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Effect of Climate Change on Agricultural Crops in Afghanistan

SURGUL AZIMI
Agribusiness Management Department, Afghanistan National Agricultural Science and Technology University Kandahar, Afghanistan
e-Mail : surugul.azimi@gmail.com

AUTHORS CONTRIBUTION

SURGUL AZIMI :

Conceptualization, design, data curing and preparation of manuscript

Corresponding Author :

SURGUL AZIMI

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ABSTRACT

Climate change poses a significant threat to global agriculture with profound implications for crop production, food security and rural livelihoods. Crop yields were also very low due to the negative effects of climate change. The yields of crops like wheat, rice and corn have recently continued to decline because of the recent drought related to agriculture, livestock, connected dynamics of desertification, land degradation, water, economic sectors, urban and energy were the most likely negative effects of climate change in Afghanistan. In this research 50 participants were surveyed by simple randomly sampling method in Afghanistan. This study employed a mixed-methods approach, combining both quantitative and qualitative methods to assess the impact of climate change on agricultural crops. The quantitative analysis involved the use of historical climate data and crop yield records, while the qualitative component included interviews with farmers and agricultural experts to gather insights on adaptive practices and perceptions of climate impact. The findings reveal that 75.90 per cent of respondents are familiar with climate change, reflecting a high level of awareness. Key causes identified include industrial pollution (37%), fossil fuel emissions (28%) and agricultural activities (21%) with deforestation recognized by only 15 per cent, indicating a potential gap in understanding its role. Observed climate changes include frequent droughts (32%) and increased temperatures (26%) with corresponding impacts on crop production such as lower yields (32%) and increased pest/ disease problems (26%).

Keywords : Climate change, Agricultural crops, Productivity, Cultural practices, Consequences, Strategies

CLIMATE change poses a significant threat to global agriculture with profound implications for crop production, food security and rural livelihoods (Cline, 2008). Rising temperatures, changing precipitation patterns, increased frequency of extreme weather events and elevated atmospheric CO, levels have direct and indirect effects on agricultural crops. These changes alter growing seasons, disrupt pollination, reduce crop yields and exacerbate pest and disease pressures (Alley *et al.,* 2009).

With the rapid increase in the world's population, there is a corresponding increase in food demand owing to concerns about the stability of the global environment (Hashimi, 2018). Water availability, air pollution, and soil fertility have a large impact on agriculture productivity. (Noyal, 2017)

Although predictions of large scale climate effects to developing country agriculture have been long standing, there have been few economic studies that actually measured climate impacts in these countries. A handful of studies were conducted using existing Agricultural Census data from India and Brazil (Robert Mendelsohn and Ariel Dinar, 2001).

Sustainable agricultural with coping measures and economic systems are needed against climatic

disasters to meet a growing population, demand for food, feed and extreme weather events (Hashimi, 2016). A sustainable agricultural system can be achieved through investment, infrastructure development and irrigation system building (World Bank, 2021).

Agriculture is the largest economic sector in the country and is expected to remain in the medium term (Singh & Sidhu, 2011). Though increasing world population, changing climate conditions and economic activities are growing with each passing day making it more important than water (Belliturk, 2016). Increasing or decreasing changes in climatic parameters will affect living things negatively leading to decrease in productivity, especially in agricultural productions (Adams, 2011). Agriculture is highly dependent on the weather pattern, because agriculture is likely to be affected positively and negatively by climate change, further change in weather patterns (climate) is expected to have an adverse effect on food security, agricultural productions and rural livelihoods (Omerkhil and Pandey, 2020).

Afghanistan with its largely agrarian economy is significantly vulnerable to the effects of climate change. The agricultural sector employs around 60-70 per cent of the population and contributes approximately 25 per cent of the GDP. However, the increasing frequency of extreme weather events, changes in temperature and precipitation patterns have been disrupting agricultural productivity, threatening food security and impacting the livelihoods of farmers (Omerkhil, 2020).

Afghanistan has faced extreme climatic events such as drought, rising temperature and scarce precipitation and these events will likely worsen in the future. Reduction in crop yield can affect food security in Afghanistan, where the majority of population and economy are completely dependent on agriculture (Raoufi, 2023).

The objective of this study is to analyze the effect of climate change on Agricultural Crops in Afghanistan.

