Farmers' Awareness and Risk Perception about Climate Change in Coastal Ecosystem of West Bengal

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ABSTRACT

Coastal area of India is more prone to the devastating impact of climate change. The present study was conducted in Sunderban coastal ecosystem of West Bengal which is famous for mangrove forest and aquatic resources but this area is now under the adverse impact of climate change. Total six villages were studied from the two blocks of South 24 Pargana district of West Bengal for the present research study. It was observed that nearly 38 per cent of the respondents had heard about climate change. Most of respondents perceived climate change due to rapid industrialization by human being. People were more aware about the phenomena like increase in temperature, reduction in agricultural and livestock production, increase diseases, increase sea level etc. than the phenomena like frequent cyclone, occurance of cold wave, heavy fog and precipitation. The mean score on the awareness about perceived consequences due to climate change was very high on item – 'reduction in agricultural production' followed by 'there will be a large scale migration or exodus of people and animals from Sunderban'. Increase in diseases due to climate change was the major perceived risk by the respondents in agriculture, animal husbandry, fishery and human health sector. Major risks related to forestry and biodiversity included decrease in forest area and reduction in certain plant, animal and bird species. Increase in poverty was the major perceived risk under socioeconomic and cultural life by the respondents.

Key Words: *Climate change; Industrialization;   Livestock production; Diseases; Sea level; Poverty;*

*T*oday, Climate change has been recognized globally as the most pressing critical issue affecting the mankind survival in the 21st century. While the policy makers, academicians and activists are engaged in mounting debate about North-South divide over sharing the major responsibility for factors leading to climate change, scientists have given a clarion call for adoption of local action of corrective measures at once to save the planet from catastrophe. The most obvious manifestation of climate change is the rising of average worldwide temperature, popularly termed as global warming. The average annual temperature of the Earth's surface has risen over the last century. Not only is the temperature rising, but the rate of warming itself is increasing too. The mean global annual temperature increased between 0.4 to 0.7 oC (*Singh, 2008*). In ecological terms, this is a very rapid change. Most of the countries are facing the problems of rising temperature, melting of glaciers, rising of sea-level leading to inundation of the coastal areas, changes in precipitation patterns leading to increased risk of recurrent droughts and devastating floods, threats to biodiversity, an expansion of plant diseases and a number of potential challenges for public health. Adverse impact on agriculture due to climatic changes will have telling effect on national economy and livelihood.

Several global studies have indicated that India is particularly vulnerable to climate change, and is likely to suffer with damage to agriculture, food and water security, human health and cattle populations. Like most other developing countries, people in India are dependent to a large extent on its natural resources for livelihood and economy. Any adverse impacts on these natural resources will have repercussion on the nation's livelihood security and economy and widen the gap between the rich and the poor. Though research

initiatives are afoot in physical and biological sciences, it is imperative to assess the climatic change from socio-economic perspective to prepare a roadmap for capacity building of people for effective adaptation and mitigation of adverse effects for sustainable livelihood and development. The present study dealt with awareness level of people in relation to climate change and its consequences. The study also revealed the different risk perceived by the people due to changes in climate.

METHODOLOGY

The study was conducted in the coastal ecosystems of West Bengal as fourth assessment report of IPCC mentioned that coastal belts are more prone to devastating impact of climate change (*IPCC,2007*) and Short term data analysis show that Indian Sunderban which is famous for mangrove forest in India may loose 15 % of land area by 2020 due to sea level rise (*Roy, 2007*). The study utilized descriptive survey research design. One district representative of coastal ecosystems was purposively selected for the study. From the selected district, two blocks and from each block three villages were selected purposively considering the potential impact of climate change in the area. Thus, total six villages were studied for the present research study. Sample of respondents were drawn randomly from selected six villages. The villages selected for present

study are given below. Twenty respondents were selected randomly from each village whose livelihood depends on agriculture and allied activities. In all, 120 farmers were interviewed from six villages of two purposively selected blocks seeing the potential impact of climate change.

