Indian J. Fish., 62 (1): 144-148, 2015

Note

Indigenous Technical Knowledge (ITK) of coastal fisherfolk on climate change - a case study in Chennai, south-east coast of India

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ABSTRACT

Climate change will have strong impact on fisheries with far-reaching consequences on food and livelihood of a sizeable section of the population. The frequency and intensity of extreme climate events is likely to have a major impact on future marine fisheries production. Fishermen have excellent knowledge on the relationship between climatic, oceanographic factors and fish catch. This knowledge enables them to switch their fishing activities with respect to species exploited, location of fishing grounds and gear used. Based on this backdrop, a survey was conducted to collect primary data on Indigenous Technical Knowledge (ITK) from 200 fishermen in and around Chennai with a structured questionnaire. Fishermen believed that reduction in fish catch in recent years is essentially due to overfishing (Garrett mean score : 82) and juvenile exploitation rather than climate change. Fishermen opined that current (62%) and wind direction/speed (28%) are the major climatic parameters affecting fisheries. Current from south to north direction which generally remains for nine months off Chennai leads to good fish catch, since it is favourable for larval distribution. They believe that combined wind blow from south and west leads to coastal upwelling, which occurs during May-June every year for 45 to 55 days. Current flow from south to north yields more rocky fishes due to turbid water condition and leads to heavy catch. However in recent years fishermen were not able to predict climatic events like in earlier years due to large unexpected seasonal variations. Fishermen suggested that government should bring regulations on craft, gear and related aspects in order to ensure sustainable fishing.

Keywords: Climate change, Climatic factors, Fishers perceptions, Garrett rank, Indigenous Technical Knowledge (ITK), Traditional knowledge

Climate change has strong impact on fisheries with far-reaching consequences on food and livelihood of a sizeable section of the population. The frequency and intensity of extreme climate events is likely to have a major impact on future marine fisheries production. Fishermen have excellent knowledge on the relationship between climatic as well as oceanographic factors and fish catch abundance.

Indigenous Technical Knowledge (ITK) also referred to as local or traditional knowledge is the cumulative body of knowledge generated and evolved over a long period of time and generations of experience (Grenier, 1998). It includes the skills, beliefs, norms, practices and behaviour patterns handed down from one generation to the next (Matowanyika *et al.*, 1994). The past studies have reported the existence of indigenous knowledge on fish habitats, migratory patterns, proper timing of fishing, fish resource management (Berkes, 1993), traditional fishing methods (Dutta and Bhattacharjya, 2009), fish behaviour and harvesting (Tuara, 1995). This knowledge is very essential to them since their livelihood directly depends on availability of fish resources which could be applied for predication of fish abundance.

Fishing communities have often developed adaptation and coping strategies to deal with fluctuating environmental conditions. Greater understanding of how communities cope with and adapt to fisheries with extreme natural variations would assist in developing adaptation strategies for climate change (Vivekanandan, 2011). Fishermen are generally able to track seasonal and spatial variations in fish stock availability and relate it to climatic variability. They are able to detect some of the variables such as speed and direction of wind and current, water mass movement and upwelling, and make

short-term predictions on fish distribution, spawning and abundance (Aparna and Trivedi, 2011). This knowledge enables them to switch their fishing activities with respect to species exploited, location of fishing grounds and gear used. The available Indigenous knowledge can be effectively used for understanding climate change related to fisheries issues (Salick and Ross 2009). The present study was undertaken with the expectation that the extensive traditional fishermen knowledge on gear and craft design, fish behaviour, identification of fish shoal, and prediction of oceanographic parameters such as weather, wind, rainfall, cyclone, and tide level, could be effectively utilised for scientific understanding on climate change.

A survey was conducted to collect primary data on Indigenous Technical Knowledge from 200 coastal fishermen in Chennai, Tamil Nadu along the south-east coast of India, with a structured questionnaire. Garrett ranking technique was used to rank the fishermen's perceptions on different climatic parameters as well as their importance and major problems in fishing (Kumar and Kumar, 2008).The data were collected from February 2011 to February 2012, with the help of structured interview schedule. To validate the findings of the study, workshops and group level meetings were conducted in villages among community leaders, fisherfolk and scientists to record their past experiences and present strategies related to extreme climate events, and to obtain their feedback on future policies in relation to climate change in marine fisheries.

The questionnaire was prepared to know, (i) the perception of fishermen on the climatic and oceanographic parameters that are changing over the years, (ii) the importance of climatic and oceanographic parameters to fisheries, (iii) the major problems facing fisheries, (iv) opinion about different climatic parameters and (v) traditional knowledge on marine fish and climatic natural disasters.

