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Abstract

The study aimed to assess paddy cultivating marginalized farmers' perceptions of climate change, impacts, and adaptation strategies in Chandrapur district, central India. Purposive sampling was carried out to identify 70 marginalized farmers from the study area in the year 2020. A specially designed and developed questionnaire was used as a tool to elicit the information from the respondent. From the identified sample population, the maximum number of farmers (35.71%) are illiterate and don't have a cell phone (57.14%). They have borrowed money to carry out agricultural activities from one or other source specifically from moneylenders (84.28%) followed by government banks (37.14%). Climate change perceptions by these farmers are well understood and clear and reported rain pattern change (85.71%) and high/low temperature (74.28%) as an important one. Crop residue burning is considered a major (94.28%) agricultural activity responsible for climate change. Impacts of climate change on agriculture, in general, is in the order of crop growth reduced > production reduction > irrigation water scarcity > soil fertility reduction > poor quality yield > late/no seed germination. Impacts on paddy cultivation, in particular, are increased insect/pest attack, yield quality deterioration, and food production reduced. Quantity of surface water decrease is reported by 87.14% respondent. The cost of insecticide/pesticide used is increased in the range of 21-40% (38.57%). Impacts of climate change on livestock are pronounced and include heatstroke (82.35%), vector-borne diseases (61.76%), production loss (50%), and death due to heatstroke (35.29%). Adaptation strategies are poorly developed with a desire for a better weather forecast (97.14%) and changing cropping patterns (74.28%). Future adaptation strategies involved an emphasis on high-yielding crop varieties, crop diversification, irrigation water use change, water storage methods, etc. The climate change-induced problems faced by these marginalized farmers are well defined and different from other farmer categories and needs a holistic approach to overcome it. Sustainable adaptation strategies emphasize on climate smart agriculture is the need of the hour to pave the way for sustainable agriculture and sustainable livelihood. This may be perhaps the first study with this aim from the region.

Keywords: Central India, Chandrapur, Climate change, Climate smart agriculture, Marginalized farmers, Paddy cultivation, Rice.

INTRODUCTION

Impacts of climate change on agriculture are being witnessed all over the world. India is more vulnerable to climate change due to its profound reliance on agriculture as 70% of the population lives in rural areas and agriculture is the primary source of livelihood. Small and marginalized farm holdings are dominated in Indian agriculture with an average farm size of 1.23 hectare (ha). Agriculture contributes 13.7% of the gross domestic product of India. Over the past 100 years (1901-2007) India has observed warming trends with 0.51oC.[1]

Climate change will have adverse impacts on agriculture in near future. However, different farmers owing to their landholding have the variable capacity to overcome them. Marginalized farmers—with landholding < 1.0 ha (2.5 acres)- are more vulnerable to climate change impacts. As their weak purchasing capacity, socio-economic status, landholding, crop failure, and vagaries of climate change makes them more prone to impacts of climate change.

Across the globe, 50% of the population depends upon rice as the staple food. Livelihood and employment are provided to millions of people by cultivating rice as being a labour-intensive crop. An increase in rice production has been witnessed due to the Green Revolution in many countries across the globe. In India, rice production has reported increased production alongside an increase in input use. Manifold increase in the use of the high yielding varieties (HYV), synthetic fertilizers, insecticides, and pesticides are reported particularly from irrigated agriculture.[2]

By the year 2030, to feed the population it is estimated that 130 million tons of rice will be required. Rice area under cultivation in India is 44 million ha (26.3% of the world rice area in 2017) and ranks first in the area and second in production (169 million tons). Of the world's irrigation water, 34-43% is utilized for cultivating rice.[3] Rice productivity in selected south Asian countries is presented in Table 1. From the table, it can be seen that India's rice productivity is lower than in other countries. A significant increase in rice production has been achieved in India from 1.1 tons/ha in 1965 to 2.33 tons/ha in 2011 although much lower than countries like Egypt, China, Japan, and Korea.

Table 1: Rice productivity in selected south Asian countries

Country	Rice productivity (kg/ha)
India	3590
China	6686
Bangladesh	4219
Myanmar	4081

The decadal trend in rice area, production, and productivity in Maharashtra and India is presented in Table 2. Domestic consumption contributes to 90% of rice consumption in India. By the year 2021-22, rice demand will be 113. Three million tons[4] with the increasing demand for rice in these climate change conditions, it becomes essential that rice productivity and production should be increased to a higher level.

1 Kumar, Krishna. "Impact of climate change on India's monsoon climate and development of high-resolution climate change scenarios for India", MoEF, New Delhi, October 2009.
2 Gujja, Biksham, and T. M., Thiyagarajan. "New hope for Indian food security? The system of rice intensification." Gate Keeper 143, International Institute for Environment and Development, November 2009.
3 Bouman, Bas, et al. "Rice: feeding the billions." In Molden D (ed) Water for food, water for life: a comprehensive assessment of water management in agriculture, London, UK: Earthscan; Colombo, Sri Lanka: IWMI., 2007, pp. 515-549.
4 Kumar, Praduman, et al. "Demand projections for food grains in India." Agricultural Economics Research Review, vol. 22, no. 2, July 2009, pp. 237-243.

