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Climate Change and Water Shortage in Pakistan: An Analysis

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Abstract

This paper has discussed how the intense change of temperature is affecting the water sources and is creating scarcity in Pakistan. Water scarcity leads to a vulnerable situation in Pakistan, as people are deprived of clean water for drinking and domestic purposes. Unfortunately they have to drink contaminated water which causes serious chronic diseases and infections. This paper has mentioned statistics of increasing temperature, shortage of water levels and the relationship exist between them. Climate change directly impacts water supply, and as the temperature increases, water starts evaporating and thus causing a shortage of water. The economic condition of Pakistan is also mentioned in the paper, it is a developing country; with no proper planning to control rapid climatic changes or to face the water scarcity. It has also discussed the climatic changes occurring from the past decade and how they are creating problems for people concerning the water. Water scarcity has also affected the agriculture of the country.

Key Words: Temperature, Climate Change, Water Scarcity, Glaciers

Introduction

Pakistan is an agricultural country, and for cultivation, it requires clean water. There are many reasons for climatic change like global warming, high pollution, deforestation, extraction of fossil fuels, exhaustion of minerals, endangering of animal species, etc. With every coming year, the climate of the earth is rising. This is because of the overconsumption of fossil fuels, which cause the emission of carbon dioxide and greenhouse gases. This carbon when mixed in the air reacts with the carbon elements found in the air and increases the temperature of the earth. This increase in temperature results in intense climate conditions just like the one we are witnessing now. Climatic changes have an impact on all sectors of life in Pakistan. The climate of Pakistan is affected by global temperature, and scientists have discovered that temperature increase in winter is more than summer; the increase in the temperature recorded in the previous century was 0.6° on an annual basis, which is in response to the global change in the climate.

This climate change is creating a highly risky situation for the country, and there is a need to pay attention to this matter. This is changing the precipitation pattern of earth, and the glaciers are also melting because of high temperatures. The water resources are coming to end on Earth. In Pakistan, because of temperature increase, drought is predicted in the future. Pakistan also has no big dams that can store water and meet the water needs of the future. Climate change is making the

evaporation of water faster and the groundwater is moving from hilly areas to lower regions, which is creating a scarcity of drinking water in Pakistan. The high temperature coupled with a shortage of water is making cultivation difficult in Pakistan. Resultantly, there will be a food shortage in the future, and scarcity of drinking water.

Methodology

The climate data in Pakistan of the overall previous century and from 1950 to 2007 is taken. The average increase pattern and temperature records for the last 70 years are included in the paper. The paper aims at finding the relation between water supply and climate change in Pakistan, and for this reason the water conditions are also mentioned in the paper. The data is taken from reliable sources so that there remains no ambiguity about the competency and accuracy of data. This data is about the overall region of Pakistan. In order to completely understand how temperature is affecting water scarcity, the historical average data of both elements are mentioned. This data reveals an increasing trend in climate from past years, and the water level growing down gradually. This methodology is to cover quantitative research.

The qualitative approach is also included in the research, which includes the causes of rising Earth temperature, which is gradually resulting in variation in climatic conditions. On the other side, the water level is also witnessed to be going down in the same period, which shows the climate is impacting the water. The sources include in research are all valid, containing reports, scholarly articles, and books. For further explaining the causes of climate impact on water shortage, the dams in Pakistan, their capacity, and current conditions are mentioned. The consequences are also mentioned to support the argument and shreds of evidence. Moreover, the causes of rising climate and increasing water scarcity are briefly discussed to explain the fact that they are interrelated.

Climate Change

Climate Change is causing variation in the natural climate level of Earth and producing elements that force it to change unnaturally. The climate of Earth is changing irregularly because of greenhouse emission, which disrupts the natural system of the environment. This fluctuation in temperature impacts every aspect of human life. The first threat of climate change creates is the shortage of freshwater, and as a result the survival on Earth will be endangered. This will also affect food production because cultivation will get affected first hand. This is exactly happening in Pakistan, and the situation will get worse in the future (BBC, 2020).

