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Farmers' perception on climate vulnerability and responsive adaptation measures in district Jabalpur, Madhya Pradesh

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Abstract
The study was carried out in Jabalpur district of Madhya Pradesh with the objective to assess the farmers' perception on climate vulnerability and adaptation measures adopted by the farmers in rice-wheat cropping system. The Shahpura block was selected randomly for study and five villages were selected purposely. The proportionate random sampling was used to make sample size 120. The study revealed farmers had perceives the changes in temperature and precipitation. The majority of farmers perceived that outbreak of insect pest and disease, emergence of weed species, declination in soil nutrient status, high input cost, reduced grain quality and low market price to produce are impact of the climate change while cent per cent farmers perceived declination in water table and low production are the impact of climate change. The farmers mainly adapted change in the variety and change in the transplanting date, increased dose of fertilizer with neem coated urea and alternate wetting –drying system, raised the height of bunds, partitioning of the large field into small field to store water and increased use of insecticide and pesticides in Rice while in the Wheat crop, farmers follows change in variety, line sowing, increased seed rate, increased dose of fertilizer with neem coated urea, adoption of sprinkler irrigation and majority of farmers adopted crop diversification. Most of the farmers had taken crop insurance. The results of study will serve a guideline to researchers, extension personal and policy maker to make effective policies and plans on climate change so farmers can double their income.

Keywords: climate change, impact, perception, adaptation measures, vulnerability

Introduction
Climate change is a global phenomenon, impacted agriculture directly and indirectly in both ways. Developing countries are severely impacted by the climate change and vulnerability. Agriculture plays important role in social and economic life of people in India, where 65% of the cropped area is rain-fed. The Intergovernmental Panel on Climate Change (IPCC) has projected that by 2100, atmospheric concentrations of carbon dioxide could have reached between 540 ppm and 970 ppm and that, as a result, global surface temperature could rise by between 1.4ºC and 5.8ºC. Increasing climatic variability with global warming has seasonal/annual fluctuations in food production. Droughts, floods, tropical cyclones, heavy precipitation events, hot extremes, and heat waves have negative impact on agricultural production and farmer's livelihood. An increase in CO_2 to 550 ppm increases yield of rice, wheat, pulses and oilseeds by 10-20%. A 1º C increase in temperature may reduce yield of wheat, soybean and mustard by 3-7%. Losses will be more with increase in temperature. The productivity of most crops decreases only marginally by 2020 but by 2100 it will be 10-40 per cent due to increase in temperature and rainfall as well as decrease in irrigation water (Shrivastava 2016) [3].

Madhya Pradesh has sub-tropical climate with hot-dry summer (April-June) followed by the monsoon season (June-September). Winter in Madhya Pradesh is cool and dry. Average annual rainfall in Madhya Pradesh is about 1300mm. About 75% of the total population of Madhya Pradesh is living in rural areas which are directly or indirectly engaged in agriculture related activities thus agriculture is most-important sector in Madhya Pradesh (Mishra *et al*. 2016) [2]. In Jabalpur district Rice-Wheat is main cropping system. In rice-wheat cropping system, rice crop is suffering from drought condition while Wheat crop is exposed to the higher temperature during grain filling stage, which ultimately causes low production and reduces the quality of grain. The climate factors like temperature and precipitation are expected to shift production seasons, pest and diseases patterns and modify the set of feasible crops affecting production, prices, income and ultimately, livelihood and lives. In order to fulfil the need of growing population and stabilize output and income, agriculture system must become more resilient i.e., more capable of performing well in the face of disruptive events.

Effective adaptation and mitigation is required to cope with the climate change (Agrawal 2007) [1]. A better understanding of farmer perceptions regarding long term climate change and vulnerability and current adaptation measures will be important to inform policy for future successful adaptation of the agriculture sector. Hence, the present investigation was an attempt to assess the farmers' perception towards climate change as well as their adaptation measures in Rice - Wheat cropping system in Jabalpur district.

