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Management for sustaining the fishery resources in Pulicat estuary, India

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The study aims to establish strategies on how to manage coastal fisheries conflicts and livelihood in Pulicat estuary. This estuary, lying in the east of the Tamil Nadu and Andhra Pradesh States in India, is the second largest brackish water body in India, the first being the Chilika estuary in the State of Odisha. The total area of the estuary is 759 km^2 with many island as part of it. But only 360 km in the southern part is active and the northern part is dormant. The rivers Araniri, Kalangi and Swarnamukhi are the major ones that feed the lagoon. The estuary faces anthropogenic, developmental, industrial and environmental issues threatening not only the livelihood activities of fisherfolk but also the very survival of the estuary. Studies show that the estuary (lake) is shrinking and the depth has decreased from 6 m to 1 m, putting the livelihood of the people at stake. Separate questionnaires were administered to 100 lake fisherfolk and 100 to sea fisherfolk. All were active fisherfolk, aged 18 to 65. And 20 in-depth interviews were also conducted among different stakeholders including members of civil society. There is a huge divide difference between the sea fisherfolk and the lake fisherfolk. There is a social stigma attached to the lake fisherfolk on the basis of caste and economical standards.

Key words: Biodiversity, conflict, conservation, pollution, ecosystem, livelihood, Pulicat Lake.

INTRODUCTION

Biodiversity has key roles at all levels of the ecosystem service hierarchy: as a regulator of underpinning ecosystem processes, as a final ecosystem service and as a good that is subject to valuation. Ecosystem science and practice has not yet absorbed the lessons of this complex relationship, which suggests an urgent need to develop the interdisciplinary science of ecosystem management bringing together ecologists, conservation biologists, and resource economists (Mace et al., 2012). The Pulicat estuary in India has faced degradation, besides disasters such as the 2004 tsunami and the floods due to depression off the Chennai coast. Human activities such as constant conflicts to grab the benefits from the spot have also contributed enormously to the disturbance of ecosystems and livelihood in Pulicat Lake in recent times than ever before with multiple non-sustainable developmental projects of the government, and the private companies. Pulicat Lake is spread between two states of India with an area of 759 km^2: the Andhra Pradesh part has 96% and the rest is with Tamil Nadu. The Tamil Nadu part of the estuary is small and it is located in Thiruvalloor District (as in Figure. 1). Pulicat

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Figure 1. The Tamil Nadu part of the Pulicut estuary is on the south.

has a long history of invasions. Ancient Tamil kingdoms from first century BC gave way to a middle period dominated by traders from the Arab world, the first Arab settlement taking place in the 9th century. The Portuguese rule in the 14th century, often renegaded from Goa on the West Coast of India, was followed by the Dutch, the English, who were there from 1825 to 1947. The middle phase was influenced by the politics of the Vijayanagar Empire, followed by the Golconda sultanate that controlled the Deccan. The name of Pulicat itself changed from Podouke in the early Greek records, to Anandarayan Pattinam in the Vijayanagar era, to Palaverkadu and Prelaya Kaveri in the 16th century, to Pallaicatta in the Dutch records and finally to Pulicat during the British times. Figure 1 shows the map of Pulicat.

Need of the study

Managing coastal fisheries conflicts and livelihood activities in Pulicat Lake is in peril. Two aspects affect the Pulicat ecosystem: degradation caused due to industrial development in the upstream of the rivers that feed into the lake, and the overexploitation of the limited resources, mainly fish resource, by the local people. There is a need to study how the communication strategies can play a major role in managing the fisherfolk conflicts in Pulicat Lake to raise the livelihood activities and sustainable development. This study examines how communication strategies can play a pivotal role in managing the fisherfolk conflicts in Pulicat Lake since the anthropogenic activities are on the rise day by day, terribly affecting the ecosystem of this precious estuary and the livelihood of the fisherfolk. This work is an interesting contribution to conservation and management of Pulicat Lake, by presenting the strategies to manage coastal fisheries conflicts and livelihood.