Table 2: Decadal trend in rice area, production, and productivity in Maharashtra and India

State/Country	1970s	1980s	1990s	2000s	2010s	Overall period 1970-71 to 2012-12
Area (million ha)						
Maharashtra	1.402 (1.686)	1.505 (-0.092)	1.524 (-0.72)	1.522 (-0.020)	1.563	1.491 (0.239)
India	38.639 (0.876)	40.654 (0.413)	43.201 (0.654)	43.404 (-0.017)	43.081	41.586 (0.369)
Production (million tons)						
Maharashtra	1.741 (6.932)	2.176 (-45.486)	2.322 (0.499)	2.416 (1.466)	3.078	2.227 (1.318)
India	44.759 (1.901)	59.775 (3.616)	80.338 (2.031)	89.166 (1.591)	100.127	70.715 (2.312)
Productivity (kg/ha)						
Maharashtra	1229.00 (5.153)	1443.4 (-0.579)	1591.6 (2.115)	1586.8 (1.494)	1852.6	1489.9 (1.046)
India	1156.3 (1.013)	1467.1 (1.371)	1858.2 (1.371)	2052.3 (1.606)	2357.6	1648.0 (1.948)

Note: Figures in parentheses indicate estimated compound growth rates 1970s: 1970–71 to 1979–80; 1980s: 1980–81 to 1989–90; 1990s: 1990–91 to 1999–2000s: 2000–01 to 2009–10; 2010s: 2010–11 to 2012–13 Compound growth rates for 2010s not worked out due to limited data.

Maharashtra state's Vidarbha region has a larger extent of paddy area under production; however, its productivity is very low when compared to other regions of the state. Salinity, poor adoption of HYV's, low soil fertility, inefficient water management, suboptimal level of fertilizer use, dry spells at critical stages, and poor resource base of farmers are important constraints that affect productivity. Additionally, erratic rainfall particularly during the Kharif season also affects significantly.[5]

According to Lal et al., (1998) rice crop is sensitive to increase in minimum temperature.[6] For every 1oC increase in temperature, rice yield may decline by 6%.[7]

Rice yield could decrease by 0.75 ton/ha (in the high yielding area) and 0.6 ton/ha (in the low yield area) due to an increase of mean air temperature by 2oC.[8] Spikelet sterility and an increase in instability of the rice yield due to an increase in temperature during flowering are reported by Matsui and Omasa (2002).[9]

Barnwal and Kothari (2013) observed studies (Cline, 2007, Aggarwal, 2008) that reported negative impacts on rice production in India.[10,11,12] Chandrapur district is the rice bowl of the Maharashtra state. According to the World Bank report, seven out of the top 10 most-affected hotspot districts in India under the carbon-intensive scenario in 2050 belong to the Vidarbha region of Maharashtra state, and Chandrapur

[5] Thaware, B., et al. "Status paper on rice in Maharashtra". http://www.rkmp.co.in

[6] Lal, Murari, et al. "Vulnerability of rice and wheat yields in NW - India to future changes in climate." Agricultural and Forest Meteorology, vol. 89, 1998, pp. 101-114, doi:10.1016/S0168-1923(97)00064-6.

[7] Saseendran, S.A., et al. "Effects of Climate Change on Rice Production in the Tropical Humid Climate of Kerala, India." Climatic Change, vol. 44, 2000, pp. 495-514, doi:https://doi.org/10.1023/A:1005542414134.

[8] Sinha, S. K., and M. S., Swaminathan. "Deforestation, climate change and sustainable nutrition security." Climatic Change, 19, 1991, pp. 201-209.

[9] Matsui, Tsutomu, and Kenji, Omasa. "Rice (Oryza sativa L.) Cultivars Tolerant to High Temperature at Flowering: Anther Characteristics." Annals of Botany, vol. 89, no. 6, June 2002, pp. 683-687, doi:https://doi.org/10.1093/aob/mcf112.

[10] Barnwal, Prabhat, and Koji, Kotani. "Climatic impacts across agricultural crop yield distributions: An application of quantile regression on rice crops in Andhra Pradesh, India." Ecological Economics, vol. 87, no. C, 2013, pp. 95-109.

[11] Cline, William. "Global Warming and Agriculture: Impact Estimates by Country." Peterson Institute for International Economics. no. 4037, January 2007.

[12] Aggarwal, P. "Global climate change and Indian agriculture: impacts, adaptation and mitigation." Indian Journal of Agricultural Sciences, vol. 78, 2008, pp. 911-919.

district is at the first position.[13]