Materials and Methods

The present investigation was carried out in Jabalpur district. The Jabalpur district has sub humid climate with 1358 (mm) average annual rainfall, 40-43 ºC (May) maximum temperature and 8 - 9ºC (January) minimum temperature. Out of the 7 blocks one block namely Shahpura was selected randomly. The block consists of 220 villages. Out of these 220 villages 5 villages were selected on the basis of maximum area under rice and wheat. The farmers were selected by the proportionate random sampling method to make sample size 120. A pretested interview schedule was used for data collection. The data were collected personally at residence as well as farm of the farmers. In order to find out the trend of change the annually meteorological data of rainfall and temperature for last 30 years of Jabalpur district was collected from Department of applied physics and Agriculture Meteorology, College of Agriculture Engineering, JNKVV, Jabalpur. Descriptive statistics were used for data analysis.

Results and Discussion

Table 1: Descriptive analysis of Rainfall, Maximum and Minimum temperature data annually at Jabalpur district during 1988 – 2017

Variables	Pooled data (1988-2017)	Sub period -1 1988-1997	Sub period-2 1998-2007	Sub period-3 2008-2017
Mean annual rainfall (mm)	1292.05	1218.57	1241.03	1416.55
Rainfall variance	30.80	35.47	26.50	30.70
Change in rainfall (%)	0.58	0.15	-0.11	-2.45
Mean annual maximum temperature (ºC)	31.69	31.65	31.48	31.92
Maximum temperature variance	1.72	1.68	1.03	2.12
Change in maximum temperature (%)	0.02	-0.22	0.12	-0.25
Mean annual minimum temperature (ºC)	18.17	18.38	18.54	17.60
Minimum temperature variance	3.46	1.84	1.96	3.88
Change in minimum temperature (%)	0.18	0.16	-0.04	0.03

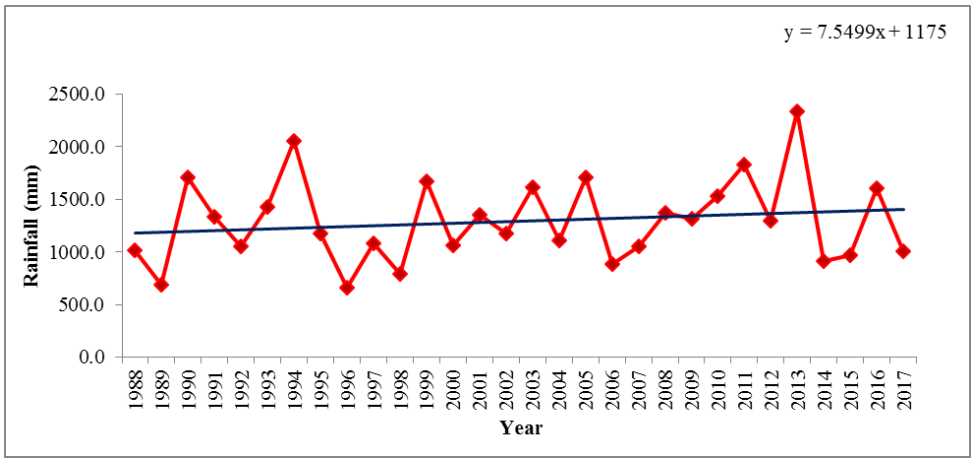

Fig 1: Trend of rainfall data at District Jabalpur (1988 – 2017)

