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Climate Change and Its Impact on Water Resource and Ground Water in Afghanistan

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ABSTRACT
Climate Change Impacts on Water Resources and Air Pollution, research is carried out to analysis Hydro-meteorological and groundwater data in Afghanistan. The negative impacts of climate change on water resources such as surface and ground water have become a severe social, economic and environmental problem worldwide, especially in the arid regions of the earth, including Afghanistan. Hence, this article studies the relationship between climate change and its' impact on water resource in Afghanistan by reviewing related literature. The main objective of this research is to find out natural causes of climate change effects on surface and groundwater resources. The findings of this study show that although there is a strong relationship between climate change and water crises, it can be a secondary factor in the case of Afghanistan. This is because the available water resources in Afghanistan are more than 50 percent higher than the country's water need. In addition, the main factors involved in Afghanistan's water crisis are explained in this study; factors that have not only caused the flow of about 67 percent of Afghanistan's surface waters to neighboring countries, but also the wastage of about 40 percent of the country's water during irrigation. Finally, limitations and recommendations for further studies also presented.

Keywords: Climate Change, Water Crisis, Water Resources, Surface Water, Ground Water

INTRODUCTION
Afghanistan is a country dominated by a dry climate, with most of the area categorized by effects of global climate changes on hydrological systems, particularly on mountain snow and glacier melting, can adapt the timing and quantity of water stream in mountain watersheds. (Rasouly, 2022). The negative impacts of climate changes on fresh water resources caused severe water shortage in Afghanistan, which is a mountainous country with desert or desert-steppe climate (World Bank, 2018). The distractive consequences of climate change in this country can be studied more precisely based on its annual rainfall distribution; as more than 50 percent of the country has 100 to 300 mm of annual rainfall, and the remaining parts, which includes the high areas of more than 2000 meters, receives about 300 to 800 mm of annual rainfall (Saffi & Kohistani, 2013). For this reason, the smallest climatic changes leave the worst negative impacts on water resources in Afghanistan. In Afghanistan, severe drought is generally equivalent to two consecutive years of low winter rainfall, occurring at least once every 10 to 15 years (Favre & Kamal, 2004). the available climate trends data from neighboring countries show that average annual temperature in Afghanistan has increased by 0.6 degrees Celsius between 1960 and 2008. As a result, there has been a change in the amount of rainfall and snowfall, which are the main sources of water resources in the country (World Bank, 2018). This is while the extent of glaciers in the mountains of Afghanistan has also decreased by nearly 40 percent during the last 40 years (Hagen, & Teufert, 2009). This study seeks to investigate the negative impacts of climate change in terms of water crises in Afghanistan.

LITERATURE REVIEW
Climate change as the main causes of water resource problems has been broadly researched globally in recent years. Because global warming has caused disturbances in the humidity and rainfall regime and has caused ever increasing droughts in arid and semi-arid areas such as Afghanistan. the areas that are currently facing water shortages will face severe water crises as a result of climate change in upcoming decades. Afghanistan. (Hayat & Elçi, 2017). Changes in the amount and quality of water resources in Afghanistan are more related to the effects of climate change (Mehrad, 2020). Sidiqi et al (2018) found that "the average annual temperature of the Kabul River basin may increase by 1.8°C, 3.5°C, and 4.8°C in the 2020s, 2050s, and 2080s,

