing the waves to be more intense and damaging when they hit the shoreline. Seawater intrusion into the villages is a perennial problem of increasing intensity.

The fishers in the Coringa mangroves in Andhra Pradesh contend that the seaward side of the mangroves is being eroded significantly as well. This flies in the face of the idea that mangroves and other 'green belts' are a protection against erosion.

Erosion and siltation go hand in hand, and siltation of the river mouths 1) obstructs the water flows from upstream; 2) forms sand bars that obstruct fishing traffic; and 3) changes the direction of water currents, tides and waves, which get deflected in other directions, causing more erosion, changing fish movements, and affecting the local biodiversity in various ways. In the Sunderbans, the simultaneous processes of erosion at one end and sedimentation at the other means that the delta keeps being pushed downward into the sea.

Probable causes of climate-change issues affecting fisheries

The factors suggested by the fishers as contributing to climate change could be considered under two headings: natural causes and man-made causes.

Natural causes

A few trends relating to climate change, for example, changes in wind patterns and rainfall, seasonal fluctuations, and natural disasters, are attributed to natural factors. However, the global phenomena such as sea-level rise, global warming, and El Niño are totally new ideas to the fishers and their ability to relate a change in their local environment to the melting of polar ice caps or a change in Pacific/Atlantic currents is extremely limited. This highlights the need to raise people's awareness about the global patterns of climate change and how it affects the local context, and also their own contributions to greenhouse gases (GHGs) in a more direct and personal manner.

Fisheries-related factors

Available evidence indicates that fisheries-related factors make a minimal contribution to the global climate-change phenomenon. However, several activities in

the sector, such as overfishing and destructive fishing practices, do upset the marine ecosystems and fragile resources thereby accelerating the climate-change processes. From a climate-change perspective, the most significant activity of the fishing communities that contributes to the emissions of GHGs is the mechanization of the various operations. Examples of fisheries-related factors exacerbating the impacts of climate change include: increasing fishing fleet size, engine powers and capacities, and poor engine and fuel efficiencies.

External (non fisheries-related) factors contributing to changes

These are by far the most important causative factors with immediate impacts on the sustainability of fisheries activities and longer-term impacts on climate change. They originate from diverse sources and vary from place to place, which makes it very difficult to pinpoint them or to suggest measures to address them. The impact of the external factors on fisheries is manifested in several ways.

Pollution. Pollution is a critical problem in all four states and its sources are as diverse as its effects on the fisheries and fishers. Some of the sources of pollution affecting the fishing communities included: industries; urban/municipal wastes; tourism; agriculture; aquaculture and hatcheries; shipping and sea ports; mining; nuclear/thermal power plants; oil refineries; and dredging and drilling activities (both nearshore and offshore).

Shoreline changes. The key shoreline changes brought about by external factors relate to increased erosion in some places, accompanied by excessive sedimentation in others. Alongside natural processes of siltation, dumping of inorganic wastes, land reclamation activities, construction of barrages and new irrigation channels, and sand-mining contribute to clogging of the estuaries and river mouths downstream. An important shoreline change in Maharashtra and Kerala is the construction of sea walls which the fishers consider to be only partly effective and only succeed in shifting the problem to the neighbouring villages.

Destruction of fish habitats and sensitive ecosystems. With the shelter that the fish got from mangroves either destroyed or changed, fish breeding and nursery grounds are lost and several traditional estuarine fish species have moved away or died out in the local waters. In Coringa, the construction of pipelines across creeks for an oil refinery not only curtailed the fishers' movements to the sea and back, but also affected fish movements in the creek, effectively wiping out some important fisheries such as the mud-crab. Such occurrences elsewhere have reportedly driven away fish from their traditional breeding grounds.

Population pressure. In all four states, increased population within and outside the sector has been pointed out as putting pressure on the fisheries and fishing resources. This increases competition and conflicts, leading to unviable livelihood patterns and exacerbating the causes and consequences of climate change.

Consequences of the changes for the lives and livelihoods of fishers

The catches of commercial species from the open-sea fisheries as well as from the estuaries have been reported to have declined over the last decade. The quantities of landings – overall and unit catches – have come down, while a large proportion of these catches consist of juveniles and smaller fish, suggesting biological overfishing.