Objectives of the study

(1) To understand the causes of conflicts among fisherfolk in Pulicat
(2) To examine the role of major stakeholders in resolving the conflict among fisherfolk in Pulicat
(3) To identify communication strategies for managing conflicts in Pulicat.

REVIEW OF LITERATURE

Majanen (2007) presents the results of an analysis of resource use conflicts near marine protected areas in Mabini-Tingloy, the Philippines. The author found large differences between groups of stakeholders in terms of

perceived benefits and costs of conservation and tourism, and these inequalities have led to conflicts between various stakeholder groups. Marked by unequal power relationships, the conflicts place subsistence fisherfolk as the weakest stakeholders. Fisherfolk also have the lowest rates of knowledge of and participation in conservation activities. The study concludes that for conservation programmes to be effectively transitioned onto the social and legal fabric of Mabini-Tingloy, resource use conflicts need immediate attention.

Turner et al. (1998) studied the littoral areas of the conservation of the ecosystem, with an array of properties and features, which have long been exploited by human populations and have contributed to the wealth and the quality life. Past and ongoing differentiation in uses of coastal zones has led to conflicts ranging from deleterious effects on supporting ecosystems to symbiosis with human activities. This study elicited the main forces influencing the development of coastal areas and the means available to assess the present use and manage future exploitation of the coastal zone.

According to Glavovic (2007), a people-centred, pro-poor approach must empower poor coastal communities to pursue the mercurial ideal of coastal conservation and sustainability through practical, locally relevant interventions. He aims to make a modest contribution to developing a more people-centred, pro-poor Integrated Coastal Management (ICM) approach. First, it explores the extent to which the coastal management literature explicitly addresses coastal poverty. Second, it outlines the sustainable livelihoods approach, which provides a useful analytical framework for better understanding of the nature of poverty and practical challenges involved in building sustainable coastal communities. Third, it describes the evolution of coastal management, revealing the challenges and opportunities inherent in adopting a sustainable coastal livelihoods approach. Finally, lessons are drawn and recommendations made to promote a more people-centred, pro-poor ICM approach.

As a commons institution, the *padu* system in Vallarpadam Island, Kochi, Kerala, India, defines the group of rights holders and resource boundaries and fishing sites. It is caste-specific, gear-specific (stake-nets) and species specific (shrimp). As used in Vallarpadam, and elsewhere in Kerala, Tamil Nadu and Sri Lanka, *padu* is characterized by the use of lottery for rotational access. The institution functions in providing equitable access, collective social responsibility, and rule-making and conflict resolution. The emergence of the institution in the study area is a response to change in markets and legislation in the 1970s. It may also be seen a response of the fishing communities to keep their options open, that is, to be resilient (Lobe and Berkes, 2004).

The study of Nair et al. (2013) on ocean state forecast systems of the Indian National Centre for Ocean Information Services (INCOIS) concludes that the forecast is reliable and highly useful. Alerts based on this operational ocean state forecast system are thus useful for protecting the property and lives of the coastal communities along the coastline of India. High wave alerts, wind speed and directionality are found to be timely and give users a sense of safety. Velvizhi et al. (2012) indicated that among the fisherfolk who have used the PFZ information for fishing it was found that there is a very strong correlation between Potential Fishing Zone information and natural indicators used traditionally by fisherfolk.

In most conservation-oriented projects in India, livelihood issues are most often secondary to the goals of conservation. Current environmental discourse in India posits two divergent views: one advocates strict conservation and maintenance of the sanctity of protected areas; the other emphasizes that people living in protected areas should not be alienated from these areas by a strict administrative regime. The latter view supports the vital role of local communities in effective conservation and natural resource management. This paper brings out the importance of livelihood issues in conventional conservation or ecological restoration projects (Panini, 2001). The Indian context is not wired to the livelihood activity of the fisherfolk with safety and security measures in place. So the livelihood is not in the forefront unlike the first world countries. Pulicat Lake too practises the *padu* system assuring rotational access as evidenced in the Kochi study.