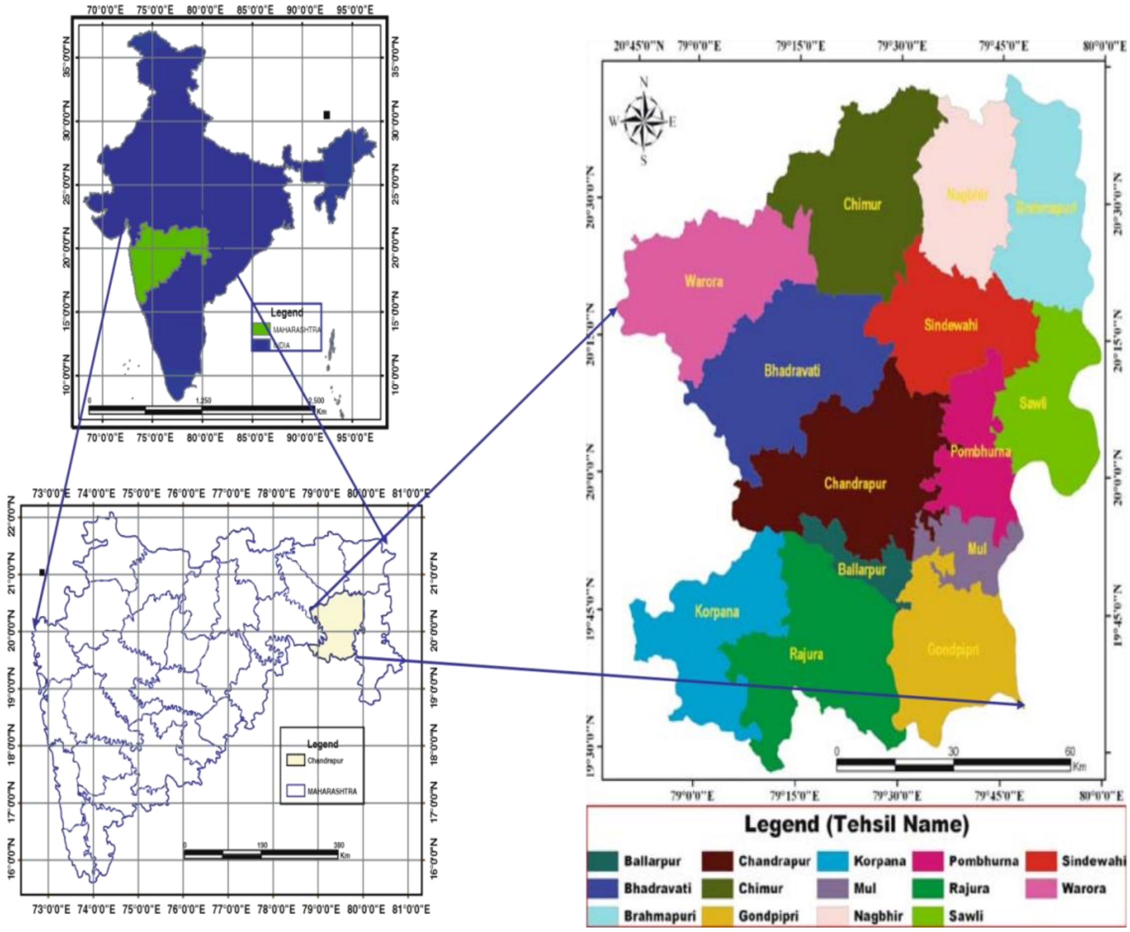


Figure 1: Chandrapur district with different administrative blocks in central India.[14]

Marginalized farmers in India are neglected. If due attention is not given to this category of a farmer, it will have direct irreparable consequences on the economy, agricultural output, and society at large. Online and print literature review revealed a paucity of studies on marginalized farmers' perceptions of climate change, impacts, and adaptation strategies in the study area and thus this understanding gap exists. This study aims to assess marginalized farmers' perceptions of climate change, impacts, and adaptation strategies adopted and willing to use in the future. This study outcome will add new understanding to these aspects especially in the paddy crop. Besides, it will shed light on problems faced by this farmer category which is different from the other categories of farmers. The outcomes will also help to anticipate secondary and tertiary impacts of these aspects specifically on farmers' suicide and debit-ridden. Furthermore, it will help in new climate change policy formulation in the future, development, and adaptation of climate smart agriculture technologies, scientific interventions, and other economic/social measures to be initiated for these farmers.

Study area Chandrapur district (19o25' N to 20o45' N and 78o50' E to 80o10' E)[15] is situated in the Vidarbha region of Maharashtra state of central India (Figure 1). It has a dry and sub-humid climate with

[13] Mani, Muthukumara, et al. "South Asia's Hotspots: The Impact of Temperature and Precipitation Changes on Living Standards." June 2018, pp. 125, doi:10.1596/978-1-4648-1155-5.

[14] Satapathy, Ranjan Deepty, et al. Spatial distribution of metals in ground/surface waters in the Chandrapur district (Central India) and their plausible sources. Environmental Geology, vol. 56, no. 7, 2009, pp. 1323-1352.

[15] Chandrapur district: https://www.researchgate.net/figure/Chandrapur-district-with-administrative-blocks-41_fig1_342863121 (25th June 2021)

an annual average rainfall of 1142 mm. The soil profile is medium to deep red and black soil with the lime mix, yellow. The district is divided into the agro-climatic zone of the Eastern plateau and hill region. The net available recharge of groundwater is 102965.41 ha meter and 12563.69 ha meter as a net annual draft which results in a balanced potential of 81680.28 ha meter. Out of the net sown area of the district 4,51,500 ha, rice is cultivated in 1,82,000 ha (2013-14) and 1,61,000 ha (2014-15) with average yield of 1,111 kg/ha. Of the total cultivators, small/marginalized farmers contributes 1,42,000 (64.5%). Landholding classification indicates marginalized farmers hold 37% of the land (1,13,227 nos.) with an area of 62,750 ha (12% of total). The social profile of the inhabitant is dominated (3,24,000, 22.68%) by Scheduled Tribe (ST) in the rural area.[16]

The total area available for irrigation (net irrigated area and fallout) is 1,42,600 ha; whereas the area irrigated by canals/channels is 50,889 ha, wells 12,727 ha and by other sources is 52,569 ha. Total nitrogen/phosphorous/potassium utilization was 1,13,296 metric tons (MT) and certified seed supplied was 8105 MT. The district has two soil testing centres. The number of agro-processing units for the availability of godown is 290 with a capacity of 69,500 MT. According to Animal Population Census 2007, the district was dominated by cattle-indigenous, goat, and poultry-indigenous (www. nabard.org).[17]

METHODOLOGY

To assess marginalized farmers' perceptions of climate change, perceived impacts on paddy cultivation, and adaptation behaviour and capacity, 70 marginalized farmers from the Chandrapur district of Maharashtra state of central India were identified as sample population. The various villages covered under the study include Malmla, Nimbada, Borda, Ghanta Chowki, Pimpalkhuta, Ajaypur, and Lohara. The study was carried out in 2020. Purposive sampling was used to identify the sample population. The inclusive criterion for it was those farmers which have agricultural land size < 1.0 ha (< 2.5 acres). The quantitative approach was used for data collection. Primary data was collected by eliciting the information from these farmers in a specially designed and developed questionnaire that emphasized climate change perceptions, impacts assessment during sowing, crop growth, post-harvest, livestock, and adaptation strategies used and planned to execute in the future. Likert scale was used for the responses of the questions to get quantitative and comparable responses. The collected data was analysed with the help of SPSS. Secondary data viz. study area, climate, rainfall, demographic profile, etc. were gathered from government databases such as Census of India, and India Meteorological Department.

