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FARMERS' PERCEPTION OF & ADAPTATION TO CLIMATE CHANGE IN DISTRICT RAMBAN OF JAMMU & KASHMIR

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ABSTRACT
The nexus of climate change and agriculture is becoming more intense and having catastrophic impacts on food and nutritional security especially in developing countries. Amongst the developing countries, India has been recognized as one of the most vulnerable developing countries towards climate change risks. This research paper highlights the impact of climate change on environment as well as on agriculture and various adaptation measures taken by the farming community. As far as impact of Climate change is concerned, the data from the research study reveals that 84% of the respondents believed that the pre monsoon showers are now absent. Regarding the change in rainfall pattern, 82% farmers were of the opinion that the rainfall is untimely. Similarly, about the impact of climate change on agriculture, 62% of the farmers had observed emergence of new insect-pests and diseases due to climate change from last few years. Failure of seeds to germinate (especially maize) was also reported by 84% of the respondents. In case of vegetables 44% of respondents told that there is increased vegetable seedlings mortality rate due to increased temperatures. Decrease in yield was reported by 94% of the farmers. The various adaptation strategies include late sowing, resowing, conservation practices like mulching and drip/sprinkler irrigation, growing of vegetables and pulses and a shift towards natural farming.

KEYWORDS: Climate change, Impact, Adaptation, Strategies, Rainfall pattern, Insect-Pests, Mortality

INTRODUCTION

Climate change as defined by United Nations refers to long term shifts in temperatures and weather patterns. Such shifts can be natural or anthropogenic. , Unfortunately, since 1800 human activities have been the main driver of climate change, primarily due to burning of fossil fuels like coal, oil and gas. The temperature of the planet has been increasing leading to climate change and global warming. The main cause of global warming is increased concentrations of Green House Gases (GHGs) carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O) in the atmosphere. Their emission is largely due to anthropogenic activities including burning off the fossil fuels and land-use change (Yoro and Daramola, 2020). According to the World Meteorological Organization (WMO), the world is now about one degree warmer than before widespread industrialization. The year 2023 has been confirmed as the warmest year on the record by World Meteorological Organization (WMO) with the global average near surface temperature at 1.45 ± 0.12 °C above the pre-industrial 1850–1900 average. 2023 was the warmest year in the 174-year observational record. This broke the record of the previous warmest years; 2016 at 1.29 ± 0.12 °C above the 1850–1900 average and 2020 at 1.27±0.13 °C. The observed concentrations of the three main greenhouse gases i. e carbon dioxide, methane and nitrous oxide reached record levels in 2022 (WMO, 2023).

In India too, various research studies have confirmed the devastating effects of climate change. A study conducted by IPE Global and Esri India found that 45 per cent of the districts were experiencing a 'swapping' trend, where traditionally flood-prone areas were becoming drought-prone and vice versa. More than 85 per cent of districts in India are exposed to extreme climate events such as floods, droughts and cyclones. The last decade alone saw a five-fold increase in these climate extremes, with a four-fold increase in extreme flood events, it said. It found that more than 60 per cent of districts in Bihar, Andhra Pradesh, Odisha, Gujarat, Rajasthan, Uttarakhand, Himachal Pradesh, Maharashtra, Uttar Pradesh and Assam were experiencing more than one extreme climate event. The analysis done by the study further revealed that more than 1.47 billion Indians will be highly exposed to climate extremes by 2036 (Daily Excelsior).

Climate change and Agriculture: Agriculture is a sector which contributes to climate change as well as is affected by climate change. The sector contributes to the climate change mainly through emission of green house gases like methane, carbon dioxide, nitrous oxide. Methane gets produced during the microbial decomposition of organic matter under anaerobic conditions. Rice fields when kept submerged in water become potential source of methane production. Livestock is another potential source of methane emission. The process of enteric fermentation in the ruminants also liberates methane in the atmosphere. Burning of crop residues as is seen in states of Punjab and Haryana is also a source of methane emission besides a source of pollution of the atmosphere. Similarly carbon dioxide, another potent green house gas results from burning of fuel in machinery during various agricultural operations, burning of crop residues and biological decomposition of soil organic matter.. The projected trends of Green House Gas emission from the agriculture

sector in India indicate that under the business as usual scenario, the emission will increase by 17% by 2030 compared to that in 2010 (Pathak, et. al, 2014).

