Evaluating Farmers Knowledge, Vulnerability and Adapting Capacity toChanging Climate Scenario in Bundelkhand region

Comment [HLL1]: The country's name should be added in the title.

ABSTRACT

Agriculture production in the Bundelkhand region is highly vulnerable to the climate change. To examine the perception, awareness, extent of knowledgeon climate change and its impact on agriculture production with coping strategies, a research study was conducted with randomly selected 70 sample farmers household from two villages of datia district. More than 80 per cent farmer feels that climate change is serious issue and it affects water availability and crop production. 77 percent respondents from watershed area expressed their view that climate change reduced crop yield followed by the reduction in milk yield, diseaseand pest incidence, rainfall reduction and environment effect. Results shows that respondents of *Jigna* village (under watershed area) are reported to be more aware about impact of climate change (temp., rainfall, wind velocity) as compared to *Dalipura* village. Farmers from both villages were reported deforestation, intensified industrialize and air pollution as reason for consequence of climate change. Intensify research efforts and Enlightenment campaign as efforts to overcome climate change are reported by majority of respondents. Changes in existing cropping pattern and soil-water conservation measuressuggested as coping-strategies for climate change.

Comment [HLL2]: Please specify which type of farmers, for example, rice farmers.

Key Words: Perception, climate change, awareness,conservation, adoption

INTRODUCTION

Agriculture production mostly dependent on the favourable climate conditions and its production affects with changes in the climatic scenario; thus, climate change poses direct and growing threat to the agriculture and livelihood. Several studies were conducted to understand the impact of climate change, awareness, risk, and strategy to adopt the changing climate scenarios. In India, climate change is a particularly serious challenge due to the high dependency on the climatic sensitive sectors like agriculture, forestry, and fisheries [1]. Agriculture on which 70 percent of the population are completely dependent, will be affected by the changes in major climate factors [2]. It means agriculture sector are more vulnerable as compared to other sectors. As climate change intensifies problems like land degradation, market volatility, rising input cost, reducing yield, insect pest attack, soil erosion, decreasing fertility, water erosion, salinity and affecting livelihood, it is recognised as potent threat to

agriculture sustainability [3,4,5]. To reduce the adverse impact of climate change or to protect the livelihood of the farmers,an appropriate adaptation measures required [6]. According to the IPCC [7], adaptation is the process of adjustment to actual or expected climate and its effects that in human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. Several adaptation strategies, such as crop and livestock mix shifts, altered planting/harvesting dates, altered livestock stocking rates, and increased pesticide use, have been observed mostly implemented by farmers acting in their own best interests [8,9,10,11].Again, application of adaptation strategies varies from region to region and adopter to adopter, due to the region-specific features such as drought severity, extent of groundwater depletion, rainfall, institutional facilities, socio economic status and managerial aspects [12,13,14]. Farmers perception and knowledge on the climate change are the major factorsin mitigation and adaptation of climate change. Specifically regionalknowledge, awareness and perception are the deciding aspects to develop a better adaptation and coping strategies to meet the adverse impact of climate change.Keeping in view above all the discussion a study was carried out with following objectives:

- To examine the perception, awareness, and extent of knowledge of farmers on climate change and their perceived adverse impact on crop production
- To determine the attitude of farmers and officials and determine the factors influencing knowledge and attitude of farmers towards soil and water conservation technologies under the changing climatic scenario
- To determine the vulnerability and adaptive capacity of farmers towards various soil and water conservation technologies to changing climatic scenario

MATERIAL AND METHODS

Locale and Sampling: The survey study was conducted in Bundelkhand region (Datia district) as a part of network project.From datia district two blocks (*datia*, *bhander*) were selected purposefully and from each block one village identified, thus making a total two villages from the district. In selection process multistage Simple random sampling was used.

Comment [HLL3]: Please clearly define why you chose two blocks purposefully.

Research design: The study followed descriptive survey research andEx Post Facto research

Method of data collection: Survey, in-depth discussion, and participant observation methods were used for collection of primary data with the help of interview schedule (structured and semi-structured). Reports, literature published by various government/ non-government

agencies and reference material available on institutes project report of watershed were referred for secondary data collection.

Sample size: In each village, 35 respondents were selected (*Dalipura&Jigna* Village) randomly to know the awareness level of the farmers, extent of knowledge, attitude of farmers towards soil & water conservation practices.

