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Research Note

Economic Analysis of Producers' Perceptions about Impact of Climate Change on Fisheries in West Bengal

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Abstract

This paper has looked at the social vulnerability of fishermen to climate change and the extent of adaptation strategies in response to climate change. It has sought insights as perceived effects based on farm household survey in Coochbehar district of West Bengal during the year 2009. Simple random sampling was used to select eighty respondents for descriptive as well as tabular analysis. The majority of farmers are small and medium. Thirty per cent of them take up fishery as primary occupation. Nearly eighty per cent are actively involved in production activities by providing labour force *inter alia* in other agricultural operations. Income from fishery ranges from ₹12,000 to ₹16,000 per acre per year. About forty-eight per cent have low level of awareness about climate change and its economic impacts on fishery. Fifty per cent of the fishers have negative perception about the effect of climate change to fish production. Only twenty-two per cent show positive approach to adopt different strategies aiming to reduce adverse effect of climate change. Ranking of negative perceived effect has also been done. The young and educated fishers assume climate change to be a serious issue which has been confirmed with a positive relation between awareness and perceived effects of climate change. The respondents who perceived negative effects of climate change are more prone to adopt strategies to cope up with the climate change. To address the constraints being experienced by the respondents, the study has made some suggestions which include resource allocation and adoption of mitigation measures, adaptive measures and rural development measures to reduce the impact of climate change on fish population.

Key words: Fishery, climate change, farmers' perceptions, ranking, adoption & mitigation strategies

JEL Classification: Q22

Introduction

In India, aquaculture forms an important sector with regard to employment, livelihood and food security. Total fishermen population is about 14.5 million (Livestock Census, 2003). The contribution of fisheries to GDP is 1.12 per cent at current prices (2007-08). Export of fish and fishery products has grown manifold over the years. According to the latest data, India exported 6.03 lakh tonnes fishery products

valued at ₹ 8,608 crore in 2008-09. India presently produces 76 lakh tonnes of fishery products (Deptt. of AH&D, GoI, 2010). According to S. Ayyapan (2010), India is home to more than 10 per cent of global fish biodiversity with 2200 species of fish and shellfish in the marine and inland waters. With water resources in terms of 29,000 km of rivers, 3.15 Mha of reservoirs, 2.35 Mha of ponds and tanks and 0.2 million hectares of floodplain wetlands, the potential production levels are estimated at over 4.5 Mt annually. Creation of required harvest and post-harvest infrastructure has been receiving due attention of the central and state

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governments. All this has been inducing a steady growth in the fisheries sector.

Recent studies indicate that climate change scenarios that include increased frequency of heat stress, droughts and flooding events reduce crop yield and livestock productivity beyond the impacts due to changes in mean variables alone (OECD, 2011). This, in turn, affects the socio-economic status and livelihood of a large number of stakeholders. The impact of pollution on aquatic resources is already becoming a problem in India (Natarjan, 2007), the climate change will put additional stress on ecological and socio-economic systems. Thus, the climate variables, viz. enhanced water temperature, extreme events like flood and drought, storms and water stress require specific adaptation actions. Farmers will have to adapt to these changes in productivity levels in order to respond to the new environment with a new pattern of comparative advantage. It is therefore essential to include adaptation strategy to climate change (Mitra, 2009).

Coochebehar is an agriculture-based district in West Bengal with high rainfall intensity (more than 3,200 mm). About 3,200 ha of water bodies are under pisciculture and nearly 28.5 thousand families are involved in this aquaculture operation. This is an essential food commodity with high demand and high market price but production always remains short (about 5 tonnes per year) of its demand. Therefore, investment in this sector would be a viable proposition (ADF, WB, 2009).

Under this perspective, a study was undertaken to explore the perceptions of fish-farmers' about the climate change and their level of perceptions regarding adaptation strategies (Oyesola, 2000)

Methodology

This study followed a "bottom-up" approach and obtained insights from the farmers as perceived effects based on farm household survey in the Coochebehar district of West Bengal during the year 2009. Simple random sampling (SRS) was used to select 80 respondents purposively from 12 villages of four blocks. A structured questionnaire was prepared for this purpose. Five categories of farming community, viz. (i) marginal (up to 1.00 ha), (ii) small (1.01 to 2.00 ha), (iii) semi-medium (2.01 to 4.00 ha), (iv) medium (4.01 to 10.00 ha) and (v) large (10.01 and

above) were maintained while collecting data following the guidelines of Ministry of Agriculture, Govt. of India. But due to insignificant presence of medium and large farmers, only the average values of different parameters of small and marginal fishers were taken into account for the analysis which would represent the characters of sample farmers in general. Statements as perceived by the fishers have been shown in general, irrespective of category of a farmer. Scores on different criteria as perceived by the farmers were noted and placed for ranking and interpretation (Abeyasekera, 2009). Secondary sources of information were also recorded to substantiate the primary data. Descriptive as well as tabular analyses were followed for analysis.