RESULTS

Profile of the sample population

Of the 70 marginalized farmers identified for this study, 97.14% (n = 68) were male and 2.85% (n = 2) female. The major occupation of these farmers is paddy cultivation (100%) followed by farm labours in other farmers' farms (95.71%) and livestock rearing (48.57%). They are engaged in rainfed paddy cultivation (90%) and only 10% had irrigation facility. In the field activities, they receive assistance from their family members, especially from their wife (57.14%) and other farm labourers (51.42%). Maximum farmers (82.85%) carry out crop cultivation activity twice a year. Of the total farmers, 35.71% were illiterate and 30% had primary education and stays in a nuclear family (72.85%). Maximum (92.85%)

[16] Census of India, 2011. Chandrapur district profile. Directorate of Census Operation, Maharashtra. Ministry of Home Affairs, Government of India, Mumbai. 2011. pp. 1-43.

[17] Census of India, 2001. Chandrapur district profile. Directorate of Census Operation, Maharashtra. Ministry of Home Affairs, Government of India, Mumbai. 2001. pp. 1-96.

farmers own the agricultural land on which paddy cultivation is being carried out, whereas 4.28% had it on a lease basis. Only 4.28% had soil health cards and 94.28% never tested farm soil quality. Cell phone use profile of farmers indicates, 57.14% farmers don't use a cell phone and of the remaining (42.85%), 34.28% had a feature phone and only 8.57% had a smartphone. Of the study population, 91.42% belongs to below poverty line (BPL) and all farmers had ration cards and purchase food gains from government outlets. Monthly electricity consumption for domestic purpose is maximum in the range of Rs. 251-500 (US$ 3.25-6.49) 72.85% and less than Rs. 250 (US$ 3.24) 21.42%.

Perceptions of climate change

Marginalized farmers' perceptions regarding environmental aspects they have experienced as varying due to climate change are depicted in Figure 2. Maximum