METHODOLOGY

Pulicat has 20 islands, the largest being Sriharikota Island where a rocket launch centre is situated. The rivers Araniri, Kalangi and Swarnamukhi are the major ones that feed the lagoon. The other large ones are Pernadu, Irrakam and Venadu. The western side is the Buckingham Canal, which was a navigation channel during the time of the British. It is connected to the sea through three tidal inlets, namely Tupilipalem, Rayadoruvu and Pulicat estuary villages respectively, from north to south. The Pulicat estuary is not only the passage of water but also a bio-corridor for the survival of both aquatic fauna and avian fauna. Vast portion of the Pulicat estuary is in the Andhra Pradesh State part and this study focuses on the small portion that is with the Tamil Nadu State. The major groups in Pulicat who are in conflict are sea fisherfolk and lake fisherfolk, as Pulicat is solely dependent on fishing as a vocation. The local language of Pulicat is Tamil. Pulicut village has the total population of 17,925 and the number of houses is 4,619 (Table 1).

Methodologies adopted are survey and in-depth interviews. The sample size of respondents for the survey (questionnaire) is 200. Two sets of questionnaires were developed exclusively for the sea fisherfolk and the lake fisherfolk, and administered by field experts in and around the Pulicat estuary. The sample size was 100 each for the sea and lake fisherfolk. All were active fisherfolk, aged 18 to 65. The lake fisherfolk belong to the lowest strata and they are mostly of Scheduled Castes or Scheduled Tribes. Prior to administering these questionnaires, a pilot study was conducted with 30 fisherfolk for reliability and face validity. Questions were simplified and designed in such a way to get the response as ‘yes’ or ‘no’. The questions started with the need of the conflict management. Further questions were asked according to their ‘yes’ or ‘no’ to investigate the benefits of the communication strategies.

Table 1. Population in Pulicat, Tamil Nadu part.

Census parameter	Census data
Total Population	17,925
Total No of Houses	4,619
Female Population %	50.3 % (9,010)
Total Literacy rate %	66.8 % (11,970)
Female Literacy rate%	31.5 % (5,650)
Scheduled Tribes Population %	6.2 % (1,116)
Scheduled Caste Population %	13.4 % (2,393)
Working Population %	36.6 %
Child (0-6) Population by 2011	2,196
Girl Child (0-6) Population % by 2011	47.2 % (1,036)

Source: Census of India, 2011.

Later, in-depth interviews were conducted with 20 stakeholders who included fisheries scientists, civil society activists, administrators and tourism officials. Since the study is mainly about sea fisherfolk and lake fisherfolk of Pulicat, the subsequent analysis and interpretation of data are given headlines as such.

RESULTS AND DISCUSSION

Sea fisherfolk

No one or agency has introduced any new strategies to increase the livelihood activities of the poor fisherfolk in Pulicat. At the same time, changes in new information and communication technologies are taking shape gradually to raise the hopes of fishing communities to find solutions in a long run towards development in the coastal areas around India. The satellite remote sensing with its modern new methodologies for measuring the spatial and temporal environmental conditions of marine ecology is catching up momentum, which is very handy for the healthy ecosystem conservation and the livelihood activities of the fisherfolk - in terms of fishing advisories and ocean state forecast.

The data collected from 100 sea fisherfolk show that the sea fisherfolk are using different communication methods for ocean forecast, disaster, potential fishing areas, pelagic fishing, marketing, distribution, weather forecast, safety and security.

