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A Study on Constraints Experienced by Farmers in Adaptability Measures to climate change

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ABSTRACT

Climate change and variability are concerns of human being. The recurrent droughts and floods threaten seriously the livelihood of billions of people who depend on land for most of their needs. The study determines the constraints experienced by the farmers in adaptability measures to climate change in Aravalli region.. The research findings revealed that (90%) of respondents said lack of information about climate change, lack of knowledge about appropriate adaptations (83.33%) and low price of the produce in market (80.83%) as the major constraints. The non availability of timely inputs (79.16%), irregularity in electricity supply (77.08%), lack of storage facility of produce, higher cost of the agricultural inputs and irregularity of extension services were the major institutional and technological constraints. The study suggested that improving information access on climate risk management, access of institutional credit facility, and capacity building programmes strengthens the famers' adaptation capacity under changing climate.

1 Introduction

Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use (IPCC 2012). Changing climatic conditions are causing significant impacts on livelihoods, food security, health, economic opportunities and the survival of humanity, especially in developing countries like that India. The past few decades indicate that significant changes in climate at a global level were the result of enhanced human activities that altered the composition of the global atmosphere (IPCC, 2007). As greenhouse-gas emissions in the atmosphere are increasing, global warming will be above 2°C by mid 2100s. The temperature is also rising due to the greenhouse effect, with every 1°C rise in temperature, there will be a 7 per cent increase in the intensification of extreme rain events (IPCC, 2018). Climate is one of inputs for agricultural growth and survival of related population. Total annual crop losses in the world agriculture are mainly due to direct weather impacts. United Nations environment programme (UNEP) declared that Carbon dioxide (CO_2) is the principal cause of climate change because of its highest contribution in global warming and other greenhouse gases also affected viz. Methane (CH_2), Nitrous oxide (N_2O) and Chloro fluoro carbons (CFC) due to fossil fuel burning, rapid industrialization and deforestation as a result of average global temperature are increasing.

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Green House Gas emissions or Climate change

Changes in climate patterns are mainly caused by GHG emissions. The main sources of such emissions are natural systems and human activities. Natural systems include forest fires, sun spot/solar spot, earthquakes, oceans, permafrost, wetlands, volcanoes (Yue and Gao 2018), while anthropogenic/human activities are industrial activities, deforestation and chemical use of fertilizers in agriculture and land use and land-use change (Edenhofer et al. 2014). So far, anthropogenic activities have caused about 1.0 °C of global warming above the pre-industrial level and this is likely to reach 1.5 °C between 2030 and 2052 if the current emission rates persist. In 2018, the world encountered 315 cases of natural disasters which are mainly related to the climate. (Fawzy et al., 2020). Greenhouse gas emissions cause heat to be trapped by the earth's atmosphere, and this has been the main driving force behind global warming. The greenhouse gases widely discussed in the literature and defined by the Kyoto protocol are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and the fluorinated gases such as hydro fluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF6) (UNFCCC 2008). According to the emissions gap report (2019) prepared by the United Nations Environment Programme (UNEP) total greenhouse gas emissions in 2018 amounted to 55.3 GtCO2e, of which 37.5 GtCO2 are attributed to fossil CO2 emissions from energy production and industrial activities. An increase of 2% in 2018 is noted, as compared to an annual increase of 1.5% over the past decade for both rise of fossil CO2 emissions in 2018 is mainly driven by
higher energy demand. Furthermore, emissions related to land-use change amounted to 3.5 GtCO2 in 2018 (UNEP 2019). The Emissions Gap Report 2022 finds that the world is far off track to limiting global warming to 1.5°C, the most-ambitious target set out by the Paris Agreement and the world must cut emissions by 45 per cent to avoid global catastrophe. Solutions to transform societies exist, but the time for collective, multilateral action is now.