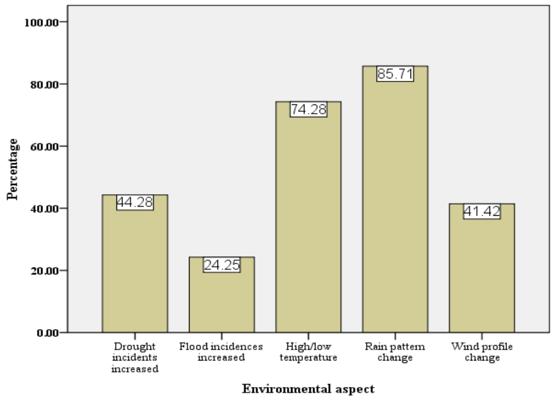


Figure 2: Climate change perceptions for the in various environmental aspects

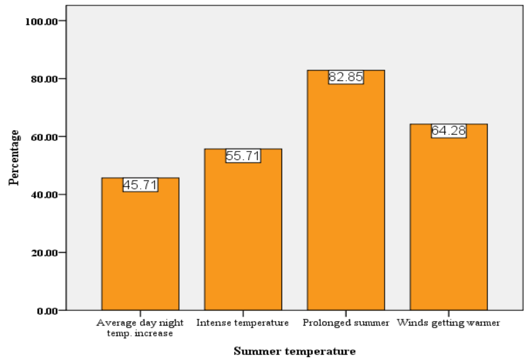


Figure 3: Climate change perceptions summer season

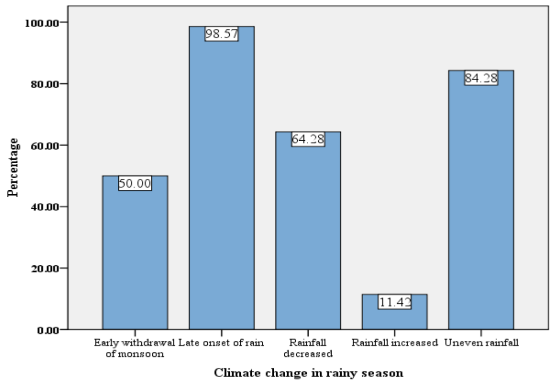


Figure 4: Climate change perceptions for the rainy season,

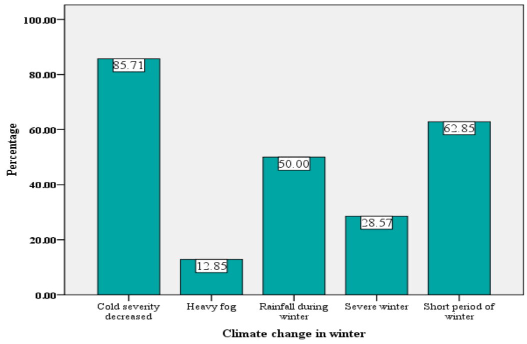


Figure 5: Climate change perception for the winter season

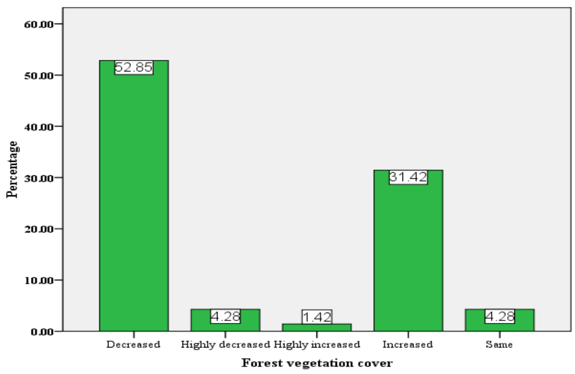


Figure 6: Climate change perception for forest vegetation cover,

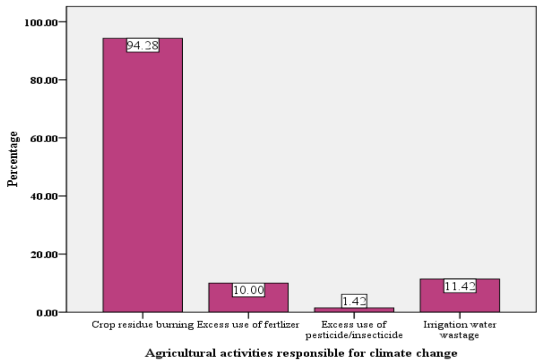


Figure 7: Agricultural activities responsible for climate Change

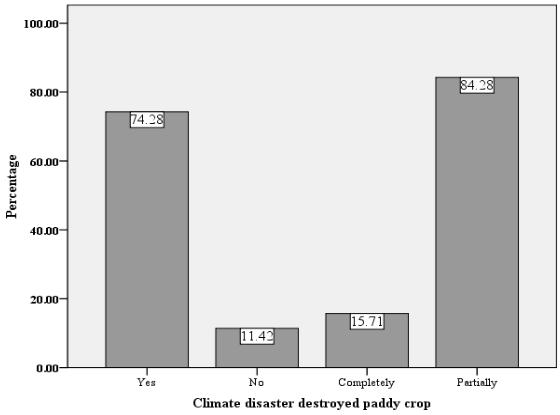


Figure 8: Climate change destroyed the paddy crop

Production loss is (85.71%) farmers reported rain pattern change followed by high/low temperature (74.28%). Prolonged summer (82.85%) and winds getting warmer (64.28%) are reported in summer (Figure 3). In the case of the rainy season (Figure 4) late onset of rain (98.57%) followed by uneven rainfall (84.28%) is reported. A decrease in cold severity (85.71%) and a short period of winter are important changes reported by farmers in winter (Figure 5). Forest vegetation cover decreased (52.85%) in the last ten years is another observation reported by them (Figure 6). Of the different causes responsible for climate change, crop residue burning (94.28%) is perceived as a major agricultural activity responsible for it (Figure 7). Destruction of paddy crop by climate change is reported by 74.28% of farmers whereas 84.28% reported partially (Figure 8).

Perceived impacts of climate change on paddy cultivation

Impacts of climate change on various paddy related agricultural activities revealed, soil moisture reduction (52.85%) followed by increased soil erosion (32.85%) (Figure 9). In the case of impacts on irrigation, the quantity of surface water (87.14%) and quality (75.71%) faced maximum impacts. On the contrary, groundwater quality and quantity are marginally affected (Figure 10). Figure 11 depicts the effects of less irrigation water on paddy cultivation. From the figure, it can be seen that insect/pest attacks increased (98.57%) followed by productivity reduction (82.85%) and poor quality of yield (78.57%). Impacts of climate change on agriculture (Figure 12) reported crop growth reduction (97.10%), production reduction (94.28%), irrigation water scarcity (88.57%), and reduction in soil fertility. Figure 13 presents impacts of climate change on paddy production with 100% reporting insect/pest attack increased, the quality deteriorated (97.14%) and production reduced (70.10%). Paddy cultivation per acre in the last five years is presented in Figure 14. Farmers have reported a decrease (71.42%) in paddy yield and this is in the range of 21-40% (57.14%), whereas 0-20% is reported by 32.85%.

Cost of insecticide/pesticide use during paddy cultivation is increased in the range of 21-40% (38.57%) and 21-40% (57.14%) (Figure 15). In the case of profit received from the farm (Figure 16) 88.57% farmers reported a decrease in profit and it was in the range of 0-20% (71.42%). Effects of climate change on livestock are reported as heatstroke (82.35%) and death due to it (35.29%). Monsoon season has adverse impacts on livestock (82.35%), vector-borne diseases increased (61.76%) and reported by 50% (Figure 17). To manage the challenges posed by climate change farmers are taking loans from various sources (Figure 18). Maximum farmers (84.28%) borrow money from moneylenders followed by government banks (37.14%) and loans against mortgages of gold jewellery (37.14%).

