Evaluation of Climate Change on Agricultural Production in Afghanistan

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Abstract

This review article focuses on evaluation of climate change on Agricultural production in Afghanistan. Because a large portion of the population in Afghanistan relies on farming as a source of income, sustainable agricultural techniques are essential. In addition, one of the south Asian nations affected by climate change is Afghanistan. Crop yields are also very low due to 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 are the most likely negative effects of climate change in Afghanistan. Climate models predict that Afghanistan will be subject to a variety of new and increasing climatic dangers. Climate change has already begun and will not stop, that it is expected to affect different biological processes differently.

Keywords: Agricultural Production, Climate Change, Global Warming, Afghanistan

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INTRODUCTION

Increasing world population, changing climate conditions and economic activities are growing with each passing day makes it more important than water (Bağdatlı and Bellitürk, 2016a). Increasing or decreasing changes in climatic values affect living things negatively and cause a decrease in productivity, especially in agricultural production (İstanbulluoğlu et al., 2013). Agriculture is highly dependent on the weather pattern, because Agriculture is likely to get affected positively and negatively by the climate change, and change in weather pattern (climate) is expected to have an adverse effect on food security, agricultural production, and rural livelihoods (EPA, 2017; Omerkhil et al., 2020). Research has been conducted to assess the potential effects of climate change on agriculture globally (Rosenzweig and Parry, 1994; Kane et al., 1992; Darwin et al., 1995). But, notable doubts remain and concern has shifted to farm-level impacts or regional effects (Adams et al., 1998; Adams et al., 1990; Mendelsohn et al., 1994) on US agriculture (Kaiser et al., 1993; Easterling et al., 1993; Adams et al., 1998). That is why Climate change is a global issue that is not only related to a land, country or a specific region; rather, it is an all-embracing thing that has affected the whole world over time. The effects of climate change on agriculture may result in less product harvests, increased temperature during growing season can decrease harvests, since crops producing less grain and nutritional quality through their physiological development (Shukla et al., 2019; Sutton et al., 2007).

The unstable effects of global climate change are distributed throughout the universe and are caused by precipitation, temperature changes, and atmospheric carbon dioxide (CO_2) levels (Solomon et al., 2009; Esa and Sapawe, 2020; Cline, 2008).

Climate change and global warming are reducing the available water resources almost everywhere in the world (Uçak and Bağdatlı, 2017). Atmospheric warming is probably increase rainfall, the pure impact of higher temperature on water availability is a race between higher precipitation and higher evapotranspiration. As the precipitation is not regular, the race will be won by higher evapotranspiration (Cline, 2008). The increment of greenhouse gasses emissions in atmosphere along with the global warming and the changes of temperature and precipitation regimes have lots of negative effects on agricultural crop production (Bağdatlı et al., 2015). CO_2 and greenhouse gases accumulated in the atmosphere descend to the earth with precipitation. This event is called acid rain. Acid rains change the pH of the water and affect the life of the living creatures in the water. It causes the natural structure of plants to deteriorate (Bağdatlı and Can, 2019). Excessive increase and decrease of temperatures negatively affect the life of living things. It will be difficult to find clean water in the future as the increase of temperatures will increase the evaporation level (Bağdatlı and Can, 2020).

Agriculture also effect by these events, specially South Asia is among the hardest hit regions by climate change Bhutan, Bangladesh, Pakistan, India, Sri Lanka Nepal, and Afghanistan (Mirza, 2011; Weiss, 2009; Safdar et al., 2022; Wijenayake, 2018). According to World Bank South Asians 750 million people were impacted by one or more climate-related disasters in the last 20 years. The reason the South Asian countries are amongst the most affected countries by global warming mainly owing to complex socio economic-demographic challenges and impoverishment. That is why change in atmospheric conditions is expected to have a bad impact on agricultural production, food security and rural livelihoods especially in Southern Asia countries (Omerkhil et al., 2020). Increasing the necessary studies and measures to minimize the emissions of carbon emissions should be taken all over the world and measures that will minimize the greenhouse gas effect will play an important role in reducing the effects of global warming (Bağdatlı and Arıkan, 2020).