Water Scarcity

Water is a natural resource, on which survival of the environment is based. Water shortage is created when these water sources are not distributed equally, which results in a lack of water supply for drinking purposes or cultivation. The climate of the earth is increasing, which makes rapid precipitation causing water shortage. This cause is just one example that is contributing to water scarcity; however there are numerous other reasons for playing their part in creating a scarcity of freshwater (Wagan & Khoso, 2013).

Water Scarcity in Pakistan

The water supply in Pakistan is getting short because of rapid climatic change. This climatic change is because of the overall rise in temperature and variations in the climate of Earth. The water consumption for the production of leather and cement etc. are taking a high amount of water. The sole output is also changed, which is a cause of climate change on Earth (Ahmed, 2002). The global temperature is rising every year; it is increasing at a rate of 0.6 degrees Celsius in Pakistan. This increase will reach the level of 1 degree Celsius at the end of the century, which is indeed an alarming situation. This temperature rise will increase heat in northern areas compared to southern areas. These areas play an important part in earning revenue in the country in respect of tourism. This climate change will result in cyclones, droughts, floods, and heat waves. Moreover, the glaciers in the Karakoram will also lead to rapid melting, which will affect the water supply. In addition to it, this climate change is so powerful and impactful, that it can even alter the rainfall patterns. Among all the above-mentioned things, water supply in Pakistan will be affected first hand from these irregular climate changes. Food and sanitation will get disturbed when climate change plays havoc with freshwater sources. Pakistan is facing flash flooding every year in northern areas. There is no visible change or rise in water level witnessed in the previous record from 1969 to 2014, comparing to the highest flows each year with total flow capacity each year in UIB (Upper Indus Basin) and Indus River. Maximum flows in Kabul River Basin is seen increasing because it contains water coming from melting of snow on mountains, which is not a favorable thing at all. Because of the rapid melting of glaciers, Gilgit River Basin is flooded earlier than its expected time with a high maximum flow of water (survey, 2019).

The World Economic Report says Pakistan is failed in controlling its population, using wise means to control resources, building effective infrastructure, and controlling inflation; these all factors has put Pakistan in a troubling situation of water scarcity. The peace and development of the country are disturbed when people are unable to get fresh water for drinking which is the basic right of every living being. Pakistan is facing a shortage of water because of no proper planning for distribution and consumption. There are no preventative measures that guide the preservation of this natural resource. Pakistan is facing water scarcity, and the situation is predicted to be worse in the coming years (Editorial, 2019). Experts are identifying horrible water situations in 2025 with a decrease of 31M ac-ft. (acre-feet), and it is expected that there will be no water in the country. It shows the country will be completely drought. This situation will lead to food shortage, deforestation and survival will become difficult for almost 1.8B citizens, says UN (United Nations) and PCRWR- Pakistan Council Research in Water Resources (LAKHO, 2019). The per capita water was 1,500m^3 in 2009. This level is decreased and has reached 1,017 m^3. Pakistan has two larger dams, Mangla and Tarbela, which have high debris and sand, reducing the storage capacity from 145 Million Acre-Feet to 14 Million Acre-Feet, which is reflecting how critical point is at Pakistan now in respect of its water reservoirs (Qadeer, 2019).

Climate Change involvement in Water Resources

IPCC AR4 says that climatic variations will become intense with every coming decade. It will bring irregular changes in precipitation patterns. The glaciers melting and the probability of dry spell and floods will be increased. Pakistan is a developing country, facing numerous challenges. It is still unable to control its population, because of which many problems are getting birth, like per capita water available to each person is decreasing, and the Water Resource Management of the country is also working on the old framework. Thus, unable to cope with the current scenario and meet modern challenges (Briscoe et al., 2006). The seasonal water flows in sources is also changing, and the water in sea level and the ground level is reducing. Water scarcity is being felt for cultivation in the agriculture sector. Pakistan is highly dependent on agriculture for its food and revenue through exporting food items. At the end of this century, the temperature change will between 1.8 degrees to 4.0 degrees Celsius, which is a highly vulnerable situation and the next century can be expected full of devastations and challenges for human survival; says fourth assessment report of Intergovernmental Panel on Climate Change. Due to global warming, the environment of high mountains and hilly areas is also getting adversely affected. For this reason, the water vapor in the atmosphere is increasing, disrupting the hydrological circle, soil moisture, and melting of snow and glaciers. All these causes are changing the quality of water (Haeberli, 1990).

