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Food Security in Context of Climate Change in Pakistan: A Review

* Dr. Nazia Tabasam
** Shagufta Rasheed
*** Dr. Almazea Fatima

Abstract

The most complex issue of today is climate change which influences all regions of the world and results in extensive agitation to the natural ecosystem. It affects the different dimensions of life such as social, political, economic, and the sciences. Distortions in the natural ecosystem ultimately affect economic progression by posing severe threats to agricultural production and food security. The main reason behind this study is to review how climate change affects the food security by impacting agricultural production in Pakistan. It is forecasted that nine billion people would be food insecure in the world by 2050 mainly due to decrease in agricultural production. Pakistan is no exception to the effects of climatic variations. Researchers found that the extreme climatic effects like the melting of glaciers, irregular rainfall, flooding, droughts, changing temperature, heat waves, storms, and pest diseases are adding to the food insecurity problem. More than 212 million people live in Pakistan, out of which 58% are malnourished and about 20% of them are food insecure. Among the food insecure nations, Pakistan is ranking at a serious threshold level and the cost of climate change adoption is too high.

Keywords: Climate Change, Food Security, Agricultural Production, Flood, Pakistan

Introduction

The most complex and severe issue today is climate change. It is a global issue and impacts each dimension of life, such as society, politics, economics, science, etc. The severity of the effects is different across various regions. The review of earlier studies on climate change, agricultural production and food security is essential to reach at all-inclusive outcomes. Among others, climatic variation is labeled as one of the major cause for low agricultural production and resultant food insecurity. This study appraise and highlight the factors identified by various scholars for future research practices and safety of ecosystem.

Climate Change

The global environmental situation showed a change in pressure, humidity, temperature, and precipitation. These changes in the global environment can be termed as "climate change" (Lipczynska-Kochany, 2018). Human activities are the main reason for changing the environmental situation. Global warming is brought on by the heat-trapping gas carbon dioxide and is mainly emitted by human activities. The heat-trapping gas stays in the atmosphere for the long term. So even if we stop emitting heat-trapping gases today, global warming will still affect the next generation (Balaban and Gedikli, 2018).

The effects of climate change cause severe disturbances to the natural ecosystem, ultimately affecting the worldwide economic system (Kohler and Maselli, 2009). It has diverse impact on various parts of the world with different levels of severity. Some regions are hit the hardest, while others are hit the least (Ali and Erenstein, 2017). One of the most impacted nations is Pakistan. In the list of most effected nations, Pakistan stood at 12th in 2012 and at 8th in 2015 (Kreft et al., 2014; Wassmann et al., 2009). Over the past few years, Pakistan has been severely harmed by droughts, floods, cyclones, and storms (Zhu et al., 2015). It is on the verge of becoming the nation most severely impacted by climate change because of a number of factors, including its reliance on the agricultural sector, water shortage, geographic location, and minimum resources to adapt to the climatic changes (Balkhair et al., 2018; Malik et al., 2012). The climate differs in the provinces of

* University of Agriculture Faisalabad
** University of Agriculture Faisalabad
*** University of Agriculture Faisalabad

Punjab and Sindh, which are the most productive provinces for the agriculture sector. The ratio of precipitation changes from 100 mm to 500 mm. The ratio increases up to 70 percent. (Malik et al., 2012.

The climate change effect is very severe in Pakistan also due to the high rate of Himalayan glaciers melting phenomena, and the other reasons are irregular rainfall patterns, flooding, droughts, lack of water resources, varying temperatures, extreme heat waves, storms, land sliding, pest and disease attacks, changes in season duration, and health issues (Abid et al., 2016; Hussain et al., 2016). Climate change harmed the overall economy, but small farmers bore the brunt of the damage because the floods damaged their total production and destroyed their lives (Ahmed and Schmitz, (2011).

These climatic disasters transformed into more persistent ones, and they caused severe losses (Qasim et al., 2015). Lots of rural inhabitants were badly damaged by the 2010 and 2014 floods in Pakistan due to its climatic situation (Banoori, 2012; Fahad and Wang, 2020). Most severe and damaging is the flood of the current year, 2022, which affects the economy severely. According to the OCHA (Office for the coordination of humanitarian affairs) report, the current flood situation in Pakistan is worse than it has ever been. It is estimated that about 8 million people have been displaced. The number of houses that have been destroyed completely is 7.8 million. The number of people who died is 1739.