The increase in factory activities, the rapid increase in the utilization of automobiles and dozens of other elements bring about the planet earth to become warmer, cause the rise of greenhouse gases. In particular, economically poor countries are affected by some factors one of this country is Afghanistan. The atmospheric concentrations of the greenhouse gases carbon dioxide (CO_2), methane (CH4), and nitrous oxide (N_2O) have climbed to unprecedented levels in the last years, according to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). Afghanistan's total greenhouse gas emission is lower than the global average of 4.4 metric tons of carbon dioxide. This country produces about 5 percent of the world's total greenhouse gas emissions. The climate models suggest that Afghanistan will be confronted by a range of new and increased climatic hazards (Rosvold et al., 2021; Pachauri and Meyer, 2014).

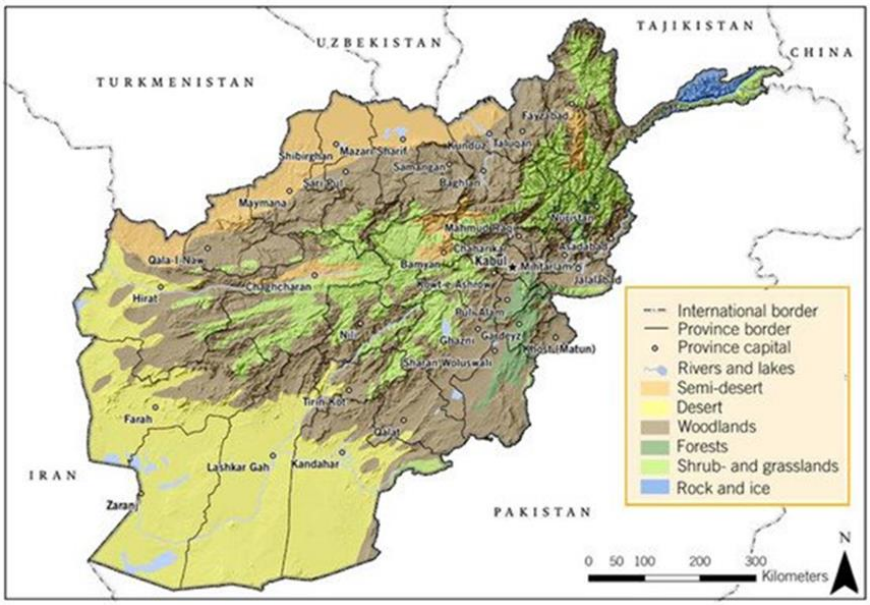

Figure 1. Physical geography of Afghanistan, including major vegetation zones (Olson et al., 2001; Aich et al., 2017).

According to World Bank Group and Afghanistan - Climate Change Knowledge, 2021 Afghanistan has a dry weather conditions with significant temperature and precipitation variation between seasons. By these characteristics, the most likely adverse impacts of climate change in Afghanistan are drought associated with agriculture, livestock, associated dynamics of desertification, land degradation, water, economic sectors, urban and energy (Savage et al., 2009). This review focused on climate change and its effects on agricultural production in Afghanistan.

