Indian Journal of Traditional Knowledge
Vol 21(1), January 2022, pp 198-207

Development of a regional climate change perception index based on traditional knowledge base of small-marginal farmers

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Received 20 November 2019; revised 24 June 2021

Due to global climatic change, the pronounced impact of temperature and precipitation variability on agriculture has lately alarmed the top-up organizations to enable effective adaptation and mitigation strategies for small-marginal farmers. In contrast, despite being the main stakeholders of this sector, these farmers have always been neglected in the decision-making process while planning for adaptation strategies to combat climate change impacts in agriculture. Practicing farmers have a wide array of knowledge, both current and traditional, related to climate change impacts. This underutilized form of the knowledge base in the form of observable environmental changes that they deal with while producing food on their farms is a valuable resource for agricultural development. Their involvement in the decision-making process would be crucial to better understand the adaptation strategies at a local scale. With this in mind, we proposed a regional index for measuring the level of perception of farmers on climate change. The proposed index is based on 21 closed-ended statements, which have been exhaustively selected from a set of 62 statements through judges' rating methodology. The final set of statements has been checked for validity and reliability measures. These statements then have been put to pilot testing in a non-sampled area comprising of small farmers (n= 40). Finally, the set of 21 statements was applied in the study area (three selected districts in West Bengal) to estimate the perception score. The results indicate very high reliability among the statements of the proposed climate change perception index of the farmers.

Keywords: Adoption, Agriculture, Climate education, Farmer's education, Local knowledge, New technologies

IPC Code: Int. Cl.[22]: E04H 9/16, F16K 27/12, G01W 1/06, G04G 17/08

In India, agriculture is a vital economic sector, and increasing agricultural production is one of the main priorities for the country's overall development[1].This sector is susceptible to climate change and is believed to be impacted adversely because of several reasons: productivity losses due to plant's tolerance to abiotic stresses, shortage of available water, soil fertility loss and increased insect pest infestation[2]. Occurrences of drought, lower precipitation, and higher temperatures are the deadliest and costliest natural disasters. There are some aspects of climate change that may bring localized benefits; however, for the most part, there will be many adverse impacts resulting in reducing farmers' income[3].

Despite these variations in rainfall predictions, climate change is widely regarded as a challenge to agricultural development. The socio-economic conditions of the farmers in India are susceptible to climate change impacts. Therefore, adaptive processes to the effects of climate change, smart climate agriculture, and resilient climate agriculture have become buzzwords and are the priority for India and crucial to building resilience into the lives of the farmers. Hence, farmer's education needs to focus on understanding climate change impacts and the scope of adaptation strategies.

The importance of a traditional knowledge base among communities has its own set of advantages. The community members have the collective knowledge of nature and are arguably the sincerest observers and transcribers of the changing environment. Their perceptions provide invaluable insights that complement scientific data chronologically. For example, in Eastern Uganda,

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local observations on the intensity of East-West blowing winds, the color of the clouds in a particular direction and plant traits predict rainfall[4]. Not only that, but this type of data also provides landscape-specific precision, which is very important, especially when physical climate models developed by scientists on a broader spatial and temporal scale need to be verified and evaluated. Moreover, such perceptions help build a solid foundation for community-based adaptation and sustainable mitigation actions.

Farmer's perception on climate change issues has been historically ignored at the decision-making level; however, their perception is valuable in understanding adaptation and mitigation strategies that are designed by the top-down system of decision making. Furthermore, with advances in our knowledge base about climate change in recent times, there is still a lot of uncertainty on specific local outcomes of changing climate amongst and between the local communities. This motivates researchers and practitioners to investigate local perceptions of climate change from the people who are directly affected.

Many studies suggest that the ways local people comprehend climate provide a basis for adaptation measures at a local level[5]. However, most of these studies have been conducted in parts of Africa. We found a study that focused on climate change perceptions of local people in Western Himalayas, which examines the climate change perception of apple farmers in the Himalayan region by comparing traditional weather cycle with farmers perception on changes in weather, apple production practices, and other observable environmental changes. Our paper aims to respond to the need for detailed exploration at the local level, the perception level of the local farmers on climate change so that climate change awareness and concepts related to its impact on agriculture can be disseminated through extension services. The study's main objective is to develop a regional index-based measurement that estimates farmers' level of perception of climate change to facilitate climate change education, the inception of adaptation, and mitigation strategies.