Results and Discussion

The survey results show that the majority (more than 97%) of farmers belonged to small and marginal categories. Therefore, small and marginal farmers were considered for the analysis and this represented the actual status of fishers community. Basic information about the status of fishing community in the area under study is given in Table 1.

A perusal of Table 1 revealed that the majority of the fishers continue fishery as an additional economic activity. Only 27.5 per cent farmers had undertaken fish production as the primary occupation. The average size of fishing area was very low (0.10 ha). Farmers were also found to employ 67 per cent of the total labour requirements which showed their willingness for commercial fishery. They marketed their produce at the nearby village or town market. Estimated income from fishery was also satisfactory which ranged from ₹ 20,500 to ₹ 27,600 per harvest per year. All these observations showed that the fishery in this area is a viable economic proposition and demands much more productive investment.

Farmers' Perception on Impact of Climate Change on Fishery

In aquaculture, fishers along with their family members (women, children, etc.) are also involved in different operations of fishery. From the socio-economic perspectives, it is an important agri-business activity. It is evident that climate change has mode impact on the fishery sector. Accordingly, the respondents were asked about the climate change and

Table 1. Basic information about farmers in Coochbehar district of West Bengal

Sl. No.	Particulars	Estimated information Small and marginal farmers
1	No. of fishers	78 (97.5%)
2	Average size of holding (ha)	0.26
3	Average size of water body (ha)	0.10
4	Leased-in water body (ha)	Negligible
5	Age of fish farmers (years)	18 to 60
6	Educational level	Primary to Higher Secondary
7	Fishery as primary occupation (No.)	22 (27.5%)
8	Other economic activities	Crop, livestock & business
9	Employment of hired labour (ha)	60 (67%)
10	Active participation in fishery operations (No.)	64 (80%)
11	Training received on fishery (No.)	51 (65%)
12	Types of fish reared	Small, big and indigenous fishes
13	Place of marketing	Local and town market
14	Income from fishery for a single operation (₹/ha)	20,500 to 27,600

how they rated it. Based on the responses, frequencies of two categories of perceptions were shown, viz. (i) low to medium and (ii) high for convenient of analysis. Table 2 reveals the extent of awareness of the fish farming community in Coochbehar district of West Bengal about climate change.

The findings reveal that 47.5 per cent of the respondents had low level of awareness about climate change and its impact on fishery in respect of production, quality and marketing. Fifty per cent of the fishers had negative perceptions about the effects of climate change on fish production. Only twenty-two per cent of the respondents showed a positive approach to take up action to adopt different strategies in view of reducing adverse effects of climate change.

It is generally recognized that those who are most vulnerable and marginalized would be most severely affected by the cumulative impacts of climate and other anthropogenic activities that degrade the natural resources. Climate change will result in a social change (Sarkar and Padaria, 2010). Fish farmers continue fishery as a livelihood opportunity and a way of life beside other economic activities like crop raising and livestock production (Sigdel *et al.*, 2011). Women and children also participate in different farming operations requiring low level of skill and knowledge. As a result, awareness about the perceptible changes in environment as well as climate is rarely observed among the fishing masses. Though it is felt that climate has been changing and its adverse effects are showing signs in the fishery sector.

Table 2. Respondents' awareness of climate change in Coochbehar district of West Bengal: 2009

Criteria / Problem	Respondents' frequencies		
	Low to medium	High	Average
Occurrences of events of climate change (felt)	Nil	80 (100%)	80 (100%)
Knowledge of climate change	38 (47.5%)	Nil	38 (47.5%)
Impact of climate change on fishery	46 (57.5%)	1 (1.25%)	47 (58.75)
Negative perception of climate change	35 (43.75%)	5 (6.25%)	40 (50%)
Positive perception for adoption strategies	18 (22.5%)	Nil	18 (22.5%)

Table 3. Fishermen perceptions of climate change and its impacts on fishery in Coochbehar district of West Bengal: 2009