Risk perception was studied to identify the risks with open ended questions based interview schedule. The list of identified risks was administered for ranking and reasoning by the respondents. Awareness of the respondents was measured with their responses on three point continuum of fully aware, somewhat aware and not aware at all with corresponding weightage of three, two and one respectively to a set of statements related to conceptual and implication domains of climate change. Also the modified 'bad consequence' scale of *O'Conor et. al (1999)* was used to assess the level of awareness about consequences of climate change. The respondents were personally interviewed by the researcher with the help of a well structured interview schedule. Data were analyzed using appropriate statistical technique.

RESULTS AND DISCUSSION

Awareness about climate change: The level of awareness was operationalized as the degree to which the farmers had information related to climate change and potential consequences. The adaptation level of

Table 1. Distribution of respondents according to their awareness about phenomena related to climate change (N=120)

S. No.	Phenomenon related to climate chnage	Fully aware		Somewhat aware		Not aware at all,		MS
		N	%	N	%	N	%	
1.	Increase in sea level and reduction in fresh water availability	52	43.3	16	13.3	52	43.3	2.00
2.	Increase in the number of cyclone per year	8	06.7	12	10.0	100	83.3	1.23
3.	Rise in both day and night temperature	84	70.0	32	26.7	4	03.3	2.67
4.	Less agricultural production	100	83.3	8	06.7	12	10.0	2.73
5.	Increase in pest attack and incidence of diseases	80	66.7	8	06.7	32	26.7	2.40
6.	Phenomenon of increased drought and flood	64	53.3	16	13..0	40	33.3	2.20
7.	Reduction of area under mangrove forest	40	33.3	20	16.7	60	50.0	1.83
8.	Reduction in number of species of forest tree, animal and fish	48	40.0	36	30.0	36	30.0	2.10
9.	Increased variability in rainfall	52	43.3	44	36.7	24	20.0	2.23
10.	Change in the pattern of cold wave, heavy fog and precipitation	40	33.3	60	50.0	20	16.7	2.16

MS=Mean Score

people to the adverse impact of climate change depends upon their awareness level. But Dietz, Dan and Shwom in a study on 'Support for Climate Change Policy' reported that very few people i.e. only 9 per cent had lot of knowledge about climate change (*Dietz, Dan and Shwom, 2007*). So, this low level of awareness retarded the adaptation potential of the community and make them more vulnerable towards climate change. In the present study, it was observed that nearly 38 per cent of the respondents had heard about climate change. Above two-third of them attributed the climate change to industrialisation, while about three-fifth of them said that major factors for climate change were increase in deforestation, heavy

use of transportation and use of oil- based motor boat for fishing and communication in the area. Use of chemical fertilizers in crop cultivation and changing land use pattern were identified as factors for climate change

by about 48 and 29 per cent of respondents, respectively. Interestingly 29 per cent of them believed that it was due to the will of the God and one-fifth of them believed that launch of aircraft led to the disturbance in earth movements, which further led to climate change. The findings revealed respondents' realisation that human activities disturbed the ecological balance and consequently, there was climate change. Such understanding provides opportunity to organise dialogue for action towards ecological redressal and willingness for benign action to minimise and mitigate the bad consequences of climate change.

Investigation revealed that equal percentages of the respondents (43.3%) were fully aware and not aware at all about rise in sea level and reduction in the availability of fresh water (Table 1). As high as 83 per cent of them were not at all aware of imminence of occurrence of frequent cyclone due to climate change.