Climate change impacts

Impact of climate change on natural and human systems as well as the risks and associated vulnerabilities is an important starting point in comprehending the current state of climate emergency. Changes in climate indicators, namely temperature, precipitation, seal-level rise, ocean acidification and extreme weather conditions have been highlighted in a recent report by the United Nations Climate Change Secretariat (UNCCS). Climate hazards reported included droughts, floods, hurricanes, severe storms, heat waves, wildfires, cold spells and landslides (UNCCS 2019). According to present study revealed that the farm practices like sowing time, pesticide use and overall health of the crops were found cent percent negative impact of climate change on agriculture in Aravalli reason.

Global climate action

Climate change realities started in 1979 when the first world climate conference was held in Geneva. The world climate conference was introduced by the World Meteorological Organization in response to the observation of climatic events over the previous decade. The main purpose was to invite technical and scientific experts to review the latest knowledge on climate change and variability caused by natural and human systems as well as assess future impacts and risks to formulate recommendations moving forward (WMO 1979). This was possibly the first of its kind conference discussing the adverse effects of climate change. In 1988, the Intergovernmental Panel on Climate Change (IPCC) was set up by the World Meteorological Organization in collaboration with the United Nations Environment Programme (UNEP) to provide governments and official bodies with scientific knowledge and information that can be used to formulate climate-related policies (IPCC 2013). The average global temperature has increased at an average rate of 0.15–0.20 °C per decade since 1975 (NASA Earth Observatory, 2020), and is expected to increase by 1.4–5.8 °C by 2024 (IPCC, 2022). The average annual temperature of the earth's surface has risen over the last century. Perhaps, the most critical step taken, in terms of action, was the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, which then went into force in 1994. Since then, the UNFCCC has been the main driving force and facilitator of climate action globally. The main objective of the convention is the stabilization of greenhouse gas concentrations in the atmosphere to prevent severe impacts on the climate system. The convention set out the commitments to all parties involved, putting major responsibilities on developed countries to implement national policies to limit anthropogenic emissions and enhance greenhouse gas sinks. The target was to reduce emissions by the year 2000 to the levels achieved in the previous decade. Moreover, committing developed country parties to assist vulnerable developing country parties financially and technologically in taking climate action. The convention established the structure, reporting requirements and mechanism for financial resources, fundamentally setting the scene for global climate policy (UN 1992). The convent is currently ratified by 197 countries (UNCCS 2019).

India's National Action Plan on Climate Change (NAPCC)

Climate change is a global challenge with diverse implications at the national and subnational levels, through

impacts on various sectors such as agriculture, water resources, forestry & biodiversity, human health, energy and infrastructure. Such diverse impacts require a range of strategies to be deployed for an effective response and for better preparedness towards climate change. In 2008, a National Action Plan on Climate Change (NAPCC) for India was released by the Honourable Prime Minister. In view of the criticality of addressing the challenges posed by climate change along with the imperatives of poverty alleviation and economic growth for India, the NAPCC 'identifies measures that promote development objectives while also yielding co-benefits for addressing climate change effectively'. The focus of NAPCC is to improve the understanding of climate science, adaptation, mitigation, energy efficiency and natural resource management & conservation. The NAPCC, further sets eight priority missions to respond to climate change; these include National Missions on Solar Energy, Enhanced Energy Efficiency, Sustainable Habitats, Water, Sustaining the Himalayan Ecosystem, Greening India, Sustainable Agriculture and Strategic Knowledge for Climate Change, covering a range of response strategies.

State Action Plan on Climate Change

There is a need to achieve synergy between national priorities and state-specific strategies, given that in many cases the actions being discussed are State subjects and have to be implemented in the States. While adaptation by its very nature is localized in action, mitigation actions taken at the state level can tap on the opportunities that the State can benefit from or follow a co-benefits approach simultaneously buttressing national mitigation efforts. In this context, it becomes crucial to prepare State level action plans on climate change in order to address current and future climate risks and tap on potential opportunities through a diverse set of response strategies. The first step towards preparation of a detailed State Action Plan on Climate Change (SAPCC) is to identify state-specific risks & impacts and opportunities in the context of climate change. Thereafter, prioritize areas for research & policy action in response to identified current & future vulnerabilities and projected impacts of climate change. Effective policy design could be laid by juxtaposing identified strategies with national priorities and Missions. Keeping these in view, a field level study was conducted with the objective to study on Constraints Experienced by Farmers in Adaptability Measures to climate change in Aravalli region of Rajasthan.

