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Impact of Climate Change on Agricultural Practices and Entrepreneurship in Doda, Jammu, India

Amit Kumar, Simerjit Kaur* and Saadat Sada

Department of Life Sciences, Rayat Bahra University, Mohali - 140 104, India

Abstract: *Agriculture production is dependent on climatic and weather conditions but now-days increasing in temperature, precipitation, and CO_2 concentration directly affects crop production. The CO_2 concentration is rising at a rate of 1.5 to 1.8 ppm per year. Decline in rainfall of 0.7 percent and 3.0 percent in 2050, of 5.0 percent and 7.6 percent in year 2100- and 3-4-degrees Celsius temperatures are increased by the end of the 21st century should be observed in India. Increasing in 10℃ in temperature reduces wheat production by 4 to 5 percent. After harvesting the crop, crop residue is burned in the field that should also help in increasing the level of CO_2 and kill the microorganisms of that field. Climate change also affects an ecosystem directly or indirectly. Change in climate will affect the groundwater recharge, water cycle, soil moisture, livestock, and aquatic species. Change in climate increase the incidence of pests and diseases, which causes a huge loss in crop production. Due to climate change deterioration in soil fertility, promote salinity, defiance many pesticides, herbicides and deterioration of irrigation water quality should be found. Entrepreneurship refers to the establishment and operation of businesses that prioritize environmental sustainability while also aiming for financial success. In India, where environment challenges are significant due to rapid industrialization and population growth, entrepreneurship has gained attention as a means to address these challenges while fostering economic growth.*

Keywords: Climate Change, Soil, Crop production, CO_2, Temperature, Entrepreneurship, Sustainability, Crop Diversification

*Corresponding Author: Dr. Simerjit Kaur
e-mail: dr.simar@rayatbahrauniversity.edu.in

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1. Introduction

Climate change is one of the biggest challenges to the world in present times. It is defined as significant changes in the average values of meteorological elements, such as precipitation and temperature, for which averages have been computed over a long period [1]. 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 [2]. The concentration of greenhouses gases such as methane (CH4), carbon dioxide (CO_2), and nitrous oxide (N_2O) have been increased by 150%, 40% and 20%, respectively since 1750 [3].

Most countries were benefitted until 1980, after which the trend remained the same for the developed world, while the Third-World countries were negatively impacted. In the 21st century, climate change will become a severe problem, and both rich and developing countries will face negative externalities [4]. As the global temperature is rising, there is a need to reduce greenhouse-gas emissions to limit the temperature increase of 2 ˚C relative to pre-industrialization. The developed countries have around a 60–80% contribution to the global temperature rise, sea-ice reduction, and upper-ocean warming, compared to 20–40% for developing countries, since 2005 [5]. In Kharif season, the average maximum temperature and average minimum temperature is predicted to rise by 1–3.3˚C and 2–3˚C; while in rabi, it is projected to increase by 2.1–3.5˚C and 2–3˚C, respectively, in simulations done for the future mid-century (2040–2069). There have also been projections of variations in the region’s rainfall, more emphatically during the Kharif season (25–35%); while in the rabi season, the variations are minimal [6]. The temperature minimums and maximums are also projected to rise in Punjab, India by the middle and end of the 21st century, as estimated by PRECIS (Providing Regional Climates for Impact Studies). Moreover, extreme incidences of high temperature (heat waves) during March to June and low temperatures during December and January (frost) are also predicted [7]. The extremes in weather parameters, mainly minimum temperature, maximum temperature, and precipitation, are also projected to be observed more frequently, with higher intensity in China, with additional warming of 0.5 ˚C. Moreover, if global warming is kept below 1.5 ˚C, the weather extremes will be lowered [8]. Farmers’ perceptions of climate change’s threat and severity have the most important motivational factor in voluntary mitigation. However, the adaptation depends on the availability of related information [9]. Small and marginal farmers are not able to cope with climate change due to less awareness, which makes them more susceptible to losses [10]. There have been ways to curb the impact of climate change by a number of agronomic practices, such as a shift in sowing dates. The optimum sowing dates for wheat have been identified as October 22–28 in the northeastern part, October 24–30 in the central region, and October 21–27 in the southwestern region of Punjab, India [11]. The means to adapt to climate change are mainly modified farm practices, and are influenced greatly by the policy decisions suiting the climatic variability and climate extremes, along with social, political, and economic conditions [12]. Direct-seeded rice (DSR) causes fewer GHG emissions compared to transplanted rice. Dry DSR and wet DSR have 76.2% and 60.4% lower potential for global warming, respectively, in comparison to transplanted rice. Moreover, wet DSR also produced a 10.8% higher yield than transplanted rice [13]. Aerobic rice also has a huge potential in the mitigation of future climate change, as it saves 73% of irrigation water used in land preparation and 56% water used in the period of crop growth. Cultivation of aerobic rice by using micro-irrigation technologies is a suitable method for sustainable rice production. It also helps in reducing methane emission from rice fields [14]. There could be possible shortage of fresh water available for irrigation in the western US, China, and south, west and central Asia, which could lead to the conversion of 20–60 million ha of irrigation area to rainfed area, and cause a loss of 600–2900 pcal in food production [15]. Drip irrigation is one of the irrigation techniques being promoted to reduced groundwater overdraft and shocks induced by climate change. It has the potential to be resilient to climate change, and reduces the demand of groundwater for irrigation. But farmers are using drip irrigation for intensive agriculture, leading to further groundwater overextraction, causing Jevons paradox [16]. These mitigation strategies have huge mitigation and adaptation potentials. However, they depend upon the suitability of a technology to the region, people's perception, economic viability, and technical complexity. Moreover, these strategies work well when a number of interventions are used together in solidarity with each other.