A sustainable agricultural system can be supported by adaptation strategies, including adoption of climate smart technologies cultivation practices, field management, cultivating for seed selection, ecological conservation and water resources management (Albut, 2018).

Afghanistan faces several critical problems due to climate change, many of which are interconnected and exacerbate existing vulnerabilities (Samadi, 2011). One of the most pressing issues is water scarcity, which has far-reaching consequences for agriculture, food security, and livelihoods (Osmani, 2015).

Material and Methods

Afghanistan is a landlocked country in southern Asia that borders with China, Iran, Pakistan, Tajikistan, Turkmenistan and Uzbekistan. The geography of Afghanistan is arid and mountainous; the Hindu Kush mountains run northeast to southwest and divide the northern provinces from the rest of the country. The study was conducted in Kandahar region of Afghanistan. Kandahar region experiences a predominantly continental climate, characterized by hot summers and cold winters. Kandahar has significant temperature variation between seasons (Fitrat, 2014).

The crop enterprises selected for this study were Wheat, cotton and barely. These crops were chosen based on their economic importance, prevalence in the study area and sensitivity to climatic changes.

This study employed quantitative methods to assess the effect of climate change on agricultural crops. The quantitative analysis involves the use of historical climate data and crop yield records. Primary data was collected through interviews with farmers and agricultural experts to gather insights into adaptive practices and their perceptions of climate change impacts. The method which was used in this research was a descriptive method. Using simple randomly sampling technique the respondents were selected.A total of 120 respondents were interviewed. Total populations are unknown to draw a statically based

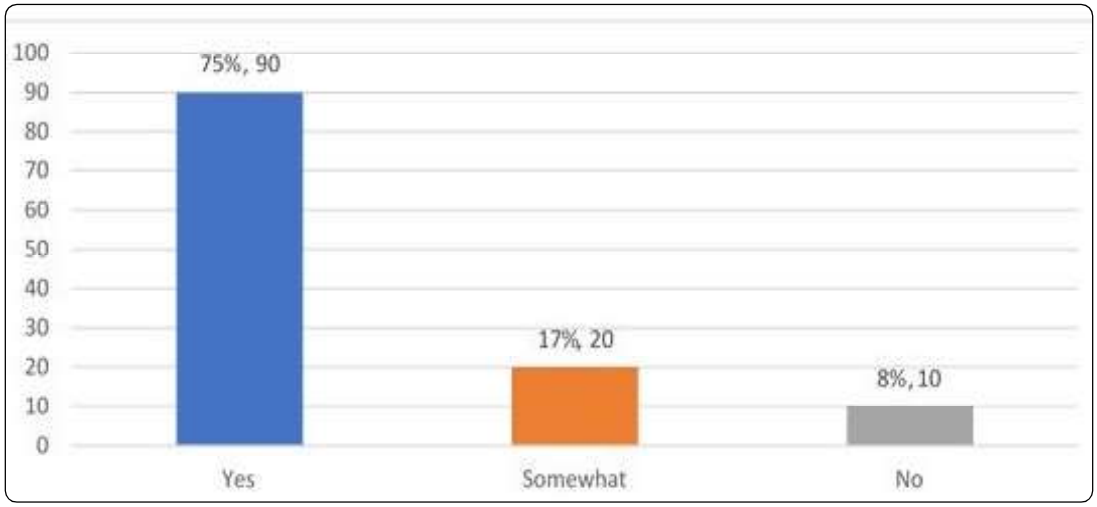

Fig. 1 : Respondents familiarity with the awareness of climate change

sample therefore we have come up with 120 responds which provided enough information for statically conclusion.

Results and Discussion

Fig. 1 shows that the majority of respondents (75.90%) report being familiar with climate change, which shows a strong awareness of the issue. A smaller portion (17.20%) falls into the 'Somewhat Familiar' category, which could indicate that some people may be aware of climate change in a general sense but lack deeper knowledge. A very small percentage (8.10%) are 'Not Familiar,' suggesting that only a few respondents are completely unaware of the concept of climate change.