2. Materials and Methods

2.1. Location of the study area

Present study was carried out in Udaipur, Bhilwara, Chittorgarh and Rajsamand districts of Sub-humid southern plain & Aravali hill zone, (Agro-ecologically the district has been part of Zone-IVA), of Rajasthan, India. This region has Sub-humid climate and have the soils; grey, brown loam, medium black, moderately deep with medium to heavy in texture. Average annual rainfall of the region is 852 mm. and majority of it received during mid-June to end of September. From the region four districts were selected for study purpose.

2.2 Sample and Sampling Procedure

A sample of 240 farmers was selected randomly from 2 villages of 8 panchayat samities. The Ex-post-facto research design was used for study purpose. The data was collected personally by the investigator himself. Before conducting the interview the aim and objectives of the study were explained to the farmers in order to get correct response and information from them. The respondents were interviewed personally, either at home or their farm. The respondents were given freedom to clarify their doubts regarding the questions during the interview. Asked the questions one by one and their responses were recorded accordingly in the interview schedule by the researcher.

2.3. Statistical analysis of the data

The data collected from the selected farmers during the course of investigation was tabulated in the excel worksheet and then appropriate analysis of data was made accordingly to the objectives formulated for the investigation. Furthermore, the statistical techniques were applied to analyze the data like frequency, percentage, means and standard deviation were followed in data analysis.

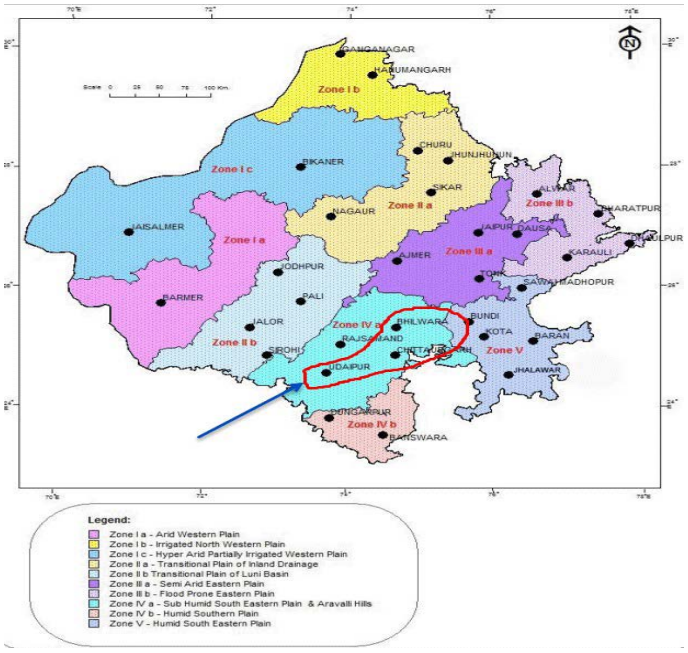

Fig. 1.1: Location map of the study area

3. Results and Discussion

3.1 Impact of climate change on agriculture

Climate change impacts are of particular concern to developing countries, where large parts of the population depend on climate sensitive sectors like agriculture for livelihood.

Farmers viewed of changing climate and their impacts on agricultural practices were elicited in twenty one farm practices. Majority of the respondents reported that climate change has resulted in negative impacts on the most of agricultural practices. For some of the farm practices have no impacts were expressed by the respondents. Farm practices like sowing time, pesticide use and overall health of the crops were found cent percent negative impact by the respondents. However views expressed by the respondents for farm operations like soil fertility, disease infestation, grain yield quality and grain yield quantity were reported negative impact by almost all the respondents and very few level of no impact on farm practices. The per cent of negative impacts was 92.91, 92.08 and 91.05, respectively and no effect was found 7.08, 7.91 and 8.75, respectively.