The fishermen's perception of climatic factors, constraints in fisheries and attitude towards the climatic parameters were analysed using Garrett's ranking technique (Kumar and Kumar, 2008) in the following manner:

$$\text{Percentage position} = \frac{100\ (R\ ij - 0.50)}{N\ j}$$

where, Rij = Rank given for the i^{th} item by the j^{th} individual and Nj = Number of items ranked by the j^{th} individual.

The percent position is converted into scores by referring to Garrett table. Then scores of the respondents were added together for each factor and divided by number of respondents. Based on the score, most influencing factors were identified through the ranks assigned. In addition to ITK compilation, climate and weather related informations were also collected and discussed.

All the fishermen were of the opinion that major changes in climatic parameters occurred in the last 10 years particularly after tsunami. Wind direction and speed, current and coastal upwelling were the major climatic parameters perceived by the fishermen to predict fishing ground and other fishing activities. Fishermen ranked wind direction/speed as first and foremost climatic parameter (Garrett mean score: 33) which significantly changed over the years followed by temperature and current (Fig 1). Vivekanandan *et al*. (2010) reported that the fishermen have given more importance to wind direction and speed as the drivers of fish abundance and availability, followed by rainfall and temperature. The present results also indicated that wind direction/speed was the prime climatic parameter which most significantly changed over the years followed by temperature and current which severely affected fish catches. Garrett scores indicated that coastal upwelling, salinity and chlorophyll have not changed significantly. However, Riedlinger and Berkes (2001) reported that the results would not be the same in all geographical locations.

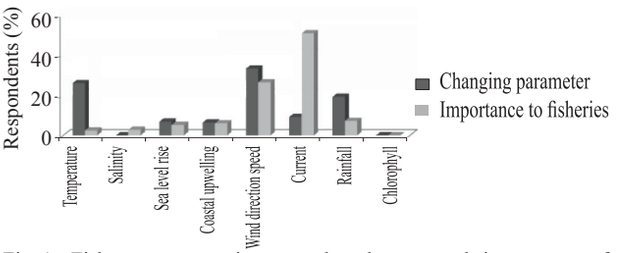

Fig. 1. Fishermen perceptions on the changes and importance of climatic parameters to fisheries

Based on Garrett analysis, current (Rank 1) was found to be the most important climatic parameter affecting fishing (as ranked by respondents) followed by wind direction/speed (Rank 2), rainfall (Rank 3) and coastal upwelling (Rank 4) (Fig. 1). Among the eight parameters, fishermen perceived maximum importance to current (Garrett mean score: 50) and wind direction/ speed (Garrett mean score: 26). The current and wind have direct relationship to each other. Fishers opined that rough current prevails at the time of heavy wind speed and that simultaneous occurrence of heavy wind as well as rough water current is not suitable for fish catch.

Among the major problems facing fisheries, fishermen ranked overfishing as the main problem (Garrett mean score: 82) followed by juvenile exploitation and climate change (Table1). The Garrett mean score showed that overfishing was a prime constraint for decline in fish catch followed by juvenile exploitation (Fig. 2). Vivekanandan *et al*. (2010) reported that overfishing was the major constraint to fishers of India. The results obtained in the present study also indicated that fishermen faced similar problems along the Chennai coast. Fishermen pointed out that though climate change was one of the reasons for declining fish catch, overfishing by mechanised trawlers using Chinese engines and exploitation of juveniles were the major reasons for declining fish catch.

While 77% of respondents were of the opinion that they could predict weather and fish catch from climatic

Table 1. Garrett rank analysis on major problems facing fisheries

Major problems facing fisheries	Garrett mean score			
	1	2	3	4
Overfishing	82	16	2	0
Juvenile exploitation	11	69	12	8
Habitat destruction	2	2	27	69
Climate change	5	13	59	23
Total	100	100	100	100

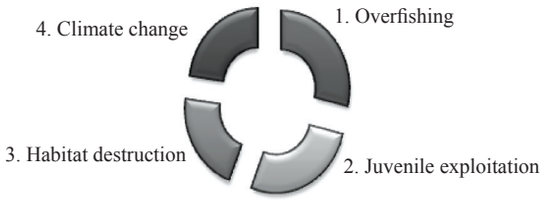

Fig. 2. Fishermen perceptions on major problems facing fisheries

condition, 97% of respondents were ready to take weather related insurance with their own money. About 94% of respondents did not complain any major new disease outburst in the last 20 years among fishermen community (Table 2). In the event of cyclone and sea erosion, 92% of respondents preferred temporary exit from their villages. Fishermen suggested that safe exit is the good adaptation option for any weather related problems in the sea. Ninety one percent fishermen used TV and newspaper for the weather related information and they are following it during heavy wind speed (>50 km h^{-1}) (Table 3).