The seasonal cycle that influences the appearance of specific varieties of fish in different seasons is changing and becoming more uncertain; availability of a fish in the wrong season is considered as much a problem as its non-availability during the correct season. Some demersal species, including shrimp, are now caught in deeper waters. Several important species have been reported to have seriously declined or completely disappeared from the catches in all the states.

The various changes in the ecosystems, fish resources, and the economic conditions of fishing have led to a decline in the small-scale and artisanal fishing systems, which depended upon the inshore waters for their existence. The adaptive strategies undertaken by the more modern small-scale fishers are costly and frequently transform the boats so much that it is no longer possible to classify them as 'traditional' or 'small-scale'.

There is a shift in fishing grounds to the offshore and deep sea which necessitates big investments in capital and operating costs. As boats move into new fishing grounds, increasingly there is resistance from the local fishers to the entry of outsiders. The traditional relations of reciprocity are being repudiated, and violent confrontations increase both at sea and on the shore.

With increased fishing distances, basic navigation and other activities have become more difficult. Such changes do mean harder working conditions and additional pressure on the physical and emotional well-being of the crew. Siltation in the creeks and river mouths makes travelling to the fishing grounds more difficult.

The changing conditions in fishers' access to fishing grounds require them to operate from central locations such as fishing harbours. For women traders, this means declining access to fish, given the higher competition from powerful traders and exporters.

With increasing need for investment on bigger and more powerful fishing systems, high levels of indebtedness prevail in the sector. The existing trade-based credit linkages reduce the fishers' ability to diversify into capturing other species of fish, to move into another area for fishing, or to move out of fishing altogether, thereby aggravating the causes and consequences of climate change, as well as curtailing the fishers' access to adaptive and mitigative strategies.

The need to shift to deeper fishing grounds has led to increased sea-safety concerns; however, few precautions are observed on board to ensure the safety of the crew, especially during long voyages. In most boats, even basic safety equipment such as life jackets is missing. Critical inputs such as mast lights, communication systems, and compasses are absent or do not function. Together with poorly maintained engines, this state of affairs is a sure recipe for disaster. One adaptation on the west coast to the increasing risks in the deep sea has been to recruit migrant fishers who

– being practically at the end of their tether – are willing to go where the local fishers will not.

Traditional fish-drying activities have been affected owing to: 1) lack of space lost to erosion and to ever-increasing real estate values; and 2) unseasonal rains destroying huge quantities of fish drying in the open, effectively wiping out the entire investment of the processors within a few hours.

In mechanized fisheries, given the large margins of profit that the traders hold, any shortfall in the overall catches or increase in operating costs (e.g. fuel) are compensated by additional revenues from fish sales, thereby masking the magnitude of the crisis or at least allowing the fishers to avoid taking it seriously, with possible long-term consequences. In small-scale fisheries, where such market-derived 'subsidies' do not exist, people are forced to move out of the fisheries.

Alongside the general decline in fish available for local consumption, there has been a paradoxical rise in the number of local fish sellers, especially women. With declining incomes from fishing, former housewives have had to seek income sources of their own and, for obvious reasons, fish trade is the immediate option available to them.

The main shoreline change in many villages has been the virtual disappearance of beaches. For both adults and children in fishing villages, for whom the beach is a virtual home-cum-office-cum-recreation centre, the loss of beaches has several social, economic, and cultural connotations. The villages are also overcrowded, with waterlogging, insanitary living conditions, and lack of privacy being the norm. With the living space being increasingly eroded, it is only the poorer people who continue to live on the beaches, exposing themselves to the daily pounding of the waves and facing the risk of losing their home and hearth sooner rather than later.

The changes in the weather and the sea conditions and in fish behavioural patterns have led to traditional knowledge becoming redundant to some extent in fishing activities, and the chances of its revival are considered to be slim. The shifts from traditional fishing grounds and the application of intensive fishing practices make traditional governance systems even weaker. With the new generation of youth in the fishing communities showing little interest in continuing with tradition, the prospects for passing on the traditional knowledge and practices – whatever is left of them – are bleak.