Materials and Methods

Research area

We conducted our research in the state of West Bengal located in the Eastern part of India. This region has diverse agricultural systems and practices serving as one of the major agricultural states in India. Specifically, we selected *Pashim Borochaki and purbo borochaki* of *Chaporer Par–II*-gram *panchayat* of Alipurduar district, *Rapatgange and patjhor* of *Hamirhati gram panchayats* of Sonamukhi block of Bankura district and *Jatirampur and Rangabelia* of *Rangabelia gram panchayat* of Gosabai block of South 24 Pargana district. These districts have been categorized into three regions Terai (Alipurduar), Red and laterite (Bankura) and Coastal (South 24-Parganas based on their geography and vegetation. These regions lie in the Gangetic West Bengal, which is basically an agricultural hot spot in the state. In recent years, this region has experienced severe impacts of climate change and has less familiarity with coping mechanisms with droughts, and floods which makes them even more vulnerable with poor preparedness.

Research methodology

Data

The data is collected to understand the attitude of farmers towards climate change through their responses to a set of validated closed-ended questions. These responses are further used to estimate the level of perception of the farmers in an index-based measurement, which could be used as a measurement tool to explore the understanding of climate change among the farming community. The data is collected using purposive simple random sampling methodology. A pilot survey has been done with n=40 farmers to understand the functionality of the CCP scale. A survey questionnaire with 21 statements is administered for the target group of respondents having at least 20-years of farming experience, and their age was above 35 years. Fifty farmers from each village were selected randomly. Thus, 150 farmers were selected as a sample and an individual interview method has been adopted. The index is developed using the data from one district (Terai; n=50) and is validated with the dataset from the other two regions (Red laterite & Coastal; n=100). A five-point Likert scale is used to record data during personal interviews.

Climate Change Perception (CCP) Index Development Process

Development of CCP questionnaire: Relevant literature on climate change perceptions, environmental changes due to climate change and impacts of climate change were studied. Key informant interviews during ice-breaking survey were carefully examined. An exhaustive list of climate change perception statements

was developed. These statements were categorized into three categories, viz., Agricultural and environmental, Social, economic and policy, and personal belief-related perceptions.

Relevancy test: All the seventy statements then were grouped under five categories. The judges were experts in the field of meteorology, researchers, scientists and faculty members of BCKV and UBKV. The statements were sent for critical evaluation with proper instructions to the judges (n=80). The judges evaluated these statements in order to assess its relevance to measure the perception of farmers on climate change. They were requested to provide their responses on a five-point scale (highly relevant-5, relevant-4, neutral-3, irrelevant-2 and highly irrelevant-1). The response rate was 50% and 40 judges responded within 2.5 months. The relevancy score of each item was found out by adding the scores on the rating scale for all responses. The data so obtained were worked out for relevancy percentage, relevance weights and mean relevancy scores for all statements. Relevancy percentage was estimated by summing up the judge's score, which were then converted into a percentage. Relevance weights (RW) was obtained by the formula:

$$\mathrm{RW} = \frac{\mathrm{HRR} + \mathrm{RR} + \mathrm{NR} + \mathrm{IR} + \mathrm{HIR}}{\mathrm{MPS}}$$

where, RW = Relevance weightage, HRR = Highly relevant response, RR = Relevant response, NR = Neutral response, IR = Irrelevant response, HIR = Highly irrelevant response, MPS = Maximum possible score.

$$\mathrm{RP} = \frac{\mathrm{HRR} + \mathrm{RR} + \mathrm{NR}}{\mathrm{MS}}$$

where, RP = Relevancy percentage, HRR = Highly relevant response RR = Relevant response, NR = Neutral response, MS = Maximum score

Mean relevancy score (MRS) was obtained by the following formula.

$$\mathrm{MRS} = \frac{\mathrm{HRR} + \mathrm{RR} + \mathrm{NR} + \mathrm{IR} + \mathrm{HIR}}{\mathrm{NOJ}}$$

where, MRS = Mean relevancy score, HRR = Highly relevant response, RR = Relevant response, NR = Neutral response, IR = Irrelevant response, HIR = Highly irrelevant response, NOJ = Number of Judges.

