Climate Change Mitigation and Social Sustainability in Agriculture in the Sub Himalaya Region

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Authors' contributions

This work was carried out in collaboration among all authors. Author TKD designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors BM and KP managed the analyses of the study. Author BG managed the literature searches. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

The present study was conducted in sub-Himalaya region of India where in the two districts of the region such as Cooch Behar and Malda districts are selectively selected for the study. Four blocks in the selected districts were randomly selected. In each block, one village was selected for the study. An exhaustive list of agricultural producers in each village was prepared and from this list, eighty agricultural producers were randomly selected. The data were collected with the help of structure interview schedule through personal interview methods. The climate change aberration in socio-cultural milieu was delineated in terms of mitigation strategy of climate change discourses, the impact of climate change on agricultural production and education is considered as predicted variables and other six nos. of attributes of socio-economic and cognitive attributes of the agricultural producer were considered as predictor variables for the study. Data were processed into statistical tools i.e. frequency, percentage, correlation analysis and regression analysis. It was found that education and farm size are positively and significantly associated with the awareness and knowledge on climate change. Results reveal that the variables farming experience and farm size are negatively and significantly contributing towards the impacts of climate change on education. It was seen that farming experience is negatively and significantly contributing towards

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impacts of climate change on agricultural production. The finding reveals that 88.75% of the farmers had modified their cropping pattern including the scientific cultivation practices to adapt the impact of climate change.

1. INTRODUCTION

In the present existing situation, the global warming *vis a vis* the change in climatic attributes is creating hazards in different aspects of social as well as agricultural sustainability. 65 percent of the people in India are purely dependent on agriculture in the remote areas for maintaining their livelihood. In the near future, due to change on global climatic attributes the production of agricultural crops will be drastically changed. Stern [1] demonstrates that the costs of climate change are inequitably born by developing countries as a result of their geographic exposure, low incomes, and greater reliance on climate sensitive sectors such as agriculture. The rural social system constitutes a number of agricultural producers who depends on the whims and fences of weather for producing the crop in the field level. The failure in agricultural production or the decrease in agricultural production may hamper agricultural sustainability as well as the social sustainability as the society is purely dominated by the agricultural producers. A significant focus of climate change (CC) research and policy has been on agriculture [2,3,4]. The social entropy and disorderness may compel the social entity to live with the uncertainties without making up sustainability as one of the components of social empowerment. The Environmental change in terms of the components like climatic attributes namely precipitation, temperature, and wind over the decades is significantly influencing the farming situation. Emissions from straw burning are likely less than those created by leaving residues in paddy fields, but burning also causes air pollution and human health hazards [5,6,7]. Climatic change has also been found to occur due to natural variability or as a result of human activities. This means that there are both natural and human factors causing climate change [8,9,10]. Climate change is known to be having impacts on agricultural production as well as indirectly on the social system. The Sub-Himalayan region is mostly affected by climatic changes and global warming. Over the past three decades, the region has witnessed an increased frequency in events such as floods, landslides, mudflows, and avalanches affecting human settlements [11,12]. n many Sub-Himalayan regions, potential yields are projected to decrease for most projected increases in temperature. Climate Change (Intergovernmental Panel on Climate Change) 2014 report, changes and variability in temperature and rainfall trends are already affecting both the biophysical and socio-economic systems.

Significant reviews have explored the myriad opportunities to reduce yield scaled net emissions in cropping systems, with a strong focus on nitrous oxide emissions resulting from soil management [e.g., 13,14,15,16,17]. Shortfalls in rainfall can reduce irrigation water supplies, leading to reduce areas under irrigated crops and potentially increased areas under rain-fed crops in the subsequent season [18].

The negative effect in solar radiation and slowly rising in temperature, resulting reduces in potential yields of rice and wheat in the Indo-Gangetic plains of India [19]. [20] report reviews the risks a warming climate poses to agriculture, water resources, and health in India. In India, over 60 percent of crops are rain-fed, which makes these agricultural areas very vulnerable to changes in precipitation due to climate change.