The objective of the study is to analyse the impact of climate change on agriculture practices adopted by the farmers (temperature, precipitation, and other climatic variables) and to collect agriculture data and production statistics to study the economic status of the farmer.

2. Methodology

A comprehensive methodology was adopted to study the impact of various factors affecting both the climate and agriculture systems. Some general methodology adopted are as follows:

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- Extensive Literature Review was conducted to understand the current state of knowledge regarding climate change impacts on agriculture. Identify gaps in knowledge and key area of concern.
- Data was collected to analyse trends and identify changes in temperature, precipitation, and other relevant climatic variables.
- Interaction with stakeholders with local farmers, communities, policymakers, and other stakeholders to gather insights, supported in understanding the concerns, and identify locally relevant adaptation strategies.
- Monitoring and Evaluation: Implemented monitoring and evaluation framework to assess the effectiveness of adaptation strategies over time. Continuously update the research based on new data and emerging climate trends.

3. Result and Discussion

During this survey which was conducted through questionaire, 88% of people agreed that climate change affects crop yields, while 12% of people agreed in increase crop yields due to climate change. Out of 50 respondents no one agreed to that climate change has no significant impact on crop yield.

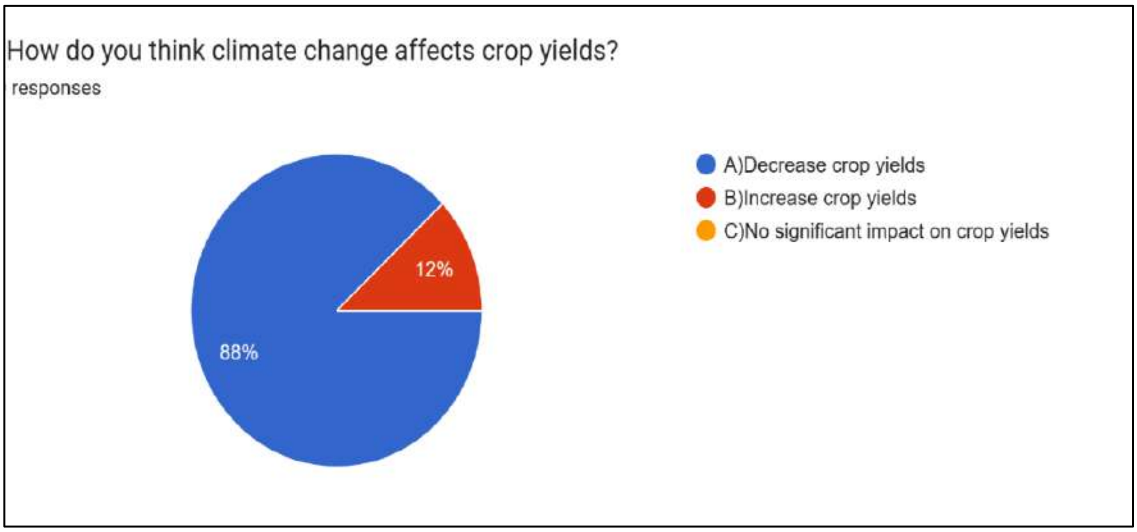

Fig 3.1: Effect of climate change on crop yields

During this survey it was observed that 50% of respondents believe that temperature change had most impact on crops, 30% respondents believe that extreme weather events had most impact on crop, while 20% think it was due to change in precipitation patterns.

During this survey, it was observed that 76% of rspondents believe that climate change delays the planting season, 16% respondents believes it advanves the planting season, while 8% believe climate change had no significant impact on plant timing.

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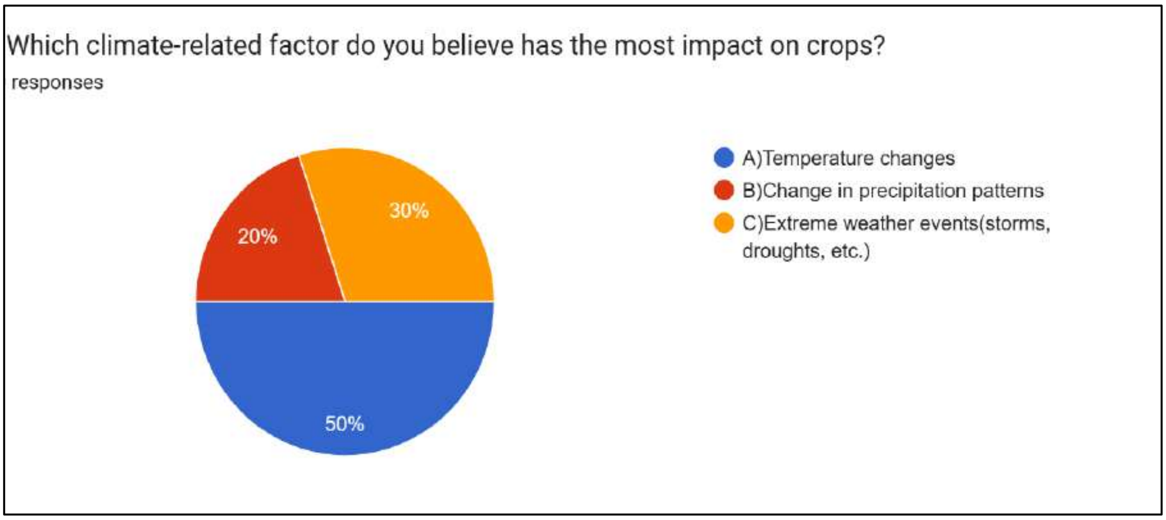