Adaptation or mitigation measures (coping strategies)

The fishers' responses to climate change (albeit as part of a greater range of challenges confronting them) are many, and vary from place to place, but mostly focus on meeting their more immediate livelihood needs which is as expected: with their backs to the wall, the communities can hardly be expected to be in a position to address broader and long-term problems, such as climate change. Most adaptations are only barely adequate to address the problems, many of them are arbitrary and temporary measures, and at least some of them actually contribute to aggravating the impacts or forcing people into criminalized or hazardous actions. While allowing

them to survive for the moment, the current level and strength of the adaptations is not very likely to see them through in the long term.

In fisheries, the targeted fish catches increasingly consist of a range of lesser varieties. Several varieties of fish previously not targeted at all or discarded at sea are now being landed. Diversification of fishing grounds takes place both vertically and horizontally from the shore. In Maharashtra, the trawlers have shifted to fishing grounds over 100 nautical miles (185 km) away from the coast, while the *dol*-netters travel longer distances horizontally along the coast, frequently fishing off Gujarat waters. The small-scale, coastal, outboard-motor gillnetters have shifted operations up to 10–12 nautical miles (18–22 km) from the shore. Similar changes have been noted in the other states.

The increase in fishing distances naturally requires that each fishing trip be of longer duration. In Maharashtra and West Bengal, the fishing duration has increased from three to four days to two weeks. Even small-scale fishing systems such as the gillnetters in Maharashtra and the fishing boats operating in the Sunderbans in West Bengal try to spend extended periods at the fishing grounds by organizing mother-boats to carry their catches to the shore at frequent intervals.

Increased fishing duration gives rise to investments in bigger capacity boats (doubling the size of the *dol*-netters in Maharashtra) and more fishing equipment to carry onboard. Bigger hulls and longer voyages must be supported by an increase in the engine capacities, with the inevitable increase in GHG emissions. In a direct climate-change-related adaptation, increased wave action in the Sunderbans required the draft of the boats to be increased by 1 ft (0.304 m) to 2.5 ft (0.762 m).

The shift to deeper waters is accompanied by increased hardships and risks to the crew, and these are sought to be addressed through the use of migrant labour, some technological innovations (GPS, cell phones, etc.), and group-based operations involving a number of boats being operated as one unit in order to optimize costs.

The migrant labourers are mostly victims of various climate-change factors such as drought and failure of monsoons in their own areas, and are frequently desperate enough to settle for any job that offers a regular salary. By accepting work in offshore waters under harsh working conditions, they are once again putting themselves at risk from natural disasters and other climate-change-related/induced phenomena.

There is a trend towards concentration of ownership in fewer hands in some places. Alongside this, the new owners tend to undertake a range of input and output services, thereby effectively gaining control over the entire supply chain. Conversely, in other locations, there are boat owners who prefer to sell the boat and work as crew – or move to other land-based activities – to reduce risk.

The fast-growing domestic demand for fish has led to a reorientation of the trade strategies in favour of urban markets, helped by improved transportation and preservation systems. This growing outstation demand helps the fishers to diversify to non-traditional species. While this has possibly helped the fishers to survive in the face of the crisis, it has meant that the cheaper varieties of fish are moving away from local markets and poorer consumers. On the other hand, such shifts have led to a change in local preferences to favour fish that were previously not consumed at all.

Women have adapted to the changing context far better than the men could and have diversified into a wide range of non-traditional occupations, including agriculture, domestic labour, and construction work. Apart from earning to keep the family fed, the women also need to travel further and for longer durations, to collect firewood, fodder, and water. The increasing out-migration of men in search of a livelihood also forces the women to be more innovative and resourceful and they have managed to cope with the challenge reasonably well. However, the informal nature of the new opportunities they utilize and the ever-increasing competition from more women joining the race mean that their ability to keep up with the challenges remains uncertain.

Institutional context of relevance to climate-change preparedness in fisheries

A significant problem from the perspective of coastal communities is the fact that in the state-level action plans currently being prepared, as well as in the research being undertaken, there is no effort made to consult with coastal communities to seek their views on the perceived impact of climate change and the sorts of response that are needed. They also point out that the technical focus of all these initiatives, with an emphasis on finding macro-level technical fixes for climate-change issues, is problematic, given that the reality at the local level is far more complex, requiring a response that also takes into account socioeconomic and other fisheries and non-fisheries factors that are locally relevant in the context of climate change.