Food and Agriculture Organisation [21] studied the mitigation measures like reducing emission from deforestation might have a negative impact on the livelihood of the rural people and also might hamper food security and sustainable development. Even in many places, it was seen that the farmers were using Indigenous Technological Knowledge to mitigate the adverse effect of climate change in agricultural production including livestock. Many projected impact of climate change studies on agriculture is the extension and intensification of challenges possessed by climate variability that are already causing pressure especially on the rain-fed cropping and livestock system [22]. Sustainable practices such as organic farming, natural farming can help farmers adapt to the changing climate. Integrated farming systems based on locally available resources by including trees, livestock, water management can help mitigate climate change to a large extent and improve the quality of life of the farmers.

With the help of these mitigation strategies, the climate change discourses may be averted and the agricultural production may be enhanced to feed the millions of hungry bowls in the Sub Himalayan region. So, the reality of social sustainability through agricultural production enhancement towards agricultural sustainability of the agricultural producers in the rural social niche can only be achieved through reducing the uncertainties of climate in the region. In this background, the present research paper has tried to envisage the impact of climate change and its' mitigation in case of restoring agricultural and social sustainability.

2. METHODOLOGY

The present study was conducted in two districts namely Cooch Behar and Malda which is under sub Himalayan region in India were purposively selected for the study. The four blocks in the selected districts were randomly selected. In each block, one village was selected for the study. The selected four villages are Gopalpur under Coochbehar block-II, Folimari under Coochbehar block-I of Cooch Behar District and Gourangapur under Gazol block and Narayanpur under Manikchak block of Malda district of North Bengal. Randomly 20 numbers of respondents from each village who were engaged in agriculture production were selected for the study. The data were collected with the help of a structured interview schedule through personal interview methods. The climate change aberration in socio-cultural milieu is delineated in terms of mitigation strategy of climate change discourses, the impact of climate change on agricultural production and impact of climate change on education, considered as predicted variables and other six socio-economic and cognitive attributes of agricultural producers are considered as predictor variables for the study. The data were processed into statistical tools like frequency, percentage, correlation analysis, and regression analysis to draw a definite conclusion from the present study.

3. RESULTS AND DISCUSSION

Table 1 presents the descriptive distribution of the socio-economic attributes of the agricultural producers and the impact of climate change on the social process associated with agricultural production. It is also reflected that the age of the respondents ranges from 20 to above 50 years. The mean score distribution of the variable age is 32.4 and the standard deviation of the

distribution is 0.82. The coefficient of variation value within the distribution 25.31% signifies the high consistency level of the distribution for the variable age. The age is one of the indicators for identifying the social stress and experience to absorb the shock of social stress which is very much impactful in the research areas related to social sustainability to cope any type of uncertainties occurs within the society. The education of the respondents ranges from no formal type of education to the graduate level of education. The mean score of the variable education is 2.19 and the standard deviation of the distribution is 0.71. The coefficient of variation value within the distribution 32.42% signifies the high consistency level of the distribution for the variable education. Education always manifests the perfection in case of solving the problem through performing a job. The problem-solving behavior has been developed with the help of formal education which in turn helps to restore social sustainability in the socio-cultural milieu. The variable farming experience of the respondents ranges from 1 year to above 30 years. The mean score of the variable farming experience is 2.56 and the standard deviation of the distribution is 0.98. The coefficient of variation value within the distribution 38.28% signifies the moderate consistency level of the distribution for the variable farming experience. The experience gathers through farming always helps an individual in case of coping the challenges associated with farming and also in case withstanding in a gross violation of set norms and principles related to farming through a sudden change. The variable farm size of the respondents ranges from 1.0 *bigha* to above 4.5 *bigha*. The mean score of the variable farm size is 2.71 and the standard deviation of the distribution is 1.03. The coefficient of variation value within the distribution 38.01% signifies the moderate consistency level of the distribution for the variable farm size. Farm size is an economic indicator for pressing the need for developing management strategies to recover from the uncertainty associated with the farm. The variable source of income of the respondents is agriculture only, agriculture and livestock, agriculture and business and agriculture and wages. The mean score of the variable source of income is 2.41 and the standard deviation of the distribution is 1.02. The coefficient of variation value within the distribution 42.32% signifies the moderate consistency level of the distribution for the variable source of income. Source of income is important for the present study as the primary