Figure 2 shows the study results of 100 questionnaires distributed to the sea fisherfolk. Most respondents say that there is enough fish resource at sea. The next important issue seems to be conflict between big and small boats. Sometimes, big boats (trawlers) damage the nets spread by small boats. Other major problems perceived are: disasters like tsunami and cyclones, need for market facilitation, and need to disseminate effectively fishing catch-related information. Besides fishing-related information, the sea fisherfolk have a better communication with the government agencies, non-governmental agencies and other institutions that support them in some form or the other. The sea fisherfolk are familiar with communication technologies like mobile phones while at sea and inland. Fisherfolk interviewed say that it is unpredictable that mobile network fails during the time of disasters due to a power cut or a snapping of a power line. Normally, mobile phones cover up to 20 km at sea coastline but mechanized trawlers sometimes go beyond that too. The fisherfolk normally do not go much beyond 20 km from the shore though they go along the coast. Erection of more mobile towers along the coast may maximize the mobile reach of the sea and reduce mobile backlash areas. Providing wireless sets at a subsidized rate to the fisherfolk could solve this problem, as fisherfolk may go further distances in the years to come. A Global Positioning System (GPS) is used to navigate at sea as well as to go in search for the spots specified in the potential fishing zone (PFZ) advisories got from satellites and disseminated through various avenues to the fisherfolk. But then, GPS malfunctions during rain and lightning making it ineffective as a disaster management tool, and so a weather-resistant GPS may be produced specially for fisherfolk. GPS is needed for locating spots as a disaster alert tool in order to pass on information to rescue fisherfolk at distress. Majority of fisherfolk use their traditional knowledge for fishing. But only one-third of them rely on satellite information for fishing forecast. Also, they are secretive about the fishing locations, and they do not normally say that there are identified fishing areas where the fish catch is good. So even if some use the PFZ advisories, they may not disclose it to others. Television is the main mass medium used by fisherfolk off-sea. But they use the radio on the sea as private commercial FMs not only broadcast news but also weather information customizing it for fisherfolk. But both television and radio are not used for conflict management. The sea fisherfolk, with the utilization of all these facilities, communicate better towards their economical growth. So there is a vast economic difference between the sea fisherfolk and the lake fisherfolk. The children of the sea fishfolk get better education in every level because of their affordability. Thus the upcoming generations go out in search of a wide range of opportunities for their employment by raising their profile and get identified with the middle-class of the society. Most of them get settled in big cities and merge with the urban community. On the other hand, there is another category of children of the sea fisherfolk who aspire to go for sea-related studies and get employed in government agencies and sea-related departments. The others, after studying the hi-tech fishing courses, go abroad and work in foreign shipping companies and fishing vessels as captains, engineers, mechanics, fisherfolk and other services in shipping. Obviously, the standard of living goes up eventually among the sea fisherfolk of the Pulicat estuary. So there