The rising temperature and the change in weather patterns due to increased temperature run the risk of adversely affecting the yield of various crops and in rare cases some of the regions can even face the risk of simultaneous crop failure. This will ultimately have a bearing on the food and nutritional security of the populace all across the globe. Climate-driven changes in crop yields at different latitudes, as projected by the US National Research Council in 2011 revealed that Maize will fail to reproduce at temperatures above 35 °C (95 °F) and soybean above 38.8 °C (101.8 °F). Global warming may favour the occurrence of insect-transmitted plant diseases due to geographic expansion and increases in populations of insect vectors (Sharma, H.S, et.al 2005). Temperature also affects most of the critical factors for livestock production such as water availability, animal production, reproduction and health. The livestock sector accounts for about 8% of global human water use and an increase in temperature may increase animal water consumption by a factor of two to three (Nardone et al., 2010). The state of Food Security and Nutrition 2021 also reports that many factors including climate change are leading to food insecurity.

Rationale of the Study: District Ramban in Union Territory of Jammu and Kashmir is largely a rainfed district. The size of holdings here is very less. As far as size of landholdings is concerned, the average size of landholdings is 0.30 ha. Of the total farm operating families, 83% are marginal one having less than 1 ha of land. About 15% of them are small having 2 ha of land, 1.67% fall in semi medium category having land up to 4 hectares and less than 1% falling in the medium category with land up to 10 hectares. Farmers are resource poor and more prone to climatic vulnerabilities. Any adaptation or mitigation strategy to combat the adverse impact of climate change will thus not be successful unless and until farmers' perception of climate change is not taken care of. Analysis of farmer's perception of climate change is a prerequisite for assessing their adaptation decisions. Successful and efficient adaptation depends on three critical factors; timely recognition of the need, the incentive and the ability to adapt (Fankhusher et al., 1999). Farmers have to perceive and realize the actual climate changes if we have to identify the need for adaptation measures. (Bryan et al., 2009) and alter the traditional farming practices to maximize returns in each new environment (Sanghi and Mendelsohn, 2008). The importance of farmers' perception of climate change in farm-level adaptation literature is also widely recognized. The present study was thus conducted with the following objectives:

i. To know the perception of farmers regarding Climate change

ii. To know the various mitigation strategies adopted by the farmers to minimize the adverse impacts of climate change on agriculture

Locale of the study: The present study was conducted in five villages of district Ramban. The villages were selected randomly. Ten farmers from each village were selected to make a total sample size of fifty.

Research Methodology: The data regarding farmers' perception regarding climate change and the mitigation strategies adopted by them was collected with the help of a pretested interview schedule. The data was collected in a face to face interview situation. The collected data was analyzed with the help of percentages and the results were documented accordingly.

Table 1: Description of variables used in the study

Variable	Description	Data Type	Source
Age	Age of farmer/household head (in years)	Continuous	Chowdhury and Khairun, 2014
Gender	Gender of the farmer (Male/Female)	Binary (1,0)	Maddison 2007 Abid et.al, 2016
Marital status	Married or Unmarried	Binary (1,0)	Nhemachena and Hassan, 2008
Household size	No. of family members	Continuous	Abid et.al, 2016 Singh 2020
Family Type	Nuclear/Joint	Binary (1,0)	T. M. Thomas, 1995
Education	No. of years of formal schooling	Continuous	Patnaik and Dass, 2017
Dependency Ratio	No. of dependent members in the family (non working women and children below 10)	Continuous	Pandey and Jha, 2012
Land size	Total cultivable land (in ha) possesses by farmer	Continuous	Patnaik and Dass, 2017
Farm Mechanization	Whether the farmer possess any machinery	Binary (1,0)	De Falco and Verones 2013
Livestock	Whether the farm household possess any livestock	Binary (1,0)	Falco et.al, 2014
Category of Farmer	Based on the size of land holding (in ha)	Continuous	Ministry of Agriculture & Farmers Welfare, Govt, of India classification