Table 1. Distribution of respondents according to their attributes

Sl. no.	Variables	Range		Mean	Std. deviation	CV (%)
		Min	Max			
1.	Age (years)	20	> 50	32.4	0.82	25.31
2.	Education	No formal Education	Graduate	2.19	0.71	32.42
3.	Farming experience (years)	1	> 30	2.56	0.98	38.28
4.	Farm size(*bigha*)	1.0	> 4.5	2.71	1.03	38.01
5.	Source of income	Agriculture	Agriculture & wages	2.41	1.02	42.32
6.	Annual Income (Rs.)	40000-60000	> 120,000	3.91	1.03	26.34
7.	Awareness and Knowledge level on climate change	32.00	45.00	38.74	3.22	8.30
8.	Impacts of climate change on Education on climate change	6.00	25.00	14.86	3.79	25.50
9.	Impacts of Climate Change on Agricultural Production	43.00	69.00	54.17	5.00	9.23
10.	Mitigation Strategies Adapted by the Farmers against Climate Change	21.00	55.00	36.89	10.95	29.68

occupation of the respondent is agriculture and the vulnerability due to change in micro climate is responsible for unbalancing the equilibrium in social sustainability. The variable annual income of the respondents ranges from Rs. 40000-60000 to above Rs. 120,000. The mean score of annual income is 3.91 and the standard deviation of the distribution is 1.03. The coefficient of variation value within the distribution 26.34% signifies the high consistency level of the distribution for the variable annual income. The annual income of the respondent is the reflection of the economy which helps in the sustainability of their social security through sustainable scientific agricultural practice.

The variable awareness and knowledge level on climate change of the respondents range from 31 to 45. The mean score of variable awareness and knowledge level is 38.74 and standard deviation of the distribution is 3.22. The coefficient of variation value within the distribution 8.30% signifies the high consistency level of the distribution for the variable awareness and knowledge level on climate change. The awareness and knowledge related to climate change discourses and the adaptation strategies to mitigate the climate change discourse is playing a crucial role in the case of retaining social sustainability.

The variable impacts of climate change on the education of the respondents ranges from 6 to 25. The mean score of impacts of climate change on education is 14.86 and the standard deviation

of the distribution is 3.79. The coefficient of variation value within the distribution 25.50% signifies the high consistency level of the distribution for the impacts of climate change on education. The education is a social indicator for empowering the agricultural producers through generating scientific orientation towards sustainable agriculture for restoring social sustainability.

The variable impacts of climate change on agricultural production of the respondents ranges from 43 to 69. The mean score of variable impacts of climate change on agricultural production is 54.17 and standard deviation of the distribution is 5.00. The coefficient of variation value within the distribution of 9.23% signifies the high consistency level of the distribution for the variable impacts of climate change on agricultural production. Agricultural production enhancement through climate change adaptation strategy creates an environment to empower rural populace towards social sustainability.

The variable mitigation strategies adapted by the farmers against climate change of the respondents ranges from 21 to 55. The mean score of the variable mitigation strategies adapted by the farmers against climate change is 36.89 and standard deviation of the distribution is 10.95. The coefficient of variation value within the distribution 29.68% signifies the high consistency level of the distribution for the mitigation strategies adapted by the farmers against climate change. Due to uneven

distribution of climate change aberration, the deterioration of quality and quantity of agricultural production is contributing in unbalancing the social sustainability in such a situation the mitigation and adaptation strategies are helpful to enhance the capacity of agriculture system for improving sustainability in the society.

The Table 2 reveals that the variables namely education and farm size are positively and significantly associated with the dependent variable i.e. awareness and knowledge level on climate change.

Education is precursor for enhancing the cognitive attributes of an individual. The formal education empowers the individual with the help of gathering information and gaining knowledge. In the present study, the information and knowledge received and contemplated from different educational attainment build a strong scientific acumen towards cc discourses and their mitigation. The mitigation of climate change through education removes several dis-orderness in the society and restores the social sustainability. That is why the variable education is positive and significantly associated with the awareness and knowledge level on climate change.

Farm size indicates personal economic status in society. Agricultural production depends on farm size and also depends on the micro climate. The agricultural producer with larger farm size updates himself with recent concept and knowledge related to agricultural production in his/her farm. He/she have to be aware and seek knowledge to overcome the uncertainty associated with the agricultural production system. Climate change is also perceived as one of the uncertainties related to agricultural production. The larger farm size and high level of knowledge on climate change is move side by side to enhance agriculture production to ensure social sustainability. That is why the variable farm size is positively and significantly associated with awareness and knowledge level on climate change.