THE IMPACTS OF CLIMATE CHANGE ON AFGHANISTAN'S AGRICULTURAL SECTOR

Afghanistan is largely dependent on agricultural production. Approximately % 67–85 of Afghans work in agriculture. (Pervez et al., 2014; Fox, 1967; Qutbudin et al., 2019; Formoli,1995; Qureshi, 2002; Tavva et al., 2013; Palka, 2001). Agricultural crops require particular climate conditions, and changes to the climate can have significant negative effects on crops. Summer and winter are the two seasons when crops are grown. The most significant food crops for the people are corn, wheat, and rice. Rice and corn are the primary summer crops while Wheat and barley are the winter crops. Seventy nine percent of Afghanistan's total cultivable land (2.575.000 ha), is used for wheat production. 200.000 ha are used for rice production, while 140.000 ha are used for corn production (Qutbudin et al., 2019). Afghanistan is a country where more than 2/3 of its people live in rural areas and eighty percent of their fed on agricultural production (World Bank, 2021; Byrd, 2008). This is despite the fact that only (%12.1) of Afghanistan's soil is agricultural land, (%5) of which is cultivated (irrigated) and (%7) is rainfed (Goodhand and Sedra, 2010). The aggravating climatic situations in Afghanistan will continue to effect socioeconomic development of Afghanistan (Osmani, 2015).

Water and agriculture resources management are likely to be severely impacted by changes in climate. The vulnerability of the agricultural section getting increase the temperatures and changes the patterns of rainfall and snow melting is high. Therefore, reduced river flow from earlier snowmelt, and Increased soil evaporation less frequent rain during peak cultivation seasons will affect upon agricultural fertility, yield and crop choice availability (Azimi, 2002). The decrease over time of the changes in the surface of the water reservoir is discernible. This also shows itself as the effect of disorder in the vaporization and current precipitation regime in the water sources dependent on global climate change (Albut at al., 2018).

Precipitation is significantly less in the southwest and northwest and significantly more at some grid sites in the northeast and southeast (Aich and Khoshbeen, 2016; Qutbudin et al., 2019). Nearly all grid sites in the northwest and southwest of the nation experienced a significant increase in temperature. Qutbudin et al., (2019) reported the geographical distributions of the changes in precipitation, Rainfall reduced dramatically at a few sites in the southwest and northwest (Kim and Jehanzaib. 2020; Qutbudin et al 2019). Influence of the global climate will have an effect on the change of seasons, especially in the observation of significant changes in temperature and precipitation (Bağdatlı and Arslan, 2020).

These changes negative effect on corn, rice and wheat products. According to forecasts and reports, some areas of Afghanistan will suffer 8.5 percent decrease in average mean rainfall. Similar to this, increases in mean minimum and mean maximum temperatures of up to 4.5 and 5 ^{o}C respectively are anticipated (Sharma et al., 2015). As the same way to another studies and researches, the susceptibility of Afghanistan to climate change can be discussed in a number of ways, water supplies, pastures, forests, biodiversity, and agricultural operations are all impacted by climate change (Commons, 2006). According the (World Bank Group, 2021) was reported Afghanistan might warm by 1.4 to 5.4 °C by the 2080s and 2090s, relative to the baseline of 1986-2005, which is greater than the global average. (Jawadi et al., 2019; Shroder and Ahmadzai, 2016).

CROP YIELD

In this part, our main focus is on the effects of climate change on crop yields. Rice and corn are grown in the summer, whereas wheat is grown in the winter (Qutbudin et al., 2019; Thomas and Ramzi 2011; Hashimi et al., 2020; Tiwari, et al., 2020). The sowing of irrigated wheat typically starts in late October and ends in early December. When sufficient soil moisture content has been accumulated by rainfall, the rain-fed cropping season begins in the winter (Rycroft and Wegerich, 2009).

Crop harvesting for the winter season begins in late May and lasts until early July because of the frigid winters. Beginning in April, the summer season lasts until the end of the winter season in early July. In contrast to rice and corn, which are only grown in the northern part of the nation, wheat is grown throughout Afghanistan. The north of Afghanistan is used as the primary source of irrigation for summer crops because there is sufficient surface water (Rycroft and Wegerich, 2009).

More than % 70 of total crop production depends on irrigation. Therefore, Crop fail owing to water shortage and the amount of potentially productive land or field left uncultivated will likely both getting increase (Parenti, 2015).

According to some studies by 2060, large parts of the agricultural economy are likely to have become edgy without remarkable investment in irrigation and water management. By these problems, more water intensive staple crops will become less noteworthy to agronomist and farmers, with a likely increase in the attractiveness of those that are more drought hardy, including opium poppy (Savage et al., 2009).