Operational defination of terms used in the paper

Perception: Perception here refers to the ability of farmer to notice or understand something in a particular way.

Drought: Drought here refers to agricultural drought. It refers to a situation in which soil moisture and rainfall during the growing season are deficient leading to low plant populations per hectare and a reduction of final yields.

Adaptation: Adaptation here means adjustments of agronomic and agro-management practices towards the prevailing or predicted climate conditions to reduce the vulnerability and ensure a climate-resilient farming system.

Conservation practices: These practices refer to various practices and methods which result in conservation of natural resources like water, air and soil. In the present study, farmer's response was collected for four conservation practices which include Zero/No Tillage, Line sowing, Drip/Sprinkler irrigation, Mulching

RESULTS AND DISCUSSIONS

Tab. 2: Socio-economic status of the respondents

Variable	No. (%age)
Age	
21-31	06(12)
32-45	18(36)
46-60	22(44)
>60	05 (10)
Education	
Illiterate	08(16)
Primary	14(28)
Secondary	19(38)
Higher education	09(18)
Gender	
Male	43(86)
Female	07(14)
Marital Status	
Married	46(92)
Unmarried	04(8)
Type of Family	
Nuclear	38(76)
Joint	12(24)
No. of dependents	
1-2	12(24)
2-4	29(58)
>4	09(18)
Main Occupation	
Government job	05(10)
Private	11(22)
Agriculture	27(54)
Labourer	07(14)
Category of Farmer	
Marginal	47(94)
Small	3(6)
Semi-Medium	-
Medium	-
Large	-
Whether having any type of farm machinery	08(16)

The data in Table 2 is a depiction of socio-economic status of the respondents. It shows that 86% of the respondents were male which means agricultural activity in this region are largely done by males, 38 per cent of the respondents were qualified up to secondary level, 92% of the respondents were married, 76% of the farmers have nuclear families, 94% of the farmers were marginal, only 16% of them possess machinery to ease their work. For 54% of the respondents, agriculture is the main occupation whereas 14% of the respondents worked as labourers as their main occupation

Table 2: Farmers' Perception of the Climate Change (N=50)

Perception statements	Response (No.)	%age
A. Do you know about climate change?	50	100
B. For how many years have you noticed changes in climate of the region		

Last 10 years	39	78
11-15 years	09	18
16-20 years	02	4
C. What impact does climate change has on environment of the region:		
i. Absence of pre-monsoon showers	42	84
ii. Change in rainfall pattern (Untimely*/Inadequate)	41*/09	82*/18
iii. Increase*/Decrease in temperature	50*	100*
iv. Increase*/Decrease in Snowfall	43	86
v. Increase*/Decrease in dry spells	47*	94*
vi. Increase*/Decrease in frequency of Floods	11*	22*
vii. Increase*/Decrease in frequency of Droughts	-	-
D. What impact does climate change have on agriculture?		
i. Emergence of insect pest and diseases	31	62
ii. Failure of seed to germinate (Kharif*/Rabi)	42*	84
iii. Increased mortality in vegetables	22	44
iv. Decrease in area under cultivation	11	22
v. Decrease in yield	47	94
vi. Increase in cost of cultivation	50	100
vii. Hardening of upper surface of Soil	39	78
viii. Loss of Biodiversity	11	22
ix. Any other Fodder scarcity leading to low milk production	36	72