Fig 3.2: Impact of climate factor on crops

During this survey, it was observed that 70% of respondents believe that climate change decreases the nutritional value, while 18% and 12% respondents believe that climate change increases the nutritional value and it does not significantly impact the nuritional value.

During this survey it was observed that 48% of respondents think that corn is most vulnerable to climate change, 42% think rice, while 10% think wheat is most vulnerable to climate change.

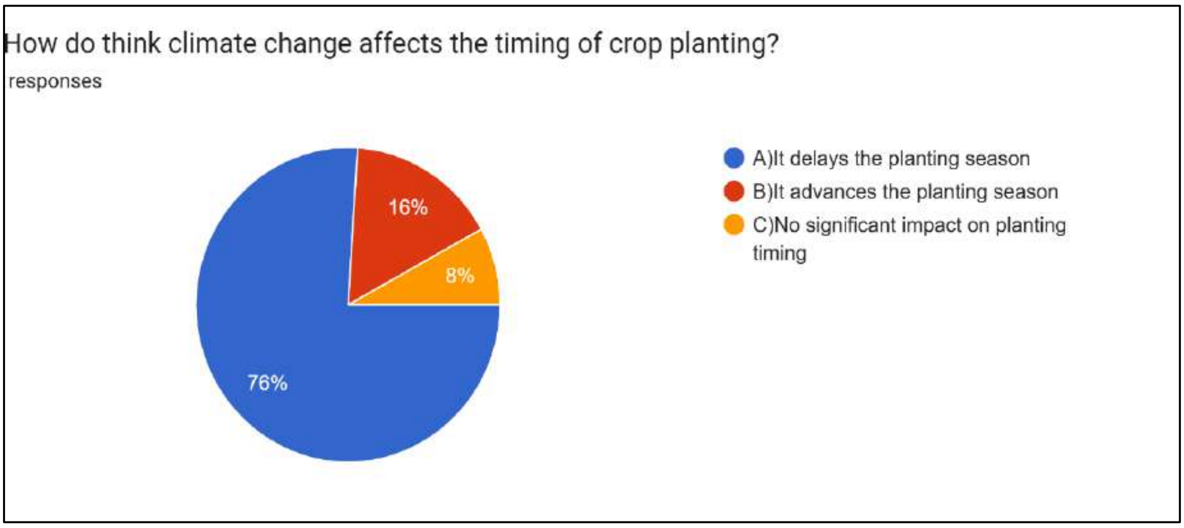

Fig 3.3: Affects of climate change on timing of crop

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During this survey it was observed that 72% of respondents believe that climate change decreases water availability for irrigation, 20% believe increases water availability for irrigation, while 8% believes that climate change had no significant impact on water availability for irrigation.

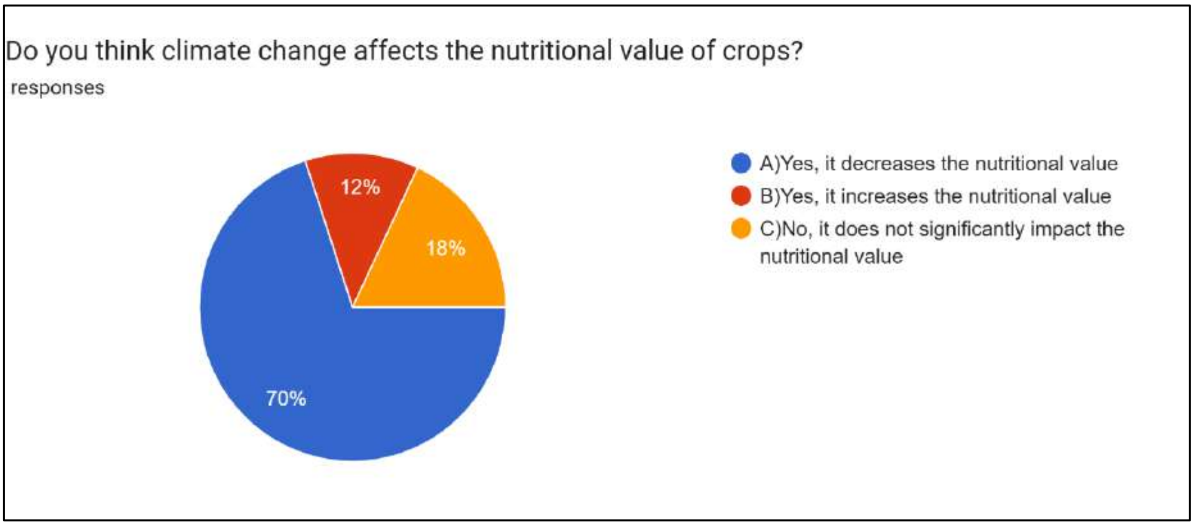

Fig 3.4: Affects of climate change on nutritional value of crop

During this survey it was observed that 80% of respondents believe that climate change decreases the quality of crops, 16% believe increases the quality of crops, while 4% believe that climate change had not significantly impact the quality of crop.