Criterion	Fishermen perceptions				Score	Rank
	Extent	Severity	Importance	Frequency		
Rise in temperature	*****	***	***	****	15	2A
Occurrences of drought	**	*	***	*	7	8
Occurrences of flood	****	***	****	***	14	3A
Occurrences of storm	**	**	**	**	8	7
Rise of tenure of hot season	****	****	**	****	14	3B
Depletion of water resources	****	****	****	*****	17	1
Deterioration of water quality	****	***	***	***	13	4A
Decline in fish in general	****	****	**	****	14	3C
Decline in indigenous fishes	*****	*****	*	****	15	2B
Decline in fish productivity	****	***	***	***	13	4B
Occurrence of diseases	***	***	**	***	11	5
Management of pond	****	***	****	***	14	3D
Disturbances of crop and or livestock planning	****	***	***	****	14	3E
Occurrence of environmental pollution	***	**	**	***	10	6
Socio-economic status of fishers	****	****	**	****	14	3F
Ecological effect	****	***	****	**	13	4C

Note: More number of * means more important.

A, B, C, etc. denote equal ranking of different criteria.

To study farmers' perceptions, scoring and ranking method was adopted. The information as perceived by the fishermen about the impact of climate change on fishery production and quality and also on their socio-economic perspectives has been presented in Table 3.

A perusal of Table 3 indicates that depletion of water resources followed by a decline in fish population and its productivity are the most important visible impacts of climate change on fishery as perceived by the fish farmers in the area under study. The climate change had also affected their socio-economic status, ecology and crop planning for livelihood. In short, it has multi-dimensional impacts on the rural life.

Efforts were also made to study adaptation strategies to cope up with the climate change and mitigate its effect on fish production and thereby sustaining food supply and livelihood activities, as perceived by the target farmers. Scoring as well as ranking method was applied. Table 4 reveals the

positive approach in adoption of different strategies to reduce the adverse effects of climate change on the fishery sector, as perceived by the fishers.

It could be observed from Table 4 that ownership of pond ranked first from the economic motive and livelihood security. It was followed by the maintenance of water body, provision of insurance facility, and community-based fishery (all ranked II). Govt. initiatives for conservation of natural resources and role of credit institution have also been found important perception towards adaptation strategies for the fishery sector to mitigate the adverse impact due to gradual climate change.

Conclusions and Policy Implications

Climate change has been perceived to put additional stress on the ecological and socio-economic systems in general and on the fishery sector in particular. The resource-poor fish farmers are the most vulnerable and are being affected maximum due to

Table 4. Adaptation strategies to mitigate the effect of climate change on fishery as perceived by the fishers of Coochbehar district of West Bengal: 2009

Constraint/Strategy	Ranking
Information diffusion & awareness	IIIA
Provision of insurance against climate change	IIA
Maintenance of permanent water body	IIB
Local weather station	IIIB
Crop/investment diversification	VIA
Demonstration and trainings	V
Assured water and critical inputs supply	VIB
Conservation of natural resources	IV
Ownership of pond	I
Community-based fishery	IIC
Government initiatives and role of credit institutions	VII

Note: A, B, C, etc. denote equal ranking of different constraints/strategies

change in the climatic scenario. The specific climate variables, viz. enhanced water temperature, extreme events like flood and drought, storms and water stress are very important to inland fisheries and these require specific adaptation strategies. The findings of the study will help in adopting appropriate policies which, in turn, will make the fishery sector economically more viable in the event of climate change. However, this may be understood in view of India's climate policy for development and equity (Nagaraj, 2010).

The study makes the policy implications to tackle the fast emerging negative impact of climate change on the fishery sector in the area under study:

- Awareness generation about the impact of climate change on the fishery sector.
- Identification of most vulnerable zones and the affected people.
- Arrangements for training & demonstration.
- Setting-up of Regional Weather Stations.
- Developing information and communication system (ICT) to provide appropriate weather prediction
- Encouraging community-based fishery and diversification of investment/crop plan.
- Investment in regional based research to find out exact impact of climate change and viable remedies thereof.

- Identify alternative livelihood opportunities for the affected people.
- Need-based policies, including credit, insurance, etc.
- Campaign to follow conservation agriculture and natural resources management.

Finally, it is suggested that assessments of vulnerability of inland fishery to climate change may also require assessment of economic scenarios since adaptive capacity is closely linked to the financial capabilities (Kavi Kumar, 2010).

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