RESULTS AND DISCUSSION

Demographic and socio-economic profile of the respondents

Demographic indicator shows an average size of family in *Jigna* (4.71) and *dalipura* (4.65). In terms of total workers, cultivators and agricultural labourers, large number of population involved in Jigna villages. In *dalipura* village more no. (29.65 percent) population belogs to sceduled caste category. (Table 1). With respect to socio economic profile of the villages, Jigna villagers have a more agriculture and livestock income as compared to dalipura, the reason is more aware of the modern cultivation and avvailability of waters in offseason (Table 2). Share of irrigated land is higher in Jigna village dude to the intervention made by the institutes for developing watershed. With respect to external contact agency, majir information provider are gram sevak, KVK and local cultivators. Major communication sources were newpapers, mobile and agriculrute fairs for majority of the respondents (Fig 1)

Table 1: Demographic features of villages

Demography	Jigna	Dalipura
Families (Nos)	854	97
Population (Nos)	4025	452
Av. Size of family (Nos)	4.71	4.65
Literacy (%)	82.2	80.6
Total workers (Nos)	1762	118
Cultivators (Nos)	862	72
Agricultural labourer (Nos)	364	30
Scheduled caste (%)	17.60	29.65

Socio-economic variables	Jigna				Dalipura			
	Average	SD	Min	Max	Average	SD	Min	Max
Family size (Nos)	4.71	3.2	3	20	4.65	2.1	2	11
Age of family head (Years)	62.5	8.4	41	82	53.0	7.8	35	69
Asset ownership (Nos)	7.3	3.5	3	14	3.4	1.5	1	7
Family income (Rs)	135602	125200	38000	490000	72345	32521	27000	155000
Land holding size(ha)	1.5	0.1	0.1	6.2	1.5	0.9	0.1	4.0
Irrigated land (ha)	1.2	1.1	0	4.4	0.8	0.5	0	2
Agricultural income (Rs)	114502.2	98728.22	20500	480000	57000	16960	17000	120000
Livestock ownership (Nos)	4.5	1.5	2	8	3.5	1.8	1	7
Livestock income (Rs)	64000	52500.2	16000	240000	38000	14937	11000	190000