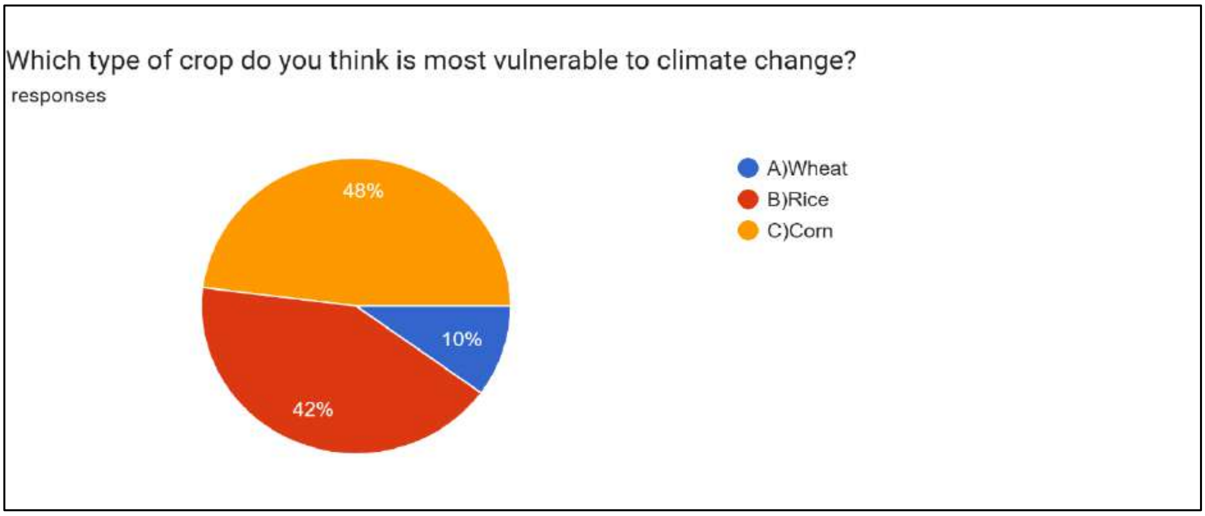

Fig 3.5: Crop Vulnerable to climate change

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During this survey it was observed that 74% of respondents believe that climate change increases the spread of pest and diseases in crops, 20% believe decreases the spread of pest and diseases, while 6% believe that climate change had no significant impact on the spraed of pest and diseases in crops.

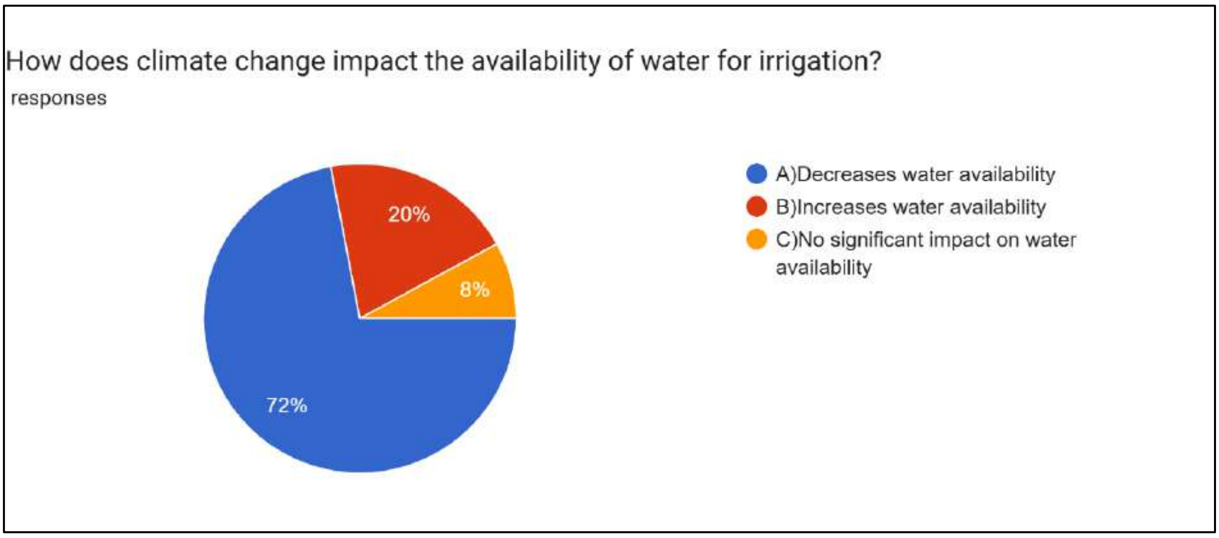

Fig 3.6: Impact of climate change on availability of water for irrigation

During this survey it was observed that 78% of respondents believe that climate change decreases profitability of farming, 16% believe increases profitability, while 6% believe that climate change had no significant impact on profitability of farming.