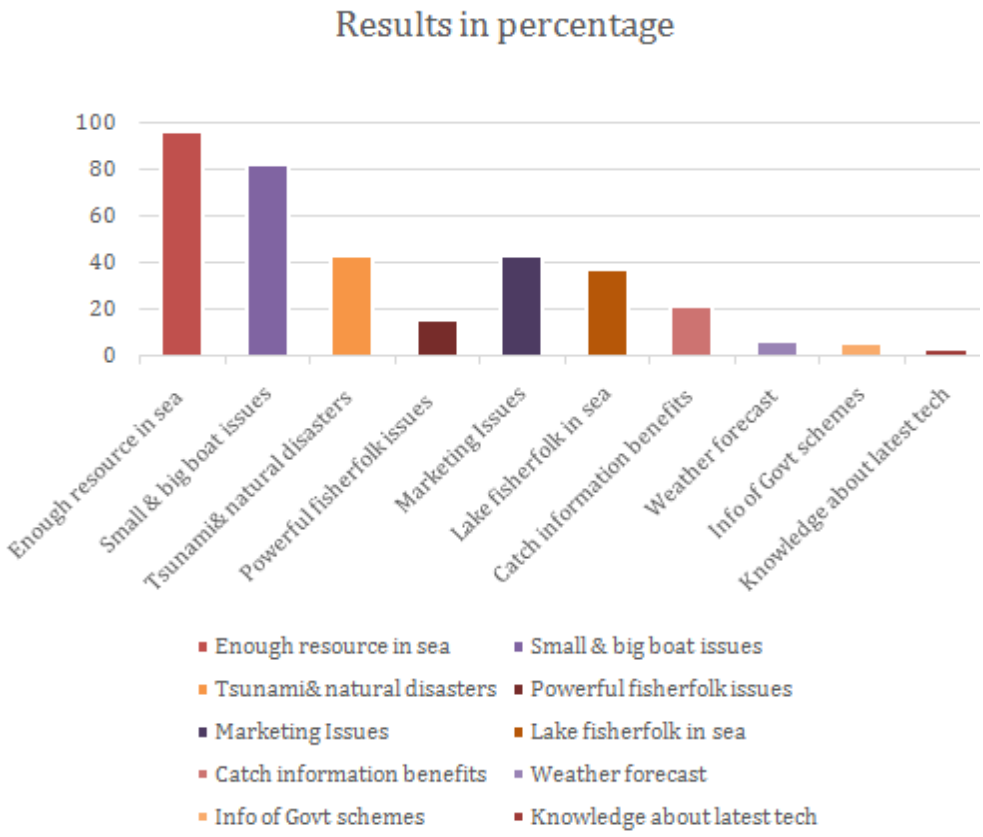

Figure 2. The problems of the sea fisherfolk.

is a cold war between these two groups which erupts as conflicts even when an issue at hand is insignificant.

Lake fisherfolk

The data collected from 100 lake fisherfolk show the pathetic condition of the lake fisherfolk. The study shows that they are not even identified as fisherfolk since they catch only crabs and prawns. This is despite the fact the Pulicat mud crab is world famous and has a delicious taste. Even if they catch fish occasionally, it is only the small size fish in a meager quantity, which has very less market value. The problems of lake fisherfolk are shown in Figure 3.

The study found that there is a social stigma attached to the lake fisherfolk as they belong to a lower caste than the sea fisherfolk. The lake fisherfolk are ignorant of all the above communication methods used by the sea fisherfolk. The only tool that is used by the lake fisherfolk is mobile phone just like any other person but not specifically for fishing-related communication. They have no connection with any of the government or non-governmental agencies for their livelihood activities. Nobody seems to be bothered about them at all except the researchers who come to do their research mainly on the technical aspects of the lake-related issues like the quality of the soil, water, species of fish, and microorganisms. So they end up fighting with each other on many of the above-discussed issues and their livelihood becomes a question mark.

There is no system whatsoever to address this issue of managing the conflicts of the fisherfolk. There are no government agencies assigned by the government to address this issue at all. The NGOs also are not interested in solving this issue, as it is very risky for the individuals who indulge in such activity since they may also be dragged into the various factors like caste, political parties' influence, etc.

Unlike the sea fisherfolk, the lake fisherfolk are impoverished. They are less articulate. However, one voice which is loud and clear (Table 1) is that there are more boats than resources in the lake. Particularly after the 2004 tsunami, many non-governmental organizations donated fibre-glass reinforced boats (FRBs) to the lake fisherfolk. The violation of the *padu* system, pollution, and inadequate market support are the other issues that come to the fore. (The *padu* system is fishing in allocated patch and days in the lake, to exploit the limited resources on a rotational basis). Since the people are ignorant and illiterate they are not even aware of their