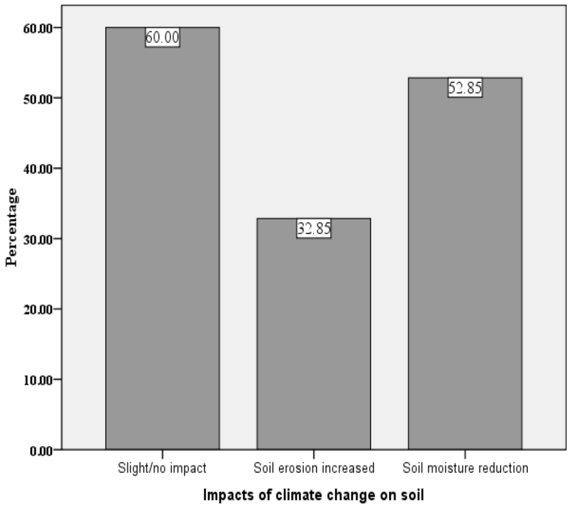


Figure 9: Impacts of climate change on soil

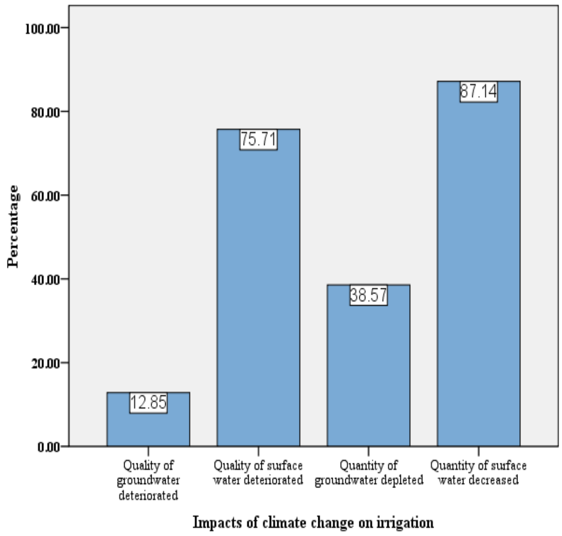


Figure 10: Impacts of climate change on irrigation

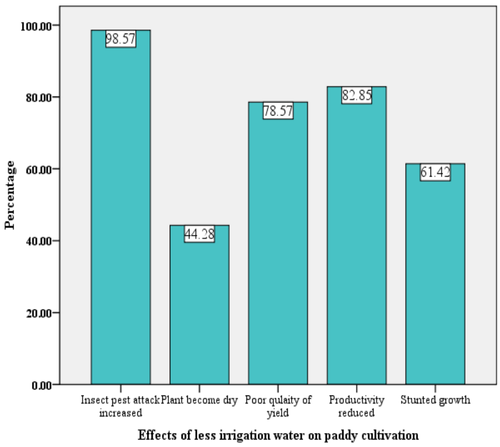


Figure 11: Effects of less irrigation water on paddy cultivation

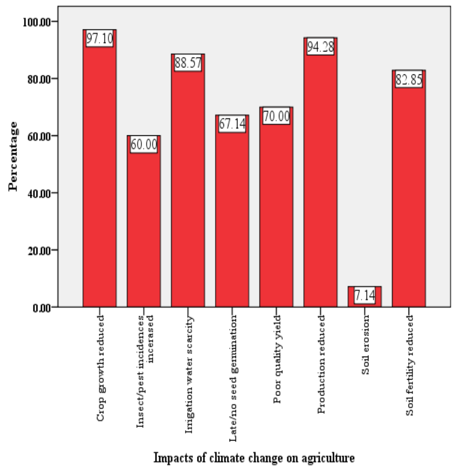


Figure 12: Impacts of climate change on agriculture

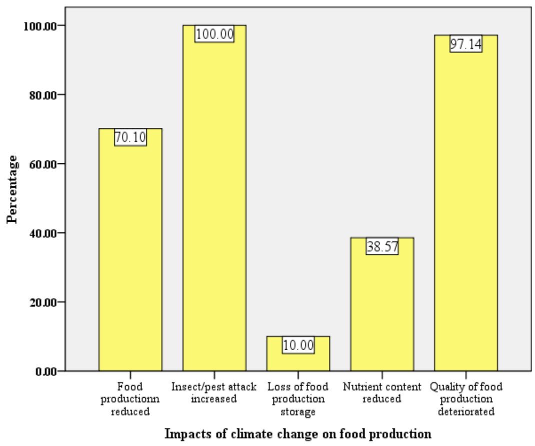


Figure 13: Impacts of climate change on paddy production

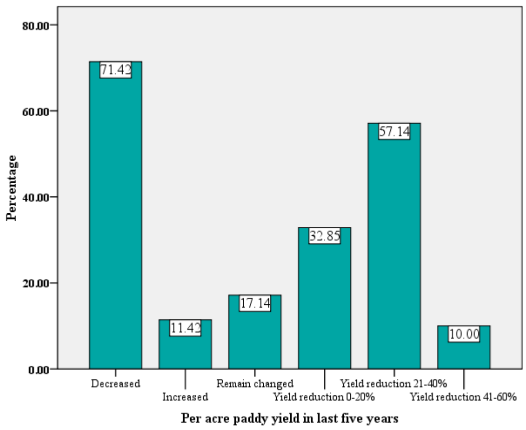
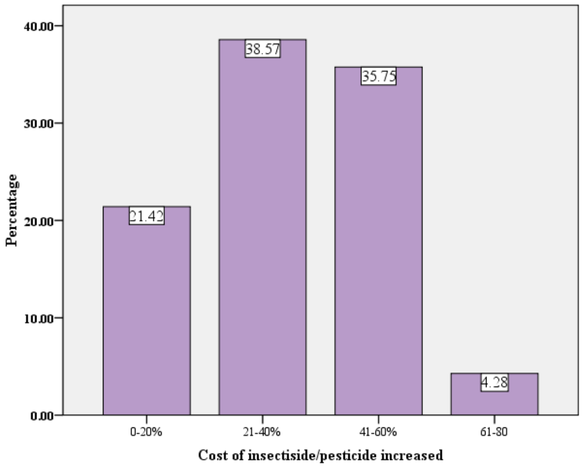