Similar findings were also reported by Chase (2020).

The impact of climate change on agriculture is related to variability's in local rather than global climate patterns. Hence, climate impacts on different agricultural practices as perceived by the respondents were studied.

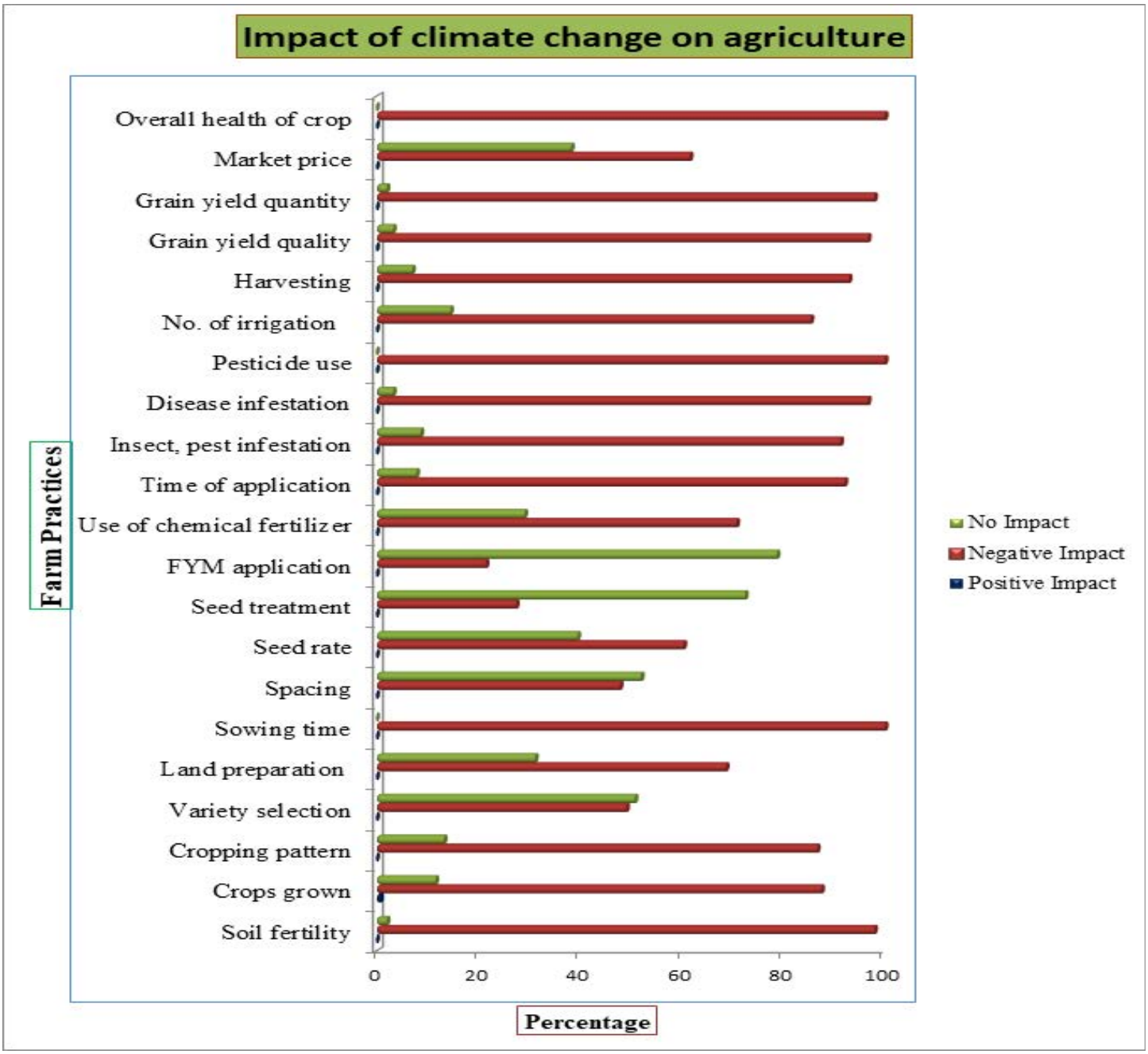

Fig. 2. Distribution of respondents according to their views about impact of climate change on agriculture