Statements having relevancy percentage > 70, relevancy weight age > 0.70 and mean relevancy score > 3.5 were finally selected (Table 1). By this process, 21 statements were isolated in the first stage, which were suitably modified and rewritten as per judge's feedback. It was essential to delineate the items based on the extent to which they can differentiate the respondent with high perception from the respondent with low perception on climate change. For this purpose, item analysis was carried out on the statements selected in the first stage. A questionnaire consisting of 21 statements was prepared and used for personal interviews for farmers (n = 40) from non-sampled area. The responses were obtained on a five-point Likert scale (strongly agree-5, agree-4, undecided-3, disagree-2 and strongly disagree-1). The perception scores of the respondents were obtained by summing up the scores of all statements.

Personal Interviews: The items in the CCP index have been first pre-tested with *n*=40 during pilot testing. The results from the pilot test showed high reliability value. Then the original CCP index has been developed using the data from Bankura district, where we found the index to have high reliability value as well.

Generalizability: Then the CCP index was applied to two other regions for further testing and generalizability with different sets of data, where we have found the index to have high reliability values as well. For any index to be generalizable, there are four very important criteria among others to be fulfilled. In this regard, the CCP index has the following properties: 1. Validity: It is measured using judges rating (content and face validity) and pilot testing (construct validity), 2. Reliability: It is measured using Cronbach alpha and 3. Predictability: It is measured by the coefficient of determination. (R squared, adjusted R square)[1]. Figure 1 summarizes the CCP index development process in the study.

Results and Discussion

Climate change perception statement categories

Agricultural & Environmental related (Table 2): These statements are impacts of climate change on agriculture and the environment collected from different scientific literatures. The impacts of climate change are well observable in the environment with significant variations in the pattern of climate events like floods, droughts etc. The variable land use has exacerbated the situation. While measuring the climate change perception of the farmers, environmental and