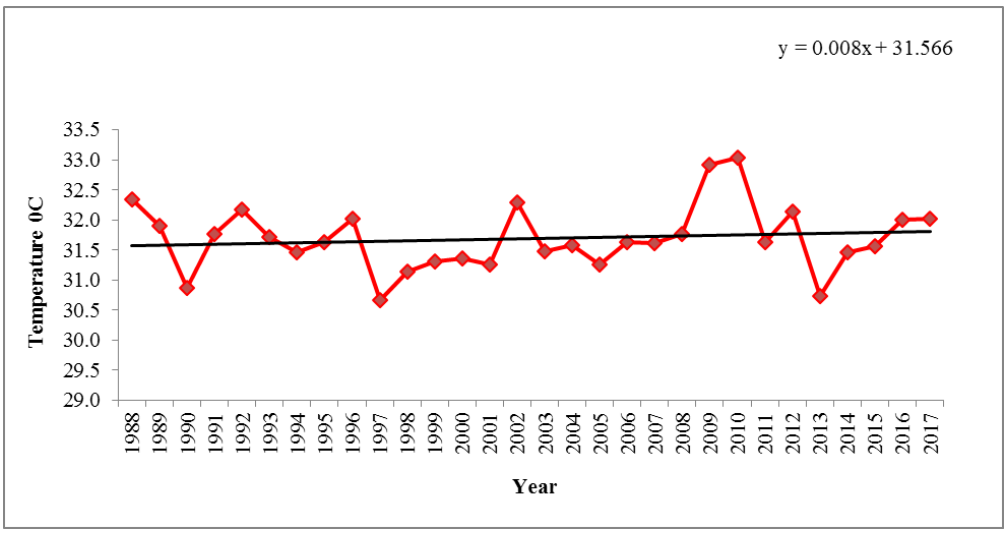

Fig 2: Trend of maximum temperature data at District Jabalpur (1988 – 2017)

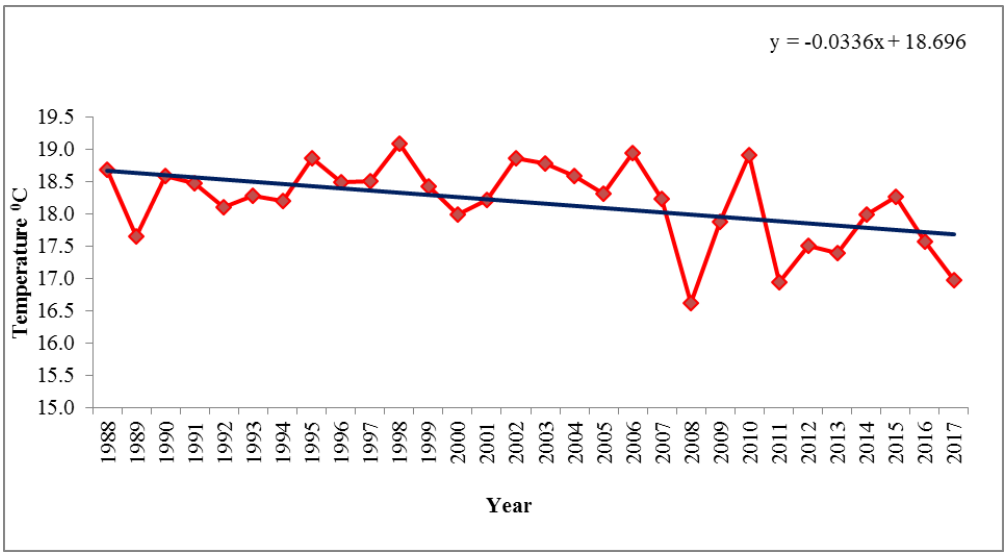

Fig 3: Trend of minimum temperature data at District Jabalpur (1988 – 2017)

Descriptive analysis of the climatic variable

The result of descriptive analysis of the climatic variable is presented in Table 1. It is evident from the Table 1 that in all the three sub period, the mean rainfall of third sub period (2008-2017) was 124 mm more than the base period (1988-2017) while the first sub period (1988-1997) shows increased variation and second sub period (1998-2007) shows decreased variation than the period under study (1988-2017). The average temperature in third sub period was slightly more that is 0.23 º C, than the base period and other sub periods and variation is increased in third sub period than other sub period and period under study (1988-2017). Regarding minimum temperature in third sub period, the minimum temperature is 0.57 º C less than the base period and the variation in minimum temperature is increased from other sub period and base period. It gives clear indication that climatic variables are less predictable. The risk in crop production increases as climate parameters become highly unpredictable and unreliable (Winkler *et al*. 2013).