Fortysix percent of respondents opined that mechanised trawlers and gillnetters were the more vulnerable sections for the weather related problems (Table 4). Fishermen believed that fish spawning activity increases when temperature increases. Almost all the fishermen agreed that ban period should be from

Table 2. Opinion of respondents about different climatic parameters

Opinion of respondents about different climatic parameters	% of respondents opined 'yes'
Prepared to take weather-related insurance	97
Regularly read or watch newspapers, radio, T.V	100
Taking any precautions based on information	87
Change/increase any disease occurrence	94
Change in the type and quantity of fish availability	84
Predict weather from climatic conditions	79
Predict fish catch from climatic conditions	77
Change in fish catch due to temperature	58
Changes in potential fishing areas	84
Changes in coastal upwelling	82
Migration of fish species to other places	53
Migration from other places in your areas	51
Changes in your craft and gear in the last 10 years	95

Table 3. Response of fishermen on mass media information for fishing

Use of mass media for fishing	% of respondents
TV	40
Radio	2
TV and newspaper	41
Radio and TV	10
Bulletins	1

Table 4. Vulnerability of fisher folk to weather related problems

Vulnerable to weather related problems	% of respondents
Mechanised	46
Motorised	39
Traditional	15

April to May. They agreed that oilsardines, pufferfish, leatherjacket, tuna and red ring catches significantly increased in recent years. Fishermen also informed that job fish, white fish, hilsa, jelly fish, Bombay duck and carangids have completely migrated from Chennai coast to other areas. They also found that mackerel catch in the shallow waters reduced significantly for the gillnetters since the fish have moved to deep sea.

Fishermen are able to predict fish catch based on current direction and other climatic parameters before they enter into the sea. Current from south to north direction which generally remains for nine months off Chennai leads to good fish catch, since it is favourable for larval distribution. Combined wind blow from south and west leads to coastal upwelling, which occurs during May-June every year for 45 to 55 days.

During the few days ahead of new moon and full moon, the fish catch will be less due to the existence of tough water current. North-east wind is an indicator of natural disasters such as storm and cyclone. They believe that fish catch will be less in transparent seawater, and in turbid conditions there will be heavy catch. Heavy fish catch occurs both in rough shallow seawater and in calm deep sea. Moreover, they are able to predict the availability of squids at southern wind blow direction, and appearance

of red rings in the sea as an indicator of availability of tuna and shrimps.

Water current driven by wind is the natural phenomenon, but the slow water movement accompanied by bad odour due to the presence of dead fish, is an indicator of less fish catch. Occurrence of large quantity of sea snakes in fishing ground indicates very less catch. Based on water colour, they can predict types of fishes in fishing ground. Black colour of seawater indicates presence of mackerels and sardines whereas white colour and dark blue colour indicate the presence of pomfrets, and probability of heavy catch respectively.

Coastal upwelling brings muddy water which leads to very good catch of all the species. Fishermen used to get good catch of seerfish, carangids, sardines, mackerels, squids, pomfrets and all type of fishes (Manjusha *et al*., 2013). During May and June months, current direction from south to north brings more rocky fishes due to turbid water condition. Fishermen opined that squid production has considerably increased during summer months particularly at southern wind blow direction. Fishermen agreed that spawning of fish increases when temperature increases. Increase in temperature results in heavy catch of sardines, lesser sardines and seerfish.

Fisherfolk use climatic parameters for prediction of climate variability, natural disaster and fish availability. In the event of cyclones and sea erosion, fishermen of Chennai preferred temporary exit from their villages. About 91% of fishermen listen to and follow TV and newspaper for weather related information. They are interested to take weather related insurance if the premium is within their capacity. They did not complain of any major disease outburst in the last 20 years among fishermen community. Fishermen suggested that government should bring regulations on craft, gear, period, fish species and related aspects, to maintain sustainable fishing.

However, in recent years fishermen were not able to predict climatic events like in earlier years due to large unexpected seasonal variations. Due to climate change, they found it difficult to predict fish availability. Now fishermen are unable to understand the current flow direction as it is very irregular, unpredictable and due to rough ocean conditions. So the fishermen were unable to depend on the climatic parameters for their fishery activities. Majority of fishers were depending on mass media communication to get climate linked information. We have articulated the baseline information of fisher's traditional knowledge, fisher's perceptions on the changes in oceanographic and climatic parameters and their constraints; that would be helpful for climate adaptation in future. However, this compiled knowledge needs scientific validation which could be disseminated for public use.

Acknowledgements

The authors are grateful to the Indian Council of Agricultural Research (ICAR) for funding the project on 'National Initiative on Climate Resilient Agriculture (NICRA). The authors are also thankful to the Director, CMFRI for the encouragement given in carrying out the study.

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Date of Receipt : 04.03.2013
Date of Acceptance : 07.10.2014