Table 1 — Selection Criteria based on mean relevancy score

S. No	Mean Relevancy Score	Implications
1.	> 3.50	Relevant
2.	<3.50	Not relevant

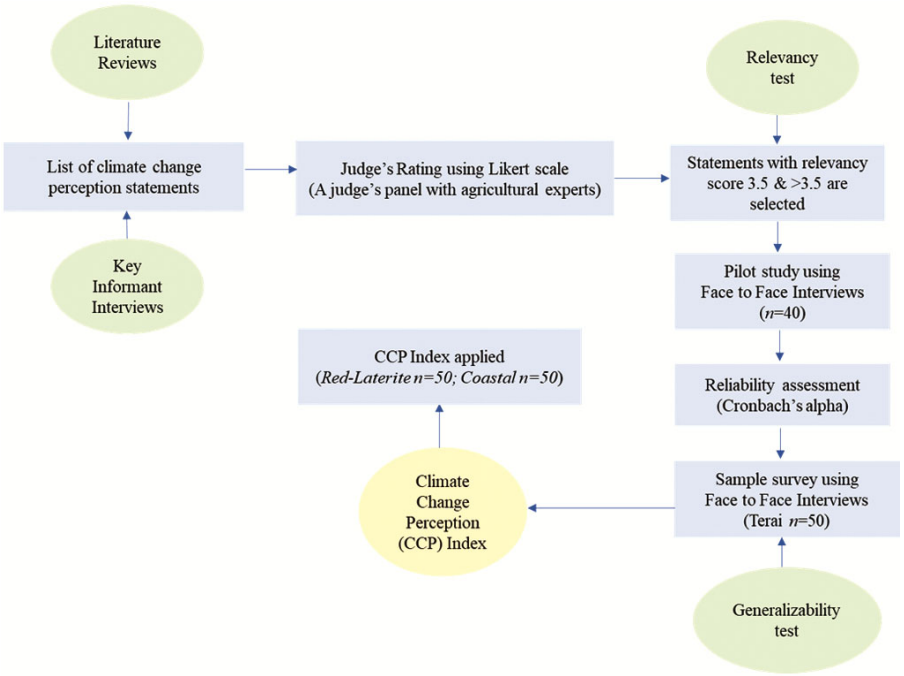

Fig. 1 — A Schematic diagram of the Index development process

Table 2 — Summary of Agricultural and environmental-related perception of farmers for Judge's rating

S. No.	Agricultural & Environmental perception statement	References (Reference list)
1.	There is a major impact of climate change in arid ecosystem of India due to global warming	Kumar & Gautam, 2014[7]
2.	Increase in sea water level	Sherif & Singh, 1999[8]
3.	Observations on change in length of season (e.g., short winter and long summer etc.).	Ruosteenoja *et al.,* 2011[9]
4.	Phenomena of irregular and erratic rainfall	Sarkar & Padaria, 2016[10]
5.	Changes in intensity and frequency of storm, cyclone etc.	Knutson *et al*., 2010[11]
6.	Floods in this country are due to climate change	Mirza, 2011[12]
7.	The number of rainfall days changed	Gong *et al*., 2004[13]
9.	Zero tillage, mulching, SRI is good for climate resilient agriculture	Sarkar & Padaria, 2016[10]
10.	Maturity period of major crops is reducing due to climate change	Taneja *et al*., 2019[14]
11.	Cultivation of paddy leads to emission of gasses responsible for global warming	Pathak *et al*., 2005[15]
12.	Climate change is affects farming in a negative way	Aydogdu & Yen, 2016[16]
13.	Climate change affected incidence of pests and diseases	Rosenzweig *et al*., 2001[17]
14.	Climate change impacted food production of my farm	Cannon, 1998[18]
15.	Rainfall fluctuation also affects crop production	Prasanna, 2014[19]
16.	Lower availability of fresh water for drinking due to increase in sea water	Hoque *et al.,* 2016[20]
17.	There will be decline in number of fish species	Jackson & Mandrak, 2002[21]
18.	Increase in sea level and reduction in freshwater availability	Kundzewicz *et al.,* 2008[22]
19.	Brown spot and blast of rice increase due to climate change	Luck *et al*., 2011[23]
20.	Increasing temperature is responsible for the early maturity of crops	Wur & Fellows, 2000[24]
21.	Climate changes reduce soil fertility status	Clair & Lynch, 2010[25]
22.	Temperatures can affect predator search	Logan *et al.,* 2006[26]
23.	Higher temperature brings changes in the pest population in rice field	Broitman *et al.,* 2009[27]
24.	Mosquitos are present all-round year due to climate change	Ramasamy & Surendran, 2012[28]
25.	New weed species have seen due to climate change	Ward & Masters, 2007[29]
26.	There are noticeable changes in flowering and fruiting time due to climate change	Sherry *et al*., 2007[30]
27.	There is more weed infestation due to climate change (leads to competition with crops for space, nutrients)	Shankara *et al*., 2013[31]
28.	There is soil nutrient loss due to climate change	Tubiello *et al*., 2007[32]
29.	Climate change have effect on rice production	Saseendran *et al*., 2000[33]
30.	Decrease in water resources day by day due to climate change	Middelkoop *et al*., 2001[34]
31.	There is a major impact of climate change in arid ecosystem of India due to global warming	Sarkar & Padaria, 2016[10]

agricultural impacts of climate change are critical to proper perception measurement. In real-life situations, the practicing small-marginal farmers are aware of many environmental phenomena already, however, they might not be rightly channelizing that knowledge for crop improvement. Through key informants, it was clear that many small-marginal farmers in the community observed (1) changes in the flowering and fruiting habits of their crop, (2) new weeds popping up in their fields, (3) changes in the pest population in rice field etc. Moreover, they are relating it to rise in temperature over years and changes in their crop production.