respectively", which makes drought and lack of water resources in this area more likely. According to Afghanistan's water sector strategy, severe floods and droughts may occur in the country in the coming decades, which will bring social and environmental disasters (Hayat & Elçi, 2017). Although, drought caused by reduced rainfall is the biggest climate risk for Afghanistan's livelihood (Akhtar, & Shah, 2020; Khalily, 2022). The climate of Afghanistan is semi-arid, wind direction are flows from north toward south, and it is started from Hindu Kush Mountains Ranges. The hydro meteorological situations in the winter seasons belongs to snow fall and at the spring seasons to rain fall, the amount of whole annual precipitation is 300 - 400 mm, and at Salang Mountain total annual precipitation is 800- 1000 mm, the higher mean air temperature is between 25- 30 Cº at the summer season, and lower air temperature winter season is -25 at the Salang and at the Jabal Saraj is -5 to -10 Cº. The landscape of Parwan Province has been formed from mountains, the main mountains of Parwan province is Salang and Pangesher mountains to plain areas of Kohdaman, the Hindu Kush mountains range are like wall at the north part of this province continues. The Jabal Saraj, and Paghman mountains ranges are located at the west side of this province. (Rasouly, 2022).

MATERIALS AND METHODS

The study of negative impacts of climate change on water resource is a priority to be researched particularly in arid regions like Afghanistan. In this article, the relevant literature has been reviewed using Science Direct - Elsevier Journals, Springer Nature and Google Scholar databases using the research terms “climate change”, “negative impacts of climate change on water resource”, “water crisis in arid region”, “water crisis in Afghanistan”, “adverse impacts of climate change on water resource in Afghanistan”. this is a literature review article.

RESULTS

In Afghanistan from last three decades’ climate change closely effects on air temperature, precipitation, surface water flows and groundwater resources. some rivers such as Kabul, Loger and Paghman are dry and they we cannot use for irrigation uses. But some rivers of Afghanistan like Panjsher and Kunar river, due to climate change warming air temperature glaciers melting increasing year by year. (Rasouly, 2022). The last consecutive years that drought occurred in this country are: 1964-1963, 1967-1966, 1970-1972, 1999-2001 and also in 2002 (in the south of the country) and the 2011 drought (Favre & Kamal,2004), among which the 2011 drought was the worst that affected more than 2.6 million people in more than 14 provinces of the country (Hayat & Elçi, 2017).

1. Change in temperature

Temporal changes of temperature are one of the distinctive characteristics of a dry climate like Afghanistan, for example, in the Hindu Kush regions temperature reaches minus 50 degrees Celsius during winter, while in the summer, it increases to more than 50 degrees Celsius in the desert areas, especially in the Margo plain in south western part of Afghanistan (Hayat & Elçi, 2017). As a result, there has been a decrease in the amount of rainfall and snow, which are the main sources of water in this country (World Bank, 2018).Research shows that "Afghanistan's average annual temperature has increased by 1.8 degrees Celsius since 1950, with the highest temperature increase in the southern plateau (2.4 degrees Celsius), followed by the northern regions (1.7 degrees Celsius), the central highlands, and the Hindu Kush mountains (1.6 degrees Celsius) and the eastern region is 0.7º” (Shokory, Schaefli, & Lane, 2023).

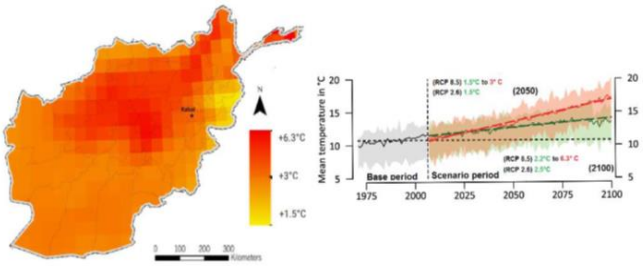

Figure 1: Represents the projected increase in temperature of different regions of Afghanistan

(Shokory, Schaefli, & Lane, 2023).

2. Changes in humidity and rainfall

Studies show that "The annual distribution of rainfall (Figure 2) in Afghanistan shows the picture of a dry country, where more than half of the country has 100-300 mm of annual rainfall. About 50percent of the remaining area of the country, which includes high areas of more than 2000 meters, receives about 300 to 800 mm of rain per year. Also, about 50 percent of the precipitation in this country occurs in winter (January to March), most of which is in the form of snow, and about 30 percent is mostly in spring (April to June) and the remaining 20 percent in it occurs in summer and autumn" (Saffi & Kohistani, 2013).