Table 2. Distribution of respondents according to perceived consequences of climate change (N=120)

S. No.	Statement	VL		SL		UD		SU		VU		Mean
		N	%	N	%	N	%	N	%	N	%	
1.	There will be increase in frequency of storm	16	13.3	44	36.7	8	06.7	28	23.3	24	20.0	3.1
2.	There will be increase in frequency of flood	64	53.3	48	40.0	8	06.7	0		0		4.5
3.	There will be heavy inundation of cultivable land	80	66.7	32	26.7	0		8	6.7	0		4.5
4.	There will be heavy reduction in agricultural production	88	73.3	32	26.7	0		0		0		4.7
5.	There will be large scale submergence of forest land	56	46.7	60	50.0	0		0		4	3.3	4.4
6.	There will be reduction in number of fish species	32	26.7	52	43.3	0		32	26.7	4	3.3	3.6
7.	Many people's livelihood will be affected	60	50.0	60	50.0	0		0		0		4.5
8.	My livelihood will be affected	72	60.0	48	40.0	0		0		0		4.6
9.	Standard of living will decrease	16	13.3	80	66.7	24	20.0	0		0		3.9
10.	Starvation and food shortage will occur in many part of the world	0		28	23.3	28	23.3	60	50.0	4	3.3	2.7
11.	Starvation and food shortage will occur in my area	28	23.3	92	76.7	0		0		0		4.2
12.	There will be increase in number of vector and rate of serious diseases	48	40.0	72	60.0	0		0		0		4.4
13.	My chance of suffering from serious disease will increase	40	33.3	80	66.7	0		0		0		4.3
14.	There will be catastrophic impact on biodiversity and coastal ecosystem of Sunderban	56	46.7	64	53.3	0		0		0		4.5
15.	There will be a large scale migration or exodus of people and animals from Sunderban	68	56.7	52	43.3	0		0		0		4.6
16	Increase of sea water will lower the availability of fresh water for drinking	76	63.3	28	23.2	8	06.7	8	6.7	0		4.4

VL: Very Likely; *SL:* Somewhat Likely; *U*: Undecided; *SU:* Somewhat Unlikely; and *VU:* Very Unlikely

However, a large majority was aware of rise in temperature. They have experienced the heat with rise in temperature over past years. Mean scores above 2 revealed their awareness of other phenomena like increase in disease, decrease in crop production and occurrence of variability in rainfall due to climate change. However, with regard to reduction of area under mangrove forest, there was equal percentage of respondents (50 %) in category of aware and not aware. What emanates from the study is that the respondents at large are not well aware of the phenomena related to climate change. Therefore, to push forward environmental conservation and adaptation measures it is imperative to promote awareness about climate change and its causes and effects.

Awareness on perceived consequences of climate change: When the respondents were asked how they felt about the likelihood of occurrences of bad consequences of climate change, majority expressed their perceived consequences as very to somewhat likely as evident by the obtained mean score of above 4 in almost all the cases (Table 2). That the starvation and food shortage would occur in many part of the world and reduction in number of fish species had mean scores below 3, which signified their perceived occurrence as somewhat unlikely. Increase in frequency of storm and too had lower likelihood of occurrence. The findings revealed that there are inherent perceived risks and apprehensions among the respondents about the consequences of climate change. It necessitates devising

Table 3. Distribution of respondents according to perceived risks (N=120)