The Table 1 displays the CO_2 emissions in million tons in Afghanistan from 2015 to 2020 and notes that these emissions are attributed to the sectors agriculture, energy, waste, industrial processes, changing land uses and forestry. With the emission of only 28.79 million tons of CO_2 equivalent (0.06% of global emissions) in 2020, Afghanistan was the 116th largest producer of greenhouse gases in the world. Afghanistan's lower CO_2 emissions do not necessarily indicate that Afghanistan has made efforts to reduce them. This means it should not be assumed that Afghanistan lowered its CO_2 emissions by switching from non-renewable to renewable resources. Afghanistan has not yet made any remarkable investments in renewable resources. In general, it can be claimed that Afghanistan's lower CO_2 emissions are bad news for its population. Because Afghanistan's economy will grow more slowly, there will be a high

Table 1

The causes and consequences of climate change in Afghanistan

Causes	2016 $MtCO_2e$	2017 $MtCO_2e$	2018 $MtCO_2e$	2019 $MtCO_2e$	2020 $MtCO_2e$
Agriculture	15.11 Mt	15.32 Mt	15.22 Mt	14.85 Mt	15.54 Mt
Energy	8.09 Mt	7.42 Mt	6.94 Mt	8.23 Mt	8.27 Mt
Waste	3.28 Mt	3.37 Mt	3.45 Mt	3.53 Mt	3.61 Mt
Industrial Processes	601.66 Kt	789.34 Kt	910.72 Kt	1.08 Mt	1.21 Mt
Land-Use Change and Forestry	-246.22 Kt	154.66 Kt	154.66 Kt	154.66 Kt	154.66 Kt
Total	26.84 Mt	27.05 Mt	26.68 Mt	27.84 Mt	28.79 Mt

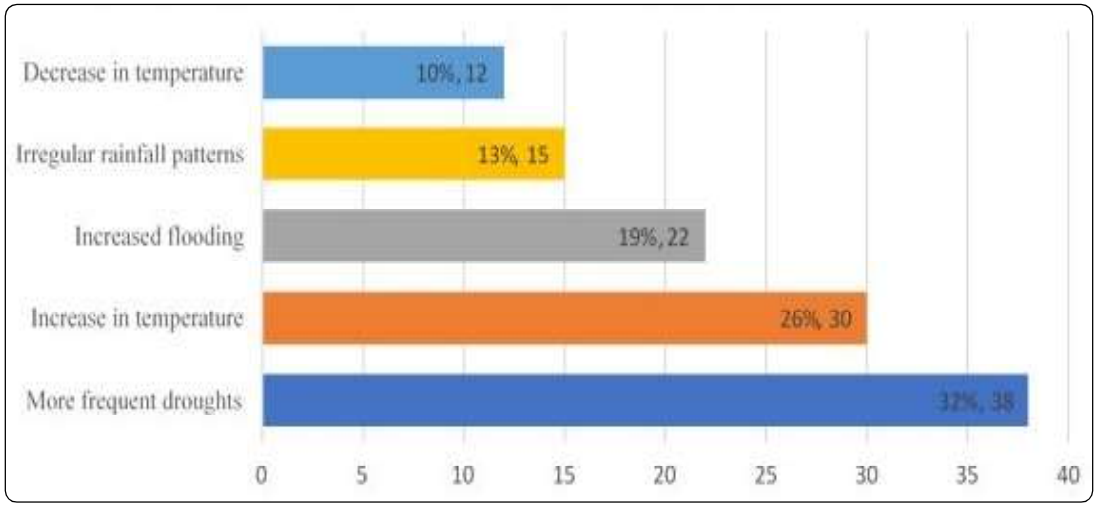

Fig. 2 : Categories of climate changes observed by participants

unemployment rate and the poverty rate will rise if there are fewer CO_2 emissions. Climate change has dire consequences for Afghanistan.

Fig. 2 highlights the types of climate changes observed by respondents. The most commonly reported change is more frequent droughts (32%), followed by increased temperature (26%). Increased flooding was noted by 19 per cent of respondents, while irregular rainfall patterns were observed by 13 per cent. A smaller portion of respondents (10%) reported decreased - temperature. These findings indicate that most respondents perceive changes consistent with the effects of global warming, particularly more frequent droughts and higher temperatures. This suggests a strong awareness of the shifting climate and its impacts, although fewer respondents noted cooling trends, reflecting the predominant global warming narrative.