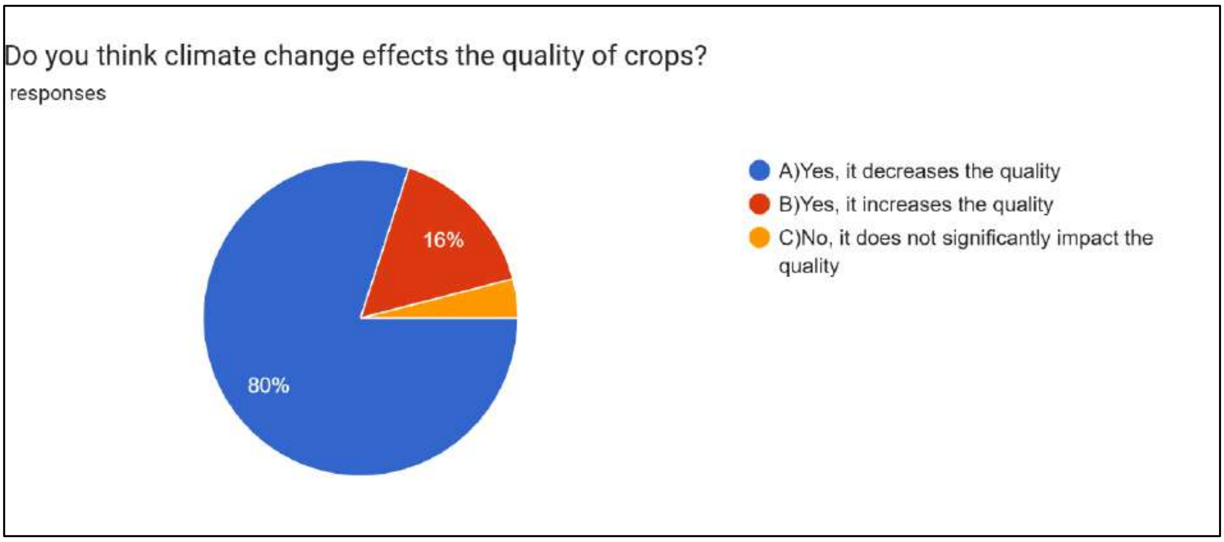

Fig 3.7: Effects of climate change on quality of crops

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During this survey it was observed that 50% of respondents believe that climate change decreases pollinator populations, 48% believe increases pollinator populations, while 2% believe that climate change had no significant impact on pollinators for crops.

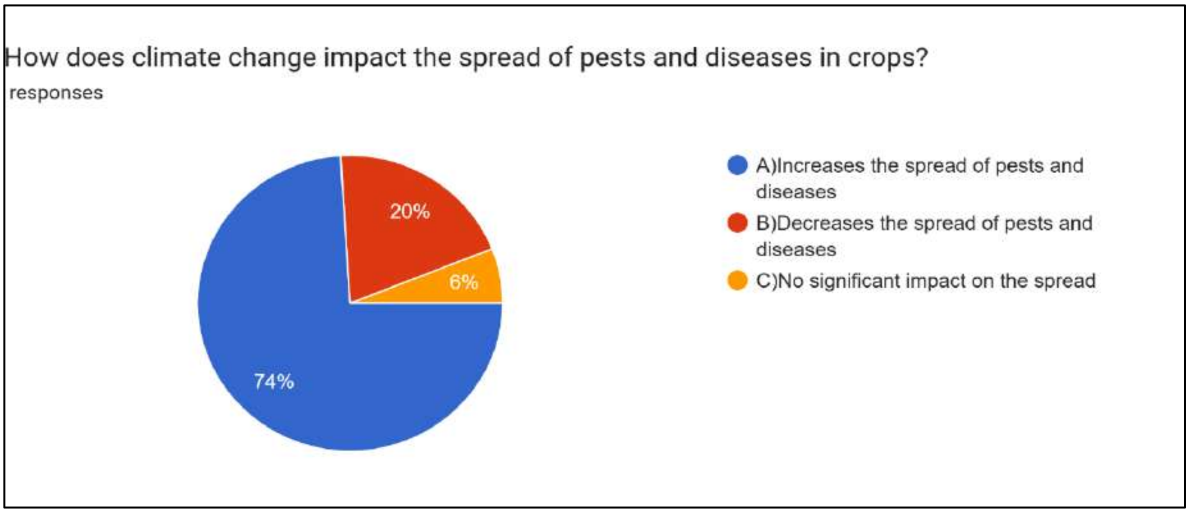

Fig 3.8: Spread of pest and disease in crops due to climate change

During this survey it was observed that 90% of respondents agreed that climate change presents new entrepreneurial opportunities,while 10% does n't agreed with it.