Some of the points that the fishers made concerning the policy-institutional context relating to climate change were:

- The existence of a multiplicity of policies, legislation, and institutional processes affecting the coast, with no institutional mechanisms to ensure coherent linkages, either horizontal or vertical, resulting in contradictions and lopsided implementation.
- Coastal protection and conservation programmes leading to increased vulnerability and decreased livelihood security for the fishers.
- Most development support is considered to be ill-conceived, out-of-date, inadequate, and inappropriate to address the emerging needs and concerns of the fishers, and sometimes aggravates the crises in fisheries.
- Apart from the lack of appropriate legal frameworks for ensuring compliance with global and national standards on various issues, most existing legal provisions are not implemented fully or in the right spirit.
- Lack of holistic understanding results in ignoring the effects of upstream activities in the coastal ecosystems and fisheries.

Suggested actions to reduce vulnerability and enhance resilience

In the fishers' perception, a comprehensive strategy to protect the lives and livelihoods of fishing communities in the context of climate change is obviously essential.

1. Enhance focus on coastal issues and representation of fishing communities in policy and research processes

A key demand of fishworker organizations is for a separate 'coastal mission' as part of the national programmes on climate change. They also seek policies and measures to build the adaptive capacity of fishing communities to deal with threats from climate change and climate variability.

2. Increase awareness among fishing communities and other stakeholders

There is a need to raise awareness in the fishing communities about climate change and its possible impacts and to persuade them to undertake more responsible fishing and post-harvest practices.

There is also a need to raise awareness among the nodal agencies dealing with climate change about the human and socioeconomic dimensions of climate change in order that these parameters are reflected in practical actions and measures and in research frameworks.

3. Improve fisheries management through bottom-up adaptive processes

Promoting responsible and equitable forms of fisheries management will, among other things, contribute to enhancing the ability of fishing communities to cope with possible climate-change impacts. Here, fishing communities stress the need for participatory, bottom-up approaches that offer more flexibility, such as co-management and community-based management, which, however, need to ensure a level playing field for all stakeholders.

4. Improve engine efficiencies for better economic and ecological impacts

An important factor in fishing from ecological and economic perspectives is the nature of the boat engines and their efficiencies. There is a strong demand for more energy-efficient engines both as a way to reduce operational costs and to reduce carbon emissions. Non-conventional or alternative fuels such as LPG, solar, and wind energy, as well as appropriate usage of sails in conjunction with the engines, will need to be researched and – where successful – popularized.

5. Address issues of sea safety and of migrant fishers

All fishing boats should have quality certification as to their seaworthiness, which needs to be periodically renewed. All boatbuilding activities should follow a HACCP (hazard analysis and critical control point) process and the construction activities should be properly documented so as to fix responsibility when anything goes wrong. There is need for an increase in the coverage and the quantum of insurance support to cover all active fishers against a wider range of calamities, with adequate compensation ensured to support the affected families.

Ensuring strong institutional support for migrants needs to be a priority, as do mechanisms to keep track of their well-being from time to time, and to assist their families back in their villages to cope with the changes that migration forces upon them.

6. Address non-fisheries issues that affect fisheries resources and the quality of life of fishing communities

Addressing issues such as pollution and destruction of coastal habitats by non-fisheries-related causes is absolutely vital, given the sheer scale of their impacts and the fact that they seriously undermine the present and future livelihoods of fishing communities.

7. Strengthen planning for disasters and disaster preparedness

The need to develop settlement-level plans, keeping in mind the vulnerability to all natural disasters, is essential. The planning process must take note of factors such as the growing problem of overcrowding in many fishing settlements, particularly those in urban and semi-urban areas.

8. Improve access to basic services and decent housing

Fishing communities in several states continue to lack proper access to education, health care, sanitation, roads, and decent housing. Urgent attention is needed to address these issues to improve, directly and indirectly, their capacity to cope with climate-change-related processes.

9. Promote livelihood diversification through consultative processes

In situations where there is a need to diversify from fisheries-related activities, it is best to draw on the options and choices already being explored by fishing communities, rather than imposing externally driven and frequently inappropriate options. Communities' own strategies have the unique advantage of building upon their strengths (or at least taking cognizance of their weaknesses); hence strengthening the positive aspects of their strategies would yield greater benefits in the long term.

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