Cent percent of the respondent's views as negative impact of climate change on the farming practices of sowing time, pesticide use and overall health of the crops, the finding is in accordance with the findings reported by Shiva Prasad (2016**).**

More than three fourth of the respondents expressed negative impacts in number of irrigation (85.41%), withstanding water shortages of crops by evaporation and evapo-transpiration there is need to aggregate intensification in number of irrigations. Farmers encountered intensification in number of irrigation as a result of increased scorching sunny hours and temperature leading to more water loss in all the stages. The above results are broadly supported by the findings reported by Yadav (2021).

Farmers observing fluctuation in market price as an indirect impact of climate change, year to year vagaries in climate leading to fluctuation in production level. This is leading to fluctuation in prices. Respondents found negative impacts of scorching sunny hours while harvesting this has leading less efficiency of work and unanticipated rainfall during harvesting stage leading another impact on grain quality and quantity.

Impact of climate change at local level is difficult to assess due to poor understanding of microclimate. Most of the farming communities cannot classify the concept climate change but are good at describing changes in weather and its impact. Farmers were asked about changes occurred in agriculture according to their past experiences as impact of climate change.

Plate 1. Effect of climate change on crop production in Aravalli region

Plate 2. Due to climate effects scarcity of fodder in the local area

Plate 3. Adverse effect of climate change on livestock health

Plate 4. Climate effect on drinking water availability

Plate 5. Climate effect on human health

3.2 Constraints experienced by the farmers due to climate change

Constraints experienced by the farmers in using various adaptation measures to mitigate adverse effect of climate change on agriculture and allied activities. The information received by the farmers on constraints was further ranked as per maximum number of responses obtained and presented in Table 1.

It can be concluded from Table 1 that the majority of respondents (90%) with ranked I said lack of information about climate change. Lack of knowledge about appropriate adaptations ranked II with (83.33%). Low price of the produce in market ranked III with (80.83%).

Moreover, findings of the study indicate that other major constraints observed by the respondents were non availability of timely inputs (seeds, chemicals and fertilizers etc.) (79.16%), irregularity in electricity supply (77.08%), lack of storage facility of produce in the village (72.91%), higher cost of the agricultural inputs (70.83%) and irregularity of extension services (68.75%) with rank of IV, V, VI, VII and VIII respectively.

The result further showed that inadequate supply of irrigation facility ranked with IX (66.66%), lacking of

training programmes on disaster management ranked with X (64.58%), long distance of regulated market from the village ranked with XI (63.33%), due to high temperature not possible to work in the field for longer time ranked with XII (62.50%) and lack of information about accurate weather forecast ranked with XIII (60.41%). Some of other constraints reported by the respondents for lack of resources at village level ranked with XIV (45.83%), no subsidies on desired agricultural inputs ranked with XV (33.33%) and lack of government policies to combat against natural calamities ranked with XVI (29.16%). The findings were line with the results of Parganiha, (2016).

These findings are also similar with findings reported by Manjunath (2016).