Figure 14: Per acre paddy yield in last five years



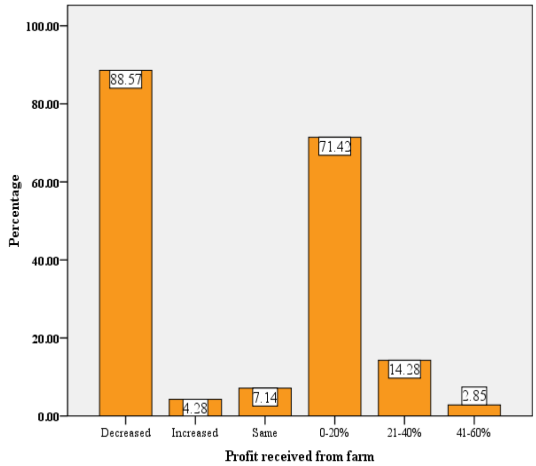
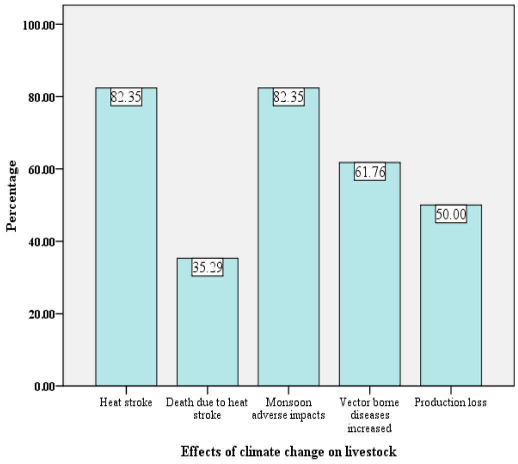


Figure 15: Cost of insecticide/pesticide in paddy cultivation, **Figure 16:** Profit received from paddy cultivation



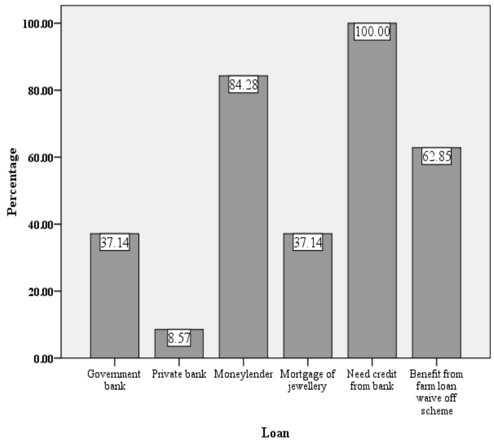
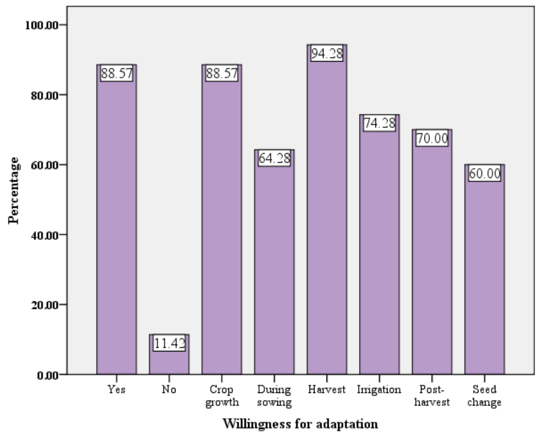


Figure 17: Impacts of climate change on livestock with paddy cultivator

Figure 18: Loan facility availed by paddy cultivators

Adaptation behaviour and capacity

Farmers' willingness for adaptation to climate change is reported by 88.57% (Figure 19). This willingness is in the order of harvest (94.28%) > crop growth (88.57%) > post-harvest (70%) > during sowing (64.28%). Furthermore, maximum willingness is reported in irrigation (74.28%) followed by seed change (60%). To cope up with climate variability farmers have a desire for a better weather forecast (97.14%) followed by a change in cropping pattern/crop management (74.28%). Farmers are reluctant to adopt new cropping technology (8.57%) (Figure 20). Measures to be taken for effective water management during climate change (Figure 21) includes an adaptation of rainfed crop (91.42%) followed by the restoration of traditional rainwater harvesting techniques (52.85%). Modern rainwater harvesting technology has received a poor response (5.71%). To manage the water demand during non-availability season (Figure 22) is most relied on purchase water (25.71%) followed by nearby river/canal (22.85%). Future adaptations for climate change are depicted in Figure 23. From the figure it can be seen that it is in the order of high yielding crop varieties (100%) > crop diversification (92.85%) > irrigated crops (68.57%) > water use change (64.28%) > water storage method (60%).