The mean annual temperature of Pakistan during the twentieth century increased by 0.57 ^{0}C at an average rate of 0.06 ^{o}C per decade. The average annual temperature indicated an increasing trend in Pakistan (FAO, 2020). The ratio of precipitation also varies in Pakistan with time due to climate change. The ratio of precipitation increased by 25 percent in Pakistan during the last century. The change in temperature and precipitation level brings about a change in crop production and yield. It also affects the soil fertility level (Schmidhuber and Tubiello, 2007).

Fig.1: 2022 flood in Pakistan

Food Security

Food security is the biggest challenge for growing population. World Food Summit has defined food security as the constant supply of staple foods to support rising food consumption and counteract changes in production and pricing (Nations, 1975). Food and agricultural organizations revised their definition of food security in 1983 ensuring all people at all times have both physical and economic access to the basic foods they need (FAO, 1983). Food security was further defined by the World Bank in 1986 as everyone always having access to enough food for an active and healthy life.

Providing access to food is a fundamental and important purpose of every economy, including Pakistan's.

Food security has four elements: availability, access, usage, and stability. The FAO estimates that 80% of the main disasters that would threaten the nation's food security are due to climate variables (FAO, 2018). The daily dietary energy intake of 2700 kcal is the most often utilized method for food security measures (Molden et al., 2007). For an average diet, one liter of water is needed to produce one kcal (Patt et al., 2009).

Fig.2: Food security in Pakistan

Climate Change and Agriculture:

The economy being always badly affected by climate change, has agriculture as a major sector. Climate change has been misrepresented to economies more and more recently (Easterling et al., 2000). In lower-income regions, the climate change predictions proposed a high level of climate vulnerability (Wheeler and Braun, 2013). The Asian regions are very sensitive to climate change (Naseem et al., 2020). In South Asia, 70% of the population reside in rural areas and agriculture sector is dominating in the region. Crop productivity is low and poverty rate is 75% in South Asia (World Bank, 2012).

For agricultural production, temperature and precipitation are considered the most important climatic factors because they affect productivity the most (Chandio et al., 2021). The economy of Pakistan mainly relies on the agricultural sector for employment, earnings, and the development of the industrial sector. So the development of the economy is impossible without the development of this sector (Abbas and Waheed, 2017; Fahad and Wang, 2020). Pakistan is an agro-based economy with 60% rural population. Its agriculture sector contributes 21.9% to the GDP and employ 45% of the labour force. So the climate change not only affect the production level but also affect the livelihood of the country's population. Increase in production, decrease the poverty level, and raise the standards of living (GOP, 2012). Among the other developing countries, Pakistan is highly vulnerable to climate change (Schilling et al., 2013). In certain regions, Pakistan had faced, the severity and intensity of climate change events like droughts, water shortages, high temperatures, floods, diseases, and pest attacks (Smit and Skinner, 2002). It has been perceived that food production is heavily dependent on climatic and weather situations. Crop growth and yield could be reduced due to insufficient water availability and heat stress. The southern regions of Pakistan are under severe threats of livelihood in the coming years due to droughts and scarcity of water. Less than 10 mm of anticipated precipitation will fall in some areas, which is the minimum quantity that is expected. Climatic conditions affect the agriculture sector in several ways, for example, it deteriorates; the soil quality, natural communities, irrigation and arable land (Gornall et al., 2010). There are two cropping seasons in Pakistan: Rabi and Kharif. These cropping seasons are very sensitive to water quantity and changing temperatures. There is a prediction that as the temperature grows, agricultural production will be reduced by 8–10% by 2040 (Cradock-Henry et al., 2020). So the climatic challenges for Pakistan's economy have increased with the passage of time even though Pakistan is among the countries that emit the least (Awan and Yaseen, 2017; Khan and Fee, 2014).

Pakistan was deemed the most affected country by German watchmakers in 2012.This continues in the form of floods (Kurosaki et al., 2011). Since 1999, Pakistan has experienced severe weather events, which damage the economy badly. From 1999 to 2003, Pakistan experienced severe

droughts. The floods of 2010, 2011, 2012, and 2014 were other evidence of severe climatic events that occurred in Pakistan. Pakistan faced economic losses of more than US$15 billion during the 2010 flood. It affected twenty million people badly. The country needed US$6 to 14 billion annually to mitigate the negative impact of climate change and stabilize the economy (Abdullah et al., 2016; Wandel and Smit 2000).