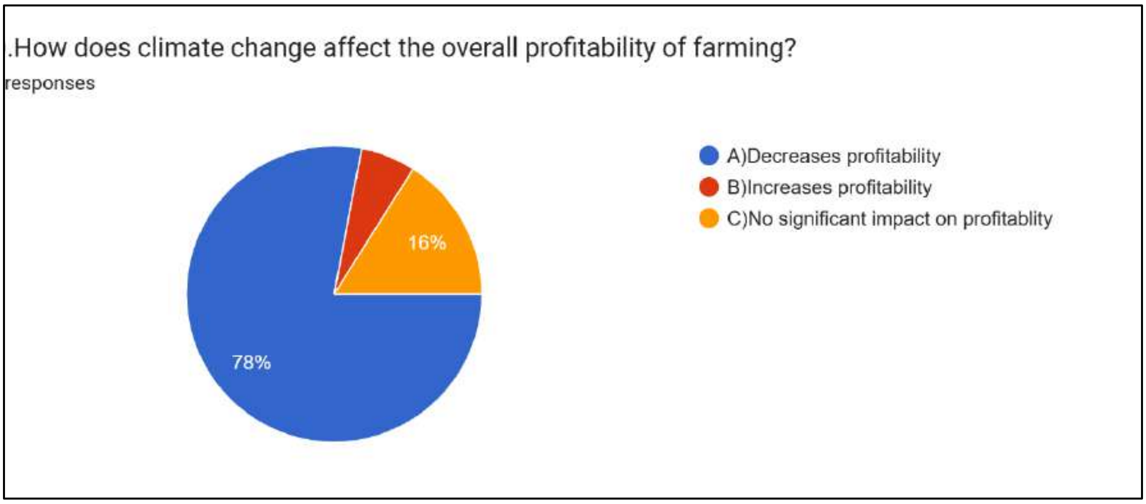

Fig 3.9: Profitability of farming affected by climate change

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During this survey it was observed that 73.5% of respondents believe that climate change decreases the availability of resources for entrepreneurs, 16.3% believe increases, while 10.2% believe that climate change had no significant impact on resource availability for entrepreneurs.

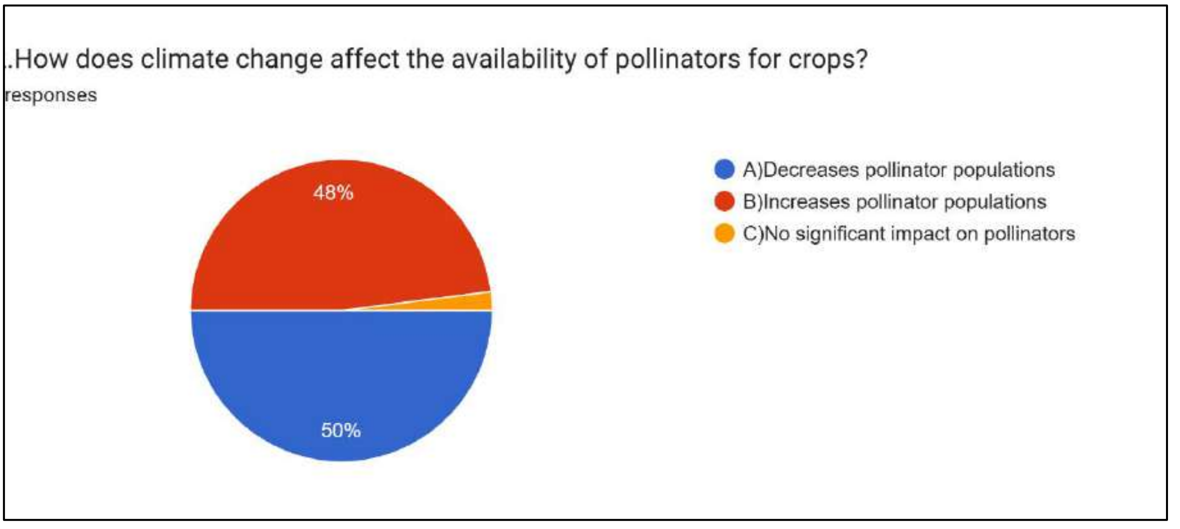

Fig 3.10: Effect on the availability of pollinator for crops

During this survey it was obserevd that 72% of respondents believe that climate change increases the risk and uncertainty faced by entrepreneurs, 24% believe decreases, while 4% respondents believe that climate change had no significant impact on risk and uncertainty faced by entrepreneurs.