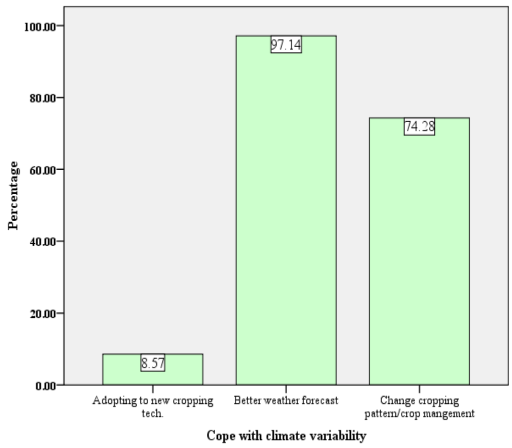


Figure 19: Willingness for climate change adaptation strategies climate

Figure 20: Paddy cultivator's with coping change

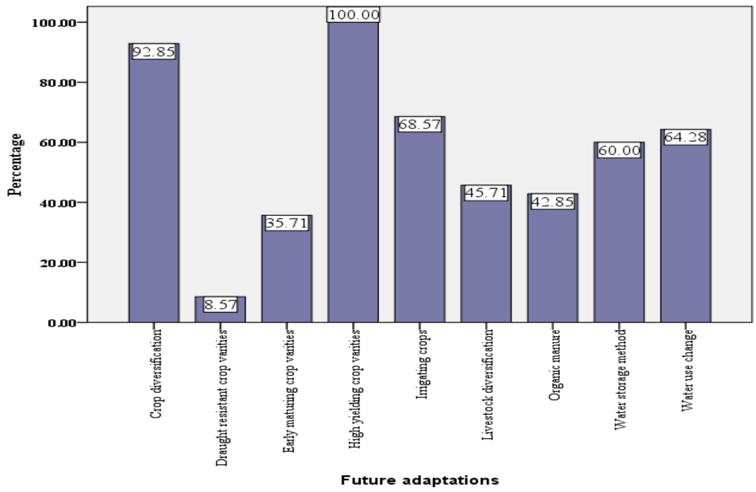


Figure 23: Future adaptation strategies for climate change

DISCUSSION

From the results obtained in this study, it can be stated that marginalized farmers' way of looking at and understanding climate change is very clear and are witnessing the same in the study area from the last few years. The results corroborate with Mertz *et al*., (2009), Banerjee (2014), Panda (2016), Putriawanti and Asai (2016).[18,19,20,21] The same result also found by Rahman and Alam (2016), Sambonsuke *et al*., (2016), Makuvora *et al*., (2018), Jamshidi *et al*., (2019).[22,23,24,25] However, the

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[25] Jamshidi, Omid, et al. "Vulnerability to climate change of smallholder farmers in the Hamadan province, Iran." Climate Risk

results are contradictory to Azhoni and Goyal (2018) which reported farmers were less aware of climate change.[26]

The crop residue burning and irrigation water wastage are identified as agricultural activities responsible for climate change. Banerjee (2014) found this climate change is due to the cutting down of trees and pollution and few respondents thought due to global warming.[27] Jamshidi *et al.*, (2019) found that smallholder farmers have acclaimed this phenomenon to be caused by human activity.[28]

Watanabe and Kume (2009) reported a direct effect on rice plant growth in paddy cultivation in Japan.[29] The same observations are also reported by respondents from the study area. Rahman and Alam (2016) reported increased dieback and mortality of seedlings, pests, and diseases.[30] These results are in agreement with the results obtained from the study area. Late or no seed germination is one of the major climate change impacts on agriculture (67.14%) identified from the district.

Reduction in surface water quantity is reported by farmers from the study area. This observation was also noticed by Banerjee (2014).[31] Enhanced insect/pest attack observations are in agreement with Banerjee (2014) and Harvey et al., (2014).[32,33] An increase in both crop and animal diseases as reported by Panda (2016) corroborates with the results obtained in this study.[34]

Agricultural adaptation strategies to be used by farmers include a change in cropping patterns, adaptation to rainfed crop, restoration of traditional rainwater harvesting techniques is also reported by Akinnagbe and Irohibe (2014).[35] Selling household assets is one of the coping measures reported by Aniah et al., (2019) is also observed from the study area.[36] Farmers raise money for agricultural activities by mortgage of wife's jewellery.

CONCLUSION

This study addresses perceptions of climate change, impacts, and adaptation strategies of paddy cultivating marginalized farmers in the region. Conclusions drawn from the results obtained in this study highlight that farmers' perceptions of climate change are well developed and clear and coherent with existing scientific knowledge generated through R&D. Impacts of climate change on paddy cultivation are witnessed by these farmers. These impacts are during the germination/initial stage, crop growth, and harvesting which has resulted in yield reduction. Moreover, impacts on livestock

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Management, vol. 23, 2019, pp. 146-159.

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[31] Banerjee, Rupsha. "Farmers' perception of climate change, impact and adaptation strategies: a case study of four villages in the semi-arid regions of India." Natural Hazards, vol. 75, no. 3, February 2015, pp. 2829-2845.

[32] Ibid.

[33] Harvey, Celia A, et al. "Extreme vulnerability of smallholder farmers to agricultural risks and climate change in Madagascar." Philosophical transactions of the Royal Society of London. Series B, Biological sciences, vol. 369, no. 1639, Feb. 2014, doi:10.1098/rstb.2013.0089.

[34] Panda, Chandan. "Marginal and Small farmers' Climate Change Perception and Adaptation." International Journal of Agriculture, Environment and Biotechnology, vol. 9, no. 5, November 2016, pp. 839-846, doi:10.5958/2230-732X.2016.00108.X.

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particularly on cows and buffalos have been reported. These impacts may have other secondary or tertiary effects on these farmers' life which will threaten their livelihood security. Adaptation strategies engaged by these farmers are not well developed as several farmers are uneducated or less educated, technologically not well off and debit-ridden.

To overcome the adverse impacts of climate change on paddy cultivation, climate smart agriculture adaptation strategies involving crop level adaptation viz. agronomic, land and water management, genetic improvement, etc. and other types of adaptation measures viz. economic, policy and technical need to be integrated and use. Furthermore, the problems faced by these marginalized farmers due to climate change are quite different from other categories of farmers due to their poor socioeconomic status, marginalized land holding, weak purchasing capacity, debits, etc. Thus, at the policy formulation level special attention to reduce their vulnerability and enhance their capacity for resilient farming is required thus to pave the way for sustainable agriculture and sustainable development. To have a comprehensive understanding of the study topic a pan-India study on marginalized farmers cultivating paddy needs to carry out in the future.

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