Personal beliefs related (Table 3): These statements were recorded from the informal interviews of key informants in the community. Understanding personal belief system in the community is crucial for obtaining perception from the households regarding any topic. Existing personal knowledge might prove a very valuable asset in case of adoption of new technologies and if not assessed properly, this might also be a potential barrier. In our case, while assessing the climate change perception of the farmers, the existing knowledge base of the farmers on the phenomenon of climate change may act as both a driver as well as a barrier. While talking to the key informants, it was found that majority farming households claim that they are aware of the terminology 'climate change', however, they do not have clear idea about its impacts. Some of them also claim that climate change has religious significance etc. These existing beliefs are potential barriers especially when any kind of public adaptation and mitigation policies are introduced from top-down approaches. However, personal beliefs like farmer's observation on new pest and disease infestation on his field and relating it to climate change are few examples of drivers that may influence adaptation policies in the community.

Social, economic & policy related (Table 4): These statements are related to climate change perceptions

Table 3 — Summary of personal belief-related perception statements of farmers for Judge's rating

S. No.	Personal belief system	References
1.	I am informed that practices like burning of crop residues in field is also contributing toward climate change	Key Informants
2.	I have knowledge about climate change	Key Informants
3.	There is an effect of CO_2 on climate change	Key Informants
4.	I think climate change is something that is affecting or is going to affect me, personally	Key Informants
5.	Climate change has a great impact on me	Key Informants
6.	Can you think of anything can be done to tackle climate change?	Key Informants
7.	I believe that there is still plenty of time to prepare for climate change	Key Informants
8.	I believe there is religious significance to climate change	Key Informants
9.	I believe that climate change will bring an understanding of God's plan	Key Informants
10.	Noticed any long-term changes in the mean rainfall over the past 15 years	Key Informants
11.	Noticed any long-term changes in the mean temperature over the past 15 years	Key Informants
12.	Climate change is the anger of God for the avarice and ill ways of humans towards nature	Key Informants
13.	New disease observed on my field due to climate change	Key Informants
14.	New insect observed on my field due to climate change	Key Informants
15.	There are evidence of changes in crop production over the past 15 years	Key Informants
16.	Climate change is affecting my farming practice	Key Informants
17.	I am worried about the indiscriminate destruction of indigenous plants and animals	Key Informants

Table 4 — Summary of social, economic, and policy-related perception statements of farmers for Judge's rating

S. No.	Social, economic & policy	References (Reference list)
1.	Climate change is unavoidable because of the way modern society functions	Stehr & Storch, 1995[35]
2.	Developed countries should take most of the blame for climate change	Neumayer, 2018[36]
3.	Governments should provide incentives for people to look after the environment	Warner *et al*., 2010[37]
4.	There is need for the government to allocate additional funds for managing climate change.	Musah-Surugu *et al*., 2018[38]
5.	Climate change is a consequence of modern lifestyle	Stehr & Storch, 1995[39]
6.	Climate change is nothing but just a natural fluctuation in earth's temperatures	Key informants
7.	Do you take climate change into account when thinking about your future?	Developed in the study
8.	Scientists can solve the problems of climate change	Morton, 2007[40]
9.	Farmers have much bigger challenges to deal with the climate changes.	Tirado *et al*., 2010[41]
10.	It is the Government's responsibility to maintain and preserve the ecological balance in the Sundarbans	Hoq, 2007[42]
11.	Fisher folks in Sundarbans should deploy sustainable practices for better environment	Hoq, 2007[42]
12.	Cost of cultivation has increased due to changes in the climate	Blignaut *et al*., 2009[43]
13.	Income from agriculture is adversely affected due to climate change	Aggarwal, 2008[44]
14.	There is decrease in the crop yield due to climate change	Alexandrov & Hoogenboom, 2000[45]
15.	Climate change affects small and marginal farmers more	Mendelsohn, 2008[46]

of farmers relating to the society, monetary incentives and the government. These perceptions are crucial for a farmers' well-being and ensure social and financial security in the community. Understanding climate change and its consequences as a barrier for their crop productivity might help the policy makers introduce innovative technologies as adaptation and mitigation strategies. For example, if farmers are of the view that yields have decreased, cost of cultivation has increased because of climate change, and that high temperatures are detrimental for food production, it is certainly easier to further discuss with them the causes of such an effect and thus introduce necessary mitigation options. These perception statements also inform about the misconceptions farmers have regarding climate change and related policies, thus, helping decision makers to understand the way they should introduce any developmental change.