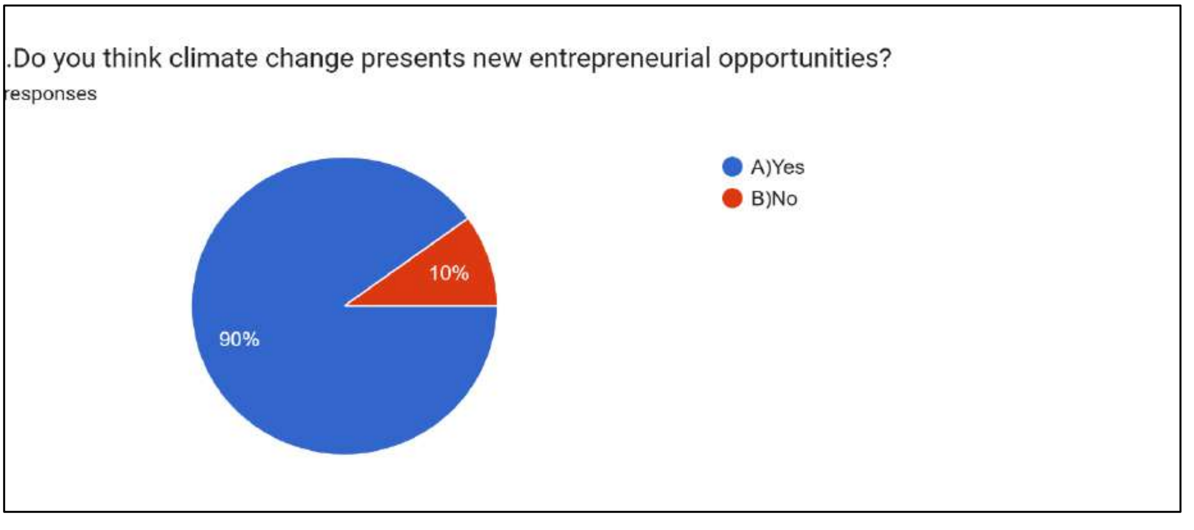

Fig 3.11: Entrepreneurial opportunities

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During this survey it was observed that 80% of respondents believe that climate change decreases availability and increase cost of insurance for entrepreneurs, 16% believes increases availability and decrease cost, while 4% believe that climate change had no significant impact on insurance availability and cost for entrepreneurs.

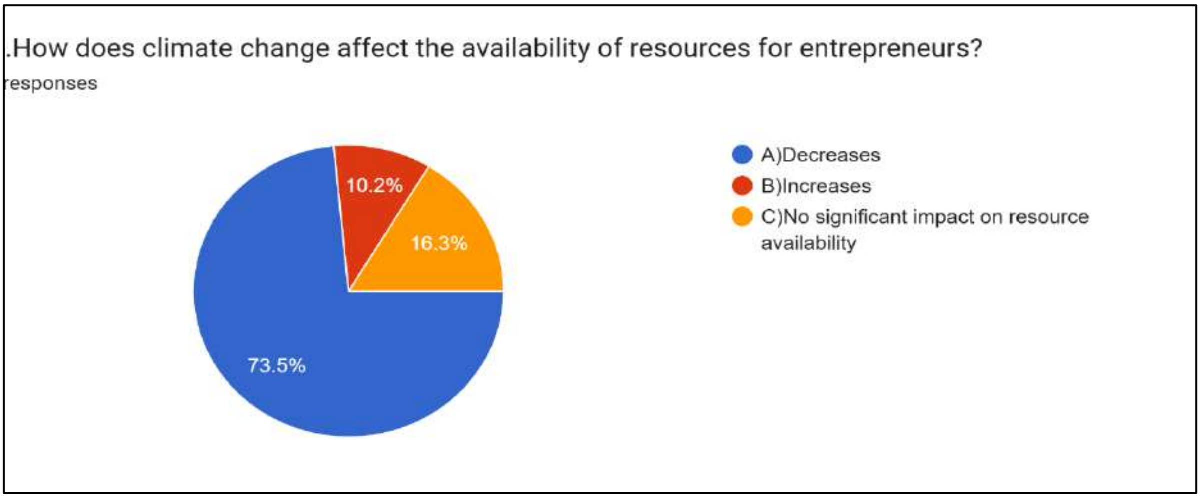

Fig 3.12: Availability of resources for entrepreneurs

Research has shown that climate change is altering seasonal weather patterns, leading to shifts in the timing of planting and harvesting for many crops. Farmers are adjusting their planting schedules to accommodate earlier springs or delayed frosts, aiming to optimize crop growth and yield under changing climatic conditions.