Fig. 3 shows the perceived effect of climate changes on crop production such as (Wheat, cotton, barely, vegetables, pomegranates and grapes) in recent years. The most commonly reported effect is lower yield (32%), indicating significant reductions in crop productivity. Increased disease/pest problems follow at 26 per cent, suggesting that climate variability is contributing to more frequent pest and disease

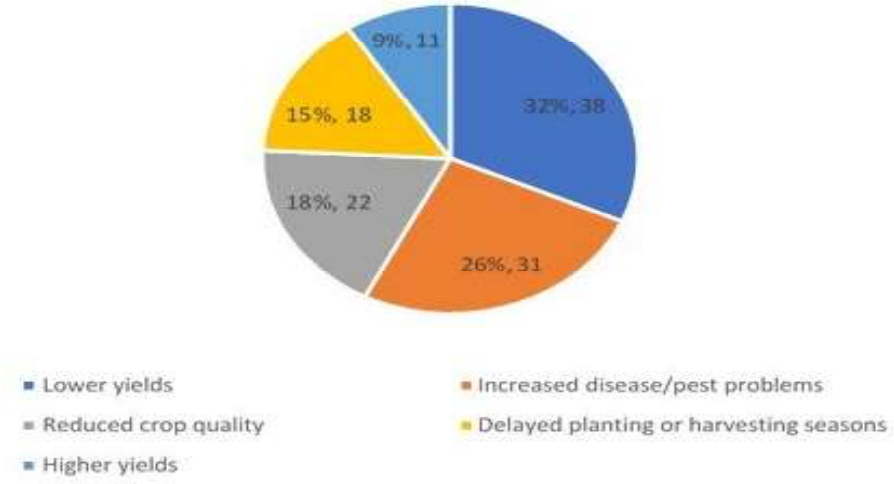

Fig. 3 : The effect of climate on agricultural crops (Wheat, cotton and barely) over recent year

outbreaks. Reduced crop quality was reported by 18 per cent, reflecting concerns about the declining quality of produce. Delayed planting or harvesting seasons accounted for 15 per cent, highlighting disruptions in traditional agricultural schedules. Interestingly, only 9 per cent of respondents observed higher yields, indicating that while some may benefit from changing conditions, the overall impact on crop production is largely negative. These results underscore the importance of developing adaptive measures in agriculture to cope with the challenges posed by climate change.

Fig. 4 reported the strategies adapted by farmers to cope with climate change. Changing crop varieties is the most common strategy, adopted by 29 per cent of farmers. This suggests a shift towards crop varieties that are more resilient to changing climate conditions, such as drought-resistant or heat-tolerant species to maintain or improve yields. Adjusting planting and harvesting times is the second most adopted strategy at 27 per cent. This indicates that farmers are modifying their agricultural calendars to better align with shifting seasonal patterns, such as earlier or delayed rains. Diversifying crops was reported by 16 per cent of farmers, reflecting an effort to spread risk by growing a variety of crops. This strategy can help ensure that if one crop fails due to climate stress, others may still thrive. Using pest-resistant crop varieties accounts for 13 per cent of responses, suggesting that some farmers are adopting crop types that can withstand increased pest and disease pressure, which is often exacerbated by changing climate conditions. No changes made were reported by 9 per cent of respondents, indicating a small proportion of farmers have not yet adapted any specific strategies. This could be due to a lack of resources, information or perceived need for adaptation. Implementing irrigation or water conservation methods was the least common strategy at 7 per cent, highlighting that while water management is critical, it may be less accessible or more costly for many farmers compared to other adaptation methods.

The above mentioned table indicated the causes of climate change. The responses were asked to rank the causes of climate change in order of importance so the rates of the causes were analyzed by using Garrett's ranking technique. The first important cause was found cutting down forests with a mean score of 77. Cutting down forests to create farms or pastures or for other reasons, causes emissions. Since forests absorb carbon dioxide, destroying them also limits nature's ability to keep emissions out of the atmosphere. The second most important cause was using transportation a mean score of 63. Most cars, trucks and planes run on fossil fuels. That makes transportation a major contributor of greenhouses gases, especially carbon dioxide emission. Road vehicles account for the largest part, due to the