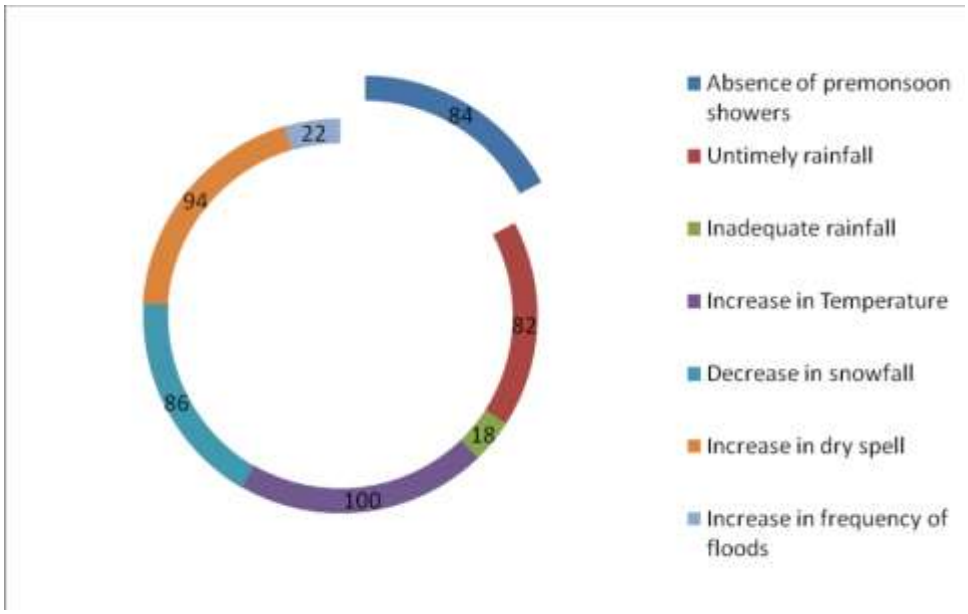

Fig.1: Impact of Climate Change on Environment as perceived by farmers (%)

The data in Table 2 clearly shows that 100% of the respondents were aware of the fact that climate is changing. The finding is in conformity with the study done by Jha and Gupta (2021) on perception of farmers about climate change in the state of Bihar. Their study also revealed that most of the farmers perceive that in the past 20 years, the temperature levels have risen. About 78 per cent of the respondents told that they are observing changes in climate of the region for the last ten years. Similarly 18% of the respondents have observed changes from last 15 years and only 4% have witnessed changes from more than 15 years.

As far as impact of Climate change is concerned, 84% of the respondents opined that the pre monsoon showers are now absent. Regarding the change in rainfall pattern, 82% farmers were of the opinion that the rainfall is untimely and 18% told that it is inadequate. All the farmers were unanimous on the statement that temperature has increased and 86% of the respondents mentioned of the decrease of snowfall in the region. Similarly 47 (94%) of respondents reported an increase in dry spell due to climate change and rise in temperature. About 22% of the respondents were of the view that climate change has also led to increase in frequency of floods (Table 2).

Regarding impact of climate change on agriculture, 31(62%) of the farmers had observed emergence of new insect pests and diseases due to climate change from last few years. Failure of seeds to germinate (especially maize) was also reported by 84% of the respondents. In case of vegetables 44% of respondents told that there is increased vegetable seedlings mortality rate due to increased temperatures. Decrease in yield was reported by 94% of the farmers. The corresponding decrease in yield was 50% for maize and 30% in case of wheat. Hardening of upper surface of soil was reported by 78% of farmers. This is due to prolonged dry spell. All the farmers interviewed told that adverse impacts of climate change on agriculture lead to escalation in cost of cultivation. Climate change also impacts milk production adversely due to fodder scarcity as a result of rising temperatures and low rainfall.