Trend analysis of climatic variable

From the figure (1, 2 & 3) it is found that there is decreasing trend in minimum temperature during the period of 1988-2017 years. There is no trend was observed in maximum temperature at Jabalpur district in last 30 years. The annual minimum temperature was observed to be slightly more variable in recent decades and has negative trend. The trend analysis of rainfall indicates no significant trend during last 30 years of data. But it can be observed from the graph (fig 3) that in the year 2009 & 2010, the temperature was higher than the average temperature and in the year 2008, minimum temperature was decreased than the average minimum temperature. The trend of rainfall was showing that in the year 2012, the rainfall is higher than the average rainfall

Table 2: Perception of the farmers towards weather parameters N = 120

S. No.	Parameters	frequency	percentage
	Temperature		
1.	***Change in temperature***		
	Increased	120	100.00
	Decreased	0	0
	No change	0	0
2.	***Variation in summer temperature***		
	High	86	71.67
	Moderate	19	15.83
	Low	15	12.50
	Not experienced at all	0	0
3.	***Variation in winter temperature***		
	High	63	52.50
	Moderate	40	33.33
	Low	17	14.17
	Not experienced at all	0	00.00
	Rain fall		
4.	***Number of rainy days (>2.5mm/day)***		
	Increased	0	0
	Decreased	109	90.83
	No change	11	9.17
5.	***Amount of rainfall***		
	More	78	65.00
	Less	42	35.00
6.	***Distribution of rainfall***		
	Even	0	0
	Uneven	120	100.00

7.	***Onset of rainfall***		
	On time	26	21.67
	Irregular	94	78.33
8.	***Dry spells during crop growing period***		
	Long	56	46.67
	Medium	47	39.17
	Short	17	14.16

Farmers' perception regarding the change in temperature

The perusal of the data presented in table 2 revealed that cent per cent farmers perceived increase in temperature. From Table 1 it is clear that in the recent decade (2008-2017) the temperature is slightly increased than the other decades. It can be said that farmers perception to temperature is similar to meteorological evident. The majority of farmers 71.67 per cent experienced high variation in summer temperature while 15.83 per cent farmers feel moderate and 12.50 per cent perceived low variation in summer temperature. The highest percentage of farmers 52.50 per cent feels low variation in winter temperature, while 33.33 per cent experienced moderate variation and 14.17 per cent farmers not experienced variation in winter temperature. This gives evidence that majority of the respondents of Jabalpur district perceived change in temperature.

Farmers' perception regarding the change in rainfall

The results shown in table 2 indicate that majority of farmers 90.83 per cent experienced decrease in rainy days while only 9.17 per cent experienced no change in rainy days. This gives clear evidence that majority of farmers perceived change in rainfall. Around 35.00 per cent farmers felt that amount of rainfall is less and near to two third (65.00 per cent) farmers feels amount of rainfall is more. From the figure (1) it is clear that the rainfall is showing increasing trend during (1988-2017). The perception of the farmers on amount of rainfall is accordance with the meteorological data. Cent per cent farmers experienced that distribution of rainfall is uneven in crop growing period. The highest proportion of farmers 78.33 per cent perceived that onset of rainfall was irregular while 21.67 per cent farmers perceived that onset of rainfall was on time. The higher percentage of farmers 46.67 observed long dry spells, while 39.17 percent observed medium and 14.16 per cent observed short dry spell during the crop growing season. This reveals that farmers were concerned about change in rainfall and its effect on their livelihood as well as farming.