S. No.	Risk	N	Explanation
A.	*Agriculture*		
1.	Increase in crop diseases	84 (70.0)	There was increased phenomenon of certain type of disease, like- blast in seedbed of paddy, yellowing of leaves, angari disease in betel vine, curling of leaves and rotting of seedlings etc. of different crops.
2.	Reduction in agricultural production	56 *(46.7)*	Reduction in yield of different Rabi crops due to high temperature and also Kharif paddy due to less rainfall.
3.	Increase in insect and pest attack	24 (20.0)	Increase in the attack of different types of jassids and micro-incidences organisms.
4.	Decrease in area under paddy cultivation	28 (23.3)	Paddy cultivation has been decreased due to less rainfall in recent time period.
5.	Decrease in area under vegetable cultivation	20 (16.7)	Cultivation of some vegetables like tomato, potato has been decreased due to high temperature in winter season whereas these crops require low temperature.
6.	Increase in incidence of salinity	48 (40.0)	Due to rising sea level and increase in temperature, the problem of salinity is increasing to a significant extent. Increase in temperature leads to increase in evaporation of water leaving dissolved salts at the surface soil, which in turn leads to increased problem of salinity.
7.	Decrease soil fertility	20 (16.7)	Soil fertility decreases due to increased sea level and excessive use of chemical fertilizer.
8.	Increase in cost of cultivation	32 (26.7)	Due to increased pest and insect attack and also due to increased diseases costs of insecticide and fertilizer have also increased to a significant level.
9.	Decrease in quality of water	24 (20.0)	Due to over exploitation of fresh water, saline water contaminates aquifer resulting brackish water table.
10.	Hardening of seed bed	12 (10.0)	Due to increase in temperature and low rainfall seed bed becomes hard lowering the growth of seedlings.
B.	*Risk related to Animal Husbandry*		
11.	Increase in disease	88 (73.3)	Different types of diseases of hen, duck, animals etc. like- white faeces, spot in the body, sterility etc. has increased.

S. No.	Risk	N	Explanation
12.	Decrease in milk production	56 (46.7)	Production of milk has also reduced mainly due to increased temperature and different type of diseases.
13.	Increased mortality	52 (43.3)	Rate of death has also increased due to different type of diseases. Fish cultivation
14.	Increase in disease	48(40.0)	Different of diseases, like- rotting, widening of head, narrow tail and decrease in growth rate has increased in a significant amount.
15	Increase in mortality	40(33.3)	Rate of death has also increased due to increase in the amount of diseases.
C.	*Risk related to Fish cultivation*		
16.	Reduction in certain fish species	28 (23.3)	Different saline water fish species has reduced.
17.	Reduction of sweet water fish	32 (26.7)	The amount of silver cup, Lebeo rohita, lota fish (local name), sona fish (local name), farsha fish (local fish), elish (local name), small shrimp etc. has reduced to a great extent.
18.	Decrease in growth rate	28 (23.3)	Growth rate of fish declined mainly due increased saline level.
19.	Increase in cost of fish cultivation	44 (36.7)	Now farmers have to move towards deep sea to catch fish which increase fish cultivation the both risk and cost of fish cultivation.
D.	*Risk related to Forestry*		
20.	Decrease in certain species	64 (53.3)	The amount of mangrove forest trees like Sundari, Garan, Hogla, Golpata etc. has declined mainly due to deforestation by human being and some forest area has already undergone the sea.
21.	Decrease in forest area	72 (60.0)	Area under mangrove forest has also declined due to deforestation.
22.	Delay in flowering	24 (20.0)	Season of flowering of certain tree species has been delayed
E.	*Risk related to Biodiversity*		
23.	Reduction in certain plant, animal and bird species	48 (40.0)	Different type local animal species like tiger, monkey etc. has reduced in number. The amount of bird species like pigeon, parrot, forest hen etc and mangrove tree species like sundari, garan, hogla and golpata etc. has also reduced in a significant number.
24.	Extinction of certain plant, animal and bird species	36 (30.0)	Certain local animal and bird species has been totally vanished from that area.
F.	*Risk related to Human health*		
25.	Increase in disease	60 (50.0)	The occurrence of fever, stroke, bone pain, pox etc. has been increased.
26.	Increase in mortality	40 (33.3)	The rate of death has also increased to a significant level due to different types of climate change induced diseases.
G.	*Risk related to Socio-eco. and cultural life*		
27.	Increased poverty	44 (36.7)	Most of the people depend on agriculture and fishery for their livelihood but production of crops as well as income had reduced due to negative impact of climate change which led to increase in poverty.
28.	Widen the gap between rich and poor	36 (30.0)	Climate change could widen the gap between rich and poor as others sector like- service, businesses was less affected compare to agriculture on which most of the poor people depend.
29.	Decrease in income	24 (20.0)	Income of the farmers has reduced due to low production and increase in cost of cultivation
30.	Increase in migration of people	32 (26.7)	Peoples are migrating towards Kolkata, Baligang and Delhi etc. for job.
31.	Increase belief in God of nature	32 (26.7)	People believed more in the God of nature, like Ganga, Shiva and Ficus tree etc. for safety against evil ad bad consequences.

proactive strategy for capacity building of people for their pragmatic view to climate change and better preparedness towards adaptation and mitigation of adverse impacts.