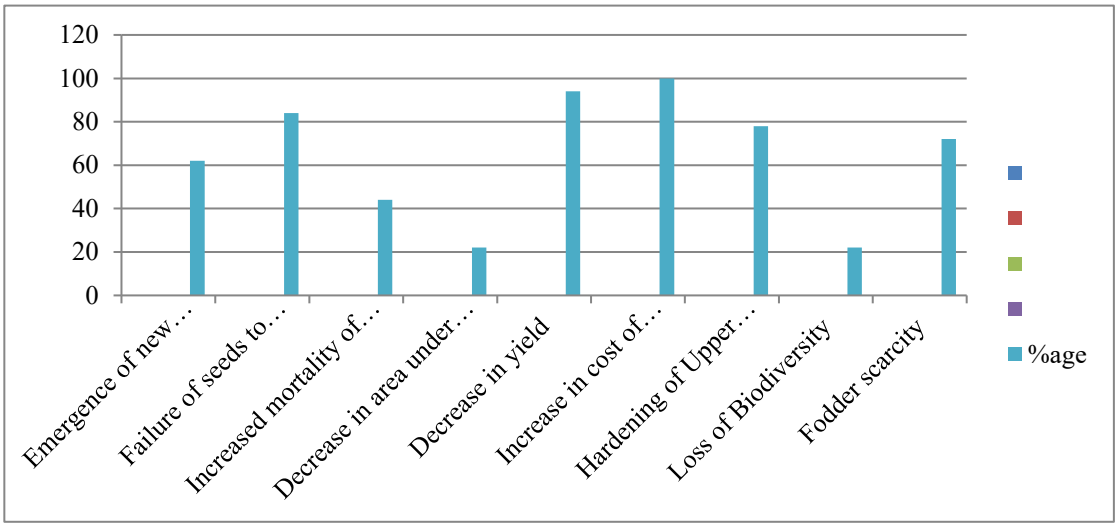

Fig.2: Impact of climate change on agriculture as perceived by farmers (%age)

The different adaptation strategies practiced by farmers of the region to cope up with the climate change are depicted in Table 3. A careful observation of the data reveals that adverse effects of climate change are mostly seen in Kharif season wherein 62 percent of the farmers have to go for late sowing of the maize crop mainly due to lack of moisture due to absence of pre monsoon showers.. Similarly Resowing of Maize as an adaptation strategy due to poor germination was perceived as an adaptation strategy by 38 per cent of the farmers. About 22 percent of the respondents reveal that they prefer to grow pulses like Lentil, Mash, Rajmash because these crops do not require much water. None of the farmers had leased out their land due to apprehension that the untimely or inadequate rainfall might lead to crop failure. Sixty Four per cent of the farmers interviewed also told that they grow vegetables (kitchen gardening or in a very small area) as a coping strategy against extreme weather events. Vegetables can also be grown with less amount of water with water coming of kitchen. As much as eight per cent of the farmers also told that they were forced to leave certain amount of their land fallow in Kharif due to poor rainfall.

As far as adaptation of conservation practices is concerned, the data is not much satisfactory. Only 16% of the respondents harvest water through small farm ponds. Line sowing is also done by just 14% of the respondents. Only 04 No. of respondents use drip irrigation and Mulching is done by only 12% of the respondents. This data can also be attributed to low level of farm mechanization in this region. About 22% of the farmers reported to be shifting towards Natural Farming. Majority of the farming community in the region does not possess Soil Health Cards. Only 12% of the farmers have availed this opportunity. The negative impacts of climate change on agriculture as reported in this study are in line with the study done by Balasha and his associates (2023) in Democratic Republic of Congo (DRC) on Understanding farmers' perception of climate change and adaptation practices in the marshlands of South Kivu. The common impacts reported by farmers in DRC included the proliferation of pests (90 %), a decrease in soil fertility (75 %), and floods, resulting in crop failure.