Table 2: Socio-economic profile of villages

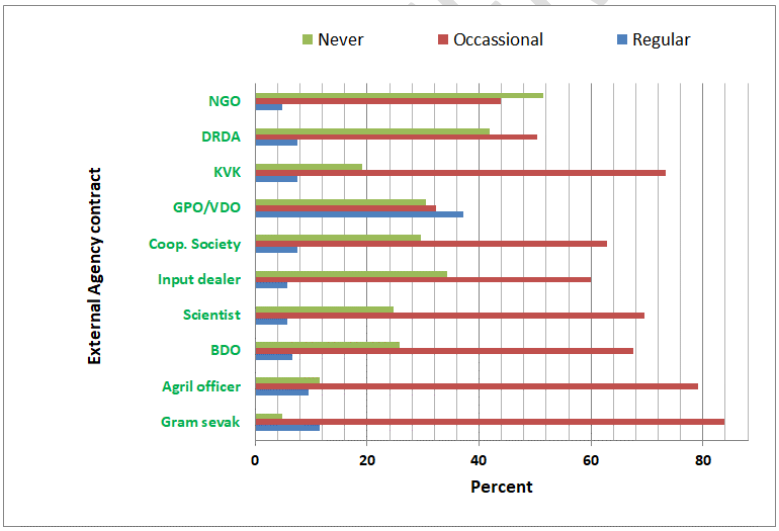

Fig 1 : Major communication sources

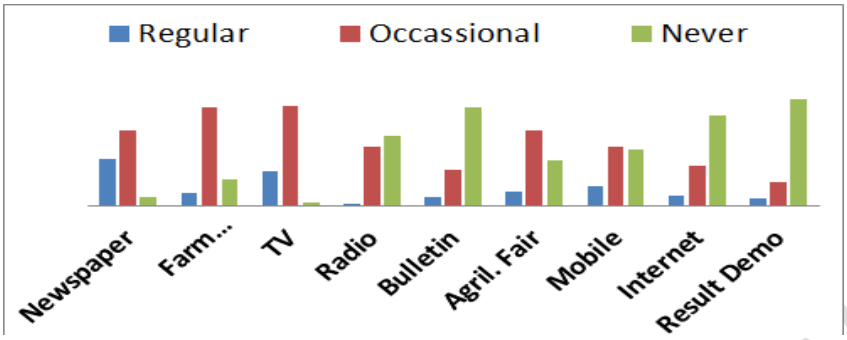

Fig 2: External Contact agency and exposure of the respondents

Perception, awareness, and extent of knowledge of farmers on climate change

Results shows that respondents of *Jigna* village are reported to be more aware about impact of climate change (temp., rainfall, wind velocity) (Fig 3). In terms of how climate change affects respondents: outcomes shows that Farmers from village *dalipura* are reported to be more affected as compared to watershed village *Jigna* (in terms of reduced crop yield, causes ill health, reduce milk yield, increase in diseases and pest infestation, Reduces the amount of rainfall Causes pollution of the environment (Fig 4).

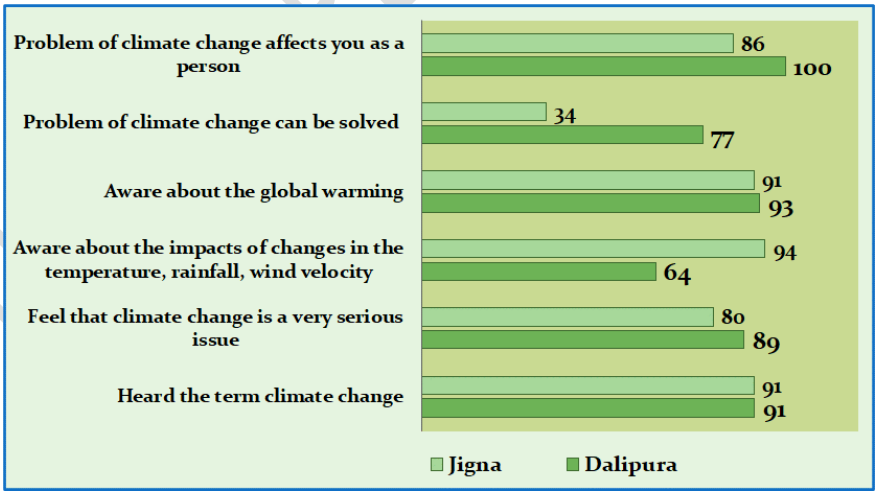

Fig 3: Awareness of climate change (No. in Percentage)

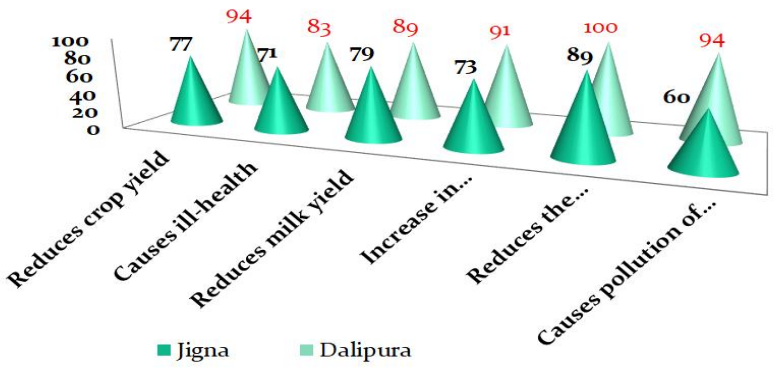

Fig 4: How does climate change affect respondents (in %)

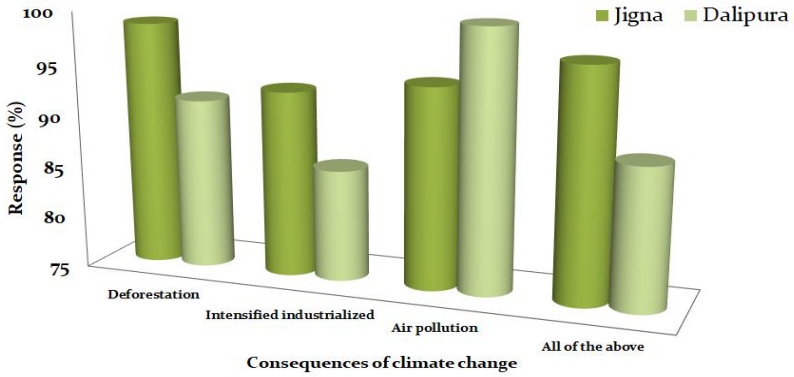

Fig 5: Reasons for consequences of climate change(in %)