Table 3 reveals that the variables namely farm size, source of income and annual income negatively and significantly associated with the variable impacts of climate change on education. When the farm size is bigger, the impact of climate change on education is in negative direction due to more engagement of the family members in the farm to mitigate the vulnerability of climate change. When the farm size is smaller,

the impact of climate change on education is in positive direction because the small farm size holder is not able to cope with the vulnerability of climate change discourses and they are sending their children to higher educational institute in search of income through formal education. So, the variable farm size is negatively and significantly associated with the impact of climate change on education for maintaining social sustainability in the society. The present study area is mainly occupied by small and marginal farm size holders. To cope such type of changes in the society which is helping in case of breaking the social sustainability, there is need of taking a concerted strategy to restore social sustainability. The variable source of income is presenting the uniqueness of getting the earning from a distinct family enterprise. In the present study the respondents are mostly associated with the vocation agriculture and allied. Due to impact of climate change discourses the farmers are likely to concentrate on their agriculture and allied sector profession to restore the normalcy within the field by averting the uncertainties associated with agriculture and allied sector which is also increasing day by day. As a result the farmers are unable to send their children to the educational institute for educational attainment as the children are also compel to be associated with agriculture and allied activities. As a result the impact of climate change on education is very negative if the source of income of the family is agriculture and agriculture related activities. That may be the plausible reason for negative and significant association of the variable source of income with the variable impact of climate change on education.

The annual income is also depends on the agriculture and allied sectors as the source of income of the respondents is mostly agriculture and allied activities. The income is increasing with the help of the profit earned from the agriculture and allied sectors by reducing the cost of investment. The agriculture and allied sector is highly labour intensive one. To reduce the cost of cultivation or the cost of labour the agriculture dependent household are employing their children as labour which in turn restricting the children to go to educational institute for formal educational attainment. The annual income is increasing due to curtailment of cost of labour in other way cost of cultivation as they are using their family members as agricultural labour. This is reason why the variable annual income is negatively and significantly associated with the variable impact of climate change on education.

Table 2. Correlation coefficient of the awareness and knowledge level on climate change (Y_1) with 6 independent variables

Variables	Coefficient of correlation (r)
Age (years) (X_1)	0.013
Education(X_2)	0.231*
Farming experience(years) (X_3)	0.047
Farm size(*bigha*) (X_4)	0.277*
Source of income(X_5)	0.173
Annual income (Rs.)(X_6)	0.058

*** Significant at 1% level, *Significant at 5% level*

Table 3. The correlation coefficient of the impacts of climate change on education (Y_2) with 6 independent variables

Variables	Coefficient of correlation (r)
Age(years)	0.051
Education	-0.010
Farming experience(years)	-0.182
Farm size(*bigha*)	-0.507**
Source of income	-0.441**
Annual income (Rs.)	-0.397**

*** Significant at 1% level, *Significant at 5% level*

Table 4 reveals that the variables annual income is negatively and significantly associated with the variable impacts of climate change on agricultural production.

The annual income is the reflection of the earning from different enterprises associated with a single household. In the present study area the respondents are mostly depending on their agriculture and allied activities for their livelihood. The agriculture nowadays due to introduction of climate change discourses is mostly depending upon the whims and fences of climatic aberrations. As a result the agricultural production is deteriorating day by day as the uncertainties embedded with agricultural activities are increasing manifold. Consequently the earning or income of a family is decreasing manifold from the agricultural sector as the productivity is not up to the mark due to this climate change. Due to this the variable, annual income is negatively and significantly associated with the variable the impact of climate change on agricultural production. The decreased level of annual income is also negatively impacting upon the social sustainability. To restore social sustainability the annual income should be enhanced for sustaining the livelihood of the marginal farmers through appropriate climate change mitigation and adaptation strategies.

Table 5 indicated that the variables education and farm size are positively and significantly associated with the awareness and knowledge on climate change. The variable education is directly contributing 25.5% in case of characterizing the awareness and knowledge on climate change. One unit change of the variable education is delineating the 2.225 unit change in the predicted variable, awareness and knowledge on climate change.