Table 1. Distribution of respondents according to constraints experienced by them

S.No	Adaptation measures	Frequency	Percent	Rank
1.	Lack of information about climate change	216	90.00	I
2.	Lack of information about accurate weather forecast	145	60.41	XIII
3.	Lack of resources at village level	110	45.83	XIV
4.	Lack of knowledge about appropriate adaptations	200	83.33	II
5.	Lack of government policies to combat against natural calamities	70	29.16	XVI
6.	No subsidies on desired agricultural inputs	80	33.33	XV
7.	Low price of the produce in market	194	80.83	III
8.	Long distance of regulated market from the village	152	63.33	XI
9.	Lack of storage facility of produce in the village	175	72.91	VI
10.	Higher cost of the agricultural inputs	170	70.83	VII
11.	Non availability of timely inputs (seeds, chemicals and fertilizers etc.)	190	79.16	IV
12.	Irregularity of extension services	165	68.75	VIII
13.	Lacking of training programmes on disaster management	155	64.58	X
14.	Inadequate supply of irrigation facility	160	66.66	IX
15.	Irregularity in electricity supply	185	77.08	V
16.	Due to high temperature not possible to work in the field for longer time	150	62.50	XII

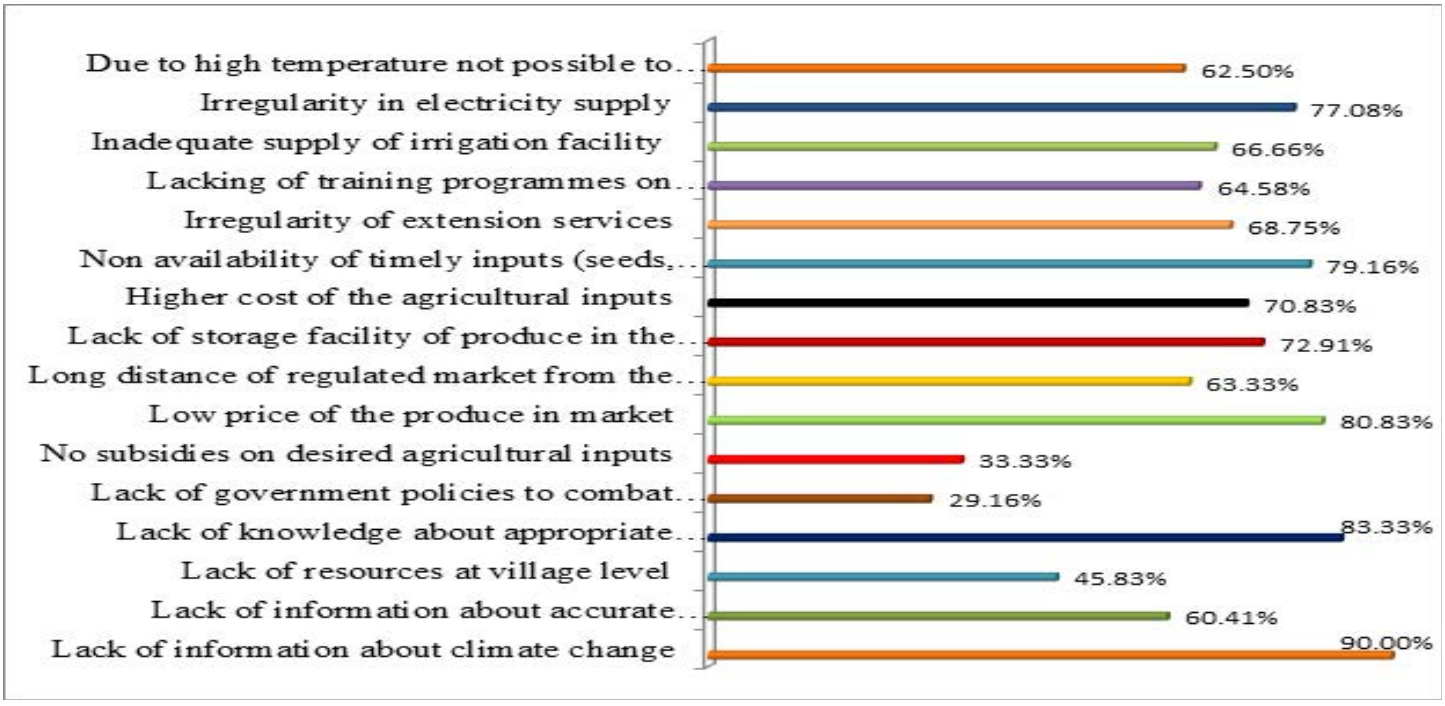

Fig. 3. Distribution of respondents according to constraints experienced

3.2.1 Suggestions given by farmers to combat climate change

The farmers of the study area were also asked about their suggestions to overcome constrains faced by them in combat to climate change and presented in Table 1.1. Majority (75.00%) of the respondents suggested that weather forecast should be more accurate and timely, whereas, 68.75 and 66.66 per cent of them said that efforts should be made to create awareness among the people about the effect of climate change and its consequences and proper information should be provided about climate change which might be enable them to adapt against climate change.

Table 1.1. Distribution of respondents according to their suggestions to minimize the constraints in combat to climate change240)

S.No	Adaptation measures	Frequency	Percent	Rank
1.	Proper information should be provided about climate change	160	66.66	III
2.	Weather forecast should be more accurate and timely	180	75.00	I
3.	Availability of agricultural inputs at village level on time	125	52.08	VII
4.	Good quality of agricultural inputs should be available on subsidized rate in proper time	100	41.66	IX
5.	Efforts should be made to create awareness among the people about the effect of climate change and its consequences	165	68.75	II
6.	Regular training programme should be organised on disaster management	140	58.33	V
7.	Effective extension services should be available to the farmers	135	56.25	VI
8.	Government policies should be made to support the farmers during natural calamities	150	62.50	IV
9.	Electricity supply should be proper	120	50.00	VIII
10.	Location specific water storage structure should be developed for effective utilization of rainwater	80	33.33	X