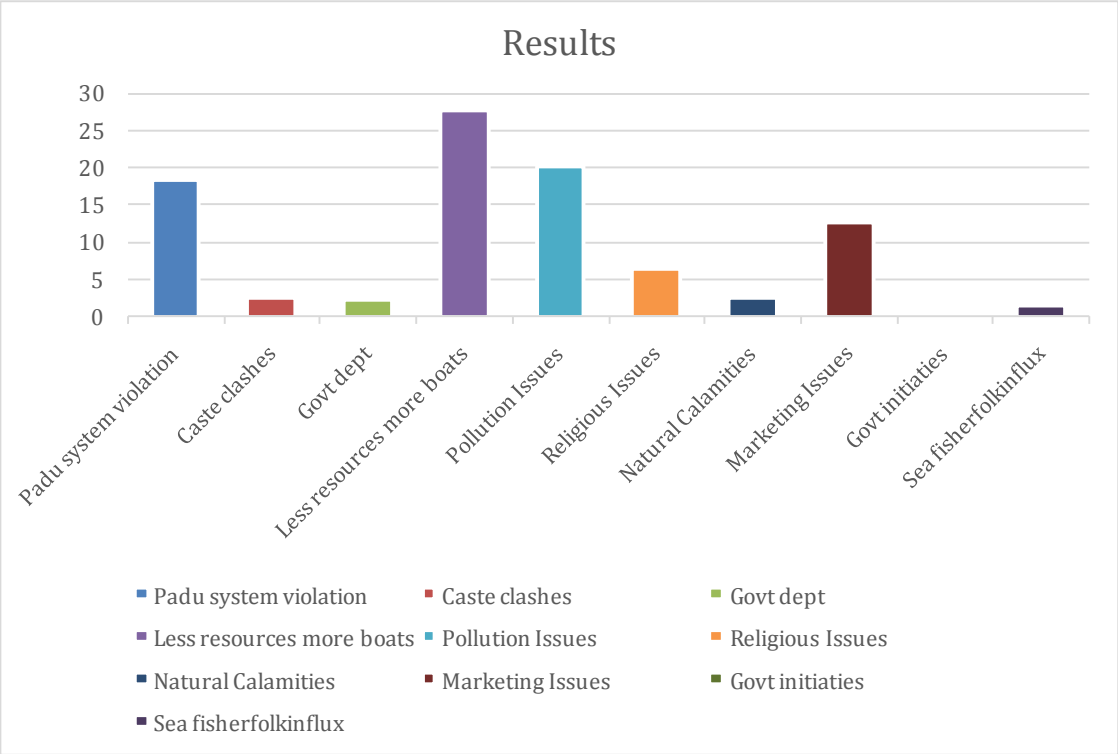

Figure 3. The problems of the lake fisherfolk.

plight. They are angry with the government and the NGOs that nothing is done to them as it is done to the sea fisherfolk. The civil society concept is not there at all to raise their voice to fight for their rights. But the fact remains that if the estuary is not taken care of by Tamil Nadu and Andhra Pradesh governments respectively it will certainly affect the ecosystem of the estuary that will affect the wellbeing of both States especially the city of Chennai in various ways.

The study clearly shows that the lake faces several anthropogenic, developmental, industrial and environmental issues threatening not only the livelihood activities of fisherfolk but also the very survival of this ancient estuary itself. A major threat for the Andhra Pradesh part of the lagoon is pollution from sewage, pesticides, industrial wastes from numerous fish processing units and oil spills from mechanized boats through Arani and Kalangi rivers draining into the lagoon. Marine chemicals and salt manufacturing industries and shrimp farming on the eastern part of the lagoon affect the Pulicat estuary's bird sanctuary, besides disturbing the livelihood activities of fisherfolk and agricultural workers. It has serious impact on aquaculture development. Major ecological threats to the Pulicat estuary of the Tamil Nadu part are a petrochemical complex, a power plant and the satellite port on Ennore Creek. Siltation and complete closure of mouths at Tupilipalem and Rayadoruvu lead to fluctuation in salinity and water level of the estuary. This has maximum effect on biotic component of the ecosystem, which is known for its biodiversity. The part of Pulicat lake in Tamil Nadu faces a greater threat than that of Andhra Pradesh. The 630 MW North Central Thermal Power Station (NCTPS), the Ennore satellite port project and a proposed petrochemical park are major threats to the estuary ecosystem. Thousands of acres of land have been cleared for the three projects.

The study concludes that there is a vicious circle that happens in this scenario that mobile communication is not possible in any way for the conservation of the ecosystem of this estuary because these people are not educated thereby there is no awareness about the degradation of the ecosystem. This put the estuary in peril destroying the livelihood activities of the lake fisherfolk. On the other hand, mobile communication is possible and supports the sea fisherfolk for their livelihood activities and the occupational safety and security measures of the fisherfolk. When the sea is rough the sea fisherfolk go to the lake for fishing which is opposed by the lake fisherfolk resulting in conflicts.