Perception towards the Impact of climate change on agriculture

Around 78.33 per cent farmers disagreed that climate change makes farm operation more difficult. The majority of farmers 87.50 per cent agree with that outbreak of insect pest and diseases were more due to climate change. The majority of the farmers 80.83 per cent said that emergence of weed species was more in the field. Around three fourth of the farmers (74.17 per cent) perceived that soil nutrient status were decreasing due to the effect of climate change. The higher percentage of the farmers (66.67 per cent) agreed with the fact that water balance is declining. The highest proportion of the farmers 65.00 per cent had perceived that input cost was increasing. It may be due to that farmers were applying increase dose of fertilizer, insecticide and herbicide and increased seed rate. Cent percent farmers had agree with that the low production of crop is due to climate change. The majority of farmers 85.00 per cent perceived that grain quality of produce is reduced. The higher percentage of the farmers (60.83 per cent) agreed that farmers were getting low market price of produce as the quality of produce was decreased due to weather variation. The most of the farmers 59.17 per cent farmers agreed that crop failure is due to climate change.

Table 3: Farmers perception towards the impact of climate change on agriculture N = 120

S. No.	Particulars	Agree		Disagree	
		f	*%*	*F*	*%*
1.	Weather variation makes farm operations more difficult	26	21.67	94	78.33
2.	Outbreak of insect pest and diseases	105	87.50	15	12.50
3.	Emergence of weed species is more	97	80.83	23	19.17
4.	Soil nutrient status is decreasing	89	74.17	31	25.83
5.	Water balance is declining	80	66.67	40	33.33
6.	Input cost is increased	78	65.00	42	35.00
7.	Low production of crop	120	100.00	00	00.00
8.	Grain quality is reduced	102	85.00	18	15.00
9.	Low market price of produce	73	60.83	47	39.17
10.	Crop failure	49	40.83	71	59.17

Adaptation measures adopted by the farmers

Farmers of the study area were adopting some adaptation measures to mitigate the effect of climate change. Adaptation measures are the practices which reduce the adverse effect of climate change. In paddy crop 61.67 per cent farmers changed the variety, while most of the farmers 63.33 percent farmers were changed the transplanting date. Few farmers (13.33 per cent) had adopted direct seeding method while none of the farmer had adopted SRI method for transplanting. The majority of the farmers 80.00 per cent applied fertilizer at increased rate. Cent per cent farmers were using neem coated urea. A sizable group of the farmers 42.50 per cent were applied organic manure in their field. The highest proportion of the farmers 61.67 per cent had adopted alternate wetting and drying system and majority of the farmers (80.83 per cent) had increased the bund height to store more water in the field while majority of the farmers (72.50 per cent) had partitioned their large field in to small field to manage water level in paddy field. A higher percentage of the farmers (65.00 per cent) change in the time of application of insecticide and herbicide, while 74.17 per cent farmers increased the dose of insecticide and more than one third farmers 37.50 per cent farmers applied herbicide at increased rate.

In wheat crop majority of the farmers (97.30 per cent) were changed the variety. Near to fifty percent of the farmers 47.50 per cent change the sowing date. Change in sowing date can reduce the impact of high temperature during the grain filling stage. Cent per cent farmers had done the line sowing of wheat and none of the farmers were adopting the zero tillage method. This gives clear evidence that farmers have lack of awareness about zero tillage method. Cent per cent farmers had applied increased seed rate. The thinking of the farmers behind applying increased seed rate is that in delayed sowing of wheat, this practice can produce more yield. Fertilizer and manure management is also a one of important adaptation

measures. The majority of the farmers (80.83 per cent) had applied fertilizer at increasing rate and cent per cent farmers applied neem coated urea while only 29.17 per cent farmers applied organic manure in their field. In irrigation management, the higher percentage of farmers 54.17 per cent increased the number of irrigation and cent per cent farmers had given irrigation by sprinkler. Near to one third (30.00 per cent) farmers had changed the application time of insecticide and herbicide while 39.17 per cent of the farmers had used insecticide at increased rate and 42.50 per cent farmers were using increased dose of herbicide to control weeds. The majority of the farmers 93.33 per cent adopted crop diversification.