Table 4. The correlation coefficient of the impacts of climate change on agricultural production (Y_3) with 6 independent variables

Variables	Coefficient of correlation (r)
Age(years)	0.018
Education	0.190
Farming experience(years)	-0.153
Farm size(*bigha*)	-0.204
Source of income	-0.193
Annual income (Rs.)	-0.271*

*** Significant at 1% level, *Significant at 5% level*

Table 5. Multiple regression analysis of the awareness and knowledge on climate change (Y$_1$) with 6 predictor variables

Variables	Standardized regression coefficients	Un-standardized regression coefficients		t-value
	(β)	(β)	S.E of 'β'	
Age (years)	0.054	0.414	1.350	0.307
Education	0.255	2.225	1.012	2.198*
Farming experience (years)	0.047	0.299	1.041	0.287
Farm size (*bigha*)	0.300	1.805	0.817	2.209*
Source of income	0.103	0.629	0.808	0.778
Annual income (Rs.)	-.170	-1.025	.771	-1.330

*R^2 = 0.398, ** Significant 1% level, * Significant at 5% level*

The respondent with higher educational status having more awareness and knowledge on climate change then lower educational status. Because they can collect the information many source like tv programme, radio programme, farm magazine, news paper, extension agents etc that is why the variables education are positively and significantly associated with the awareness and knowledge on climate change.

The variable farm size is directly contributing 30% in case of characterizing the awareness and knowledge on climate change. One unit change of the variable education is delineating the 1.805 unit change in the predicted variable, awareness and knowledge on climate change. The respondents with big farm size more awareness and knowledge on climate change because they are always engaged with their farm activities and its management. For this reason they are more alert and aware to collect information about their farm management due to climate change.

The R^2 value being 0.398, it is to infer that the six predictor variables put together have explained 39.80% variation embedded with the predicted variable, awareness and knowledge on climate change. Still, 60.20% variable embedded within predicted one remains unexplained. Thus it would be suggested that inclusion of some more contextual variables possessing a direct bearing on the awareness and knowledge on climate change could have increased the level of explicability.

Table 6 indicated that the variables farming experience and farm size are negatively and significantly contributing towards the impacts of climate change on education.

The variable farming experience is directly contributing 32.0% in case of characterizing the impacts of climate change on education. One unit change of the variable education is delineating the 1.239 unit change in the predicted variable, impacts of climate change on education. It is seen that farmers having higher farming experience are economically poor and they are give more preference to farm activity for income generation then education. So, the variable farming experience is negatively and significantly associated with the impact of climate change on education for maintaining social sustainability in the society.

The variable farm size is directly contributing 34.8% in case of characterizing the impacts of climate change on education. One unit change of the variable education is delineating the 1.273 unit change in the predicted variable, impacts of climate change on education. When the farm size is smaller, the impact of climate change on education is in positive direction because the small farm size holder is not able to cope with the vulnerability of climate change discourses and they are sending their children to higher educational institute in search of income through formal education. So, the variable farm size is negatively and significantly associated with the impact of climate change on education for maintaining social sustainability in the society.

The R^2 value being 0.384, it is to infer that the six predictor variables put together have explained 38.40% variation embedded with the predicted variable, impacts of climate change on education. Still, 61.60% variable embedded within predicted one remains unexplained. Thus it would be suggested that inclusion of some more contextual variables possessing a direct bearing on the impacts of climate change on education could have increased the level of explicability.

Table 6. Multiple regression analysis of the impacts of climate change on Education (Y_2) with 6 predictor variables

Variables	Standardized regression coefficients	Un-standardized regression coefficients		t-value
	(β)	(β)	S.E of 'β'	
Age (years)	0.280	1.302	0.709	1.836
Education	0.051	0.268	0.547	0.490
Farming experience (years)	-0.320	-1.239	0.547	-2.266*
Farm size (*bigha*)	-0.348	-1.273	0.441	-2.886**
Source of income	-0.194	-0.725	0.426	-1.701
Annual income (Rs.)	-0.136	-0.499	0.409	-1.221

*R^2 = 0.384, ** Significant 1% level, * Significant at 5% level*

Table 7 reveals that the variables farming experience is negatively and significantly contributing towards impacts of climate change on agricultural production.

The variable farming experience is indirectly contributing 30.7% in case of characterizing the impacts of climate change on agricultural production. One unit change of the variable education is delineating the 1.570 unit change in the predicted variable, impacts of climate change on agricultural production. The farmers having higher farming experience hiving economically poor and lower educational status and less aware about the climate change and which results poor management of agricultural production. That is why variable farming experience negatively and significantly association with the impacts of climate change on agricultural production.