Crop yields are very low because of the low water use, and lack of organization, improved seed, and chemical fertilizer. Recently, drought has caused further decrease in the crop yields, e.g., wheat, rice and corn. Potential impact of climate change on wheat, rice and corn are one main challenge in hydro-climatological studies around the world is inadequate or lacking long-term records and reliable climatic data (Ahmed et al., 2018). In the central highlands, winter wheat planting can begin in October, although spring wheat planting can be harvested there starting in August (Sharma et al., 2015).

Wheat crops in Afghanistan are impacted by temperature patterns and precipitation from October to June. Wheat is as a cool-season crop, wheat can be successfully grown in Afghanistan thanks to the country's climate. Fluctuations in rainfall distribution can affect the nation's wheat harvest by millions of tons (Sharma and Habibi, 2012). Similar to this, fluctuations in rainfall distribution can affect the nation's wheat harvest by millions of tons (Sharma and Habibi, 2012).

Global climate change, the industrial revolution of the then mankind atmosphere to release the carbon dioxide, methane, ozone and nitrogen oxides as gases are very quickly heat the earth by the greenhouse effect that occurred as a result of the increase is a result of an increase above normal (Bağdatlı and Bellitürk, 2016b).

Qutbudin et al., (2019) reported that almost the entire country had temperature increases, with the exception of the southeast. For the wheat cropping season, the counts of the grid sites where precipitation, temperature, and standardized precipitation evapotranspiration index (SPEI) changed considerably across a 50 year sliding window and a 10-year period of 1901 to 2010. SPEI was found to be sensitive to rainfall and temperature. Decreases in SPEI were observed at up to 45 grid points (%16 area) during the period temperatures were increasing at about 40 grid points (%14 area) and when rainfall was decreasing at 70 grid points (%25 area) until 1931. In addition, the geographical distributions of the changes in precipitation, temperature, and the standardized precipitation evapotranspiration index (SPEI) during the rice-growing season was provided. Precipitation was significantly less in the southwest and northwest and significantly more at some grid sites in the northeast and southeast, according (Aich,and Khoshbeen, 2016; Qutbudin et al., 2019).

Nearly all grid sites in the northwest and southwest of the nation experienced a significant increase in temperature. The other crop is corn, according some studies; it has been investigated effect of climate change on corn products. (Qutbudin et al., 2019) was reported the geographical distributions of the changes in precipitation, which depicts temperature and SPEI during the corn-growing season, Rainfall reduced dramatically at a few sites in the southwest and northwest. Nearly all grid sites in the northwest and southwest of the country saw a considerable increase in temperature. As a result the number of grids for the corn cropping season during a 50-year sliding window and a 10 year period of 1901 to 2010 that reported substantial changes in rainfall, temperature, and SPEI (Kim and Jehanzaib, 2020; Qutbudin et al., 2019). Therefore these changes negative effect on corn , rice and wheat products.

CONCLUSION

In this review, we assessed the changes in meteorological during crop growing seasons in Afghanistan, because Afghanistan is primarily dependent on agriculture and has a diverse climatic profile. According to certain research, the country has been significantly impacted by climatic changes during the wheat, rice, and corn cropping seasons due to a study of the changing characteristics of droughts for various crop producing seasons. The country was increasingly afflicted by droughts as a result of changes in temperature and rainfall.

Afghanistan, like many other semi-arid and arid countries, is vulnerable to the effects of a changing climate since water is scarce in these areas due to the low annual rainfall and high rates of evaporation. Climate models predict that Afghanistan will be subject to a variety of new and increasing climatic dangers as a result. Climate change has already begun and will not stop. Different biological processes are anticipated to be affected differently by it. The threat of climate change must be seriously considered in Afghanistan. We must consider the issue of climate change while creating the nation's development initiatives and managing its water resources, which is one of the important, factors that has a direct impact on agriculture.

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