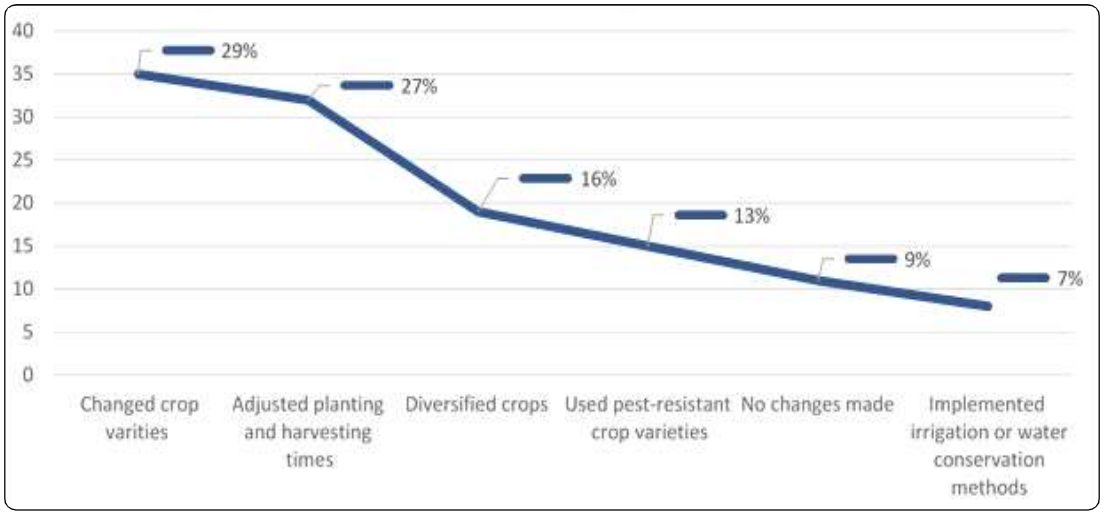

Fig. 4 : Strategies adopted by farmers to cope with climate change

combustion of petroleum-based products, like gasoline, internal combustion engines. The third important cause was manufacturing goods with a mean score of (54). Manufacturing and industry produce emissions, mostly from burning fossil fuels to produce energy for making things like cement, iron, steel, electronics, plastics and other goods. The fourth important cause was generating power with a mean score of 46. Generating electricity and heat by burning fossil fuels causes a large chunk of global emissions. Most electricity is still generated by burning coal, oil, gas, which produces carbon dioxide and nitrous oxide – powerful greenhouse gases that blanket the Earth and trap the sun heat. The fifth important cause was powering buildings with a mean score 36. Residential and commercial buildings consume over half of all electricity. They continue to draw on coal, oil and natural gas for heating and cooling, they emit significant quantities of greenhouse gas emissions. The sixth important cause was producing food items

Table 2

Garret's ranking technique for ranking the cases of climate

Cutting down forests	7	71
Using transportation	63	2
Manufacturing goods	54	3
Generating Power	46	4
Powering building	36	5
Producing food items	23	6

with a mean score of 23. Producing food causes emission of carbon dioxide, methane and other greenhouse gases in various ways, including through deforestation and clearing of land for agriculture and grazing, digestion by cows and sheep, the production and use chemical fertilizers.

This study is to analyze the effect of climate change on Agricultural crops such as Wheat, cotton and barely. 75.90 per cent respondents were familiar with climate change, which shows a strong awareness of the issue. However, 8.10 per cent of respondents were not familiar with climate change. The emission of CO_2 is attributed to the sectors of Agriculture, Energy, Waste, Industrial processes, changing land uses and Forestry. Afghanistan was the 116th largest producer of greenhouse gases in the world. Afghanistan lowered its CO_2 emissions by switching from non-renewable to renewable resources. Respondents perceived climate change primarily through observable phenomena such as 32 per cent frequent droughts, rising temperatures and irregular rainfall patterns, which align with global warming trends. A smaller portion of respondents 10 per cent reported decreased temperature. The finding indicate that most respondents perceive changes consistent with effects of global warming, particularly more frequents droughts. These changes are also seen to negatively impact agricultural productivity with 32 per cent lower yields, increased pest problems and disrupted farming schedules being the most commonly reported consequences. Adaptation strategies employed by farmers to cope with climate change is to changing crop varieties is the most common strategy with 29 per cent. Changing crop varieties, adjusting planting times and diversifying crops are popular methods, though limitations in resources and knowledge from implementing.effective measures like irrigation or water conservation. Finally, the ranking of causes using Garrett's technique underscores deforestation, transportation and manufacturing as the top-contributors to climate change, reinforcing the need for targeted action in these areas. The results emphasize the necessity for enhanced education on climate-related issues, investment in sustainable agricultural practices and robust policy measures to mitigate the adverse impacts of climate change and build resilience across communities.

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