Perception statements with high relevancy score

The relevancy test is performed to find out a set of most relevant statements for assessing the climate change perceptions of farmers (Fig. 2). The results from judge's rating show that 21 perception statements out of 62 are relevant for the climate change perception index with a mean relevancy score 3.5 and above. Ten Agricultural and Environmental, five Social, economic and policy and four personal beliefs of the small-marginal farmers statements have a mean relevancy score of 3.5 and above. The most relevant perception statement is a social, economic, & policy-related statement (*S14- Income from agriculture is adversely affected due to climate change*).

S1= Climate change affects small and marginal farmers more; S2 = Change in length of season – short winter and long summer etc.; S3 = Phenomena of irregular and erratic rainfall has increase; S4 = Changes in intensity and frequency of storm, cyclone etc.; S5 = There is an effect of CO_2 on climate change; S6 = Zero tillage, mulching, SRI are good for climate resilient agriculture; S7 = Climate change is affecting farming in a negative way; S8 = Climate change impacted food production of my farm; S9 = Climate change affected incidence of pests and diseases; S10 = I have noticed any long-term changes in the mean rainfall over the past 15 years; S11 = I have noticed any long-term changes in the mean temperature over the past 15 years; S12 = Farmers have much bigger challenges to deal with the climate change; S13 = There is decrease in the crop yield due to climate change; S14 = Income from agriculture is adversely affected due to climate change; S15 = Water resources are decreasing day by day due to climate change; S16 = I am worried about the indiscriminate destruction of indigenous plants and animals; S17 = Fisher folks in Sundarbans should deploy sustainable practices for better environment; S18 = It is the Government's responsibility to maintain and preserve the ecological balance in the Sundarbans; S19 = Increase in sea level and reduction in fresh water availability; S20 = There will be decline in number of fish species; S21= Lower availability of fresh water for drinking due to increase in sea water

1. ***Agricultural & environmental***

The following agricultural and environmental perceptions were relevant: *S19- Increase in sea level and reduction in freshwater availability (4.55), S6- Zero tillage, mulching, SRI are good for climate*