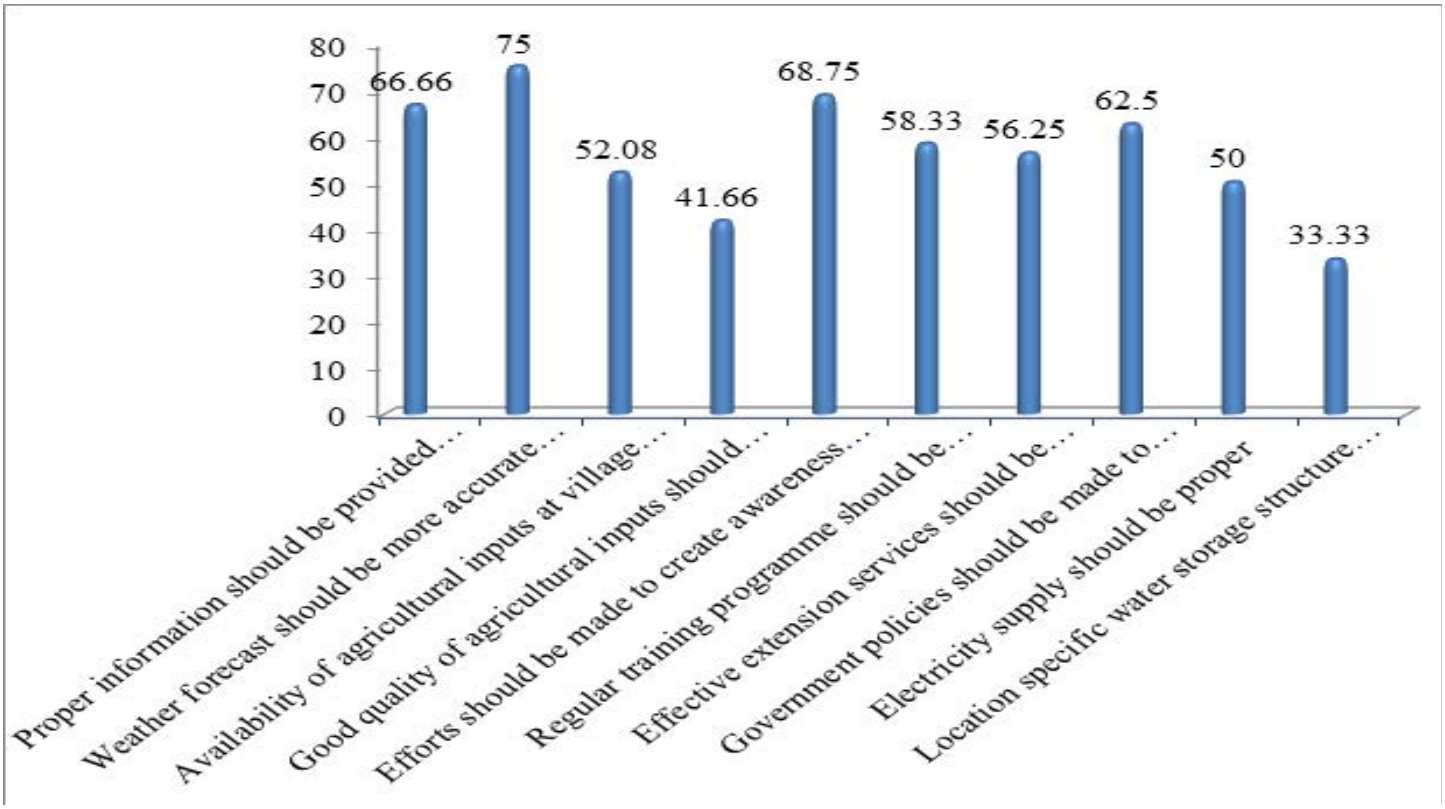

Fig. 4. Distribution of respondents according to their suggestions to minimize the constraints in combat to climate change

The other suggestions given by respondents were government policies should be made to support the farmers during natural calamities (62.50%), training should be imparted to build the capacity for better adaptation (58.33%) and extension services should be available to the farmers (56.25%). Furthermore, farmers suggested that availability of agricultural inputs at village level on time should be ensured (52.08%), electricity supply should be proper (50.00%), good quality of agricultural inputs should be available on subsidized rate in proper time (41.66%) and location specific water storage structure should be developed for effective utilization of rainwater (33.33%). According to the farmers of study area above arrangements may help them to overcome constraints to combat against climate change. The findings are supported by the findings reported by Manjunath (2016). Above findings are also in line with the findings of Ramesh Irappa Chadachul (2017).

4. Conclusion

This research has shown that farmers have very differing beliefs concerning about climate change and they view also the connected risks and opportunities differently. Similarly, farmers views on their responsibilities to act differ as do their own possibilities to adapt and mitigate the climatic changes. Majority of respondents found to be lack of information about climate change, lack of knowledge about appropriate adaptations and low price of the produce in market. Moreover, findings of the study indicate that other major constraints observed by the respondents were non availability of timely inputs (seeds, chemicals and fertilizers etc.) irregularity in electricity supply, lack of storage facility of produce in the village, higher cost of the agricultural inputs and irregularity of extension services.

The study area were also asked about their suggestions to overcome constrains faced by them in combat to climate change, majority of the respondents suggested that weather forecast should be more accurate and timely, whereas, 68.75 and 66.66 per cent of them said that efforts should be made to create awareness among the people about the effect of climate change and its consequences and proper information should be provided about climate change which might be enable them to adapt against climate change.

The farmers had inadequate knowledge towards effect of climate change on agriculture and allied activities to both farmers and extension personnel need to improve the knowledge and skills about climate change and adaptive management strategies by providing training programmes. The subject matter specialists of KVK's, Agricultural and line departments should visit the farmers field and collect on adaptation measures taken by farmers and were lacking were observed and guide them to solve the field problems of farmers in accordance with resources availed with farmers to sustain their credibility. Without this endeavors, it is impossible to draft policy measures that will be accepted and thoroughly implemented by farmers. This serves as a good starting point for climate action in agriculture in Aravali hill zone of Rajastha, India.

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Conflict of interest

Authors have declared that there is no conflict of interest exists.

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