Study results shows that major reasons reported for consequence of climate change were deforestation, intensified industrialized, air pollution and other emission factors (Fig 5), majority of respondents from both villages reported above listed consequences of climate change. With respect to efforts to overcome climate change perceived study identified Intensify research efforts and Enlightenment campaign as major efforts to address the climate change (Fig 6)

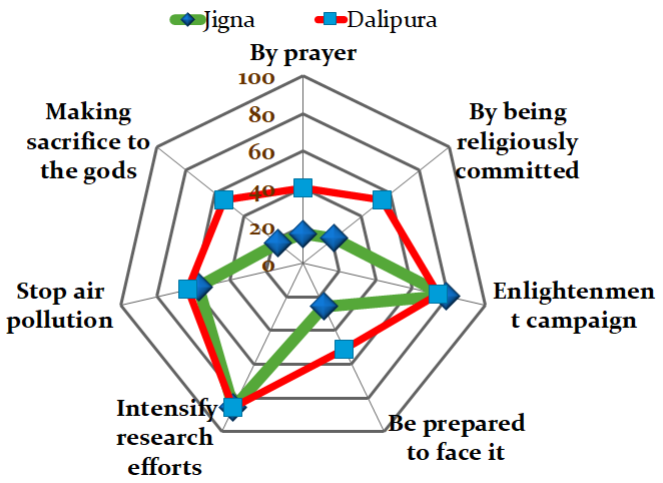

Fig 6: Efforts to overcome climate change perceived

Soil and water conservation practices constructed/adopted:

Major soil and water conservation practices adopted at the study villages were bunding, broad bed furrow, farm pond, summer ploughing, bore well recharge pit, nala bund and check dem. These conservation structures were constructed during the implementation of watershed programme at *Jigna* village (Table 3). In comparison to *dalipura* village where farmers are less aware of the advance conservation measures, due to low access, weak communication and awareness of benefits received from the conservation measures.

Table 3: Soil and water conservation practices adopted/constructed at your farm (Vill : Jigna)

Sl. No.	Conservation structure	Year	Status	Govt. /Private	Self	Help in mitigating the effects of Climate Change		
						Fully	Some What	Not at All
						Frequency (%)	Frequency (%)	Frequency (%)
1	Bunding	2017	working		Self	20	65	15
2	Broad bed furrow		-		Self	20	60	20
3	Farm Pond		working	Govt.	Self	42	45	13
4	Summer Ploughing	2017	working		Self	12	50	38
5	Bore well Recharge Pit	2012	working		Self	38	42	20
6	Naala bund	2007	working	Govt.		8	48	44
7	Check Dam	2007	working	Govt.		12	45	43

Table 4: Soil and water conservation practices adopted/constructed at your farm (Vill :dalipura)

Sl. No.	Conservation structure	Year	Status	Govt. /Private	Self	Help in mitigating the effects of Climate Change		
						Fully	Some What	Not at All
						Frequency (%)	Frequency (%)	Frequency (%)
1	Bunding	2017			Self	20	35	45
2	Farm Pond	2014		Govt.	Self	40	45	15
3	Summer Ploughing	2017			Self	45	20	35

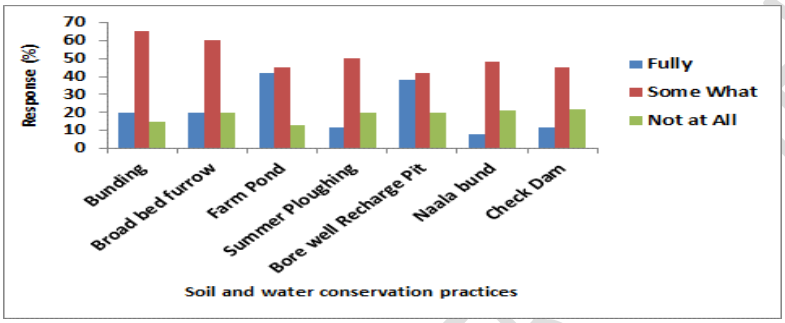

Fig 7: Soil and water conservation practices help in mitigating climate change

Figure 7 shows the response of the farmers towards soil and water conservation measures, in terms of how these practices help in mitigating climate change. As indicated in figure majority of respondents agree these practices somewhat helpful in addressing the climate change issue.