The poverty rate is high among farmers in Pakistan, so their adaptive capacity is low. The different climatic events that occurred in Pakistan from time to time also affected the farmers' decisions regarding management and adaptation to climate change, because these events posed a serious threat to their production (Wandel and Smit 2000). The most realistic climate model predicted an increase in rainfall during the summer, but this is not true (GOB and UNDP, 2009). Climate change also affects the Himalayan glaciers, which are melted by about 75 percent due to climatic factors. It is forecasted that glaciers will disappear by 2035 (Misra, 2014).

Climate change is also the primary cause of various crop diseases. Different diseases attacked the crops and trees and reduced their productivity and quality. The change in the average annual temperature is the major cause of disease attacks. It is much higher than the threshold level (Ali et al., 2017). The increase in temperature also causes other problems. At the growing stage of the crops, the excess energy is used for respiration, and less energy is left for the growth of the crops. It is all because of the high temperature. As the average annual temperature of Pakistan increased up to 10 ^{0}C, the increase in temperature cause 5 to 10 percent reduction in many food and cash crop production (Ahmed et al., 2016).

Agriculture productivity is negatively impacted by climate change, and by the middle of this century, Pakistan is predicted to lose about $20 billion. This loss could be due to reductions in wheat and rice production. Both are important food crops for the country (Hatfield and Prueger, 2015). Agriculture, livestock, and land use activities account for 24% of climate change. It is estimated that the increase in the use of nitrogen manure and animal compost production in the agriculture sector would increase the nitrous oxide concentration from 35 to 60% in 2030. Due to the impact of these composts, agricultural output decreased and the agriculture sector's overall share of GDP decreased, from 38.9% in the 1970s to 19.3% in 2019 (Eckstein et al., 2018).

For a country like Pakistan, which has a high population growth rate, the decline in agricultural production has created a horrible situation and could create a severe food insecurity situation in the country. The public became more exposed to danger and food shortages. Two effects of climate change that are driving social and political unrest as well as international migration are water scarcity and diminished food security. Access to drinkable water has been challenging for millions of people (GOP, 2019).

In Pakistan, the difference between supply and demand as a result of a water scarcity is widening rapidly. The United Nations agencies, the government of Pakistan, and the State Bank estimated that the per capita water availability in Pakistan has decreased from 2500 cubic meters in 1952 to 1150. So the reduction in per capita water availability is approximately 1100 cubic meters per year, during the most recent ten years (World Bank, 2008). Irrigation helped boost agricultural production and generate revenue from the agriculture sector, which helped stabilize food production and prices (Fahim, 2011; Rosegrant and Cline, 2003). Pakistan is one of the ten nations facing serious threats in water availability. There is a need to mitigate the impact of climatic disasters on the development of the economy.

Climate Change and Food Security:

The worst effects of climate change on agricultural production may result in 9 billion world population as food insecure by 2050. So increase in agricultural productivity is inevitable for food security and poverty reduction (Von Grebmer et al., 2017).There is a list of countries, including Congo, India, China, Ethiopia, Bangladesh, Pakistan, and Indonesia, comprise 65% of the world's population and are affected by food insecurity (FAO, 2014). So food security is a global issue, and as people become more food insecure, they become more restless. Main reason among others, is the climate change. Food availability reduces as production declines (Barnett et al., 2005; Rosenzweig and Parry, 1994).

Pakistan has a population of over 212 million people, with 58% suffering from malnutrition and about 20% suffering from food insecurity. According to the global hunger index classification of serious categories of food insecure nations, Pakistan ranked 106 out of 119 developing countries

(Naseem et al., 2020). Due to climate change, the livelihoods of many people in Pakistan and food security are in danger. Livestock is also essential for Pakistan's food security. The grass, water, and feed for cattle are badly affected by climatic changes which lead to contagious and lethal diseases. As a result, the production of meat and milk has decreased to large extent. The quality and amount of feed, biodiversity, disease vectors, and animal diseases all have a big impact on livestock production (Aftab and Hickey, 2010). The wheat crop is the primary focus of policymakers because it is a staple food in Pakistan. About 22.45 million hectares of total cultivated area is used for wheat farming, out of that 12.52 million hectares are watered by tube wells and other sources, while 6.34 million hectares are irrigated with canal water. The remaining 3.59 million hectares area is rain fed (GOP, 2017).