The R^2 value being 0.309, it is to infer that the six predictor variables put together have explained 30.9% variation embedded with the predicted variable, impacts of climate change on agricultural production. Still, 69.10% variable embedded within predicted one remains unexplained. Thus it would be suggested that inclusion of some more contextual variables

possessing a direct bearing on the impacts of climate change on agricultural production could have increased the level of explicability.

Table 8 shows the ranking of various mitigation strategies adopted by the farmers in the study area. The finding reveals that 88.75% of the farmers had modified their cropping pattern including the scientific cultivation practices to adapt the impact of climate change in the study area. The adjustment according to the need of the agricultural practices during crop growth stage is very important in case of getting higher yield by utilizing the micro-climate optimally. So, this is an important change observed in the study area to mitigate the climate change phenomena. Next strategy according to the perception of the agricultural producer is crop rotation practice. The 86.25% of the respondents practiced crop rotation to optimally utilize the resources for combating the ill effects of climate change on production and productivity vis a vis agricultural and social sustainability. 80% of the respondents practiced intercropping in their field. It was seen that 68.75% of the respondents practiced Integrated Farming System and Zero tillage practice respectively. 67.5% of the respondent started of use of short duration and disease resistance varieties and shifted to other

Table 7. Multiple regression analysis of the impacts of climate change on agricultural production (Y_3) with 6 predictor variables

Variables	Standardized coefficients	Un-standardized coefficients		t-value
	(β)	(β)	S.E of 'β'	
Age (years)	0.298	1.828	0.993	1.842
Education	0.160	1.124	0.766	1.466
Farming experience (years)	-0.307	-1.570	0.766	-2.051*
Farm size (*bigha*)	-0.188	-0.910	0.618	-1.474
Source of income	-0.062	-0.307	0.597	-0.514
Annual income (Rs.)	-0.173	-0.840	0.572	-1.467

*R^2 =0.309, ** Significant 1% level, * Significant at 5% level*

Table 8. Ranking of adaptation and mitigation strategies adopted by the farmers against climate change

Mitigation strategies	Frequency	%	Rank
Change in cropping pattern	71	88.75	I
Practice of crop rotation	69	86.25	II
Practices of intercropping	64	80.0	III
Integrated Farming System(IFS)	55	68.75	IV
Zero tillage practice	55	68.75	V
Use of short duration an disease resistance varieties	54	67.5	VI
Shifting to other enterprise for maintaining of livelihood.	54	67.5	VII
Migration of rural youth of to urban area	40	50.0	VIII
Planting of *tolerant* crops variety	32	40.0	IX
Mulching with paddy straw /tree leave or polythene in vegetable cultivation	28	35.0	X
Practice of rain water harvest	21	26.25	XI
Planting of illegal crop like tobacco	20	25.0	XII
Practiced of drip irrigation	8	10.0	XIII

enterprise for maintaining of livelihood respectively. 50.0% of the respondent's household members/rural youth migration to urban area for income generation.40% of the respondents started planting of tolerant crops variety. The results indicate that 35% of the respondents started use of mulching with paddy straw /tree leave or polythene in vegetable cultivation followed by 26.25% of the respondents practiced of rain water harvest. 25.0 per cent of the respondents had started practice of cultivation of illegal crop like tobacco followed by 10% of the respondents practiced of drip irrigation for vegetables cultivation.

4. CONCLUSION AND RECOMMENDA-TIONS

In the realm of second green revolution, several challenges on climate change are playing crucial role for deteriorating the agricultural sustainability and sustainability social niche. It is not only affecting the agricultural production scenario but also increasing the social chaos due to food and nutritional insecurity. To mitigate the ill effects of climate change in agricultural production scenario, its required to restore the agriculture and social sustainability. But it is an herculean task to resolve the climate related issues in agriculture. The mitigation of climate change discourse in agriculture can be minimized, if the educational level, awareness and knowledge about impact of climate change will increased. The increased level of farming experience and application of scientific protocol for best management practices in case of crop production. The social sustainability can be obtained in an agricultural producers dominated

society through enhancing the yearly earning in agriculture and allied sector by incorporating adaptation strategies of climate change. The various climate change mitigation ITKs practiced by the farmers need to identified, documented and need to popularized among the farmers. It is recommend that all line departments/Universities including NGOs need to be organized on regular bases awareness programme, conferences, seminars and workshops for farmers to raise the level of awareness and knowledge of farmers on the impact of climate change and needs to suggest available possible scientific mitigation strategies.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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