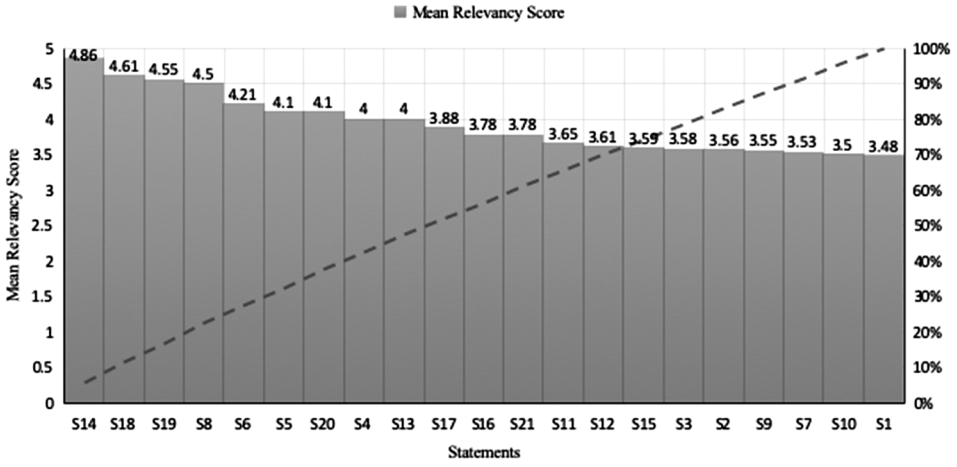

Fig. 2 — Mean relevancy score of statements for CCP Index

resilient agriculture (4.21), *S20- There will be decline in number of fish species (4.1)*, *S4- Changes in intensity and frequency of storm (4.0), S21- Lower availability of fresh water for drinking due to increase in sea water (3.78), S15- Water resources are decreasing day by day due to climate change (3.59), S3- Phenomena of irregular and erratic rainfall has increased, Change in length of season (short winter and long summer), (3.56), Climate change affected incidence of pests and diseases (3.55)*, *Climate change is affecting farming in a negative way (3.53).*

The environment is experiencing different forms of changes due to climate change, which includes variable temperature and precipitation due to climate change impacting the sea level as well as freshwater availability, erratic and irregular rainfall, changes in length of season and changes in intensity of extreme events like storms, and floods. Moreover, water resources are rapidly decreasing and freshwater for drinking has become a scarce resource in many developing and underdeveloped countries. All these have dire impacts on sustainable development of the communities across globe.

In the agricultural sector, besides yield and soil fertility increase, techniques like SRI, zero tillage and mulching would benefit the environment by enhancing soil organic carbon. Anthropogenic warming of the earth due to climate change has resulted in reduction in number of fish species. Irregular rainfall has resulted in crop failures. To add to this situation, climate change has affected the pattern of incidence of pests and diseases affecting agriculture in a negative way.

2. *Social, economic, and policy*

The following social, economic and policy-related perceptions were relevant: *S14- Income from agriculture is adversely affected due to climate change (4.86), S-13- There is decrease in the crop yield due to climate change (4.00), S1- Climate change affects small and marginal farmers more (3.48), S17- Fisher folks in Sundarbans should deploy sustainable practices for better environment (3.88), S-18 It is the responsibility of the Government to maintain and preserve the ecological balance in the Sundarbans (4.61).*

Climate change has social, economic and policy interventions. From the economic point of view, farmer's income from agriculture is a very important aspect that ensures the continuity of this practice. With declining profits, small-marginal farmers tend to opt for other non-agricultural occupations. Next very important consideration for them is the yield of the crop they are farming. Better yields are always a motivating factor for being in this profession. Social and policy-related factors like government's role in implementing sustainable practices for better environment and preserving the ecological balance are crucial for the farmers to understand before they can make decisions on whether or not they would adopt them if offered as public extension facilities.

3. *Personal beliefs*

The following personal beliefs were relevant: *S8- Climate change impacted food production of my farm (4.50), S5- There is an effect of CO_2 on climate change (4.1), S21- I am worried about the indiscriminate destruction of indigenous plants and animals (3.78) and S10- I have noticed long-term changes in the mean rainfall over the past 15 years (3.68).*

Personal beliefs play a very important role in adoption of anything new. Personal beliefs do not always have positive motivations, often they lead to negativity which is harmful for the policy makers especially if they are trying to introduce an innovation in a community. While framing perception statements, we were keen to understand the information given to us by the key informants on general perception of people in the study area on climate change. Among them, the crucial ones according to the experts were, one, the fact that climate is impacting their production, carbon dioxide is the culprit behind climate change, environmental concern about destruction of indigenous plants for farming and observation on changes in rainfall over past 15 years.

The personal belief of small-marginal farmers that production decline has something to do with climate change is a positive motivation in case climate change awareness, adaptation, and mitigation strategies have to be introduced and adopted in the community. Similarly, environmental concerns among farmers also play an important role in maneuvering their attitude towards positive inception of climate change awareness, adaptation, and mitigation strategies.