Risk perception: In this study risk perception was conceptualized as the perceived likelihood of dangers or negative consequences related with climate change. Analysing risk perception of farmers was valuable for understanding their behaviour. It also helped in determining how they would recover. For that reason, *Nhemachena and Hassan (2007)* tried to assess farmer's perception to climate change. In another study on perception of climate change it has been found that a significant number of farmers believed that temperature had already increased and precipitation had declined for eleven African countries (*Maddison, 2006*). The findings also revealed that farmers with the greatest farming experience were more likely to notice changes in climatic conditions. The study also reported that farmer experience, access to free extension service and markets were important determinants of adaptation. The insight gained and recording of intended behaviour of the farmers in the event of bad consequences due to climate change would be highly useful in devising a strategy for preparedness and adaptation measures to constant the unfavourable consequences of climate change. Using semi-structured schedule and open-end questions, the perceived risks were identified in important livelihood areas like agriculture, animal husbandry, fishery, forestry, biodiversity, human health and socio-economic and cultural domains. The perceived risks as well as the changes observed by them in the ecosystem of their area along with reasoning are furnished in (Table 3). Increased incidences of pests (Blast in seedbed of paddy, yellowing of leaves, angari disease in betel vine, curling of leaves and rooting of seedlings etc. of different crops were reported in the area), reduction in acreage of some crops (Cultivation of some vegetables like tomato, potato has been decreased due to high temperature in winter season as these crops require low temperature), reduction in yield, increased cost of cultivation etc. were important perceived risks in agriculture. Similarly in case of animal husbandry increase in disease incidences and mortality are the

important perceived risks. Different types of diseases of hen, duck, animals etc. like- white faeces, spot in the body, sterility etc. have increased in the area as noted by the respondents. Increased incidence of diseases is also an important perceived risk in case of fishery. Different of diseases, like– rotting, widening of head, narrow tail and decrease in growth rate of fish have been observed to be increased in the area. Decrease and loss of flora and fauna were notified as risks related to biodiversity as they play important role in their livelihood. Poverty and migration were identified as important risks under socio-economic and cultural domain.

CONCLUSION

The present study disproved the hypothesis that climate change is merely a hoax as most of the sample population has experienced some changes in relation to different climatic phenomenon over the last few years. The study showed mixed type of result about awareness level of people in relation to climate change. Though some people were fully aware of climate change but majority of them lacked in detail information about climate change. So, to solve the problem of climate change at first we have to create awareness among the people by using mass media followed by individual contact method through trained extension agents. The findings revealed respondents' realisation that human activities disturbed the ecological balance and consequently, there was climate change. Such understanding provided an opportunity to take proper action towards ecological redressal and willingness for benign action to minimize and mitigate the bad consequences of climate change. Awareness of consequences due to climate change was more on the items which affect their livelihood directly like reduction in agricultural production as most of people were engaged in farming for livelihood. So, agriculture is one of the most vulnerable sections due to climate change and there is an immediate need for proper adaptation strategy. Major risk due to climate change included increase in diseases in crops, fishery, animal husbandry and health sector. These all expressed the altitude and longitude of the risks posed by climate change. Increase in migration of people, increase in poverty and increase

in gap between rich and poor were some socio-cultural risks caused by climate change signifying its extent far beyond the biological and physical risk. So, today climate change is a real phenomenon and it is affecting the people of coastal ecosystem in different ways. To get rid of that we need appropriate adaptation and mitigation strategy both at state level and community level by involving the local people.

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