Pakistan is situated in 30.35 degrees north in longitude, and 69.34 degrees east in latitude. Because of this location, Pakistan heavily depends on ice and snow melting for water. But unfortunately, the snow and ice in upper mountainous regions are melting faster and before time, which is creating a shortage of freshwater supply. Pakistan has built dams for power generation, which rely on water of Indus River Basin, which came from HKH- Hindu Kush-Karakoram Himalaya. The risks to water sources due to climatic changes are large in number. Glacial fluctuation is also seen due to climate change, just like the visible shrinkage appears this century compared to the previous one, says WGMS-World Glacier Monitoring Service(Naithani et al., 2001). In research, it was revealed that about 67% of glaciers in the Himalayas are shrinking, because of intense climate conditions (Muhammed et al., 2004). Moreover, a recession is predicted on Gangotri glacier over the length of 30Km. This glacier is found on the Eastern side of the Himalaya Range. This glacier shrinkage is increasing in an irregular pattern, the glacier shrinkage was just 2 Km in 200 years, and in the last 20 years, it is about 850m, which is leading to a terrifying situation. Pakistan is more at a vulnerable stage because its glaciers were retreating faster than any other glaciers of the world. If this deglaciation is not controlled, Pakistan will be deprived of them in 2035, says WGHG (Working Group on Himalayan Glaciology) in the report presented in 1999 in ICSI- International Commission for Snow and Ice (Rees & Collins, 2004). Glacier retreating results flood in lower regions and land sliding, almost every year, lower areas of Punjab and Sindh are drowned because of floods. The World Bank Report of 2005 identified this situation and says the glaciers of Himalayas will lose their presence in the next 50 years, and Pakistan will be caught by the dry spell (World Bank Report, 2005). This will result in high water flow in the Indus River. After the melting of these glaciers, the low level of water in Indus will reduce by 40% at the end of this century. Floods have taken almost 7,800 lives in the previous sixty years. Moreover, it also has caused a loss of Rs. 385 B. Pakistan is unable to store water, and this water appeared in the form of flood, making areas drown (FFC Annual Report, 2007). The per capita

water storage capacity of Pakistan is $150m^3$ which is too low compared to other countries, and it will unable to meet demands in the future. The USA has 6,000 cubic meters and China has 22,000 cubic meters storage capacities per head (World Bank Report, 2006).

Water sharing with India

The majority of water needs are fulfilled by the Indus River in Pakistan. There are water disputes between Pakistan and India. The lower regions of Pakistan are flooded each year because India releases excess water from dams, as Pakistan has no dams on their way so this water creates trouble for it. Pakistan is an arid country and is on forth number regarding the water consumption in the world. The single source of water in Indus River for Pakistan, which has six other tributaries, comprising of Chenab, Sutlej, Beas, Jhelum, and Indus River (Tariq & Van De Giesen, 2012).The water of Monsoon in summer also falls in these rivers which are 494-millimeter average every year. Water in these rivers comprises of rainwater, glaciers, and snow melts. The surface water in Indus River is 20 to 258 cubic kilometers, out of which about 190 cubic kilometer falls in Pakistan. From this surface water in Indus River, 50 cubic kilometers is the water coming from underneath the surface ground. Discussing this water proportion in percentage, we can say that almost 83% of water is groundwater and 74% is surface water available in Indus River (Laghari, Vanham, & Rauch, 2012). Water provided by the Indus River is sufficient to meet the requirements of 300M individuals (Frenken, 2012). Three countries; Pakistan, India, and Afghanistan are depending on the Indus River for cultivation. This sole river has become a bone of contention between these three countries due to food supply (Wescoat , Halvorson, & Mustafa, 2000).