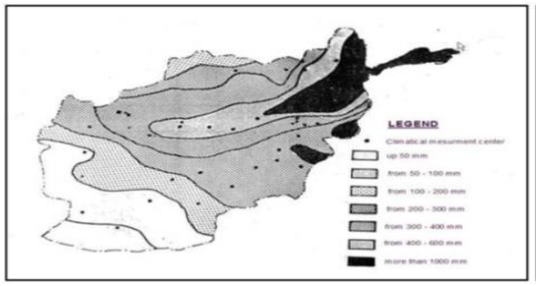

Figure 2: shows the average annual rainfall in Afghanistan (Saffi & Kohistani, 2013).

On the other hand, water distribution in Afghanistan is unequal in various ways. For example, the average rainfall in Afghanistan is between 250 and 310 mm, which is about one third of the average rainfall in the world (Fahim, 2016). In the short term, rainfall in Afghanistan is expected to increase slightly on average, about more than 10 to 20 mm.

3. Evapotranspiration

The annual evaporation and transpiration rate in the Hindu Kush highlands is relatively low (about 1,000-1,300 mm) due to severe and long winters. But in the relatively flat areas of the north, it varies between 1300 and 1500 mm, and in the plains of the south and southwest of the country, it reaches 1800 mm. However, summer evaporation and transpiration rates are high everywhere, with a daily peak of around 6-8 mm in July/August. Due to the strong wind, especially in Mazar-i-Sharif and Herat (120-day Herat wind), the maximum amount of daily evaporation and transpiration is 9 mm and 10 mm, respectively (Mahmoodi, 2008).

4. Negative impacts of climate change on water resources in Afghanistan

Afghanistan is located in dry region, it is still relatively rich in water resources due to the presence of high mountain ranges such as Wakhan, Hindu Kush and Baba, which are covered with snow and glacier deposits. The origin of more than 80% of the country's water resource is formed by the Hindu Kush mountain range and altitudes above 2000 meters, and it creates a permanent flow in all major rivers by melting snow during the summer (Mahmoodi, 2008). Water resources in this country are divided into five river basins: Amu, North, Harirud-Morghab, Helmand and Kabul. Recent estimates indicate that the country's annual water resource capacity is about 75 billion cubic meters, of which 57 billion cubic meters are surface water and 18 billion cubic meters are underground water (Mahmoodi, 2008). The total amount of groundwater extraction is estimated at 3 billion cubic meters. In total, about 15 percent of the total volume of water used annually is underground water, and approximately 85% of it is water from rivers and streams (HDR, 2011). Afghanistan's water resources are highly dependent on reversal and unstable rain and snowfall. Glacier retreat and early snowmelt have strong effects on reversal water availability.

DISCUSSION

Studies confirm a strong relationship between climate change and water scarcity and water crisis, but in case of Afghanistan the available water resource is theoretically much more than the current water needs of this country. In addition, drought as a consequence of climate change is somehow a natural process that occurs once every 10 to 15 years in Afghanistan. Therefore, considering the climate change as the main cause of water shortage in Afghanistan can be only a claim. It is because the available water in this country is more than 70 billion cubic meters (surface water 57 billion cubic meters and underground water more than 10 billion cubic meters) (Saffi & Kohistani, 2013).

Accordingly, it seems that the negative impacts of climate change on water resources in Afghanistan is a normal trend which temporarily causes water shortage. The main causes of water crisis in Afghanistan are

firstly, political instability and unprofessional human resource in the country that lead to mismanagement of water resources in the country.

CONCLUSION

Study shows that the negative impacts of climate change on Afghanistan's water crisis is temporary and marginal. The main causes of water crises in this country are due to problems with the management of transboundary water and hydro-political issues in the country.

Conflict of Interest: All authors express no conflict of interest in any part of the research.

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