Conclusion

The outcomes of the study are important for the management and conservation of biodiversity in solving

conflicts among communities along the Pulicat estuary. There are a number of researches done in the Pulicat estuary over time on the technical, chemical, biological aspects of water, soil, sediments, flora, fauna, microorganisms, limnology, remote sensing and so on, but hardly anything is done on the livelihood activities of the fisherfolk and the conservation of the ecosystem. This study makes a significant contribution to the scholarly works on the livelihood activities of the sea fisherfolk and the lake fisherfolk in the background of managing the conflicts of the fisherfolk through communication strategies in Pulicat Lake. Some of the findings are:

(1) There is a huge divide difference between the sea fisherfolk and the lake fisherfolk and their lifestyle.
(2) There is a social stigma attached to the lake fisherfolk on the basis of caste, and the economical standards.
(3) There are conflicts due to the violation of the traditional the *padu* system of fishing.
(4) There is a constant conflict between the fishing communities on the basis of inequalities.
(5) There is a conflict due to the ignorance of the lake fisherfolk and the exploitation of the agencies connected to fishing and Coastal community development authorities.
(6) Modern technologies connected to fishing are non-existence among the lake fisherfolk, unlike those of the sea fisherfolk, which causes conflict.
(7) Besides the conflicts between the sea and lake fisherfolk, there are conflicts among the lake fisherfolk because of the caste difference that exists among the villages.
(8) The study furthers our understanding of the impact by specifying the mechanisms through which impact can be modelled, especially focusing on knowledge level as the intermediary outcome of communication strategies.
(9) Employment was promised by the Government in the Ennore Thermal power station in the year 1985 for 840 Pulicat villagers but only 150 were employed, that too as temporary employees. They were not paid well so eventually, all left their jobs and came back to Pulicat.
(10) No proper fish market is provided and maintained. No cold storage is provided to keep fish catch fresh. Engine subsidy too was stopped.
(11) Private prawn farms are put up on the river in connivance of the Government in violation of Costal Regulation Zone (CRZ) regulations.
(12) The petrochemical project was planned but people stopped it temporarily by filing a court case against it.
(13) Corporate companies have been given permission to build harbours upstream of this sensitive ecosystem which is against the interest of Pulicat villagers.
(14) 70% of the cost share of the bar mouth opening promised by the Government but it is not done. Now there are plans to build a training wall so that the bar mouth is permanently open.
(15) No bridge is provided by the Government in Pasiyavaram in Idamani Island so children go to school on boats on rainy days.
(16) After the 2004 tsunami, some of the lake fisherfolk started going to the sea by the boats provided by an non-governmental organization called the Madras Social Service Society (MSSS). They gave up *padu* fishing but they too started going for sea fishing resulting in conflicts.
(17) Conflicts among different villages arise on the basis of livelihood issues like fishing-related conflicts, castes, religion, safety, security, health, hygiene and marketing.
(18) The sea fisherfolk have a better communication with the government agencies, non-governmental agencies and other institutions that support them in some form or the other. Conflict with the lake fisherfolk is due to the partiality by these agencies.

Some of the suggestions of the study are:

(1) The study supports the development of crispy message design for more effective communication for the fisherfolk.
(2) Special attentions should be given by the government and non-governmental organizations to uplift the lake fisherfolk.
(3) Communication strategies cannot be done instantly with the lake fisherfolk since the people are so ignorant that it takes a long time to create awareness to bring them together cutting across caste and other internal factors.
(4) Care should be taken to conserve the Pulicat ecosystem by restraining developmental activities and to promote livelihood options of the local people.

Overall, the study makes a significant contribution to future designing and the deployment of convergence of communication for managing the conflicts and enhancing livelihood activities choices of the fisherfolk of Pulicat Lake.

The government, which has the sole responsibility to take care of the ecosystem, is in the forefront to destroy it in the name of all kinds of developmental activities. The saddest thing is that the technically qualified government officials are hand in glove with the politicians to plan and execute these development projects that directly and indirectly destroy the ecosystem eventually. There are a few more projects in the planning level to be executed in the future that will cause more havoc to the ecosystem of the Pulicat estuary.

Future research

There is a lot of scope for further study in constructing new communication strategies by using latest communication tools. There is a need for further research to adopt new communication strategies to create awareness among the fisherfolk towards managing the

conflicts by themselves, to focus on the conservation of the ecosystem, and to enhance the livelihood of all the fisherfolk of Pulicat.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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