Indus Water Treaty

Pakistan and India were part of the subcontinent before separation. But after seven months of their separation, India deliberately stopped the water supply of Sutlej. This water flowed on the border side of Punjab, and the food production of people was dependent on it (Frenken, 2012). It was a high threat to the agriculture sector of Pakistan. There was an agreement for water distribution between India and Pakistan which was ended on March 21, 1948. Later, on May 4, 1948 these countries acknowledged the water conflict and agree on the point that, the River flow will not be disrupted until Pakistan look for its other water resources (Begum, 2011). World Bank interrupted in this matter in 1960 and join these countries on one agreement called Indus Basin Water Treaty (IBWT) or simply called the Indus Water Treaty. This contract covered the water problems of these countries. In this agreement, it was accepted that Pakistan will be given three western rivers, and India will be given three eastern rivers. The Three western Rivers given to Pakistan were Indus, Jhelum, and Chenab, and the three eastern rivers given to India were Beas, Ravi, and Sutlej (Mustafa, Akhter, & Nasrallah, 2013). This treaty also granted India some preferential privileges over non-consumptive applications. India and Pakistan are still following this treaty; although they have fought three battles against each other. This treaty has resolved the water conflict across the border but has led to many disputes between provinces of Pakistan. The crops in Southern Punjab are irrigated by canals system. This canal system is the world's largest canal system. But unfortunately,

although of having the largest canal system in the world, Pakistan is unable to settle the water disputesbetween Baluchistan and Sindh and Punjab and Sindh. Moreover, India has built dams and hydro projects on the rivers coming to Pakistan(Briscoe et al., 2006). These projects are creating discord between these two countries because they control water flow coming to rivers in Pakistan, and these rivers are the only source of water needs. The major hydro-electric projects of India built in the perspective of this cause are Salal Hydroelectric Power Station, BagliharHydel Power Project, Kishanganga Hydroelectric plant, and Ratle Hydroelectric Plant. These dams are causing water conflict between India and Pakistan (Mustafa, Hydropolitics in Pakistan's Indus Basin. , 2010).

Salal Hydroelectric Power Station or Salal Dam is built on the Chenab River which was given to Pakistan under the Indus water Basin treaty, and India is controlling its water flow through this dam. Moreover, Baglihar Dam is also built on river Chenab originating from the disputed territory of Jammu & Kashmir. India is trying hard to get control over the western rivers given to Pakistan, For this purpose, it has started a large number of water projects in Jammu & Kashmir including Dulhasti Hydroelectric Project, Dumkhar Project, Uri Hydroelectric Project 1 & 2, ChutakBarrage, Nimoo Bazgo Project, Bursar Dam, and Pakak-Dul Dam(Atef et al., 2019). These water projects are being operated by proper planning and strategy to make the canal system of Pakistan ineffective, and thus damaging the agriculture sector of Pakistan. The goal of India is to stop the water of River Chenab for 25 days by building dams it already has completed 14 hydropower projects in this regard. Resultantly, 7 million acres in Punjab which is irrigated by the Chenab River will barren and the crops will be destroyed (Mustafa, Hydropolitics in Pakistan's Indus Basin. , 2010). The Kabul River originating from the Hindu Kush falls in Indus River. Farmers in Khyber Pakhtunkhwa depend on KRB. India is also starting hydropower projects on KRB to increase pressure on Pakistan for water (Malik, 2019).

Quantitative Approach

Above were the causes of climate change and water scarcity. This section will prove with actual figures how climate change is creating water shortage. Indus River is 2880 Kilometers, being the longest river in the Asian continent (Khan, Koch, & Tahir, 2020). The drained length is 912,000 square Kilometer. The water of Indus River covers are of 165,400 square Kilometer in Tarbela Dam (Ali & De Boer, 2007). The total national Greenhouse Gas emission was 182 million tons of carbon dioxide equivalents, which increased to 309 MtCO2ein 2008, and this trend continues with the same intensity. It was 369 MtCO2ein 2012, and in 2020 it is 650 MtCO2e. This is showing a critical situation, and if this situation is not controlled, it will reach to 4,200 MtCO2e in 2050. In all these years of GHG emission, the energy and agriculture sector has the highest contribution. Similarly, if discussing the temperature inclination, there was an annual 0.57 degree Celsius average rise every year inthe previous century in Pakistan. Between 1961 to 2005there was a 0.47 degree Celsius increase in temperature. In 2004, the highest climate change was witnessed, in winter where the temperature goes from 0.52 degrees Celsius to 1.12 degrees Celsius. This was because of irregular post-monsoon. Baluchistan bears high temperatures comparing to the northern areas of Pakistan. From 1960 to 2007, the

lowest temperature change was measured at 0.48 degrees Celsius, and the highest temperature variation was recorded as 0.87 degrees Celsius(Chaudhry et al., 2009). Solar radiation was found to increase by 0.5% to 0.7% in the last half-century. In the central regions of Pakistan, temperature rise by 0.9 degrees Celsius, and the cloud cover was found to reduce at 3 to 5%. The humidity in Baluchistan by 5% and the rainfall was reduced from 17% to 64% in the previous century (Chaudhry, 2017).