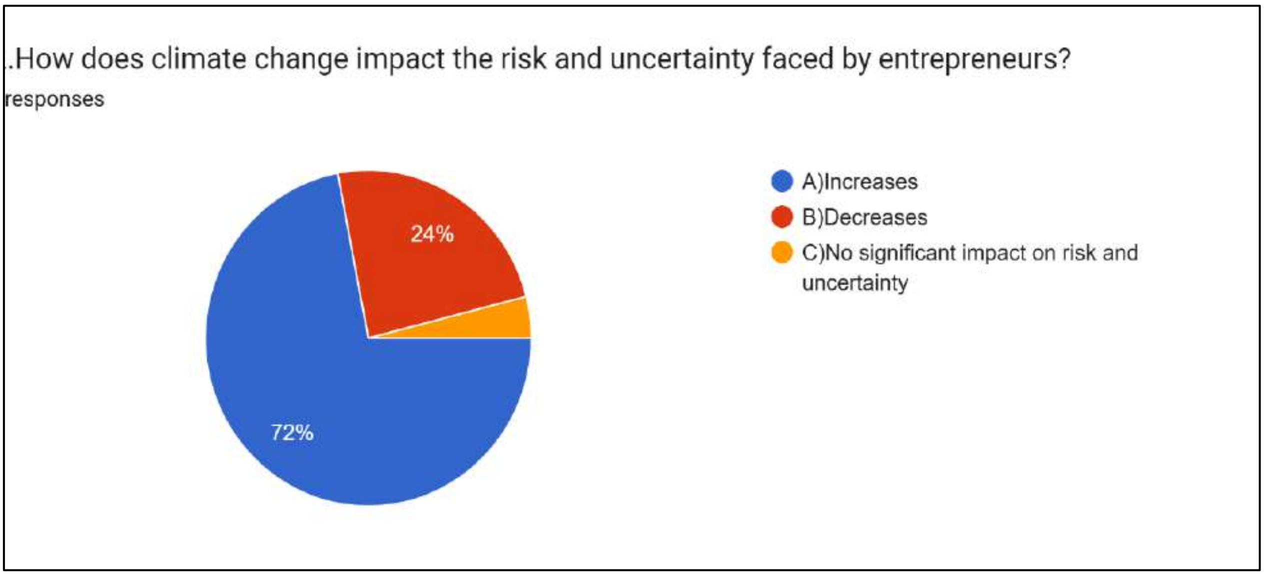

Fig 3.13: Risk and uncertainty faced by entrepreneurs

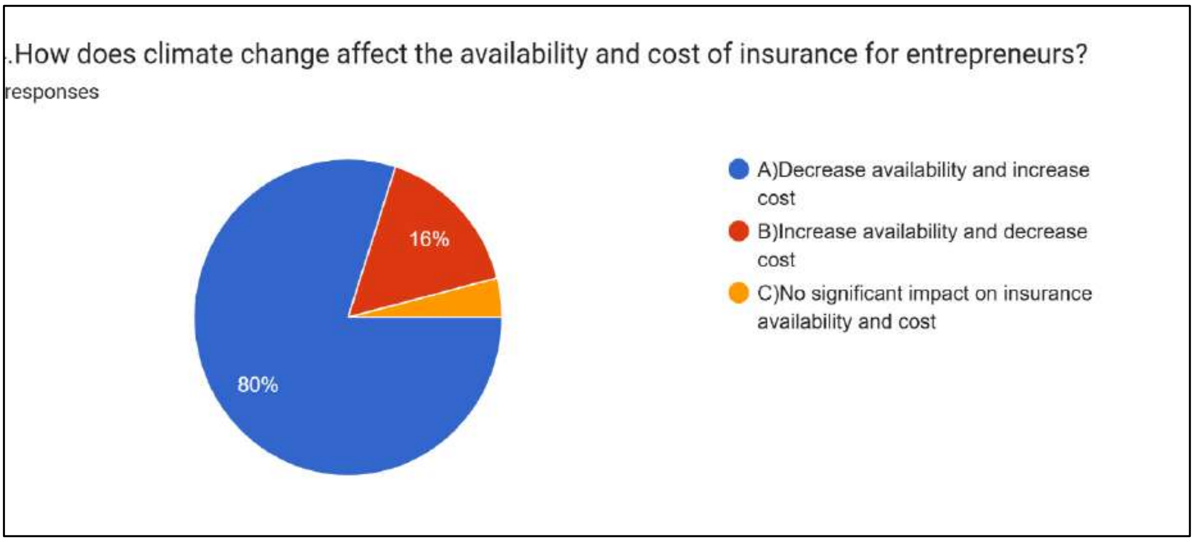

Fig 3.14: Availability of cost of insurance for entrepreneurs

During this study, it was observed that there are changes in precipitation patterns, including more frequent and intense droughts in some regions and increased rainfall in others, pose challenges for water management in agriculture. Research indicates a growing need for improved irrigation systems, water conservation techniques, and strategies to enhance soil water retention to cope with erratic rainfall and prolonged dry spells. Farmers are adopting diverse adaptation strategies, including crop diversification, agroforestry, and the use of climate-resilient crop varieties. These efforts aim to enhance agricultural resilience and minimize vulnerability to climate-related risks.

4. Conclusion

It has been concluded that addressing the impact of climate change on agriculture practices requires a multifaceted approach that integrates scientific research, technological innovation, policy support, and community engagement. Sustainable agricultural practices and resilient farming systems are essential to ensure food security and mitigate the adverse effects of climate change on both agricultural productivity and rural livelihoods. Addressing the impact of climate change on agriculture necessitates a comprehensive strategy that encompasses several key components. Firstly, scientific research plays a crucial role by deepening our understanding of how climate change affects agricultural ecosystems, crop yields, and soil health. This research informs the development of adaptive strategies and technologies that can help farmers mitigate risks and optimize productivity in changing environmental conditions. Technological innovation is another vital aspect of addressing climate change in agriculture. Advanced technologies such as precision agriculture, climate-smart crop varieties, and efficient water management systems enable farmers to enhance resource use efficiency, reduce greenhouse gas emissions, and adapt to climate variability. These innovations not only improve agricultural productivity but also contribute to environmental sustainability. Also, policy support is essential to create an enabling environment for sustainable agriculture. Governments and international organizations can implement policies that incentivize the adoption of climate-smart practices, provide financial support for adaptation measures, and promote research and development in resilient farming techniques. Policy frameworks that integrate climate adaptation into agricultural planning and investment are critical for building resilient food systems.

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