Reliability assessment of CCP index

Reliability of the CCP Index is done using Cronbach's alpha test. Cronbach's alpha test measures the overall consistency of the CCP Index with 21 statements. The test was performed three times for three regions. Terai, Red laterite and Coastal regions have an

Table 5 — Reliability analysis of the proposed Climate Change Perception index

Test level	Cronbach's Alpha (reliability)	Cronbach's Alpha Based on Standardized Items	No. of items
Pre-test (Terai)	0.70	0.71	21
Posttest (Red laterite)	0.72	0.74	21
Posttest (Costal)	0.80	0.83	21

alpha value of 0.70, 0.72, and 0.80, respectively, showing high degree of reliability (Table 5).

Predictability assessment of CCP index

Simple linear regression was performed with the CCP index values as the dependent variable and 21 statements response as independent variable for n=150. The results (Table 6) show that coefficient of determination values for the Terai, Red laterite and Coastal areas to be 0.80, 0.86, 0.97, respectively, which indicates high degree of predictability.

Climate change perception index

The developed climate change perception index has a set of 21 statements that had more than 70% where the two levels of perception are considered (high=60-105 and low=21-60). In this study level of perception on climate change was measured based on CCP index. Here 150 respondents were interviewed based on 21 statements, there response collected in Likert scale. After that 21 statements value for each farmer response are summed up. Where the maximum value for 21 statements is 105 and minimum value is 21. The farmers having score within 21-60 considered as low perception and farmers having score 60-105 considered as high level of perception on climate change.

$$\text{Climate Change Perception Index} = \frac{\text{Sum of scores of each of 21 statements}}{\text{Number of statements}}$$

From the study it is found that in Terai zone, among 50 farmers, 40 farmers (80%) have high perception (61-105) on climate change and the rest 10 farmers (20%) are with low perception (21-60) on climate change. In Red-lateritic zone, out of 50 farmers, 46 farmers (92%) are with high perception (61-105) and only 4 farmers (8%) have low perception (21-60) about climate change. Again, in case of Coastal and saline zone, among 50 farmers 39 farmers (78%) have high perception (61-105) and 11 farmers (22%) have low perception (21-60) on climate change Majority farmers in these regions have high perception on climate change, which is a driver for the policymakers to introduce climate-resilient agricultural practices and facilitate climate education to ensure sustainable development in agricultural practices.

Table 6 — Predictability Analysis of the proposed Climate Change Perception Index

Test level	R squared	Adjusted R squared
Terai	0.804	0.657
Red laterite	0.865	0.763
Coastal	0.973	0.953

Conclusion

Climate change is greatly affecting agricultural production; therefore, merely understanding the terminology of climate change is not enough. It is important that the farmers are able to relate their current and traditional knowledge base with the everyday changes they observe on their farms. Adoption of any new technologies as a climate change adaptation and mitigation option is more likely if the farmers are not only well-informed but also have full reliance on it. Climate change perception index at a regional scale is a useful tool to understand the level of awareness of small-marginal farmers on the environmental changes resulting from climate change and then facilitate farmer's education on climate change from that very point. It also gives the decision-makers an idea on the level they might want to introduce policies for climate-resilient farming. For example, it would be way easier to introduce climate-friendly agricultural technologies in a high climate change perception community than the low one. Having said that, it is highly likely that the adoption of these technologies would be better in high perception communities, which in long run, would save the government's resources which could be channelized for other developmental activities.

Acknowledgment

This work is a Ph.D. project (2015-2019) at the Department of Agricultural Extension, Bidhan Chandra Krishi Viswavidyalaya funded by the University merit research scholarship scheme from 2015-2019, government of West Bengal. The authors would like to thank the state agricultural university, Bidhan Chandra Krishi Viswavidyalaya for providing funding support for the study. The authors also thank Prof. D Majumdar and Prof. L Das for providing valuable inputs during the study in the area of

Statistics and Meteorology respectively. We also acknowledge the contribution of the community members in the region of the study for responding to our information needs and cooperation during the course of the research.

Conflict of Interest

The authors declare no conflict of interests.

Authors' Contribution

S B contributed to the groundwork for this research, conducted the field surveys, and performed the statistical analysis. **J** K D conceived the idea and contributed to the development of the manuscript. S R contributed to the idea refinement, statistical analysis, and manuscript writing. S C contributed to the data collection and manuscript development.

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