The water sources are highly found to be negatively impacted by climate change. The canal system of Pakistan is dependent on precipitation, snow, and glaciers melt and groundwater. The winter rains and monsoons are showing variation in their pattern as a result the water flow in the river becomes uncertain. Similarly, the melting of ice and glacier has also become irregular, and it is difficult to predict the water flow in rivers from these sources. The per capita water availability is low because of the low storage capacity of dams in Pakistan. Similarly, precipitation is also increasing, which increases the demand for water. This creates a thinking situation for the government where it already has a low per capita water availability, and out of which is precipitating rapidly. 0.2M acre-feet per year are decreasing in terms of water storage capacity in Dams because of the accumulation of deposits. In Indus River, 50 MAF (million-acre-feet) is rainwater coming in monsoon season. Moreover, 142 Million acre-feet are river inflows in IRS. There is a decrease of 77.3 Million acre-feet to 39.3 million acre-feet on an average basis. During Rabi season, there are almost 33 days, in which there is no water inflow in Mangla and Kotri; which provide water for cultivation and drinking purposes in Badin, Thatta, and Hyderabad (Ahmad, 2009).

Analysis

According to the data of seventy years taken above, it is clear that climatic changes are creating a serious scarcity of water in Pakistan. Pakistan is already facing a shortage of water because of the low water storage capacity of Dams. The dams of Pakistan are filled with deposits as a result the storage capacity is decreasing each year. Moreover, India has built dams on rivers coming to Pakistan form Jammu & Kashmir by violating the Indus Water Treaty. The industries are also consuming water, which is reducing per capita water availability. Besides, water is wasted in high amounts annually, as people are unaware of its scarcity. Industries are disposing of wastes in an open environment. This untreated waste contaminates the atmosphere, thus the rainwater is also polluted and isacidic. Hence, they are unfit for drinking and domestic uses. Moreover, no new dams are being built, resultantly; the majority of the waterfalls in the Arabian sea and are wasted. The rainfall patterns are changing, and the canals depending on rainwater for cultivation are drought.

Findings and Conclusion

There is a need for efficient use of water resources. Pakistan can get high value from its water if it is handled strategically. Pakistan has high water than many other countries, it has a long coastline with the Arabian sea extended over 146 km. it is admitted that water is although low per capita water, but the water it has is enough to give it economic and social privileges. There is needed to take urgent action, to control this water scarcity. The country is expected to make significant changes in policies and structure, to overcome shortages, to promise a peaceful and secure life in

the country (Altaf, 2019). Need fora national water policy that efficiently handles water pollution, water wastage, and take measures to control this scarcity. Control the excess concentration of arsenic in drinking water, and keep it healthy and fresh. There is a high need to build dams, to store water. As the Kala Bagh dam is the victim of politics, and for these reasons, it has not been built, nor is its structure finalized after passing many years. Multiple small dams can be built to control water scarcity (Randhawa, 2017). There is a need to plant trees and forests can help in stabilizing the environment (Qureshi & Akintuğ, 2014). Pakistan is blessed with glaciers which are highest in number comparing to other countries, these glaciers are melting due to temperature increase, there is need to control greenhouse emission, and secure these glaciers (Nabi, Ali, Khan, & Kumar, 2019).

The temperature of the earth is rising because of human activities which are damaging the balance of the environment. Resultantly the climate of the earth is changing. Similar is for Pakistan where the climate is dramatically changing, causing many other factors. Water sources are the most sensitive factors which easily get affected by climatic change. The glaciers and snow on mountain tops are melting rapidly and the glaciers are also retreating every year. There is an expected dry spell in Pakistan because of this water scarcity. The food supply and life of humans will get affected by this climatic change. It becomes necessary for the government to take preventative measures and get control of this threatening situation.

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