Approximate decline in wheat production was 1.9 percent during the period from 2013–2014 to 2014–2015. Wheat availability per person would drop from 198 kg per year in 2012 to 84 kg per year, if the temperature would increase by 3^0C until 2050 (33). The increased precipitation level puts the wheat crop at risk during the growing and flowering stages (Abdullah et al., 2016). One study projected a 6 percent decline in wheat yield and a 15 to 18 percent decline in basmati rice yield (Chaudhry, 2017). Population of Pakistan fulfil their 48% of the calories from wheat crop (37). The low wheat yield is caused by three main factors, tillage, climate change and weed invasion. New and effective weed management practices can improve wheat output by roughly 50–80% (Abbas et al., 2022).

Although the nature of the flood is diverse locally, catastrophic natural risks and flooding frequently occur in Pakistan (Tariq et al., 2014). In Pakistan, the floods in 2010, 2013, 2015 and 2022 left behind significant devastation. The floods caused damage to residents and businesses located in the river's natural floodplain. Infrastructure damage, the loss of crops, livestock, and cattle, and the displacement of people due to floods cause delays in the ongoing development and political processes. Food security is seriously impacted by these floods, particularly in emerging and underdeveloped nations (Davies, 2013; Tinh and Hang, 2003; Theron, 2007).The flood of 2015 severely hit the agriculture industry when standing crops covering roughly millions acres were devastated. Pakistan is unable to effectively lessen the effects of catastrophes. By the mid-century, Pakistan could lose $20 billion due to the effects of climatic variations on important food crops like wheat and rice (Shahzad and Amjad, 2022).

The production of all the major crops and cereals will decrease, especially of wheat crop to the maximum by 2080, as reported by International Institute for Applied System Analysis in Austria (Chaudhry, 2017). According to the Pakistani government and the United Nations development programme, 40% of Pakistanis experience food insecurity. Only 46 out of 120 districts in Pakistan experienced food security; the rest were food insecure as calculated in the year 2003 (Khalil, 2007; Tariq et al., 2014).

Pakistan’s population is increasing rapidly while the water levels are declining. The decrease in the availability of water ultimately reduce the food production. It was estimated that water demand for crop production would increase by 2030, particularly for the wheat and other food crops. According to an estimate, the water demand will rise with the increase in temperature of 10 degrees Celsius until 2030. It concludes that the increase in temperature requires extra water in the agricultural sector (FAO, 2008).

Different levels of food security exist at the micro, meso, and macro level. The degree of food insecurity ranges from low to moderate, moderate to high, and high to extreme (Fahim, 2011). As Pakistan is mainly dependent on hydroelectricity, the water and energy resources would become deficient in coming years. Which will ultimately cause low productivity and food insecurity. Keeping in to consideration these challenges, the country is doing its best to increase the food security level. Pakistan aspires to end hunger by 2030 in accordance with the SDGs (Von Grebmer et al., 2017). However, the adoption of climate change related technologies and practices is difficult for poor countries, like Pakistan (Abid et al., 2015; Kandlikar and Risbey, 2000).

Conclusion:

The most significant element for researchers over the past many years has been climate change. As per literature climate change impacts in Pakistan are evident, and these are varying across regions and seasons. Different patterns of precipitation and temperatures were observed in various regions. The emission of greenhouse gases has increased with the passage of time due to various human activities and also due to changes in their living standards. The increase in greenhouse gases caused the rise in

temperature in several countries including Pakistan. Pakistan is experiencing severe climatic effects as a result of the melting Himalayan glaciers, rainfall, varying temperatures, drought, flooding, storms, earthquakes, water shortages, intense heat waves, landslides, pest diseases, and an alteration in lifestyle.

Literature shows that Pakistan has a high poverty rate and low capacity to adopt the new technology to combat worst effects of climatic variation. The poor adapt to climate change in their daily activities, particularly in the agricultural sector, which is the most affected by it. In 2050, the population of the world could rise by 9 billion, but cereal production is not increasing fast enough. Fundamental and comprehensive policies are required in Pakistan to avoid future food insecurity. Furthermore, the implementation of such policies require huge investment to tackle the challenges of climate change. Major investment areas could be improvement in energy resources, better infrastructure and new varieties of crops that are climate change resistant.

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