Soil and water conservation are one of the important adaptation measure to climate change. A very few 4.17 per cent farmers were adopted rain water harvesting while 9.17 per cent of the farmers were doing mulching. The majority of the farmers 72.50 per cent had done soil test of their field. 37.50 per cent farmers had planted tree in their field. The highest proportion of the farmers 55.00 percent had access to weather advisory services. The majority of the farmers 76.67 per cent had taken crop insurance.

Table 4: Adaptation measures adopted by the farmers to mitigate the adverse effect of Climate Change

S. No.	Adaptation measures	frequency	Percentage
(A)	**Crop management**		
	Paddy		
1.	Change in variety	74	61.67
2.	Change in transplanting date	76	63.33
3.	Method of sowing		
a)	Direct seeded	16	13.33
c)	SRI	0	0
4.	Fertilizer management		
a.	Increased rate of fertilizer	96	80.00
b.	Neem coated urea	120	100.00
c.	Organic manure	51	42.50
5.	Irrigation management		
a)	Alternate wetting and drying system	74	61.67
b)	Raised bund height	97	80.83
c)	Partitioning the large field into small field	87	72.50
6.	Insect pest and disease management		
a)	Change in the time of application	78	65.00
b)	Increased dose of insecticide	89	74.17
c)	Increased dose of herbicide	45	37.50
	Wheat		
1.	Change in the variety	117	97.50
2.	Change in planting date	57	47.50
3.	Method of sowing		
a)	Line sowing	120	100.00
b)	Zero tillage	0	00.00
4.	Increased the quantity of seed	120	100.00
4.	Fertilizer and manure management		
a.	Increased rate of fertilizer	97	80.83
b.	Neem coated urea	120	100.00
c.	Organic manure	35	29.17
5.	Irrigation management		
a)	Increased the number of irrigation	65	54.17
b)	Sprinkler irrigation	120	100.00
6.	Insect pest and disease management		
a)	Change in the time of application	36	30.00
b)	Increased dose of insecticide	47	39.17
c)	Increased dose of herbicide	51	42.50
7.	Crop diversification	112	93.33
(B)	Soil and water conservation		
1.	Rain water harvesting	5	4.17
2.	Mulching	11	9.17
(C)	Soil testing	87	72.50
(D)	Plantation of trees	45	37.50
(E)	Access weather advisory services	66	55.00
(F)	Crop insurance	92	76.67

Conclusion

It can be concluded from the study that majority of the farmers experienced change in weather parameters and a sizable group of farmers experienced the impact of climate change on agriculture. None of the farmers were adopting SRI method and zero tillage technique. Awareness programme related to climate change and frequent training programme should be organized at community level. Indigenous coping strategies should be adopted with scientific knowledge so the input cost can be reduced with environmental friendly approach. Access to climate information and weather is prerequisite for early preparation to reduce adverse effect of climate change, therefore extension system and other agencies

should take initiative to provide climate information at right time.

References

1. Agrawal PK. Climate Change: Implications for Indian Agriculture. Jalvigyan Sameeksha. 2007; 22:37-46.
2. Mishra V, Shah R, Garg A. Climate change in Madhya Pradesh: Indicators, Impacts and Adaptation. Indian Institute of Management Ahmedabad. Working paper, 2016.
3. Shrivastava A. Climate Change and Indian Agriculture. International Policy Digest, 2016. https://intpolicydigest.org/
4. Shrivastava AK, Agrawal KK. Climatic variability and Its Impact on Crop Acerage and Yield in Madhya Pradesh. 2016, 1-74.
5. Winkler JA. Cinderich AB. Ddunba SD. Doubler D. Nikolic J. Perdinan Pollyea AM. Understanding the impacts of climate on perennial crops. Climate Vulnerability. 2013; 2:37-49.