CONCLUSION

Respondents of *Jigna* village (under watershed area) are reported to be more aware about impact of climate change (temp., rainfall, wind velocity) as compared to *Dalipura* village. Farmers from village *Dalipura* are reported to be more effected (in terms of reduce crop yield, milk yield, rainfall, ill health) as compared to watershed village *Jigna*.Farmers from both villages were reported deforestation, intensified industrialize and air pollution as reason for consequence of climate change. Intensify research efforts and Enlightenment campaign as efforts to overcome climate change are reported by majority of respondents.Changes in existing cropping pattern suggested as coping-strategies for climate change. Number of

conservation measures adopted by the respondents higher in case of watershed village *Jigna* as compared to non-watershed village.

Comment [HLL4]: Why you compare these two villages. And, could you please discuss or mention why the respondents of Jigna village are reported to be more aware about the impact of climate change as compared to Dalipura village.

REFERENCES

[1] Sharma, S. K. & Chauhan, R., 2011. Climate Change Research Initiatives: Indian Network for Climate change assessment. Current Science, 101(3), pp. 308-311. 3

[2] Gosain, A. K., Rao, S. & Arora, A., 2011. Climate change impact assessment of water resources in India. Current Science, pp. 356-371

[3] Tripathi, A.; Mishra, A.K. Knowledge and passive adaptation to climate change: An example from Indian farmers. Clim. Risk Manag. 2017, 16, 195–207.

[4] Shrestha, R.; Rakhal, B.; Adhikari, T.R.; Ghimire, G.R.; Talchabhadel, R.; Tamang, D.; KC, R.; Sharma, S. Farmers' Perception of Climate Change and Its Impacts on Agriculture. Hydrology 2022, 9, 212

[5] Conde, C.; Ferrer, R.; Orozco, S. Climate change and climate variability impacts on rainfed agricultural activities and possible adaptation measures. A Mexican case study. Atmósfera 2006, 19, 181–194

[6] Bryan, E.; Deressa, T. T.; Gbetibouo, G. A. and Ringler, C. (2009). Adaptation to climate change in Ethiopia and South Africa: options and constraints. Envir. Sci. & policy, 12(4) : 413-426.

[7]IPCC. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part a: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press; 2014. p. 1132

[8] Cho SJ, McCarl BA. Climate change influences on crop mix shifts in the United States. Scientific Reports. 2017;7:40845. DOI: 10.1038/srep40845

[9] Fei CJ, McCarl BA, Thayer AW. Estimating the impacts of climate change and potential adaptation strategies on cereal grains in the United States. Frontiers in Ecology and Evolution. 2017;5:62. DOI: 10.3389/fevo.2017.00062

[10].US EPA. Climate Change Indicators: Length of Growing Season [Internet]. 2016. Available from: https://www.epa.gov/climate-indicators/climate-change-indicators-length-growing-season [Accessed: 2017-08-22]

[11]JE M, McCarl BA, Wein AM. Adaptation to climate change: Changes in farmland use and stocking rate in the U.S. Mitigation and Adaptation Strategies for Global Change. 2013;18:713-730. DOI: 10.1007/s11027-012-9384-4

[12] Alauddin, M. and Sarker, M.A.R. (2014). Climate change and farm-level adaptation decisions and strategies in droughtprone and groundwater-depleted areas of Bangladesh: an em

[13] Zeweld, W.Van; Huylenbroeck, G.; Tesfay, G. and Speelman, S. (2017). Smallholder farmers' behavioural intentions towards sustainable agricultural practices. J. Envir. Mgt., 187 : 71-81

[14] Deressa, T.; Hassan, R.M.; Alemu, T.; Yesuf, M.; Ringler, C. (2008). Analysing the determinants of farmers' choice of adaptation methods and perceptions of climate change in the nile basin of Ethiopia. International Food Policy Research Institute (IFPRI) Discussion Paper No. 00798. Environment and Production Technology Division, IFPRI, Washington D.C