Table 3: Adaptation strategies practiced by the farming community

Adaptation strategy	Response (No.)	% age
i. No adaptation	-	-
ii. Late sowing (in Kharif)	31	62
iii. Resowing (in Kharif)	19	38
iv. Crop rotation	12	24
v. Intercropping/Mixed cropping	14	28
vi. Growing Pulse crops	11	22
vii. Lease out land	00	00
viii. Grow vegetables	32	64
ix. Put land under Orchards	04	8
x. Leave certain area fallow	04	8
xi. Use of Climate resilient varieties	12	24
xii. Use of Compost*/Vermicompost	38*	76*

xiii. Farm mechanization	9	18
xiv. Conservation practices such as a. Farm ponds b. Zero/No Tillage c. Line sowing d. Drip/Sprinkler irrigation e. Mulching f. Any other	 08 - 07 04 06 -	 16 - 14 08 12 -
xiv. Crop Insurance	04	08
xv. Shift towards Natural farming	11	22
xvi. Integrated Farming System	04	08
xvii. Soil Health Card	06	12
xvi. Any other	-	-

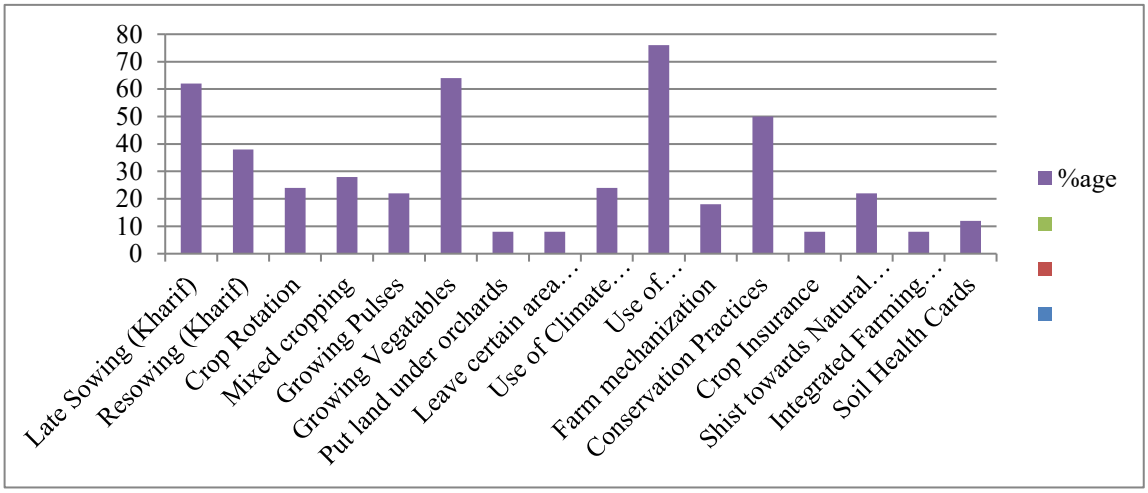

Fig. 3: Adaptation strategies being practiced by farmers (%)

Conclusion: The finding of the study concluded that farming community is aware of the phenomenon of climate change and they are feeling the negative impacts of climate change on agriculture. The livelihoods of population directly engaged in agriculture thus have to be protected. It is necessary that the adaptation of agricultural sector to the adverse effects of climate change be ensured (Asfaw et.al, 2016). The results obtained from this study are in conformity with the study done by Jha and Gupta (2021) on perception of farmers about climate change in the state of Bihar. Their study also revealed that most of the farmers perceive that in the past 20 years, the temperature levels have risen. Jha and Gupta have also reported Climate change to be a continuous process; without any counteracting responses, the magnitude and intensity will only increase in the future. Awareness and Adaptation has been proposed as a critical policy option for combating the unavoidable consequences of climate change by several researchers. Suitable region specific adaptation strategies are required to reverse or halt the adverse impacts of climate change. For adaptation strategies to be successful, it is also essential that all the stakeholders be involved so that the adaptive capacity of the farmers could be enhanced.

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